Summary

The subject of the dissertation *Biodiversity. Science, Culture, Ethics* is humans' relation to and interpretation of biological diversity. The dissertation consists of two parts. The first part examines the concept of 'biodiversity' and the various ways the diversities of life have been ordered and classified. The second part examines the values and meanings attached to biological diversity and its components. The two parts are interrelated to the extent that the various orderings reflect the interests and values, which humans attach to biological diversity itself as well as to its components.

The basic question in part one is how humans order and theoretically deal with biological variety. Some kind classification or systematisation will be necessary in order to get an overview of the diversity. But how is it done? Obviously, there are a number of ways in which organisms differ from each other. Not all of them are equally interesting, however, nor equally interesting to everybody. The first question is which of the differences have been considered so remarkable that systematic traditions have been build upon them. The second question is whether the choice of differences and the systems that emerge around them can be regarded as universal in any sense.

The first chapter deals with a debate, which has taken place among ethnobiologists over the latest decades, about the possibility of identifying universal features in pre-scientific folk taxonomies. The conclusion of the chapter is that there are reasons to believe that there are certain universal features, particularly the hierarchical organisation focusing primarily on morphological characters, although some reservations need to be made for cultures without a written language. The presence of the morphological hierarchy suggests a cultural awareness of the diversity organisms that goes beyond utility and cultural significance.

The hierarchy of folk taxonomy can also be found in the writings of the earliest natural historian, Aristotle, one of the main figures in chapter 2, which deals with antique taxonomies. This chapter analyses the systematic efforts of the most important antique naturalists: beside Aristotle, these are Theophrastus,

Dioscorides, and Pliny, who together dominated natural history right up to the 17th and 18th centuries. It is shown how the earliest theorists of natural history use a number of classifications. Apart from the hierarchy based on morphological and physiological characters, one may be called ecological-functional, one is geographic, one is based on utility, one – the so-called scale of nature – is based on qualitative features, and one focuses on various features of cultural significance. To this is added Plato's principle of bipartition, which has had a considerable influence on biological systematics.

All these varying kinds of systematic orderings have later been used by natural historians. This is shown in the following chapters. The subject of chapter 3 is some of the changes in systematics, which take place in natural history from the emergence of printed herbals at the end of 15th century up to the dawn of evolutionary theory in the beginning of 19th century. The early herbals were primarily, although never exclusively, focused on medical utility, mainly inspired by Dioscorides. During the 16th and 17th centuries a number of other interests became more and more important, particularly gardening, flower painting, and an enhanced interest in the organisms themselves, partly due to the growing number of organism brought in from overseas. These new interests influenced the way botanical books were organised, resulting in the use of other kinds of organising principles. Utility principles related to medical interest is supplemented with those of gardening interest. Most significant, however, is the return to the hierarchical principles originating from folk taxonomy, culminating in the Linnaean system from mid-18th century.

Chapter 4 is devoted to the controversies, which occur in modern systematics and taxonomy in the wake of Darwinian evolutionary theory and Darwin's own hints about taxonomy. The three main traditions – evolutionary, numeric, and cladistic – are presented, and the strengths and weaknesses identified. The chapter stresses the pragmatic elements involved; elements which together with the different scientific purposes determine the choice of taxonomic principles. Each school has advantages in certain respect, and they are all "natural" in the sense that they reflect actual relations. The differences come out of the fact that the schools have their primary focus on different relations.

In chapter 5 two alternative or supplementary types of classification are examined, both of which can be found originally by Theophrastus and later on highlighted particularly by Alexander von Humboldt and later on by Eugen Warming and Christen Raunkiær. The first of these is the physiognomic or functional classification of organisms as 'life forms' or 'vegetation form,' i.e., a kind of classification which is based on convergent or analogous characters rather than on homologous and genealogical traits. I trace the origin and analyse the meaning and uses of some of the basic concepts: 'life form,''guild,' 'functional group,' and 'niche.' The second kind of alternative or supplementary classification is based on geographical, i.e. climatic and edaphic characteristics as well as on physiognomic, phytosociological and floristic features. It orders

organisms in vegetations, formations, associations, habitats, or ecosystems. In the chapter various attempts to classify are presented, and some of the basic controversies are discussed. The pragmatic component in the selection of organising principles is stressed again.

Chapter 6 with the controversial qualitative scale of organismic features, the *scala naturae*, which was introduced by Aristotle (on the basis of folk understanding), and which has been extremely influential. Some of the earlier versions of the scale are mentioned, before Lamarck's attempt is analysed in more detail. The analysis of Lamarck's points is used as a stepping stone to the presentation of modern attempts to interpret the scale. It is argued that the use of the scale makes sense when based on some version of autonomy.

The species level is without comparison the categorial level, which attracts most attention in the debate on biodiversity. The species concept is the subject of chapter 7. An obvious question is whether species are simply cultural constructs, which vary considerably between cultures and over time, or whether there is some universally accepted set of principles, which make it possible to determine the extension of each species objectively. In chapter 7 I discuss a number of attempts to define species. All of them identify some important aspect, but none is capable of covering all aspects. Some kind of pluralism is needed. The chapter ends with a discussion of two alternative suggestions about how to deal with this pluralism.

The final chapter of part I, chapter 8, is about some of the various ways biodiversity is measured. These measures are diverse themselves for a number of reasons. Firstly, they are made for different purposes: ranking in relation to conservation priority decisions, registration of changes over time, as well as various scientific purposes like the testing of ecological hypotheses. Secondly, diversity can be measured on different scales: local, regional, national and global. Thirdly, some measures are within-habitat measures whereas others are between-habitat measures. Fourthly, some measures include calculations related to the taxic divergence of species, whereas others simply count numbers. Fifthly, some measures focus on functional or structural features, whereas others don't. Sixthly, some measures are direct, whereas others are meant to be complementary. Seventhly, some measures take distributions and relative numbers of organisms into account; others don't. Further divergencies could be added.

The large number of measures that can be used makes it unclear when it is biodiversity itself that is measured and when it is only an indicator of biodiversity. The very concept of biodiversity is slippery, difficult to catch, and even more difficult to measure in an appropriate way. Other kinds of measures and indicators are therefore often used. Some of these are discussed: hot spots, key-, umbrella-, and flagship species. The chapter ends with a discussion of some cognate – alternative or complementary – goals that has been formulated in relation to conservation: ecosystem health, biological integrity, and naturalness.

The second part of the dissertation is devoted to the question why biodiversity is worth preserving. It presents and discusses the various reasons, which have been put forward in defence of biodiversity, as well as the different values that are attached to biological diversity and its components. Part II begins with a chapter on the ethical or moral status of humans. Various versions of five basic arguing strategies are presented, all of which conclude that humans do have a special moral status. The first strategy uses religious arguments. The second one focuses on power relations. In the third one 'mutuality' is the key word. The fourth one talks about faculties of particular moral relevance. The fifth one argues along teleological or perfectionist lines, making the recognition of a special moral status of humans depend on their ability to create products of higher quality than other organisms – as well as on their ability to hold back and take moral responsibility for the protection of other species. Thus, even if humans do have a special status, this cannot be used as an argument for an unconditional right to exploit fellow creatures.

The subject of the following chapters is the various values related to biodiversity and its components. These values are seen as lying on an uninterrupted spectrum from self-centred utility to different kinds of values that imply some kind of distance to human satisfaction. The basic question is how far each value brings us, if it is transformed to an argument in defence of biodiversity.

Chapter 10 focuses on utility. Direct utility of organisms is separated into *general utility*, where a high degree of substitutability is possible, and *specific utility*, where it is not. It is argued that even when specific utility is considered, direct utility does not take us very far in terms of the number of species used. Indirect utility is a stronger argument, but it is not altogether clear, how far it takes us. The problem of redundancy is discussed, and it is concluded that utility may not be as strong an argument as defenders of biodiversity would prefer – unless indirect utility is needed in the protection of valuable features that are not directly related to utility.

Which kinds of values are these non-utility features related to? In chapters 11 and 12 various activities, practices or traditions are presented, which concentrate on certain non-utility features of the components of biodiversity – organisms and nature types – and where diversity itself plays a significant part. The first kind of practice is the development of gardens. Apart from the utility garden three kinds of gardens are separated: the delight-garden, the ornamental garden, and the encyclopaedic botanical garden. Even though several gardens unite the three basic types, the values related to each type can be separated. In the delight-garden human well-being is the main goal. The ornamental garden is more decentred in the sense that care for human needs become secondary to the care for the ornamental organisms themselves. This decenteredness is even more apparent in the botanical garden as a garden devoted to a decentred interest in organismic diversity. The development of the botanical gardens in Copenhagen, as reflected in the writings of some of the central figures, is taken as

an example of the changing values and goals related to the collection of a diversity of organisms. A similar change is evident in the development of natural history collections and museums which is considered in the second part of chapter 11.

A third kind of practice is the subject of chapter 12. Travels to areas of high biological diversity or to areas of divergent diversity have been a practice of biologists and other kinds of naturalists at least from the second half of the 17th century. In this chapter a number of significant travel accounts are analysed in order to identify the values involved: from Hans Sloane, Linnaeus and his disciples, over the spokesmen of the picturesque, Banks, Forster and von Humboldt, Schouw and Warming, Darwin and Wallace to John Muir. The analysis shows that a number of different values are in work. Apart from utility and power, which are the dominant, though not exclusive interests related to the earliest travels, various kinds of aesthetic values are involved – including the beautiful, the sublime, and the picturesque – together with different kinds of scientific interest. Some of these are actually developed in relation to the travels, as is the case with biogeography, ecology, and evolutionary theory.

In the following chapters 13 and 14 the non-utility values involved in the practises concerned with biodiversity are scrutinized further. I concentrate on the three most important types of values: aesthetic value, identification value, and scientific or philosophical value. Once again the analysis starts with values, which at least appear to be fairly egocentric, and ends with values that are more obviously distanced to the satisfaction of immediate physical human needs.

Aesthetic value is often interpreted as yet another subject for human interest, leading to more well-being. In chapter 13 this interpretation is dismissed on the basis of the same reasons that Kant used against it. Aesthetic value should not be confused with amenity or pleasantness, nor with recreative value. These are values that are exclusively related to the well-being of humans. Aesthetic value, on the other hand, is basically a disinterested interest, i.e., it presupposes the ability of the observer to distance him- or herself from self-related needs. Beauty may be considered as the main aesthetic value. Various interpretations of beauty in relation to organisms are discussed, some of which broaden the spectrum of beautiful organisms considerable. Subsequently, other aesthetic values are introduced, which may be helpful in defending the preservation of a diversity of species.

In the second part of the chapter the focus shifts from organisms to landscapes and nature types. It begins with references to various classical authors' emphasize on variety within and between areas as a basic component in positive aesthetic experiences of landscapes. Then some basic landscape aesthetic categories – atmosphere, character, spirit or mood – are introduced in relation to the theories of Hirschfeld, Carus, Böhme, and Seel. The intersubjectivity of atmospheres is underlined. Several authors have argued that true aesthetic appreciation of organisms and landscapes depends on scientific understanding. How-

ever, even though it is recommendable to move beyond "aesthetic egoism," to use Kant's phrase, and avoid misinterpretations of the subject at hand, there is never just one correct understanding, nor is there a direct road from scientific understanding to aesthetic appreciation.

Chapter 14 is devoted to other kinds of non-utility values that have been related to biological diversity: identification value, scientific value, and transformative value. Identification value is an obvious feature in relation to the most advanced organisms, placed on top of the scale of nature. Amongst humans there can be friendships based on mutual understanding, and sympathy is possible to have in relation to all sentient beings. But how about the rest of the living world? The chapter examines various attempts to identify an identification value that covers all living beings: Schopenhauer's idea of the will of life uniting all living creatures, Schweitzer's universal reverence for life, Wilson's biophilia and Hoffmeyer's biosemiotics. It is argued that even though it may be reasonable to talk about a universal identification value, on which another kind of disinterested interest can be based, it obviously has to be scaled.

Scientific value has been related to utility value at least since Francis Bacon. However, even Bacon himself admits that the purpose of science goes beyond that of utility. In the second part of chapter 14 statements from a number of scientists on the various purposes of the scientific study of the diversity of organisms are discussed. It is argued that scientific value can be a strong argument in favour of the preservation of biodiversity, as long as it is conceived as the basis of a disinterested interest. The chapter ends with a discussion of the kind of value that Bryan Norton has called "transformative," i.e., the value related to the positive transformation of human beings and their preferences. Norton is seen as a representative of a tradition, which is particularly strong in America, and particularly related to the experience of wilderness. It is argued, however, that the focus on transformative value does not bring any new arguments forward in the defence of biodiversity that are not already covered by other non-utility values.

The assumption that humans do have a special moral status compared to that of other species has not been challenged in the chapters 10 to 14, although the assertion of disinterested interests makes this assumption less important. In chapter 15, however, the assumption itself is confronted, as various various theorists are introduced, who argue against considering humans as morally particular in one or more senses. The key concept is 'intrinsic value.' The chapter begins with some methodological considerations, using Rawls' theory of reflective equilibrium as the starting point. Then various versions of 'intrinsic value' are presented and discussed. It is argued that only an extension of Kant's idea of transcendental worth can bring forward arguments about obligations, which are not already covered by the disinterested interests presented in chapters 13 and 14. However, the problem with transcendental worth is that it excludes all kinds of qualitative considerations like those leading to the scale of nature. Accep-

tance of an extended intrinsic value in the Kantian sense leads to biospherical egalitarism, but this is not a reasonable option, not even in Taylor's version, where human beings are allowed a large scope of freedom.

The final chapter focuses on the question of democratic decision making in relation to prioritising biodiversity. Two analytical distinctions are presented. The first one distinguishes three separate reasons for democratic decision making: self-determination, co-determination, and respect for arguments. The second one separates three kinds of goods: the exchangeable, the critical, and the unique goods. It is argued that respect for (public) arguments is an important democratic value, which any protection of biodiversity will be depending on. Appeals to private preferences are less likely to be successful.

This thesis has been accepted by the Faculties of Engineering, Science and Medicine at Aalborg University for public defence in fulfilment of the requirements for the doctoral degree in science. The defence will take place in lecture room B, Kroghstræde on Friday, March 27, 2009 at 1.00 p.m. punctually.

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