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Sustainability and biodiversity:
Ethical perspectives on forest management

Ph.D. thesis

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Preface

This thesis, *Sustainability and biodiversity: Ethical perspectives on forest management*, was submitted to the Royal Veterinary and Agricultural University (KVL) in partial fulfilment of the requirements of the Ph.D. degree in the subject area Bioethics and Forest Management.

My main supervisor was Professor Peter Sandøe of Centre for Bioethics and Risk Assessment, KVL. My co-supervisor was Professor Jens Peter Skovsgaard of the Danish Forest and Landscape Research Institute (DLFRI).

The present project was undertaken between March 1998 and May 2001 within the Department of Animal Science and Health, where the Centre for Bioethics and Risk Assessment is based. Most of the day-to-day work, however, was done at the Department of Forestry at DFLRI, a research institute operating under the auspices of the Ministry of Environment and Energy. For a six month period between September 1999 and March 2000 I was attached to the Department of Philosophy (and more specifically to what is now the Institute of Environment, Philosophy and Public Policy) at Lancaster University in the UK.

I am grateful to the Royal Veterinary and Agricultural University for the three-year research scholarship that enabled me to complete this project. I am also grateful for financial support from the DLFRI between March 2001 and May 2001.

It is a pleasure to be able to thank the various people who have assisted me in this endeavour. Professor Alan Holland and Professor John O'Neill (Department of Philosophy, Lancaster University, UK) were generous hosts, shared their knowledge, and offered constructive criticism.

I would also like to express my warm thanks to Dr. Paul A. Robinson (Lexicon Editorial, Oxford, UK) for a very skilled revision of the written English in the thesis.

In general, I would like to thank colleagues – most of them based at the DLFRI and KVL – both for showing continuing interest in the project and for reacting to my work with useful comments. Flemming Rune, a Researcher at DLFRI, and Steffen Stræde, a Consultant at Rambøll, particularly deserve to be singled out here.

More particularly I would like to thank Professor Niels Elers Koch, the Director General of the DLFRI, for making me aware of Professor Peter Sandøe's work and agreeing to host the Ph.D. project at DLFRI. I would also, and especially, like to thank Niels Heding, a Senior Researcher at the Department of Forestry, DLFRI, for his initial help, for constructive comments and for unwavering encouragement and support. Similar gratitude is due to my co-supervisor, Professor Jens Peter Skovsgaard, who agreed to take me on at the Department of Forestry at DLFRI, offered both general supervision and constructive criticism, and put me in contact with Professor Peter Sandøe. Professor Sandøe himself provided excellent supervision throughout the project, was meticulous in his reading of my drafts, and commented skilfully on the leading ideas of thesis. He was both an inspiring collaborator and a supportive mentor, and he shared his enthusiasm and expertise generously. For this, I would like to express my warmest thanks.

Responsibility for the content and any errors remains solely mine.

Hørsholm, May 2001

Christian Gamborg

Contents

English summary

The aim of this Ph.D. thesis is to look at forest management from a range of ethical perspectives. This involves formulating, and analysing in detail, certain ethical assumptions. These assumptions underlie and inform some familiar approaches to management practice. As such they have a bearing on several forestry-related issues of current interest.

Achieving and maintaining an economically, ecologically and socially sustainable approach to forest management while at the same time conserving biodiversity is a major challenge facing forestry today. This is true not only in Denmark and the rest of Europe but also worldwide. In Denmark, and in large parts of Europe, forest is managed according to a multiple-use paradigm. Multiple-use incorporates elements such as resource and nature conservation, and nature restoration. Paradigmatically, it produces forests in which timber, wildlife and recreation interests are managed for simultaneously, often in the same area/stand. It is, then, a way of addressing the concerns and needs of a number of different stakeholders – consumers, special interest groups and future generations.

The thesis presents stakeholder-based analyses of forest management issues. But it also examines the value framework underlying rival approaches to management. In the context of forestry, it asks how value should be characterised, what possesses value, and how values are best promoted. Some of these issues become clearer in the light of ethical positions. Drawing on these positions, the author asks whether the aim should be to maximise value or to weigh up the consequences of a given activity or policy; whether we have a special obligation to maintain particular forest values and whether there are certain things we should abstain from doing in a forest management context.

More specifically, the thesis discusses ethical perspectives on six interconnected issues raised by multiple-use forest management. These issues are:

(1) Value assumptions of the concept of sustainability; (2) the current 'back to nature' trend in silviculture and forest management; (3) the use of introduced species and genetically modified trees in forestry as examples of the manipulation of nature; (4) value assumptions attaching to the concept of biodiversity in relation to ecological restoration and multiple-use forest management; (5) a range of views on forest value emanating from an economic and, especially, ecological point of view, the latter being assessed using nature quality indices; and finally (6) the acceptability of forest management and silvicultural practices, as assessed in ethical accounting and the ethical matrix.

The thesis aims to contribute to introducing a higher degree of ethical transparency in forest management. This is an important condition to attain higher levels of 'stakeholder acceptability' vis-à-vis forest management decisions and, in general, to maintain or develop a better accord between management practices and stakeholder values. To reach this accord it will be necessary to promote greater awareness of the value conflicts concealed in concepts such as those of sustainability and biodiversity. It will also be necessary to clarify and critically evaluate the value assumptions that underlie forest management practices. In this way, fruitful dialogue with the rest of society, including politicians and the general public, can proceed.

Keywords: acceptability, biodiversity, ecological restoration, environment, ethics, forest management, forestry, genetic modification, introduced species, nature, silviculture, stakeholder, sustainability, values

Dansk sammendrag

Formålet med denne ph.d.-afhandling er at se på skovdrift fra forskellige etiske synsvinkler. Det sker i form af at sætte ord på samt analysere etiske antagelser bag specifikke eksempler på dyrknings- og driftspraksis og andre skovbrugsrelaterede emner.

Opnåelse og fastholdelse af økonomisk, økologisk og social bæredygtig skovdrift samt bevarelse af den naturlige mangfoldighed i skovene er to af de vigtigste overordnede udfordringer for skovbruget og skovforvaltningen, ikke blot i Danmark, men også i Europa og resten af verden. I Danmark og i store dele af Europa forvaltes skovene flersidigt. Flersidig skovdrift og –forvaltning omfatter benyttelse og ressource- samt naturbevarelse såvel som naturgenopretning. Her forsøges det at tilgodese en række interesser (fx træproduktion, jagt, rekreation) på samme tid og ofte på samme areal. Flersidig skovdrift og forvaltning kan derfor ses som en måde, hvorpå man forsøger at betænke en række skovinteressenters eller -aktørers (såsom forbrugere, specielle interessegrupper og fremtidige generationer) bekymringer og behov.

Udover at give interessent-baserede analyser af skovdriftsemner undersøger afhandlingen også den bagvedliggende værdiramme. I afhandlingen analyseres forskellige holdninger til, hvad der i en skovbrugssammenhæng kan anses for at være fundamentale værdier og på hvilke måder, disse værdier kan fremmes. Nogle af disse emner klargøres i lyset af etiske grundholdninger. For eksempel undersøges det, om det er et spørgsmål om at maksimere værdi, vægte konsekvenser, eller om vi har særlige forpligtelser til at bevare visse skovværdier, eller der direkte er ting, vi skal afholde os fra at gøre i en skovdriftssammenhæng. Mere specifikt diskuterer afhandlingen etiske perspektiver på seks indbyrdes forbundne emner, som flersidig skovdrift og –forvaltning rejser. Disse emner omfatter:

(1) Værdiantagelser i forbindelse med bæredygtighedsbegrebet, (2) den nuværende 'tilbage til naturen' tendens inden for skovdyrkning og –drift, (3) brugen af indførte arter og genetisk modificerede træer i skovbruget som eksempler på manipulation af naturen, (4) værdiantagelser i forbindelse med biodiversitetsbegrebet i relation til naturgenopretning og flersidig skovforvaltning, (5) forskellige syn på, hvad en værdifuld skov er ud fra økonomiske og økologiske tilgange, bl.a. via begrebet naturkvalitet, og endelig (6) opgørelse af accept af driftsformer og dyrkningstiltag gennem brugen af etisk regnskab og etisk matrix i skovbruget.

Afhandlingen peger på behovet for en højere grad af gennemskuelighed i skovdriften og –forvaltningen fra et etisk synspunkt. Dette er en vigtig forudsætning for at opnå en højere grad af accept af drifts- og forvaltningsbeslutninger samt for generelt at fastholde eller udvikle bedre overensstemmelse mellem praksis- og interessentværdier. I afhandlingen konkluderes det, at for at opnå denne, forbedrede overensstemmelse kræves for det første en større opmærksomhed omkring de værdikonflikter, der kan være skjult i brugen af begreber såsom bæredygtighed og biodiversitet. For det andet kræves der en forbedret afklaring og gennemgående kritisk diskussion af værdiantagelser i forbindelse med drifts- og forvaltningspraksis. På denne vis kan en frugtbar dialog mellem skovbruget og beslutningstagere samt befolkningen videreudvikles.

Nøgleord: accept, biodiversitet, bæredygtighed, etik, miljø, genetisk modificering, indførte arter, interessenter, natur, naturgenopretning, skovbrug, skovdrift og –forvaltning, skovdyrkning, værdier

Synopsis

1. Overview

The thesis comprises this synopsis and the six papers listed below.

1. Dubgaard, A., Sandøe, P., Gamborg, C. and Larsen, A. 1999. Bæredygtighed – økonomi, etik og energi. (In Danish, English abstract) *Nationaløkonomisk Tidsskrift* 137: 256-283.

2. Gamborg, C. and Larsen, J.B. 'Back to nature' – a sustainable future for forestry? Submitted to *Forest Ecology and Management*.

3. Gamborg, C. and Sandøe, P. Designer trees, exotic species and the ethics of manipulating nature. Submitted to *Environmental Values*.

4. Gamborg, C. and Sandøe, P. Beavers and biodiversity: the ethics of ecological restoration. Forthcoming in *Philosophy and Biodiversity*. Okksanen, M. (ed.). New York: Cambridge University Press.

5. Gamborg, C. and Rune, F. Economic and ecological approaches to assessing forest value in managed forests – ethical perspectives. Submitted to *Society and Natural Resources*.

6. Gamborg, C. The acceptability of forest management practices: an analysis of ethical accounting and the ethical matrix. Submitted to *Forest Policy and Economics*.

Appendix 1 contains a list of publications written during the Ph.D. project period 1998–2001. A list of all references used in the synopsis and in the six papers appears in Appendix 2.

This synopsis serves two objectives. First, it sets out the background to the themes developed in the thesis and explains why the work was undertaken. In the background and rationale section the discipline of applied ethics, its relationship to forest management, and the growing body of research within these fields, are described. Secondly, the connections between the six papers that make up the thesis are made explicit. Each paper, including its main conclusions, is summarised.

2. Background and rationale

Trees and forests are but one aspect of nature.[1] The forest forms, and always has formed, an integral part of the lives of those in the community that lives in and around it. It is a source of energy, building materials, fodder, fibre and even food.[2] It is also used for shelter, for grazing and for litter racking, and it offers shelter from such calamities as sandstorms and avalanches (Rowe, 1947; Westoby, 1987). Again, the forest provides many amenities, is extremely versatile and is often used for many purposes, not least recreation. Because the forest fulfils many functions, it is ascribed a number of active and so-called passive use values: economic, ecological, social, symbolic, spiritual and scientific values.

At the same time, the forest can be a useful aid to understanding the interaction between humans and nature from an ecological and economic point of view.

> Forests are, in the economy of man and nature, of direct and indirect utility, the former through their produce, and the latter through the influence which they

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1 *Nature* can be defined as: "all the animals, plants, rocks, etc. in the world and all the features, forces and processes that happen or exist independently of people, such as the weather, the sea, mountains, reproduction and growth" (Cambridge International Dictionary of English). Most definitions imply that nature is at the same time the material world and its phenomena or the forces and processes that produce and control all the phenomena of the material world. In a more colloquial sense, nature may be defined as the world of living things and the outdoors. Often, it is also defined in contrast with civilisation as a primitive state of existence, untouched and unaffected by artificiality. (This freedom from artificial influence is reflected in the use of the word 'natural' to describe the characteristics and qualities of a person.) *Environment* may be defined as the "complete range of external conditions, physical and biological, in which an organism lives" (Allaby, 1998: 143).

2 A broad definition of *forest* is: "An ecosystem characterised by a more or less dense and extensive tree cover, often consisting of stands varying in characteristics such as species composition, structure, age class, and associated processes, and commonly including meadows, streams, fish and wildlife" (Helms, 1998: 70). The term 'ecosystem' was coined by the English ecologist A. G. Tansley (1935: 299), who defined it as including "not only the organism-complex, but also the whole complex of physical factors forming what we call the environment of the biome". An ecosystem can be described as a discrete unit of living and non-living parts interacting to form a stable system. The concept can be applied on a smaller or larger scale. Several definitions have been given since Tansley's. See Odum (1975) and Walter (1984) for an account of the relation of the concept of an ecosystem to other vegetational concepts. For an analysis relating the concept of an ecosystem to the history of ecological ideas, see Worster (1994).

exercise upon climate, the regulation of moisture, the stability of the soil, and their sanitary, ethic and aesthetic effect upon man (Schlich, 1922: 5).

A wide of range of issues relating to forests, forest management and forestry have arisen and received considerable attention around the world over the past twenty-five years.[3] In Europe, the main issues have been the maintenance of profitability, concern about the so-called novel forest decline (dieback), forest fires in the Mediterranean area, and more recently afforestation and concern about losses of biodiversity and habitat. In North America, it is the continued economic use of forests, the clearing of old-growth forest, habitat loss and the spotted owl issue, together with general concern over protection of biodiversity, that provoke the greatest concern. By contrast, on the South American, Asian and African continents, the exploitation of rainforest and other forest types, deforestation, the depletion of forest-related biodiversity and the attainment of community forestry are the key issues (see e.g. Wolvekamp, 1999). The emergence of these issues suggests that today's forestry needs to be more than profitable or economically feasible; more than environmentally reasonable, or ecologically tolerable; and indeed more than socially satisfactory: it needs to be *ethically* acceptable. According to Wagner et al. (1998: 40) the social or ethical acceptability of specific forestry practices rests on a number of factors. It

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[3] A modern definition of *forest management* is: "the practical application of biological, physical, quantitative, managerial, economic, social and policy principles to the regeneration, management, utilisation, and conservation of forests to meet specified goals and objectives while maintaining the productivity of the forest. Forest management includes management for aesthetics, fish, recreation, urban values, water, wilderness, wildlife, wood products and other forest resource values" (Helms, 1998: 71). The last part of the definition actually alludes to management of a forest under a multiple-use management regime (see below, note 10). *Forestry* is the systematic use of a forest, and as such much more than exploitative tree logging. Nearly 200 years ago, the first Danish Professor of Economics, Christian Olufsen (1764–1827), described forestry succinctly as follows: "a tree is cut, another one is planted. In essence, the sum of forestry." (Olufsen, 1811, my translation). This 'definition' reflects an historic context in which there was a lack of fuelwood and timber and where afforestation was one of the main objectives (as was the case at the time in many European countries with low forest cover and economic hardship). Many definitions have followed. A recent one is: "the profession embracing the science, art and practice of creating, managing, using, and conserving forests and associated resources for human benefit and in a sustainable manner to meet desired goals, needs, and values" (Helms, 1998: 72).

"results from a complex interaction of a person's environmental values, agreement with goals, risk perceptions and trust in science and management".

Forests have been looked at in two distinct ways. According to one of these, the forest is essentially a resource that can be used by human beings. A concept often employed in this connection is that of 'sustainability'. This stresses the possibility of harvesting a renewable, but limited resource on a continuous basis.[4] However, forestry in Denmark (and other countries in Europe with low forest cover) does not contribute significantly to the gross domestic product. At most roughly a quarter of total annual wood consumption in Denmark is domestically produced, and less than 4,000 people work in the Danish forests.[5] According to the second, and quite common way of looking at forests, the forest is more than simply a resource. It is both a significant part of the landscape and a habitat for plant and animal life. The concept of 'biodiversity' is associated with this approach.[6]

Together, the concepts of sustainability and biodiversity may be used to address questions about how we perceive forests and nature in general, and how we should use and manage forested land. When these issues are connected with general ethical claims – claims about what is 'good' or 'right' and conversely what is 'bad' or 'wrong'; about what could be done, and what is acceptable in a forestry context – ethical perspectives on forest management are formed. Related questions focus on the reasons for aiming at sustainable forest management, the type of sustainability alluded

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4 *Sustainability* can be broadly defined as a state or process that can be maintained indefinitely. As a concept, sustainability originates from a more than 250-year old principle of sustained yield (see von Carlowitz, 1713).

5 Approximately 45,000 are employed in the wood industry, other wood related industries and the paper recycling industry. A typical forest property derives its revenue from wood production (40–75%), the production of Christmas trees and decorative greenery (25–50%) and user payments, especially hunting rights (0–25%): see Einfeldt and Fodgaard (1997).

6 *Biodiversity* is defined in the Convention on Biological Diversity (1992) as "the variability among all living organisms from all sources, including, inter alia, terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems". However, it has been subject to many definitions and interpretations: see e.g. Takacs (1996).

to and what, exactly, can be considered sustainable forestry.[7] How to agree on definitions, and on the measures required to reach a particular version of sustainability, is an ethical issue. For it depends on what concerns are seen as ethically relevant in the first place, and how these concerns are balanced. Ethical questions about biodiversity include the following. Why do we want to conserve biodiversity? What kinds of biodiversity do we mean? When is biodiversity sufficiently protected? In clarifying the various reasons that have been offered in support of the claim that we should conserve the forests' biodiversity, we will shed light on the concept of biodiversity itself. We will then have a better understanding of biodiversity as a management objective, and clearer picture of the different ways in which people perceive nature. The more specific ethical issues, addressed in this thesis, relate to current foci and trends within European forest management.

2.1 Recent developments in forest management

Two major goals of forest management at present seem to be the efficient production of wood and fibre products and the conservation of forest-related biodiversity. Worldwide, wood consumption has risen, and although wood production has also increased, concerns have been expressed about keeping up with demand. In Denmark, for example, less than a quarter of the total wood consumed is domestically produced.[8] However, at the same time, prices have gone down, making it difficult to attain economic sustainability in forestry. Secondly, naturally occurring forest-related biodiversity has been eroded over the last century. A so-called biodiversity crisis has been proclaimed by ecologists like Norman Myers and E.O. Wilson, who have

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7 *Sustainable forest management* and *sustainable forestry* were defined, following United Nations Conference on Environment and Development in 1992, as the practice of meeting the forest resource needs and values of the present without compromising the similar capability of future generations. This definition was expanded after the Montreal Process of 1993, where criteria of sustainable forest management were identified. Likewise, in a European context, the Helsinki conference in 1993 defined sustainable forest management as: "the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity and regeneration capacity, vitality, and potential to fulfil, now and in the future, relevant ecological, economic, and social functions at local, national and global levels, and that does not cause damage to other ecosystems" (Ministerial Conference, 1993).

predicted that between one-third and two-thirds of all species will be lost around the world in the next century if present land use and resource extraction trends continue.

In many European countries with little forest cover afforestation has increased. Overall stand-productivity has also risen considerably throughout the twentieth century. Over the last century, new demographic structures have developed: both the rural population in general and farmers in particular occupy a smaller proportion of the population as a whole. In many European countries, the standard of living and the general level of welfare have increased over the past hundred years. Nature is no longer viewed merely as a renewable resource, if indeed it ever was. It is viewed as among other things a source of recreational activities. However, at the same time difficulties reconciling the different views that have been taken about how to utilise the forest have become evident. There is now a need for something more than discussions about use or no use. In many European countries, the real discussion concerns intensity of usage and the degree of manipulation that proposed uses involve, for there is practically no wilderness left in Europe.

When forest management objectives change, they do so in part in response to demographic developments and changes in the level and distribution of welfare. As time has gone by, the range of people and organisations that can be regarded as stakeholders in the forest has changed, and the number of parties affected by forestry has increased. In a European context, this means that less emphasis has been placed on timber production and more on other products, services and functions of the forest:[9] "Forestry is changing; it is becoming a wider philosophical, scientific,

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[8] This is part of a larger discussion about wood substitution. Some of the identifiable trends are towards less virgin wood for paper, more recycled wood, wood fibre efficiency, and sustainable substitutions where possible.

[9] For example, nature restoration 100 years ago was in many cases about reclaiming land (e.g. where it had been taken over by drifting sand dunes). Regarding themselves as nature restorationists, forest workers tried to transform sandhills into lush woodlands for the benefit of man, as well as the animals and plants that depend on a forest climate. Today, three generations later, forest workers are given courses in 'desert management' where the aim is to restore the sand dunes – that is, to get rid of the trees planted or seeded under great duress at the end of the nineteenth century! The trees, formerly considered useful and selected for their ability to spread under harsh conditions are now seen as invasive, introduced species. This is not necessarily

technical and social concept than it was twenty years ago" (Boyd, 1987: 132). However, so far European forest management is not experiencing as great an upheaval as has occurred in North America, where there are emerging paradigms of adaptive management, ecosystem management and so on (Kohm and Franklin, 1997). In Europe, the current focus is more practical: the issue is how to adapt present silvicultural practices so that the requirements of sustainable forestry and biodiversity conservation can be met. Present efforts tend to involve trials of new approaches – approaches such as so-called 'nature-based silviculture'.

These changes raise the question of how the forestry sector should be encouraged to evolve over the coming years. In the 1980s, and indeed before that, in many 'afforestation countries' of Europe – the UK, Denmark and the Netherlands, for example – with tracts of reasonably young, evenly aged, mostly coniferous plantations, changes in forestry mainly reflected the desire to satisfy both nature conservation and development objectives. Essentially, three archetypes of forest management may be distinguished. These are shown in Table 1.

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something to bemoan. It illustrates rather well the fact that within a single forest rotation, the prevailing values of society can change.

Table 1. Three 'archetypes' of forest management and their objectives and concerns

'Archetype'	Management objectives	Basis of objectives	Dominant concerns
Production forest	To yield an economically feasible or optimal quantity of timber and non-timber forest products	(Economic) rationality and utility	Healthy, resistant stands of trees High volume production High wood quality
Park forest	To provide recreational opportunities	Aesthetic, romantic and amenity values	Adequate opportunities connected with aesthetic ideals and demand
(Semi-)natural forest	To maintain structures and processes characteristic of the forest in a particular region	Ecological considerations	Deadwood Key habitats Biodiversity

Where most present-day forest management is concerned, the question is not one of attending either to nature conservation or production, but rather one of choosing the appropriate level of intensity – in, say, silvicultural practices and forest operations – to meet a combination of the management objectives listed in Table 1 simultaneously.[10] This integrated approach was espoused in the strategy of the World Conservation Union (IUCN, 1980). This strategy tried to promote a resource use

[10] In North America, more attention to nature conservation interests had been paid through the Multiple-Use Sustained Yield Act of 1960. This act identifed timber, watershed, wildlife and fish and outdoor recreation as possible multiple uses. The Federal Land Policy Management Act of 1976 which followed this act stipulated that a combined and diverse resource use should be made, trying to take into account the future needs (Helms, 1998). It could be a combination of resource uses that would not necessarily yield the greatest unit return or economic output. However, the act did not require the multiple uses to be integrated at one site; they could be segregated from each other. This was possible because vast tracts of land are available in North America. In Europe, on the other hand, land for forestry was scarcer. The integration of objectives had to take place in most cases at the stand or forest level and less often at the landscape level.

philosophy, captured in the phrase "conservation for sustained development", that balances wood production and nature conservation instead of polarising them. Development, often conceived of in economic terms, was seen as constrained by nature conservation concerns. Focusing on the survival of native species in their natural habitats, nature conservation was a new culture of the twentieth century (Sheail, 1998). This was not easy, because the "new conservation movement had to find its own way among the existing, powerful vested interests, making a plea for a recognition which was sparingly and often reluctantly given" (Boyd, 1987: 115). Today, after the World Commission on Environment and Development, the so-called 'Brundtland' commission has taken up the concepts of sustainability and sustainable development, refined them and effectively communicated these concepts to a broader audience. And following the United Nations Conference on Environment and Development – the 'Earth Summit' of 1992 – nature conservation has not been perceived to the same extent as a constraint for forestry.[11] This contrasts strikingly with the traditional distinction between foresters as resource conservationists, on the one hand, and environmentalists as nature conservationists, on the other, illustrated in Table 2.

[11] *Sustainable development* has been defined by the 'Brundtland' Commission as: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987: 8). Future generations are taken to be generations of people not yet born. Generally, this definition of sustainable development is considered a little vague, and the exact meaning of the expression 'sustainable development' is subject to much dispute (Palmer, 1997). The concept's ethical thrust is toward social justice and toward future generations. These concepts have been discussed extensively (e.g. McNeill, 2000; Lee, 2000; Sikora and Barry, 1978).

Table 2. Characteristics traditionally ascribed to foresters and environmentalists

Foresters (as resource conservationists)	Environmentalists (as nature conservationists)
Imperialists	Arcadians
Materialists	Idealists
Reductionistic	Holistic
Control, order	Freedom
Standard attitude: A forest is a natural resource and should accordingly be under some form of resource management	Standard attitude: a forest is a particular kind of nature and should be left unmanaged (but in some cases, management for nature conservation is acceptable)

Source: based on Peterken (1996).

However, in most cases this distinction is now archaic. It has been succeeded by a convergence of objectives. This convergence is usually described under the heading 'sustainability'. Interestingly, the general idea of sustainability in the forestry context (in German: *Nachhaltigkeit*) can be traced back to a Saxon forest regulation of 1560 (Kurth, 1994). The term 'sustained yield' was used in connection with the procurement of firewood by a Saxon mining manager called H.C. von Carlowitz at the beginning of the eighteenth century. He described silvicultural methods designed to increase forest productivity. The criteria for sustained yield were biologically determined. They concentrated on specific tree species; on the composition, volume and quality of production; and on felling at a rate lower than the annual growth increase.

During the last 250 years, the interpretation of sustainability has evolved. In the middle of the nineteenth century, the main focus was on sustaining the economic value of the forest, or the economic output of the forest in the long run, instead of on the maintenance of a certain level of wood production (Zürcher, 1965). In the middle of the twentieth century, economists attempted to operationalise the concept of sustainability more precisely and formulated minimum standards of conservation

(Ciriacy-Wantrup, 1952). The principal idea was to prevent economically irreversible deterioration of soil, water, flora and fauna, i.e. to avoid deterioration that would be too expensive to reverse.

The concept of sustained yield has expanded to include non-wood products as well, reflecting the multiple-use management paradigm. Thus, sustainability has evolved from a concept concentrating on the level of wood production, or yield, to the present, more comprehensive concept integrating ecological, economic and social aspects of forestry. However, the role of the concept of sustainability in a forest is disputed. Four interpretations can be distinguished. These are briefly presented below.

(1) Sustainability is inherent in, and fundamental to, the general concept of forestry (Müller, 1969). In contrast with the *ad hoc* and unregulated exploitation known as timber mining that preceded it, modern forestry as it has operated over the last 250 years has been by definition planned and regulated. This more recent use of the forest by man accordingly embodies the concept of sustained yield or sustainability. Hence talk about sustainability in connection with modern forestry is in principle redundant.[12]

(2) Sustainability is just one example of a forest management principle. Sustainability in forestry is one of many reasonable planning and management objectives. Essentially, sustainability can be conceived of as a restriction on the utilisation of a forest which it seems sensible to apply in view of the inherently long-term nature of forestry.

(3) Sustainability is a folly. In forestry, it is unrealistic, and it is rooted in a mistaken ideal. Attempts to invoke the idea of harmonious nature and infinite surplus have proved misconceived through the course of the last 250 years (see Schanz, 1996:

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[12] The redundancy arises if sustainability is inherent in the concept of forestry and forestry is defined as: 'forestry is the sustainable utilisation of a forest'. For from this it would follow that sustainable forestry is the 'sustainable sustainable' utilisation of a forest.

67).[13] The many interests relating to forestry, and the multiple objectives, cannot be properly handled under a single heading of sustainability.

(4) Sustainability is a moral foundation underlying forestry. It can be seen as something backed by a categorical imperative, or maxim, that applies to any forestry activity.[14] Viewed as such, sustainability is a philosophy of intergenerational production, or just utilisation, that relates to the regenerative capacity of natural ecosystems. It prescribes certain deep principles that should govern forest planning and management. These take into consideration the needs of future generations for forest utilities. The sustainable use of a forest is, then, a moral imperative.

Some observations about these interpretations of sustainability can now be made. The first interpretation is that sustainability epitomises forestry – that forestry is a form of human prospering through the maintenance of a renewable resource in perpetuity. However, many activities falling into the category of forestry have in fact been exploitative, and this suggests that there is a need to emphasise a long-term perspective on resource conservation by attaching the label 'sustainable'. In the second interpretation, it is pointed out that, in the forestry context, sustainability is simply one example of the many restrictions placed on forest management by social, economic and ecological factors, and hence does not call for special attention. However, because the concept is used to provide a comprehensive framework within which forestry can operate, it may be argued that it requires particular special attention. According to the third interpretation, it seems that some flatly reject the idea of an integrated concept of sustainability because in forestry it represents a misleading ideal. However, what can be rejected is any use of the concept of sustainability that does not recognise the balancing values imported by the concept. Finally, in the fourth interpretation, some see sustainability as a moral imperative implying certain

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[13] The idea of a harmonious nature is but one conception. Others conceptions include those in which nature is seen as capricious, tolerant, benign or ephemeral (Thompson et al., 1990 cited in Schanz, 1996:67).

[14] This interpretation very loosely echoes the term 'categorical imperative' coined by the German philosopher *Immanuel Kant* (1724-1804) as a guiding principle of actions. The dictates of the categorical imperative can go against one's immediate wishes and predispositions.

management principles. Here, it is worth pointing out that rules which prescribe actions are not necessarily 'moral imperatives', but may be framed in another ethical framework.

Clearly, these attitudes to sustainability indicate that the concept of sustainability in forestry needs to be examined more closely. At present, there seems to be two main ways in which forestry, especially in Central and Northern Europe, can develop. The first is down a technical-biotechnological path. The other is down a biological, or ecological, nature-based path.

Most of the papers in the thesis deal with ethical issues arising from the future development of temperate forest management. One such issue is: why is there a reluctance to use genetically modified trees in forestry when at the same time traditionally bred material is used and species from other continents have been widely introduced? The kind of objections and concerns raised here depend on empirical, scientific and economic results and reasoning, as well as on other ethical assumptions (see the paper 'Designer trees, exotic species and the ethics of manipulating nature'.) The attractions of the so-called 'back to nature' trend in forestry may seem self-evident when we consider the recent growth in concern about nature conservation, but why are the stands of tree resulting from plantation silviculture and forest management in many European countries not seen as 'proper' or 'genuine' nature?[15] How, in any case, should 'nature' be defined? What level of intervention is consistent with it? (See the paper '"Back to nature" – a sustainable future for forestry?')

The restoration of a particular landscape element, such as a river or a forest, and the restoration of a species array by reintroducing certain faunal and floral species, raise the issue of the ethical acceptability of such practices. Differences of opinion over acceptability are influenced by factual disagreements, to be sure. But they also seem to arise from divergent value assumptions, differing conceptions of biodiversity and

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[15] *Silviculture* can be defined as "the art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis" (Helms, 1998: 167).

nature, and diversity among ethical outlooks (see the paper 'Beavers and biodiversity: the ethics of ecological restoration'). The concept of value is notoriously hard to deploy with exactitude, and it remains a potentially ambiguous tool in discussions about forest use and management. This leads to the question why some forests are highly valued whereas others are not. In connection with this, it might be asked why a more 'original' or 'wild' environment, with a higher degree of 'authenticity', is often highly valued. In most parts of Europe, and especially Denmark, 'wild' nature cannot be found. At most, urban and rural landscapes can be distinguished. The reasons that have been offered for attaching value to what is wild and original raise a number of ethical issues (see the paper 'Economic and ecological approaches to assessing forest value in managed forests – ethical perspectives').

Forest management, and especially multiple-use forest management, aims to accommodate the concerns and needs of several interest groups at the same time. This raises the question: what kinds of stakeholder should be included here? Consumers and special interest groups, certainly, but should any other parties be taken into account? It also forces us to consider how the different considerations stakeholders bring in, some of which are potentially conflicting, should be balanced (see the paper 'The acceptability of forest management practices: an analysis of ethical accounting and the ethical matrix').

In general, these questions point to the need to engage in ethical deliberation. Hence it becomes necessary both to clarify the notion of the ethical and to ask what kinds of ethics are relevant in a forest management context.

2.2 The relevance of moral and ethical concerns to forest management

The words 'moral' and 'morality', and the related terms 'ethical' and 'ethics', are often used interchangeably, but they are in an ethical/philosophical context often assigned specific meanings.[16] 'Morality' relates to a personal or social set of standards for good or bad behaviour or character. These standards might be based on, for example, fairness and honesty. They are something each individual believes in and,

perhaps, acts in accordance with. Similarly, 'ethics' is likely to refer to the "general beliefs, attitudes or standards that guide customary behaviour" (des Jardins, 1997: 16). However, in philosophical discussion the term 'ethics' can also be used to denote the systematic study of what is morally right and what is not. Here ethics does not involve straightforward acceptance of the idea that customary behaviour is right: instead it requires us to examine critically our customary behaviour and especially the norms or standards via which we guide our behaviour. For example, how can moral norms be justified? How do we explain and defend our presently held values? Controversies relating to the natural environment can often be traced back to differences in the disputants' basic beliefs, general attitudes or values. Ethical concerns are influenced by beliefs about the basic conditions of nature, the importance of nature to human life and the role of human beings in manipulating the environment. One's acceptance of a set of goals and approaches in forest management is connected with the environmental values one adopts (Wagner et al., 1998). Moreover, these values and ethical beliefs underlie the complex trade-offs between conservation and the consumption of renewable resources.

In general several steps are involved in the ethical examination of an activity or policy – in an exercise, that is, of applied ethics. The first step is to identify the ethical issue, or issues, at stake. This involves the identification of (explicitly or implicitly made) ethical judgements such as: 'natural biodiversity ought to be preserved'. The identification of these normative judgements is important, since many disagreements persist because the underlying ethical judgements are insufficiently recognised.[17] A further step in the analysis is to assess these judgements, and in particular to examine the reasons offered in their support. This involves the clarification of differences in the definition or interpretation of key concepts. It also requires us to identify underlying value assumptions and general ethical principles and theories.

The examination of ethical aspects of general questions about the environment and more specific questions about forest management is important, therefore, for three

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[16] Please note that in some works, the definitions of 'moral' and 'ethical' are interchanged.

[17] A normative judgement is often, but not always, indicated by the words 'ought' or 'should'.

reasons. First, ethical analysis can assist by identifying ethical issues and by offering reasons for patterns of behaviour. Secondly, ethical analysis can help to clarify basic concepts and to make explicit common beliefs. In this way it can direct our attention to possible conflicts among underlying value assumptions. Thirdly, ethical analysis can help us to assess specific cases and controversies, and if necessary it can suggest ways in which attitudes, beliefs and behaviour need to change.

2.3 Recent developments in applied ethics

Ethical analysis of the kind just described is, as was mentioned in passing, an example of applied ethics. It is worth pausing here to explain the relationships between the various types of ethical reflection. Ethics as a general category can be divided into descriptive ethics and moral philosophy, as shown in Figure 1.

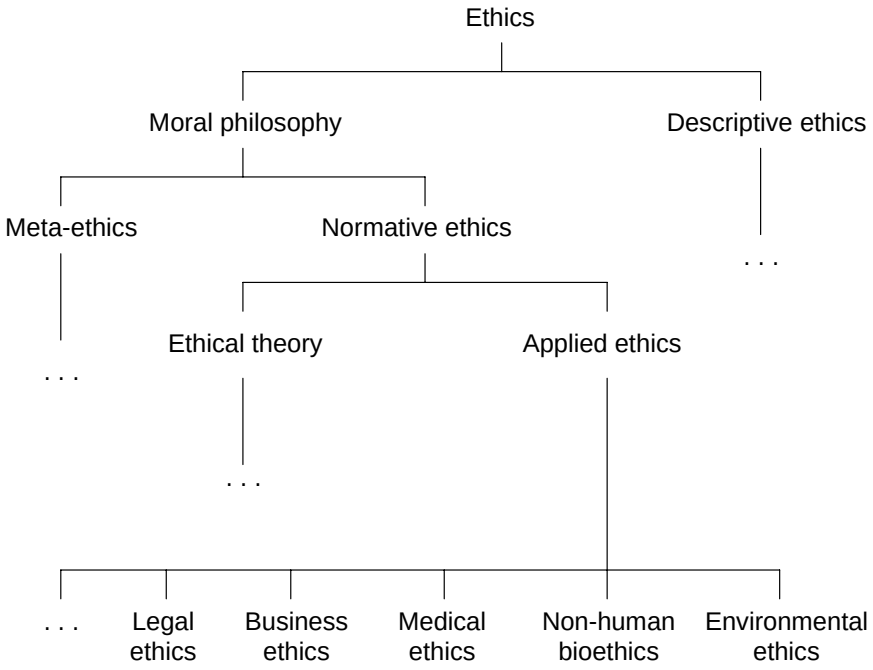

Figure 1. The division of ethics into descriptive ethics and moral philosophy, and sub-divisions. Note that not all sub-divisions are shown here, as is indicated by the ellipsis (. . .).

Moral philosophy is normally divided into normative ethics and meta-ethics. The latter is concerned with the nature of morality and moral epistemology. Normative ethics examines questions of, for example, duty and value, and can be further divided into ethical theory and applied ethics.[18] Applied ethics is "concerned with furthering our understanding, and thus the resolution, of practical issues of right and wrong" (Dare, 1998: 183). However, the resolution of these issues requires attention to some of the perennial questions of ethics and philosophy in general – for example, what is the good life, and what is a good society? (Almond, 2000). To answer these questions, ethical theories, such as utilitarianism, liberal rights theory and virtue ethics can be consulted.

Thirty years ago, applied ethics was not considered a proper field in its own right. Philosophers were preoccupied with the refinement of ethical theories and with meta-ethical problems such as defining moral terms properly (Dare, 1998). However, in the intervening period, specific practical issues have been addressed. These include euthanasia, birth control, animal rights, and questions about the social implications of technological change and scientific advances. They also include issues arising from race and gender, personal relationships and man's relationship with nature and the environment. Moreover, the development of professional codes of responsibility, and reflection on their proper role, is also a matter of applied ethics. As a result, several sub-fields have been established, including medical ethics, bioethics and environmental ethics (see Figure 1). Environmental ethics is, of course, concerned with our relation to the natural environment.

In general, environmental ethics may be viewed as a systematic account of the moral relationship between human beings and the natural environment (des Jardin, 1997). An assumption underlying it is that human behaviour is governed by moral norms. Environmental ethical theories make different suggestions as to what these norms are. Much work has been done on building a theory of environmental ethics that would

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[18] An *ethical theory* can be understood as an "attempt to provide systematic answers to the philosophical questions raised by descriptive and normative approaches to ethics" (des Jardins, 1997: 17).

show to whom, or what, humans have responsibilities, and to try to explain the kinds of responsibilities involved and the justification of these. An environmental ethical theory might be expected to tell us which kinds of beings have moral standing – that is, to whom it is appropriate to direct moral consideration (see Goodpaster, 1978; Elliot, 1995). Very roughly, three types of theory can be distinguished. The question is whether we have responsibilities *regarding* the natural environment, or responsibilities *to* the natural world. That is, what can be considered morally significant in its own right?

(1) An anthropocentric, or human-centred, environmental ethic holds that environmental responsibility derives entirely from human interests. According to this view, only human beings are moral agents, or have moral value or moral standing. Any responsibility regarding the natural environment is indirect. Ultimately, it is a responsibility to other humans. Our duty to, say, protect a forest depends on the extent to which this type of natural environment is considered conducive to human survival or well-being. This view can be extended so that future human generations are also objects of moral responsibility. Much of the concern about future generations visible in some views on sustainable development can be explained in anthropocentric terms.

(2) A second view expands the circle of morally significant agents to include higher animals, such as the squirrel, the beaver and the cat. This expansion is based on an appeal to criteria of sentience. According to this view, our responsibilities to the natural environment depend on the impact of our actions on sentient creatures, and in particular on animal welfare. This view has been influential mainly in the improvement of the conditions in which livestock are kept. It has had less influence on general resource-management and forestry.

(3) Theories in the third group, which are considered by some to be the only true exemplars of the environmental ethic, are biocentric or ecocentric. According to the biocentric, or life-centred, view we have direct responsibilities to the natural environment. All varieties of animal and plant deserve direct moral consideration.

Differences of opinion exist about how to express this responsibility. One view is that, independently of their psychological capacities, animals and plants have moral standing and intrinsic value. On this view our duties to animals and plants are direct (Attfield, 1981).[19] The ecocentric approach, by contrast, shifts the focus from living individuals to more abstract entities such as species, populations or entire ecosystems. It involves the claim that we have moral responsibilities either to collections of individuals or relationships of individuals. This view has been dominant in ethical work on natural resource management, agriculture, forestry and nature conservation.

Theories of the kind just classified focus on the moral foundations of environmental responsibility and the extent of this responsibility. In the past thirty years these theories have been subject to intense debate. Their content, and the soundness of the concepts they involve, has been rigorously examined. This has resulted in the theories being defended, and subsequently refined, in a variety of ways. However, it is one thing is to determine what has moral standing and quite another to decide what weight differing concerns should be assigned, and thus how these concerns should be balanced. (Note that the latter task is bound to be important in the context of multiple-use forestry.) Here, both environmental ethics and bioethics can make a useful contribution.

2.4 The relationship between bioethics and environmental ethics

Bioethics has often been identified with medical ethics (sometimes as referred to as 'biomedical ethics'). Discussions have focused on the use of human subjects in biomedical research, partly prompted by the events during World War II. Later on, the use of animals for experimentation was questioned from within bioethics. The

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[19] For example, in relation to the felling of a tree, the claim is that because they possess intrinsic value, trees are worthy of respect, and that therefore it is prima facie wrong to cut them down or in any other way destroy their living potential. Another way to argue this is to say that we should not consider the moral significance of felling the tree merely by looking at affects on other humans and animals. "The thought is that the tree itself has claim to moral consideration and that the death of the tree is a feature of the act relevant to its [the act] moral evaluation" (Attfield, 1981: 10). To cut a tree, kill it, or limit its growth is to impede its "flourishing", i.e. to frustrate its "biologically determined goals" (Attfield, 1981: 10). Here, further clarification of

term ‘bioethics’ is thought to have been used for the first time by Potter (1971). His original definition is: “biology with humanistic knowledge from diverse sources . . . [to] forge a science of survival that will be able to set a system of priorities” (Potter, 1971: 4). The key notion in this definition is survival. He speaks of “acceptable survival” in connection with medical and environmental problems. Acceptable survival is today best understood as involving a sustainable society within a healthy ecosystem. In a broader sense, bioethics has recently been defined as “the study of the moral, social and political problems that arise out of biology and the life sciences generally and involve, either directly or indirectly, human wellbeing” (Frey, 2000: 89). In the 1980s, non-human bioethics developed rapidly as questions about the use of gene technology and other types of modern biotechnology, and especially animal husbandry and agriculture, grew in urgency.

The development of non-human bioethics may be characterised as one in which specific applied issues are addressed at the same time as broader questions concerning the natural environment and man’s relation to it. In this development, the concept of sustainable use of the natural environment is prominent.

Bioethics and environmental ethics have developed largely independently of one another.[20] In the late 1960s and early 1970s, it was hoped that environmental ethics would contribute to the resolution of pressing issues such as deforestation, the depletion of the ozone layer and the loss of biological diversity. Most people deemed these environmental issues, which arose as a result of human activity, to be practical problems both for the environment and humans dependent upon the environment.[21] However, in the following decades, theoretical questions about the nature of the value

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what flourishing and biologically determined goals amount to is required. We also need to know how to adjudicate conflicting interests.

20 However, the subject areas of bioethics and environmental ethics can in fact overlap. Some commentators even talk of ‘environmental bioethics’ and ‘agricultural bioethics’.

21 Pre-Socratic philosophers (i.e. those ruminating before c. 430 BC) discussed the question of moral respect for non-human animals. The importance of the natural environment to our well-being has been contemplated since the time of Rosseau (1712–1778) and Kant (1724–1824). The contrast between the built and the natural environment, as well as the significance of ‘place’, was a central feature of the philosophy of Heidegger (1899–1976).

of nature were discussed and practical solutions were to that extent postponed (Rowlands, 2000). In particular questions about the value of wilderness – which can be broadly defined as an uncultivated area of land with no (or few) roads or towns built upon it – and about our ethical obligation to preserve such wilderness have been examined. Preoccupation with questions about the nature of value in the natural world seems to have been prompted by among other things species loss and land clearance (see Rolston, 1988b).

However, the characterisation of wilderness has proved difficult and controversial. Wilderness is defined in the 1964 United States Wilderness Act, Section 2c as "an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain" (quoted in Palmer, 1997: 106-107).[22] Before the formal designation of wilderness areas several writers, including John Muir (1838–1914), addressed the idea of wilderness and examined the ways in which such land might be valuable to humans.[23] As mentioned above, there has been considerable debate within environmental ethics about the idea of wilderness. A number of environmental ethicists, including J. Baird Callicott, have argued that the idea of wilderness should be abandoned.[24] Callicott (1991) argues that the idea of wilderness is ethnocentric and ignores the presence and former impact of native Americans. He also argues that the idea of wilderness is static and rests on a fundamental and undesirable separation of humans and nature – leaving areas of wilderness as shrines of nature. However, environmental ethicists such as Holmes Rolston maintain that the idea of wilderness still has a point.[25] Rolston (1994) argues that some of the designated

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22 In the United States Wilderness Act 1964 wilderness is characterised as an area which "(1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable, (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation, (3) has at least 5,000 acres . . ., and (4) may also contain ecological, geological, or other features of scientific, educational or scenic value" (quoted in Palmer, 1997: 107).

23 The first formal wilderness area in United States was designated in 1924. The American forester, Aldo Leopold (1887–1948), suggested the establishment of such areas.

24 See e.g. Nelson (2001) for a resumé of Callicott's views and ideas within environmental ethics in general.

25 See e.g. Weir (2001) for a brief overview of the Rolston's main ideas on environmental ethical issues.

areas of wilderness have in fact been little used by native Americans, and that the idea of wilderness does not necessarily exclude humans anyway. The idea behind invocation of the concept of wilderness is to set certain limits to what humans can do. Ethicists such as Callicott, however, disagree. According to Callicott (1991), the focus should be on sustainable development. Humans should be viewed as part of nature, as beings capable of living in harmony with ecosystems. We profit little by clinging to an outdated idea of wilderness.

To summarise, it might be said, that while recognising the importance of such notions, and the insight they offer into conceptions of nature, environmental ethics has now shifted beyond the focus on wilderness, species loss and values in nature. It is the applied ethical issues that are raised by human use of the natural environment that concern most environmental ethicists today. On the other hand, (non-human) bioethics has moved from specific, mostly biotechnological, questions to ethical issues relating to our use of the natural environment and our relation with nature. The disciplines of both bioethics and environmental ethics seem, then, to have moved towards a point at which the concepts of sustainability and biodiversity are in very much in focus. Ethical questions relating to forestry can therefore be addressed from the viewpoint of these two disciplines (see the paper 'Designer trees, exotic species and the ethics of manipulating nature').

2.5 Ethics in forestry

Ethics in forestry may be characterised as a combination of issues from applied ethics, and more precisely from bioethics and environmental ethics. In this respect, it is similar to agricultural ethics.[26] Agricultural ethics can be defined as the study of moral issues relating to farming, under which human interference with the course of nature is included (Comstock, 2000). Forestry often entails, like farming, systematic cultivation of the land: here it is the equivalent of agriculture, namely silviculture.

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[26] Thompson (1995) noted in the mid-1990s that the main journals in the field of environmental ethics (e.g. *Environmental Ethics* and *Environmental Values*) contained few papers pertaining to agriculture. There seems to have been a change now, with more papers being published on applied problems within agriculture, animal husbandry and forest management. New journals (e.g. *Journal of Agricultural and Environmental Ethics*) also address these issues.

Some questions raised in agricultural ethics (e.g. the influence of certain practices on social and natural conditions, and issues of fairness in the distribution of cultivated produce and land) are also relevant to forestry (Irland, 1994). However, forestry also involves conservation and restoration. In the following discussion we will briefly review three main ethical schools and types of ethical issue relating to, predominantly North American, forestry (List, 2000). However, the types of ethical issue raised are also relevant to European forestry with some exceptions discussed after the brief review.

One school of ethical thought in forestry adopts the anthropocentric economic resource model or what might be labelled 'resourcism'. In this model the forest is treated as a resource for human consumption. This model is known in North America as the 'wise use' or Pinchotian conservationism model:

> The first great fact about conservation is that it stands for development. There has been a fundamental misconception that conservation means nothing but the husbanding of resources for future generations. There could be no more serious mistake. Conservation means provision for the future, but it means also and first of all the recognition of the right of the present generation to the fullest necessary use of all resources . . . (Pinchot, 1907: 40).

'Preservationism' is a second school of ethical thought in forestry; and in different ways it both complements and opposes 'resourcism'. Preservationists generally do not oppose every use of the forest, but they focus on the forest's protection for non-economic reasons (List, 2000). Their main concern is to preserve forests in a 'wild' state. In the US this outlook is typified by a group of writers including John Muir. These so-called 'wilderness visionaries' (Vickery, 1994) voiced their concerns at a time when forest exploitation in North America was prevalent:

> Any fool can destroy trees. They cannot run away; and if they could, they would still be destroyed,—chased and hunted down as long as fun or a dollar could be got out of their bark hides, branching horns, or magnificent bole

> backbones. Few that fell trees plant them; nor would planting avail much towards getting back anything like the noble primeval forests (Muir, 1901: 365).

According to this view, *nature* conservation – as opposed to *resource* conversation – is the ethically legitimate objective. This can either be approached from a human-centred (or anthropocentric) point of view or a life-centred (or biocentric) point of view.

A third position on the ethics of forestry, again looking at matters from a North American perspective, is the so-called 'land ethic' proposed by the forester and founder of modern wildlife management Aldo Leopold (1949). The land ethic offers a comprehensive perspective, including a decision process for handling such diverse issues as wilderness preservation, forestry, pollution and resource depletion. Moreover, unlike a biocentric, individualistic theory, the land ethic avoids certain theoretical problems posed by the felling of a single tree or the culling of deer. Leopold's writings have attained an almost canonical status and have been much discussed (e.g. Callicott, 1989, 1998; Society of American Foresters, 1998; Zeide, 1998). His work forms the basis of the ecocentric ethical outlook. It also underpins ethical deep ecology. Leopold's theories have become increasingly relevant to modern forestry as the focus of discussion has moved towards a more ecologically benevolent silviculture. In the US this has been signalled both by the use of such headings as "biotic forestry" (List, 1998) and, more generally, by forest management practices that are sensitive to impacts upon the natural environment and go under the heading "ecosystem management" (see e.g. Kohm and Franklin, 1997). Leopold held that we should regard trees and other forest components as integral parts of "biotic communities". He insisted that we should neither exclude use nor concentrate solely on preservation. The familiar passage below addresses the problem of ethically acceptable forest management:

> The 'key-log' which must be removed to release the evolutionary process for an ethic is simply this: quit thinking about decent land-use as solely an economic problem. Examine each question in terms of what is ethically and esthetically

> right, as well as what is economically expedient. A thing is right when it tends to preserve the integrity, stability and beauty of the biotic community. It is wrong when it tends otherwise (Leopold, 1949: 262).

The idea is to combine ecological observations with the principle of preserving "integrity, stability and beauty" to arrive at normative conclusions about what to do in a specific land-use or management situation. However, Leopold's key concepts of integrity, stability and beauty have resisted easy definition. Still more importantly, Leopoldians face the difficult question – mentioned above in Section 2.4 – of how to balance the concerns of integrity, stability and beauty where they conflict. Without some kind of rubric or calculus here, it will sometimes be impossible to tell whether "a thing is right". Indeed in most cases, managing land involves compromise among diverse interests. Leopold's insinuation that there is simply a question of right or wrong leaves no room for things being more or less right.

C. D. Stone (1974) has attempted to operationalise some of the above-mentioned ethical issues in a legal context. He asks whether legal rights can be conferred on trees and other natural objects. The paradigm case Stone focuses on concerns a legal dispute over Mountain King Valley, a wilderness area adjacent to California's Sequoia National Park. In this dispute, Walt Disney Enterprises wanted to develop a ski resort in the valley. The nature conservation organisation, the Sierra Club, filed a suit in the federal court to prevent this commercial development. The suit was rejected in California courts on the grounds that the Sierra Club lacked standing. Members of the society were not harmed, in a legal sense, by the proposed development. According to Stone, the Sierra Club should have been allowed to file the suit as a legal guardian of the threatened rights of the mountain and the trees:

> [T]hese objects have traditionally been regarded . . . as objects for man to conquer and master and use . . . Even where special measures have been taken to conserve them, as by seasons on game and limits on timber cutting, the dominant concern has been to conserve them *for us* – for the greatest good of the greatest number of human beings (Stone, 1974: 10).

In the last part of this passage, Stone alludes to the well-known resource conservation dictum of Pinchot. According to Stone (1974: 16, emphasis in original), "Conservationists . . . want to conserve and guarantee *our* consumption and *our* enjoyment of these other living things. In their own right, natural objects have counted for little . . ." Stone's suggestion raises several issues that need to be resolved: Who is the proper guardian of the rights of these natural objects? Who decides what is in the object's 'best interests'? Would a local commercial timber company be the proper guardian? A local fishing club? Or the Sierra Club? According to Stone, some sort of public consensus would need to be achieved on this issue.

Since Stone's early discussion, it has proved difficult to extend rights-based moral standing to trees, rivers and mountains. Theorists have as a result turned away from legal and moral rights and concentrated instead on the nature of values in a forest (e.g. Rolston, 1988a; Rolston and Couffal, 1991).

Other issues in applied ethics, including that of setting an ethically acceptable degree of manipulation of nature, have been vigorously discussed. These discussions are often prompted by developments within modern biotechnology, and especially genetic engineering. Current centre on the question how to alleviate the pressure on the natural environment now that, in both forestry and farming in Europe, many of the former production goals that caused these pressures have largely been met. The predominantly North American discussion about wilderness is less relevant in a European context. In Europe, and especially in countries such as Denmark, it is practically impossible to find natural landscapes that are unmanaged and free of any kind of (deliberate or non-deliberate) human intervention. Here the main ethical questions are about defining the kind of nature conservation to practise in a natural environment heavily influenced by man, finding acceptable degrees of control of the natural environment and deciding on the intensity of the kind of natural resource management involved in forestry. These are the issues this thesis addresses.

3. Main objectives

The aim of the present thesis is to look at forest management from a range of ethical perspectives. This involves formulating, and analysing in detail, certain ethical assumptions. These assumptions underlie and inform familiar approaches to management practice. As such they have a bearing on several forestry-related issues of current interest.

The multiple-use management paradigm, which is dominant in Denmark and large parts of Europe, fosters management for such things as wildlife and recreation interests as well, and at the same time, as timber production. Often these goals are indeed to be pursued in the same area or stand. In this way, multiple-use is a way of addressing the concerns and needs of different stakeholders – for example, consumers, special interest groups and future generations. Although it may be recognised within forestry that different stakeholders make distinct ethical assumptions and attribute quite different values to forests and forestry, these values and assumptions need to be clearly formulated. Increased clarity about what is at stake from an ethical perspective will make it easier to understand what the different stakeholders consider to be desirable and ethically acceptable in the way of forests and forest management practices respectively. The thesis aims to facilitate discussion about underlying value assumptions and the role they play.

The most fundamental task of an ethical analysis is to identify the concerns that bear on a specific forest management issue and discuss what different stakeholders see as important and valuable. An important follow-up question is how to balance these concerns where they conflict. Although the thesis will present stakeholder-based analyses of forest management issues, it is also an objective of the present work to examine the underlying value framework. The thesis will analyse different attitudes to questions about what is of value. It will ask how to characterise value in the context of forestry and explore ways to promote these different values. Some of these issues become a good deal clearer in the light of ethical theories. For example, armed with such theories we can ask whether the aim should be to maximise value or to weigh up

consequences. We can ask whether we have a special obligation to maintain particular forest values, and whether there are certain things we should abstain from doing in a forest management context. All these questions will be examined in the thesis.

The thesis will discuss ethical perspectives on six interconnected issues raised by multiple-use forest management. This means we shall consider examples of actual ethical problems in forestry. As Forbes and Lindquist (2000: 9) point out, such an approach ". . . is the next logical step in progress for forestry ethics". The thesis seeks to provide a thematic discussion of the different value assumptions in play here. It discusses ways of evaluating different forest management systems in connection with underlying perceptions of nature and value foundations. It will both apply and analyse approaches such as ethical accounting and the ethical matrix in order to facilitate the discussion of ethical issues in forestry. The thesis will critically examine some of the main concepts used in forest management, such as sustainability and biodiversity, and will try to bring out the way in which value conflicts can be hidden behind these concepts. A more detailed outline of the six papers is given below in Section 5.

It should be noted that many other important ethical issues pertaining to forest management are not included. For instance, issues of autonomy, democracy and rights are not examined in the present work. Moreover, the thesis does not examine questions raised by a professional forestry ethic or code of conduct. These codes are common in North America: for example, the Society of American Foresters has developed a code of conduct (see Society of American Foresters, 1996; Ebel, 2000). They are less familiar in Europe however.

It is important to stress that the thesis does not intend to moralise, i.e. to express first-order judgements about the rightness or wrongness of forest management practices. Nor does it promote just one ethical theory. The main goal of the thesis is to facilitate critical reflection on forest management issues from an ethical perspective. It reflects on actual and possible reasons why certain practices are as ethically problematic or unacceptable. The thesis tries to demonstrate that it is important to try to understand

the different attitudes and considerations bearing on forest management. It proceeds on the surely sound assumption that this may eventually result in better dialogue among forest stakeholders.

4. Methodology

"As I remember, ethics was not an issue at the top of my agenda as a student or young professional. I vaguely remember discussing ethics in a philosophy class in college. At the time, I made no connection between ethics and the profession of forestry . . . The discussion of ethics is necessary, timely, and productive" (Ebel, 2000: 1). Ethical questions about the *use* of nature have been the subject of systematic, comprehensive research in Denmark only in recent years. Some of this research is described in the following section.

4.1 Recent Danish research

Operating under the auspices of Odense University (now the University of Southern Denmark), the *Humanities Research Center* conducted a number of studies over a five-year period between 1992-1997 on cultural, ecological, sociological and philosophical aspects of our perception and uses of nature. The title of this project was 'Man and Nature'. In the mid-1990s, other interdisciplinary research programmes were also undertaken – for example, 'Man, Landscape and Biodiversity' with the objective of studying ". . . the interactions and dynamics involving human impacts and design of landscapes."[27] Focus was on "the effect of human exploitation of natural resources (related to production as well as to recreation) on biodiversity", and moreover how the use of natural resources can affect attitudes to the landscape.[28] Research projects in this programme included 'Value, Landscape and Biodiversity', which involved philosophers, ecologists, economists and landscape architects from five Danish universities, and 'Boundaries in the landscape', which aimed at clarifying ". . . the connections between the use of nature and nature and social processes in relation to landscape structure and biodiversity."[29] However, the main focus in all of these projects was on the countryside in general and the open landscape, and to a lesser extent forests.

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27 http://www.fsl.dk/boundaries/fBoundaries.htm.

28 http://www.fsl.dk/boundaries/fBoundaries.htm.

29 http://www.fsl.dk/boundaries/.

Other research institutions in this field include the *Centre for Ethics and Law in Nature and Society* and the *Center for Social Research on the Environment* (CeSaM). The aim of the Centre for Ethics and Law is to ". . . initiate research and international cooperation in the fields of ethics and law."[30] The intention is to examine the relationship between bioethics, social ethics and environmental ethics, on the one hand, and biolaw, social law and environmental law, on the other. Projects undertaken over the period 1993–1997 included one in which an attempt to clarify fundamental bioethical problems was made, particularly in relation to law, and another in which basic ethical problems in biomedicine and health research were documented and analysed across fourteen European countries. The overall purpose of the CeSaM is to ". . . provide insights into the complex interrelationships among the various social actors, or stakeholders, involved in environmental policy- and decision-making".[31] A more general aim of the centre is to support environmental research within the social sciences and humanities. CeSaM has participants in several Danish universities. Its secretariat is based at the University of Aarhus.

In 1997, and with the support of the University of Copenhagen, the Royal Veterinary and Agricultural University (KVL) established a five-year research chair in bioethics at KVL. The objective of this initiative was to identify and analyse ethical questions relating to research areas within KVL, such as modern animal husbandry, biotechnology, agricultural food production and forestry. It was agreed that different ethical views on these matters should be examined, and that pertinent concepts, such as sustainability and the perception of nature, should be clarified. In 1999, a multidisciplinary research centre focusing on the use of gene technologies in (particularly) food production was established. *The Centre for Bioethics and Risk Assessment*, with a secretariat at KVL, represents biological and social sciences as well as philosophy. The main task is to ". . . respond to concerns, voiced or otherwise demonstrated by the Danish public, regarding further advances in gene

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30 http://www.inet.uni2.dk/home/centre_for_ethics_and_law/about.htm.

31 http://www.au.dk/~cesamat/.

technology in food production and the release of genetically modified plants into the environment."[32]

These activities and projects point to a growing research environment in Denmark in the sphere of applied ethics and the natural environment, including farming and forestry. This thesis is intended to make a contribution to this increasingly vigorous area of research.

4.2 Ethical analysis and interdisciplinarity

What is entailed by the title 'ethical perspectives on forest management'? The overall topic, ethics and forest, can at the same time be perceived as a very narrow one and a quite broad one. To explain, this thesis has a broad scope inasmuch as it addresses ethical questions relating to forests. However, the scope is narrow in the sense that it addresses only issues related to forest management and forestry. The thesis may be seen as having a broader scope since there are many ethically relevant issues existing within this the topic of forest management and forestry: these range from global deforestation, forest restoration at the stand or landscape level and biodiversity conservation, at one extreme, to more specific regional issues such as pesticide use and conservation of old-growth. However, the scope of the thesis is narrower because only a small part of these issues – which are particularly relevant in a European context – are dealt with.

Ethical analysis of forestry and forest use in general can be performed at a number of levels and in connection with many aspects of forestry. In this thesis, I will consider the following two kinds of ethical analysis.

(1) The first involves the analysis of fundamental discussions about perceptions of the 'right' way to use a forest – for, say, production purposes, nature conservation or restoration. Here, the aim is to examine the value assumptions underlying prioritisation, identifying relevant ethical concerns, A further purpose is to consider how ethical concerns should be balanced where they conflict. The papers in the thesis

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[32] http://www.bioethics.kvl.dk/epresent.htm.

involving particular case studies, such as 'Beavers and biodiversity: the ethics of ecological restoration' and 'Designer trees, exotic species and the ethics of manipulating nature', offer this kind of analysis.

(2) The second kind of ethical analysis involves the consideration of central, but value-laden and often ambiguous notions relating to forestry and forest use in general. It is widely believed that ethical issues arise *after* scientific research has been conducted. In fact, they need to be addressed prior to, or in conjunction with, such research. Ethical assumptions about what is good and bad, or right and wrong, are generally implicit and unacknowledged in the conduct of scientific research. Two papers in the present thesis therefore examine concepts, used in the discussion of forestry and in forest use in general, that import ethical attitudes. These are 'Bæredygtighed – økonomi, etik og energi' and 'Economic and ecological approaches to assessing forest value in managed forests – ethical perspectives'.

It will be clear by now that this thesis is a piece of interdisciplinary research. To see what this means, consider the analysis and discussion of empirical results, and compare it with the analysis and discussion of arguments and underlying assumptions. And consider a proposal to restore part of a forest ecosystem in order to (a) enhance the habitats of certain endangered or threatened species, and (b) further the overall objective of maintaining or increasing the level of natural biodiversity. Several types of argument could be made in connection with this proposal. Science-based arguments might either substantiate the claim or show it to be unsound. For example, a scientific case for saying that biodiversity is not increased by the proposed measures might be propounded. However, underlying value assumptions, connected with different ethical theories, are also bound to play an important part, and the task is to analyse the arguments used, scientific or otherwise, and bring forward these assumptions.

Applied ethical analysis can assist forestry, both as a profession and an academic discipline, by showing how values and ethical outlooks can exert a discernible influence on forest management practices and silvicultural proposals. Environmental ethics, as an academic discipline, needs to be applied to actual practices. It needs to

move beyond the theoretical level and discuss such matters as the nature of value in the natural world and the ethical status of wilderness. In forestry, there are at least three ways of doing this. First, philosophers can apply ethical theories to specific cases connected with forestry and more generally natural resource management. In this way, philosophical quality may be introduced, but there is a danger that the descriptions of actual practices and objectives will be irrelevant or inaccurate. Secondly, forest scientists without philosophical training might themselves embark on ethical deliberation. This is likely to reverse the advantages and disadvantages just described. Until now the first of these approaches has prevailed. However, thirdly, co-operation between philosophers and foresters may provide a more promising approach. Such co-operation requires additional training on both sides – especially, perhaps, if a forester is to be able to engage in fruitful ethical deliberation.

5. Structure and outline

The thesis comprises six papers. The papers present, analyse and critically discuss ethical perspectives on: (1) the concept of sustainability, (2) the so-called 'back to nature' trend in forest management and silviculture, (3) forest-related manipulation (4) the concept of biodiversity and ecological restoration, (5) forest values in relation to managed forest, and (6) acceptability and accountability in forest management. In one way or another, all the papers concern sustainability and biodiversity in a forest management context. The papers include elements of conceptual analyses and the applied analysis of actual case studies.

In the first paper, 'Bæredygtighed – økonomi, etik og energi' (in Danish, English abstract, 'Sustainability – economics, ethics and energy') a conceptual analysis of sustainability is developed. Sustainability is a key concept within natural resource management and indeed, in effect, within any activity having consequences of an intragenerational or intergenerational kind. The basis of the demand for sustainability is ethical, as is shown by the following, often asked, questions. What do we owe future generations? Do we have duties toward or with regard to nature? How do we distribute obligations and duties in relation to future generations and nature? The aim of the paper is to analyse the ethical assumptions implicit in economic sustainability theory. In this paper, the Danish energy policy is used as a paradigm case. Examples used in the paper to shed light on the problem of substitution and distributive justice include the use of agricultural food crops for energy and the use of wood fuels as a substitute for fossil energy.

The paper examines the concept of sustainability as it has been defined and applied within resource and environmental economics. A number of conflicting interpretations of sustainability are presented in this paper. These range from so-called 'very weak' to 'very strong' sustainability. They differ in two primary respects. One difference is in the possibility of substituting natural for man-made capital; the other concerns discounting. It is argued that a profound disagreement over whether nature has economic resource value only or should be valued according to other standards underlies the economic discussion about substitution. Equally, disagreement over the

principles of intragenerational and intergenerational distributive justice lies beneath, and informs, contemporary discussion of discounting. The main conclusion of this paper is that, to some extent, the differences between the various interpretations of sustainability reflect differing empirical assumptions – for example, about technological innovation. However, a disagreement over values and ethical principles is clearly involved as well. These value assumptions and ethical principles must be analysed and discussed as a preliminary to economic analysis.

In the second paper, '"Back to nature" – a sustainable future for forestry?', the concept of sustainability as it is defined within forestry is used as a yardstick to analyse and assess a certain trends in forest management and silvicultural practice. The main aim of the paper is to gain a better understanding of the rationale of the so-called 'back to nature' approach to forest management and silviculture.

The case for adopting this 'back to nature' approach is examined, and it is shown that this case depends heavily on the current interest in obtaining or maintaining sustainability, and in maintaining or increasing the level of forest-related biodiversity. It is asked whether the 'back to nature' trend represents a shift in ethical outlook. The development of the trend, and the retreat of the productionist paradigm, is traced, and it is explained how this development represents a departure from the classical silvicultural systems. *En route*, the dividing line between forest non-intervention and intervention is examined. It is argued that discussions about a managed forest will concern the intensity of the relevant management routines, i.e. the degree of use of, control over and modification of the natural environment.

An important thing to stress is that, in adopting nature-based silviculture, foresters are bound to address nature conservation concerns more seriously. They must now meet society's changed demands on a forest and forestry practice. More broadly, forest stakeholders need not only to discuss the ways in which the natural is perceived or enquire into what the 'proper' use of a forest is, and what constitutes a 'genuine' forest, but they need to engage in a discussion about which values to promote and which concerns are considered ethically relevant (see paper No. 5).

It might be difficult to pinpoint what a sustainable future for forestry entails, but it is clear that a sustainable future for forestry will require us to balance these values both against one another and against any concerns felt to be ethically relevant by the various stakeholders.

In the third paper, 'Designer trees, exotic species and the ethics of manipulating nature', the main aim is to analyse the connection between modern biotechnology and forest and landscape management, and to discuss ethical responses to current practices.

Forest management is at its core concerned with using, changing or regulating the natural environment in pursuit of defined objectives. With increased skills, scientific knowledge and technical expertise, the degree of change and regulation of nature has risen throughout the twentieth century in particular. Besides drainage and the use of pesticides and fertilisers, current measures include, in particular, harvesting as a way of regulating and controlling the distribution of species in time and space. A poor array of naturally occurring tree species is found in Europe, as compared with arrays found further east and west along the same latitude. As a result many tree species have been introduced by Europeans to enhance wood production. Moreover, in the past 75 years, selective breeding has moved into the sphere of forest management, and now, of course, it is possible to modify a tree's genome. However, the public is apprehensive about these latter developments; and the increased attention to the use of native species and nature conservation observable at present in many European countries also appears to be in conflict with intensive and technology-dependent management practices.

Both the native versus non-native issue and the question of using genetically modified trees are in part empirical. That is, these issues can, to some extent at least, be tackled by natural scientists. However, underlying value judgements are also, and inevitably, involved. Biotechnological intervention and forest and landscape management can

both be seen as *manipulations* of nature, although obviously they operate at different levels: the former intervenes at the micro-level and the latter intervenes at the macro-level. (The word 'manipulation' is used here as a convenient general term for any purposive human impact on the development of a forest.) Can species and gene introductions be assessed by asking how much manipulation they involve then? The paper argues that they can. Such an approach would indeed help to clarify the way in which manipulation at one level can have ramifications at another level. It is suggested that we should consider methods, production systems and practices at both the micro-level and macro-level from a combined, non-anthropocentric bioethical and environmental ethical perspective.

In the fourth paper, 'Beavers and biodiversity: the ethics of ecological restoration', the concept of biodiversity is examined through an analysis of a recent case of beaver reintroduction in a forested area in Denmark. The question here concerns the acceptability, not of species introduction (as it was in the third paper), but species *re*introduction. It is asked: what assumptions about the value of nature and biodiversity underpin nature restoration, and in particular species restoration?

Multiple-use forest management is about procuring timber and non-timber forest products, as well as about managing for water, recreation and wildlife. Beavers have been reintroduced to Denmark after an estimated absence of in excess of 2,000 years. The aims of the reintroduction were mixed. The initiative was undertaken partly to ensure the long-term survival of beavers as a species throughout Europe, but the animals were also reintroduced as agents that foster biodiversity and promote variation and dynamics in the natural environment.

Appeals to biodiversity are made by both advocates and opponents of species restoration, but with very different results. In this paper, it is suggested that this is because two quite different conceptions of biodiversity are being pressed into service. One of these conceptions treats biodiversity as something that is constituted by certain 'end-states'. The other treats it as a certain kind of 'historical' process. The main lesson to be drawn from the beaver case concerns the values that underlie debates

about restoration. Greater awareness of these values is required if they are to be properly promoted. A careful examination of the conflicting notions of biodiversity invoked in discussions of the adoption of restoration policy in multiple-use forest management will prove helpful in deciding whether, where and what to restore.

In the fifth paper, 'Economic and ecological approaches to assessing forest value in managed forests – ethical perspectives', ways of assessing a forest's value are examined. The main aim of the paper is to show how to make the process of ascribing value to a forest more transparent. Forest values can be seen as relatively enduring concepts of what is good or desirable, or conversely what is bad or undesirable, about a forest.

It is often claimed that forests of high, or higher, value ought to be prioritised in management. However, we need to ask which forests are the most valuable, and from what perspective. With the trend towards greater integration of production and nature conservation in forestry, traditional economic approaches have been considered inadequate in the formulation of forest policy and the setting of forest management objectives. However, in the last few decades, other types of economic approach to the assessment of forest value have gained a foothold. They have done so, where they have, because among other things they reflect concern for nature conservation issues in relation to, for example, future generations more adequately. However, non-economic approaches have become even more prominent. From an ecological point of view, the concepts of ecosystem health and nature quality must be employed if we are to assess a forest's value properly. Here, 'better' systemic health, or 'higher' nature quality, confer higher value on forests in which they are present. Clearly, however, the concepts of 'health' and what is 'natural' need to be carefully elaborated. In particular, the use of these concepts in the context of the intensively managed forests of Europe needs to be explained.

Two issues are at stake. One is about what happens when better defined utility or use values are complemented by other kinds of value. The approaches mentioned above try to capture these 'other' values and in this way assess the 'true' or 'full' value of a

forest. The second issue concerns problems surrounding the actual measurement and estimation of these values. Clarification of these issues, and the critical discussion it requires, will help to make the process of ascribing value to a forest more transparent.

In the sixth paper, 'The acceptability of forest management practices: ethical accounting and the ethical matrix', practical methods of assessing forest management practices are analysed. The main objective is to examine the feasibility of stakeholder approaches, such as the idea of ethical accounting and the so-called ethical matrix, in such assessment. It is argued that these tools must not be seen as panaceas to analyse the value assumptions underlying certain management practices. We need to reflect on the ethical outlook implicit in these approaches *before* using them.

In primary sectors, such as farming and forestry, there seems to be a shift away from a shareholder-orientated approach to a broader stakeholder approach in which users and directly or indirectly affected parties are taken into account. A distinction has been made between what are called visible and invisible stakeholders. This distinction helps us to anticipate the acceptability and accountability of forest management practices. Ethical accounting is a stakeholder-orientated accounting process. It can be used to bring out the values underlying the management practice and to relate these to actual results and consequences. This approach is clearly applicable at the management level. The ethical matrix is a tool for assessing the ethical impact of new technologies, changes in production system and management practices on specified stakeholders. It is designed for use at the political decision-making level. The two approaches are therefore complementary rather than alternatives.

Both approaches are facilitating methods. They are not intended to yield 'correct' answers, but instead reflect the inputs in a systematic way. As such they can be used effectively to create more transparency in the decision-making process on several different levels. Each approach can be useful in a forest management context. However, if either is to be of real use, due consideration of the considerable variation in ownership and management objectives, especially when a forest is managed under a multiple-use regime, is required. As was mentioned above when the previous paper

was described, a forest has many diverse values. While these ensure that both ethical accounting and the ethical matrix are relevant and helpful, they also make the two approaches more difficult to apply. It also has to be recognised that a greater number of invisible stakeholders needs to be taken into account. However, most importantly, it must be recognised that careful consideration of one's basic ethical view and one's underlying values is necessary if one to be in a position to choose meaningfully between the two approaches.

6. Main conclusions and the significance of the thesis

Over the last twenty-five years especially, forest management in Europe and North America has been rethinking its foundation. At the same time, as List (2000) points out, environmental philosophy has also been engaged in a process of expanding and revising its foundation. The principal focus for both environmental philosophy and forestry is the concept of value. Value can here be understood in more than one way – for example, as what different stakeholders consider important; as value in a forestry context; as the values, understood as functions, of a forest; or, finally, as basic beliefs which influence attitudes to the various potential uses of a forest.

The thesis sets out examples of ethical dilemmas. It focuses on issues inherent in forest management and silvicultural practices, and it presents a number of the most pressing questions in applied ethics that forestry raises. Suggestions about the ways in which ethical perspectives on forest management can be used to understand the practices that will be adopted in forestry in the coming years are made. At a methodological level, the thesis also attempts to contribute to the general development of research in applied environmental ethics, particularly in a forestry context.

The thesis asks whether forests and forestry require special treatment. Thus it asks: are there ethical issues that are exclusive to forest management and require special attention? Or can 'answers' to the problems in forestry be deducted from existing theories and research in the area of environmental ethics? In pursuing these questions, it is natural to ask whether tools used in adjacent areas, such as agriculture and animal husbandry, can be of use in relation to forestry.

The thesis explains how ethical analysis can be applied in connection both with economic and ecological analysis of forest management and specific silvicultural practices. The description of actual cases from forestry may stimulate discussion among professional philosophers with an interest in environmental ethics. Moreover, the engagement with actual problems within forest management and administration may contribute to a more comprehensive approach to on-going discussions within forestry.

Forest management can benefit from the analysis of its underlying value assumptions in several ways. (1) Such analysis helps to identify ethical issues and reveal the reasons why people and agencies have act as they do. (2) Such analysis also helps to clarify basic concepts and directs enlightened attention to possible conflicts arising from value pluralism. (3) Finally, such analysis assists us in assessing specific cases involving particular management practices. Ethical analysis can assist various stakeholders: it can enable policy makers to shape attractive forest policies, enable forest managers to understand different attitudes to the practices they operate with, and enable environmentalists to justify their actions and beliefs. To the extent that they are disseminated, all three of these benefits will increase public awareness of the ethical issues raised by managed forests.

An overall contribution of the thesis is to point for the need to introduce a higher degree of ethical transparency in forest management. This is an important condition to attain higher levels of 'stakeholder acceptability' vis-à-vis forest management decisions and, in general, to maintain or develop a better accord between management practices and stakeholder values. Such an accord requires, first, a greater awareness of the value conflicts concealed in the use of concepts such as sustainability and biodiversity. Secondly, it requires improved clarification, and a thoroughgoing critical discussion, of any value assumptions underlying forest management practices. These are some of the conditions under which fruitful dialogue with the rest of society, including politicians and the general public, can proceed.

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SUMMARY: *The paper examines the concept of sustainability as defined and applied within resource and environmental economics. There are a number of conflicting interpretations of sustainability which are presented in this paper. They mainly differ in two aspects: One regards the possibility of substituting natural for man-made capital, and the other concerns discounting. These differences do to some extent reflect different empirical assumptions, e.g. relating to technological innovation. However, there is clearly also a disagreement concerning values and ethical principles involved. It is argued that underlying the economic discussion about substitution is a profound disagreement regarding whether nature only has economic value as a resource or must be valued according to other standards. Underlying the discussion about discounting is an argument concerning principles of intra- and intergenerational distributive justice. The Danish energy policy is used as a paradigm case. The main aim of the paper is to give a comprehensive picture of the ethical assumptions implicitly made by economic sustainability theory.*

1. Indledning

Hensynet til beskyttelse af miljø og naturressourcer er rykket stadigt højere op på den politiske dagsorden gennem de seneste årtier. Dette er bl.a. kommet til udtryk i form af en målsætning om at sikre en samfundsøkonomisk bæredygtig udvikling. Miljø- og ressourceøkonomer har siden midten af 1970'erne søgt at formulere og anvende kriterier for, hvad der kan betegnes som en bæredygtig udvikling.

Denne artikel er et resultat af projektet »Hvad er en bæredygtig energipolitik« finansieret af Energistyrelsen over Energiforskningsprogrammet. Vi vil gerne takke Jørgen Birk Mortensen, Peder Andersen, Bent Thage og Jesper Munksgaard samt en anonym referee for værdifulde kommentarer.

Fælles for de økonomiske analyser af bæredygtighed er en tilslutning til en målsætning om at sikre en ligelig fordeling af goder over tid. Men dér er der væsentlige uenigheder, hvilket afspejler sig i indbyrdes modstridende økonomiske definitioner af bæredygtighed, herunder forskellige syn på diskontering. Disse uenigheder afspejler i et vist omfang forskelle i empiriske antagelser med hensyn til mulighederne for i fremtiden at løse miljøproblemer gennem teknologiske nyskabelser. Der er dog også forskelle med hensyn til de bagvedliggende værdier og etiske idealer. Således afspejler forskelle med hensyn til definitioner af økonomisk bæredygtighed i høj grad forskellige syn på hvilken værdi, der tilkommer naturen; om den blot er at betragte som en ressource, eller om naturfænomener kan have en egen værdi. Forskellige syn på diskontering bygger på forskellige principper for, hvad der kan anses for at være en retfærdig fordeling af goder mellem generationerne.

Hensigten med artiklen er at præsentere og diskutere de forskellige økonomiske udlægninger af bæredygtighed i lyset af etiske overvejelser vedrørende naturens værdi og fordelingsretfærdighed. Problemer i forbindelse med den danske udnyttelse af fossil energi vil blive anvendt som eksempel i forbindelse med diskussionen af de forskellige bæredygtighedsopfattelser. Det drejer sig dels om udtømningen af de danske olie- og gasressourcer. Bliver der ikke gjort nye større fund, vil det om 15 år være slut med både olie- og gasproduktion fra Nordsøen.[1] Et andet problem i energisektoren er de miljømæssige konsekvenser af udledningen af CO_2. Danmark er et af de lande i verden, der har det største CO_2-udslip pr. indbygger.

Artiklen er skrevet ud fra den grundlæggende antagelse, at hverken etiske overvejelser, naturvidenskabelige undersøgelser eller økonomiske analyser kan give et selvstændigt svar på, hvad en bæredygtig udvikling kræver. Forudsætningerne for bæredygtighedsdiskussionen er etiske: hvad skylder vi kommende generationer, har naturen et selvstændigt krav på hensyn, og hvordan fordeler vi forpligtelser i forhold til naturen og fremtidige generationer? Naturvidenskaben giver faktuelle oplysninger om effekten af menneskelige aktiviteter på naturlige økosystemer. Men hverken de etiske eller naturvidenskabelige betragtninger fortæller, i hvilket omfang vi kan tillade os at producere og forbruge varer og tjenester. Svaret på dette spørgsmål afhænger i lige så høj grad af vore forventninger til de økonomiske og teknologiske feedback-mekanismer, der bestemmer, i hvilken udstrækning vi kan substituere os ud af de begrænsninger, som en endelig naturressourcebeholdning repræsenterer.

2. Generelle bæredygtighedsbetragtninger

Forestillingen om en bæredygtig udvikling går i sin mest generelle form ud på, at

1. De 15 år er et skøn, der fremkommer ved simpel division af den forventede restbeholdning af olie og gas med udvindingen, jf. Leth-Petersen (1998). Der er naturligvis ikke tale om en analyse af det optimale udtømningsforløb.

den nuværende generation vedvarende skal kunne udnytte naturens ressourcer på en måde, så der tages hensyn til mere og andet end den snævre og kortsigtede nytte. Dette princip er kendt fra planlægningsdiscipliner tilbage i 1700- og 1800-tallet bl.a. med relation til skovbrug (Oesten 1993).

Udgivelsen af IUCN's (1980) »World Conservation Strategy«, der talte for bevarelse af arter og økosystemer, markerede fornyet interesse for ideen om vedvarende nytte fra naturlige ressourcer, og senere blev debatten gjort bredere ved at inddrage spørgsmål om retfærdig økonomisk fordeling og maksimering af menneskets eksistenstid (Gowdy 1994). Brundtland-kommissionens (1987) rapport »Vor fælles fremtid« fik med stor succes udbredt budskabet om, at vi har en pligt til at fremme en udvikling, der:« ... opfylder de nuværende generationers behov uden at bringe fremtidige generationers muligheder for at opfylde deres behov i fare.« (s. 42). I international sammenhæng blev begrebets udsagnskraft udvidet i forbindelse med Rio-topmødet om miljø og udvikling og de deraf følgende deklarationer og konventioner. Brundtland-kommissionens tanker om en retfærdig ressourcefordeling af goder og byrder mellem rige og fattige lande er også her centrale elementer.

Den positive værdiladning, som blev knyttet til begrebet bæredygtighed efter Brundtland, medførte, at andre målsætninger, som skulle nyde politisk fremme, blev lagt ind under begrebet om en bæredygtig udvikling. Eksempelvis kan man i en redegørelse fra Landbrugsministeriet (1991) se følgende målsætninger knyttet sammen med ideen om et bæredygtigt landbrug: Indtjening til landmanden, gode arbejdsvilkår, arbejdsmiljø, beskyttelse af det ydre miljø og dyrevelfærd.

Bæredygtighedsbegrebet er med forbløffende hast blevet symbol på noget, som er ubestrideligt godt, og ikke-bæredygtighed vil få vel forsvare. Men mangel på en præcis og operationel definition har medført, at alle mere eller mindre har taget begrebet til sig i troen på eller i håbet om, at det kan være med til at retfærdiggøre netop deres værdier (Cocklin 1995). Bæredygtighedsbegrebet er af kritikere kaldt alt fra en diffus udviklingsfilosofi (Heilig 1997) til et i økonomisk henseende overflødigt begreb (Beckerman 1994, 1995). Bromley (1998, s. 239) sammenfatter den hidtidige udvikling ved at konstatere, at:

> Sustainability is at once a fine idea and hopeless concept. It is good because it reminds us of the fate of future persons, it is hopeless because it begs for operational content.

Erkender man, at bæredygtighedsbegrebet i sin brede, men noget substansløse form ikke er videre brugbart, har man to valgmuligheder. Enten opgiver man begrebet, eller også forsøger man en begrebsmæssig opstramning. Inden for økonomien har man klart valgt den sidste strategi. En række miljø- og ressourceøkonomer har forsøgt at udvikle mere præcise og operationelle begreber om en bæredygtig udvikling. Dette

må i forhold til bæredygtighedsdiskussionen ses som et klart fremskridt, men følgerne af denne begrebsmæssige opstramning er ikke fuldt erkendte. Konsekvenserne af opstramningen er nemlig, at man i højere grad må være bevidst om de bagvedliggende værdiantagelser og forestillinger om fordelingsretfærdighed, som den økonomiske bæredygtighedsteori hviler på. Derfor er bæredygtighed ikke længere pr. definition at regne som utvetydigt positiv.

Disse antagelser vedrører bl.a. naturens værdi og fordelingen af goder. Det første kommer til udtryk i økonomiske vurderinger af, i hvilket omfang det er rimeligt at substituere naturressourcer eller kompensere miljømæssige tab med producerede goder. Det kan vise sig at være etisk problematisk, når det drejer sig om essentielle miljøværdier som økosystemer, arter, landområder og andre goder med symbolværdi. Spørgsmålet er her, hvilke miljøværdier der falder ind under det økonomiske godebegreb, og hvilke der må vurderes ud fra andre normer. I det omfang den økonomiske bæredygtighedsteori f.eks. ikke tillader, at naturressourcer substitueres med anden kapital, vil dette udtrykke en etisk norm om naturens egenværdi. Denne problemstilling uddybes i afsnit 4.1 med eksempler hentet fra jordbrugssektoren og energisektoren.

Den anden type etiske overvejelser vedrører, hvad der skal forstås ved en retfærdig fordeling mellem og inden for generationer. Et centralt økonomisk spørgsmål vedrørende valg af diskonteringsrate hviler på etisk begrundede principper for retfærdig fordeling. Et vigtigt bud på sådanne principper er, at det er retfærdigt, at nulevende generationer sikrer, at kommende generationer kan opnå (mindst) samme velfærd som os. Der er her en inspiration fra den amerikanske filosof John Rawls' (1971) tanker om retfærdig fordeling mellem grupper i et samfund – det såkaldte *maximin-princip*. En nærmere præsentation og diskussion af dette og andre retfærdighedsprincipper vender vi tilbage til i afsnit 4.2. og 4.3.

For at denne form for etisk refleksion skal kunne give mening, kræver det imidlertid, at man betragter det fulde spektrum af økonomiske bæredygtighedsteorier, der optræder inden for det miljø- og ressourceøkonomiske område og baggrunden for disse baseret på klassisk økonomisk vækstteori.

3. Økonomiske bæredygtighedsteorier

Klassiske økonomer som Smith, Malthus, Ricardo og Marx nærede stor interesse for økonomisk udvikling og opstillede en række mere eller mindre formaliserede vækstteorier. Mens Smith så optimistisk på menneskehedens langsigtede økonomiske muligheder, havde såvel Malthus som Ricardo et decideret pessimistisk fremtidssyn. I deres teorier repræsenterede den begrænsede mængde af naturressourcen jord en uoverstigelig barriere for langsigtet økonomisk vækst. Marx så, som Smith, et kolossalt udviklingspotentiale i den kapitalistiske økonomi, men samtidig klassemodsæt-

ning, der uvægerligt måtte føre til kapitalismens sammenbrud. I 1940'erne og 50'erne skete der en (gen)opblomstring af økonomisk vækstteori. Perioden var især præget af modstridende keynesianske og neoklassiske teorier om mulighederne for at sikre stabil vækst i markedsøkonomier præget af konjunktursvingninger (for en oversigt se Sen 1970). Hverken keynesianske eller neoklassiske vækstteoretikere betragtede naturressourcer eller miljøet i bredere forstand som vækstbegrænsende faktorer.

Med udgangspunkt i Ramsey (1928) udviklede neoklassiske økonomer kriterier for optimal økonomisk vækst (se især Koopmans 1967). Her er det ikke konjunkturspørgsmålet, der er i fokus, men afvejning mellem nutidige afsavn i form af opsparing og fremtidige gevinster i form af øgede forbrugsmuligheder. *Optimal vækstteori* har siden fået væsentlig betydning for økonomisk bæredygtighedsteori, bl.a. som grundlag for kontroversielle cost-benefit analyser af fordelagtigheden af begrænsning af CO_2-udslip og drivhuseffekt. Vi vil derfor tage bestræbelserne på at definere kriterier for *optimal* økonomisk udvikling som udgangspunkt for gennemgangen af økonomisk bæredygtighedsteori.

3.1 Optimal vækst

Man kan som udgangspunkt benytte Pareto-princippet som et minimumskrav til effektiviteten af en intergenerationsfordeling. Efter Pareto-princippet kan en intergenerationsfordeling siges at være økonomisk efficient, hvis det ikke er muligt at forbedre nogen generations velfærd uden at forringe andre generationers velfærd. Der er uendeligt mange fordelinger, som opfylder dette intertemporale efficienskrav. For at vælge mellem disse må der opstilles en intergenerations-velfærdsfunktion, der afspejler etiske kriterier for intergenerationsretfærdighed (Toman m.fl. 1995). Én mulig intergenerationsvelfærdsfunktion er optimal vækstteoris maksimering af den diskonterede værdi af fremtidige nyttestrømme. Dermed bliver nulevende generationers valg af diskonteringsrate bestemmende for størrelsen af den kapitalbeholdning, der overdrages til kommende generationer og disses forbrugsmuligheder.

Nordhaus klimamodel (DICE) er et godt eksempel på anvendelse af optimal vækstteoris principper i en bæredygtighedssammenhæng (Nordhaus 1994). Kriteriefunktionen maksimerer den diskonterede værdi af de globale nyttestrømme over den valgte tidshorisont

$$\max_{[c(t)]} \sum_{t} U[c(t),\ L(t)]\,(1+\rho)^{-t} \qquad (1)$$

hvor U er nyttestrømmen, $c(t)$ er forbruget pr. capita i periode t, $L(t)$ er verdensbefolkningens størrelse i periode t, mens ρ er diskonteringsraten.

Simuleringer med DICE-modellen over en hundredårig periode viser, at det ikke skulle være økonomisk fordelagtigt at gennemføre væsentlige reduktioner i udslippet af drivhusgasser på kortere sigt. Nordhaus anbefaler derfor en afventende politik. Dette resultat er ikke overraskende i betragtning af den lange tidsforskydning mellem udslip og miljøeffekt og de valgte diskonteringsrater (6% p.a. i begyndelsen faldende til 3% p.a.). Ved en diskonteringsrate på 3% p.a. er nutidsværdien af 100 kr. om hundrede år ca. 5 kr. Skader, der først indtræffer langt ude i fremtiden, vurderes derfor reelt som betydningsløse næsten uanset størrelse.

3.2 Begrundelse for diskontering

Den samfundsmæssige diskonteringsrate udtrykker trade-off-relationen mellem afståelse af nutidigt forbrug med henblik på øget fremtidigt forbrug. Arrow m.fl. (1996) opdeler begrundelserne for diskontering i to hovedkategorier: en *præskriptiv* begrundelse, der hviler på etiske overvejelser – imperativer om man vil – og en *deskriptiv* begrundelse, der henviser til private agenters og politiske beslutningstageres faktiske adfærd.

3.2.1 Den præskriptive tilgang

Denne tilgang tager udgangspunkt i Frank Ramseys banebrydende artikel fra 1928 om optimal vækst. Ramseys teori bygger på to neoklassiske antagelser af henholdsvis psykologisk og teknologisk karakter. Den første er nytteteoriens antagelse om, at stigende pr. capita indkomst/forbrug ledsages af aftagende marginalnytte ($u'(c) > 0$; $u''(c) < 0$). Den anden er en teknisk begrundet antagelse om, at forøgelse af mængden af kapitalgoder i forhold til mængden af arbejdskraft i den aggregerede produktionsfunktion $F(K, L)$ medfører, at kapitalens marginalprodukt aftager ($\partial F(K, L) / \partial K \rightarrow 0$ når $K \rightarrow \infty$). Med konstant befolkning kan man altså øge det fremtidige forbrug pr. capita gennem nettoinvesteringer (afståelse af nutidigt forbrug), men det bliver stadig vanskeligere på grund af aftagende kapitalproduktivitet. Dertil kommer så, at det bliver sværere at øge målvariablen samfundsmæssig *velfærd* gennem øget forbrug på grund af faldende marginalnytte. Kapitalakkumulationen kan med andre ord forceres så meget, at man sætter mere velfærd til i nutiden (faldende forbrug er forbundet med stigende marginalnytte), end man vinder i fremtiden på grund af en kombination af faldende kapitalproduktivitet og marginalnytte.

Man kan nu opstille forskellige etiske/præskriptive kriterier for, hvordan forbrugsudviklingen *bør* forløbe over tid. Ifølge Ramsey (1928) bør samfundet vælge det vækstforløb, der sikrer den størst mulige sum af velfærd over tid. Diskontering af *forbrugsstrømme* burde derfor kun ske ud fra antagelsen om faldende marginalnytte og kapitalproduktivitet. Det optimale vækstforløb er karakteriseret ved, at forbruget pr.

capita vokser således, at marginalnytten af forbrug falder med en rate, der er proportional med kapitalens marginalprodukt. I det optimale vækstforløb akkumuleres der kapital i et omfang, som sikrer, at forbruget pr. capita (c) vokser således over tid, at marginalnytten af forbrug aftager med en rate, der er lig med kapitalens marginalprodukt gange marginalnytten:

$$\frac{d}{dt} u'\{c(t)\} = -\frac{\partial f(t)}{\partial K(t)} u'\{c(t)\} \qquad (2)$$

Nettoinvesteringerne vil være positive og forbruget pr. capita vil vokse indtil enten kapitalproduktiviteten eller marginalnytten er faldet til nul – en tilstand Ramsey betegnede som *bliss*, dvs. lyksalighed. Her er alt, hvad der *økonomisk* kan gøres for menneskers velbefindende, gjort (Ramsey 1928). Et sådant forløb kræver, at markedsrenten (og den samfundsmæssige diskonteringsrate) svarer til kapitalens marginalprodukt $r(t) = \partial F(t) / \partial K(t)$. Sammen med ovenstående ligning giver denne forudsætning:

$$r(t) = \frac{d}{dt} u'\{c(t)\} / u'\{c(t)\} \qquad (3)$$

I et steady state forløb med konstant befolkning og konstant vækstrate i forbruget får vi:

$$r^* = \eta g^*$$

hvor r^* og g^* er *steady state* værdierne af renten og forbrugets vækstrate; $-u''(c)\, c/u'(c)$ benævnes marginalnytteelasticiteten.

Vi vil betegne denne tilgang som utilitaristisk begrundet diskontering (utilitarisme er nærmere forklaret i afsnit 4.3).

I gængse fremstillinger af den samfundsmæssige tidspræference (*STP*) indgår der også en ren tidspræferencekomponent ρ (se f.eks. Nordhaus (1994):

$$STP = \eta g + \rho$$

Den rene samfundsmæssige tidspræference ρ betegnes også som *nyttediskonteringsraten*, idet en given fremtidig nytteændring tillægges lavere vægt end en tilsvarende nutidig nytteændring. Komponenten ηg betegnes som *godediskontering*, idet diskonteringsbegrundelsen ikke er lavere vægtning af kommende generationers nytte, men derimod forventet forbrugsvækst og faldende marginalnytte af forbrugsgoder.

Vækstbegrundet diskontering kan altså ikke siges at være diskriminerende over for fremtidige generationer. Her ligger det etiske problem i den empiriske usikkerhed omkring fastlæggelsen af forventningerne til fremtidig vækst. Den rene tidspræferences nyttediskontering kan derimod betragtes som udtryk for *empatisk afstand* til medlemmer af fremtidige generationer, dvs. det er svært at have forståelse for deres følelser og vanskeligt at sætte sig i deres sted (Arrow m.fl. 1996).

Ramsey (1928) betragtede det som »ethically indefensible« at vægte fremtidige generationers nytte lavere end nutidige generationers. Den utilitaristiske nyttemaksimeringsbegrundelse for kun at acceptere godediskontering er dog langtfra ukontroversiel. Er nytteelasticiteten lav (dvs. at marginalnytten kun aftager lidt ved stigende forbrug), fører Ramseys kriterium for optimal vækst til høj akkumulationsrate og lavt nutidigt forbrug. Nutidige generationers velfærd ofres til fordel for fremtidige generationers overflod. At det utilitaristiske nyttemaksimeringsprincip ikke sikrer det enkelte individs (her den enkelte generations) velfærd er en velkendt etisk problemstilling, som vi ser nærmere på i afsnit 4.3.

Rawls maximin-kriterium er det utilitaristiske nyttemaksimeringsprincips diametrale modsætning (se afsnit 4.3). Maximin-kriteriet kan udtrykkes som en samfundsmæssig velfærdsfunktion (W) af typen: $W = \min(U1,..., Un)$, hvor $U1,..., Un$ er (ordinalt sammenlignelige) individuelle nytter. Det vil sige, at maksimering af samfundets velfærd er ensbetydende med maksimering af den mindste Ui. Den rawlsianske velfærdsfunktion er altså kun følsom over for det dårligst stillede individs tab eller gevinst. I en intergenerationssammenhæng indebærer maximin-princippet, at det er den dårligst stillede generation (af samtlige generationer i al evighed), der har krav på hensyntagen. Det resulterer i et bæredygtighedsprincip, der kræver et *konstant* forbrug over tiden svarende til det maksimalt opnåelige (Solow 1974). Set i relation til den samfundsmæssige tidspræferencerelation ovenfor indebærer maximin-princippet, at $\rho = 0$ (ingen diskontering af fremtidig nytte), mens $\eta = \infty$ (Arrow m.fl. 1996). Det sidste led betyder, at maximin-princippet ikke sikrer Pareto-efficiente intergenerationsfordelinger, dvs. en forbedring af en generations nytte, uden forringelse af nogen anden generations nytte, vil ikke blive registreret som en forbedring af en maximin-velfærdsfunktion.

Chichilnisky har foreslået en intergenerationsvelfærdsfunktion, der er følsom over for såvel nutidige som fremtidige generationers nytte – så man både undgår det, Chichilnisky betegner som »dictatorship of the present« og »dictatorship of the future« (for detaljer se Chichilnisky 1997).

Anvendelse af Chichilniskys velfærdsfunktion kræver kvantificering af parametre, der vægter hensynet til nutiden over for hensynet til den fjerne fremtid. Her giver Chi-

chilnisky ikke umiddelbart nogen hjælp, men principielt må tilgangen betragtes som mere tilfredsstillende end den utilitaristiske eller den rawlsianske velfærdsfunktion.

3.2.2 Ikke-fornybare naturressourcer og diskontering

I optimal vækstteori er det substitutionen mellem kapital og arbejdskraft, der er i fokus. Kapitalens aftagende marginalproduktivitet skyldes, at kapitalmængden øges i forhold til arbejdsstyrken/befolkningen. Aftagende kapitalproduktivitet er derfor ikke ensbetydende med faldende produktion pr. capita, men alene faldende vækstrate pr. capita. Problemstillingen er imidlertid en anden, når producerede kapitalgoder skal kompensere for en absolut faldende restbeholdning af naturressourcer. Pezzey og Withagen (1998) analyserer diskonteringsprincippet i relation til bæredygtighedsbegrebet med eksplicit inddragelse af naturressourcer R i den aggregerede produktionsfunktion $F(K, L, R)$. I et bæredygtigt udviklingsforløb skal udtømningen af ikke-fornybare naturressourcer kompenseres med producerede kapitalgoder (jf. Solows og Hartwicks modeller i afsnit 3.3). Det betyder, at forholdet mellem mængden af produceret kapital og naturressourcer øges over tiden. I takt med den stigende kapitalintensitet forventes kapitalens marginalprodukt at gå mod nul ($\partial F(K, L, R) / \partial K \rightarrow 0$ når $R \rightarrow 0$ og $K \rightarrow \infty$).[2] Opretholdelse af konstant produktion og forbrug pr. capita kræver altså stadig større mængder kapital til at kompensere for en given nedgang i mængden af naturressourcer. Diskontering med en *konstant* positiv rate kan derfor ikke være i overensstemmelse med en bæredygtighedsopfattelse, der kræver opretholdelse af et ikke-aftagende pr. capita forbrug over tid. Diskonteringsraten må aftage/gå mod nul i takt med faldet i kapitalproduktiviteten.

Indfører man forventninger om teknologiske fremskridt, der modvirker nedgangen i kapitalproduktiviteten, kan diskonteringsreglen modificeres til, at diskonteringsraten skal være mindre end vækstraten for teknologiske fremskridt (Solow 1992). En antagelse om fravær af teknologiske fremskridt er naturligvis pessimistisk. På den anden side er en forudsætning om *evigtvarende* teknologiske fremskridt et udtryk for en risikofyldt satsning – på kommende generationers vegne. Anvendelse af en aftagende diskonteringsrate over lange tidshorisonter kan derfor betragtes som udtryk for et forsigtighedsprincip.

Den præskriptive udledning af den samfundsmæssige diskonteringsrate tager ikke udgangspunkt i empiriske observationer af folks tidspræferencer, men bygger på nytteteoretiske og etiske overvejelser. Undersøgelser af folks faktiske adfærd synes imid-

2. Som det fremgår af afsnit 3.3.1, vil en forudsætning om, at producerede kapitalgoder og naturressourcer er perfekte substitutter (substitutionselasticiteten = 1) »løse« problemet med faldende kapitalproduktivitet. Det indebærer til gengæld en problematisk forudsætning om, at naturressourcers marginalprodukt går mod uendeligt i takt med udtømningen.

lertid at vise, at folk diskonterer i scenarier, der indebærer afvejning af *samfundsmæssige* omkostninger nu over for fremtidige benefits – vel at mærke med *aftagende* diskonteringsrate over lange tidshorisonter (Chichilnisky 1997). En bæredygtighedspolitik, der bygger på forsigtige forventninger til fremtidig vækst, vil derfor tilsyneladende være i god overensstemmelse med individuelle tidspræferencer.

3.2.3 Den deskriptive tilgang

Kritikere af den normative udledning af den samfundsmæssige tidspræference hævder, at fastlæggelsen af diskonteringsraten bør ske med udgangspunkt i den faktiske samfundsmæssige beslutningsadfærd og kapitalens markedsbestemte alternativomkostninger (se f.eks. Nordhaus 1994). Anvender man lavere diskonteringsrater i bæredygtighedskalkuler end i andre samfundsmæssige sammenhænge, er det udtryk for en selvmodsigelse, hævder Nordhaus. I stedet bør der kræves samme samfundsmæssige afkast af investeringer i begrænsning af f.eks. drivhuseffekten, som samfundet kan opnå ved den bedste alternative investering. Begrundelsen er, at miljøinvesteringer ellers vil fortrænge andre investeringer med højere afkast – hvad der ikke er i overensstemmelse med en velfærdsmaksimerende allokering af ressourcerne. Fremtidige generationers interesser bør tilgodeses gennem andre former for omfordeling end langsigtede, lavtforrentede miljøinvesteringer. I den hjemlige debat er denne argumentation blevet fremført af Bjørn Lomborg som begrundelse for, at den vedtagne klimapolitik skulle være irrationel (Lomborg og Larsen 1999).

Netop kompensationsantagelsen rejser etiske problemer. Der eksisterer ikke nationale eller internationale omfordelingsmekanismer, som sikrer, at de skadelidte i fremtiden faktisk bliver kompenseret, et spørgsmål vi vender tilbage til i afsnit 4.3. Endvidere er der substitutionsproblemer i den forstand, at visse miljø- og kulturgoder, især de af dem, der indgår direkte i nyttefunktionen, måske ikke lader sig erstatte, se nærmere i afsnit 4.1. Det kunne f.eks. vise sig vanskeligt at få danskere til at acceptere økonomiske trade-off betragtninger i et scenarium, hvor Danmark om nogle hundrede år vil blive oversvømmet på grund af drivhuseffekten.

3.3 Substitutionsproblemet

Indtil 1970'erne spillede naturressourcer og miljø ingen særlig rolle i økonomiske vækstteorier. En undtagelse er den amerikanske ressourceøkonom S.V. Ciriacy-Wantrup, der i begyndelsen af 1950'erne formulerede det (formentlig) første eksempel på en økonomisk bæredygtighedsdefinition, betegnet som *safe minimum standard of conservation* (Ciriacy-Wantrup 1952). Her ses det som afgørende at forhindre økonomisk irreversible forringelser af naturressourcer som jord, vand, flora og fauna. Med økonomisk irreversible forringelser menes skader, som det måske vil være fysisk mu-

ligt, men prohibitivt dyrt at genoprette. Den løbende udnyttelse af en fornybar ressource må derfor ikke stige til et niveau, der truer ressourcens evne til at reproducere sig selv. Dette krav kan betragtes som overholdelse af et forsigtighedsprincip i forbindelse med udnyttelsen af fornybare naturressourcer.

Bæredygtighedsspørgsmålet bliver mere kompliceret, når det drejer sig om udnyttelse/udtømning af ikke-fornybare naturressourcer som mineraler, fossile brændsler o.l. Ikke-fornybare naturressourcer er det pr. definition umuligt at erstatte med ressourcer af samme slags. Et kategorisk bæredygtighedsbegreb, der krævede, at kommende generationer skulle modtage en ressourceportefølje med uændret gôdesammensætning, ville indebære, at alle ikke-fornybare ressourcer skulle ligge urørte til evig tid. Afviser man denne ekstremløsning, men fastholder bæredygtighedsprincippet, må kommende generationer kompenseres med andre goder for den gradvise udtømning af de ikke-fornybare ressourcer. De kapitalgoder, som nulevende mennesker kan øge beholdningen af, omfatter fornybare naturressourcer som f.eks. skov, producerede kapitalgoder såsom produktionsudstyr, bygninger, infrastruktur, samt menneskelig kapital, bl.a. viden og teknologisk niveau.

Forudsætningen om, at producerede goder kan erstatte naturressourcer, rejser to typer af grundlæggende spørgsmål: empiriske og etiske. Empiriske problemer består i at forudsige miljøets assimilationskapacitet, drivhuseffektens omfang, den fremtidige teknologiudvikling m.m. Disse spørgsmål er det sjældent muligt at give et sikkert svar på. Etisk set er der som tidligere nævnt to ting på spil, nemlig spørgsmålene om fordelingsretfærdighed og naturværdiers substituerbarhed i moralsk forstand. Ved sidstnævnte forstås, at en forudsætning om, at det altid er muligt at kompensere for et miljømæssigt tab med producerede goder, kan vise sig at være etisk problematisk, når det drejer sig om essentielle miljøværdier som økosystemer, arter, landområder og andre goder med symbolværdi. Spørgsmålet er her, hvilke miljøværdier der falder ind under det økonomiske godebegreb, og hvilke der må vurderes ud fra andre normer. Denne problemstilling diskuteres i afsnit 4.1. I det følgende vil vi se nærmere på den økonomiske teoriudvikling, som den tekniske substitutionsproblematik har givet anledning til.

Positionerne kan i dag opdeles i varierende grader af »svage« og »stærke« bæredygtighedsopfattelser. Den svageste version – kendt som Solow-bæredygtighed – forudsætter, at det altid er muligt at kompensere for et miljømæssigt tab med producerede goder. I dag går mange mainstream- økonomer imidlertid ind for stærkere bæredygtighedsforudsætninger, der afviser, at miljø- og ressourceproblematikken alene kan overlades til teknologiske og økonomiske kræfter. Med udgangspunkt i Turner (1992, 1993) vil vi opdele de økonomiske bæredygtighedsopfattelser i fire kategorier: meget svag, svag, stærk og meget stærk.

3.3.1 Meget svag bæredygtighed

Den meget svage bæredygtighedsteori har sit udspring i Solows (1974) og Hartwicks (1977) skelsættende bidrag. De fokuserer på mulighederne for at opretholde konstant forbrug over tid, samtidig med at ikke-fornybare naturressourcer såsom olie og kul udtømmes.

Solow (1974) analyserer bæredygtighedsaspekterne af en asymptotisk udtømning af en ikke-fornybar naturressource. Den etisk begrundede bæredygtighedsforudsætning er rawlsiansk: alle generationer skal have samme forbrugsmuligheder. I modellen frembringes økonomiens netto-output Q ved en produktionsfunktion, hvor der foruden kapital K og arbejdskraft L også indgår en strøm R af en ikke-fornybar naturressource:

$$Q = F(K, L, R)$$

Det antages, at Q ikke kan produceres uden R, men at der ikke er nogen øvre grænse for R's produktivitet ($\partial F(K,R) / \partial R \rightarrow \infty$ når $R \rightarrow 0$). Ved anvendelse af en Cobb-Douglas produktionsfunktion, hvor substitutionselasticiteten mellem naturressourcen og de andre produktionsfaktorer er lig 1, viser Solow, at konstant forbrug over tiden kan realiseres ved opretholdelse af en konstant kapitalmængde i samfundet. Kommende generationer med mindre beholdninger af naturressourcer kan altså kompenseres med andre kapitalgoder. Konklusionen er, at vi ikke skylder kommende generationer en bestemt mængde naturressourcer, men et samlet kapitalapparat, der sikrer dem mulighed for at opnå (mindst) samme forbrug som os (Solow 1986).

Hartwick (1977) formaliserede dette resultat til en regel om anvendelse af den ressourcerente, der opnås ved at udtømme en naturressource. De centrale antagelser er, at ikke-fornybare ressourcer udtømmes i overensstemmelse med Hotellings regel.[3] Hartwicks regel siger, at hvis samfundet investerer den løbende ressourcerente, dvs. nettoafkastet fra udvindingen i reproducerbare kapitalgoder, vil det være muligt at opretholde et konstant forbrug over tid.

Solow (1986) arbejder videre med Hartwicks regel. Han viser, at bl.a. befolkningsvækst giver problemer for anvendelsen af den lighedsnorm, der ligger bag Hartwicks regel. Vokser befolkningen hurtigere end produktiviteten, vil investering efter Hartwicks regel sikre lighed mellem generationerne, mens forbruget pr. individ vil være

3. Under forudsætning om fuldkommen konkurrence og fuld forudseenhed siger Hotellings regel, at skyggeprisen på den tilbageværende mængde af en ikke-fornybar ressource vil vokse med en rate, der svarer til markedsrenten (Hotelling 1931). Hvis markedsrenten svarer til den samfundsmæssige diskonteringsrate indebærer Hotellings regel, at markedsmekanismen vil føre til udtømning i samme takt, som en rationel samfundsmæssig beslutningstager ville vælge (Dasgupta og Heal 1979).

faldende. Det er således et centralt spørgsmål, om velfærden skal måles pr. person eller pr. generation. Dette diskuteres nærmere i afsnit 4.3.

Et andet problem er udviklingen i de relative priser. Asheim (1994) viser, at man, for at opstille kriterier for en bæredygtig opsparing, skal kende de priser, der er forenelige med en bæredygtig udvikling. F.eks. kan de aktuelle råvarepriser og dermed ressourcerenten være for lave til, at investering efter Hartwicks regel kan sikre en bæredygtig udvikling. Det vil gælde, hvis råvarepriserne og dermed ressourcerenten stiger i takt med udtømningen af de ikke-fornybare ressourcer. Modsat kunne man forestille sig, at den teknologiske udvikling ville overflødiggøre en række naturressourcer. Bliver vind- og solenergi tilstrækkeligt billige, vil en større eller mindre del af de fossile brændselsreserver blive værdiløse.

Pearce m.fl. (1995) opstiller nationalregnskabsindikatorer for, om et samfund lever op til det meget svage bæredygtighedskrav. Forbrugs- og investeringsgoder (C og I) frembringes ved en produktionsfunktion $F(K, L, R)$, hvor K og L er henholdsvis producerede kapitalgoder og arbejdskraft, mens R er input af naturressourcer udvundet af en beholdning S, hvor de fornybare naturressourcer bidrager med en tilvækst svarende til $g(S)$. Den aggregerede nyttefunktion er $U(C, E)$, hvor C er forbruget af producerede goder, mens E er miljøydelser. Miljøydelserne påvirkes negativt af forureningsniveauet X, der løbende reduceres med mængden $d(X)$ på grund af naturlig nedbrydning og opbygges gennem udledning af forurening $e(F)$ – f.eks. i form af drivhusgasser.

Det traditionelle indkomstmål BNP i en lukket økonomi udtrykkes som:

$$BNP = F(K, L, R) = C + I$$

Et »grønt« nettonationalprodukt (NNP) kan defineres som:

$$NNP = C + I - r(R\text{-}g) - p(e\text{-}d)$$

hvor I er nettoinvesteringerne, idet vi for nemheds skyld ser bort fra afskrivninger, r er ressourcerenteraten, mens p er de marginale samfundsmæssige omkostninger ved forurening. Udtrykkene $r(R\text{-}g)$ og $p(e\text{-}d)$ er altså henholdsvis værdien af afskrivningerne på beholdningerne af naturressourcer og værdien af nettoforureningsskaderne.

Af disse grønne nationalregnskabsstørrelser kan der udledes et udtryk for den reelle opsparing (Sg), der tager hensyn til udtømning af naturressourcer og ophobning af forurening:

$$Sg = I - r(R\text{-}g) - p(e\text{-}d)$$

De positive bidrag til opsparingen udgøres således af nettoinvesteringerne i producerede kapitalgoder såvel som tilvækst i naturkapitalen – f.eks. i form af skovrejsning, vækst i fiskebestande o.l. Også naturens evne til at nedbryde forurening bidrager til nettoopsparingen.

Det meget svage bæredygtighedsbegreb kræver kun, at den aggregerede kapitalgodebeholdning ikke er faldende. Denne forudsætning er opfyldt, hvis $Sg \geq 0$.

3.3.2 Svag bæredygtighed

Det meget svage bæredygtighedskriterium, der blev gennemgået ovenfor, kan betragtes som den neoklassiske økonomis teknologioptimistiske svar på 1970'ernes ressourcepessimisme, eller nymalthusianisme om man vil. Dette ressourcepessimistiske syn blev bl.a. udtrykt i Rom-klubbens grænser-for-vækst-paradigme (Meadows m.fl. 1972), der primært fokuserede på udtømningen af ikke-fornybare naturressourcer.

I dag gælder opmærksomheden i højere grad de miljømæssige konsekvenser af afbrændingen af kulbrinter – specielt i forhold til atmosfæren i forbindelse med drivhuseffekt og i forhold til biodiversitet. Det er svært at acceptere fuld substituerbarhed mellem denne type naturressourcer og producerede goder. Ciriacy-Wantrups safe minimum standard-tese er dermed kommet i fokus igen (Toman 1994). Det har resulteret i det, vi her betegner som det svage bæredygtighedskriterium, også kaldet modificeret Solow-bæredygtighed (Turner 1992).

Denne opfattelse afviser, at miljø- og ressourceproblematikken kan overlades til teknologiske og økonomiske kræfter alene. Svag bæredygtighed kræver opretholdelse af et vist minimum af naturressourcer – typisk såkaldte nøglearter og økologiske nøgleprocesser – for derigennem at sikre økosystemers stabilitet og evne til selvopretning. For denne type ressourcer må der anvendes et forsigtighedsprincip (Toman 1994). Det betyder, at der – ud over Hartwicks regel – skal anvendes fysiske indikatorer (i form af f.eks. safe minimum standarder) til overvågning af, om udviklingen er bæredygtig. Kravet om fysiske indikatorer er den afgørende forskel på svag bæredygtighed og meget svag bæredygtighed. Sidstnævnte betragter som nævnt udviklingen i en økonomisk variabel, det samlede kapitalapparat, som en tilstrækkelig bæredygtighedsindikator.

3.3.3 Stærk bæredygtighed

Stærk bæredygtighed antager, at økosystemer generelt udvikler sig ikke-lineært og i diskontinuerte spring – i strid med den neoklassiske økonomis konveksitetsantagelser. Mængden af naturkapital skal ifølge en stærk bæredygtighedsopfattelse fastholdes på et uændret niveau. Substitution mellem forskellige typer naturkapital er dog tilladt. F.eks. kan udtømning af oliereserver erstattes med opbygning af vedmasse i nye skove,

der kan levere materialer og energi til kommende generationer (Daly 1990). Men som det illustreres i afsnit 4.1.2, anses denne erstatning af nogle for at være etisk uacceptabel, hvis erstatningen indebærer tab af specielle æstetiske værdier samt særlige natur- og miljøværdier såsom økologiske nøglearter.

Ifølge Turner (1993) er den afgørende forskel på svag bæredygtighed og stærk bæredygtighed, at stærk bæredygtighed kræver bevarelse af den samlede naturkapital. Under det stærke bæredygtighedskriterium underordnes den økonomiske analyse økologiske principper (Pearce m.fl. 1995). Den økonomiske teoris rolle bliver da reduceret til costeffectiveness analyser af alternative strategier til opnåelse af en på forhånd fastsat standard for miljø- og naturressourcer eller optimering af naturkapitalens sammensætning.

Vi vil betegne de bæredygtighedsantagelser, der gøres af økologisk økonomi, som stærke (se Costanza m.fl. 1991 og Costanza m.fl. 1997). Økologisk økonomis idegrundlag går tilbage til Kenneth Bouldings (1966) klassiske artikel »The Economics of the Coming Spaceship Earth« og Nicholas Georgescu-Roegens (1971) bog »The Entropy Law and the Economic Process«. Ifølge dens fortalere er økologisk økonomi en ny teori, der sammenkæder økonomi og økologi på en måde, der gør op med både traditionel økonomisk og naturvidenskabelig teori (Costanza m.fl. 1991). Resultaterne af økologisk- økonomiske analyser præsenteres ofte som videnskabelige *sandheder*. Eksempelvis skulle det være videnskabeligt påvist, at den absolutte fysisk-biologiske grænse for biosfærens bærevne er ved at være nået, en kendsgerning som traditionel økonomi ikke har erkendt (Daly 1991).

Daly opfatter det økonomiske system som »... an open subsystem of the finite natural eco-system«. På makroplanet er forholdet mellem disse to systemer ikke et spørgsmål om økonomiske trade-off relationer, men derimod af fysisk-biologisk karakter. Denne stærke bæredygtighedsantagelse er bl.a. baseret på biologiske modelberegninger (Vitousek m.fl. 1986), der viser, at menneskeheden i dag anvender 40% af den mængde biomasse, der er tilgængelig for menneskelig udnyttelse. Sammenholdt med andre fysisk-biologiske indikatorer, såsom drivhuseffekten og nedbrydning af ozonlaget, mener Daly, at vi allerede har øget den økonomiske aktivitet ud over det, der kan anses for bæredygtigt på længere sigt. Kritikere af økologisk økonomi peger på, at det stærke bæredygtighedskriteriums afvisning af muligheden for substitution mellem naturressourcer og produceret kapital savner empirisk begrundelse: »The problem for advocates of strong sustainability is that assertions of non-substitutability do not constitute evidence on non-substitutability« (Pearce og Atkinson 1998).

Vi afviser ikke Dalys påstand om, at en satsning på teknologiske udvikling er forbundet med en risiko. Men til fordel for accept af en *vis* risiko taler, at forsøg på opbremsning af den globale vækst langt fra vil være risikofri. Her må man holde sig for

øje, at den nuværende situation – hvor den vestlige verden tegner sig for hovedparten af det globale ressourceforbrug – er under hastig forandring med den økonomiske vækst i milliardbefolkningsøkonomierne Kina og Indien samt væsentlige dele af det øvrige Asien. En omfordeling af ressourcer fra de nuværende industrilande til resten af verden kan kun sikre en bæredygtig udvikling på kortere sigt – medmindre de nye vækstområder vil acceptere en lavere vækst, end de har mulighed for at realisere. Det er der næppe grund til at tro, at de vil gøre *frivilligt*. At forsøge sig med tvangsmæssige indgreb vil være væsentlig mere risikabelt end fortsat vækst. Helt at afvise satsning på teknologiske løsninger kan derfor blive en politisk risikofyldt bæredygtighedsstrategi.

3.3.4 Meget stærk bæredygtighed

Denne opfattelse afviser, at der findes teknologiske muligheder for helt eller delvis at løse miljø- og ressourceproblemerne. Grundlæggende skal naturen efterlades i samme stand, som vi overtog den. Ifølge Howarth (1997) er bevarelsen af naturlige værdier en forudsætning for en »fair« behandling af fremtidige generationer, idet nutiden ikke kender de fremtidige generationers behov og interesser. I sin yderste konsekvens afviser meget stærk bæredygtighed opfattelsen af natur som en ressource. I stedet understreges naturens egenværdi. Hermed ophører bæredygtighed med at være et økonomisk mål. Bæredygtighed bliver snarere et mål for, i hvilket omfang mennesker formår at begrænse deres aktiviteter.

Med det meget stærke bæredygtighedskriterium forlader vi den *antropocentriske*, dvs. menneskecentrerede, opfattelse af naturen. Bæredygtighedsdiskussionen bevæger sig dermed over i etiske opfattelser, hvor økonomiske afvejninger ikke længere har relevans. Går vi til den modsatte yderlighed – den meget svage bæredygtighedsopfattelse – er der ingen begrænsninger på substitutionsmulighederne. Bæredygtighedsproblemet reduceres til et spørgsmål om intertemporal fordeling af forbrug uden særlig hensyntagen til ressourceporteføljens sammensætning. De sidste 2-3 årtiers diskussion mellem svage kontra stærke bæredygtighedsopfattelser har anfægtet antagelsen om generel substituerbarhed mellem kapital og naturressourcer.

4. Etiske antagelser

Spektret meget svag til stærk bæredygtighed viser, hvor stor spændvidde forskellige teknologiforventninger giver bæredygtighedsbegrebet – under etiske antagelser vedrørende retfærdig fordeling mellem generationerne. Men som nævnt tidligere, er der stor forskel på, hvad der rent faktisk anses for at være retfærdigt. Her er der behov for at præcisere, hvilke etiske principper for retfærdighed, som ligger bag de forskellige økonomiske bæredygtighedsudlægninger. Det andet sted, etisk begrundede normer spiller en afgørende rolle i bæredygtighedssammenhæng, er i forbindelse med de

gennemgåede positioners holdning til substitution. Vi vil forsøge at belyse disse ud fra eksempler fra jordbrugssektoren i forbindelse med substitution af fossil energi med fornybare ressourcer såsom korn og træ.

4.1 Substitution

Fossile brændsler kan som nævnt tænkes substitueret med forskellige former for fornybare ressourcer såsom træ eller korn. Ifølge svage bæredygtighedsopfattelser anses dette for fuldt gyldigt, mens meget stærke udlægninger ikke kan vedkende sig fuldstændig substitution.

4.1.1 Kornafbrænding

Braklægning anses af mange for en etisk acceptabel løsning på overproduktionen af fødevarer. På en del af de braklagte arealer er det tilladt at dyrke *non-food* afgrøder, eksempelvis energiafgrøder, som kan anvendes som substitution for fossile brændsler. Ved at dyrke energiafgrøder på 10% af landbrugsarealet kan der i princippet spares et CO_2-udslip svarende til ca. 5% af den årlige danske CO_2-udledning. Dyrkning af energiafgrøder på brakarealer er forholdsvis ukontroversielt, så længe der er tale om planter, der ikke kan anvendes til menneskeføde. Det har imidlertid vist sig at være stærkt kontroversielt at anvende de samme marker til dyrkning af energiafgrøder, hvis disse kan anvendes til menneskeføde, eksempelvis korn.

Siden 1990 har der været forbud mod at anvende korn og andre fødevare- eller foderafgrøder i kollektive varmeforsyningsanlæg i Danmark. Der kan være samfundsøkonomiske grunde til ikke at fremme dyrkning af energikorn, men en væsentlig årsag til forbudet er formentlig, at det betragtes som etisk uacceptabelt at afbrænde korn, når der er mangel på fødevarer i nogle dele af verden. Når afbrænding af korn til energiformål kan opfattes som etisk kontroversielt, kan det skyldes, at man bevidst ødelægger fødevarer. Ved braklægning er der derimod tale om, at man *undlader* at dyrke jorden og dermed afstår fra at producere fødevarer. Dette kan forklares med, at mange drager en etisk skillelinje i mellem, hvad vi gør, og hvad der sker som konsekvens af, hvad vi undlader at gøre.

Her er der således modstrid mellem den svage bæredygtighedsopfattelses krav om fuld substituerbarhed, og hvad der forekommer at være rodfæstede moralske overbevisninger. Disse overbevisninger bunder i en opfattelse af, at det ikke er tilstrækkeligt at foretage en moralsk vurdering af en handling alene på baggrund af dens forventede konsekvenser. I tillæg hertil skal intentionerne bag den pågældende handling inddrages i den moralske vurdering.

En substitut, som ifølge meget svag økonomisk bæredygtighedsteori kan vise sig teknisk mulig og i en vis grad endog økonomisk ønskelig, kan altså samtidig fremstå

som etisk uacceptabel. Det andet eksempel, hvor træ tænkes at substituere fossilt brændsel, kan ligeledes give etiske problemer her specielt i forhold til de stærkere bæredygtighedspositioners holdning til naturens egenværdi.

4.1.2 Natur- og miljøværdier

Brug af overskydende biomasse såsom træflis fra skovene kan få negative økologiske konsekvenser for de pågældende skove. Ønsker man en effektiv substitution af fossile brændsler med fliset træ fra skovene, kunne man ud fra et teknisk og økonomisk synspunkt argumentere for målrettet plantagedrift med hurtigtvoksende træarter. Denne udgave af skovbrug er imidlertid kommet i konflikt med moderne opfattelser af, hvad der kræves, for at skovdriften kan anses for fuldt bæredygtig (Behan, 1997; Gamborg, 1998). Mange ser skovene som naturlige økosystemer, hvor biodiversitet og æstetiske værdier bevares i tilknytning til produktionen af vedmasse (Kimmins, 1997). En manglende accept af øget brug af træ fra skovene som substitut for fossilt brændsel kan etisk set begrundes på flere måder.

På den ene side kan man tage udgangspunkt i et rent antropocentrisk synspunkt og lægge vægt på, at denne substitution måske medfører tab af f.eks. biodiversitet, der ellers kunne komme fremtidige generationer til gode. Eller man kunne hævde, at en øget biomasseudnyttelse vil medføre tab af herlighedsværdi og eksistensværdi, selv om brugsværdien i form af mere energi blev øget.[4] Folk med specifikke leksikografiske præferencer vil også afvise substitutionen.[5] Her værdsættes dele af naturen, f.eks. bøgetræer, så højt, at den enkelte ikke ville kunne acceptere en nedgang i bøgearealet til fordel for andre, hurtigtvoksende træarter, selv om det gavner den samlede nytte i bred forstand bl.a. via nedsat CO_2-udledning.

Andre vil med udgangspunkt i en ikke-antropocentrisk tankegang hævde, at det vil være et overgreb på naturens egenværdi, dvs. en værdi som ikke nødvendigvis kræver tilstedeværelsen af menneskelig værdisætter. Tab af biodiversitet skal derfor ikke ses som tab af en potentiel ressource, men som tab af egenværdi (Buchdal og Raper, 1998). Ifølge såkaldte biocentriske teorier, fremsat bl.a. af den norske filosof Arne Næss, skal mennesket blot ses som en del af naturen. Foruden mennesker og dyr tilkendes også planter, mikroorganismer og økosystemer selvstændig moralsk værdi:

> The well-being and flourishing of human and non[-]human Life on Earth have value in themselves (synonyms: intrinsic value, inherent worth). These values are independent of the usefulness of the non-human world for human purposes. [Næss 1987, s. 97].

4. Eksistensværdi er den værdi, individer tillægger bevidstheden om, at sjældne arter, enestående naturlige økosystemer eller andre lignende »goder« eksisterer, selv om de pågældende individer ikke bruger dem eller drager umiddelbar nytte af dem på anden vis (Freeman, 1993).
5. Dvs. et gode opfattes som uvurderligt og i princippet vigtigere end alle andre goder (Jacobs, 1997).

Næss (1973) hævder grundlæggende, at princippet om biocentrisk egalitarisme er gældende, dvs. at alle naturfænomener i princippet har *samme krav* på beskyttelse. Der argumenteres endvidere for en dybereliggende enhed med alle andre organismer. I den dybdeøkologiske opfattelse spiller ikke-menneskelige væsner og naturlige objekters »interesser« en selvstændig rolle. Om end et tilsyneladende øget velfærdshensyn forekommer umiddelbart sympatisk, er synspunktet dog blevet kritiseret for at være umuligt at praktisere og et skridt på vejen til en *økofascisme*, hvor en nedprioritering af mennesket synes udtalt.

Etisk begrundede hensyn til naturen kan dog godt indgå i økonomisk værdisætning og dermed trade-off relationer til andre goder (Dubgaard 1996). I velfærdsøkonomisk forstand er miljøetiske værdier et udtryk for *menneskets* opfattelse af moralske forpligtelser over for ikke-menneskelige eksistenser – og vilje til at give afkald på andre goder for at bevare miljøværdier.

Ud over substitutionsproblematikken spiller spørgsmålet om, hvad der udgør en retfærdig fordelingsnøgle inden for og specielt mellem generationer, en afgørende rolle. I det følgende ser vi nærmere på, hvilke etiske idealer, der er knyttet til retfærdighedsspørgsmålet og dermed også til problematikken vedrørende diskontering, omtalt i starten af afsnit. 3.2.

4.2 Forpligtelser over for kommende generationer

Perspektivet i bæredygtighed er opretholdelse af nytte fra ressourcer, så også fremtidige generationer betænkes i fordelingen. Grundlæggende kan man skelne mellem to væsensforskellige retfærdighedsopfattelser. Den ene opfattelse er at yde efter ansvar eller forpligtelse. Jo mere man f.eks. forurener, desto mere skal man bidrage til en senere oprydning. Den anden opfattelse er at yde efter evne. Selv om man f.eks. forurener kraftigt til skade for fremtidige generationer, kan man som ludfattig kun bidrage begrænset til en efterfølgende oprydning.

Eksempelvis rejser FN's klimakonvention i energisammenhæng nogle basale retfærdighedsspørgsmål, bl.a. fordeling af omkostninger i forbindelse med klimatilpasning, fordeling af bekæmpelsesomkostninger lande i mellem – specielt mellem lande med forskel i velfærd og forbrug samt udledninger af drivhusgasser – og generationer i mellem samt fordeling af fremtidige udledningsrettigheder (Banuri m.fl. 1996).[6]

4.3 Principper for fordelingsretfærdighed

Princippet om strikt lighed eller jævnbyrdighed udtrykker lige fordeling af byrder og goder. Alle fordringshavere bør have lige andele, hvorfor denne tolkning af retfær-

6. FNs klimakonvention blev underskrevet af 154 lande ved Verdenskonferencen om Miljø og Udvikling (UNCED) i Rio de Janeiro i juni 1992 og trådte i kraft i 1994.

dighedsbegrebet er tæt knyttet til egalitarisme. Princippet optræder i den konkretisering af stærkere bæredygtighed, der er forsøgt i form af opstilling af et såkaldt økologisk råderum, hvor der tilstræbes en absolut lige fordeling af naturlige ressourcer på globalt plan.[7] En hovedindvending mod dette princip er, at der ikke skelnes mellem forskellige måder at skabe lighed på. Er det f.eks. acceptabelt at skabe lighed ved at sørge for, at alle får det lige dårligt?

Proportionalitetsprincippet fastholder, at folk skal modtage i forhold til, hvad de skyder ind og yde i forhold til deres bidrag til skadevoldelse. Princippet er sammen med safe minimum standard princippet en af grundpillerne i det svage bæredygtighedsbegreb, jf. Turner (1993). Dette princip genfindes bl.a. i ideen om, at forureneren betaler. Jo mere man belaster det globale miljø f.eks. i forbindelse med brug af fossil energi, desto mere skal man kompensere andre lande. Et problem ved princippet er, at det tager højde for skyld, men ikke tager evnen til at løse den pågældende opgave i betragtning.

Princippet om nyttemaksimering som fordelingsretfærdighed har rod i klassisk utilitarisme, hvor byrder og goder skal fordeles på en måde, så der er den største mulige nytte for flest mulige – en maksimering af den samlede nytte.

> ...it is the greatest happiness of the greatest number that is the measure of right and wrong [Bentham 1776, s. 3].[8]

Problemet ved nyttemaksimering er, at det i en intergenerationel sammenhæng ikke nødvendigvis fører til en retfærdig fordeling. Et andet spørgsmål er, om målet er at holde den gennemsnitlige nytte konstant eller summen af nytten konstant. Vælger man det sidste mål, kan konsekvensen være, at vi forpligter os til at skabe en verden med milliarder af marginalt lykkelige mennesker i stedet for en verden med en mindre befolkning af særdeles lykkelige mennesker (Parfit 1984). Dvs. i en intergenerationssammenhæng ville det resultere i marginalt lykkelige generationer. Dette argument synliggør konflikten mellem hensynet til den enkelte og den samlede befolkning, når nytte diskuteres i en klassisk nyttemaksimerende tilgang til fordelingsretfærdighed og bæredygtighed.

Tages et konkret eksempel med udledning af CO_2, hvor man ønsker man at fremme sin forpligtelse over for kommende generationer, synes det – ud fra et nyttemaksimerende synspunkt – nærliggende at argumentere for at lægge indsatsen, hvor den forekommer at gøre mest gavn set i forhold til omkostninger og reduktion af CO_2-udled-

7. Det pointeres, at alle mennesker på jorden har samme ret, men ikke nødvendigvis pligt til at bruge ressourcerne. En konsekvens af anvendelse af dette princip ville være, at de velstillede lande skulle reducere deres ressourceforbrug betragteligt. Mere væsentlig er måske en diskussion om lighed i forhold til velfærd. For en kritisk diskussion af økologisk råderum, se bl.a. Moffat (1996) og Larsen og Munksgaard (1999).
8. Jeremy Bentham (1748-1832), engelsk jurist og filosof.

ningen. Følgen kunne være at lande, hvor det er dyrt at skære ned på CO_2-udslippet, kan købe rettigheder til udledning af lande, hvor det er billigere at reducere (se f.eks. Kærgård 1998).[9] Handel med CO_2-kvoter kan ud fra et nyttemaksimerende synspunkt forsvares, for hvis kvoterne ikke er omsættelige, kan det tænkes, at lande, der har større udslipskvoter, end de aktuelt bruger, vil være tilskyndet til at opbygge en stærkt energiforbrugende produktion (Hansen 1997).

Men der er blevet sat spørgsmålstegn ved, om denne handelsform er fordelingsmæssig retfærdig og dermed moralsk acceptabel. Accepterer man, at det er muligt og retfærdigt, at forureneren kan betale sig fra det, er det samtidig ensbetydende med en moralsk accept af, at man må skade miljøet (Dubgaard 1996). Det strider mod den norm, at befolkningen har ret til miljøgoder såsom ren luft – på samme måde som man har ret til ikke at blive bestjålet eller udsat for fysiske overgreb. Ud fra denne synsvinkel bør man derfor overholde princippet om lige rettigheder samt bestræbe sig på at begrænse sin egen forurening.

En kritik af det generelle nytteetiske argument om, at det er fornuftigt og moralsk ønskværdigt, at samfundet som helhed betragtet søger at skabe den størst mulige samlede mængde lykke, er bl.a. givet af filosoffen John Rawls (1971). Rawls kritiserer den utilitaristiske ide om nyttemaksimering som grundlag for fordelingsretfærdighed i forbindelse med samfundsmæssige prioriteringer. Ifølge Rawls tager nytteetikken ikke forskellen mellem personer alvorligt. Denne kritik genfindes i grundlaget for både de svage og stærke økonomiske tolkninger af bæredygtighed, som beskrevet i afsnit 3.

Det er udtryk for uretfærdighed, hvis samfundets goder fordeles på en måde, så de ikke kommer alle til gode. Princippet om, at nogle individers ubehag eller indskrænkning af frihed kan kompenseres af en større nytte for andre og dermed retfærdiggøres, er ikke foreneligt med Rawls' opfattelse af fordelingsretfærdighed.[10] Rawls forsvarer derimod en opfattelse, der i en lidt forsimplet økonomisk version tilsiger at give første prioritet til at hjælpe de dårligst stillede (maximin-princippet). De svageste skulle altså have indtil det punkt, hvor de ikke længere er de svageste.

I meget svage bæredygtighedstolkninger, hvor det samlede kapitalapparat opretholdes, og taberne har krav på kompensation, kan tabene være af en art, som ikke synes at kunne kompenseres. Var det f.eks. Danmark, der ville blive oversvømmet som følge af

9. På samme vis har international handel med kvoter for CO_2-*fortrængning* været diskuteret. Et kulfyret elværk ville kunne købe »aflad« i form af et certifikat, der dokumenterer tilplantning af et antal hektar skov, som ville optage CO_2 fra luften (Heding 1998). Princippet blev udeladt af Kyoto-protokollen fra 1997, men er fortsat diskussionspunkt ved klimaforhandlinger. I stedet blev det besluttet, at de industrialiserede lande først skal fremme bæredygtig udvikling i udviklingslandene gennem støtte til konkrete CO_2-reduktionsprojekter.

10. En gennemgang af Rawls retfærdighedsbegreb er givet af Holtug m.fl. (1997) og af Hougaard og Møller (1992), sidstnævnte specielt i relation til retsfilosofi og økonomisk teori, særligt kontraktteorien i »Public Choice« skolen.

klimaforandringer, er det næppe tænkeligt, at denne udvikling set med danske øjne ville blive opfattet som bæredygtig. Der er således et skisma mellem den nytteetiske tankegang om at sikre det størst mulige samfundsmæssige gode og Rawls princip, der bygger på en kantiansk tanke om at sikre de svage. En indvending mod Rawls princip om altid at fokusere på de dårligst stillede er, at man kan komme til at ofre meget store ressourcer med meget lille effekt, dvs. hvor nytteforøgelsen er marginal. Et eksempel på dette er sikring mod oversvømmelse som følge af klimaforandringer i et fattigt, sparsomt befolket område. Omkostningsbevistheden er beskeden i det Rawlsiansk inspirerede princip for fordelingsretfærdighed. Et slags kompromisprincip for fordelingsretfærdighed, der ligger mellem den klassiske utilitarismes og et Rawlsiansk inspireret princip, er den engelske filosof Derek Parfits (1995) *prioritetsprincip*.

Udgangspunktet er her, at en person tæller relativt mere, jo dårligere stillet personen er. Imidlertid er der ifølge princippet plads til at hjælpe relativt bedre stillede før dem, som har det dårligere. Det sker, hvis det kan godtgøres, at effekten af at hjælpe de bedre stillede er tilpas meget større end effekten af at hjælpe de dårligst stillede. I henhold til de økonomiske bæredygtighedstolkninger betyder det, at jo nemmere det er at substituere, desto mere uplausibelt forekommer Rawls synspunkt om ikke at inddrage effekten. Det er dog tydeligt, at dette princip ikke er uden vanskeligheder at anvende i praksis. Et åbent spørgsmål er at vurdere, hvornår effekten er »tilpas« meget større.

En generel vanskelighed i diskussionen af retfærdighedsprincipper i forbindelse med bæredygtighed, særlig udtalt i forbindelse med anvendelse af fossile brændsler, er, at tidshorisonten er meget lang. Effekterne af eventuelle klimaforandringer, der vil følge af vores generations brug af bl.a. fossile brændsler, vil mærkes af fremtidige generationer i forskellige lande med forskellige præferencer, som ikke er kendt i dag.

Det er muligt, at fremtidige generationer om 50 år vurderer, at et givet niveau af kompensation i dag i form af kapitalopbygning er utilstrækkeligt i forhold til eventuelle negative klimaeffekter 50 år fremme i tiden. Ønsket om intergenerationel retfærdighed får dermed direkte konsekvenser for udformningen af strategier for at modvirke globale klimaændringer i forbindelse med drivhuseffekten. Chichilnisky (1993) har argumenteret for en safe minimum standard i forbindelse med sådanne strategier for at undgå, hvad hun kalder »the dictatorship of the present« i forhold til fremtidige generationer, jf. afsnit 3.2.1.

Sådanne strategier kan eksemplificeres ved de seneste danske energihandlingsplaner. Et afslutningsvist spørgsmål er derfor, om det nuværende danske forbrug af olie og naturgas er inden for rammerne af en sådan standard?

5. Brug af fossil energi

Efter en periode, hvor nye Nordsøfund mere end opvejede forbruget, er situationen

nu den, at udtømningen af de danske olie- og naturgasressourcer er nært forestående. For olie er restudvindingsperioden faldet fra 64 år i 1986 til 16 år i 1997. For gas er restperioden faldet fra 38 år i 1986 til 16 år i 1997. Bliver der ikke snart gjort nye væsentlige fund, og det er der p.t. ikke meget, der tyder på, vil det i år 2013 være slut med både dansk olie- og gasproduktion fra Nordsøen. To generationer vil således have brugt alle kendte (syd)danske olie- og gasreserver.

De sidste to danske energiplaner »Energi2000« (Energiministeriet 1990) og »Energi 21« (Miljø- og Energiministeriet 1996) har bæredygtighed som overordnet politisk målsætning for den danske energipolitik. Spørgsmålet er, om en så hurtig udtømning af de danske olie- og gasreserver kan være i overensstemmelse med Danmarks bæredygtighedsmålsætning for energisektoren og samfundet som helhed.

Var udtømning det eneste problem, kunne man anvende Hartwicks regel som grundlag for generationskompensationsmålet. Når de danske forekomster er brugt, vil der stadig være store olie- og gasreserver i resten af verden, som kommende generationer kan importere af. Øger vi nationens kapitalbeholdninger med ressourcerenten fra udvindingen af de danske reserver, har vi ifølge Hartwicks regel kompenseret fremtidige generationer for udtømningen af Nordsøkapitalen.[11]

Ressourcerenten fra udnyttelsen af de danske olie- og naturgasressourcer er for 1997 opgjort til godt 8 mia. kr. mod godt 3 mia. kr. i 1986 (Leth-Petersen 1998). For at efterprøve, om Hartwicks regel er overholdt, skal ressourcerenten sammenholdes med samfundets *nettoopsparing*.[12] I 1997 udgjorde nettoopsparingen ifølge nationalregnskabet 78 mia. kr. Nettoopsparingen varierer en del fra år til år. I gennemsnit af de sidste 10 år har den udgjort knap 6% af den disponible nettonationalindkomst. Det svarer i 1997-priser til et gennemsnit på omkring 50 mia. kr. om året. Selv om estimatet af ressourcerenten fra olie- og gasudvindingen skulle øges med op mod en faktor 5, ville der altså være dækning for de nuværende generationers træk på samfundets kulbrintekapital. Det Økonomiske Råd har gennemført en mere omfattende opgørelse af den *ægte* opsparing i Danmark, hvor der foruden udtømning af nordsøressourcerne også indgår forskellige forureningskomponenter samt opbygning af human- og videnskapi-

11. Der er naturligvis ingen garanti for, at de nuværende priser på olie og gas afspejler den fremtidige knaphed på fossile brændstoffer, men der er et teknologiloft over olieprisernes udvikling på længere sigt. Skulle de globale oliereserver slippe op inden for en overskuelig fremtid, findes der enorme forekomster af bl.a. kul, olieskifer og tjæresand. Disse faste energiråstoffer kan med kendt teknologi omdannes til flydende brændstof – om end til væsentligt højere raffineringsomkostninger. Overgrænsen for olieprisstigninger udgøres således af de marginale udvindingsomkostninger for kul og olieskifer m.m. plus omkostninger ved at omdanne disse energiressourcer til flydende eller luftformigt brændstof.

12. Danmarks nettoopsparing er i nationalregnskabet defineret som nettoinvesteringerne (i maskiner og udstyr, bygninger, besætninger og lagerbeholdninger m.m.) samt Danmarks nettofordringserhvervelse (af aktier og obligationer m.m.) over for udlandet.

tal (Det Økonomiske Råd 1998). Også her er konklusionen, at dansk økonomi kan betragtes som bæredygtig ud fra et (meget) svagt bæredygtighedskriterium.

En anden ressourceproblematik er muligheden for at bruge teknisk mulige og økonomisk realistiske fornybare alternativer. Imidlertid er de fulde omkostninger ved brug af disse, f.eks. i forhold til påvirkningen af særlige natur- og miljøværdier, langt fra etisk opgjorte. Det er dog langt mere sandsynligt, at drivhusproblemet – snarere end ressourceudtømning – kommer til at sætte grænsen for brugen af fossil energi. Her har kompensationsspørgsmålet ikke noget at gøre med, om det er energiressourcerne fra Nordsøen, vi anvender, eller om det drejer sig om importeret olie og kul. Generationskompensationsproblemet består i, at vi udnytter en helt anden naturressource: atmosfærens begrænsede evne til at optage drivhusgasser, før klimaeffekterne bliver uacceptable.

Vore opsparingsforpligtelser over for kommende generationer som følge af vort energiforbrug afhænger derfor af vore forventninger til de fremtidige omkostninger ved produktion af vedvarende energi. I dag er prisen på vindmøllestrøm omkring 25% højere end på kulkraftstrøm, hvis der ikke tages hensyn til CO_2-gevinsten (Larsen og Munksgaard 1996). Når det drejer sig om vedvarende energi til motorkøretøjer (etanol, biogas m.v.) er alternativerne til fossilt brændsel noget dyrere, men mulighederne for teknologiske fremskridt sikkert også større.

Vi høster altså økonomiske fordele ved at afbrænde billig fossil energi på bekostning af kommende generationers muligheder for at udnytte atmosfæren som CO_2-modtager ved produktion af billig fossil energi. Vore forpligtelser over for fremtidige generationer kan ses som et krav om at opspare den ressourcerente, som vi opnår ved at udnytte atmosfæren som CO_2-depot. Hvor stort dette beløb er, afhænger af omkostningerne ved vedvarende energiproduktion i fremtiden. Som foregangsland inden for udvikling af alternative energiteknologier (specielt vindmøller) har Danmark allerede ydet et væsentligt bidrag til at sikre fremtidige generationers forsyning med billig vedvarende energi.

6. Konklusion

Det har ikke været målet med artiklen at give et endegyldigt svar på spørgsmålet, om den danske energipolitik er bæredygtig eller ej, men derimod at vise, hvilke bæredygtighedskonklusioner man når frem til ved forskellige etiske og empiriske forudsætninger. Vi har søgt at klarlægge, hvilke grundlæggende etiske og til dels empiriske spørgsmål politiske beslutningstagere må svare på, før den økonomiske teori kan vurdere, om den faktiske udvikling kan betragtes som bæredygtig.

Diskontering spiller en central rolle i bæredygtighedsdebatten. Ved benyttelse af selv en forholdsvis lav diskonteringsrate (f.eks. 3% p.a.) over lange tidshorisonter le-

der de fleste miljømæssige cost-benefit analyser til trivielt forudsigelige konklusioner om, at det ikke kan betale sig at gøre noget, der først får effekt om f.eks. 100 år eller mere. På den anden side vil en samfundsmæssig diskonteringsrate på nul også give anledning til problemer. Det skyldes både bortfald af diskonteringsprincippets effektivitetskrav til samfundsmæssige allokeringsbeslutninger og det etiske problem, der består i, at fremtidige generationers velfærd kommer til at dominere over nutidens. Vi betragter Chichilniskys og Pezzey og Withagens forslag om at en benytte aftagende diskonteringsrate over lange tidshorisonter som teoretisk interessante svar på de etiske problemer, diskontering giver anledning til i en bæredygtighedssammenhæng. De løser dog ikke de empiriske problemer, der knytter sig til fastlæggelsen af de langsigtede vækst- og produktivitetsantagelser, der bestemmer udviklingen i den ønskede samfundsmæssige diskonteringsrate. Et andet problem er mulighederne for substitution mellem producerede kapitalgoder og naturressourcer. Diskussionen af dette problem har udmøntet sig i svage og stærke bæredygtighedsopfattelser.

Den *meget svage* bæredygtighedsopfattelse appellerer til økonomiske effektivitetshensyn i miljø- og udviklingspolitikken. Kun tiden kan vise, om den meget svage bæredygtighedsopfattelse hviler på realistiske teknologiantagelser. Der er med andre ord tale om en risikopræget udviklingsstrategi. Vi kunne sagtens tilslutte os den meget svage bæredygtighedsopfattelse, hvis »indsatsen« på kommende generationers vegne svarede til det, som folk er parate til at satse på den ugentlige tipskupon. Problemet er de meget lange tidshorisonter kombineret med risikoen for, at miljøændringer kan vise sig irreversible og have katastrofale konsekvenser. På den baggrund er der for meget *happy-go-lucky-holdning* i den meget svage bæredygtighedsopfattelse.

Den *stærke* (økologisk økonomis) bæredygtighedsopfattelse er umiddelbart sympatisk, idet den afviser *gambling* i form af en satsning på, at ressource- og miljøproblemer kan løses gennem teknologiske fremskridt. Vi er dog skeptiske over for den kategoriske opfattelse af såkaldte naturvidenskabelige sandheder om miljøets katastrofale tilstand, som denne tilgang bygger på. Kravet om en hurtig opbremsning af den økonomiske vækst og befolkningstilvæksten indebærer alvorlige politiske risici, der kunne gøre økologisk økonomis kur værre end problemet, den skulle løse.

En acceptabel bæredygtighedsstrategi bør efter vor opfattelse i det mindste sikre et acceptabelt minimum af naturressourcer samt visse æstetiske og natur- og miljømæssige værdier, som vi har svært ved at forestille os substitutter for, jfr. afsnit 4.1. Dette fører os over i den *svage* bæredygtighedsopfattelse, hvor effektivitetskrav kombineres med restriktioner på substituerbarhed i form af safe minimum standarder. Her befinder vi os formentlig på linje med den (miljø)økonomiske mainstream, f.eks. Pearce og Atkinson (1998) og de danske økonomiske vismænd. I efterårsrapporten fra Det Økonomiske Råd (1998) hedder det således:

> For visse af naturens funktioner, især de livsunderstøttende, findes der givetvis en nedre kritisk grænse, som det vil være forbundet med store negative konsekvenser at overskride... Kritisk naturkapital unddrager sig dermed kravet om afvejning mellem gevinster og omkostninger.

Konsekvensen af at bringe naturvidenskabelige og etiske aspekter mere eksplicit ind i den økonomiske bæredygtighedsanalyse er måske tab af, hvad der kunne opfattes som vanlig økonomisk analyseform. Der eksisterer ingen eksakte kriterier for, hvad der kan betragtes som sikre minimumsstandarder, eller hvordan f.eks. prioritetsprincippet skal praktiseres. Det svage bæredygtighedskriterium indebærer, at der forud for økonomiske analyser diskuteres bagvedliggende etiske værdiantagelser. Det giver alt andet lige et bedre beslutningsgrundlag, og indsigten kan vise sig nyttig for videreudviklingen af økonomisk bæredygtighedsteori i forbindelse med forståelse og håndtering af andre end rent økonomiske værdier.

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‘Back to nature’
– a sustainable future for forestry?

Christian Gamborg and J. Bo Larsen[1]

Abstract

In this paper we examine whether the present ‘back to nature’ trend offers a sustainable future for forestry. We trace developments in back to nature silviculture against the backdrop of a receding productionist paradigm in forestry, and we ask whether these developments are sustainable in a post-Brundtland sense. We analyse in detail what is involved in a back to nature approach and examine whether this approach represents a change of ethical outlook or is merely is a prudent response to shifting priorities. *En route*, the dividing line between forest non-intervention and intervention is examined. The back to nature trend seems to suggest that habitual thinking, and the creation of dogmatic approaches, should be avoided in forest management and silviculture. Instead, the development of a raised awareness of the different values of the various forest stakeholders is required. This means acknowledging that a sustainable future for forestry requires a continuous process of balancing these values against the concerns that are considered ethically relevant by different stakeholders.

Keywords: nature-based silviculture, forest management, values, ethics, sustainability, exploitation

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1. Introduction

What should tomorrow's forest look like? What kind of products, services and experiences should it be able to provide? What functions do we want it to perform? These are some of the far from unproblematic questions the various stakeholders in the 'global forest village' face today. The questions can be raised in connection with both the management of existing forests and plantations and the afforestation efforts now taking place in many parts of the world. However, in Europe and elsewhere, problems are associated with many intensively managed plantations: problems of ecological stability and flexibility, of biodiversity, and of an aesthetic and recreational kind (Larsen, 1995; Emborg and Larsen, 1999). The 'back to nature' trend now seems to represent a very likely development path for forest management. In general usage, for example in relation to lifestyle, 'back to nature' signifies "advocating or relating to reversion to a simpler way of life" (Pearsall and Hanks, 1998). In many European countries, at least, where even-aged plantations of introduced coniferous species dominate, where there is a growing urban population, and where there is generally strong competition for land, an integrated approach along the lines of back to nature forestry seems attractive.

There appear to be widening gaps between the public perception of a forest, the forest owners' expectations, and industry's needs (List, 2000; Steel et al., 1994). Across Europe, and in parts of North America, even-aged, production-orientated plantations are beginning to be regarded in the same way as old industrial complexes. Most European plantations were created primarily to provide wood for domestic timber processing. This happened after the natural forests had been cleared, when the scarcity of wood became a reality (Kirby and Watkins, 1998). Today the plantations are being maintained in what is, in effect, a completely different era, with different objectives, priorities and values (Farrell et al., 2000). The production of timber, with increased productivity and the regimented afforestation of unproductive uplands or heathland, has become a central objective. Moreover, economic and technical efficiency have been prioritised in pursuit of high yields. This approach represents a production philosophy in which the emphasis is on human utility. In North America and in Europe, the sustained yield, multiple-use paradigm has been invoked to contest this

view for several decades (Maser, 1993; Berlyn et al., 1996). Here, the production of wood products is not necessarily more important than other aims, i.e. aims relating to the production of non-timber forest products, the protection of landscape amenities and cultural heritage, nature conservation, environmental protection and the encouragement of recreational use of woodlands. Economic and technical efficiency is still a priority, but ecological and social factors are also increasingly taken into account and this leads to the multiple use of a forest.

Going beyond multiple-use, an emerging view is that more consideration will need to be given to natural and environmental values if societal concerns are to be met (Kohm and Franklin, 1997; Berlyn et al., 1998). A forest is no longer seen merely as a production unit serving human needs and technological wants. It is increasingly perceived as an ecosystem whose living and abiotic components should be given serious attention by managers (Maser, 1994). To some, indeed, the ecosystem's health ought to be the predominant concern. Management designed to maintain or increase what might be called good health, or the right ecological balance with a proper composition and functionality, becomes a goal in itself (see Costanza et al., 1992).

The roles here are once more reversed: human extraction is yet again, albeit voluntarily, placed under the vagaries of nature. This broad trend may be dubbed back to nature forestry, although it has already acquired a number of alternative names. In Europe it is often called 'close-to-nature' or 'nature-based' silviculture; in North America, at a more general level of forest management, the terms 'ecosystem management', 'adaptive management' and 'new forestry' are more likely to be used.

In this paper we explore the border between non-intervention and nature conservation, on the one hand, and extractive silviculture and management in the classical sense, on the other. The key question is whether back to nature forestry is likely to be part of a so-called sustainable future for forestry. To answer this question, we start by clarifying the different varieties of back to nature forestry, tracing their origin and development. We seek especially to characterise nature-based silviculture, which is an approach of central European origin and part of the conceptual foundations of

ecosystem management. Next we examine whether, from an economic, ecological and social perspective, the current trend is toward sustainable forest management. Finally, we examine another departure from the classical silvicultural systems. We look at a low-key approach – so-called 'sustainable exploitation' – as a further development of the back to nature approach, and perhaps as part of a sustainable forestry practice in the future.

2. Back to nature approaches

The recent, and growing, interest in back to nature silvicultural systems represents a new form of discussion among forest scientists and practitioners. Formerly, discussion in this field focused either on yield (e.g. Leibundgut, 1983), or the conversion from monoculture to mixed forest (Gayler, 1985), or, especially in the 1980s, the relationship between nature-based silviculture and air pollution and the so-called novel forest decline (Hatzfeldt, 1985). Currently, however, discussions focus on the role of nature-based silviculture in conserving biodiversity (Christensen and Emborg, 1996) and improving stand stability (Emborg and Larsen, 1999). Moreover, general concepts are now regularly applied to specific regions, with different forest types and under different natural conditions, in North America (Bergeron and Harvey, 1997; Schulte and Buongiorno, 1998; Hansen et al., 1999), and especially Europe (Bradshaw et al., 1994; Mason and Quine, 1995; Skovsgaard, 1995; Fries et al, 1997; Lähde et al., 1999; Nabuurs and Lioubimow, 2000; Bengtsson et al., 2000; Emborg et al., 2000).

Mason and Quine (1995: 14) treat the challenge of converting large parts of even-aged conifer plantations to more structurally and functionally diverse forests as a task of "at least equal magnitude to that involved in their establishment earlier this [i.e. the twentieth] century". Larsen (1997) believes we are at a crossroads. He suggests that we require a complete reassessment of current silvicultural practices, and that this reassessment may follow one of two paths. The first option is to continue with the kind of technological rationalisation that has been a dominant feature of forest management in the last century. The second is to opt for so-called 'biological

optimisation', a key component in a back to nature silvicultural approach. In what follows, we will briefly review the origin and development of this concept.

Managed forest ecosystems and natural forest differ greatly in their structure, dynamics and functions. Nature-based silviculture mitigates this difference by taking advantage of naturally occurring processes (Schmidt, 1998). Early developments took place in the mountainous regions of central and southern Europe, where the role of forests in protecting against avalanches is of special importance. In his seminal work on mixed forest, Gayer (1886) argued for the importance of stability and continuity of forest stands. The rationale for reintroducing more complex forest stand structures was economic, despite its apparent reliance on ecological arguments. This approach is not treated by its proponents as involving classical silvicultural systems, such as group selection or irregular shelterwood. Instead it uses a "less formal approach" (Helliwell, 1999: 379).

Alternatives to the classical high forest system, with clear-cutting, were reassessed in the wake of the depression experienced in Germany and other central European countries after World War I. Silvicultural ideas of that time were typical of the *Zeitgeist*. They contrasted with the rigid rationality of nineteenth century forestry, with its formalistic and schematic principles. The underlying perception of nature as a collection of mechanistic objects suitable for scientific scrutiny was succeeded by an elegiac philosophy, with roots in romanticism, in which nature was conceived of as an organism. The ideas of the German professor of forestry, Alfred Möller (1922), are expressive of this philosophy. He treated the forest as a coherent entity and stressed the interactions between elements of this entity (Kremser, 1976). In a way, this approach is similar to the present conception of the forest as an ecosystem. The term 'ecosystem' – itself a contraction of 'ecological system' – was coined much later and is usually ascribed to Tansley (1935: 299). According to Möller, the forest had value in itself as an autonomous organism. Ecological equilibrium and continuous forest cover were key features of his silvicultural theory of (what he called) the "Dauerwald". He therefore ruled out the use of clear-cutting before regeneration and abandoned the prevailing age class system.

Möller had problems defining his terms. The substantiation of some of his claims and the validation of certain profitability calculations also presented difficulty. For these reasons, not to mention the premature death of Möller, and his general lack of recognition by the forest science establishment in Germany, there was a decline for the *Dauerwald* movement in the mid-1920s (Wobst, 1979). The forest-science establishment also confused the principal ideas of *Dauerwald* (and hence associated Möller) with a more specific silvicultural system used in parts of Switzerland and France called *Plenterwald*. But this system was considered unfit to be operated in the German forests in the north (Heyder 1986). In view of this it is important to stress that Möller was not advocating the (re)introduction of *Plenterwald* – which he had characterised as a "dream, not even a nice one" (Möller quoted in Heyder, 1986: 433). The general idea of the forest as independent system possessing more than instrumental value, and the idea of harmony, can be found in later conceptions of nature as a system in ecological balance.

The concept of close-to-natural, near-natural or nature-based silviculture is not an adaptation of the notion of *Dauerwald*, but certain *Dauerwald* silvicultural principles – in particular, the idea of continuous forest cover – can be found in it. The first more systematic description of the principles of near-natural silviculture has been ascribed to Krutzsch and Weck (1935). Krutzsch and Weck's description followed several decades of investigation at the German forest estate Bärenthoren (Krutzsch, 1926). Roughly speaking, the objective here was to maintain a species-rich, natural, healthy and productive forest. This objective had a mixed reception. In scientific periodicals, fellow foresters and scientists objected to it, claiming that it was unrealistic and based on false assumptions and incorrect calculations (Heyder, 1986). Moreover, the basic principles were controversial and readily disputed. The situation indeed resembles the discussion of sustainable forest management practices that is taking place now, fifty years later.

Immediately after the war, the debate about forestry intensified in Germany. The close-to-natural approach was rejected. It suffered from its association with the Nazi

regime after 1933. A so-called natural forest was seen as stronger, and as being of a healthier race than alternatives, and the nature-based approach to silviculture was required by law (Duchiron, 2000). Forests were conceived of as an important societal good, capable of providing recreational opportunities while at the same time providing high quality timber (Heyder, 1986). However, there was a huge demand for timber and wood for fuel in the immediate aftermath of the war (Wobst, 1979). Moreover, large areas of the German forests were cleared for use by the allied forces after the war. This ensured that afforestation and plantation silviculture were key imperatives in post-war German forestry.

In the post-war period, attempts to apply the principles of nature-based silviculture were nonetheless made, but they were infrequent and sporadic, and generally modest in scale (Wobst and Wobst, 1975). One notable development was the foundation of a silvicultural forum for discussion called ANW (Arbeitsgemeinschaft naturgemässe Waldwirtschaft). As a result of political opposition, ANW was not formally established in Germany before 1950. Mainstream foresters regarded it as a group of romantic missionaries with a limited following (Duchiron, 2000). Today, the work initiated by ANW is carried out on a European basis under the auspices of a new federation of foresters called 'Pro Silva'. Like ANW, Pro Silva encourages the exchange of ideas about forest management (Pro Silva, undated).

After decades of neglect among the mainstream of foresters, nature-based forest management received growing attention in Europe in the 1990s owing to its potential to deliver sustainable forestry (Touzet, 1996). It continues to provoke interest today. This back to nature trend has now moved beyond the German-speaking and French-speaking countries. As a result, it has been given many different names in English, some of which reflect substantive differences in approach and others of which amount to no more than nomenclatural variation. Among the more common names we find "close-to-nature silviculture" (Dolinšek, 1993; Motta et al. 1999; Schutz, 1999), "nature-based silviculture" (Bradshaw et al., 1994; Emborg et al., 2000), "nature-oriented silviculture" (Fähser, 1995; Koch and Skovsgaard, 1999; Nabuurs and Lioubimov, 2000), "near-natural silviculture" (e.g. Tarp et al., 2000) and the

"continuous cover approach" (Peterken, 1996; Kuper, 1996). Some terms, such as "biodiversity-oriented silviculture" (Parviainen et al., 1995; Björse and Bradshaw, 1998; Lähde et al., 1999), emphasise goals associated with nature conservation. Other terms denoting practices closely related to the back to nature approach include "ecological silviculture" (Benecke, 1996) and "natural silviculture" (Zerbe, 1997). Similar terms have been suggested by Frivold (1992), Orazio and Nocentini (1997), Bergeron and Harvey (1997), Fries et al. (1997) and Kerr and O'Hara (2000).

Approaches to forest management, and indeed forestry, within the back to nature scheme include: "ecosystem management", "ecoforestry" (Drengson and Taylor, 1997), "new forestry" (Franklin, 1989; Clark and Stankey, 1991), "sustainable, economical and ecologically sound forestry" (Fryk, 1993) and "wholistic forest use" (Hammond, 1991). The notion is thus applied on the silvicultural level as well at a more general managerial level. In the following section, we shall examine the notions of the *natural* and *nature* invoked in back to nature silviculture. After this we will try to clarify the relationship between the back to nature trend and sustainability post-Brundtland.

3. The concept of nature in the back to nature approach

Back to nature forestry is not a 'no use' option adopted in response to an 'any use' policy. It does not involve returning the forest back to nature, that it to say is does not entail complete non-intervention. The proposals of the advocates of back to nature forestry are quite modest: to reform current practices so that they are more environmentally benign, and more sensitive to the values of nature conservation and the demands of sustainability, by mimicking natural forest structures, processes and dynamics.[2] Three definitions, or rather interpretations, can be singled out. Back to nature could imply approximating a certain forest structure or composition at a given

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[2] It must be noted that back to nature refers to the active, but the active use in question here is not the same as that which figures in what is known as Pinchot's 'wise-use' policy. The active use Pinchot explores is associated with the more productionist perspective that dominated early twentieth-century forest management (Norton, 1991) and was prevalent in agriculture (Thompson, 1995).

point in time. This is a temporal interpretation. Another way to interpret it is to say that back to nature implies changing the way we intervene, not advocating a reversion to a certain point in time. A third way is to state that it merely implies a desire to revert to a more simple form of forestry or silviculture. We will now concentrate on the two first interpretations where the conception of nature is prominent.

One might well wonder whether back to nature silviculture is not a contradiction in terms if used in the two first senses described above. The answer depends on how nature and silviculture are perceived. Nature in the sense of life can be defined as "all the animals, plants, rocks, etc. in the world and all the features, forces and processes that happen or exist independently of people, such as the weather, the sea, mountains, reproduction and growth" (Cambridge International Dictionary). Such a definition can be interpreted in different ways. On one interpretation, humans may be seen as excluded, and natural is taken to mean not involving anything made by people, and thus any natural kind of silvi*culture* will appear to be inherently contradictory. Using such an interpretation as the basis for back to nature silviculture may prove somewhat problematic since there are virtually no forests left which have not been subject to human intervention or indirect impact on earth, let alone in Europe. The majority of forests in Europe is managed, is influenced by people. On another interpretation of the above definition, humans can be included. Here, nature is seen as something also including the activities of humans, occupying a position somewhere on a spectrum for the untouched to the overtly designed, planned and planted. Such an interpretation seems more plausible to use when advocating back to nature silviculture. However, this would still leave a more practical problem concerning the selection of an appropriate blueprint state – something that can be aimed or copied from – in the, mostly, managed forests of Europe. Changes in, for example, climate and soil are known to have an influence on the structure of natural woodland vegetation. Thus, at best the remnants of natural forest vegetation will be a proxy to copy from and the processes, structures and dynamics to imitate will be estimates.

The term back to nature implies not only a search for a return to an original position, it also implies that present types of forestry do not meet the perceived standards of

what is (in the context of forestry) natural. When we advocate a back to nature approach, a certain perception of nature and the natural is invoked. Thus, there is a normative content in the back to nature concept. The natural becomes a value that is considered worth promoting as part of the good. But here, good can be understood in two fundamentally different ways: for something may be good in its own right, or good because it is conducive to human well-being.

According to a human-centered (anthropocentric) position, a forest, and indeed nature conservation practice, are ultimately for the benefit of man (Norton, 1991). On this approach a natural forest may be deemed more desirable because it possesses certain use values which eventually adds to human well-being. It also is recognised that forestry is a long-term project and that sustainability considerations therefore need to be taken into account. But nature conservation concerns, which are prominent features of back to nature silviculture, now become a question of prioritising different human interests and values. In this account, then, an erosion of biodiversity resulting from the adoption of certain forest practices could be interpreted primarily as a loss of a resource for current and future generations.

In an alternative and non-human centered approach – e.g. the land ethic of Aldo Leopold (1949) – nature is conceived of as something possessing value in itself, independently of man. The terms 'intrinsic' and 'inherent' value are sometimes used in this context. Now there are many accounts of intrinsic and inherent value (O'Neill, 1992). Intrinsic value is sometimes treated as non-instrumental value, so that its possessor (in this case nature) is an end itself and not a means to some other end. On this interpretation we would need to explain why we have a responsibility not to damage forest ecosystem for the sake of the forest (or nature) itself. Talk about the conservation of a forest for its own sake is sometimes rather loose, or indiscriminate, and so such talk does not necessarily signal acceptance of a profound environmental ethical theory in which nature is ascribed interests and non-instrumental value.

In using a forest we may disturb its balance. However, granted that it is possible to talk about a balance, the question is whether the disturbance of this balance is

equivalent to damaging nature in itself. According to an interest model, where humans can have an interest in promoting one balance rather than another, nature has to been seen as an independent subject with well defined interests. But, even if nature can be seen as something that has interests of its own, one might still ask whether it has an interest in being balanced in one way instead of another. The idea of balance in nature has in any case been replaced by a theory of shifting dynamic equilibria, or temporary structures, and related processes recognised as balances. The central question here concerns the plausibility of the claim that nature has an interest in being in one state of balance instead of another. To answer this question affirmatively is, as Jensen (1994) points out, to suppose that one of the shifting balances is more natural than (and thus preferable to) one of the others.

Another approach is to say that nature does not 'need' to be ascribed interests to be 'damaged'. Instead, it might have a well defined value, sometimes referred to as value in itself, and a decrease in value is possible. Here, it could be argued, disturbance to the forest should be avoided for its (i.e. the forest's) own sake. However, the expression 'for its own sake' may be used to indicate that people derive something of value from nature and that nature has more than mere resource value. On this approach, nature-based silviculture can be seen as a prudent response to the shifting demands we make on a forest as a result of newly recognised needs and different systems of value and belief. Perhaps as such it is more likely to become a lasting trend. But this still leaves the following question: to what extent can the back to nature approach be regarded as sustainable in a contemporary, post-Brundtland sense?

4. Is back to nature sustainable in a post-Brundtland sense ?

The back to nature approach, with its reliance on the natural forest's structures, processes and dynamics, is seen as a promising way to meet the criteria for sustainable forest management (Franklin, 1995; Larsen, 1995; Koch and Skovsgaard, 1999; Emborg and Larsen, 1999). The principles of sustainable forest management have evolved over the past three centuries in central Europe (Baader, 1933; Zürcher, 1965; Schanz, 1996). Currently, four major forest functions are believed to be

important in sustainable forest development: the conservation of ecosystems, the protection of soil and climate, the production of timber and other products, and the provision of recreational and other social and cultural amenities. It is often stressed that these functions are interdependent. The protection function, for example, is an integral part of the production function. Building on the ideas of the ANW, the Pro Silva federation has set out a range of principles intended to ensure that a forest performs its desired functions. These are listed in Table 1.

Table 1. Principles of nature-based silviculture prepared by the European federation of foresters, Pro Silva

- *Soil productivity*: Maintaining and protecting soil productivity through continuous forest cover and maintenance of forest biomass (including dead wood).
- *Vegetation*: Maintaining natural forest vegetation, although the forest is used for production purposes.
- *Energy and mineral cycles*: Maintaining and protecting natural energy and mineral cycles, and improving carbon storage and forest climate.
- *Regeneration*: Using natural dynamic forest processes, including using spontaneous forest renewal (i.e., natural regeneration).
- *Mixed forest*: Propagating mixed forest with attention to rare species.
- *Fertilisers*: Minimising use of fertilisers, pesticides and drainage
- *Use of non-native species*: Restricting the use of non-native species to cases of economic necessity provided they can be mixed with native species, which are generally favoured.
- *Diversity*: Adding value and enhancing diversity in forest structure through forest regeneration, stand tending and exploitation as a means of obtaining niches in time and space.
- *Felling methods*: Using selective felling to avoid clear-cutting and other methods destroying forest conditions.
- *Target-diameter felling*: Abolishing rotation age as an instrument for determining when a tree should be cut, and adopting methods based on a target-diameter felling

Source: Based on Pro Silva (undated).

The general principles listed in Table 1 do not imply a specific silvicultural system. They can be used for broad guidance in the utilisation and control of natural processes in the forest. The principles are meant to be flexible. Their ranking can be altered, according to shifting priorities and underlying values. The more important matter is how they relate to different sustainability criteria. In 1994, at the First Expert Level Follow-up Meeting of the Ministerial Conference (1993) in Helsinki, one set of criteria – six European criteria – of sustainable forest management were agreed upon as a way to make sustainability more operational:

(1) The maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles.
(2) The maintenance of the health and vitality of forest ecosystems.
(3) The maintenance and encouragement of the productive functions of forests (vis-à-vis wood and non-wood products).
(4) The maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems.
(5) The maintenance and appropriate enhancement of protective functions in forest management (notably pertaining to soil and water).
(6) The maintenance of other socio-economic functions and conditions.

So what is the relationship between nature-based silviculture and each of these criteria? Let us address each criterion in turn. (1) Nature-based silviculture involves greater standing volumes than traditional management. This is mainly due to the absence of clear-cuts and the support of continuous forest cover. One way to interpret this criterion is to say that an enhancement of the forest's resources, and increases in wood and carbon storage, should be facilitated, in keeping with the Kyoto Protocol.

(2) Here the fact that there is no clear-felling contributes to the improvement of the forest's climate and mitigates the impact of climatic extremes. One of the guiding objectives for nature-based management is the maintenance and enhancement of so-called ecosystem health and vitality. One of the ideas is to use tree species and provenances that are well adapted to the site conditions. Contrary, perhaps, to what

might be expected, back to nature silviculture does not exclude the use of introduced species, provided that they have proven to be adapted to the environmental conditions and seem adaptable. Moreover, supplementation of the native vegetation patterns by introduced tree species may be justified inasmuch as it increases the adaptability of the forest to climate change and enhances economic profitability. In the restoration of a degraded forest, where natural regeneration can prove rather troublesome, non-indigenous tree species are also an option in nature-based silviculture. For this, however, certain conditions have to be met according to the, for example, Pro Silva principles listed in Table 1. The introduced species must be able to regenerate naturally and should neither suppress nor eliminate indigenous species. They must not impoverish the soil, or make stands more susceptible to wind damage, or promote the spread of disease.

(3) The question whether production is enhanced by nature-based silviculture has been much discussed. Productivity is at the core of both the old sustained yield and intermediate multiple-use paradigms. Critics maintain that as long as volume, and not quality, is the main factor in pricing timber, the level of production is an index of profitability. Basically, the continuous forest should have higher levels of production than that attainable with the classical clear-felling system. However, not all of the presently high yielding, introduced conifers are adapted to their sites, and of course this can lead to a decrease of productivity. Nonetheless, it could be argued that an increase in functional flexibility justifies a decrease in the level of production by ensuring that wood produced in the forest remains marketable, whatever needs emerge in an intergenerational perspective. Furthermore, the contribution to stability and the ecosystem's health, as well as flexibility, can be considered of major importance for sustainability in its economic dimension (Lohmander, 1992; Reed, 1993; Thorsen, 1999).

(4) Throughout the world, forest ecosystems are seen as valuable reservoirs of biodiversity. Nature-based silviculture seems to conserve biodiversity more effectively than systems in which stands of even-aged trees of a single species are clear-cut. Increased stability and continuous forest cover, in combination with the predominant

use of deciduous, indigenous tree species and either no, or little, use of pesticides may enhance the type of biodiversity that thrives in an undisturbed forest. Although nature-based silviculture can encourage biodiversity by alleviating the pressure on some animals (such as insects) and plants, it is less conducive to light-dependent species and species occurring in the early stages of succession. Nature-based silviculture does not necessarily involve wet forest, dead trees and deciduous old-growth, but these conditions help to establish many tree-dependent mosses, lichens and mycorrhiza fungi. The build-up of deadwood debris also provides habitats for hole-nesting birds, a large range of insects and saprophytic fungi. In nature-based forestry, standing dead trees and some deadwood on the forest floor are retained. Some, however, will be cleared. Most back to nature approaches are production-orientated. They therefore have to balance the goals of production and biodiversity. This means that fewer old trees, which are valuable economic assets, are retained. Standing dead trees, from which insects may attack living trees, may need to be removed, for instance. Other production-enhancing methods are used in back to nature silviculture, such as the planting of native, or non-native species, to complement natural regeneration. In conclusion, nature-based management generally supports biodiversity by integrating the conditions that foster it in the production paradigm. It must be acknowledged, however, that the biodiversity of a managed forest is both qualitatively and quantitatively different from that of natural, non-intervention forest (Christensen and Emborg, 1996), and that additional measures are needed to protect biodiversity specifically connected with deadwood and both the late and early successional stages.

(5) The protective functions of a forest depend largely on its stability and perpetuity, and these latter features are a central objective in nature-based management. See (2) and (4).

(6) This socio-economic criterion can be met in part through nature-based management. Many European forests have a substantial recreational role. In Denmark, surveys of the recreational use of forests over the last 25 years have consistently shown that mature beech monocultures – which, mindful of the limited of biodiversity therein, environmentalists refer to derogatively ‘green deserts’ – are

among the most favoured forest types (Jensen, 1999). On the other hand, encounters with wildlife are also highly valued, as is general appreciation of nature. Nature-based silviculture seems to be able to cater to these values.

The close-to-natural approach, then, appears to have the potential to meet several of the sustainability criteria. However, there are evidently some problems to be faced. We presently need more precise economic assessments of the nature-based approach and broader types of cost-benefit analysis (see Tarp et al., 2000). We also need a better understanding of the implementation and adaptation of such nature-based principles in local conditions, and in particular an understanding of how to avoid procedures associated with the classical silvicultural systems. Clearly, this calls for fresh planning initiatives and new tools of forest management and control.

When these steps are taken, and when the classical silvicultural systems has been challenged, it may be interesting to examine whether there are any novel variants of back to nature forestry, especially in a forest with inherently low production capacity, low profit potential, but high nature conservation value. Nature-based management is traditionally labour intensive. If current developments within forestry continue, it is likely to become more difficult to get people to do manual forestry work. The question is whether a variant of nature-based approach of the kind just mentioned – more natural kind of forest, involving less control and possibly more natural biodiversity – could in fact become a sustainable option.

5. What are the alternatives? Towards sustainable exploitation

If the objective of forest management were to disturb and disrupt the forest ecosystem as little as possible, non-intervention in some form would be the logical answer: we might, for instance, simply set up forest reserves, and indeed this has been done already. However, if the intention is to harness the forest's ecosystem in management for timber and non-timber forest products, while at the same time trying to maintain the natural structure and dynamic of the forest, a better understanding of the ecology

of the natural forest is needed. In particular we need to be able to predict ecological consequences of management practice (Emborg et al., 2000).

Although it is conceptualised by its advocates as a non-formal alternative to silvicultural systems that are formal in the classical sense, back to nature silviculture is still prescriptive in character by setting up certain principles to follow (compare Table 1). Perhaps it has more in common with traditional methods where good silvicultural practice is regarded more as a form of craftsmanship, or art, than it has with the science-based, and intensive, classical silvicultural systems. However, traditional approaches were based on naturally regenerated forests to a greater extent than is the case today. Back to nature foresters today have to convert existing plantation forests to more naturally structured forests. This is a kind of restoration process. Alternatively they can wait for natural succession to occur on non-forested land. Beyond back to nature forestry, we might secure forests with a more natural forest structure and dynamic by practising sustainable exploitation as a modern equivalent to pre-forestry silviculture. This approach would represent a development of nature-based silviculture in the sense that it would build solely on existing plant material – native as well as introduced – and use natural regeneration.

Different models of the evolution of forestry and related management practices have been developed (Peterken, 1996; Kimmins, 1997). A rough sketch showing phases in the development of forestry practice, including sustainable exploitation, appears in Figure 1. The first phase corresponds to existing models. Later phases depict possible developments. Here, the dotted lines running across the circle indicate ways in which other regions might bypass the European development, avoiding the loss of forest areas and the degradation of remaining woodland.

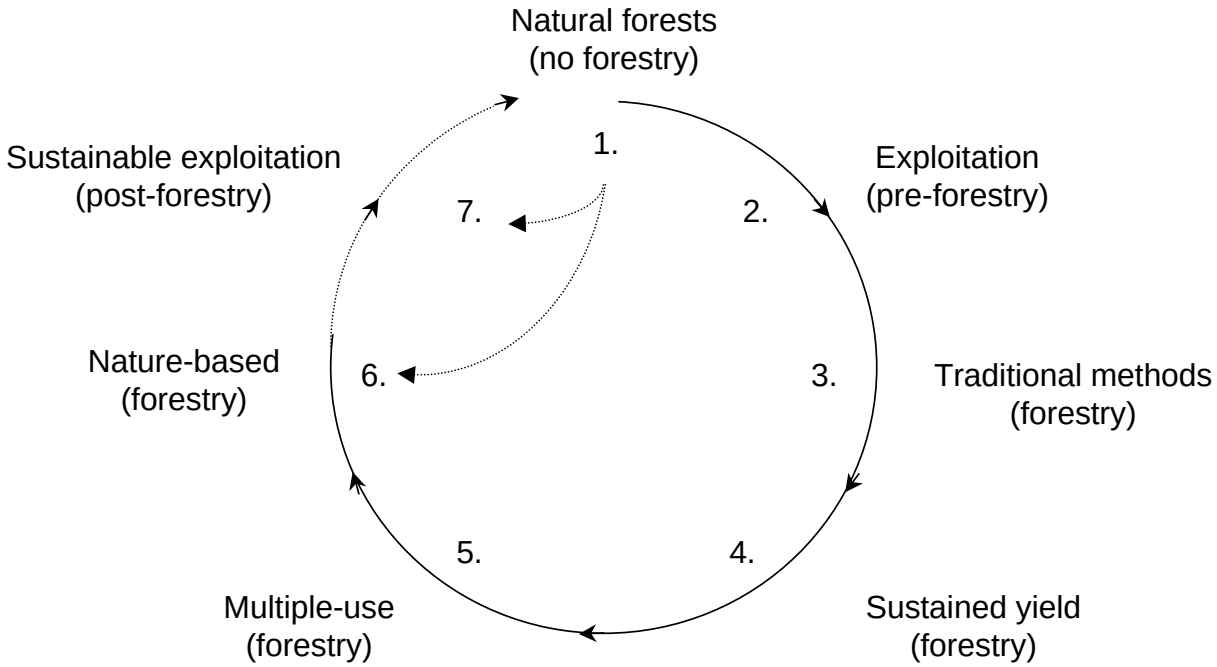

Figure 1. The historical development of forestry in Europe, sketched in seven phases, including a projected 'post-forestry' seventh phase. The dotted lines inside the circle suggest possible short cuts for countries or regions that do not conform to this developmental pattern.

The first phase involves co-called baseline natural forest, defined as forest (relatively) untouched by man where no extraction has taken place. The next phase involves aggressive exploitation of natural forest, its clearance for other land development and selective, uncontrolled cutting. Pre-silvicultural exploitation involves the clearance of natural woodland and selective felling. This leads to the demise of the natural woodland and can therefore be characterised as a pre-forestry phase.

The third phase includes so-called traditional forestry, which is an all-encompassing term covering practices such as coppicing, wood pasture and more or less controlled selection systems. In this phase, only existing, native species are used. The fourth

phase is characterised by increased control. One of its main objectives is sustained yield. In this phase, even-aged plantations of predominantly non-native species are often clear-cut to provide high yields of timber and non-timber products. Levels of control and manipulation are at their highest, and there is almost no remnant of the original, natural forest. The phase is, then, largely one of afforestation. In the fifth phase, the initial afforestation process is complete and the plantations can be managed according to a multiple-use, sustained yield principle.

In the sixth phase, a return to the perceived structures, functions and dynamics of the once natural forest is aimed at. Here, restoration plays an important role, converting existing plantations into more diverse and structurally varied, mixed forests. Careful selective cutting in a mixed forest of predominantly native trees and the preservation of continuous forest cover typify this silvicultural approach. Finally, in the anticipated seventh phase, managerial intervention decreases to a sustained minimum. The main goal of sustainable exploitation would be to offer a more flexible approach in circumstances where more conventional silvicultural measures cannot be afforded or objectives besides wood production play an important role.

There are similarities between this roughly sketched system of sustainable exploitation and the pre-silvicultural approach: extensive use, selective felling and the grounding of regeneration on existing natural conditions are shared features. But there are also some notable differences. One of these concerns the degree of control over the selective felling process. This will be considerable in the sustainable exploitation approach, since here it is expected that greater control will be exerted and that no clearing of the woodland will occur. (Purposive control of existing, natural conditions of the kind associated with nature-based silviculture would, however, be entirely abandoned.) A second contrast is that, whereas the original exploitation was based solely on the utilisation of natural, primary woodland, sustainable exploitation would involve secondary, and at most semi-natural woodlands or converted plantations with non-native species. Wood and other non-timber forest products would still be extracted, but through an extensive, controlled selection system.

Essentially, this last phase represents the dividing line between actual forest management and silvicultural practice, on the one hand, and non-intervention, where core use and passive use values of the forest are maintained, on the other. Arrival at this phase could therefore be characterised as the conclusion of a full circle in the silvicultural development of the natural forest. The development can be described by invoking one or more of a number of parameters, such as use of technology, regeneration methods, and so on. Schütz (1997, 1999) suggests that different varieties of close-to-nature silviculture can be defined in terms of the degree of naturalness, diversity and intervention; and to some extent these factors correspond to those we have chosen to single out, that is: controllability, the intensity of usage and the degree of modification of natural conditions required to achieve management objectives. The relations of these factors to different phases of forestry are shown in Table 2.

Table 2. The development of silvicultural approaches / dominant forest management objectives characterised by three factors: control, usage and modification. High (***), intermediate (**), low (*), absent (–)

Forestry phase	Controllability	Intensity of usage	Degree of modification of existing natural conditions[1]
Exploitation	–	*[2]	*[2]
Traditional methods	**	**	**
Sustained yield	***	***	***
Multiple-use, sustained yield	***	***	***
Nature-based	**	**	**
Sustainable exploitation	*	*	*

[1] Prior to the extraction of wood and non-wood products.
[2] It may well be argued that in some cases, where the forest is completely cleared, the intensity of usage and degree of modification of the existing natural conditions are both high.

As Table 2 shows, there is a gradual development from the pre-forestry stage to the most intensive types of use encountered in the fourth and fifth phases. Here, the

modification of natural conditions is most comprehensive. The higher the intensity of usage, and the more complete the modification of the existing natural conditions, the lower natural diversity is likely to be. The same is plausibly the case with naturalness. However, to establish this link one needs to determine more carefully what kind of naturalness is being referred to. It must be noted that the speculation about future developments mainly rests on a supposed continuation of the current back to nature trend. It tries to take this trend one step further. But other possibilities obviously exist. One envisages more intensive silvicultural systems that use genetically engineered trees to obtain a more environmentally benign type of silviculture with less need of fertilisers. (This might apply to the cultivation of Christmas trees, for example.) Here higher levels of control are evident, but they are not necessarily accompanied by a greater intensity of usage. Any determination of the degree of modification of the natural conditions will be part of a more comprehensive discussion about levels of interference and the manipulation of nature.

6. Conclusions

Back to nature can be understood in at least three different ways. First, in a temporal sense where back to nature refers to the structure or composition of forest at a special point in time. Secondly, back to nature can also be seen as referring to the way we intervene in the forest. In both cases, and especially in the first sense, a well defined baseline is needed. However thirdly, back to nature can also be understood more broadly as the wish to revert to a 'simple' way of forestry or silviculture in particular. The implication of the last interpretation is that the need to operate with a very specifically defined blueprint state is not as pronounced as in the other interpretations. Instead, measures to simplify operations and practices should be considered.

Back to nature approaches seem to fulfil – at least partly – the requirements of sustainable forest development in a post-Brundtland sense by meeting socio-economic and nature conservation concerns. In a sustainability context, nature-based silviculture has been suggested as preferable, ethically speaking, to a system in which there is a

sharper division between production and preservation (Ortloff, 1999). Nature conservation through non-intervention or set-aside management produces no wood. Nature-based silviculture, by contrast, generates wood while at the same time seeking to address wider concerns and interests.

As an overarching management philosophy incorporating insufficient flexibility to adapt to shifting demands, productionism is on a receding path. On the other hand, an approach in which the notion of a natural forest is defined so as to exclude the original or the cultural is conceptually inadequate, especially in a European context. Hence, a strict, or purist back to nature approach is unlikely to be conceptually acceptable. As Larsen (1997) stresses, the concept of functional flexibility is more important. The concept of back to nature forestry may suggest that habitual thinking and the creation of dogmatic systems should be avoided within silviculture. Moreover, it may not be productive to project one's "dreams about lost nature to the artificial [i.e. cultivated] forests" (Oldeman, 1990: 742). Instead, the inherent creativity aspect of forest management, and (more especially) of any kind of silviculture, should be emphasised.

An important thing to stress is that, in adopting nature-based silviculture, foresters are bound to address nature conservation concerns more seriously. They must now meet society's changed demands on a forest and forestry practice. More broadly, forest stakeholders need to discuss the ways in which the natural is perceived or enquire into what the 'proper' use of a forest is, and what constitutes a 'genuine' forest. However, this is part of a discussion about which values to promote and which concerns are to be considered ethically relevant. The latter is especially relevant if back to nature is understood primarily as a desire to revert to a 'simpler' way of forestry or silviculture. Moreover, such a discussion may help to highlight the process of balancing of costs and benefits, as well as concerns and values, inherent in the concept of sustainability and in modern forest management.

It might be difficult to pinpoint what a sustainable future for forestry entails, but it is clear that a sustainable future for forestry will require us to balance these values both against one another and against any concerns felt to be ethically relevant by the

various stakeholders. In this way, the dialogue between foresters or resource conservationists, on the one hand, and environmentalists or nature conservationists, on the other, can become more constructive. The debate about changing silvicultural practices is, after all, be more than a technical, scientific and managerial matter.

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Designer trees, exotic species and the ethics of manipulating nature

Christian Gamborg and Peter Sandøe[1]

Abstract

This paper examines the connection between modern biotechnology and forest and landscape management. One of the current centres of interest in the debate about modern gene technology focuses on the use of this technology to produce food crops. But the commercial use of genetically modified trees is now being discussed as well. In the forestry context, the concern is not about human health. It is about interference with existing ecological relations. At the same time, amid growing concern about natural biodiversity, extensive use of introduced species in forest and landscape management is beginning to be queried. One way to connect these debates is to view them both – gene technology and species introduction – as examples of the *manipulation* of nature. This manipulation occurs at different levels: the micro and macro-level, respectively. Both species and gene introductions should be assessed by asking how much manipulation they involve. Such an approach would help to clarify the way in which manipulation at one level has ramifications at another level. It is suggested that we should consider methods, production systems and practices at the micro- and macro-level from a combined non-human bioethical and environmental ethical perspective

Keywords: bioethics, breeding, environmental ethics, forest management, genetic modification, introduced species, manipulation, values

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1. Introduction

The European landscape is an ancient, culturally shaped landscape, heavily marked by human enterprise. It has been altered by among other things the reclamation of wet, low-lying inlets and shallow lakes for agricultural use, the clearing of natural woodland, and the transformation of old coppices and moors to productive plantations. As a result of successive waves of human activity and the subsequent impoverishment of habitats, some species have become extinct (Pimm, 1998; Abrams, 1996). With increasingly sophisticated skills and techniques the natural environment has been modified to satisfy our shifting needs. For at least 250 years, exotics have been used in forestry. Species of tree have been introduced from other regions, other countries, and even other continents, to supplement the relatively poor native array of species found in most of Northern Europe (Godfray and Crawley, 1998). Moreover, over the past 75 years, attempts to improve varieties of forest tree by selective breeding have been common in many European countries; new varieties now complement the traditional use of wild forms. Through these developments forest management practices have become more independent of the site-specific conditions and the plant material available.

Over the last decade, and following the engineering of the genome, more advanced so-called designer trees have become a reality. These genetically modified trees have also been called ‘GM trees’, ‘transgenic trees’ or ‘super trees’. The commercial application of genetically modified trees in forestry is now imminent. In principle, it ought become possible to grow species of tree with specifically installed traits, in a way that is not limited by species boundaries (Damgaard et al., 1998). This promises substantial advances in disease and growth control and improvements in productivity and/or quality.

However, the public are apprehensive. They suspect that genetically modified trees will not come without costs such as disturbance to the existing ecological balance (Owusu, 1999). The results of genetic engineering in the forest context have been

disapprovingly dubbed "Frankenstein forests" or "Frankentrees" (Warwick, 1999).[2] Moreover, in many European countries, increased attention to native species and the role of natural biodiversity in modern forest and landscape management has rendered these developments in some ways obsolete. The current trend in European forest and landscape management seems indeed to be toward, not just increased interest in native species, but a "native only policy" (Kendle and Rose, 2000). This preference is influenced by the belief that native species are better than non-native alternatives in, for example, their growth, stability and biodiversity value. However, exceptions can be found where introduced species are as successful in these respects.

Plainly, both the native versus non-native issue and the question whether to use genetically modified trees are in part empirical. They can therefore be tackled to some extent using natural sciences. Here, questions such as the following need answering. How do the introduced species disperse their seed? What are their main competitors? What ecological factors influence the degree of invasiveness of a particular species? In part, however, the issues here are non-empirical, or conceptual. We need, that is to say, to address fundamental questions about values – to ask, for example, what can be considered a 'proper' use of the natural environment, and why non-native species are thought to constitute a 'threat' to the natural environment. Often these two levels of the debate are conflated. When this happens, the fact underlying value judgements are being used in conjunction with, or as an indirect support for, scientific opinions about gene technology and forest and landscape management can be hard to discern.

A connection between gene technology, on the one hand, and forest and landscape management, on the other, is that both can be seen as *manipulations* of nature – although obviously, at different levels. Throughout the present discussion, the word 'manipulation' is used as a convenient general term for any purposive human impact on the development of a forest. The manipulation of nature involves more or less skilful change of natural structures, elements and conditions in pursuit of some

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[2] Other current topics include patenting of genetically modified organisms, labelling of products, and the possibility of exerting democratic control on the development and application of

specified purpose. As such, gene technology and forest and landscape management should be considered and evaluated by way of the same line of reasoning and according to the same kinds of ethical thinking. Currently, there seems to be a division between bioethics, which deals with matters at the *micro*-level (e.g. conventional selective breeding and gene technology) and environmental ethics, which deals with matters at the *macro*-level (e.g. landscape management and silviculture). However, bioethics can include environmental concerns. Potter (1971:4), who is usually said to have coined the term, defined bioethics as the combination of "biology with humanistic knowledge from diverse sources . . . [to] forge a science of survival that will be able to set a system of priorities." Potter (ibid.) speaks of "acceptable" survival in relation to, especially, medical and environmental priorities. Today, the concept of acceptable survival has been supplanted by the concept of sustainable development. In the 1980s, non-human bioethics developed into addressing questions about the use of modern biotechnology, especially in relation to agriculture and animal husbandry. Increasingly, more general issues related to the use of the natural environment have been taken up.

While environmental ethics and bioethics have developed largely independently of each other since the beginning of the 1970s, a certain convergence of the two disciplines is noticeable now (e.g. Frey, 2000; Gillon, 1998). Environmental ethics has undergone development from more theoretical discussions about the natural environment – e.g. species loss, the value of wilderness and how to value nature – into a discussion of more applied issues related to the use of the natural environment

Manipulation at the micro-level often has repercussions at the macro-level. Here, the problem is not simply one of quantifying the associated risks and perceived utility of these types of manipulation. We have beliefs, indeed strong convictions, about what is right and fair in our social arrangements. Sentiments in one area can improve our understanding of what appeared to be a separate issue. For example, disapproval of the idea that genetically modified trees should be used in forestry might help us to

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biotechnology (see e.g. Holland and Johnson, 1998; Rexroad, 1998, Holland and Pratt, 1995 and Thompson, 1998).

clarify the animosity, now becoming apparent, towards non-native tree species. It is necessary to discuss the values at stake, for instance, when genetically modified trees are rejected and conventional breeding practices and non-native species are used in forest and landscape management. In what follows we look at different types and different levels of manipulation in the managed forest. We examine some of the value judgements involved in common consequentialist and non-consequentialist responses to the manipulation of nature.

2. The managed forest and manipulation

The manipulation of natural forest ecosystems was described by forest ecologists, especially in the 1980s and 1990s, in systems terminology: phrases such as 'harming natural processes', 'disconnecting natural nutrient and energy cycles' and 'disrupting nature's ecological integrity' were often used at this time. In many cases, these phrases referred to contemporary forestry practices that were proved questionable in the light of the new sustainability paradigm introduced by Brundtland (WCED, 1987) and after the United Nations Conference on Environment and Development in 1992. Following these developments, official criteria and indicators of sustainable forest management were in introduced in Europe (Ministerial Conference, 1993).

In essence forest management is about making use of, changing or regulating the natural environment so that certain well-defined aims – centrally, the production of timber – can be achieved. With increasingly sophisticated skills, scientific knowledge and technical expertise, the possibilities where the manipulation of nature is concerned have become greater and greater, particularly over the last few centuries.

We will, then, distinguish between two levels at which forests can be manipulated: the macro and the micro-level (Figure 1).

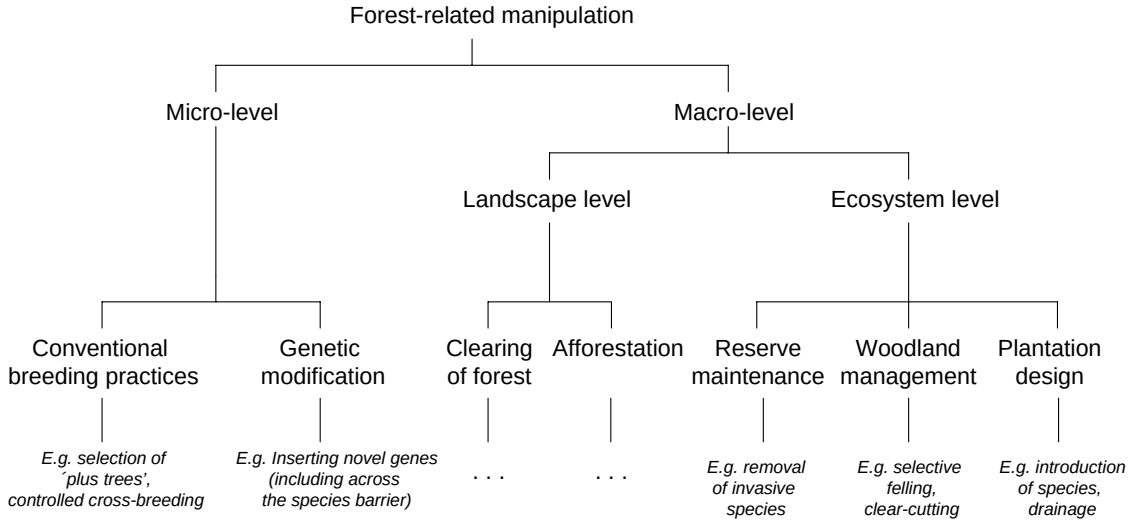

Figure 1. Manipulations of the forest at the micro- and macro-level, with examples, where applicable, in italics.

Manipulation at the macro-level – for example, the landscape level – includes forest clearance and the subsequent conversion of the cleared land to other land-uses. Alternatively it might involve the afforestation of abandoned fields or moors. At the level of the forest ecosystem three types of manipulation can be distinguished: (1) maintenance of nature reserves, (2) management of native (broadleaved) forests and (3) design and management of (coniferous) plantations.

(1) The maintenance of nature reserves, i.e. nature conservation, is usually connected with a low degree of intervention, and so-called 'natural' forest ecosystems are normally characterised as ecosystems with little or no direct man-made intervention. Deadwood is left to improve biodiversity (Hodge and Peterken, 1998). A common objective is to maintain the ecological status quo. Manipulating species composition – for example, by removing invasive, exotic species, or eradicating naturalised species (e.g. *Acer pseudoplantanus)*, or reintroducing native species – is not uncommon. These species are apparently removed or returned to keep the ecosystem as 'natural'

as possible. Here, the natural is equated with the 'original', i.e. whatever was present before the non-original species invaded the ecosystem.

(2) The second type of manipulation at the level of forest ecosystem involves managed, sometimes semi-natural, forests. In semi-natural forests, stands consist mainly of native species that were not planted and are naturally regenerated. Moreover, changes in structure and species composition are often more recognisable than they are in the natural forest. These forests can be managed under, for example, coppicing and high forest silvicultural systems. Felling, including clear-cutting, and occasionally drainage are examples here of manipulation. At present, more ecologically benign, nature-based types of forest management that build on a "continuous cover approach" are becoming popular (Kerr and O'Hara, 2000). The aim here is to minimise direct manipulation of the ecosystem by exploiting the natural regeneration of native tree species for the most part.

(3) The third type of intervention in the forest ecosystem involves the highest degree of manipulation. These specifically designed 'artificial' forest ecosystems are often made up of uniform plantations of same-age trees and are characterised by a high degree of continuous management. Species, age composition and distribution are examples of factors that are regulated through silvicultural measures such as planting and especially cutting. It is often said that the only thing needed in silviculture is the blazing of trees. In this way, essential growth factors such as light can be regulated. The trees can be spaced out in their youth and thinned at the maturation phase, and the best specimens can be cut when they reach maturity, leaving behind shelter and seed trees. Moreover, artificial drainage and introduced species are common in plantation forestry. In the last hundred years, the use of improved (i.e. bred) material, fertilisers and pesticides has been frequent. However, it should be noted that fertilisers and pesticides are used in much smaller quantities than they are in intensive agriculture.

Manipulations of nature at the micro-level can be divided into two prominent types: conventional improvement and, more recently, genetic engineering. Conventional improvement might involve, for example, so-called 'plus tree' selection and controlled

selective breeding techniques. Genetic modification involves the insertion of novel genes.

In practice these distinctions between the different types of manipulation may not be as clear-cut as they appear. Manipulations at both levels are likely to have impact on the ecosystem. Moreover, it would seem that the manipulation of ecosystems through management, at least, is virtually inevitable, regardless of the state of the forest ecosystem at hand. In fact, in most cases it is not a question of *whether*, but rather *what degree* of manipulation to allow. The decision will depend on many factors: the objectives of the forest in question, and economic, ecological, social and legal desiderata are all taken into consideration. Often, economic calculations of associated costs and estimated benefits are the key determinants of manipulation of the forest. Here, the profitability of different management schemes is analysed, and these analyses are coupled with ecological considerations. However, these analyses do not cover all the matters at stake. In the following we will take a closer look at two examples of nature's manipulation, one at the macro-level (species introduction) and the other at the micro-level (genetic modification), and ask whether similarities which would permit a common ethical analysis obtain.

3. Manipulation at the macro-level: species introduction

An exotic species is an introduced, non-native species. It is a species that has reached areas where it did not previously occur by means of human intentional or accidental transportation (Allaby, 1998). Botanists distinguish between two types of non-native, or non-indigenous, species. Non-natives introduced (roughly) before AD1500 and now considered to be established elements of a region's flora, are called archaeophytes. More recent introductions are called neophytes. Many neophytes are very common and do not conform with the general conception of an exotic as being unusual or foreign-seeming. The terms 'neophyte' and 'archaeophyte' are not used much outside specialised scientific literature. Instead, incoming plants and animals are described as: introduced, non-native, non-indigenous, exotic or alien. They have also been labelled bioinvaders, immigrants and colonisers. Clearly, these terms become less descriptive

as we move to the end of the list (Eser, 1998). Some introduced species have become naturalised. A naturalised species is one originally introduced by human agency but now wild in invaded native communities and able to maintain itself without human assistance.

In traditional low-cover forest countries such as the UK, Denmark and the Netherlands, the majority of commercial forest tree species have been introduced to replace or complement natural regeneration. There are few native forest species in Europe, and this contrasts with the situation in the same latitudes in other parts of the world (Bradshaw, 1995). This is a result of the relative recentness, in geological terms, of the last ice age. Most of the introductions to species-poor countries in Europe with diverse growth conditions, such as the Netherlands, Denmark and the UK, took place between the sixteenth and nineteenth centuries; but there were further introductions in the twentieth century. The trees included conifers as well as broadleaved deciduous varieties. Some of these introductions (e.g. *Acer pseudoplatanus*, *Picea abies*) have been little more than an extension of the natural European range, whereas others (e.g. *Pseudotsuga Menziesii*, *Abies grandis*) are trans-continental.[3] These species have been introduced for a variety of reasons, such as making possible afforestation or reforestation under difficult environmental conditions (Rackham, 1990). Introduced species may grow more rapidly, provide higher yields of wood and possess greater resistance to local diseases and other damaging agents (Zobel et al., 1987). From a management perspective, a diverse range of species gives more choice and opportunity when planning. Table 1 shows the kinds of species typically found in the three types of managed forest that were discussed in the previous section.

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[3] Even trans-hemispheric species have been introduced, e.g. *Nothofagus* spp. to the UK (Peterken, 2001).

Table 1. Tree species typically found in three types of managed forest

Species	Managed forest		
	Nature reserve (Maintenance)	Woodland (Management)	Plantation (Design and management)
Native	X	X	X
Naturalised	(X)	X	X
Reintroduced	X	(X)	
Introduced			X

Table 1 shows that introduced species are almost always found in managed plantation forests, although some can be found as naturalised species in semi-natural woodlands and nature reserves. Plantation is the dominant type of managed forests in many European countries with low forest cover.

The degree of manipulation associated with the introduction of species can be described in several different ways. An important way is to characterise the ecological effects of the introductions on other tree species, on the relationship between the tree species, on the site and on biodiversity (Sutherland, 1998). Here the ability of an introduced species to spread through pollination and seed dispersal is a highly significant ecological effect. As Engelmark et al. (2001) point out, as the seeds are disseminated and spread, and trees are regenerated beyond the initial plantations, there may be negative consequences for biodiversity in the future. In the 1970s, lodgepole pine (*Pinus contorta*) was systematically introduced in Sweden to meet a predicted timber shortage (Elfving et al., 2001). In general in Sweden, however, the use of introduced species is limited and 95% of the growing stock are native species. In the UK, introduced species are more frequently used, particularly in upland areas (Rackham, 1990). In a small forest country like Denmark, roughly two-thirds of the

forested area is covered with introduced species (Danmarks Statistik, 1994). Here the use of native species of non-local provenance – e.g. oak stands originally established using masts from Dutch roadside trees, or beech stands originating from Swiss beech masts – is not uncommon.

Examining the case of introduced tree species in the UK, Peterken (2001) stresses that well-documented knowledge of ecological impact is in fact quite limited. The majority of introduced species have been present for less than 200 years, and most are not abundant where they do occur. The tentative conclusion Peterken draws is, however, that introduced trees have in general been ecologically damaging to biodiversity. The damage is done through loss of semi-natural habitats and site degradation – for example, through drainage. Other types of ecological damage depend to some extent on the invasiveness of the species. It is claimed that indigenous species, by contrast, offer ecological advantages such as straightforward adaptation to the environment, and the ability to fill ecological niches and conserve native flora (Nyland, 1996).

However, some points can be made in mitigation of the damage done by introduced species. In relation to the last criticism mentioned above, it should be pointed out that mature trees are generally valued in the landscape irrespective of origin. Similarly, when more diverse structures develop in stands consisting of introduced species, they become more acceptable in the eyes of the public (Peterken, 2001). Furthermore, the reduction in biodiversity has not been severe or large-scale, and wildlife has in several cases benefited from the introduction of forest tree species. Perhaps more importantly, forest expansion has been facilitated by introduced species, and in this way erosion control programmes and wildlife habitats have, for example, been created. In any case, these afforestation measures are less destructive of biodiversity than intensive agriculture: “If nature conservationists had to choose between replacing semi-natural vegetation with arable land or plantations of introduced trees, they would choose plantations” (Peterken, 2001: 41).

In any given case, it is bound to be questionable whether an erosion of biodiversity is due to the introduction of non-native species or plantation afforestation and/or changes

in forest management and silvicultural practice. Types of change include the alteration of composition (from deciduous to coniferous trees and from mixed stands to monocultures) and structure (from multi-strata stand to more uniform plantations and from mature and mixed-aged trees to same-age trees). There may also be changes in site conditions relating to the local hydrology and soil.

The acceptance of macro-level manipulation using introduced species depends not only on present and foreseen ecological effects, but also the cultural associations of an introduced species. Perhaps, then, signs of management connected with the use of introduced species amount to a special category of damage. However, introduced tree species seem to undergo a process of assimilation in the habitats they arrive in. As they become more mature their reception is influenced by changes in the perception of nature. The kinds of manipulation considered acceptable from an ethical point of view thus appears to change over time. We will examine this issue more closely in connection with the acceptance of manipulation at the micro-level; but before we can do this, we need to characterise manipulation at the micro-level more fully.

4. Manipulation at the micro-level: selective breeding and genetic modification

Manipulation at the micro-level designed to improve forest trees has been going on for the last 70 years. The purpose of such improvement is to breed trees with ideal characteristics that are capable of replacing or supplementing those that would emerge through natural regeneration. Examples of so-called ideal characteristics include improved (e.g. accelerated or larger) growth, more desirable structure, and increased resistance to diseases, pests and drought. Tree improvement makes use of inherent genetic differences between trees in a population and the tendency of inherited traits to control factors such as growth and development of the progeny (Larsen, 1956). As explained below, improvement strategies operate at a basic silvicultural level; they also operate at a more advanced level, using fairly intensive selection and propagation methods (Nyland, 1996).

At the basic level, artificial regeneration can make use of local seeds from, for example, seed collection stands or seed production areas. Another way of complementing local stock is to use non-local and introduced species. This was examined in the previous section. Intensive strategies include the establishment of seed orchards where cuttings from select trees called 'plus trees' are artificially propagated. Other strategies exploit controlled selective breeding programmes to create hybrids and use a variety of clonal propagation methods. The clones are tested and selected for a relatively small, well-defined geographical area. Clonal temperate forestry was envisaged, especially in the 1970s, as having a promising future in the mass production of, for example, wood for pulping.[4] However, the expected benefits of using clones in terms of enhanced growth and wood quality did not materialise. Moreover, clonal methods turned out to be uneconomical. Clonal plantation forestry has been used mainly in fast growing, short rotation coppice in the Mediterranean countries and (especially in Sweden) in the production of wood for fuel.

The difficult task for those seeking to improve trees is ensuring that trees with good phenotypes – that is, the interaction between a tree's genetic makeup, or genotype, and specific environmental factors – pass on these traits to their progeny. Moreover, trees that do well in one area often show poor growth in other areas (Nyland, 1996). Comprehensive suitability tests are therefore necessary. Certain risks are associated with very intensive improvement programmes in which a relatively small proportion of the total population is used for propagation and breeding. These risks include reduced genetic diversity and reduced tolerance to environmental factors (Zobel and Talbert, 1984). Given the considerable time a forest tree species takes to mature, the testing of whether desired traits have been passed on or not, and of the suitability and adaptability of a tree to different site conditions, can obviously be a long-term project – one spanning decades. Immediate verification is impossible here.

Over the last decade, novel ways of manipulating the traits of species of forest tree have been developed in an effort to remedy some of the drawbacks of conventional

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[4] A clone is a group of "genetically identical cells or individuals derived from a common ancestor" (Allaby, 1998:88).

tree improvement methods. Two of the chief advantages of genetic engineering over conventional cross-breeding techniques are the speed by which new varieties can be developed and the ability to cross species barriers. Genetic modification has been used to manipulate the genetic material of a cell in order to produce new traits. In principle, recombinations of genes coming not only from related tree species but also from other plants, and indeed microbes and animals, can be introduced. Thus, genetically modified, or transgenic, trees are trees that have had genes from other species inserted in their genome. (A genome is the full complement of an organism's genes.) The term 'genetically modified' is primarily used in Europe; in North America 'transgenic' is more common.[5]

Over the last few years, genetically modified fruit and forest trees have been developed a good deal, although the absolute number of trials here is very small compared to the number of trials conducted with agricultural crops (Bajaj, 1999). Since 1988 there have been 116 confirmed GM fruit and forest tree trials around the world.[6] The second half of the 1990s witnessed a considerable growth in the number of trials; in 1998 alone, 44 new trials were recorded. At the time of writing 31 field trials were registered in a comprehensive EU database of GM tree field trials. These trails are carried out predominantly by academic or state research institutions.[7]

Some of the anticipated benefits of genetically modifying trees are similar to those of conventional forest tree improvement: faster growth, higher yield, and differences in wood composition such as lowered lignin content in order to reduce the amount of

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5 Lappé and Bailey (1999) argue that there is a semantic difference between calling a genetically altered organism 'transgenic' or 'genetically modified'. 'Transgenic' is considered scientific jargon, which is just confusing to the general public, whereas 'genetically modified' more readily conveys the message (ibid.).

6 The first field trial on trees, using genetically modified poplars, was in Gent, Belgium in 1988 (Owusu, 1999).

7 According to Owusu (1999), three private companies have established trials in the UK; Shell Forestry, Zeneca and Stora Celbi.

chemicals used for pulping the wood.[8] However, most work is presently aimed at conferring herbicide, cold and drought resistance as well as insect resistance.

The risks associated with genetic modification of trees are the same as those associated with conventional tree improvement. For example, by changing fundamental characteristics of the wood, such as the lignin content or the growth speed, the general resistance of a tree to various types of biotic damage (e.g. by insect attacks) and abiotic damage (e.g. by storms) may be affected. Environmental problems may also arise if unwelcome insects or pests become resistant to the insecticides the genetically modified tree produces. To cope with this more and/or other insecticides might be required. Because a tree is a long-lived perennial with complex flower biology, there is also a risk of spreading novel genes to wild relatives through species invasion or gene flow. The weakening or removal of part of the food chain in a forest is another ecological risk connected with genetically modified trees. This can have an adverse effect on local animal and plant life: for example, the widespread use of insect resistant trees is likely to create problems for birds that feed on insects and worms. Finally, wherever there are plantations of fast growing genetically modified trees with increased soil nutrient and water demand there is the risk of over-intensive land use.

A principal difference between the risks associated with genetically modified annuals and perennials, such as trees, is the time factor. Christmas trees grow for 8-10 years and willow or poplar in short rotation coppice has a rotation period of 20 years. A conventional plantation of spruce has a lifespan of 50-80 years before final harvest and a stand of oak takes 120-140 years to reach its economically optimal rotation age. A genetically modified insect resistant oak tree might be attacked by a bark beetle which, after 30-40 years, has developed resistance to the genetic modification. In general, the long-term effects of modification on bird and insect life are difficult to assess. Since trials have only just started, there is little evidence to back up any worries.

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[8] Of more doubtful usefulness is the kind of genetic modification of Christmas trees that five British students have come up with: a fluorescent tree with genes from a jellyfish, perhaps to

One of the main conclusions of a Danish study of the feasibility of using genetically modified trees in forestry (Kjær and Jensen, 2000) is that, unlike agricultural crops, GM trees offer few real benefits. Coniferous plantation forestry and broadleaved woodland management are the most common types of Danish forestry. The majority of Danish forests are genetically and functionally diverse – that is to say, most forests are managed under some form of multiple-use management. At present, the expected benefits do not seem to justify the economic costs and environmental risks associated with genetically modified trees. Because of the considerable length of time it takes before a tree flowers, and because of the long lifespan of a tree, it is difficult to test the stability and expression of changed genes, and equally hard to assess a gene's long-term effects on the ecosystem. Moreover, many of the desirable traits in forest tree species, such as health, quality and adaptability to climate change, are polygenetic. At present, these traits are too complex to be genetically engineered in a desired direction. Moreover, the value of genetic diversity renders reduction of the gene pool undesirable.

In some cases, however, genetically modified trees may bring real gains. Possibilities include short rotation coppices for wood for fuel and Christmas tree plantations. At present, it is difficult to obtain economies of scale in short rotation coppices owing to the high cultivation costs and low profitability. However, Christmas tree and greenery plantations occupy approximately 5% of the Danish forested area. These plantations are intensively managed, with a considerable input of energy, fertilisers and pesticides, to create a highly value-added niche product. Here, the reduction of herbicide and insecticide use is an interesting possibility (Kjær and Jensen, 2000). Efforts are being made in Denmark to insert a gene into the most commonly used Christmas tree species (*Abies nordmanniana*). The gene codes for the production of a natural insecticide that will make the Christmas tree resistant to certain insect attacks.[9]

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prevent children being burnt from candles and to prevent trees going up in flames. It must be noted, however, that is just a thought experiment as yet.

[9] In this case, involving a non-food product, there is no worry about direct effects on human health. The gene in question comes from the snowdrop, a small plant with white bell-shaped flowers (Saitz, 2000). The British researcher Dr *Arpad Pusztai* used this gene in his now

In this particular case, the economic costs are more likely to be justified, testing is easier, and the existing genetic diversity of the stand is not very great. The ecological effects are also easier to assess because of the short rotation age.

In forestry, biotechnology has not (yet) been subjected to anything like the intensity of debate it has received where agricultural products, and in particular, genetically modified crops such as soya beans, are concerned. There are several reasons for this. To begin with, fewer trials have been conducted with genetically modified forest trees. Consequently, data on the ecological effects of genetic modification in this field are currently scarce. Secondly, no commercial use has been made of genetically modified trees in forestry – as yet. In Denmark, and probably throughout Europe, genetically modified trees are unlikely to appear for the time being except in specialised plantations. A Christmas tree plantation, however, has more in common with agriculture in its modification of the natural environment, degree of control and general managerial intensity. Thirdly, and probably more importantly, trees are not *food* crops, and this means that their modification poses no direct risk to human health of the kind that arises when we eat toxic or allergenic substances.[10] The worry about genetically modified trees instead concerns their potential to have an irreversible negative impact on the natural environment. This worry is intensified by the longevity of trees (as compared with food crops such as maize), since this makes it more likely that there will be unknown implications. All concerns here have to be seen in connection with how a forest is perceived by the public. Forests, unlike agricultural fields, are seen as 'uncultivated'. So the concern about modification may be rooted in unacknowledged disapproval of the management of forests *as such*.

At any rate, concerns about genetic engineering in forestry relate in an interesting way to two currently recognisable and opposing trends in forest management. One trend is technological. It is represented by developments in tree improvement, including genetic modification, and the continued use of introduced species; and

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notorious experiments with genetically modified potato plants that seemed to cause illness to rats.

characteristically, followers of this trend attempt to mitigate ecological, environmental and economic problems using modern (bio)technology. The other trend is the organic, 'ecological' or 'back to nature' trend. This trend is especially pronounced at present in agriculture and animal husbandry. In forestry, it is exemplified by so-called nature-based silviculture (Emborg and Larsen, 1999). The second of these trends is generally regarded as more straightforwardly acceptable in ethical terms than the first. Surveys have shown that European citizens are critical of applications of modern biotechnology to, specifically, agriculture and food applications; and it has been found that this attitude is linked to the usefulness of the application, the perceived risks associated with it, and its ethical implications (Biotechnology and the European Public Concerted Action Group, 1997).[11] In the next section we will sketch the main ethical responses to the GM debate and introduced species. Hitherto, the developments at the macro-level, such as species introduction, have been discussed largely in terms of consequentialist objections. In contrast, the GM debate has in general provoked what might be called non-consequentialist concerns and objections.

5. Summing up: two views on manipulating nature

It is often said or implied that the use of introduced species, or the application of genetic engineering, is neither good nor bad in itself. This view is based on consequentialist assumptions. On it, concerns might relate to the consequences of sustaining introduced species in 'artificial' or man-made forest ecosystems; or they might be connected with the long-term impact of GM forest trees. Ethical acceptability depends on the extent to which introduced species or GM trees can be expected to add to human welfare (or more broadly: human well-being). It may be that, while the benefits of introduced species in increased productivity and thus profitability are reaped, the true costs of introducing non-native species, i.e. of manipulation at the ecosystem level, are yet to emerge. In the case of GM trees,

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[10] Here fruit bearing-trees such as orange trees, papaya and walnuts are excluded. These types of trees raise more or less the same questions about risk and utility as agricultural crops.

[11] In connection with other applications, such as medicine, modern biotechnology is considered acceptable, according to the survey (Biotechnology and the European Public Concerted Action Group, 1997).

predictions regarding the long-term ecological impacts are perilous. Increased susceptibility to storm damage, insect attacks, lack of regeneration and acidification of the soil are some of the signs of poor adaptation to the surroundings.

This view focuses on results. In a forest, decreased functionality (from a human use perspective) and lower levels of stability may affect human welfare both now and, especially, in future. A forest may be negatively affected by the use of GM trees or non-native species. However, it may also be the case that these somewhat speculative concerns cannot be backed up by substantial evidence. The possible risks have to be determined through risk analysis: before any decision as to their acceptability is made, they must be balanced against expected utility, in a broad sense of that term. For instance, where a certain level of 'natural' biodiversity was considered good, the introduction of non-native species that might oust other naturally occurring species, thereby lowering the biodiversity of a given area, would be considered morally unacceptable.

From a non-consequentialist perspective – a perspective that is almost inherently sceptical about the use of genetically modified trees and introduced species – so-called natural processes should form the basis of any intervention in the forest's natural development. When species are introduced, or when GM trees are used, existing ecological relations may be disturbed. Species introduction as well as genetic modification is unacceptable because species integrity, as non-consequentialists see the matter, is degraded. There is at least one clear sense in which genetic modification is not seen as a continuation or refinement of conventional breeding practices. Namely because it makes the insertion of genes across species boundaries possible – species which otherwise would not be able to interbreed.

Moreover, it is not sufficiently recognised that the history of an ecosystem is disrupted by introductions. However, following natural, unassisted migration, a species 'new' to an area or region in question is normally considered ethically acceptable. This process-based view might in part explain the rejection of manipulation at the species/ecosystem level. Once it is accepted, any introduction of species, any case of

so-called biological invasion where non-native species invade native ecosystems, and indeed any case of use of genetically modified trees, will give rise to (non-consequentialist) moral concern.

This concern has to been seen in the context of a formerly prevalent but now receding theory in ecology known as the balance-of-nature theory. In this theory, questioned by Peretti (1998), the concept of stability "inside" and "outside" ecosystems is an important feature. Peretti challenges what he calls "purist biological nativism" and poses an important question: "If peaceful coexistence in a multicultural society is a good goal for humans, why not for other species?"(Peretti, 1998: 190). It might be suggested that this question has an immediate answer. The evidence we have from most continents on the invasive character of introduced species suggests that peaceful coexistence among non-humans may not always be achievable (see e.g. Weidema, 2000). To some observers an international mix of species would in any case be undesirable, because it would be a step towards the global homogenisation of biodiversity and the natural environment (Mooney and Hobbs, 2000; Williamson, 1996; Cronk and Fuller, 1995). Instead of indigenous, well-adapted species we will end up with a group of omnipresent species, some of which, in deference to the past, we persist in calling alien invasive species. Each of these non-native species "becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity" (IUCN, 2000). However, according to Evans (1998:199), native-only policies can best be described as, "a thinly disguised xenophobia – a form of ecological imperialism which determines what should be 'natural' based on human preferences." This viewpoint essentially calls for a discussion about how nature should be characterised. Nature could be seen, as Peretti (1998) points out, either as consisting of closed, co-evolved communities of native species, or as systems subject to frequent migration with a cosmopolitan species composition. A conception of nature along the second of these lines ought to have various ramifications in policies on introduced species and GM trees relating to managed forests.

6. Conclusions

There are several similarities between species introduction and genetic modification. Both types of manipulation, that is to say any purposive human impact on the development of a forest, involve the introduction of new material. At the macro-level, species are introduced to an ecosystem, thereby potentially changing that ecosystem's character. At the micro-level, genes are introduced to a species genome, thereby altering that species' character. Eventually, however, any changes to the character of a species may influence the character of the ecosystem in which it lives. Hence, from an ethical point of view both kinds of introduction should be analysed as examples of the manipulation of nature.

From a non-consequentialist perspective, the *extent* of manipulation involved in species and gene introduction could be determined with reference to certain principles and rights. The question would be: which of these is violated, and how much? However, this approach may prove difficult, because it requires the relevant principles and rights to be ranked in some way. From a consequentialist perspective, on the other hand, balancing is both possible and a key issue. In this perspective, the impacts, costs and benefits, as well as risks, should be assessed, ranked and ultimately balanced – perhaps on a case-by-case basis. This, according to the consequentialist, is the only way to determine whether species or gene introduction involves the greatest degree of manipulation in any given case. In some cases, species introduction would represent a greater manipulation of nature than gene introduction. In others, the opposite would be true.

To encompass both kinds of assessment, a combined ethical approach to micro and macro-level cases is needed. It is necessary to treat the application of modern gene technology as well as modern forest and landscape management as manipulations of nature. However, it may be difficult to pinpoint where manipulation at one level begins and ends. Manipulation at one level is likely to have consequences at another level. For example, micro-level manipulation of the genome of a given species of tree, followed by the introduction of that species to a natural ecosystem, may impact at the macro-level upon the role, distribution and performance in the relevant ecosystem of

another species of tree. Consequently, there seems good reason, from an ethical perspective, to treat the use of gene technology and forest and landscape management (e.g. using introduced species) as joint problems.

However, a combined ethical perspective is not merely a question of semantics. It is not, that is to say, a mere broadening of the definitions of bioethics or environmental ethics to encompass each other. It calls for a substantial rethinking of the conventional division of bioethical and environmental ethical theory; and it requires us to apply scientific, legal and sociological approaches that have been used in bioethics to environmental ethical issues. Bioethics and environmental ethics are branches of applied ethics, i.e. the study of ethical issues that arise or might be expected to arise from real activities. Consequently, it seems reasonable to demand that they should reflect the nature of real activities and be capable of fully addressing any associated problems. If this demand is met, bioethics and environmental ethics will be able to make a significant contribution to the resolution of the real issues to which gene technology and forest and landscape management give rise. A thoroughgoing approach may, moreover, improve our understanding of any underlying value judgements.

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Beavers and biodiversity: the ethics of ecological restoration

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Abstract

This paper is about the value conflicts that lie behind ecological restoration initiatives. We focus on a case of beaver reintroduction in southern Scandinavia. We ask: what assumptions about the value of nature and biodiversity underpin nature restoration, and in particular species restoration? Beavers have been reintroduced not only to ensure their long-term survival as a species, but as agents that foster biodiversity and promote variation in the natural environment. In the paper, we show that appeals to biodiversity are made by both advocates and opponents of species restoration, but with very different results. We suggest that this is because two quite different conceptions of biodiversity are at stake. On one conception, biodiversity is constituted by certain "end-states". On the other, it is defined by a certain kind of "historical" process.

Keywords: beaver, biodiversity, *castor fiber*, ecological restoration, end states, ethics, historical process, natural, reintroduction, values.

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1. Biodiversity and ecological restoration

Ecological restoration has recently been portrayed as process capable of reversing the loss of natural biodiversity now occurring in many densely populated areas and intensively managed landscapes in Europe (Throop, 1997; Hobbs and Norton, 1996). Species restoration schemes operate throughout Europe and in parts of North America as well. For example, they have involved the lynx in Poland, and the wolf and the moose in New York State. Human subsistence activities, such as hunting and agriculture, have resulted in losses of wildlife species. Natural environments have been intensively utilized for many centuries, especially in Western Europe and parts of North America; and a high level of productivity characterizes these domesticated environments (Nash, 1989). As a result of these efforts to transform the natural environment into a highly efficient growth medium, variation is lacking and natural biodiversity has declined.

Species have died out regionally, and their opportunities to return to former haunts have been seriously limited by intensive management of the natural environment (Thomas, 1992). Moreover, man-made artifacts such as roads, towns and bridges, as well as the straightening of rivers, block the paths of migrating wildlife. New policies on the conservation of wildlife, and on the general management and protection of the natural environment, are pursued in many affluent industrialized countries. These aim to recreate and maintain the dynamics and variation of natural ecosystems (Kane, 1994; OECD, 1999). This presents new opportunities for the conservation discipline (Pickett and Parker, 1994). According to Jordan (1994), ecological restoration may well become just as important as a conservation tool as wilderness preservation.

Restoration is the attempt to reverse human impact by restoring, or returning, an ecosystem or habitat to an earlier state – its so-called 'predisturbance situation'. In this sense, it has been described as trying to turn back the environmental clock. In other words, restoration attempts to copy a specific historical structure. Certain restoration efforts are perhaps most aptly characterized not as turning back the environmental clock but 'making it tick again' (Cowell, 1993). For this reason restoration has been viewed as a variety of "creative conservation" (Sheail et al., 1997). Standard

examples of restoration practice include the elimination of introduced (i.e. technically exotic) animal or plant species, the reintroduction of formerly native species, and the large-scale alteration of entire landscapes.

However, while it is generally recognized that biodiversity has been lost, and continues to be lost (Tilman, 2000), and while it is widely acknowledged that steps must be taken to resolve this problem, experts disagree over whether ecological restoration in general, and more specifically reintroduction, are effective remedies. The issues raised by the use of restoration ecology to protect biodiversity cannot be settled solely on the basis of prudential considerations. We argue that disagreements pertaining to species reintroduction which superficially appear to be about 'factual' biological and managerial issues really stem from fundamentally different conceptions of the value nature in general and biodiversity in particular.

In the paper we will use the case of beaver reintroduction in southern Scandinavia to illuminate the philosophical issues underlying the value of biodiversity. First, we rehearse some of the main types of argument relating to the practice of ecological restoration. This is followed by a description of the case study, and by a summary of what we take to be the main positions in the ongoing debate over reintroduction of beavers. We then interpret these different positions, asking in each case how 'biodiversity' is being understood. In this way, we try to establish the causes of the disagreement. It is important to distinguish between disagreements caused by conflicting interests and disagreements caused by conflicting values. We shall focus on a special type of disagreement where there seems to be a genuine conflict of values pertaining to biodiversity. Finally, we show how the claim that biodiversity should be protected is made by several participants in the debate and taken to have remarkably different implications: the need to protect biodiversity has been invoked both in attacks on, and defenses of, reintroduction and other forms of ecological restoration.

2. Three attitudes to ecological restoration

One of the first modern and comprehensive definitions of ecological restoration was given by the Society for Ecological Restoration: "the intentional alteration of a site to establish a defined indigenous, historic ecosystem. The goal of the process is to emulate the structure, functioning, diversity and dynamism of the specified ecosystem" (Aronson et al., 1993).

Species reintroduction can be seen as a limited type of ecological restoration – a type used where a particular species is missing. According to guidelines developed by the World Conservation Union Re-introduction Specialist Group, reintroduction is an ". . . attempt to establish a species in an area which was once part of its historical range, but from which it has been extirpated or become extinct" (IUCN, 1995).[2] The overall aim of reintroduction is to establish viable, free-ranging populations in the wild of species that have become globally, or locally, extinct in the wild, and to do so with minimal commitment to long-term management. The term reestablishment is according to IUCN (1995) a synonym, but implies that the reintroduction has been successful. Sometimes, distinctions are drawn between restoration, rehabilitation and reclamation. Definitions of these terms vary, and the differences between them are often not entirely clear. Rehabilitation may defined as encompassing "a range of options which do not aim at exact fidelity to a predisturbance system" (Throop, 2000: 13). However, the functioning and species composition of a rehabilitated system may be similar to the way they once were. Reclamation, on the other hand, is a process of conversion involving radical shifts in the structure of a system.

A more recent definition of ecological restoration, adopted by the Society for Ecological Restoration in 1996, reflects a shift in the goal of restoration from establishing a historically defined ecosystem to recovering ecological integrity: "Ecological restoration is the process of assisting the recovery and management of ecological integrity. Ecological integrity includes a critical range of variability in biodiversity, ecological processes and structures, regional and historical context, and

sustainable cultural practices".[3] This more process-oriented goal undermines some of the criticisms that have been leveled at the previous definition. Instead of placing value specifically on the recovery of 'natural balance', or on the recreation of a predisturbed state, the emphasis is, perhaps more modestly, on the repair of past damage. It has been claimed that, understood in this way, ecological restoration cannot be used as readily as an argument to justify current or forthcoming degradation (Cowell, 1993).

These differing conceptions of ecological restoration have at times stirred up a rather harsh debate, especially among environmental philosophers (Woolley and McGinnis, 2000).[4] Some negative views of the so-called 'restoration thesis' are recapitulated by Elliot and Katz. The restoration thesis is the claim that any loss in the value of an area is only temporary and can in principle be compensated for later by the recreation of something of equal value. Elliot (1982) rejects this thesis and, using an analogy from the art world, describes restored areas as 'fakes'. One of his main claims is that naturalness cannot be restored if 'natural' is defined as unmodified by human activity. According to Elliot (1997) an ecosystem's value is dependent upon its history – its having evolved out of natural processes.

Katz (1992), while accepting Elliot's main view, discusses some of the limitations in the art analogy. One of his claims is that the restorationist's use of the terminology of 'repairing' ecosystems presupposes anthropocentrism and involves a fondness for technological fixes. According to Katz, restoration is part, not of the solution, but the problem of continuing human domination. Katz (2000) argues that the human intentionality is what creates the distinction between human artifacts (e.g. restored ecosystems) and natural entities. We should understand "that there is a realm of value with which we should not interfere . . . We cannot be the masters of nature, molding nature to our wishes and desires, without destroying the value of nature" (ibid:38).

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2 It may also concern a lower taxonomic unit, for example sub-species, if that can be unambiguously defined.

3 http://www.ser.org/definitions.html.

4 Examples include Mannison (1984); Elliot (1984); Katz (1991); Gunn (1991); Elliot (1994) and Katz (1996).

According to Light (1991), however, a more productive response to the problem of restoration is to distinguish between so-called 'benevolent' and 'malicious' restorations. From this more pragmatic perspective, Light argues that Elliot's case focuses on malicious restoration. Such restoration acts in effect as an excuse for the deliberate damage of the natural environment. But benevolent restoration need not be a sign of human domination, as Katz has claimed. Instead it may signify an intention to heal the relationship between human beings and nature. Moreover, Attfield (1994) asserts that our role in relation to nature is a dual one. First, we must act as preservers and restorers, because the full value of a predisturbed system can be recovered provided that an array of former species can flourish in accordance with their nature. Second, our flourishing is important as well, and it is not necessarily a sign of domination. Rolston (1994) also supports the idea of restoration as part of a relationship with nature where intervention is inevitable. He claims, in contrast with Elliot, that ecological restoration can help to salvage values, and that natural values and naturalness do return. However, he concedes that for obvious reasons historical continuity cannot be recovered. Another important point is that many ecological restoration projects do not in fact attempt to restore ecosystems that are natural in the sense implying that the systems are humanly undisturbed and spontaneous. They aim to restore ecosystems that are natural in a culturally dependent way.

In order to clarify the case study, we will distinguish between three standard attitudes to reintroduction (see Table 1).

Table 1. Three attitudes to the introduction and reintroduction of species

	Attitude		
	Wise use	Pragmatic	Respect for nature
Accepts species introduction	Yes	No	No
Accepts species reintroduction	Yes	Yes	No

The first, which we call the *wise-use* attitude, has not been prominent in this particular debate. It is rooted in Pinchotian conservationism and represents an essentially anthropocentric ethical outlook, stressing the value of nature's use. According to this position, any species can in theory be introduced, or reintroduced, depending on its associated benefits and harms. First, the foreseeable negative consequences of a proposed introduction – for example, the damage done by the reintroduced species to forests and fields – should be determined. Secondly, perceived benefit of the introduction, i.e. its use-value, should be assessed and balanced against the predictable negative consequences to decide whether introduction can be recommended. This attitude is the underlying rationale in game management, where the anthropocentric commitment is both evident and has justified the hunting of introduced species, as well as forest management and farm practices, throughout the last hundred years. Many of present arguments for ecological restoration are in essence based on this attitude.[5]

At the other end of the spectrum is an approach that might be named the *respect for nature* attitude. On this approach species introduction is opposed *a priori*.[6] Proponents of respect for nature look upon the human interference involved in restoration as yet

[5] See Throop (2000).

[6] We do not use the phrase 'respect for nature' in the way Taylor does (1986). Given respect for nature in Taylor's sense, certain principles of distributive and restitutive justice could permit reintroduction.

another sign of human domination of nature.[7] Reintroduction breaks up the historic continuity of a specific habitat or landscape. Both the reintroduction and (more seriously) the introduction of species, amount to meddling with nature, and neither can be morally justified.[8]

Thirdly, a combination of the two previous attitudes, a *pragmatic* attitude, can be discerned. Pragmatists oppose species introduction. However, they accept reintroduction, partly on wise-use grounds. In effect they apply a form of environmental impact assessment here. From the philosophical point of view, reintroductions may be of a malicious or benevolent kind.[9] On the other hand, pragmatists agree with those who demand respect for nature that species introductions are neither acceptable nor desirable, whatever benefits arise. Reintroduction is seen as an exception to otherwise standard nature conservation practices. This somewhat radical departure could, for example, be justified where it is difficult for the species in question to migrate naturally to the country.

In the following discussion, we will, as we have said, consider a real case. We shall review some of the actual reasoning attending this case and relate this to the three attitudes we have identified. Conflicts of interest are rampant in questions of reintroduction. An example would be the conflict between the interests of sports hunters and those of fish farmers. But the focus in the case study is on value conflict. True value conflicts occur when, for example, an environmentalist acknowledges intrinsic value in nature and a natural resource manager conceives of nature as only having instrumental value. The recognition of these differences in underlying value assumptions can contribute to our understanding of crucial differences in opinion regarding species restoration. Another fundamental clash is illustrated by the way

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7 See Katz (2000).

8 It important to note that those who almost never expect environmental and socio-economic costs to be met by sufficient benefits share views on species introduction and reintroduction, but for entirely different reasons. Conservative farmers and urbanites may exemplify this NIMBY (Not In My BackYard) attitude.

9 See Light (2000).

biodiversity is used as an argument. The wise-use and extreme respect for nature positions both use it, but with entirely different outcomes.

3. Case study: reintroduction of the Eurasian beaver

The Eurasian beaver (*Castor fiber*) is a semi-aquatic herbivorous rodent with webbed hind feet and a characteristic broad flat scaly tail. It is well known for constructing dams, dens and partially submerged lodges, and was once abundant in forest zones and wooded river valleys in Europe and Asia (Andersen, 2001). In the course of the last millennium, beavers have died out in many European countries. In Denmark, where our case study is located, beavers died out probably more than 2,000 years ago, in the Bronze Age (1,800 to 500 BC). With increasing cattle husbandry the prime beaver habitats, the wild meadows along small streams, were lost through the use for grazing and hay harvest (Aaris-Sørensen, 1998). Moreover, habitats were generally degraded or disappeared as a result of population increase and subsequent growth in agricultural activity. These required extensive clearing of natural woodlands. Excessive hunting also contributed to the decline (Fritzbøger, 1998). Beavers disappeared in Italy and Britain in the sixteenth century and in Sweden and Finland in the second half of the nineteenth century (Nolet and Rosell, 1998). There were only five small populations of 700 animals in total in Europe at the beginning of the twentieth century.[10] Today, bans on hunting, the establishment of wildlife sanctuaries and, since the mid-1920s, species reintroduction, have boosted the Eurasian beaver population to c.350,000 animals. Most European countries where the beaver was once native have now reintroduced animals from the few surviving populations in Europe.[11]

In Denmark a number of more or less directly involved interest groups have a stake in the beaver's reintroduction.[12] First, there is the Danish Ministry of Environment and

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10 Beaver hunting provided pelts, meat and chemical substances derived from its castor sacs that were used both for medicine and as a base aroma in perfume.

11 See for example Nolet and Baveco (1996); MacDonald (1995); MacDonald et al. (1995); Halley (1995); Mammal Society (1999).

12 The case study is based on, among other things, drafted reintroduction policies, proposed management plans, and statements from special interest groups, lot owners, and a governmental advisory council. The case is mainly based on the Danish process, but similar types of argument can be found in discussions of species reintroduction in other countries in Europe.

Energy. This ministry has supported the reintroduction plan. Secondly, there is the National Forest and Nature Agency, a government body responsible for drafting management plans, implementing these, and organizing public consultation. Thirdly, landowners, such as woodland owners and farmers, are likely to be directly affected by any plans involving reintroduction. And finally, special interest groups and nature conservation bodies represent the interests of those, among the public, who desire input to the issues affecting the natural environment.

3. 1 Reasons offered in favor of reintroducing beavers

The National Forest and Nature Agency is responsible for the beaver reintroduction scheme. It offers two major reasons why the beaver should be reintroduced (Asbirk, 1998) First, there is an international legal responsibility to consider reintroduction if the beaver is unlikely to be able to migrate naturally to part of its former range. The Eurasian beaver has a fragmented distribution across its potential range, and this is interpreted as a sign of non-favorable conservation status. Secondly, several benefits appear to arise from reintroduction. The beaver is considered a keystone species. Such as species plays a vital role in an ecosystem, for example by maintaining the diversity of the ecosystem (Gilpin, 1996). Beavers and their activities are likely to render recreational enjoyment of nature more colorful.

The legal responsibility arises from the Bern Convention. Article 11(2) of this Convention on the Conservation of European Wildlife and Natural Habitats stipulates that:

> Each Contracting Party undertakes: (a) to encourage the reintroduction of native species of wild flora and fauna when this would contribute to the conservation of an endangered species, provided that a study is first made in the light of experiences of other Contracting Parties to establish that such reintroduction would be effective and acceptable.

The beaver is listed in Appendix III of the Bern Convention, which means that appropriate and necessary legislative and administrative measures should be taken to

ensure its protection. However, this does not necessarily entail restoration in countries where it has become extinct. But in view of the biodiversity goals enshrined in the EEC Council Directive on the Conservation of Natural Habitats and Wild Fauna and Flora, a case for species restoration can be made (EEC Council Directive 92/43/EEC of 21 May 1992). Restoration should be considered with regard to species listed in annexes II and IV – that is, where the conservation status is judged "not favorable" and strict protection is needed. Implementing the provisions of this directive, member states shall, according to Article 22(a):

> Study the desirability of re-introducing species in Annex IV that are native to their territory where this might contribute to their conservation, provided that an investigation, also taking into account experience in other Member States or elsewhere, has established that such re-introduction contributes effectively to re-establishing these species at a favourable conservation status and that it takes place only after proper consultation of the public concerned.

The status of the Eurasian beaver on the global IUCN red list is not endangered but "Low risk: near threatened" (Asbirk, 1998: 15). According to the IUCN (1994) Red List categories, a taxon is Lower Risk when '. . . it has been evaluated, but does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable.' The subcategory, Near Threatened, includes taxa which '. . . do not qualify for Conservation Dependent [another subcategory in Lower Risk], but which are close to qualifying for Vulnerable.' A taxon is Vulnerable when it is '. . . facing a very high risk of extinction in the wild in the medium-term future'. Here, it is a matter of debate whether the best conservation strategy is to repopulate most of the natural range or to concentrate on certain key areas (Nolet and Rossell, 1998). It is a question of spatial scale – a question of whether to reintroduce in each of the countries in which the beaver once lived. Reintroduction is deemed necessary because it is almost impossible for the beaver to migrate naturally to certain countries in which it is absent. Sea surrounds Denmark on three sides, and the only possibility of natural migration is from the south, via Germany. However, this might prove difficult,

because all the waterways run East-West or West-East, and many man-made artefacts such as roads, towns, and dry cultivated land block the way (Asbirk, 1998).

Besides the legal reasons, a few moral arguments in favor of beaver reintroduction have been given. Most other European countries have already reintroduced the beaver during the past 80 years, and now, the government suggests, Denmark should follow suit. The Eurasian beaver is native to the country. According to the government's National Forest and Nature Agency, it has a "right" to live there (Klein, 1999b:5).

But not only does Denmark have a legal, and perhaps moral, obligation to consider reintroduction; several expected benefits are connected with the reintroduction of beavers. It is a well documented empirical fact that beavers will foster variation and stability because they are a keystone species in wetland habitats (Nolet and Rossell, 1998; Andersen, 1999). One of the main arguments put forward by the National Forest and Nature Agency is that the beaver will help to create more dynamics in nature: "It is not the beaver as a species which is the deciding factor, but the beaver as one of the most powerful driving forces in the most characteristic, original Danish nature types" (Klein, 1999a: 6, our translation).

Beavers create open areas in wet woodland and thus help to increase a diversity of light-dependent flora. Threatened insects and mushrooms dependent on dead wood (which is rarely found in modern hardwood plantations) benefit from their tree-felling activity. The beavers might also prove useful as a new, sought after game species, since relatively large numbers of people hunt for sport today. And in a broader perspective, beavers are likely to generate high quality recreational experience of nature of the kind currently in demand by the public at large in many Western European countries: "The beaver is an interesting animal that it is exciting to experience in nature. The beaver is able to habituate to boat traffic and the outdoor-life of human beings, so there are good opportunities to see or find its tracks" (Asbirk, 1998:23, our translation). In a situation where true wilderness areas characterized by natural dynamics are hard to find, other ways of making it possible for the public to enjoy so-called 'quality nature experiences' need to be considered.

The reintroduction of beavers will help to create natural dynamics and thus wilderness-like areas.

The main justification for the artificial return of beavers may be summarized as the fulfillment of legal, and to some extent moral, responsibilities; the prospect of benefits such as increased variation in nature; and the possibility of improved recreational experience of nature. According to opinion polls, animal rights groups, nature conservation groups and a substantial sector of the public at large want to "help" threatened animal species and add variation to nature (Klein, 1999b). However, while many have this general attitude, some serious reservations about reintroduction are also discernible.

3.2 Reasons offered against reintroducing beavers

Opposition to species restoration comes from several quarters. Some opponents, such as farmers and recreational fishermen, fear the environmental impacts of the beavers. Others, such as some nature conservation groups, believe that beavers will have too little impact on the landscape and call for solutions that could lead to more substantial ecological change. These groups do commend beaver reintroduction, but they think comprehensive reintroduction policies need to be thought through first. An independent government advisory council also finds that policies need to be thought trough before initiating reintroduction (Naturrådet, 1998). The council generally argues that species restoration breaks natural continuity. Let us take a closer look at these arguments.

Landowners – for example, those with farms adjacent to proposed release sites –worry that beavers will do direct or indirect damage to trees, or, by causing flooding, wreck cultivated fields and fish farms. Some woodland owners and farmers fear that beavers will change the general appearance of old cultural landscapes. Special interest groups, such as the sports anglers, are concerned that fishing will be disturbed, and oppose reintroduction of beaver. Moreover, the sports anglers want the current population beavers removed from the country (Thygesen, 2000). Even hunters, who generally welcome new game species, point out that considerable regulation might be needed,

since the beaver's main natural enemy, the wolf, is absent in most parts of Western Europe: "[W]e will not be the authorities' 'dustman' . . . we like to go hunting, but we will not be human scavengers . . . it is important that a new species gets the opportunity to act naturally"(Steinar, 1998: 8, our translation).

Nature conservation groups assert that beaver reintroduction, even if the beaver is a keystone species capable of bringing variation into ecosystems, is too limited. It will not lead to a much-needed general habitat improvement, as the blocking of drainpipes on old woodlands might. These groups question the argument that, as an ecologically important species, the beaver will be a significant generator of habitat restoration.

At a conceptual level, some conservation groups have claimed that the reintroduction of beavers by artificial means will leave no room for natural dynamics. They interpret natural dynamics as dynamics without human interference. From this it follows that the resulting dynamics created by artificially brought in beavers cannot be regarded as natural. Implicitly, of course, the non-natural is regarded as less valuable here than the natural. The claim is that non-natural migration is meddling with nature, which is presently not called for. National Nature and Forest Agency biologists have countered that, on the contrary, it is not natural that the beavers can no longer be found in the wild (Asbirk, 1999, pers. comm.) Regardless of the soundness of this viewpoint, a governmental advisory body, the Danish Nature Council, and some nature conservation groups have argued that, lacking a consistent policy, 'random' species restoration will fail to deliver a 'naturally' functioning ecosystem. Instead, a member of the Council argues, such restoration turns nature into an open zoo or theme park: "Some of us get a feeling that isn't real . . . when I see that beaver, I will think of the originator of the idea . . . if I come to the Silkeborg lake district and see a beaver swimming around, maybe even with a collar, then it is a zoo" (Stensgaard, 1998a: 3, our translation). Thus, it is stressed that historic continuity is imperative for the appreciation of beavers, for the valuing of biodiversity, and for admiring nature in general. The independent advisory government council points to the fact that for the last thirty years, habitat improvements have formed the basis of Danish conservation practices. The Council denies that species reintroduction can be justified on the

grounds that it is likely to be difficult for beavers to migrate naturally to Denmark. The fact that there is a theoretical, albeit slim, possibility that some beavers would overcome the obstacles is sufficient to show that reintroduction should be opposed.[13]

4. The ongoing debate and the three attitudes to reintroduction

From a management perspective – that is, either the wise-use or the pragmatic attitude –the ecological value of the beaver is very important. Restocking an animal such as the Eurasian beaver will not only protect a flagship species, it is argued, but enhance threatened biodiversity within the habitat. The beaver is considered part of the 'original' fauna. Its presence will, it is claimed, help to restore the ecological integrity of a natural ecosystem. This notion of an 'original' habitat type depends on an underlying value assumption. As part of a restoration scheme of the Eurasian beaver and subsequent restoration of wetland ecosystems, the reintroduction of the beaver is believed to lead to a more original habitat involving a higher level of biodiversity. This habitat is believed to be typical of the region's natural environment, i.e. the situation before human settlement and over-hunting occurred.

By contrast, from a user standpoint direct and indirect use-values, such as recreational and aesthetic values, are emphasized. It is evident that here it is not solely the protection status of the Eurasian beaver which is decisive. The beavers are reintroduced to habitats that are hardly prime beaver habitats and are in need of substantial restoration. Human presence is seen as a constant, a condition to which the beavers will have to become accustomed. At the same time beavers are treated as means to satisfy the human need, or desire, for nature-based recreational experience.

From an environmental policy perspective, it is our obligations to the international community and future generations (described above) that matter. Arguments drawing on these factors differ from justifications of reintroduction that focus on a species' instrumental value to humans. They stress the cultural and historical value of the

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[13] Unlike in, for example, the UK, where it is most unlikely that beavers will arrive by means of natural migration (MacDonald, 1995).

beaver as part of the native wildlife heritage of Europe. Moreover, many of the legal justifications rest on the assumption that beavers are granted existence-value. It is apparently this that explains why measures against threatened species should be pursued. The underlying argument seems to be that if part of nature is destroyed – in this case, if an animal species is exterminated as a result of human activity – restoration is required. This view is shared by a Danish environmental NGO called Nepenthes. A member of Nepenthes argues that restoration ecology, which admittedly differs from natural processes, can in fact help to alleviate a shared sense of moral guilt over the destruction and degradation of the natural environments: "We say, we want this and that! It is not self-created nature, but it is exciting anyway. I find it far more constructive to go out and do something, instead of sitting back being ashamed" (Stensgaard, 1998b:4, our translation).

A moral rationale for the restoration process would attach significance to the making good, or correction, of some injury – in this case, damage inflicted by us on natural ecosystems. However, it is not entirely clear who the beneficiaries of such correction are. Are they contemporary humans, or future generations, or the populations of animals and plants in the restored ecosystem?

The reintroduction of the beaver forces us to ask whether restoration of the entire species array from the period following the last ice age is called for as part of a biodiversity conservation scheme. Should wolves be reintroduced, notwithstanding the fact that, in many European countries, wolves were regarded as pests and culled less than a century ago because of the threat they posed to livestock? There is no comprehensive, clear policy on mammal and predator reintroduction and natural migration. However, when it comes to questions of reintroducing predators such as the wolf, concerns over potential harm to humans feature prominently. Likewise, the migration of wild boar to a country like Denmark, which has large exports of agricultural products, forces us to consider the risk of spreading disease to livestock animals.

The argument that restoration practices turn natural environments into zoos is expressive of the respect for nature attitude. It presupposes that the evaluation and appreciation of natural areas and the biodiversity they contain depend upon a minute knowledge of local history and ecological processes. This knowledge has been described as ". . . knowledge that can be acquired through education and experience, just as one learns the history of art" (Katz, 1991:92, cf. Elliot, 1982). Historic continuity is broken when species are restored, and in this way spontaneity and authenticity are lost, according to this view. Instead, natural restoration – natural, in the sense that it occurs without human assistance – is opted for, even if it takes decades, or perhaps centuries, for the animal in question to migrate across national borders unassisted.

It is clear from this analysis that the arguments in favor of reintroducing beavers are not purely ecological, but have underlying value assumptions. The opponents of species restoration question these assumptions and insist that the reintroduction issue cannot be settled on the basis of the instrumental value of the beaver. The value of the biodiversity the beaver might support, and the value of the landscape the beaver might shape, have to be considered carefully.

5. Values and notions of biodiversity

This last claim prompts us to ask what is meant by 'biodiversity'. It is evident from the preceding analysis of the beaver case that many types of value are at stake when species reintroduction is advocated or opposed. The values include use-values (e.g. relating to the beaver's pelt and hunting as such) and aesthetic values (e.g. relating to the 'cute' appearance of the beaver). Moreover, the ecological value of the beaver as a keystone species, its less tangible existence-value as a species, and the possible attribution of intrinsic value stressing its right to live, are also occasionally invoked.

The question is: which value counts when we are discussing species reintroduction, or more generally ecological restoration, in relation to biodiversity preservation? Are the relevant values of a non-intrinsic kind only? Such values are commonly associated

with traditional management of the natural environment and the attempt to balance (direct or indirect) benefits against costs. Or do we have to include values other than the non-intrinsic kind when deciding whether to restore? These differences in underlying value questions are reflected in different notions of biodiversity.

Ecological restoration, including species restoration, is a tool to conserve biological diversity. Its advocates appeal to a notion of biodiversity in which species richness is stressed. The conservation goal here seems to be twofold, as the case with beaver reintroduction illustrates. One goal is the conservation of the beavers as a species. This assumes that establishing beavers in their entire former range will improve their long-term conservation status. The second objective concerns the conservation of the various threatened species that depend on the variation in wetland habitats which beavers are able to create and maintain. In this second objective, the value of the beavers is instrumental and dependent on the improvement of biodiversity.

The ultimate value of biodiversity is also instrumental, however. For biodiversity is valued as a means of improving the ecosystem's integrity, stability, and resiliency. It is therefore questionable whether it is imperative that it is a former native species that performs these tasks. If the important factor is the role a species plays in maintaining biodiversity, there should be no problem in introducing some other species, provided the ecological role is the same. In relation to these issues the wise-use and pragmatic attitudes appear in effect to take the same view.

In addition to an ecological counter-argument stressing the need for a keystone species, another objection can be raised against this suggestion. Opponents of ecological restoration emphasize that the conservation of biodiversity is of importance only where it relates to the maintenance of natural processes. It is only where authenticity is preserved that the respect for nature attitude views biodiversity as valuable in itself. Thus, natural processes have to be retained as the basis for biodiversity, and historic continuity with the past must be upheld.

In effect, the advocates and antagonists of restoration invoke two quite different notions of biodiversity. One is linked to species richness and ecosystem integrity, and the other is connected with authenticity and natural processes. Advocates appeal to a notion of biodiversity stressing species richness, where the value of biodiversity is instrumental. Biodiversity is seen as a means of improving the integrity of the ecosystem integrity. Opponents refer to a notion of biodiversity linked closely with the concept of authenticity. They emphasize the importance both of retaining natural processes as the basis for biodiversity and of maintaining natural continuity. These different notions of biodiversity influence the way in which a given ecosystem or species is valued, and indeed evaluated. A conceptual framework originally developed in political philosophy might prove useful in tackling questions about how best to understand the different notions of biodiversity.

5.1 Valuing biodiversity: 'end-state principles' and 'historical principles'

In his theory of distributive justice, the political philosopher Robert Nozick (1974) distinguishes what he calls *end-state principles* from *historical principles*. According to Nozick, a social situation is fair and just, judged by end-state principles, only if it involves a distribution of goods which, irrespective of origin, displays a certain structure.[14] Thus, in order to assess whether a state of affairs concords with an end-state principle we require no information about the way this state of affairs was brought about. On historical principles, by contrast, whether a state is legitimate depends on its historical evolution, or the way it was brought about. Here information on how the given state has arisen is not just relevant but essential to a determination of justice.

This distinction can be applied to the biodiversity issue. In wise-use and (to a certain extent) pragmatic approaches to reintroduction, end-state principles focusing on structure, stability and functionality are used to determine the value of a specific ecosystem. A certain number and distribution of species will be indicative of the

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[14] Utilitarian accounts of justice make use of an end-state principle: the classical formulation treats a distribution as just if it maximizes the overall quantum of happiness. Nozick's own theory of just acquisition deploys historical principles.

functionality, stability and resiliency that is characteristic of the ecosystem. As long as this is secured, positive value can be assigned to the ecosystem and the biodiversity contained within it. In the respect for nature approach, on the other hand, end-state principles alone are insufficient to determine the value of an ecosystem, and historical principles have to be applied. Here, the value of the ecosystem depends on its history, how it came to be as it is.

Table 2 shows the relationship between these principles of evaluation and the differing conceptions of biodiversity presupposed in the wise-use and respect for nature approaches to restoration.

Table 2. Conceptions of the nature and value of biodiversity and principles of evaluation: their relationship to three attitudes to restoration

	Wise use and pragmatic attitude: restorationists	Respect for nature attitude: anti-restorationists
Conception of biodiversity	Species richness	Authenticity, natural processes
The value of biodiversity	Instrumental: adds to ecosystem integrity	Intrinsic
Principle of evaluation	End state principle: ecosystem's stability, structure and functionality	Historical principle: ecosystem's history and evolution

According to restorationists, a wet woodland habitat with reintroduced beavers and other typical, but perhaps previously endangered, faunal and floral elements should be judged against a suitable, selected reference. A reference is here understood as an ecosystem exhibiting certain structural or functional elements believed to be representative of a 'natural' ecosystem with minimal human intervention. Thus, the

habitat may be judged favorably, regardless of any breaks in historical continuity, following restoration efforts. Anti-restorationists disagree with this. Facts about how the beavers actually came to be at the site would seriously affect their evaluation of the habitat. If the beavers were introduced, or reintroduced, that habitat would not possess the same value as it would have done, had the beavers migrated to the area without direct human interference. The beavers would presumably still add to the stability and resiliency of the ecosystem in the long term. They would probably help to conserve biodiversity as well. But the historical fact that introduction, or reintroduction, once took place would for them be a critical difference. Judged by historical principles the ecosystem would be, if not worthless, then at least less valuable than an authentic ecosystem.

However, the appeal to authenticity in cases of reintroduction in domesticated environments causes problems. If domesticated environments relate to wilderness areas in the same way as domesticated animals relate to wildlife, is an authentic dog best represented by a wolf? Clearly, it is difficult to decide where the demarcation line should be drawn. There is a long tradition of heavy utilization and manipulation, for example, drainage in many post-industrial societies. Since, it is difficult, and in a European context in many cases futile, to restore an ecosystem to an early pristine or pre-settlement condition, ecological restoration is at best an exercise in approximation (Cairns, 1995).

Moreover, many species that are now considered native were introduced just a few centuries ago (Agger and Sandøe, 1998). The current paradigm in ecology has replaced the idea of a 'balance of nature' with an idea of a 'flux in nature', and this too makes it difficult to identify authenticity (Picket and Parker, 1994; Aronson et al., 1995). The distinction between 'nature' and culture has also become obscure, which again renders the notion that a habitat is authentic, or natural, or original problematic.[15] In many cases the best option seems to be to repair damage, or return an area to a former condition, and to acknowledge that this condition, being historically defined, is to some degree arbitrary.

6. Conclusions

At first glance, species reintroduction addresses biological, technical and managerial issues. Beaver reintroduction has been justified primarily on an ecological basis: that is to say, it is defended on the grounds that it restores species richness and maintains evolutionary and ecological processes. However, as this case study illustrates, basic ethical questions regarding the origin and character of nature's value bear upon these factual issues. Appeals to the powerful concept of biodiversity are made both by the advocates and opponents of restoration, but as we have seen, with significantly different results.

In our view restoration practices can be as acceptable, and in many cases as necessary, as preservation efforts or wise-use policies involving minimal intervention, say, to protect certain species. However, the main lesson from the beaver case concerns the values underlying debates about restoration. Greater awareness of these values is required if they are to be properly promoted. We suggest that a careful examination of the conflicting notions of biodiversity invoked in discussions of restoration policy and management will prove helpful in deciding whether, where and what to restore.

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[15] Compare with Light (2000), who talks about the "culture of nature".

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Economic and ecological approaches to assessing forest value in managed forests – ethical perspectives

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Abstract

In this paper, ways of assessing a forest's value are examined. With the trend towards greater integration of production and nature conservation in forestry, traditional economic approaches to assess forest value have come to be regarded as inadequate in the determination of forest policy and the setting of forest management objectives. In the last few decades other types of economic as well non-economic method to the assessment of forest value have gained a foothold. From an ecological perspective, approaches using novel concepts such as 'ecosystem health' and 'nature quality' to assess forest value in a non-economic way are being developed. The use of these approaches requires careful consideration of how nature and the natural can be understood. Moreover, to arrive at a sound and attractive account of forest value we will need to clarify how value is understood from an economic and ecological perspective. Two things are at stake. One is the attempt to capture values besides more well-defined use or utility values. The second thing is the effort to try to make these values measurable. Such clarification, and the critical discussion it requires, will help to make the process of ascribing value to a forest, and indeed good forest management, more transparent.

Keywords: forest management, nature quality, health, values, ethics, sustainability

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1. Introduction

The conservation of remaining natural biodiversity in managed forests is considered to be one of the major challenges facing Europe in the twenty-first century (Tilman, 2000). It has been claimed that the concept of sustainability will be undermined through the loss of "biological capital" if this challenge is not met (Pinchot, 2000). During the twentieth century the main aim in managed forests was to define and implement multiple-use, sustained yield forest management. Towards the end of the century, however, and under the influence of sustainability considerations, ways to balance and integrate nature conservation and economic development became a more pressing concern (Kennedy et al., 1998).

How can we assess the 'true' value of the semi-artificial, engineered or domesticated forests that occupy a large proportion of the forested area in Europe? It is often claimed that forests of high, or higher, value ought to be prioritised in management (e.g., Wedell-Neergaard, 2001), but which forests are the most valuable, and from which perspective? These forests are not managed entirely for timber production. Nor are they put wholly to other forms of sustained multiple-use, but they contain a considerable range of natural features that can be conserved.

Traditionally, purely economic types of valuation have been central to the setting of forest management objectives. Here, determinations of what is considered good or bad, or valuable or worthless, are essentially based on assessments of public and individual preferences. The preferences also inform the most common way to weigh, for example, different management alternatives (More et al., 1996). In the last few decades, in addition to direct use value new kinds of preference-based value, such as 'existence' or 'bequest' value, have been suggested in attempt to assess the 'full' or 'true' value of forest. Inclusion of such values, it is argued, should assist in reflecting concern for nature conservation issues in relation to future generations more adequately.

But outside economics, other types of valuation have gained a foothold as a result of increased emphasis on environmental and nature conservation values (Averill et al. 1998). An example is an ecological perspective on value. From an ecological point of view, two of the main concepts employed at present to assess forest value are ecosystem health and nature quality. Very crudely, the better a forest's systemic health, or the higher its nature quality, the greater is its value from the point of view of ecological assessment. Often high value is equated with being 'natural'. However, concepts such as that of the natural are sometimes defined quite loosely, especially in Europe with a high proportion of domesticated or engineered forests. Two issues are at stake here. One is what set of conditions is considered conducive to 'good' health or 'high' quality. The other issue is how to measure such conditions and subsequently assessing forest value in an adequate way.

A third way to capture the 'true' or 'full' value of the forest has come from environmental ethicists with a non-human-centred (or non-anthropocentric) ethical view. They suggest that we ought to treat nature, and therefore forests, as things that possesses intrinsic value. Only in this way, it is argued, adequate consideration is given to nature conservation issues. This approach is fundamentally different from the two approaches mentioned above, because it does not require any measurements.

The objective of the paper is to examine these views on forest value. We argue that there are two issues, which needs to be addressed, related to attempts of capturing the 'true' or 'full' value. One issue is what happens when more well-defined utility or use values are complemented by other kinds of value. Another issue is the measurement and assessment of such values. We describe typical welfare-economic and ecological conceptions of forest value. We realise that new approaches within economics have tried to accommodate ecological, and – to some extent – ethical elements. However, the intention of the paper is not to champion a single perspective. We examine some of the concepts deployed in these ecological approaches. These are concepts such as wildness,

naturalness, authenticity and originality. First, however, we need to briefly review the relation between managed forests and the concept of forest value.

2. Forest value in relation to managed forests

Forest values are relatively enduring concepts of what is good and desirable about forests, or conversely bad and undesirable (Bengtson, 1994). However, the term 'value' can be used in several distinct ways. In one sense, the value of forests relates to the functions or purposes they have in human use. For instance we speak of forests providing things of value such as timber, clean water and recreation. In another sense, values denote the scales, or standards, used for specific judgements in decision-making. They are the basis of criteria used to evaluate certain management practices. Both senses of the term 'value' are currently used.

Much of the research on forest value and its relationship to forest management and natural resource management in general has been done in North America. The bulk of this research is in good part empirical. Its aim is to identify the values, relating to forests, that are currently held by various individuals and groups with differing objectives and backgrounds (Forbes, 2000). Xu and Bengtson (1997) examined the development of the core forest values of three parties – foresters, environmentalists and news media – each of which will play an important role in public debate about the design and management of forests over the coming years. Bengtson et al. (1999) confine themselves to US national forests. Their studies show that, in the United States at least, a gradual evolution in dominant forest values has taken place over recent decades. Forest values of growing importance include amenity values and recreational values, as well as aesthetic spiritual values. All of these are seen as enhancers of human well-being (Patel et al., 1999). This is in contrast with the attitude, often taken in commercial forest management, that forests are valuable solely as a source of commodities. As a result of this evolution, differences between the public and commercial foresters over what is considered acceptable in forest management practice are pronounced. In North America, particularly, silvicultural

practices such as clear-cutting and pesticides use have now been opposed by the public (Wagner et al., 1998).

Forest values can be traced back to different ethical outlooks or belief systems. Empirical studies of US forests are carried out to try to measure the extent of public support for specific forest values and their ethical underpinnings (McFarlane and Boxall, 2000). However, as Minteer and Manning (1999) point out, the public is a very diverse group of stakeholders. According to Shindler and Cramer (1999), people's interactions with, for example, forest agencies can be measured by the extent to which the values and concerns expressed by the public are given consideration in decisions. To facilitate this measurement, different types of classification system relating forest values and environmental ethics have been developed (Manning et al., 1999). Not surprisingly, almost the whole spectrum of value concepts has been considered – including, at one extreme, strict resource use values and, at the other, for example, aesthetic values. The ethical views found in a study by Manning (2000) included human-centred (anthropocentric), life-centred (biocentric) and ecosystem-centred (ecocentric) views.

Many of these studies concern (relatively) unspoiled or untouched nature: so-called wilderness. But in a European context this focus is inappropriate, since here the (intentional and unintentional) interventions of human beings have influenced the composition and structure of nearly all forests. Substantial areas of original forest have been converted to plantations, sometimes with an intervening period of agriculture or some other use. Forest plantations seem to have gained a bad reputation (List, 2000). The claim is often made that, like industrial agriculture, industrial plantation forestry damages the natural environment (Maser, 1994). Fertilisers and herbicides, both of which potentially end up in streams and drinking water, allegedly cause this damage. But it also occurs when the soil is impoverished through the planting of non-native species that are unsuitable for the ecological conditions of the plot. Again, it occurs when habitats are destroyed (e.g., when wetlands undergo extensive drainage). In every case, there is a cost: biodiversity suffers.

Thus silviculture of the kind incorporating even-aged stands that are clear-cut and with marked unifunctionality are perhaps a moribund type of forestry. Sagoff (1992:59) poses an important question: "Why should we care about wild forests, for example, as distinct from faster-growing biotechnology-based silvicultural plantations?" Plantations have been called 'tree farms'. Perhaps it is the last hundred years of association between intensive plantation forestry and agriculture (e.g., Jacobi, 1908) that has caused this alleged difference between so-called wild forests and plantations. Aldo Leopold (1949: 259) crystallised this attitude with his distinction between 'group A' and 'group B' foresters. Group A regards the land merely as a growth medium whereas group B regards the land from a broader, ecologically sensitive point of view:

> [G]roup A is quite content to grow trees like cabbages, with cellulose as the basic forest commodity. It feels no inhibition against violence; its ideology is agronomic. Group B, on the other hand, sees forestry as fundamentally different from agronomy because it employs natural species and manages a natural environment rather creating an artificial one. Group B prefers natural reproduction on principle . . . It worries about a whole series of secondary forest functions: wildlife, recreation, watersheds, wilderness areas. To my mind, Group B feels the stirrings of an ecological conscience.

The management ideology of group A foresters lead to, in the words of one observer, plantations which are "as carefully tended as cornfields – and as ecologically sterile" (Williams, 2000:1). Another way to distinguish is between 'false' and 'genuine' forests. A 'false' forest does not necessarily apply to plantations where aesthetics and recreational use are prioritised over ecological concerns. Those who use the term 'false' forests disapprove of plantations which are presented as, or made to look like, genuine forests. Often, the term 'genuine' here refers to the type of forest once natural to the region in question.

In Denmark and in several other European countries, however, plantations have many functions and are managed according to a multiple-use regime. They are located at different points along a continuum, from so-called false forests to genuine forests, although there are of course few genuine forests, or from tree farms to managed natural environment or wild forests. It is these plantations – plantations that are variously 'artificial' or 'non-natural' – that form the main topic in what follows. (We say that this is the *main* topic because we shall also attend to semi-natural woodlands.) We shall ask: in what way is value generally being ascribed to these plantations to reflect concern for a broader range of issues than mere timber production – issues such nature conservation or aesthetic considerations?

3. An economic view on forest value

Within neo-classical welfare economics, it is generally accepted that value is based on the interaction between the valuer (a human subject) and the valued (an object). According to this line of thinking, individually held values are the basis of individual preferences, and these preferences confer value on their objects. It has been described as essentially a consumer-based theory, tracing the value of things to values which people derive while partaking of them (Goodin, 1992).

Much environmental economic research has focused on developing methods to measure, or estimate, these individually assigned values.[2] Besides private preferences, there are public preferences which can be based on a set of social norms, i.e. principles of behaviour that ought to be followed. Consistently with this economic conception of value, forest value can be thought of as consisting of different preference-based types of value. This way of looking at things is elaborated in Figure 1.

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[2] Approaches to measurement include replacement cost or opportunity cost methods, revealed preference methods such as travel cost methods or hedonic property methods where indirect proxy price variables are used, and expressed preference methods such as contingent valuation methods (see e.g. Pearce and Turner, 1990)

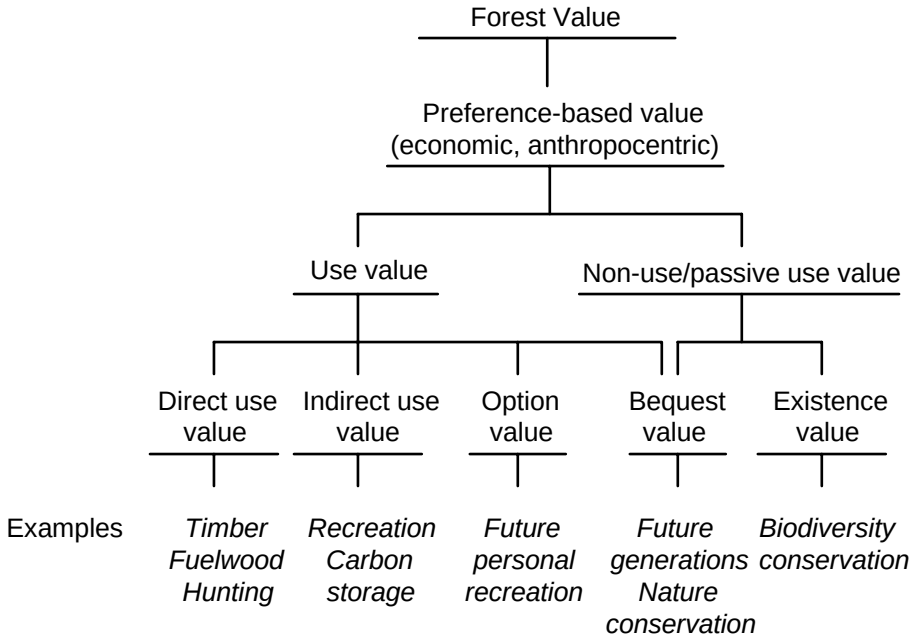

Figure 1. The varieties of forest value. The total economic value consists of secondary values, i.e. values relating to functions and services of a forest. Based on Turner et al. (1994: 112).

Direct and indirect use value, together with passive use (also known as non-use) value, make up preference-based value. Direct use values are marketable, i.e. possess a market price. Indirect use values are non-marketable, i.e. possess no market price. In some cases, the term 'indirect value' refers to what are known as *ecological functions* of the forest, such as carbon storage (Turner et al., 1994). Passive use values consider the possibility for future use. An example of a passive use value is option value. Option value represents an individual's willingness to pay to maintain the option of utilising – in a broad sense – a forest in the future. Other examples of passive use value include so-called existence and bequest value ascribed to woodland. Existence value may represent an individual's willingness to pay to ensure that some forest exists. If the willingness is

especially motivated by the desire to bequest the resource to future generations, such a value is sometimes called bequest value (Pearce, 1995). This is done well knowing that one may never in fact use the forests, and benefits accrue just from the knowledge of the existence of a forest or certain species or habitats in a particular forest.

What is the relationship between these types of value and forest management? Direct use value, such as timber revenue, was once assumed to be the main value of a forest and is often considered expressive of an anthropocentric outlook. The objective here is to maximise profit by maximising the direct use value of the forest under certain internally or externally posed restrictions. The management paradigm likely to be associated with this outlook is sustained yield. This is what the proponent of resource conservation (or to use his own terminology, 'wise-use') Gifford Pinchot (1905:10) argued: "The question is not of saving trees, for every tree must inevitably die, but of saving the forest by conservative ways of cutting the trees". Even-aged monocultures and intensive plantation forestry are typical of this management paradigm. Within it, it is considered acceptable to use pesticides, fertilisers, introduced species and specially bred plant material. Rotations are determined according to their economic value, and regeneration is most often accomplished by planting after clear-cutting.

Where both direct and indirect use value are emphasised – and so where, for example, recreation plays an important role – the likely associated management paradigm is multiple-use, sustained yield. In this paradigm wood production is normally integrated with other concerns, such as recreational objectives. These direct and indirect use values are measurable to various degrees and can be subject to trade-offs. Where managers attach more weight to passive use values such as existence value and bequest value, a management paradigm that is sensitive to sustainability considerations, in a modern sense, is likely to be applicable. The management paradigms typically found in many European countries today are probably best characterised as a combination of these three schemes. Most national forest schemes in Europe include multiple-use and sustainability objectives, even if these objectives allow of more than one interpretation.

Commonly, the values mentioned above are referred to as secondary. Secondary values are defined as the functions and services of the forest. Secondary values contrast with primary values. The latter are defined as life supporting functions. These functions and the web of interaction they constitute are sometimes referred to metaphorically as the 'glue' of the forest ecosystem. It is argued that the true economic value of the forest ought to be composed of secondary *and* primary values. It is also argued that the latter have been underestimated so far in economic valuation and ought to be reflected in connection with sustainability concerns. The idea here is that in order to obtain true economic and ecological sustainability, we need to recognise both the primary and secondary values of the forest.

The practical difference between these types of value is illustrated in the following case. Suppose an inconspicuous forest species becomes extinct. This will not be registered as a loss of secondary values unless the relevant species is either marketable as game or in some other (direct or indirect) way contributes to the services and functions of the forest. A species that is inconspicuous is not very likely to possess an existence value, and it is therefore unlikely that anyone will be willing to pay for the preservation of the species with which we are concerned. However, from an ecosystem perspective – a perspective, that is to say, in which primary values are treated as significant – the now extinct species might be recognised as having been instrumental in the life supporting functions of the forest ecosystem.

Primary and secondary values can also be invoked in a *non*-economic perspective to help explain the concept of *intrinsic* value in relation to forests. Intrinsic value is here defined broadly as the forest is seen as having value in itself, regardless of its perceived usefulness to humans.[3] From an ethical point of view, some of the so-called passive use values, such as existence value, could be seen as problematic because these values are tried to be made measurable or assessable before they are fully conceptualised, and to

some, intrinsic value is precisely non-measurable. In the following passage Maser (1996:176) outlines the consequences of the claim that the forest, as part of nature, has intrinsic value:

> Nature has only intrinsic value. Thus, each component of the forest, whether a microscopic bacterium or a towering 800-year-old tree, is therefore allowed to develop its prescribed structure, carry out its prescribed function, and interact with other components of the forest through their prescribed interrelated, interactive, interdependent processes. No component is more or less valuable than another; each may differ from the other in form, but all are complementary in function.

In contrast with this, for example, Norton (1991) states that when we value nature by supporting the preservation of plant and animal species, or even entire ecosystems, we do not need to embark on non-anthropocentric environmental ethics: it is unnecessary to posit, or recognise, intrinsic value. However, on this view a forest is also more than a mere resource. It is a source of aesthetic or spiritual gratification and a provider or a wider range of ecological services.

Another way to try to capture these forest values could be through the development indices, or ecosystem-related concepts. With these concepts we can try to characterise, and in some cases attempt to measure, forest value from an ecological perspective.

4. An ecological perspective on forest value

There are a number of relatively new ways of conceptualising forest value from an ecological perspective. Of these, we shall examine just two. The first (discussed in 4.1) makes us of the technical concept of ecosystem *health*. The second (4.2) uses the concept of nature *quality*.

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[3] For an overview on intrinsic value, see e.g. O'Neill (1992).

4.1 Forest health, the natural and naturalness

Views on how to define health in connection with forests, and therefore forest management, vary widely. From a classical perspective, sometimes called a 'utilitarian', health is defined at the level of the individual tree or stand. The definition of health closely relates to management objectives. If the management objective is to produce timber, trees that are free of pests and in other ways productive are considered healthy. Effectively, then, a forest is considered healthy where, and to the extent that, management goals are attained. It follows from this that dead tree need not to be a health problem in itself when the objectives include aims other than timber production, such as watershed management or biodiversity preservation (Kolb et al., 1994).

Drawing on a metaphor from medicine, where sick or unhealthy individuals merit treatment, it is plausible to characterise individual plants – for example, trees – as unhealthy. Here, the unhealthiness refers, perhaps, not to an abnormal situation, but situations where coexistence with other species groups, such as parasites, weakens the plant's normal physiological functions. (Precisely what counts as normal would of course need to be clarified here.) For instance, the pathogen *Ophiostoma novoulmi* adversely affects water-conduction in the vessels of the xylem, causing branch dieback, premature defoliation and, potentially, the death of the entire tree. In certain species of elm tree its presence is referred to as Dutch Elm *disease*. This is part of a metaphor, and one that is extended when research into ways to avoid the attacks is described as finding a 'cure'.

From what is sometimes called an ecosystem perspective, health is defined at the level of the ecosystem or landscape (Kohm & Franklin, 1997). Health depends not only on society's objectives vis-à-vis the forest but also on the interaction of the biotic and abiotic processes that create the basis for native species habitat. Here a healthy forest is one that maintains its complexity, structure and resilience (Kimmins, 1996; 1997). Ecosystem health has a number of advocates, and indeed its maintenance is at the core of the new trend of ecosystem forest management. Leopold (1949) included ecosystem health as a

part of his Land Ethic, which was seen as a way of reflecting a so-called ecological conscience. He defined the health of the land as "the capacity for self-renewal" (ibid.: 259). According to Leopold, conservation involves precisely the ability to maintain this capacity. As such, health is seen not so much as a static condition, but as a process of self-maintenance and regeneration (Callicott, 1992). One of the beneficial consequences of applying the concept of ecosystem health, it may be argued, is that considerations on management practices more readily become comprehensive.

A conceptual prerequisite of our talking about an unhealthy ecosystem is the notion of land as an organism. An ecosystem contains the "complexity of living organisms, their physical environment within a defined unit of space, through which matter and energy flow" (Gilpin, 1996). A problem arises when the metaphor of health originally applied to the individual organism is used of groups of species, ecosystems, or the landscape as such. The sickness of one group of species – for example, parasites – that are part of the 'land organism' can be associated with the good health of the land. However, the very existence of other species might indeed depend upon this sickness (Zeide, 2000). Furthermore, if land were regarded as an organism, any loss of species would be detrimental to the organism in the long run, and any kind of manipulation, such as introducing species, would be tantamount to an attack. It may be argued that the concept of ecosystem health makes it impossible to regard particular organisms, or groups of organisms, as undesirable or of negative value, and a problem arises over the measurement of a forest's ecosystem health (Costanza, 1992). As such, it may prove difficult to prioritise in the process of management decision making. One solution could be to distinguish between 'naturally' and 'non-naturally' occurring organisms, for example, defined in terms of whether they are introduced or not.

In this connection, and in the context of domesticated and heavily used forests in Europe, we need to ask how the notion of a *natural* habitat is to be understood. The term 'natural' is generally troublesome to use and demands clarification. Terms like 'natural' are often used in attempts to characterise valuable forests from an ecological perspective.

However, the terminology is confusing, as the following example from Gilpin (1996) shows:

> Natural forest (old-growth forest): With the dominant trees being older than a certain age, depending on the species involved, native or old-growth forest is important as it provides wildlife habitats in many areas, offers variety in the trees and the vegetation, and presents nature least affected by human activity.

'Natural forest' and 'old-growth forest' are synonymous in this passage; and the latter appears to be being used synonymously with 'native forest'. 'Natural' means something like *least affected by human activity*. If we equate the natural with old growth, many forests with no or little management – forests, that is, which are not exploited and which lack structural characteristics such as having dominant trees that are older than a certain age – will not be considered natural. This does not seem right. The confusion stems from an underlying unclarity about how to categorise ecosystems in (especially) domesticated environments. The categorisation is based mainly on biological criteria, but it also depends on some culturally determined attitudes towards the natural environment. Labels like 'natural' and 'virgin' are often used without the user realising the underlying biological and ethical implications.[4] The concepts *natural* and *nature* are some of the most difficult and ambiguous concepts to define. Attempts at definition often involve a circular argument in which terms such as 'nature', 'natural' and 'wild' are deployed in rotation. In an ecological sense, 'natural' is used to pick out vegetation and landscapes. It indicates self-sown and self-grown vegetation, uncultivated landscapes and unconstrained environmental processes. 'Natural' denotes something that exists in nature in an

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[4] "[No-one] has yet described for me the difference between that wild forest which once occupied our oldest townships, and the tame one which I find there to-day. It is a difference which would be worth attending to. The civilized man not only clears the land permanently to a great extent, and cultivates open fields, but he tames and cultivates to a certain extent the forest itself. By his mere presence, almost, he changes nature of the trees as no other creature does... It has lost its wild, damp, and shaggy look, the countless fallen and decaying trees are gone, and consequently that thick coat of moss which lived on them is gone too." (Thoreau 1864:115)

unregulated way, without control. It therefore presupposes a conception of the 'ordinary course' of nature.

In one sense (often called a wilderness sense) vegetation can be described as natural if natural factors alone are responsible for the present appearance of the vegetation in question. According to the *Merriam-Webster's Collegiate Dictionary* wilderness' is "a tract or region uncultivated and uninhabited by human beings" or "an area essentially undisturbed by human activity together with its naturally developed life community"'. In the wilderness sense, a natural environment is true to nature and original, but devoid of direct human involvement. 'Natural' is also often used to denote vegetation that has been at a specific locality from time immemorial. In this sense, the notion of 'virgin habitat' coincides with 'natural habitat'.

In another sense, natural can be explained by defining it in opposition to the urban. Given this type of definition, often called a 'rural' definition, a cultivated landscape may very well be natural.[5] In this sense, human impact is accepted as an influential factor. Normally, in a farmed landscape, the 'natural' vegetation refers to self-grown native species in for example, hedges. But annual and perennial woody crops would normally not necessarily be included as 'natural'.

The ideas of nature and the natural have evolved a good deal historically. In the ancient world, nature was conceptualised as a process or principle of development. The Latin *nascere* means 'to be born', and this points to both origin and development at the same time (Olwig, 1984). In this sense of 'natural', any state *developing* from an originally natural state will be considered natural. The ancients considered the pastoral landscape natural, although that landscape was influenced heavily by man and no longer in a primitive condition, because humans were considered as part of nature. However, in modern times, the use of 'natural' has been restricted: excluding human influence, it

[5] 'Natural' can also be defined within an urban setting to denote natural objects such as park trees as opposed to benches and pavement.

applies only to ‘original’ or pristine conditions. Hence, the wilderness interpretation of nature can be seen as modern and the rural definition can be seen as classical.

It is difficult to say what constitutes natural, as opposed to artificial, woodland. Plantations rely on natural processes regardless of occasional human interference. In the wilderness sense, natural woodland is woodland that grows without direct management or exploitation. However, this sense is virtually inapplicable, since all woodlands are the result of precarious interactions between the native vegetation, natural processes and the local people (Clark et al., 1989). Perhaps we should adopt Peterken’s view that we do not need to define the natural “any more than we need to define the precise limits of ‘close to’ in describing, say, the position of a house in relation to a church.” (1996:12) Following this suggestion, we would retain the modern meaning of natural as involving separation from people, but regard some forests as more or less natural: that is, treat natural as a continuous variable.

This approach is indeed reflected in the development of the concept of ‘naturalness’. The concept of naturalness can initially be defined as a state of ecosystem without human interference. The term ‘naturalness’ denotes somehow the result of wildness, and Anderson (1991) even considered naturalness to be ‘conservation potential’. This potential could be assessed by determining the degree to which a system would change if humans were removed from it; alternatively, and from a management point of view, one could try to determine the amount of cultural work that would be needed to fulfil the potential. More systematically, Peterken (1981) operates with five categories of naturalness. These are listed in Table 1.

Table 1. Five degrees of 'naturalness' displayed by forests

1. Original-naturalness The state that existed before people became a significant ecological factor. Thus, in Europe a forest with original-naturalness will have the species composition and structure etc it would have had c.11,000 years ago, after the last Ice Age.	*4. Potential-naturalness* What a site at present containing native species would develop into if the influence of human beings were removed and succession were accomplished in a single instant. A hypothetical test of knowledge of secondary succession with the present species array, focusing on native species.
2. *Present-naturalness* The state that would prevail now if human beings had not interfered, taking into account changes in temperature, in CO2 level, and in climate in general, and any resulting changes in soil. So present-natural forests would not be the same as the forests of, e.g. 5,000 years ago.	*5. Future-naturalness* The state that would eventually develop if the impact of human beings were zero, but allowing that other species might colonise, and that soils and climate might change, e.g. as a result of that colonisation.
3. Past-naturalness A combination of original- and present-naturalness when woods have components inherited directly from the original-natural forests.	

Source: based on Peterken (1981).

This system of classification is mainly based on management intensity: the less managed and/or the longer unmanaged a site is, the higher score of naturalness. This poses problems where intensity has fluctuated. In order to use the proposed terminology, we need to address several questions. First, how should we quantify naturalness in a forest context – that is, which characteristics ought to be included? Stand age, structure and functionality are obvious candidates, but what about stand history? Secondly, granting that it is possible to quantify degrees of naturalness, different characteristics still have to be balanced. For example, which of these has the greater degree of naturalness: a 200-year-old, non-intervention pine plantation, or a 100-year-old, self-sown managed birch

stand? In many cases, we need recourse to the term 'semi-natural'. In a European context, hardly any forest can be described as purely original-natural, although some could be described as close to original-natural. In North America, the term 'original-natural' has been used to describe woodland as it appeared before European settlements.

In many cases, faithful characterisation of a particular wood will require a combination of the various qualities of naturalness; and generally speaking, no woodland could be entirely original-natural in Europe – the human influence here has been too great. Thus, in a European context, the concept of 'nature quality' has been developed.

4. 2 Nature quality

Nature quality, as a concept, is a relatively new invention. It is an approach that can be used to "describe essential biological and geomorphological qualities of natural and semi-natural ecosystems" (Nygaard et al., 1999: 7). Synonyms seem to include 'biological quality', but it is worth pointing out that the term 'habitat quality' is narrower in its application and not used in connection with the landscape as such. *Nature* is regarded by those who use the concept of nature quality as involving not only organisms, things and substances created without human interference, but also culturally dependent ecosystems, organisms, spontaneous processes and ecological interactions (ibid.). Thus, nature is not defined exclusively in a wilderness sense but contains also elements of a classical definition. The concept of *quality* entails a process of defining and measuring – or assessing – certain, e.g. structural elements.

In order to apply the concept of nature quality in practice – in relation to forest management – Møller (1999) has set up an index based on structural indicators (see Table 2). On a somewhat crude basis, this index shows the correlation between degrees of nature quality and types of forest.

Table 2. The relationship between degree of nature quality and type of forest, with examples

Nature quality	Type of forest
*	Young, intensively managed, planted stand, for example on former agricultural land (e.g., Christmas tree plantation)
**	Even-aged, younger monoculture
***	Managed, uneven-aged, older forest composed of native tree species, preferably under a selective silvicultural system
****	Relatively untouched, semi-natural forest with structural variation, old trees and deadwood
*****	Virgin forest and large areas of old-growth forest with high variation, old trees, coarse woody debris and a history of long continuity

Source: based on Møller (1999).

Møller's index (1999) allows us to get an overview of the status of a forest in relation to the criteria of nature quality. However, preparing such an index is time consuming because it requires a full inventory. The method has also been criticised for involving subjective assessments, especially in relation to the weighing of the different elements is concerned. Apart from the more practical (and economical) problem of time consumption, the problem with assessment of elements is not the assessment in itself, but perhaps more a lack of transparency of the procedure and criteria for balancing.

Another approach has been suggested by Rune (1997). This involves the assessment of nature quality at three levels: the landscape level, the stand level and the plot level. The following are some examples of the assessments. At the first level forest edges, age distributions and wetland areas are recorded. At the second level the number of large

trees and deadwood are recorded. At the third level, biodiversity is assessed through a recording of vascular plants, fungi and so on. At each level between three and five specially adapted indices are calculated. These express selected thematic aspects of nature quality in forests, such as forest age mosaic, the presence of coarse woody debris, and the development of epiphyte growth. This approach can be used to help set management priorities for cultivated forests, but it is not designed to be used as a tool for prioritising nature protection measures at the policy level. It is a method of assessing the relative state of forest values according to specific criteria in order to document overall 'improvements' or 'aggravations' in relation to approved nature quality objectives in the forest's management. The method is, then, a specific implementation of the general concept of nature quality.

The application of the general concept of nature quality is not restricted to forests, as used by Nygaard et al. (1999) and presses into service four criteria: wildness, originality, continuity and authenticity.

Wildness is here defined as natural processes without human interference. This definition resembles the modern notion of nature described above. (The quality, then, of nature turns out to be natural!) It is, however, not entirely clear whether this includes natural processes only. In a situation in which human beings have influenced the natural ecosystems significantly, not all types of management are considered to have an adverse effect on wildness criteria. Somewhat paradoxically, the creation of wildness through planned 'natural' disturbances, such as fires, sometimes requires intervention management as a prerequisite.

An original landscape is basically one that is unchanged by human activity. But owing to natural dynamics (i.e., without direct human interference), there are always changes in species composition, soil structure and so on. Hence, when it is pushed to its logical conclusion, 'originality' can be used as a criterion of nature quality only when applied to an imagined successional stage that might have developed if human beings had not

intervened. Although forest is an original type of vegetation (or natural climax vegetation) in, for example, Denmark, a given forest needs not to be original. The originality depends on factors such as hydrology, soil, regeneration patterns and, most importantly, species composition. A plantation of an introduced, highly bred species of Christmas tree in short rotation would have limited originality, because the native species that might have been expected to be there have been replaced by another, non-native species through human intervention. In other words, an emphasis on originality is a priority where native species are concerned.

The third criterion is continuity in time and space. However, as Nygaard et al. (1999) point out, the timescale here is not the same as it was in the originality criteria. A shorter period is involved, especially on nutrient-poor, sandy soil (Dzwonko and Loster 1990). An area with long-standing continuity is not necessarily original. But continuity in time is thought to be an important prerequisite of variation and complex structure. Obviously, continuity in space requires areas that are undisturbed by human beings. During the 1980s and 1990s lists of between 500 and 1,000 continuity-indicating forest species (of both plant and animal) were elaborated for northern European forests (Rune 2001). Forest management practices such as clear-cutting, intensive soil preparation and the application of fertilisers and pesticides break continuity. In heavily domesticated landscapes such as those in Denmark, the Netherlands and the UK, forest continuity is quite limited.

The fourth criterion, authenticity, relates to what is considered ‘real’ or ‘genuine’ as opposed to ‘false’ or ‘fake’. Nature can be authentic without being original in the sense used above. Authenticity, in contrast with wildness, originality and continuity, cannot be determined through empirical surveys of degradation (or habitat loss) or through an assessment of the proportion of introduced species. The ways in which species interact are more important than the actual species themselves, and maintaining these interactive processes is the most important factor in sustaining authenticity. A man-made type of nature (for example, fields lying fallow) can be authentic if it fulfils our expectations as to origin, composition and species interaction. Reintroductions of locally extinct species

compromise authenticity because they do not conform to our expectations regarding origin. Thus authentic species must be natural migrants to an area, even if their presence, and continuing survival, is the result of human support.

In the vicinity of these four criteria of nature quality there are several terms with similar meanings.[6] *Biodiversity* can be used as another measure of forest value. A forest of high value could accordingly be defined in terms of high levels of (natural) biodiversity. Not all kinds of biodiversity are considered equally valuable (Agger and Sandøe, 1998). A given level of biodiversity in introduced species would perhaps not yield the same value as a similar level of biodiversity in indigenous species. Any use of biodiversity is likely to rest, then, on certain value judgements. As Nygaard et al. (1999) note, a high level of biodiversity is not equivalent to a high level of nature quality. Natural ecosystems with a characteristically low level of species diversity can have a high level of nature quality if they possess sufficient wildness, originality, continuity or authenticity.

As an alternative to the emphasis on forest structures and characteristics such as wildness, originality or authenticity, factors such as stability, functionality, flexibility and adaptability have been suggested to take into account when assessing forest value from an ecological perspective – although it may have economic ramifications (Larsen, 1995). A forest with a high degree of continuity may contain several organisms adapted to specific micro-habitats which themselves enter into complex interactions, and where this is so the forest is not very flexible or adaptable. From this particular ecological perspective, then, forests of great value may contain well-adapted but introduced species. A highly valued

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6 Another concept rather closely related to the concepts of ecosystem health and nature quality is *biological*, or ecological, *integrity* is. Frey (1975) proposed a definition, later amended by Karr and Dudley (1981), which runs thus: "Biological integrity is the capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organisation comparable to that of a natural habitat". Biological integrity comprises elements of both composition and process, but it focuses primarily on a system's capacity to generate diversity (Rune, 2000). The concept of *rarity* is also often brought into discussions of nature quality. In a simple way, the number of rare species found in a forest could be considered a measure of that forest's value. Likewise, the rarity of each species found could be used as an accumulative measure. However, rarity does necessarily indicate a high level of nature quality, because it is merely a matter of relative occurrence and can have many causes.

type of forest management would be flexible in response to the shifting needs and potentially different priorities of future generations. So-called nature-based silviculture is claimed to be such an approach (Emborg and Larsen, 1999). Enhanced nature quality would involve features, such as stability and flexibility, that support economic and ecological sustainability (Thorsen, 1999).

Forests with impressive nature quality may be greatly valued, but they are far from essential to sustainable development (Arler, 2000b). Ecological sustainability does not necessarily lead to a high level of nature quality, and a high level of nature quality is hardly a prerequisite for long-term sustainability.[7] However, forests with high levels of nature quality may be considered valuable, not because they are useful, but for other reasons relating to, for example, beauty, character, biodiversity, narrative content and autonomy (Arler, 2000a). The economic and ecological perspective could perhaps coincide where a preference for high levels of nature quality has been expressed.

It may seem peculiar that the concept of nature in nature quality is defined broadly to include humanly created, or dependent, ecosystems; and this may seen especially odd when the criteria address qualities primarily of humanly undisturbed ecosystems. However, some of the criteria do in fact permit the broader definition. For instance, authenticity can be applied to a gravel pit (one that we are not pretending is anything else). Moreover, an approach covering humanly created types of ecosystem recognises the role of humans in, and as a part of, nature. This need not prevent us from valuing nature with less human interference more highly than humanly disturbed nature. But problems arise because no matter how conscientiously we try to fix the originality criterion by referring to an imagined successional stage, as discussed above, we cannot

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[7] According to the Convention on Biological Diversity (1992), Article 2, sustainable use means "the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations". If this is accepted, a forest's value will be determined by its ability to maintain the potential to meet the needs of present and future generations, regardless of it's nature quality as defined by Nygaard et al. (1999).

fully characterise a baseline scenario. Reference to a past natural situation may turn out to be irrelevant, given, for example, the current climate or level of pollution.

5. Conclusions

The term 'forest value' can refer to what is good or desirable about forests. From an economic perspective, the idea of good forest management determines what a good forest is. Traditionally, good forestry has been defined as profitable forestry. Today, however, it is widely accepted that 'good' forestry may also involve optimising more than immediate profit defining values. The 'true' value of the forest seems also to be determined by other, essentially preference-based so-called non-use or passive use, values such as option or existence value. From an ecological perspective, it seems that the tables are turned: notions of a good forest determine what good forest management is. What is good is defined as what is either natural or has strong affinity to the natural, explained and measured through concepts such as ecosystem health or nature quality. Factors to consider include authenticity, wildness and naturalness. This, however, requires us to specify the type naturalness at issue. Combined, the approaches within economics and ecology may be seen as attempts to characterise and capture part of the notion of intrinsic value, espoused by certain environmental ethical theories.

To arrive at a sound and attractive account of forest value we will need to clarify how value is understood from an economic, ecological as well as ethical perspective. Two things are at stake. One is the attempt to capture value besides more well-defined use or utility value. Here, one of the problems concerns conceptualising these values. The second thing is the effort to try to make these values measurable. Here, a problem is making it clear when values are in fact estimated or assessed and not measured. Such clarification, and the critical discussion it requires, will help to make the process of ascribing value to forests, and indeed good forest management, more transparent.

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The acceptability of forest management practices: An analysis of ethical accounting and the ethical matrix

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Abstract

In this paper the feasibility of using stakeholder approaches to assess forest management practices is examined. The paper focuses on two such approaches: the idea of ethical accounting developed for livestock farming and the so-called ethical matrix. More extensive accounting is needed in forestry. The public is increasingly sensitive to, and aware of, the broader impact of forest management, not only on human welfare but also on environmental values such as nature conservation and biodiversity. Green accounting is being used to assess the environmental effects of forestry. In a broader approach such as ethical accounting as developed for livestock farming, both the purpose and the type of use that is being made of the forest must be examined. It is also necessary to ask which visible or invisible stakeholders are to be included. However, it is important to note that the adoption of stakeholder approaches does not remove the need to reflect on one's fundamental ethical position. In fact, one must critically consider one's basic values before applying these approaches to forestry.

Keywords: ethical accounting, ethical matrix, forestry, stakeholder, values

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1. Introduction

Modern forest management and forestry practices are characterised by three things in particular. First, forestry is a very long-term activity, with one rotation spanning several generations. This means that managerial alternatives must be carefully considered. Secondly, the profitability of forestry is declining. In many countries forest trees are not exactly cash crops, except perhaps where Christmas tree growing is concerned, and generally speaking non-commercial values of the forest (e.g. ecological, cultural, recreational) are emphasised in planning and management. Thirdly, in many industrialised, affluent countries of the sort found in Western Europe, the production function of a forest is not necessarily the main concern any longer. Many of the efficiency and production-orientated objectives in forestry in the industrialised part of the world have been met. However, certain costs of attaining these objectives – in, for example, habitat loss and declining natural biodiversity – have become apparent in intensively managed forests (Rune, 2001). This has caused concern among both environmentalists and the public at large (Krott, 2000; List, 2000).

Similar types of concern have been expressed about the environmental impact of pesticides and fertilisers in modern, industrial agriculture, and with regard to modern animal husbandry's effect on animal welfare (Jensen and Sørensen, 1999; Thompson, 1995). The shift, in agriculture, animal husbandry and forest management, from a focus on sufficient production levels and the price of products to concerns about animal welfare, the environment and nature conservation has been influenced by demographic changes and by people's rising levels of welfare. Moreover, there seems to be a move in the primary economic sectors, including forestry, from a shareholder-orientated approach to a broader, stakeholder approach where non-financial interests are emphasised.

Governments have reacted to the concerns mentioned above by introducing regulations favouring production systems in the primary sector that operate with more than just economic aims. Moreover, extended accounting systems intended to assess environmental impacts have been developed, sometimes involving certification

schemes. However, there also seems to be an interest in finding ways of changing management practices in order to act in way that is more 'ethically correct' – that is, to become accountable, in an ethical sense, for a broad array of concerns expressed by various stakeholders, and in this way to achieve, or sustain, stakeholder acceptability.

At present, however, it is unclear what becoming more accountable to stakeholders in an ethical sense entails. Ethically correct behaviour is unlikely to be unambiguously defined. What such behaviour requires will depend, for example, partly on the underlying values of, respectively, the producer and other stakeholders. The definition will also depend on how we interpret the notion of a 'stakeholder', since this will determine who is to be included on a list of relevant stakeholders. Stakeholders are often treated as people with an interest, not necessarily a financial interest, in a business or activity. However, we also need to know how to strike a balance between the potentially conflicting interests, needs or rights of any stakeholders we include. Here, two ways of extending accountability developed within the agricultural sector may prove useful – if they can be satisfactorily transferred to forestry.

A stakeholder-orientated approach to ethical accounting has been developed for livestock farming (Sørensen et al., 1998). This ethical type of account – which is drafted so as to complement the farmer's ordinary financial accounts and environmental account – enables the farmer to monitor the impact of management practices on selected stakeholders as part of a strategic planning process. Besides elaborating the basic values of the farmer, the account describes measures that will bring production methods and activities into line with these values. In this approach, both the livestock themselves and future human generations are treated as stakeholders. This is a novel feature and is not found in other types of ethical account (e.g. that developed by Pruzan and Thyssen, 1990).

The other ethical tool that makes use of a stakeholder approach is the so-called 'ethical matrix'. This tool facilitates analysis of the impact of different technologies or production systems on ethically relevant affected parties (Mepham, 2000). The matrix displays the affected parties in relation to key ethical principles such as well-being and

justice. In a specific case, an example is given in each cell stating what consideration of the relevant principle might entail in relation to the affected party. The matrix can be used in the course of public consultation, where it may enable us to anticipate the development of public perceptions and the likely public reaction to coming changes.

The main question to be examined is whether either of these approaches can be successfully applied in connection with forestry. Both seem likely to be useful gauges of the underlying values of the producer, that is, the forest owner or forest manager. Both will probably help us to anticipate responses to changes in management practice or to the introduction of new technology. But it is nonetheless necessary to examine the ways in which forestry differs from production systems in, for example, animal husbandry without presupposing the adaptability of the approaches. For it has been argued that, although these approaches might be suitable for assessing which practices can be viewed as involving 'ethically correct behaviour' in forestry, we need to determine their ethical foundation before they can be applied. To examine these claims, two examples of the stakeholder approach – the idea of ethical accounting as developed for livestock farming and the ethical matrix – will be characterised. In connection with each of these examples, the key concepts of extended accountability and acceptability in relation to ethical outlook will then be discussed. Finally, the applicability of ethical accounting and the ethical matrix to forestry will be examined.

2. Extending accountability

In the sense of the term at issue in the present paper 'accounting' can be seen as the preparation of a structured overview of the impact of a number of specified actions (themselves part of a more comprehensive sequence of events) upon a stated objective.

Often alternative courses of action, designed to meet the stated objective, will need to be considered. The objective will guide the weighing-up of these alternatives, or rather, the weighing-up of the numerous single actions of which they consist. The general purpose of an accounting system is to give a selected group of stakeholders accurate information which enables them to control events (Abdel-khalik, 1997).

Stakeholders have previously been understood, almost in the same way as shareholders, as persons, or groups of people, who have a personal or financial involvement – or *stake* – in a business. This interpretation is reflected in the New Oxford Dictionary of English definition of a stakeholder as a "person with an interest or concern in something, *especially a business*" (Pearsall and Hanks, 1998, emphasis added). But more often now, the term 'stakeholder' is used in contrast with 'shareholder' to stress that the interest is not necessarily financial and, in particular, not necessarily based on the possession of shares in a company. In the broader sense, a stakeholder can be seen as somebody who can affect, or be affected by, a certain action. Evidently, this increases the number of potential stakeholders that have to be taken into consideration when one is deciding on management practices.

The main task of a conventional financial account is to portray a "true and fair" view of the economic position and progress of a company (Peasnell, 1993). In this account, directors are accountable to shareholders and perhaps creditors, i.e. the de facto owners. However, as Perks (1993) points out, there are several non-exclusive ways in which accountability can be improved, besides being more effective in general. First, more companies or organisations could be accountable. Secondly, companies or organisations could be accountable to a wider group of stakeholders. Thirdly, the companies or organisations concerned could be accountable for a wider range of activities.

Environmental, or so-called green accounting is a way of extending accountability by making an organisation or company accountable both to a wider group and for a wider range of activities. Here, the shareholder approach is replaced by a stakeholder approach and affected parties become the focus. In contrast with an ordinary financial account, where money flows are accounted for, a green account measures the resource consumption and environmental impact of (say) a business or certain production activities (Schaltegger and Burrit, 2000). There seem to be two main reasons for including environmental accounting in the accounting portfolio. One is to remain cost effective in the event that product prices (e.g. those of agricultural crops or timber) go

down or markets become unstable. Another is to be able to document an environmentally friendly profile as part of a marketing strategy (Bennet and James, 1998).

Corporate social reporting is another way of extending accountability. It covers a wide variety of reporting by companies and other organisations on wider social and economic matters (Perks, 1993). The terms 'social accounting' and 'public interest accounting' are sometimes used to emphasise performance indicators other than profit margin. The information disclosed in such a report includes environmental performance, energy efficiency, fair business practices, human resources and community involvement (ibid). In the early 1970s the main focus was on statements of added value, as well as reports on employment and employee reports. In the 1980s and 1990s leading reasons for preparing these types of social account included the growing interest in ethical investment practices and increased concern about the environment. Naturally, what is regarded as ethical and un-ethical varies considerably (Perks et al., 1992).

Taking social reporting a step further, Pruzan and Thyssen (1990) have developed the idea of an ethical account. Their thesis is that, in a modern society with a plurality of values, it is not possible to identify the 'right' or 'true' set of values (Jensen et al., 1990). Decisions rest upon these values, and the way to act ethically, according to this ethical account, is to make sure that the selected types of stakeholder offer reasoned consent to these decisions (Hansen et al., 1990).

This approach is based on a discourse-based ethical foundation on which the rightness of an action is a matter of it conforming to a special type of informed agreement. On this view of things, the actual process whereby such an agreement is reached is crucial. According to Habermas' (1990) discourse ethics, morality emerges within a communication framework. In the conversation, or discourse, all who could be affected by the adoption of a certain moral action or normative claim should be included. When we make normative statements such as "we ought not to jeopardise the interests of future generations", we either tacitly assume that these norms are valid

for all people or argue to bring others to accept our view. According to Habermas, it is the communicative activity which, through discourse, leads to universally valid claims. In contrast with Rawls' (1972) contractualist theory of justice, in which it is claimed that genuinely binding moral principles are the ones any rational being could agree to, there is no "veil of ignorance" in Habermas' discourse ethics: everybody is fully aware of the others' identities, perspectives and, to some degree, intentions.

In Pruzan and Thyssen's work, the process of making an ethical account consists of three basic steps. First, stakeholders are identified. Secondly, through an "equal" dialogue with chosen stakeholders, the shared values that the company or organisation should focus on are established.[2] Thirdly, in a way that reflects these shared values, certain criteria that the company has to meet are set up (Pruzan, 1994). The important thing in this type of accounting is the process of levelling and entering a dialogue with the identified stakeholders and in this way gaining acceptance of actions and practices (Pruzan, 2000).

Does this approach have any obvious shortcomings? In forestry a great variety of stakeholders have to be considered, and some of these stakeholders will not have the capacity for speech. Moreover, Pruzan and Thyssen's ethical account does not seem to register special interests, such as those of future generations, which are not ordinarily expressible in a practical discourse. For reasons such as these, it is time we looked in earnest at ethical accounting as developed for livestock and the ethical matrix.

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[2] Certain conditions, which Habermas (1990) stated as three principles for developing these norms in a practical discourse, have to be met. First, all affected parties must accept the consequences and side effects with regard to the satisfaction of everyone's interests (with alternative possibilities in principle known). Secondly, only those norms that meet, or could meet, with the approval of all affected parties in their capacity as participants in a practical discourse can be included. Thirdly, consensus can only be achieved if the participants participate freely. Equality and freedom of participation and expression are basic notions in the discourse. More specifically, procedural rules for the ideal speech situation are set up. These include the rule that every subject with the competence to speak and act is allowed to take part in a discourse, the rule that everyone is allowed to introduce whatever assertions he or she desires and to express his or her attitudes, desires and needs, and the rule that no speaker may be prevented by coercion from exercising his or her rights.

3. Ethical accounting as developed for livestock farming and the ethical matrix

The purpose of an ethical account in the context of livestock farming is "to report on the consequences for all parties affected and ensure that the farmer makes explicit ethical priorities" (Sørensen et al., 2001:1).

The idea is to monitor the consequences of management practices and, having become aware of those consequences, to relate them to explicitly stated ethical priorities. This approach does not offer simple prescriptions, but it can be used as an advisory tool that offers elementary guidance on activities and practices. When used as part of a decision-making procedure, or in relation to a strategic planning process, the ethical account enables the farmer to improve his or her awareness of possible needs for change – for example, in a daily practice. Equally, it may alert the farmer to the need for a different balancing of concerns. An important part of the strategic planning process is the drafting of alternative plans in which different concerns are emphasised. In ethical accounting it is essential that the farmer agree to all of the ethical considerations that are needed to evaluate the alternative plans.

Contemporary interest in ethical accounts in livestock farming can be seen as a response to growing public concern about animal welfare (Jensen and Sørensen, 1999). However, animal welfare is but one of the concerns that people have about modern animal husbandry. Others are of an economic or ecological nature. By setting up an ethical account, it should be possible to combine the objective of increased animal welfare with other goals. The concern for animal welfare is an ethical concern in the sense that it is considered morally unacceptable to produce dairy products, meat and so on in a way that causes animal suffering (Jensen, 1996).

Why is it beneficial to the farmer and society at large to engage in process of ethical accounting? Jensen and Sørensen (1999) offer two main reasons. First, farmers may be motivated to adjust their management practice after being confronted with

information about how their current practice negatively affects the interests of other parties. Secondly, if farmers want to act in accordance with the ethical concerns they themselves agree to they need guidelines on assessing their current practice. As the possible changes in production methods result in changes in management objectives, it becomes necessary to determine which trade-offs have to be made if new objectives conflict with existing ones. The preparation of an ethical account is a learning process for the farmer, and one in which he or she learns to recognise the underlying value assumptions of practices and to operationalise these fundamental values (Sørensen et al., 1998).

The ethical account for livestock farming is based on a conception of ethical behaviour originating in the 'Golden Rule': always act in a way that you would like others to act towards you. The main concern is with the actual or expected consequences of one's actions upon others – the stakeholders. This contrasts with the idea of ethical accounting developed by Pruzan and Thyssen (1990). In that approach, the focus of attention is the *dialogue* with stakeholders, whereas for Sørensen et al. (2001) ethical action involves the consideration of the *effects* of one's actions on all affected parties, regardless of any actual or potential dialogue. In the latter, broadly consequentialist approach, the identification of stakeholders – including those unable to influence decisions and/or unable to voice their concerns – obviously becomes an important task.

In a Danish project piloting the ethical account for livestock farming four groups of stakeholders were identified: (1) the producer (i.e. the farmer), (2) consumers, (3) livestock, and (4) future generations. There is a greater number and a greater variety of stakeholders in this approach than there is in the approach originating from Pruzan and Thyssen (1990). Concerns relating to the natural environment and long-term biodiversity are seen as stemming from the more basic interests of present and (especially) future generations. However, because not all of the affected parties can – and nor perhaps should they – be accorded equal weight, some interests are bound to be furthered at the expense of others. In an ethical account, however, the choices involved in balancing different stakeholder interests become more transparent.

Let us turn now to the ethical matrix developed by Mepham (2000). The purpose of this matrix is to facilitate the ethical assessment of production systems: "The Matrix permits analysis of the ethical impacts of any production system (e.g. the application of a biotechnology) from the perspective of the different groups affected by its employment" (Mepham, 2000: 168). The ethical matrix is conceived of as one element in a process of decision-making following public consultation on ethically sensitive issues.

The general idea of the ethical matrix is to provide a framework for rational ethical analysis. In this framework three criteria are employed. These criteria represent an adaptation of four ethical principles – non-maleficence, beneficence, autonomy and justice – originally introduced by Beauchamp and Childress (1994) in connection with medical cases.[3] In the ethical matrix, these original principles are applied to a wider group of individuals than Beauchamp and Childress envisaged and the first two are converted into one criterion: well-being. To act in an 'ethical way', according to the ethical matrix approach, is to carefully consider the observance of the three principles in connection with chosen stakeholders.

To meet the criterion of well-being, the new technology or production system must yield quantitative and qualitative benefits to the stakeholder in question. For instance, genetically modified crops may raise the level of production or be of immediate economic benefit both to the farmer and consumers. But they may also bring benefits of other kinds: for example, by leading to healthier products, better conserved natural biodiversity or a cleaner environment. A positive effect on well-being, health and so on is a generally considered a prerequisite if the risks associated with a new technology or production system are to be accepted (Biotechnology and the European Public Concerted Action Group, 1997).

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[3] Mepham (2000) is used in the following paragraph as the main source of the idea of an ethical matrix.

To meet the criterion of autonomy, new production methods must treat affected individuals as autonomous and independent, and not just as instruments serving a technical, scientific or economic purpose. Here, the question whether this includes sentient and non-sentient animals, and plants, as well as human beings, and if so, what degree of manipulation or utilisation is to be considered an infringement of autonomy, arises. In view of this, discussion of *inter alia* how one displays respect for non-sentient living organisms will be necessary.

The principles of well-being and autonomy reflect both consequential as well as non-consequential features of production. The third criterion, of justice as fairness, requires us to ensure a just distribution of goods, on the one hand, and responsibilities or burdens, on the other. This principle is Rawlsian in nature. Mepham notes that, in an early paper, Rawls (1951) addresses the question of finding a "reasonable" decision procedure – that is to say, a procedure through which, and by "rational means of enquiry", preference can be given to one interest over another in cases where they conflict (Rawls, 1951:177, quoted in Mepham, 2000: 166). Distributional justice can be intra- or intergenerational. Some might argue that it can arise between and among species as well. It is debatable what is entailed by the concept of fairness.

The ethical matrix cannot be used to determine which kinds of technology or production system ought to be promoted and which kinds ought not. It is merely a framework that helps to ensure that the ethical aspects of production are examined in a systematic way. As such, it gives some guidance where future activity is concerned. Moreover, it may also serve as a starting point for a discussion of some of the ethical principles and concepts it deploys – for example, well-being, distributional justice and the vulnerability and integrity of natural ecosystems.

Ethical accounting for livestock farming and the ethical matrix extend accountability by expanding the range of activities to which accountability attaches and increasing the number of stakeholders to whom accountability, or at least ethical consideration, is owed. This latter notion – the key notion of a stakeholder – will be discussed at the

start of the next section. In subsections 4.1 and 4.2 the applicability of ethical accounting and the ethical matrix to forestry will be examined.

4. Ethical issues in extending accountability to forest management

In general, extending accountability over a wider group and greater range of activities presents some problems. First, who is to be included in the list of stakeholders? Secondly, are all stakeholders entitled to the same degree of consideration where their well-being (or some other valued state) is concerned?

The first question here asks who is considered an ethically relevant stakeholder. The definition of stakeholder rests on the notion of interests. To be a stakeholder, one must be able to express, or at least be capable of having, interests. This raises the further question of how broadly interests are defined. Are interests to be understood as legal rights, the having of, or capacity to have, a preference for something? Human beings can express interests and future generations seem capable of having interests although they are not able to express them. Furthermore, according to one class of ethical theories, sentient animals are also seen as being capable of having interests. This inclusion seems to be largely accepted. More debatable is the question of ascribing interest to non-sentient animals and plants or even entire ecosystems. Often, the notion of an interest is based on the possession of a nervous system. On this account it becomes difficult to talk about the interests of nature – for example, of being in one ecological state instead of another.

The second question asks whether all stakeholders are entitled to the same degree of consideration. It is often the case that some stakeholders deserve greater consideration than others. Besides the degree to which a person or group is affected by a certain action, place in the moral hierarchy also plays a significant role in determining how much consideration should be given. Traditionally, close persons or groups – in the spatio-temporal, or some other, more culturally determined, sense – are given more consideration than their more distant equivalents (Nash, 1989). In a business context, for example, an employee could well be given more consideration than a competitor.

However, differences in consideration also relate sometimes to the degree to which certain stakeholders are able to voice their concerns. Here, sentient animals as well as future generations face a problem. One way to solve this would be to designate spokespersons for these stakeholders. However, in this way the stakeholders would not be directly represented, for example, in a dialogue. Another response, which is adopted in the ethical account for livestock farming, is to introduce an assessment of the actual and expected consequences for the stakeholder. This can be done through the incorporation of, for example, different types of environmental account where enhanced accountability may be the outcome. This is clearly an improvement, but it nevertheless incorporates an interpretation of the needs and demands of, for example, future generations through the selection of criteria and indicators to be included in the sub-account.

A framework for categorising the different stakeholders provided by Rubenstein (1994) provides a useful way to look at stakeholders. Rubenstein distinguishes between "visible" and "invisible" stakeholders. Visible stakeholders, who usually have an economic interest, include so-called contractual and interdependent stakeholders. Contractual stakeholders are traditional shareholders with a direct financial or contractual interest in the company's or organisation's activities. Interdependent stakeholders include customers, employees and the government. They and the company or organisation enjoy mutual economic dependence.

Invisible stakeholders, on the other hand, have largely been recognised as having interest in the activities and practices of an organisation only during the last fifty years (Rubenstein, 1994). They can be divided into two groups: current and future generations. In many cases, the interests of these stakeholders – sometimes called survival interests – are of a non-economic nature. The stakeholders include any humans and non-humans who are more or less directly affected by an organisation's activities or management practice (e.g. because their health is at stake). Users of shared resources are also invisible stakeholders. This is worth highlighting, since shared users are especially relevant in a multiple-use forestry context. Future generations are another group of invisible stakeholders. An example of interests of

future generations in a forestry context could be equity in terms of natural resources. The existence of these stakeholders evidently depends upon our choice. Obviously, they cannot, as is the case with some stakeholders in the former group, speak for themselves. They need either a spokesperson who can speak on their behalf or to have the expected consequences of any activity that might affect them assessed.

4.1 Ethical accounting and forestry

The four groups of stakeholders identified in ethical accounting for livestock farming include both visible and invisible stakeholders. The producer, including potential shareholders or creditors, and the consumers (i.e. customers) appear in the visible group of stakeholders, whereas livestock and future generations are part of the invisible group of stakeholders.

There are notable differences between farming and forestry. A well-rehearsed difference relates to the planning, decision-making and management timescale, which is far longer in forestry. For the forest manager it is especially important to be able to judge future developments and assess whether current trends will persist or are merely the consequence of short-term politics. This is because changes, and especially reversals of earlier commitments, often cannot easily be made.

The most important difference between ethical accounting on livestock farms and in forestry may be the much greater number of diverse, visible and invisible stakeholders who benefit from the forest or are (directly or indirectly) affected in some other way by management practices. In most cases, forests, including privately owned forests, are used by many others besides the owner, his or her family, the management team and contractors. Customers, for example, emerge as quite a varied group when one takes into account the amount of so-called immaterial goods and services the forest can provide. Increasingly, customers want information about the full cost of forestry, including the cost in natural resources consumed in the process of producing timber and non-timber forest products. Environmentally aware customers are especially concerned with the forest's management performance as measured by the set of criteria for sustainable temperate forest management.

Often the forest is managed under some form of a multiple-use scheme and generates, among other things, timber, wildlife and recreational interests. Accordingly, members of the public who use a forest for recreational purposes are included in the group of invisible stakeholders. Special interest groups, such as associations of birdwatchers or nature conservation societies, require information on the size of clear cuts, the use of herbicides or the harvesting of old growth stands. These special interest groups are sometimes seen as spokespersons for other groups of invisible stakeholders, including future generations and perhaps some specific groups of animal species, such as the birds. The interests of future generations are far more salient in forestry settings as a result of the obvious fact that the mere process of growing trees normally spans several generations and is inherently, in this sense, an intergenerational activity.[4]

However, in a multiple-use forest, several interests will need to be addressed at the same time and on the same piece of land. Consequently, none of the invisible stakeholders appear on the management agenda as prominently, or straightforwardly, as farm animals do in an ethical account for a livestock farm. This may have ramifications within the selection process.

Once stakeholders have been selected, it is necessary to identify the activities for which they can legitimately demand accountability. As a result of the longer timescales in forestry, and because of the difficulties inherent in predicting the long-term, accumulated consequences of management practices on the abiotic and biotic parts of a forest ecosystem, accountability may be more elusive here than it is in livestock farming. If an ethical account in forestry is to be produced over a period of consecutive years, it is important that the statement can withstand scrutiny in, for example, twenty years; and twenty years is a relatively short period of time in a forestry context. Finally, in assessing the feasibility of ethical accounting in forestry, we need to ask what scale of forestry might be relevant.

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[4] Notable exceptions in Europe are short-rotation fuelwood coppices and Christmas tree growing.

Experiences from the Danish project piloting ethical accounting for a livestock farm have shown that the process of ethical accounting can be costly as well as time consuming, albeit rewarding for the farmer. Often, small-scale forestry is a secondary source of income, or perhaps a source of other benefits (hunting, soil protection or aesthetic pleasures), for the farmer. Where this is so, the forest is not very likely to be included in the accounting process.

Moving on to the private forest industry, which derives a substantial part of its income from large-scale forest-based operations, we may expect that ethical accounting will be relevant. However, since there is no 'correct' bottom line in this kind of account, the incentive to engage in it is probably limited.

Those involved in each of these types of forestry are likely to be more interested in meeting International Standards Organization (ISO) standards on harvesting operations. These standards can be met as part of a certification process. They form part of an environmental accounting process that is more prescriptive than the ethical account. One incentive that forestry companies have for joining a certification scheme is the likelihood that value will thereby be added to their products. Certification may indeed be a condition of being able to market and sell the timber or non-timber products at all. Larger forest corporations may be interested in showing their willingness to accept ethical accountability to a wide group of stakeholder, or to society as such. The question is whether they will engage in the certification and auditing processes, or prepare an ethical account, in the way described in the ethical account for livestock farming. It is important in the ethical account that the producer is genuinely interested in engaging in ethical thinking; but this kind of genuine interest might be hard to find in larger corporations.

If ethical accounting is to be used in forestry, it will be at the level of planning and management. By using the ethical account, the planner and manager may be better able to gauge the impact of future activities on stakeholders. It may be argued that in a planning and management context, contemplating and anticipating the impacts of practices and activities is as crucial as having one's practices certified.

4.2 The ethical matrix and forestry

The ethical matrix allows us to explore the underlying ethical aspects of new developments in forestry such as the use of genetically modified trees and the use of exotic species. In Table 1 an ethical matrix is applied to an imagined case in which genetically modified trees are used in commercial forestry.

Table 1. An ethical matrix showing the bearing of three ethical principles on five affected parties in connection with a proposal to use genetically modified trees in forestry

Affected party	Ethical principle		
	Well-being	Autonomy	Justice
Producer	Profitability and adequate working conditions	Freedom to adopt or not adopt	Fair treatment in trade and law
Consumer	Availability of wood and non-timber forest products	Choice (e.g. labelling)	Universal affordability
Society	Gross domestic product	Democratic decision-making	Fairness in global trade
Future generations	Possibilities for meeting diverse needs	Choice and democratic decision-making	Intergenerational fairness
Biota	Conservation of the biota	Maintenance of biodiversity	Natural dynamics of the biotic populations

Source: based on Mepham (2000).

The stated purposes of genetically modifying forest tree species are to improve herbicide, insect, pest, drought and cold resistance; and to change specific properties of the timber – for example, to lower the lignin content of the wood in order to reduce the need for chemicals in a wood pulping process (Mullin and Bertrand, 1998; Tømmerås et al., 1996).

The ethical matrix shown in Table 1 embodies just three ethical principles: well-being, autonomy and justice. However, other principles can of course be included. The principle of participation and openness in the decision making process, for instance, appears in an example given in BioTIK-gruppen (1999). This principle is elaborated in the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, also known as The Aarhus convention (1998). The aim of this Convention is to simplify access to environmental information and, relatedly, to improve public participation in the making of decisions that could have an impact on the environment.

The affected parties in the matrix in Table 1 are the producers, the consumers, society, future generations and the biota. The producers may be forest managers acting on behalf of forest owners. Consumers here represent, as it were, the common laws and common interests under which producers and consumers act. Future generations, as an affected party, are especially relevant in a forestry context where the production period may be well over 100 years and thus span several human generations. 'Biota' is used in this context as a collective term for all other living organisms. This contrasts with an alternative approach in which certain elements of the forest's wildlife are singled out and afforded special consideration. In an animal husbandry situation or in relation to genetic engineering involving sentient animals, the latter approach would be more appropriate.

The matrix can be used by a panel – consisting of, for example, scientific experts, members of (local) government, representatives of administrative agencies and other public bodies, representatives from private industry as well members of the public – to consult on a specific issue. In the consultation process, 'spokespersons' for each

affected party present their (so to speak) client's cases, outlining the pros and cons. Each panellist, and each member of the audience, is then given a copy of the matrix similar to the one shown in Table 1. After the presentation of the case and any ensuing discussion, participants indicate in each cell of the matrix whether they feel that the ethical principle is likely to upheld, violated or unaffected by the proposed technology, production system or practice. By collating these responses, it is possible to obtain a "verdict" – that is, a measurement of the prevailing "ethical mood" among the participants (Mepham et al., 1997).

It should be noted that the handling procedure outlined above is in a process of continuous development and generally needs to be adapted to individual cases. It must also be stressed that the ethical matrix is not a special type of opinion poll. Rather than testing the participant's untutored opinions, it is to be used in a process in which arguments and the opinions they purport to justify are tested and then developed, accepted or rejected by the participants as they see fit.

One particular thing that needs to be considered when the matrix is applied in a forestry context is whether the affected party labelled 'biota' in Table 1 should be subdivided into groups of animals. In situations where a proposed management change is likely to have a profound effect on some elements of the forest's fauna, it could be helpful to single these elements out. For example, deer might be best treated separately in connection with nature-based silviculture. Another thing that needs to be considered is whether, for example, trees or other plants should be listed as individual affected parties. For the past thirty years, discussion has taken place within environmental ethics about extended rights and moral standing (see Stone, 1974), the ascription of intrinsic value (see Attfield, 1981; Callicott, 1986) or duties (see Rolston, 1988) to non-sentient animals and plants. At the centre of this discussion is the general idea of a non-anthropocentric ethic. Over time the discussion has focused in turn on rights, intrinsic value and duties. Recently, what Johnson (1991, quoted in List, 2000) calls "well-being interests" became the topic. However, from an opposing, anthropocentric point of view it may be argued that these considerations can be captured just as well by appealing to the interests of (say) future generations.

It may seem that in principle the ethical matrix only allows for an ethical criterion's being either respected or not respected. It may be objected that in many situations there is bound to be a trade-off process, and that therefore the question concerns the extent to which an infringement of a principle is acceptable. However, in a public consultation on the marketing of genetically modified food where the ethical matrix was applied, the option of finding that the principles, or criteria, were likely to be neither "respected" nor "infringed" was available (Mepham et al., 1997). Moreover, in that consultation responses such as "not sure" and "don't know" were legitimate. A large number of neutral responses and "not sure's" might indicate that the acceptability of violations of the relevant principle or criterion depends on the degree of manipulation. If the pros and cons were introduced in a more elaborate way, the debate might be polarised, but the achievement of such polarisation is certainly not the idea behind the ethical matrix (Mepham et al., 1997).

The ethical matrix may be used to probe the acceptability of forest management practices; and it may help to guide the process of finding a more or less acceptable degree of manipulation in a forest at the overall policy level. In the European context it is often not a question of whether to manipulate or intervene, but rather of what degree of manipulation or intervention is acceptable.

5. Conclusions

The desirability of applying the ethical account as developed for livestock farming and/or the ethical matrix to assess the impact of activities and practices in forestry depends on the following factors: the main purpose of using a stakeholder orientated approach, the level of use, how prescriptive it should be, and the advantages and disadvantages of the approach. Both approaches seem to have a potential use in forestry as tools that extend accountability and help us to judge the acceptability of management practices.

In contrast with more simple prescriptive approaches, both approaches are perhaps most aptly thought of as facilitating methods. Ethical accounting and the ethical matrix are not intended to yield 'correct' answers. By comparison, environmental accounting is an extended accounting process. It is prescriptive and operates with minimum standards. The two kinds of approach must be seen as complementary rather than as alternatives, because they work on different levels. The ethical account developed for livestock farming and the ethical matrix can be used to create more transparency in the decision-making process, whether at the planning and management level or at the political level. Each of these approaches offers a way of preparing for the future. Each examines the likely effects of, for example, potential changes in management practice with regard to stakeholders.

If these methods are to be used in forest management, the many types of ownership, multiple-use management objectives and the variety of functions of a forest will require careful consideration. In a specific case, these matters need to be resolved before an ethical account can be constructed. Moreover, it has to be recognised that the combination of the large number of (visible and invisible) stakeholders in a forestry context and the fact that a forest has many diverse values makes stakeholder-based approaches both more attractive *and* more difficult to apply. The discourse-based ethical account developed by Pruzan and Thyssen (1990) only operates with visible stakeholders – that is, with people who are plainly in a position to influence the corporation or organisation. The ethical account developed for livestock farming includes invisible stakeholders as well, and the ethical matrix makes possible the inclusion of invisible stakeholders as affected parties. However, while these reflections about purpose and level of use are necessary they are, as yet, inconclusive.

Most importantly, in determining the advantages and disadvantages, as well as the main purpose, of these approaches, an ethical attitude has to be chosen *before* the approach itself. The choice of ethically relevant stakeholders depends on one's ethical attitude and the choice of ethically relevant principles to incorporate in the ethical matrix depends on one's preferred ethical platform. Moreover, whether one favours an approach to 'ethically correct' behaviour in which ethical consequences are

emphasised – as opposed, for example, to a discourse ethical approach – also depends on ethical outlook. As tools that may assist us in acting in an 'ethical way', the ethical account and the ethical matrix certainly should not be regarded as a panaceas. Critical consideration of one's basic ethical outlook and underlying values is still necessary before these approaches can be used in connection with forestry.

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Appendix 1

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Appendix 2

Total list of references

Title		Abbreviation
Synopsis	:	(SYNO)
Bæredygtighed – økonomi, etik og energi	:	(BÆRE)
'Back to nature' – a sustainable future for forestry?	:	(BACK)
Designer trees, exotic species and the ethics of manipulating nature	:	(DESI)
Beavers and biodiversity: the ethics of ecological restoration	:	(BEAV)
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