biodiversity

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THE VALUES OF BIODIVERSITY. AN INTRODUCTION

1. Inventories of Life

The idea of biological diversity has somehow existed in the human mind since the very beginning of the existence of our species. According to some researchers[1], human minds would have evolved so as to be receptive to nature's diversity: in order to survive, primitive human beings had to harness such diversity through grouping things, distinguishing edible from non-edible fruits, dangerous from harmless animals, toxic from non-toxic plants, etc. These very classes, namely edible vs. non-edible, toxic vs. non-toxic, have also shaped the first scientific taxonomies. These were actually pharmacopoeias, one of the earliest is the *Shen-nung pen ts'ao ching (Divine Husbandman's Materia Medica*) attributed to the legendary father of Chinese medicine, the Emperor Shen Nung who, according to the legend, personally tasted the herbs to test the medicinal value of the 365 medicines included in his inventory.

Similarity and diversity of morphology, genetic makeup, ecological functions, and reproduction means are at the very core of modern biological taxonomies. The first step in building a biological classification is to collect samples of a certain kind, as the following anecdote from Darwin's autobiography[2] exemplifies:

> But no pursuit at Cambridge was followed with nearly so much eagerness or gave me so much pleasure as collecting beetles. It was the mere passion for collecting, for I did not dissect them and rarely compared their external characters with published descriptions, but got them named anyhow. I will give a proof of my zeal: one day, on tearing off some old bark, I saw two rare beetles and seized one in each hand; then I

[1] See Oksanen 2004: 1 ff.

[2] Darwin 1958: 62.

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saw a third and new kind, which I could not bear to lose, so that I popped the one which I held in my right hand into my mouth. Alas it ejected some intensely acrid fluid, which burnt my tongue so that I was forced to spit the beetle out, which was lost, as well as the third one.

After this first step, a taxonomist must of course go further, and check whether those observable differences are in some way connected to evolutionary processes or, said differently, whether a supposed morphospecies corresponds to a genuine evolutionary species. In several cases – for instance when intra- and interspecific phenotypic variability are overlapping[3]; or when morphological traits are too few, as for bacteria – molecular biological technologies are used, such as DNA barcoding.

Considering biodiversity specifically, it is a rather uncontroversial stance that "biodiversity both as a vernacular and a scientific concept is about the classification of perceptible things and phenomena, especially species"[4]. The idea lying beyond the introduction of the term "biodiversity" (which occurred in 1986 during the National Forum on BioDiversity which took place in Washington DC, as can be read in several of the papers that form the present volume) was indeed to handle the decline of the biodiversity itself, understood as species richness. Today, in order to *practically* proceed with the achievement of that goal, the first step is to describe, evaluate, and assess the biodiversity of a certain area at a given time. To do so, what is needed in the first place is, at large, the counting of the elements of the system and the assessment of the degree of differentiation among them. In other words, when we know what to count and how to compare what we are counting, we are making our way towards an understanding of what must be saved (and, at least partially, of what biodiversity is). To do that means to make taxonomies, namely scientifically based inventories of natural objects.

Clearly, making taxonomies is all but an easy task, as it is shown – making reference especially to deep-sea fauna inventories – in the contribution "Ideal and Actual Inventories of Biodiversity" by Anouk Barberousse and Sophie Bary. In pre-evolutionary approaches, making classifications was somewhat easier, since the classified things were considered to be static and members of discrete groups. This is because species were thought of as the atoms of the creation, by virtue of their having essences coming directly from God. Accordingly, *all* species were already existent and no new species could ever appear (otherwise it would have meant that something was missing in the universe, hence that creation, and God himself as creator, were not perfect). Somehow,

[3] As for some venerids, the most speciose family of heterodont bivalve mollusks, see Chen *et al.* 2009.

[4] Oksanen 2004: 2.

pre-evolutionary premises would make it easier to satisfy the major requirements of *ideal* inventories: systematicity and exhaustivity. But the theoretical framework pre-evolutionary taxonomies were grounded in missed the most important point: life evolves. It continuously produces, and loses, diversity. By means of divergence processes (caused by differing types of factors, from geographic isolation to hybridization), new species originate, some of them become extinct and others transform themselves, becoming different species, with different genetic makeups, morphologies and ecological functions.

Although traditional essentialism and creationism are dead issues in biology, Linnaeus's system – stated in his *Systema naturae*, whose first edition (1735) goes back to pre-evolutionary times – is still in use, in spite of its static conception of the diversity of life. Indeed, it is the system referred to by contemporary international codes that regulate zoological and botanical nomenclature. This may be seen as an inconsistency. According to Barberousse and Bary, on the contrary, the persistence of fixist, creationist, and essentialist assumptions in taxonomies, does not imply that the Linnean tools for nomenclature should be rejected, because they are useful tools that help taxonomists to carry on their work. A work which is made difficult by a series of practical constraints and cognitive biases. Some times, for instance, it happens that the more specimens to be classified that are at hand, the more differences are spotted and then more species are postulated. Some other times, just the opposite happens, as in the case of species or higher taxa showing a strong sexual dimorphism, or in polymorphic species. A striking example is the case[5] reported by Johnson and his colleagues in 2009 concerning some fishes living in the oceanic bathypelagic realm (1000-4000 m). They were assigned to three different families: Cetomimidae (whalefishes), described in 1895, Mirapinnidae (tapetails), described in 1956, and the Megalomycteridae (bignose fishes), described in 1966. Based on morphology and mitogenomic sequence data, Johnson and colleagues did show that these fishes, rather than being separate families, are larvae, males and females, respectively, of a single family Cetomimidae! Misidentification was caused by the fact that this fishes have larvae living in upper, and richer, water (200 m), and by the dramatic morphological transformations the larvae go through – changes in skeleton, particularly in the head – because of developing different feeding mechanisms. (Deep-sea is a nutrient-poor habitat; accordingly, organisms develop strong morphological and behavioral specializations in order to survive.)

A different cognitive bias are different lumper/splitter tendencies, resulting from different researchers having different subjective tendencies to split organisms into more or less species taxa[6]. Conflicting theoretical frameworks, practical difficulties, and cognitive biases become even more evident when taxonomic

[5] I am grateful to Sandro Minelli for having brought this case to my attention.

[6] Hey 2001; Richards 2010.

work meets biodiversity discourse. In this case, making taxonomies implies dealing not only with epistemic and practical constraints, theoretical and cognitive biases, but also with political and economic interferences and interests, as Barberousse and Bary explain.

As mentioned, diversity is the product of evolution: life evolves producing novel diversity and species become extinct as a consequence of natural or anthropogenic processes. Biodiversity, as Alessandro Minelli writes in his contribution, is the product of change. Nonetheless, "biodiversity exists also because there are rules against an uncontrolled mixing of individuals or species". Our species, in a diversity of actions "ranging from the ancient agricultural practices such as livestock hybridization and the use of grafts to the modern applications of genetic engineering and transplantation techniques", breached so-called natural boundaries, both those between one individual and another, and between species and species. A burning issue is, of course, that of GMOs – to which has been devoted the Cartagena Protocol, an international agreement on biosafety adopted in 2000. Do GMOs follow under the extension of the concept "biodiversity"? Or rather, are they to be considered a threat to biodiversity because of their impact on the environment? The impact of GM crops, in particular, is of concern for the diversity of crop landraces. It is estimated that approximately 7,000 plant species have been used for human consumption; but just four crops – wheat, maize, rice and potato – account for one-half of the total world food production. The worry is that the introduction of GM crops will decrease the genetic diversity of crops. Coping with this worry is the main aim of the Cartagena protocol, which sets conditions for cross-border movements of bioengineered seeds and transgenic plants and animals[7]. According to a less optimistic interpretation, the real aim of the Cartagena protocol, as well as of the Convention on Biological Diversity signed in Rio de Janeiro in 1992, should be read as a compromise. The compromise is between the North – rich in technologies – and the South – rich in biodiversity and then in genetic varieties on the sharing out of the rights on biodiversity, understood as an economical resource[8].

2. Three understanding of the value of biodiversity

Speaking of agricultural biodiversity, one of the main meanings of the term "value" becomes evident when connected to biodiversity, namely *economic value*. We care about biodiversity and we want to conserve it because our lives materially depend on it. In the so called ecosystem-services approach, biodiversity is mainly understood in terms of the services that ecosystems can offer to present

[7] See Lévêque and Mounolou 2003.

[8] See, for instance, Aubertin, Boisvert and Vivien 1998.

and future human beings. Ecosystem services represent the benefits that human beings can derive from ecosystem functions, such as food production, water supply, climate regulation, soil formation, pollination, as well as recreational and cultural services. Such services can be monetized. It has been estimated that "for the entire biosphere, the value (most of which is outside the market) is estimated to be in the range of US $ 16-54 trillion (1012) per year"[9]. In the remainder of this introduction, two further meanings of the value of biodiversity will be explored – *ethical and aesthetical value*. Before that, however, let us discuss what biodiversity is (supposed to be).

2.1. What, if anything, is biodiversity?

> Biological diversity means 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[10].

> Biodiversity is "the variety of life", and refers collectively to variation at all levels of biological organization[11].

> Biodiversity is not simply the number of genes, species, ecosystems, or any other group of things in a defined area […] More useful than a definition, perhaps, would be a characterization of biodiversity that identifies the major components at several levels of organization[12].

> Biodiversity is an attribute of an area and specifically refers to the variety within and among living organisms, assemblages of living organisms, biotic communities, and biotic processes, whether naturally occurring or modified by humans[13].

These are just a few examples of how biodiversity has been defined. In his review of the relevant literature from 1976 to 1996, Don C. DeLong (1996) lists no fewer than 85 definitions of biodiversity. They differ primarily in their degree of inclusiveness: from those that include the present/past/future of all life on Earth to those that restrict biodiversity to the state of a specific area at a given time; from those that include processes to those that only countenance entities; from those that include human-induced biodiversity (such as alien spe-

[9] Costanza *et al.* 1997.

[10] CBD 1992.

[11] Gaston and Spicer 1998: 3.

[12] Noss 1990.

[13] DeLong 1996.

cies or genetically modified crops) to those that exclude it from the inventory, equating biodiversity with wilderness, and so on.

What are we to make of the fact that there are so many definitions of biodiversity, often inconsistent with one another; and some of them clearly not implementable in conservation policies? Using a term with different meanings can be one of the major stumbling blocks to reaching an agreement in decision making. To establish effective shared conservation strategies, an agreement on the definition of biodiversity, even provisional and operative, would be desirable. This indeterminacy makes room for manipulation and misinformation since different interests and different motives are involved in biodiversity conservation. These differences have clear political and economical implications, as already mentioned, and a vague concept is easier to use in different contexts for different purposes. On the other hand, this very same indeterminacy is one of the reasons why use of the concept of "biodiversity" has proven to be such a success.

In 1995, Jacques Blondel wrote that the concept of biodiversity was just an empty shell, reaffirming in different words a judgment already given by Stuart H. Hurlbert that, "species diversity [had] become a meaningless concept"[14]. The concept of species diversity, because of the semantic and technical problem that affected it, had become, according to Hurlbert, a "nonconcept", as it is written in the title of his article, and should have been abandoned. In a similar spirit, Christian Lévêque defined "biodiversity" as an "*auberge espagnole*", a bag in which each of us puts its own personal representation of nature. It cannot then be surprising – Lévêque argued – that the term "biodiversity" has become so popular, since each of us can find what s/he previously put in it[15]! If biodiversity is nothing but a mental representation, shouldn't the term be dismissed from scientific discourse? According to some, the answer is in the positive. In a recent article with the provocative title "Save the Planet: Eliminate Biodiversity"[16], Carlos Santana argues precisely that biodiversity (it is not entirely clear whether he refers to the term, the concept, or the object) is an "unnecessary placeholder for biological value of all sorts, and that we are better off eliminating it from conservation biology". Is that the only way?

Contributions from Philippe Huneman and Patrick Blandin, respectively, address the issue in a different way. Huneman acknowledges that there is probably no plausible answer to the question "Is there a real scientific necessity for 'biodiversity'?", and that the term "biodiversity" is simply overdetermined. In other words, it is possible that the political genesis of the term somehow "corrupted" its scientific origin. It is well known that the coinage of the name

[14] Hurlbert 1971.

[15] Lévêque 2010.

[16] Santana 2014.

"biodiversity" was part of an explicit political operation. This is clearly stated in the words of Dan Janzen, invited by E.O. Wilson to speak at the 1986 Forum:

> The Washington conference? That was an explicit politic event, explicitly designed to make Congress aware of this complexity of species that we're loosing. And […] the word was punched into that system at that point deliberately. A lot of us went to that talk on a political mission. We were asked, will we come and do this thing? So we did.[17]

It is somehow ironic that the forum where this entire "biodiversity-phenomenon" started was sponsored by the National Academy of Science, reputed for extreme conservatism, and according to which, "Science must be kept above the fray of politics and squabbles if its word is to carry the considerable weight of objectivity, truth, and value-neutrality"[18].

Be that as it may, if we focus instead on the question "What is biodiversity?", the answer lies, for Huneman, in the tension between biodiversity and biodiversities. That is, on the one hand, the characterization of biological diversity as defined by the 1992 Convention on Biological Diversity – which gave rise to a large concept of "biodiversity" as somehow holistic and concerning the well-being of the Earth. On the other hand, the many specific concepts of diversity elaborated in scientific ecology or in other branches of biology, all of them fragmented but at the same time "calling scientists for integrations and disciplinary syntheses". It is these different and conflicting characterizations that Huneman's paper focuses upon.

Blandin chooses a more historical approach to tackle the very same question: "Is there a real scientific necessity for 'biodiversity'?". Using the year 1988 (the year of publication of *Biodiversity*, the Proceedings of the Forum, edited by E.O. Wilson) as a dividing line between *pre* and *post* ecological works on biological diversity, Blandin's contribution explores whether something, in post-'88 researches, represents a genuinely novel scientific interrogative compared to pre-'88 researches.

2.2. Ethical and aesthetical value of biodiversity

When invented, "biodiversity" was intended as a slogan to draw the attention and support of decision makers, governments, scientists, and citizens to the rapid decrease in the number of species. In particular, the intent was to raise political and academic awareness of species loss and decline caused by human activities. Some researchers claim that we are facing an unprecedented loss of species. Wilson[19] hypothesized that the extinction rate could be between

[17] Takacs 1996: 37.

[18] *Ibidem*: 35-36.

[19] Wilson 1992.

27,000 and 100,000 species per year and the Millenium Ecosystem Assessment suggests that the contemporary extinction rate could be 1,000 to 10,000 times higher than rates recorded among fossil lineages. A brand new scientific discipline – Conservation Biology – was established in the U.S. at the end of the 1980s with the aim of conserving biodiversity.

It is undeniable that we think that biodiversity has a value. We have already seen that biodiversity has a value because of the services that ecosystems provide to us. Among them, we find not only material benefits but also recreational and cultural benefits, such as for instance "aesthetic, artistic, educational, spiritual, and/or scientific values"[20].

Aristotle was probably the first, in the Western philosophical tradition, to reveal the double characterization, scientific and aesthetic, of the diversity of life. In the first book of *On the Parts of Animals*, he wrote:

> Every realm of nature is marvellous: and as Heraclitus, when the strangers who came to visit him found him warming himself at the furnace in the kitchen and hesitated to go in, reported to have bidden them not to be afraid to enter, as even in that kitchen divinities were present, so we should venture on the study of every kind of animal without distaste; for each and all will reveal to us something natural and something beautiful. Absence of haphazard and conduciveness of everything to an end are to be found in Nature's works in the highest degree, and the resultant end of her generations and combinations is a form of the beautiful[21].

Jorge Marques da Silva's essay represents an attempt to shape, in a contemporary theoretical framework, this intuition. According to him, "A reconciliation between science and nature is possible by way of the role played by ecological and biological sciences on the aesthetical and ethical appraisal of natural diversity". In fact, as Marques da Silva argues, even though science was founded to dominate nature, a different role can be assigned to it when environmental aesthetics and environmental ethics meet. Making reference, in particular, to Allen Carlson's philosophical aesthetics, the paper shows that the aesthetical appreciation of nature requires a scientific understanding of the ecological and biological processes, where biodiversity plays a central role.

Sue Spaid's paper turns to the relation between biodiversity and cultural engagement, arguing that "human beings who value their own culture protect nature". To defend this thesis, Spaid takes into account different elements, including the link between the variety of spoken language of an area and the biodiversity that characterizes it; the role of cities and remote communities safeguarding habitats; as well as the interaction between biodiversity and multiculturalism.

[20] Costanza *et al.* 1997.

[21] Transl. by W. Ogle. Provided by The Internet Classics Archive. Available online at: http://classics.mit.edu//Aristotle/parts_animals.html

Until here, we have spoken of values that are *instrumental*: biodiversity has value because it allows us (or other species) to reach some end that we (or other species) find desirable, be it a material, cultural, or an aesthetical benefit. A classic example of something possessing instrumental value is money; we usually look for money because of things that we want to buy with it, and not for money itself. But, of course, this is not the only possible value we can attribute to biodiversity. According to some authors, attributing a mere instrumental (and usually anthropocentric) value to biodiversity is not a fully satisfactory approach. On the one hand, they say, it is not exhaustive, since there are lots of endangered species that are unlikely to be a potential resource to humans or to other species. On the other hand, it doesn't seem "fully moral": "To value all other species only for human interests is like a nation's arguing all its foreign policy in terms of national interest", says Holmes Rolston[22]. According to these authors, then, species – and biodiversity – should rather be considered as having an *intrinsic* value, that is a value *per se* and not for some other means. The Convention on Biological Diversity, for instance, is based on such a view. In the Preamble it is stated that the contracting parties are "conscious of the *intrinsic* value of biological diversity […] and its components". Matteo Andreozzi's essay is devoted to the discussion of the possible intrinsic value of biodiversity. Andreozzi, against those environmental ethicists who deny biodiversity any intrinsic value, analyzes the distinct meanings that the concept of intrinsic value can have, concluding that biodiversity can be seen as having an intrinsic value according to one of these possible understandings, and that "ascribing intrinsic value to biodiversity allows a true reconciliation between anthropocentric interests and the need to extend the moral community beyond humanity"[23].

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[22] Rolston 1985.

[23] I thank Anouk Barberousse, Jorge Marques da Silva and Alessandro Minelli for their useful comments to a previous version of this text.

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