Philosophy and Biodiversity

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Biodiversity Considered Philosophically

An Introduction

MARKKU OKSANEN

1. BIODIVERSITY IN THE HUMAN MIND

Biodiversity is peculiar in the sense of being both novel and traditional at the same time. The emergence of the *term* from the discipline of conservation biology is well documented in current history (see Takacs 1996). It is a neologism, dating back to 1985 when Dr. Walter G. Rosen coined it while planning a conference that aimed to bring together what was known about the state of biological diversity on Earth (Wilson 1988, vi). The conference, the National Forum on BioDiversity, was held in Washington, D.C., in September 1986 and the proceedings of this meeting were also titled *Biodiversity* (Wilson 1988). So, biodiversity is a contraction of biological diversity.

A rough *idea* of biological diversity, and thereby of biodiversity, has existed in the human mind ever since evolution endowed our hominid ancestors in the phylogenetic tree with adequate cognitive abilities, in particular that of classification. Therefore, any attempt to definitively date when humans first conceived of nature as diverse is doomed to fail: we live from and within the world of diversity and we are a part of that totality. Some scholars, finding support from different theoretical standpoints such as evolutionary epistemology[1] and cognitive anthropology (Atran 1998), have argued that the human mind has evolved so as to be receptive to nature's diversity and it has a natural capacity, or even "innate dispositions" (Ruse 1989, 189), to organize different elements in nature into handy mental tool-kits that help humans to survive and, ultimately, to live well. Other scholars reject these evolutionary accounts of our cognitive faculties and think of them as acquired and culturally transmitted (e.g., Maffie 1998).

I would like to thank Juhani Pietarinen, Helena Siipi, and Timo Vuorisalo for their helpful comments and Niall Scott for checking the language.

Whatever we think of the origin of this ability, both sides must admit that humans need organisms for food, fiber, medicines, tools, and many other purposes. To utilize natural diversity, we have to categorize things; to categorize, we need the criteria of similarity and difference, by means of which we can distinguish edible types from nonedible, useful types from useless, dangerous types from harmless and so on. As Wilson (1994, 40) puts it, "In all cultures, taxonomic classification means survival." Thus, the categorization of the biotic world involves knowledge about it that promotes the evolutionary success of our kind by reducing uncertainties of living. Although the primary motive for categorization might have been practical, it has also served many other purposes, as people distinguish holy or sacred types from profane and beautiful types from ugly, and so on. These categories comprise the cultural dimension of human existence and it is by no means obvious in what way, if any, they are related to the human evolutionary process.

The diversity of life is evident for us at the level of common-sense perception of reality. Thus, biological reality does not consist of unidentifiable objects. Kim Sterelny (1999, 119) has used the term "phenomenological species," as distinct from "evolutionary species," to point out that living organisms have such salient properties that for us the living world contains "identifiable clusters of organisms." The allure of categorization is so strong that even when we are willing to emphasize the individuality of living beings, we tend to delineate them in terms of natural kinds or sortals and identify them as members of certain categories; the idea of "bare particular" is doubtful (see J. Wilson 1999, 16–21). To know an entity is to know it according to its general properties that are denoted by generic terms, such as species membership; thus, to know something is to be informed enough to classify it. When we do not know an entity's kind, we are want of the crucial piece of information to entertain it and we cannot conceptualize it: it remains as a strange or mysterious object. The notion of biodiversity, particularly in folk biology, is a mid-level concept that applies to organizing the apparent resemblance and difference of things. The notion makes sense only within an apprehension of the world that neither regards each individual component of reality as "bare particular" nor the system of nature as a tightly functioning whole, in which any component, or sets of components, cannot be individuated. In brief, biodiversity, both as a vernacular and a scientific concept, is about the classification of perceptible things and phenomena, especially species.[2]

There are many ways of approaching the concept of diversity. We can say, in general, that the categories of nature's diversity constitute scientific knowledge when established according to the rules and standards of scientific research, and folk-biological knowledge when they are established outside the institution of science. In illiterate communities, folk-biological knowledge is delivered from one generation to another through oral tradition. In literate communities the means of knowledge dissemination are more varied for obvious reasons. Western philosophers and scientists have not, in general, acknowledged these "common-sense" achievements, but during the last decade or so, some signs of change have become obvious, and the concept of biodiversity has played a vital role in the course of change. On the one hand, this change goes in tandem with a growing commercial interest in nature's biotic treasures and their potential industrial use; through millennia traditional peoples have acquired basic knowledge of the pharmaceutical, cosmetic, and agricultural uses of various species and varieties of plant and animal life (see, e.g., Swanson 1995; Brush and Stabinsky 1996). On the other hand, it has been noticed that the folk-biological classifications were at times done so well that they coincided with the scientific knowledge (see Medin and Atran 1999), although the reasons for classifying may have fallen short of the standards of biological science.

Views on the philosophy of biology are also changing and such stances as pluralistic realism or "promiscuous realism" have gained support (Dupré 1981, 82). To put it simply, these positions are in favor of the claim that there are many different but defensible ways of classifying nature's diversity. This may imply a certain degree of tolerance and greater understanding of folk-biological classification (cf. Dupré 2002; R. A. Wilson 1999). On the negative side of folk-biological classification, its evaluative dimension is highly selective and typically it manifests many other values and beliefs that are susceptible both from the scientific and conservation points of view. But scientific classification also serves many utilitarian purposes. There are traces of both of these tendencies in the early modern age of botany (Tudge 2002, 21) and they are discussed in the article on Rousseau, for example (see Arler, this volume). Scientific classification rests, however, on a very peculiar idea, that of fully stretched self-criticism, according to which the apparent similarity between living beings can turn out to be illusory and virtually all systems of classification are fallible: one day there is only one species of the African elephant, the next day researchers distinguish between two species of the African elephant, between the forest and the savannah elephant (Roca et al. 2001), that are morphologically distinct and occupy different ecological niches. The replacement of an old belief by a new one because of the discovery of these essential differences is usually interpreted as scientific progress. Despite the fact that the idea of scientific progress and systematic scrutiny can be incongruent with the most conservative systems of folk biology, there is no point in deeming folk-biological systems of belief as constant. Both scientific and folk-biological systems of belief are more or less flexible.

All in all, irrespective of the validity of folk-biological classification, the mere existence of it confirms the idea that the interest of ancient philosophers and naturalists in nature's diversity did not appear out of the blue and the current scientific interest in biodiversity can be seen at the other end of the continuum.[3]

Nature was the predominant concept in classical Greek philosophy from the very beginning. The pre-Socratic philosophers, for instance, assumed that they could identify some primitive element, or elements, of which the world was built. The speculative metaphysical investigation of nature evolved into natural history and into the science of biology and ecology by the nineteenth century. It is telling that in 2001, just fifteen years after the invention of the term biodiversity, a five-volume *Encyclopedia of Biodiversity* was published. Moreover, thousands of scientific articles, as counted by Julia Koricheva and Helena Siipi in their contribution "The Phenomenon of Biodiversity," have been published. Some of these have been published in newly established journals that include "biodiversity" in their titles. Other large-scale projects are on their way to being accomplished, such as the enlargement of the abovementioned *Encyclopedia of Biodiversity* to an electronic version and the enterprise to make an inventory of all species on Earth.[4] As I see it, without the long preceding history and the established tradition of natural history, broadly understood, nothing like this may have happened, at least not so quickly. Biodiversity has become a buzzword, that is, a currently fashionable expression or a catchword. As is the case with buzzwords generally, biodiversity has also been given innumerable definitions, some of which have grown out of the original context, decreasing its usability. In the opening chapter Koricheva and Siipi provide a survey of this use of the focal concept and analyze how the meaning given to it implies variation in conservation policies.

By coining the new concept, the conservation biologists had a mission in mind: to promote the cause of conservation and to alarm the decision makers about the biological diversity "crisis," as E. O. Wilson (1985) and many others have labeled it (see Haila, in this volume). Thus, biodiversity, the neologism, is a value-laden notion that manifests both the sense of wonder before diversity and the worry over its loss. It was the rapid, mainly anthropogenic, decline of biological diversity that induced the U.S. scientists to invent the catchword and to launch a campaign. What followed can easily be deemed an academic success story, irrespective of the unfortunate background of this enterprise, as it led to worldwide concerted action to block the declining trend. The most notable attainment thus far is the *Convention on Biological Diversity*

(CBD) that was signed at the *United Nations Conference on Environment and Development*, held in Rio de Janeiro in 1992. The CBD has three main objectives: to conserve biodiversity, to enhance the sustainable use of its components, and to share the benefits arising out of the use of genetic resources fairly and equitably (see Glowka et al. 1996).

The CBD begins with the definition of biodiversity that has been widely used. Article 2 defines biological diversity as "the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems." Most contributors to this volume and biodiversity textbooks in general tend to follow this definition or simplify it, for instance, as follows: biodiversity refers to the whole variety of life on Earth and to its physical conditions (cf. Perlman and Adelson 1997). By the end of 2002 the convention has been approved by 186 nations. (Ironically, the most notable opposition to it came at that time from the country in which the concept originated, as the then-president George Bush refused to sign it, see Porter, Brown, and Chasek 2000, 124–30.)

Because the history of the neologism "biodiversity" is short and well known, it has often been used as a case of the social construction of environmental problems. This is the starting point of Yrjö Haila's chapter, "Making the Biodiversity Crisis Tractable: A Process Perspective." Drawing from studies on science, Haila claims that biodiversity is above all a dynamic social construction that has become "the organizing center" of various environmental and social concerns. He examines "how the process of construction has fed back to the understanding of the issue itself." He goes on to scrutinize more substantial ecological issues and criticizes the views of prominent conservation biologists, in particular E. O. Wilson and Paul Ehrlich. Like Koricheva and Siipi, Haila offers a comprehensive treatment of the biodiversity problematique that takes a stance on many singular issues. He ends by emphasizing the process nature of biodiversity and the importance of critical discussion regarding the objectives of conservation by means of which weaknesses in opposing extremist stances would become more clear.

2. BIODIVERSITY IN A WORLD OF CHANGE AND CONSTANCY

Given the history outlined above, Sarkar's (2002, 132) remark that "Biodiversity must be analyzed in the context of conservation biology" becomes incontestable. What, then, is philosophically fascinating about biodiversity that goes beyond the burning practical concerns of conservation biology? I think that simply the existence of this volume offers a better answer than I could ever provide here, but let me think about it for a moment. This motivating question is in the background of other questions that I will introduce in the remainder of this chapter.

To begin with, if "the task of conservation is to conserve biodiversity" (Sarkar 2002, 133), it raises the question of what exactly is to be conserved. Ideally we would have a precise operative, hierarchical formulation of what "biodiversity" comprises. The vastness of the extension of the concept biodiversity undermines this prospect and brings in convention: we have to make choices. Although we have the global convention on biodiversity, it is less likely that we will have universally shared biodiversity preservation policies that even include conservation priorities in trade-off situations. Therefore, any answer to the question "What is biodiversity?" has an evaluative dimension (see chapters by Koricheva and Siipi, Haila, Hobson and Bultitude, Rawles, Gamborg and Sandøe, in this volume).

Focusing merely on species, any such attempt to provide an operative definition first leads to systematics, the objective of which is to study and classify the earth's living beings. How, then, does one distinguish between different kinds of organisms? Do natural kinds have essences that are typical of them and only of them? Presuming the traditional realist position according to which species are natural kinds that exist independent of our perception and beliefs, on the one hand, how then does one identify categories that correspond with reality? If we presume, on the other hand, that species are human constructions, it gives rise to many other questions: Is there any truth-value in taxonomic statements? If not, are we then allowed to classify entities however we like? Or should we be paying attention to either individuals or populations in the first place? These questions have been continuously tackled by both taxonomists and philosophers of biology (see, e.g., R. A. Wilson 1999), and answers to them form different background assumptions in conservation biology.

Things get more complicated when the notion of biodiversity is not limited to species; what goes below (e.g., genetic diversity) and above (e.g., ecosystem diversity) this basic unit of categorization is also relevant. Biodiversity exists at different levels of organization, that is, in historically varying genetic lines and communities. The issue of genetic diversity coincides with the issue of species diversity to some extent: how to constitute a scientifically purposeful and/or a policy-relevant distinction between evolutionary significant units within the same species (e.g., subspecies). As to the communities, their classification is also troublesome because there are no sharp lines in nature, but nature constitutes a system made up of interconnected, interdependent, and co-evolving units.

The understanding of biodiversity depends a great deal on the perspective we have chosen. Is biodiversity, above all, a global concept, requiring an objective, disentangled perspective, or can biodiversity be understood locally, from within the biogeographic locality? I think that both perspectives are of importance, and to confront the global perspective with the local one is unfruitful (see Attfield in this volume). Rather it should be seen as an interplay between the concrete and the abstract, between actually existing entities and theoretical idealization. The relationship between the local and the global has various dimensions. Because of the scarcity of empirical evidence, our worry about the future of biodiversity is indefinite: we are often devoid of basic biological information and do not know what we are losing or have already lost and how these changes affect ecosystem functioning (Tilman 2000, 209). Therefore, decisions on land use have to be made on uncertain ground, making mistakes common and requiring re-orientation (see Hobson and Bultitude this volume). Some scholars have suggested adaptive management as a solution to this problem (see Norton 2003). It has a policy dimension. Although conservation policies are implemented locally, in the most abstract sense – and also in a politically significant sense – biodiversity conservation is based on an understanding of diversity of life on Earth: diversity characterizes life. And furthermore, it is based on a particular understanding of the natural world – most of all, on that view the theory of evolution provides. Yet, it is the value of a specific biogeographic locality which matters most, and this requires an ethical judgment. A maximal diversity stored in a gene-bank is a somewhat ambivalent idea and applicable only to a situation in which we are about to lose diversity in its historical context. Thus, zoos and gene-banks should have a very limited role in conservation, and the approach to conservation should rather be ecosystem-centered (Norton 1987).

What is so special about biodiversity that we should pay attention to it and work to preserve it? To answer this question, we need to enter the realm known for the past thirty years as environmental ethics. Environmental ethics systematically examines the ethical relationship between humanity and the rest of nature. The history of systematic environmental ethics is not much older than that of the notion of biodiversity itself. This is the case in particular, if we speak of environmental concern in a global sense, that is, in a sense that is not place-bounded and goes beyond the everyday anxieties about eking out a continuous livelihood from the local environment: the global aspect of environmental *concern* is an essential part of environmental ethics and, in particular, of ethics of biodiversity conservation. This kind of concern for species or for the natural world has not been part of the Western mentality, despite the overwhelming interest in nature and its diversity.

The Greek philosophers reflected on such questions as "Why are there so many kinds?", "What is the relation of a kind to its individual representatives?", "Are these kinds arranged in systematic ways?", and "Why is there order in nature?" Some of their research questions are as topical as ever. The twenty-first century biologists have been looking to explain, for instance, why diversity characterizes life, how different species manage to coexist, and how stability and dynamism relate to each other (see, e.g., Sterelny 1999, 119; Tilman 2000; Brooks and McLennan 2002, 8). Of the Greek philosophers, Aristotle is generally recognized as an originator of the science of biology; his views continued to be powerful until the nineteenth century.

This volume pays special attention to Aristotle's "mentor," Plato. According to Arthur Lovejoy's classical work *The Great Chain of Being*, Plato was the first to make extensive use of the idea that the actual world consists of all possible kinds of living beings. The world is a *plenum formarum*, full of all kinds of beings that ever can exist, and it is the better the more kinds it contains. This idea, which Lovejoy called the Principle of Plenitude, has played a very important role in Western philosophy (Lovejoy 1964; Knuuttila 1999). The principle was adopted by Christian theology, which for centuries taught that the omnipotent God has created the world as perfect and hierarchically structured, admitting of no disappearance of its constituents. It implies the idea that the number of species remains fixed because nothing can disappear from the great chain of being, or *scala naturae*: whenever and wherever a local extinction was noticed, it was nothing but a local matter and the missing species must have survived elsewhere (Moore 1999, 109).

In essence this seems to be Plato's view as well. Does it mean that he thereby was bound to a static conception of nature? Juhani Pietarinen argues in his "Plato on Diversity and Stability in Nature" that Plato's explanation of natural changes has interesting similarities with modern ecological theories. In particular, what Plato calls sensible nature is not "a static collection of various kinds of species," but rather a dynamic system being in a state of constant change but endowed also with a certain ability to resist changes. This kind of "dynamic stability" is essentially dependent on diversity in Plato, according to Pietarinen's interpretation. The relationship between diversity, stability, and dynamism has been the despair of modern ecologists.

It is now unanimously accepted that an extinction of a species can occur. The fossil record clearly speaks for the existence of species that died out long before we entered the scene. Paleontologists have identified five major waves of mass extinction (Sepkoski 1993; see also Boulter 2002, 23–55) and we are, as conservation biologists assert, in the midst of the sixth wave, which is inflicted by humans (Boulter 2002, 189). David Raup (1991, 3–4) has calculated that 99.9 percent of species that ever existed have disappeared. Raup's assumption is of course unproven, as we do not even know the number of currently existing species, so we could not know that of the past (Boulter 2002, 138ff.). The destiny of dinosaurs and mammoths and more recently of dodos, passenger pigeons, and Tasmanian tigers is, nevertheless, familiar to everyone. Even Christian creationists must have reconciled their creeds with the apparent historicity of species. (This is, of course, nothing but an assumption because logically it does not prevent religious zealots from creating new imaginary tales on extinct species in support of their creeds.) Whoever is suspicious about biodiversity conservation policies is motivated by other reasons, such as a belief that it does not pay to conserve, or that humanity can do quite well in a less diverse world. I will return to this issue later on.

Despite the prima facie similarity of the questions being asked by ancient and modern scholars of nature, there are numerous differences in their approaches and answers. For modern ecologists, the meaning of "Why" questions is quite different from that of traditional theologians. The latter have understood them as predominantly metaphysical questions, for example, calling for the underlying plan of the Creator and the idea of cosmic teleology in which each type of being has its own purpose in the functioning of the system, whereas modern scientists reject such ideas and explain the emergence and survival of species with reference to suitable conditions of existence, both biotic and abiotic, that influence the fitness of individuals. This change owes a great deal to Charles Darwin who, however, did not question all prior beliefs.

Although Darwin's theory of evolution and natural selection questioned the traditional theological view, Kim Cuddington and Michael Ruse argue in their chapter "Biodiversity, Darwin, and the Fossil Record" that Darwin still held to the traditional idea of equilibrium. He assumed that the number of species remains somewhat constant even though individual species appear and disappear. When a species is lost, mainly due to competition, it becomes replaced by a new one, often by a near but improved relative of the lost species. An exception to the rule is the case where physical conditions are suitable for species multiplication, for instance through the increases in resource level (in particular, energy). In sum, Darwin was wavering somewhere in between the two opposite poles – the one in which the number of species is eternally fixed (the traditional belief) and the other in which the number of species can increase without any limit (the evolutionary belief). However, his vision of the extant diversity emphasized constancy in the living world: “Darwin paints a picture of nature as essentially stable and predictable in his time, whatever it has been like in the past,” Cuddington and Ruse write. The two authors claim that Darwin did not postulate this kind of hypothesis of “dynamic equilibrium” on any evidence, but was rather affected by the pre-scientific, historical views. Cuddington and Ruse also argue that the dynamic equilibrium hypothesis has not lost all of its attraction, as some modern paleontologists, Jack Sepkoski in particular, have “restated” Darwin’s position. However, for a modern evolutionary ecologist the idea that the global species number is fixed is absurd: there is no top limit to biodiversity.

Today we look at the phenomenon of diversity through the lenses of evolutionary theory and ecological science. From this perspective biodiversity refers to a set of entities and processes that comprise a complex dynamic system; for this reason it is difficult to define biodiversity in a precise manner, as many contributors to this volume remark. It is an undeniable fact that the diversity in ecological systems is historically varying: when a species is wiped out, there is no necessary substitute for it in the form of new evolving species but, rather, in the form of an invader. Moreover, due to interdependencies between populations of different species, the extinction of one species may imply the same to those that are dependent on it, unless others are able to adapt themselves to the new situation or an immigrant species fills the vacant niche. The diversity of nature varies temporally, yet the understanding of mechanisms of this variation is wanting. Ecologists aim to determine, for instance, the spatial distribution of diversity and relate their findings to various environmental and historical factors so as to explain the origin and the persistence of the extant diversity in a given area of nature. Those ecologists who emphasize competition as the main limiting factor of biodiversity tend to ignore other factors, such as diversity in itself as a “raw material” of further speciation, and this leads them to place emphasis on the notion of stability in the sense of equilibrium.

How does species richness contribute to ecological stability? Many biologists reject the diversity–stability hypothesis, but it has not been outcompeted. To mention just a few recent examples, in a special issue of biodiversity in *Nature*, David Tilman (2000, 208) summarizes the findings of review articles on these experiments: “These reviews show that, on average, greater diversity leads to greater productivity in plant communities, greater nutrient retention in ecosystems and greater ecosystem stability.” However, the case may not yet be closed: experimental studies have been conducted for merely a decade and for a relatively limited range of species number. New experiments result in new views. One such experiment shows that there is no positive correlation between great diversity and resilience and resistance to change (Pfisterer and Schmid 2002). The contrasting views reflect differences in a number of questions: whose stability is at issue? A stability of population or of community? What kind of consequences for the ecosystem functioning will result from the loss of biodiversity? What do we mean by stability, exactly?

Gregory Mikkelson discusses some aspects of the debate in this volume ("Biological Diversity, Ecological Stability, and Downward Causation"). His main point is to show the importance of holistic explanations in ecology. For instance, positive or negative effects of diversity in community level on the stability of the component lower-level populations offer an example of downward causation, and the diversity–stability hypothesis an example of holistic explanation. Mikkelson argues that downward causation plays a more important role in nature than scientists have so far recognized, and that neither the same-level causes nor bottom-up causes deserve predominant emphasis in ecology. This means, in effect, rejection of reductionistic explanations. Mikkelson recommends less money for "reductionistically driven ventures" like the Human Genome Project and more for "holistically inspired endeavors, such as what we might call the 'Earth Specionome Project.'"

Fair enough: how could we otherwise learn about the current biodiversity crisis than by aiming to describe the existing species? The project requires an enormous amount of empirical work in the field and taxonomic work in museums before perhaps the greatest question of all for the general public in regard to biodiversity – How much biodiversity does exist on Earth? – is closer to being answered. Yet many scholars are skeptical about the success and rationale of this enterprise and think the question is unanswerable because of its vastness and complexity (Levin 1999, 77). Moreover, all measurements require the identification of units being measured, which necessarily leads to simplifications and thus underestimations (see Purvis and Hector 2000). Haila (in this volume) criticizes the endeavor of naming all the living beings for neglecting the dynamic aspects of the nature of life and being unable to enhance the understanding of those mechanisms that bring about the diversity in systems (also see Hobson and Bultitude's chapter in this volume).

Let us consider this issue from a different angle. In the beginning of this chapter I spoke about the phenomenological species. Common-sense perceptions of the world are often contradictory as there are two strong intuitions that defy each other. When we identify biological entities as members of species, we usually also identify them as individuals or as particulars. To quote Ernst Mayr (1997, 124): "The most impressive aspect of the living world is its diversity. No two individuals in sexually reproducing populations