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NATURALNESS IN BIOLOGICAL CONSERVATION

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ABSTRACT. Conservation scientists are arguing whether naturalness provides a reasonable "imperative" for conservation. To clarify this debate and the interpretation of the term "natural," I analyze three management strategies – ecosystem preservation, ecosystem restoration, and ecosystem engineering – with respect to the naturalness of their outcomes. This analysis consists in two parts. First, the ambiguous term "natural" is defined in a variety of ways, including (1) naturalness as that which is part of nature, (2) naturalness as a contrast to artifactuality, (3) naturalness as an historical independence from human actions, and (4) naturalness as possession of certain properties. After that, I analyze the different conceptions with respect to their implications for the three management strategies. The main conclusion is that there exists no single conception of naturalness that could distinguish between the outcomes of the three management methods. Therefore, as long as the outcomes of the different methods are regarded as being of a different value in conservation, we should either abandon the idea of naturalness as the guiding concept in conservation or use the term "natural" only in the ways that take both its historical and feature dependent meanings into consideration.

KEY WORDS: conservation, ecosystem engineering, naturalness, preservation, restoration, unnaturalness

1. INTRODUCTION

We are constantly convinced about the importance of biological conservation. As a result of pervasive human activities, species become extinct, ecosystems and ecosystem types are lost, and the remaining populations and species are loosing their diversity. Bioscientists, bioethicists, and environmentalists commonly agree that conservation and management are needed. The current situation is so alarming that we cannot just close our eyes and let things happen; something needs to be done.[1] However, consensus seems

[1] There are objections even to this view. Advocates of the Wise Use Movement (WUM) want to expand the use of nature. They seek unrestricted access to all natural resources for economic use, benefit, and profit. Their agenda includes open access to mineral and oil resources in all wilderness areas and national parks, logging of all US old-growth forests, and amendment of the Endangered Species Act to exclude "non-adaptive" species and those "species lacking the vigor to spread in range" (Grumbine, 1994b).

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to end here. The methods and exact objectives of biological conservation are the subject of heated debate. Among other things, scientists are arguing about the role of naturalness. Some claim that naturalness provides a reasonable and fundamental "imperative" for conservation and management (Anderson, 1991; Hunter, 1996; Angermeir, 2000). Others are unwilling to accept that naturalness and unnaturalness should have anything to do with conservation ideals (Comer, 1997; Haila, 1997; Povilitis, 2001). Yet, setting clear and agreed upon goals is crucial for the success of biological conservation (Grumbine, 1994a).

The debate over naturalness concerns the fundamental values and goals of biological conservation and, thus, the role given to naturalness has important implications for how conservation is practiced (Grumbine, 1994a). If naturalness will be accepted as the ultimate goal of conservation, it will provide a standard by which to judge the permissibility of ecosystem alteration and appropriateness of conservation efforts. According to Angermeier (2000), the standard implies, for example, that natural disturbance regimes should be used as essential models for how timber harvests should be carried out. Nevertheless, naturalness as the fundamental goal of biological conservation does not imply that all other conservation goals and concepts should be abandoned. Quite the contrary, naturalness may be seen as a foundation for many conservation imperatives such as diversity, integrity, evolution, and ecosystem function (Angermeier, 2000).

The debate over the role of naturalness includes numerous different analyses about the terms natural and unnatural (see, for example, Elliot, 1982; Hunter, 1996; Katz, 1997a; Oelschlaeger, 1999) and there have been several attempts to form a framework for quantifying naturalness (see, for example, Anderson, 1991; Angermeier, 2000; Banko, 2001; Zechmeister et al., 2002; Madsen et al., 2003). However, the term natural is highly ambiguous and numerous different morally relevant and irrelevant interpretations of it can be found (see, for example, Radcliffe, 1984; Matthews, 1988; Williams, 1982). In this paper, I will analyze four different forms of naturalness: (1) naturalness as that which is part of nature; (2) naturalness as a contrast of artifactuality; (3) naturalness as an historical independence from human actions; and (4) naturalness as a possession of certain properties.[2] The four forms of naturalness have additional subcategories. I will

[2] The four forms of naturalness are not reducible to each other or to any single conception of naturalness. The four forms of naturalness do not cover all meanings of the term "natural." Outside their realm there exist multiple forms of naturalness such as naturalness as functional normality (Wachbroit, 1994), naturalness as familiarity (Radcliffe, 1984) and naturalness as adequate need satisfaction (Matthews, 1988). These forms of naturalness, however, go beyond biological conservation and the scope of this paper.

argue that since these conceptions of naturalness concentrate solely either on history or on current features of entities, they are not compatible with the practices and intuitions behind selection of conservation strategies. The issue is especially urgent with respect of the methods of ecosystem preservation, restoration, and engineering. Thus, if we are willing to use naturalness as a criterion in ecosystem conservation, we need to either change our views about the desirability of the three conservation strategies or define naturalness on a way that acknowledges its double meaning as a historical as well as a feature dependent concept. The focus of the paper is in ecosystems. Nevertheless, most of the considerations are applicable to other levels of biological hierarchy too.

2. THREE MANAGEMENT METHODS

2.1. *Ecosystem Preservation*

Biological conservation can be carried out in various ways. I will analyze the methods of ecosystem preservation, ecosystem restoration, and ecosystem engineering and define them in a way that they will basically cover all possible conservation activities. These three methods are ideal in a sense that it is uncertain whether pure forms of any of them can be carried out in practice. Ideal preservation seems impossible, because even after the preservation procedure has been carried out, people continue to indirectly (and often unintentionally) affect the area. This happens through pollutants, climate change, and modification of adjacent sites. Moreover, scientists lack the knowledge (about ecosystem composition, structures, and functions) that would make perfect restoration possible in all cases. This is also true about most types of intentional ecosystem engineering. In any case, the real management strategies are often some modified variants or mixtures of the ideal methods.[3]

As the meaning of the term "preserve" implies (Merriam-Webster Dictionary, 2003), the goal of ecosystem preservation is to keep the preserved ecosystem alive, intact, free from decay, and safe from destruction. In practice, reaching these goals may require activities such as fire management, but in its ideal sense, ecosystem preservation has the following two forms. First, preservation may mean that an ecosystem or an area is – as far as possible – protected from disturbing human influences. The area is left to develop in its own way. For example, primeval forests have been preserved by totally prohibiting logging and by maximally preventing all human

[3] Most of my arguments would work well also with non-ideal real world cases. Nevertheless, the use of ideal terms clarifies the arguments.

caused changes in them. Second, preservation may mean a ban on changes in types of land use. For example, the preservation of old grasslands and pastures has been carried out by management that restricts their use to certain types of traditional grazing. Human impact is not prevented but strictly limited in order to maintain traditional types of cultural ecosystems. The basic idea behind both types of preservation is to save the ecosystem – not necessarily in its current static state, but as a dynamic evolving entity.

2.2. *Ecosystem Restoration*

Unlike ecosystem preservation, ecosystem restoration aims at making certain changes to the current state of the managed ecosystem or site. "Ecosystem restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed" (SER, 2002). In other words, the objective is to return disturbed or even destroyed ecosystems back to earlier conditions with regard to their composition, structure, and function. Restoration means recreating a functioning self-regulating ecosystem that is integrated with the ecological landscape in which it occurs and similar to the ecosystem type that was in the site before human caused changes (Angermeier and Karr, 1994; Higgs, 1997). The restoration procedures may vary greatly from ecosystem "building" to restoration of extirpated species and elimination of introduced exotic species. A common feature of all ecosystem restoration is that a specific earlier state of the site or the ecosystem is seen as ideal and that humans intentionally modify the ecosystem in order to return it to that state (Cowell, 1993). Ecosystem restoration has been used for ecosystem management after mining operations, highly degraded pasture, and logging (Cairns, 1988; Uhl, 1988).

2.3. *Ecosystem Engineering*

The third ideal conservation method is ecosystem engineering. "Ecological engineering is the design of sustainable ecosystems that integrate human society with its natural environment for the benefit of both. It involves the design, construction, and management of ecosystems that have value to both humans and environment" (Odum, 2003). By ecosystem engineering, I understand all intentional ecosystem modification where the objective is not to recreate some earlier state of the ecosystem. The aim of ecosystem engineering may be to create a site that is physically different from all ecosystems developed through natural evolution. Typical examples include different kinds of gardens, commercial fields and pastures, as well as the outcomes of desert farming projects and bioshelters connected to them (Todd, 1988). In extreme cases, ecosystem engineering might involve methods like genetic engineering and chimera creation. As Paul Angermeier (1994) points out through these kinds of procedures, we could conceivably manufacture a world even more biologically diverse and variable than the one derived through evolutionary processes.[4]

However, ecosystem engineering also includes less extreme activities. Ecosystem engineering may mean the intentional creation of an ecosystem that is physically very similar to some naturally evolved ecosystem where this type of an ecosystem has not existed in the site before. An artificial lake is an example of this kind of an engineered ecosystem. Its composition, structure and functions may be very similar to the ones of a lake that has evolved without human interference. Moreover, ecosystem engineering may be carried out by modifications of already existing ecosystems. For example, a new species – the Texas panther – has been intentionally added to the ecosystem of the southern Florida to increase the genetic diversity of Florida panther – the keystone species of the area. By hybridizing with Florida panthers, a healthier and more fecund hybrid panther population will grow and expand to fill the available remnant habitat, and therefore continue to act as a keystone predator in this ecosystem. It has been stated that without this intervention the extinction of the Florida panther would have threatened the whole ecosystem (Bowen, 1999).

Ecosystem engineering is different from preservation and similar to restoration in that it involves the active and intentional human modification of the managed area. However, engineered ecosystems differ from both the preserved and the restored ones in a sense that their features are not similar to ecosystems that have existed in the site before. Their features are invented and designed by human beings.

2.4. *Three Methods and Naturalness*

It may seem that the methods are listed here in order of the naturalness of their outcomes. According to this line of thought, ecosystem preservation is the best – or even the only – method for maintaining the naturalness of the conserved ecosystem. Outcomes of restoration are less natural than preserved ecosystems. Yet, they are not as unnatural as outcomes of ecosystem engineering, which are the least natural ones. It might further be claimed that the differences in naturalness form the basis for determining the acceptability and desirability of the methods. The unnaturalness of the outcomes of ecosystem engineering can be considered a prime reason as to why it cannot be

[4] As the anonymous referee pointed out, it may be that Angermeier's point is valid only if all existing biodiversity would be maintained and GMOs could be simply added on top of that.

accepted as a single major method of ecosystem management.[5] Similarly, because of the naturalness of its outcomes, preservation is the most commonly and easily accepted of the three methods. The value of ecosystem restoration has been widely discussed. Many conservation scientists find it desirable (Cairns, 1988; Jordan, 1988), but others (Elliot, 1982; Katz, 1997a) are skeptical about the value of restored ecosystems.

The claim about the correlation between naturalness and the desirability of the methods can be questioned in at least two different ways. First, it might be claimed that the naturalness of an ecosystem is never a sensible objective for biological conservation in the first place. Therefore, it is not judicious to try to explain the differences in the acceptability of the methods by referring to the naturalness of their outcomes. A second possible objection is that the intuition about the naturalness of the outcomes of the methods is misguided. Even though naturalness may offer a sensible criterion, the common intuition about differences in naturalness of the three conservation methods is mistaken. It is not true that the preserved ecosystems are always simply and plainly the most natural and engineered ecosystems the most unnatural ones. I will focus on the second objective by analyzing the different meanings of the term natural and their implications for "naturalness" of the outcomes of the three methods. First, however, I will briefly examine the first objection.

3. HUMAN BEINGS AS PART OF NATURE

The most common argument against accepting naturalness as an objective for biological conservation is that human beings are part of nature.[6] This conception of naturalness was first clearly stated by John Stuart Mill (1969) in his 19th century work titled "On Nature." According to Mill's line of thought, human beings as well as *all* their actions and *all* the outcomes of those actions are part of nature and in that sense natural. Outcomes of different conservation activities make no difference in this respect; they are equally natural (and as natural as any other parts of nature). Even if the value of outcomes of

[5] This does not imply that ecosystem engineering could not indirectly help to gain objectives of ecosystem conservation. As William Burley (1988) notes, small well-managed plantations can take much of the pressure off natural forests in timber production. Similarly ecosystem engineering may serve conservation in other levels of biological hierarchy. Species diversity can for example be preserved in botanical gardens, which are actually engineered ecosystems.

[6] As an anonymous referee pointed out, the sensibility of this statement presupposes that it is somehow justified to draw a distinction between humanity and nature. For history of the views about relationship between human and nature see Williams, 1982.

different management strategies may differ, this is not due to the differences in their naturalness (Callicott et al., 2000). As Baird Callicott (1996) writes, ''[w]e are part of nature, so [for example] our recent habit of recycling sequestered carbon may be biologically unique, but it is not unnatural.''

Mill and Callicott argue from the fact that human beings (and their actions and outcomes of those actions) are natural in a sense of being part of nature to the claim that it is not sensible to try to compare any two entities with respect to their naturalness. Everything that exists is similarly part of nature and therefore the naturalness of entities cannot be sensibly compared.[7] Of course, this also applies to the project of comparing the naturalness of outcomes of different conservation methods. Since outcomes are equally natural, the project is not sensible.

Mill and his advocates are, of course, right in their claim that the human species is a product of nature's evolution and, in that sense, part of nature. Our basic physical features have developed via gene-based evolutionary processes and are thus similar or close to features of many other species. Many of our action types are genetically based and in that sense determined by evolution. All our actions and their outcomes seem to be natural also in another sense. No human action or product of human action can break laws of nature. Everything we do or produce is natural in a sense that it happens within limits of natural laws.

Nevertheless, the argument for equal naturalness is not convincing. Even though ''being part of nature'' is a relevant and meaningful interpretation of the term ''natural,'' it is not the only meaning of it. The view of human beings as part of nature would make all comparisons of naturalness absurd only if term ''natural'' were unambiguous. Only if expression ''being part of nature'' were the only meaning of the term ''natural,'' any comparison of naturalness would be a senseless project. The view of human beings as part of nature does not necessarily imply that whatever humans do or produce is natural in all senses that are important to biological conservation. Even if we admitted that human beings are natural in the preceding sense, it is still possible for us to argue that, in some other sense, products of human activities can be more or less natural or unnatural (see, for example,

[7] It is common to argue against this view by claiming that humans are cultural as well as biological beings. According to this line of thought, existence of human culture allows us to extend our actions beyond our biology and, thus, we are distinct from nature. Human beings are not just a species among others but a special case, something outside the nature's realm (Oelschlaeger, 1999; Angermeier, 2000). I am not sure whether this objection is convincing. As Gary Snyder (1990) argues, human culture can also be seen as product of evolutionary processes and, thus, its existence does not necessarily exclude the view of human species, human actions and products of human actions as part of nature.

Verhoog et al., 2003). Our natural origin does not make all our actions and outcomes of our actions natural in all different senses of the term.

The sensibility of the naturalness discussion has also been questioned by noting that horrible things happen in nature. Nature contains torture, violence, pain, and suffering. Thus, naturalness should not be taken as moral ideal (see, for example, Midgley, 1995). This objection can be answered similarly to the one referring to humans as part of nature. The term "natural" is ambiguous and even though the presented form of naturalness – that is naturalness as all that happens in nature – is certainly irrelevant to morality, other forms of naturalness may still be morally noteworthy.

However, every discussion on morality of naturalness must acknowledge the wide misuse the term. It is common that people label as unnatural things and ways of action they do not like and that they find odd, foreign, and uncommon. This seems to happen especially in the sphere of sexual ethics where homosexuality, *in vitro* fertilization, and birth control, for example, have been condemned as unnatural by some people. This way of using the term unnatural is, of course, morally irrelevant. Not everything uncommon and foreign is morally suspicious and commonness and familiarity does not guarantee moral desirability (Räikkä and Rossi, 2003; Radcliffe, 1984). Thus, in order for an argument from naturalness to be convincing, it must include an analysis of the term "natural."

4. NATURAL AND ARTIFICIAL

4.1. *Conception of Artifacts*

Naturalness is often regarded as being the opposite of artificial; things are divided into artifacts and non-artifacts. This distinction is compatible with the claim that human beings are part of nature and in that sense natural. Our being a part of nature does not exclude the possibility of sensibly dividing things into artifacts and non-artifacts (Christensen et al., 1996). However, can the distinction between artifacts and non-artifacts (or naturally born entities) explain our intuitions about acceptability of the different management strategies? In order to answer this question, the term "artifact" needs to be clarified.

Artifacts differ from other entities with respect to their histories. History of any artifact involves intentional human made modifications. Moreover, every artifact has been intentionally brought into existence by human beings[8] (Hilpinen, 1995; Lee, 2003). However, neither of these two facts

[8] According to Aristotle, the difference between artifacts and other entities is based on how they have become into existence. Some entities exist by their nature and some from other causes. Some entities existing from other causes are artifacts (Aristotle, Physics II 192b9-33).

alone forms a sufficient condition for an object to be an artifact. Interhuman relationships may be the intended products of human action, but it would be misleading to consider them artifacts (Katz, 1997b). Similarly, the intentional modification of an entity does not necessarily turn it into an artifact. For example a skier, who intentionally adds a ski track to a forest by skiing through it, does not turn the forest into an artifact. Neither is the sufficient condition for being an artifact found by simply combining these two conditions. Human infants are often intentionally brought into existence. Other people also intentionally modify them through activities like teaching and feeding. Nevertheless, infants are not artifacts. The more sophisticated combination of the two historical conditions, however, helps to clarify the distinction between artifacts and non-artifacts.

(C) An entity x is an artifact if x has been intentionally brought into existence by intentionally causing the coming artifact x to have certain properties.

According to C, the intentional modification of the coming artifact is always closely and necessarily tied in the process of bringing about existence[9] of that artifact. Bringing about the existence of an artifact consists of causing that future artifact to have certain properties. In other words, the intentional modification of properties of the coming artifact is how that artifact is brought into existence. For example, by carving the wood a carpenter modifies the properties of the coming chair and thus also brings about its existence. As this example shows, bringing about the existence of an artifact and causing that coming artifact to have certain properties are actually not two separate activities but a single procedure to which both descriptions can be sensibly given. Artifacts are brought into existence by causing those coming artifacts to have certain properties. Similarly same action can be described as turning on the light and as flipping the switch and we may say that lights are turned on by flipping the switch (Davidson, 1980).

However, the condition C alone does not sufficiently separate between artifacts and non-artifacts. According to it, a victim intentionally turned into a cripple by intentionally shooting him/her into a knee, may be an artifact. This is the case, if the shooter has intentionally brought about existence of a cripple by intentionally causing the victim to have a lame leg. Thus, in addition to C, another condition is needed.

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[9] The term "bring about the existence of x" is problematic since nothing is ever brought into existence entirely by human beings. There is always something out of which it is produced. In the case of ecosystems, further problems are caused by the on going change that is typical to all living entities (Jax et al., 1998). For further discussion on issue see Hilpinen (1993), Jax et al. (1998), and Siipi (2003).

(F) An entity x is an artifact if causing x to have certain properties has led x to have some designed functions.

Condition F captures the fact that having designed functions is necessary for being an artifact (for this view see for example Brennan, 1984; Varner, 1990; Lee, 1999; Ruse, 2003). Having a designed function implies that the entity is used or can be used for fulfilling some human goals and purposes. Moreover, in order for the functions to be *designed*, the entity needs to have acquired them through the same intentional human made modification by which it was brought into existence in the first place. The entity with designed functions has an ability to fulfill purposes that are the reason for its existence as a kind of being it is. It has been brought into existence in order for it to fulfill some human goals (Brennan, 1984; Lee, 1999). This is true about all artifacts, even though it is also true that artifacts usually have more in them than what their creators intended. Artifacts are usually not *just* function fulfilling tools (Vogel, 2003).

The double condition C of F can be applied to biotic elements and some of them clearly fulfill it. According to the combination of C and F, ecosystems like gardens and modern commercial fields are artifacts. Their history involves modifications (additions and extractions of different species) by which their existence was brought about. Moreover, they have designed functions such as food production. Nevertheless, not all human-related biotic elements are artifacts. The double condition excludes from the sphere of artifacts all biotic elements that have been modified by human beings but not brought into existence by them. Many commercially exploited but "naturally" evolved forests, for example, belong to this group of non-artifacts. Moreover, human infants that have been intentionally brought about and also intentionally modified by other people do not fulfill the conditions set by C and F. In their case the modification and the bringing about of their existence are two separate activities. The procedures are not reducible to each other and neither is the existence brought about by modification.

4.2. *Three Conservation Methods and Artifactuality*

Do the outcomes of the three conservation strategies differ with regard to the status of being artifacts? An ecosystem conserved by any of the presented methods – preservation, restoration, and engineering – may be an artifact or non-artifact. The possibility of being an artifact is partly due to the fact that not only non-engineered ecosystems – like old-growth forests – are objects of the various management methods. Also ecosystems that have originally been brought into existence by the intentional modification for certain purpose are often conserved. In other words, cultural ecosystems that are already artifacts are sometimes the objects of ecosystem preservation. Old fruit and rose gardens, for example, have been preserved in order to maintain the biotic diversity typical of them.

The three methods, however, differ in respect of whether their use can turn a non-artificial ecosystem into an artifact. The preservation of an ecosystem does not cause changes in its status as an artifact or a non-artifact. This is due to the fact that ideal preservation does not include any kind of ecosystem modification. Ecosystem restoration and engineering, on the other hand, can turn ecosystems into artifacts.

Suppose a non-artificial ecosystem – for example a forest – is totally destroyed by a mining company. As a result of its activities, almost all flora, fauna, and typical ecological functions of the forest disappear from the site. After the mining operation, the site is perfectly restored. It is now in all relevant respects physically identical to the original forest ecosystem. This restored forest is an artifact. It was brought into existence by intentionally modifying properties of the coming forest. The fact that the original evolutionally evolved ecosystem is used as a model is not important to the status of the site. The restored ecosystem is not the original forest but a human made copy of it. Moreover, the restored ecosystem has a designed function. A conservationist restoring an ecosystem is not motivated by the pleasure of the restoration activity alone. Rather, s/he usually has an explicit reason for wanting to have an ecosystem of a certain type and the function of the restored ecosystem is revealed from that reason. Sometimes the reason can be rather vague; in the case of the restored forest, the designed function may be something like "contributing to local and global biodiversity and providing ecosystem services." However, even then the reason for bringing a certain type of an ecosystem into existence is based on benefits its existence may confer. Those benefits are the function of the restored ecosystem.

Nevertheless, not all restored ecosystems are artifacts. Whether or not a restored ecosystem is an artifact depends on the site's status before and after the restoration operation. If the restored site has not been destroyed but "only damaged," it does not need to be re-created but only modified to return to its former and "healthier" state. In this case, the restoration operation has not turned the ecosystem into an artifact. The ecosystem has been intentionally modified, but not brought into existence, by human beings.

The same is true of ecosystem engineering. Consider the above example, in which Texas panthers were introduced to southern Florida's ecosystem. This engineering procedure does not turn the southern Florida ecosystem into an artifact. The ecosystem has been modified, but it has not been produced by these modifications and thus the modification has not turned it into an artifact. However, it is also easy to imagine cases where strong intentional ecosystem modification results in the creation of an ecosystem that did not exist in the site when the engineering procedure began. In such cases, as long as the produced ecosystem has designed functions, the ecosystem should be regarded as an artifact.

The distinction between artifacts and non-artifacts only partly explains our common intuitions about differences in the naturalness of the outcomes of the different management strategies. All three methods can be used to manage non-artificial as well as artificial ecosystems. Moreover, even if preservation efforts can never turn a site into an artifact, the other two methods do not differ from each other in this respect. Both can cause an ecosystem to become an artifact, but both can also be used in such ways that a site retains its non-artificial status.

5. INDEPENDENCE FROM HUMAN BEINGS

5.1. *Naturalness as a Continuous Gradient*

It might be suggested that the distinction between artifacts and non-artifacts is not really in the interests of conservationists. Even a strongly managed ecosystem may fail to be an artifact. What conservationists seek is some deeper and more sensitive independence from human involvement.

The term "natural" is often used to refer to entities that are not human and distinguished from humanity. Naturalness is regarded as being an opposite to everything that is human produced, modified by humans, or in any sense defined by the order of humanity (Soper, 1995). Mere human modification – without causing existence – is sufficient for this kind of unnaturalness. It might be suggested that this kind of naturalness is the objective of conservation, and that the three methods differ from each other in this respect. This suggestion is not incompatible with the view of human beings as part of nature. Even if humans, their actions, and the products of their actions are part of nature, we can still value ecosystems that are independent of us and natural in that sense. A human being is a species capable of making choices. We can make conscious choices as to whether or not we will be active parts of certain ecosystems, and sometimes non-interference is most highly valued.

However, the suggestion that naturalness in the sense of independence from human beings should be accepted as a goal of conservation efforts can still be objected to. It might be claimed that all current ecosystems – as well as outcomes of all three management methods – are indifferent with respect to this kind of naturalness. According to this line of thought, no current ecosystem is really natural. Practically every area on earth has been affected by human activities. Most ecosystems have experienced some direct human interference and presumably all the rest of them have been affected by entities such as pollutants and climate change (Christensen et al., 1996). Since no area independent from human activities really exists, there is no point in proposing this kind of naturalness as an objective for biological conservation nor in comparing the outcomes of different management methods in this respect.[10]

The objection can be answered by claiming, following Angermeier, that naturalness is not an all-or-nothing affair but a continuous gradient:

> Naturalness, the degree to which a thing is natural, is represented by a continuous gradient between extremes of entirely natural and entirely artificial [or unnatural]. The extremes are only abstractions. Entirely natural areas no longer exist, but some areas clearly are more natural than others (e.g. an unplowed prairie versus cattle pasture versus shopping mall) (Angermeier, 2000).

Even if no area is (any longer) natural in the sense of being totally independent of humans, some places are more natural than others. Total naturalness is an abstract state at the end of a continuum and some ecosystems are closer to that ideal than others. Similarly, even if no management strategy can produce totally natural ecosystems, products of some strategies can be more natural, closer to the ideal naturalness, than the products of others (Verhoog et al., 2003). Total unnaturalness is also an abstraction. Even the ecosystems we consider most unnatural retain some naturalness (Snyder, 1990). Angermeier (2000) gives the example of intensively managed Iowa cornfields. Their compositions are totally produced by human, but many soil properties and the vast majority of corn genes are natural.

5.2. *Naturalness as a Degree of Interference*

However, the expression "more independent from humans" is ambiguous and it is not clear how two ecosystems could be compared in this respect. One method could be to measure the ecosystem's degree of independence from humans by determining the amount of time and effort and the types of actions human beings have used for influencing the ecosystem. The more time and effort and the more interfering types of actions were used for ecosystem modification, the less natural would the ecosystem be.

Even setting aside the difficulties related to giving measures to the degree of interference of different types of actions, this kind of interpretation is unsatisfactory. The same type of human activity, for example species introduction, may – depending on factors such as time, the species to be

[10] Bill McKibben discusses the issue in his book "End of Nature."

introduced, and the type of ecosystem – cause very different changes. Sometimes, albeit rarely, the only effect of species introduction is the existence of an extra plant or animal in the ecosystem. Yet, sometimes an introduced species through competition, predation, and the transmission of diseases drives some local population into extinction and thereby causes dramatic changes in the composition, structure, and functions of the ecosystem.[11] (Angermeier, 1994; Perlman and Adelson, 1997.)

Moreover, naturalness as a degree of human interference cannot explain the intuition about the differences in desirability of the three management strategies. This form of naturalness does separate ecosystem preservation from the other two methods, but ecosystem restoration and engineering are often indifferent in this respect. Some engineered ecosystems, such as gardens and commercial fields, require constant and direct intervention in order to remain their current ecosystem type. These engineered ecosystems differ in fundamental ways from restored ecosystems, in which human intervention ideally decreases or even disappears after the restoration operation has been carried out. However, not all restored and engineered ecosystems differ with regard to permanence and periodicity of human intervention. As pointed out in subsection ''ecosystem engineering,'' ecosystem engineering may also mean intentional creation of an ecosystem – for example an artificial lake – that is very similar to some naturally evolved ecosystem that has not previously existed in the area. Moreover, ecosystem engineering may consist of an introduction of a single new species to a naturally evolved ecosystem. In such cases there exists no difference in currency, directness, permanency, and periodicity of ecosystem restoration and engineering. Both restoration and engineering can be carried out by similar methods, for example, by species introduction or species destruction, and both can include any amount of human time and effort. Therefore, for the rest of this paper, the focus is shifted from human actions to the products of those actions. Instead of evaluating human actions, I will concentrate on their effects.

The expression ''more independent from humans'' can be interpreted as referring to the number of changes caused to the ecosystem by human activities. According to this line of thought, the more change processes human beings have brought about in the ecosystem, the less natural it is (Anderson, 1991). This conception of naturalness is different from the

[11] The rabbits in Australia offer a fine example of a species introduction that causes major changes in an ecosystem. An opposite case is the (unintentional) introduction of La China (*Impatiens wallerana*) in Costa Rican rain forests. La China grows among widespread, weedy, second growth plants and it seems that the only change its introduction has brought about is the existence of the extra plant in the rainforest (Perlman and Adelson, 1997).

preceding one and also different from the conception based on artificiality. The focus of interest is now purely on human caused ecological change processes that have happened in the history of the ecosystem. The interest is not in the amount or quality of human action itself, nor purely in the current properties of the ecosystem. What we are interested in, are the amount and quality of change processes.

This conception of naturalness runs into the same problem as the preceding ones. According to it, preserved ecosystems differ considerably from ecosystems managed by restoration or engineering. However, since both ecosystem restoration and ecosystem engineering can involve any number of changes to be caused to the ecosystem, their outcomes, according to this conception, can also be equally natural or unnatural. The problem is actually common to all historical conceptions of naturalness – that is conceptions referring to happenings in the history of ecosystems. Since the method of preservation does not ideally bring about any (ecological) changes in the managed ecosystem, its outcomes are, according to all historical conceptions of naturalness, more natural than outcomes of the other two methods. On the other hand, because the histories of restored and engineered ecosystems do not necessarily differ in any respect, *all* conceptions referring to happening in the history of an ecosystem are unsatisfactory for analyzing differences in their naturalness. However, as Nicole Karafyllis (2003) points out, the term "natural" has also non-historical meanings. The term "natural" can refer to the structure and state of an entity. Can the solution be found from these non-historical, feature-dependent conceptions of naturalness?

6. FEATURE-DEPENDENT CONCEPTIONS

6.1. *Comparison to Ideal Ecosystems*

In the context of feature-dependent conceptions, the evaluation of the naturalness of an ecosystem is always based on some kind of a comparison. In order to find out whether some ecosystem is more or less natural, its current physical (non-historical) properties and features need to be compared with the physical properties and features of some ideally natural ecosystem.[12] The more the current physical properties and features resemble the physical features and properties of the ideal ecosystem, the more natural

[12] The idea of comparison has offered a strong reason for preservation of wild ecosystems. Ecosystem management requires natural or wild areas as controls (for this view see Christensen et al., 1996).

the evaluated ecosystem is considered to be. The crucial question is, "Which ecosystems are these ideally natural ones?"

The obvious suggestion is that ideally natural ecosystems are those that are independent of human activities. However, the non-existence of totally human independent ecosystems makes this suggestion practically difficult. Another possibility is that the naturalness of an ecosystem could be measured by comparing its current physical features to the features of some ideal and imaginary totally natural (i.e., human independent) ecosystem. Alternatively, the problem could be solved by using as comparative models those real ecosystems that are closest to the ideal. These conceptions of naturalness are purely non-historical. According to them, naturalness is not a matter of ecosystem's history – that is how it became into existence – but a matter of its current physical properties and features.

It has also been suggested that ideally natural ecosystems have properties that are commonly valued in ecosystem conservation. Such properties might include diversity, integrity, viable populations of species, evolutionary and ecological processes and functions, and species with evolutionary potential (Grumbine, 1994a; Christensen et al., 1996; Angermeier, 2000). However, the suggestion is problematic. The selection of the properties of ideal ecosystems is either founded in some form of naturalness or the selection is done independently from any conception of naturalness. In the latter case, it is difficult to see how possession of the selected properties would be relevant for naturalness. In the former case we are taken back to the basic question, "Which form of naturalness – if any – is relevant in ecosystem conservation?"

6.2. *Three Methods and Feature Dependent Conceptions*

The feature dependent conceptions of naturalness do not separate the outcomes of different management strategies from each other. All three conservation methods may produce ecosystems that are equally natural in respect of their features and properties. The features of ideally preserved and ideally restored ecosystems are identical and this similarity actually is the aim of any restoration operation. If the restoration operation is carried out completely, no physical differences exist between it and the original or preserved ecosystem. The only difference is a historical fact that the restored ecosystem has been brought into existence by human beings. Some engineered ecosystems may also – at least in theory – be natural in terms of their properties. Through ecosystem engineering, people could create an ecosystem the physical features of which were similar to some human-independent ecosystem that has not existed in the site before. For example, a rain forest created in Finland would be similar to some human-independent ecosystem but dissimilar to any ecosystem that has existed previously in its site. More realistically, an artificial lake may greatly resemble a natural lake in terms of its physical features. According to the stated criteria of feature dependent naturalness, these ecosystems are as natural as preserved and restored ecosystems.

The feature dependent conception of naturalness only distinguishes between one kind of engineered ecosystem – those that do not share their properties and features with any human-independent ecosystems – and other outcomes of the three methods. Thus, the conception does not explain our intuitions about the acceptability and desirability of the three conservation methods. However, the feature dependent conception of naturalness might slightly be improved. According to the better conception, the more the features and properties of an ecosystem resemble the properties of some human independent ecosystem that has existed in the site before, the more natural the ecosystem is. This conception does distinguish between the outcomes of ecosystem engineering and the outcomes of the other two methods. Nevertheless, according to it, preserved and restored ecosystems are similarly and equally natural. Indeed, no conception of naturalness that is based on the properties of ecosystems can ever explicate differences between the naturalness of preserved and restored ecosystems. The simple reason for this is that ideally preserved and restored ecosystems share exactly the same features and properties.

7. CONCLUSION

I conclude that no single conception of naturalness can distinguish between the outcomes of the three conservation strategies. According to any naturalness conception that is based on (non-historical) features and properties of the ecosystem, the outcomes of preservation and restoration are similarly natural. Moreover, according to any conception referring to happenings in the history of an ecosystem, restored and engineered ecosystems are often similar in their naturalness. They can, after all, be produced by exactly similar methods. Thus, a single conception of naturalness can never explain the common tendency to list the management methods in the order of their acceptability.

What does this conclusion imply? It may be taken to mean that naturalness does not – and can never – provide a sensible and objective criterion for biological conservation. According to this line of thought, our intuition about the acceptability and desirability of the three management methods may be justified. Nevertheless, justification for it does not rest on naturalness of the outcomes of the methods.

The second possibility is that one of the preceding forms of naturalness does actually offer a good and sensible criterion for biological conservation. The common intuition about how the three methods should be preferred against each other, is, nevertheless, mistaken. The methods cannot be straight forwardly listed in order of their acceptability and desirability. A decision about the selection of the appropriate management method should be based on a specified conception of naturalness, not on the status of the used method. This view immediately raises the issue as to the status of the conception that should guide biological conservation.

The third alternative is to accept the unsatisfactory nature of any single conception of naturalness without abandoning either the view of naturalness as a guiding concept or the intuition about the acceptability of three management methods. The advocate of this view claims that naturalness is a criterion that can be used provided that multiple different meanings of the term are taken into consideration. According to this line of thought, naturalness offers a multidimensional criterion for biological conservation. Consequently, naturalness becomes a gradient with several mutually independent factors. The most natural entities – such as remote unexplored wild areas – are natural in several or all senses presented above. Most ecosystems are natural in some sense but unnatural or less natural in the other. Highly unnatural ecosystems are unnatural in various respects, but as long as we are talking about biotic entities some naturalness is always present.

The third alternative is not foreign to modern science and the current ecosystem management practices. In plant ecology, naturalness has been measured by so-called hemerobiotic states (see, for example, Banko, 2001; Zechmeister et al., 2002). The hemeroby of an ecosystem consists of seven main parameters: (1) regeneration after human disturbances (without human restoration operations); (2) fertilizer and pesticide input; (3) frequency and intensity of soil disturbance; (4) mechanic soil compression; (5) sealing of soils by sand, gravel, etc.; (6) removal of biomass; (7) naturalness of vegetation: i.e., number of planted species and percentage of invasive and non-invasive species (Zechmeister et al., 2002). The first and the seventh parameter are dependent on current properties and features of an ecosystem, others are related to historical forms of naturalness. As long as the parameters from two to six are understood widely to refer to all human interference in the history of an ecosystem and also all changes caused by those human interferences, this form of naturalness can quite efficiently separate between the three management strategies. This and other multidimensional criterions can explain the implicit hierarchy of three conservation methods, for they are based on a combination of historical and feature dependent views of naturalness.

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