

Biodiversity for the present and future of humanity: A suggestion for the SDG process

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Introduction

Earth is so far the only planet known to humanity that supports life. The existence and diversity of life makes our planet unique and our lives possible. Humans satisfy their essential needs and get several benefits from the existence of other forms of life on our planet, either directly or indirectly. In this article we will address the importance of biodiversity as well as the complexity and uncertainty linked to its disturbance. Biodiversity loss threatens our very existence, thus requiring global protection in order to guarantee the services for future generations. We argue that current global governance regarding biodiversity conservation is failing to provide sufficient protection, and that the future post-2015 agenda with the upcoming Sustainable Development Goals (SDGs) constitutes an opportunity to improve the conservation of biodiversity for the well-being of present and future generations.

What constitutes biodiversity?

The term biodiversity describes a broad field of research within biology. Biodiversity is a compound word originating from biological diversity and is defined 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 a part; this includes diversity within species, between species and of ecosystems” (United Nations, 1992, p. 3). Biodiversity is usually structured into three constituent components: species diversity, genetic diversity and ecosystem diversity (Hooper et al., 2005). These components interact and influence each other, highlighting the fact that the term biodiversity goes beyond just richness of species (Hooper et al., 2005).

Biodiversity encompasses all forms of life existing on Earth. This also includes human beings. However, humans play a special role regarding biodiversity. *Homo sapiens* has created its own sphere in terms of an anthropogenic society which at first

glance seems fairly detached from nature. Consequently, the question if biodiversity is important for humans arises. Our answer is ‘yes’, because biodiversity is crucial for the well-being of humans and the functioning of our society.

Ecosystems and their services for humans

One component of biodiversity is ecosystem diversity. An ecosystem can be defined as “an assemblage of organisms of different types (species, life forms) together with their abiotic environment in space and time” (Jax, 2006, p. 240). Ecosystems are diverse in their appearance, terrestrial or aquatic, and exist in every region of the world. Besides being a fundamental constituent of nature, ecosystems also provide direct services for humans, the so-called *ecosystem services*. This concept is described as “the direct contributions that ecosystems make to human well-being” (Potschin, Haines-Young, Saarikoski, & Jax, 2014, p. 1).

Ecosystem services are divided into three main components: *Provisioning, Regulation & Maintenance*, and *Cultural*. They eventually describe a service or good that humans directly derive from ecosystems. These services include most fundamental contributions for human life.

Provisioning services include all tangible outputs from ecosystems which can be directly traded, exchanged, consumed or used in manufacturing (Haines-Young & Potschin, 2013). Examples for a provisioning service are, amongst others: human nutrition, fibre, fodder, renewable biotic energy and fresh-water supply for drinking and non-drinking purposes.

Regulation & Maintenance describe the structuring and modifying characteristics of ecosystems. These services are not consumable in the traditional sense “but affect the performance of individuals, communities and populations and their activities” (Haines-Young & Potschin, 2013, p. 28). Examples for these services are pollination as a regulation of the biotic environment, air purification, pest and disease control, or climate regulation, including carbon sequestration.

Cultural services include ecosystem outputs that are non-material but have recreational, cultural, historical or intellectual value to humans. Despite being hard to quantify due to their immaterial character, cultural services play a very important role for our history and society. These services include aesthetic values, inspiration for art and design, nature experiences as well as recreation and tourism (Haines-Young & Potschin, 2013).

Ecosystem services show how important ecosystems are for human well-being from economical, dietary, and psychological perspectives. Without the natural provisioning of these outputs our societies would be significantly impaired, and finding

compensation for the natural services would be highly difficult.

During the last years, scientific evidence increased and confirmed the positive relation between biodiversity and the functioning ecosystem (Cardinale, 2012). Furthermore, the efficiency of some ecosystem services can be traced back directly to the abundance of species. One key finding is that the relation between the functioning of ecosystems and species diversity is non-linear and saturated (Cardinale, 2012). This means that there is a point from which the functioning exponentially declines – a so-called ‘tipping point’. However, science does not know how much biodiversity loss takes a systems to its tipping point, so we cannot estimate which rate of biodiversity loss is bearable and what the consequences are once the tipping point is passed. There is an objective risk, but there is still high uncertainty how close the point of no return is.

Another important feature of biodiversity is that it increases the stability of ecosystem functioning over time (Cardinale, 2012). This means, *sensu contrario*, that a decrease in biodiversity is detrimental to ecosystems, their functioning and the services they provide. Furthermore, there is evidence that a decline in biological diversity impairs the ability of ecosystems to perform their basic functions, such as biomass production, decomposition, or cycling of nutrients. One example of the direct relation between biodiversity and ecosystem services is that increasing plant biodiversity enhances fodder production in grasslands, fosters their resistance to invasive species and makes them less vulnerable to plant pathogens (Cardinale, 2012).

Box 1:**Genetic Diversity Benefits –****More Genetic Diversity and more Honey**

The importance of diversity is not limited to ecosystems and species, but also plays a significant role on a genetic level. Genetic diversity is of vital importance for the adaptive capacity of species and in some cases directly leads to benefits for humans, too. One example for this is honey bees. Honey bees spread their genes by either producing reproductive males or by founding new colonies (Mattila & Seeley, 2007, p. 362). Bees are social insects and many queens mate with several males, so-called polyandry (Tarpy, 2003, p. 99). Consequently, the higher the abundance of genetically different male bees, the higher the genetic diversity of offspring from polyandrous queens.



Image 1: Honey Bees on a comb*

Research has shown that colonies with high genetic diversity are more fit than genetically uniform colonies (Mattila & Seeley, 2007; Tarpy, 2003). Genetically diverse colonies gain weight significantly faster, have a higher rates of proliferation, display improvements in discovery and exploitation of food resources, are more successful in founding new colonies, and have a smaller likelihood of being severely affected by diseases. All these factors generate directly obtainable benefits for humans, namely an increase in pollination activity and honey production.

** See Photo Credit Section*

Biodiversity - current trends

Despite all benefits and services humanity derives from ecosystems, habitat destruction is continuing and biodiversity is significantly shrinking. The 2014 WWF Living Planet Report indicates a stark development. According to the Living Planet Index, the populations of monitored

vertebrate species declined by 52% over the past 40 years (WWF, 2014). This significant loss in populations is happening at a rate which is not sustainable for biodiversity and ecosystem intactness. According to the 2005 Millennium Ecosystem Assessment, around 62% of terrestrial ecosystems are degraded or used unsustainably (Millennium Ecosystem Assessment, 2005). These figures are seriously distressing and raise the question of why the process of degradation is still ongoing, notwithstanding our knowledge about the value and importance of biodiversity.

Current biodiversity governance

There is no doubt about the fact that the current state of ecosystems and biodiversity throughout the world is worsening, and the lack of universal coverage on case-specific degradation results in poor biodiversity governance. Plenty of multilateral treaties have been adopted, emphasising a lack of sufficient knowledge, especially in the marine sector (Craig, 2012). Biodiversity governance, although still in the process of fundamental development, is a widely fragmented field (Ekström, Young, Gaines, Gordon, & McCay, 2009). This becomes apparent when looking at the current global biodiversity governance.

The Convention on Biological Diversity (CBD), adopted in 1992 and established under the umbrella of UNEP, constitutes one part of the three Rio conventions (together with UNFCCC on climate and UNCCD on desertification). The CBD aims at conserving biological diversity, contributing to its sustainable use and achieving a “fair and equitable sharing of the benefits [...] of genetic resources” (United Nations, 1992, p. 3). To implement these objectives, additional protocols have been set up. The Cartagena Protocol on biological safety (enactment 2003) regulates the transboundary transport, handling, and use of genetically modified

organisms. The Nagoya Protocol regulates the access to genetic resources and their fair benefit sharing (ABS - access and benefit sharing). While the CBD has almost universal coverage (except for the USA, Andorra and the Vatican), the additional protocols currently list only 163 and 51 parties, respectively. The Strategic Plan for Biodiversity 2011-2020 includes 20 targets (Aichi targets) to reduce global biodiversity loss by 2020. The current Global Biodiversity Outlook 4 indicates that it is unlikely to achieve more than one of the 20 targets and it would require increased efforts, although many indicators show positive trends (Secretariat of the Convention on Biological Diversity, 2014).

There are plenty of conventions and intergovernmental organisations acting in the field of biodiversity. For instance, the Ramsar Convention on Wetlands of International Importance, especially on Waterfowl Habitat represents one of the oldest international environmental UN treaties, signed in 1971. It recognises the high importance that wetlands have, especially as a resting place for migratory birds. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, enacted 1973), also called the Washington Convention, evolved from an IUCN resolution (IUCN, 2000). The Bonn Convention on the Conservation of Migratory Species of Wild Animals (signed in 1979) is another example of early global biodiversity-related treaties.

Moreover, there are many other treaties without a direct link to the UN, such as the International Convention for the Regulation of Whaling, or the Bern Convention on the Conservation of European Wildlife and Natural Habitats. Most of them have a more regional focus.

Other conventions, though not established with a primary focus on

biodiversity, exert significant influence on the integrity of ecosystems and biodiversity through standards, scope and effectiveness of framework regulation. The UN Convention of the Law of the Seas (UNCLOS), International Maritime Organisation (IMO) and the World Trade Organisation (WTO) exemplify this, since they contain obligations relevant to biodiversity conservation.

This fragmented structure results in juridical and functional overlaps, as Ekström et al. (2009) describe. In order to provide policy-makers with assessments of scientific knowledge the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) was created in 2012.

International treaties and conventions are considered *hard law*, therefore binding for their signatories (Klemm & Shine, 1993). However, global governance is impeded by the consensus-based and voluntary nature of public international law, lacking effective sanction mechanisms. The current situation of most species and habitats is a clear example of the *tragedy of the commons*, a problem where several users interact and contribute to the exploitation, destruction or depletion of a commonly owned resource (in this case biodiversity). This might explain why a private, economic-driven governance has grown in order to counter such tragedies.

Private actors, even at the global level, have created tools to compensate for low legal norms. For example, the Forest Stewardship Council (FSC) labelling forest products, and the Marine Stewardship Council (MSC) labelling marine products, have gained recognition and are now internationally accepted. Other forms of public-private cooperation, like the European Business and Biodiversity Initiative, bring together industry, decision-makers and NGOs.

Due to their significant size, well-established networks and considerable funding, a number of NGOs are able to influence biodiversity governance as well. Some of these organisations have been operating for more than a century and have become considerable players in the field. They fund studies and provide scientific observation data through their vast network of members. In regard to biodiversity, the International Union for Conservation of Nature and Natural Resources (IUCN), Conservation International (CI), WWF, and the Nature Conservancy are the most prominent NGOs. Furthermore, there are advocacy groups specialised in certain groups of species, like BirdLife International or Oceana.

Some authors like Daccache (2013) describe the expansion of biodiversity governance towards non-state actors as a shift to neoliberal governance. In his view, organisations like IUCN moved from a preservationist (1950s-60s) to a utilitarian (1960s-80s) to an economic and neoliberal approach (1990s-present).

Biodiversity governance within states

Parties to the CBD are obliged to submit National Biodiversity Strategy Action Plans (NBSAPs). This task is performed with limited vigour. While certain nations have dedicated enormous amounts of workforce and finance to halt biodiversity loss within their territories, others prioritise policies that are non-sensitive to this issue. A typical example can be found in subsidies. According to the current Global Biodiversity Outlook 4 (Secretariat of the Convention on Biological Diversity, 2014) the CBD's decision to phase out subsidies harmful to biodiversity (Aichi target 3) is implemented slowly. National legislation in different countries still provides contradictory incentives (e.g. to preserve biodiversity and to engage in harmful activities).

Box 2:

Species Diversity Benefits – The Monster Case

Biodiversity and functioning ecosystems are vital in order to maintain our current state of the environment. But even on a less systematic scale biodiversity can be of great importance for humans. Single species may comprise valuable traits that help humanity in various, thus far unknown ways. One example for this is *Heloderma suspectum*, the Gila monster. It is a heavy-bodied, venomous lizard home to North-America and known to humans for several thousand years. However, it was just in the past decades that scientists discovered further value of *H. suspectum* for humans.



Image 2: *Heloderma suspectum**

Exanatide is a drug synthesised from the saliva of *H. suspectum* which showed positive results in sustaining healthy glucose levels and a progressive weight loss among people who suffer from type II diabetes mellitus (University of North Carolina at Chapel Hill, 2007). Considering the large amount of species as yet undiscovered, biodiversity represents an immense pool of potential values and uses for humans.

* See Photo Credit Section

Precautionary principle and intergenerational justice

Apart from the previously mentioned functions and services provided by biodiversity, it is most likely that there are many more which are not yet discovered. Those *unknown unknowns* (Myers, 1993) need protection, even for utilitarian reasons, because it is hardly possible to estimate their future value. Due to this high uncertainty and the irreversibility of biodiversity loss, it behoves us to apply the precautionary principle. By putting biodiversity at stake,

humanity is taking an immeasurable risk. As was already expressed in the Millennium Ecosystem Assessment of 2005, we need to use the precautionary principle when linking biodiversity and human well-being (Millennium Ecosystem Assessment, 2005).

Besides addressing the well-being of present generations, the precautionary principle also takes future generations into account. Hence, we advocate to combine the precautionary principle with the concept of intergenerational justice, thereby following the guidelines of IUCN to combine complementary principles (IUCN, 2005). Intergenerational justice is a common concept in climate change policies, but it has not been introduced in biodiversity conservation to the full extent. We see the potential to apply intergenerational justice to biodiversity governance and make it a key concept for policy making. In order to do so, we must respect three normative principles: conservation of options, maintenance of the quality of the planet, and provision of equitable rights of access to resources (Weiss, 1992). A loss of biodiversity directly implies a loss of options for future generations, since human capital is not able to entirely substitute natural capital. The idea of *strong sustainability* - which considers natural capital non-substitutable - should be encouraged when addressing biodiversity conservation. This stands in contrast to the overoptimistic *weak sustainability* approach - which believes natural capital to be substitutable by human capital.

Intergenerational justice can be framed as a right of future generations, as a duty for present generations, but also as temporal dimension of human solidarity (Weston, 2012). That common temporal dimension for the three conceptions of intergenerational justice applies to underrepresented generations, both the ones to be born and the ones who are too young to decide for themselves. If the current trends of

biodiversity loss continue, the impacts of biodiversity loss may take place during the lifetime of today's children, as it is the case of climate change.

Biodiversity loss is a global issue

The current and worrisome state of the Earth's biodiversity and the urgency to take action for both, present and for future generations makes it necessary to tackle the problem from a global governance perspective. The Sustainable Development Goals (SDGs) provide a window of opportunity for a global framework in the post-2015 agenda to explicitly link biodiversity with human development, and thus enabling us to transcend the moral obligation in conserving biodiversity and make it a legal duty and right (Weston, 2012). Even though the SDGs are considered *soft law*, their influence on policy makers can lead to legal reforms and to the adoption of these goals in national regulations, as has happened before with the Universal Declaration of Human Rights and the Millennium Development Goals (MDG Achievement Fund, 2013).

A proposal for an integrated SDG on biodiversity

The current SDG proposition for biodiversity does not cover the issue comprehensively. Biodiversity has a specific goal in the SDGs agenda (Goal 15), referring to terrestrial ecosystems. However, it does not directly address biodiversity conservation of marine species and ecosystems. Instead, Goal 14 frames the conservation in the oceans as the sustainable management of fisheries. Marine ecosystems have nevertheless been mentioned in the Major Groups and Other Stakeholder's Final Compilation Document on SD Goals and Targets (OWG13) (United Nations, 2014), as well as the adverse impacts on them, such as marine pollution or ocean acidification

(proposed Goal 14). The proposed Goal 15 refers only to poaching of both terrestrial and marine species. Instead, biodiversity should be comprehensively considered in one common goal, with the same conservation principles. The final Open Working Group (OWG) session advocates for a biodiversity goal in line with the Aichi Targets, and this might be the right path to follow, both scientifically and morally.

The content of the final sustainable development goal on biodiversity should integrate all of Earth's biodiversity, with specific mentioning of the protection of ecosystems. Therefore, we suggest the inclusion of two elements, namely *Dimensions* and *Underlying Principles*.

Dimensions make reference to the different types of benefits humans derive from biodiversity, comprising *provisioning*, *regulating*, and *cultural* values. *Underlying principles* steer the process of defining and implementing the biodiversity SDG and should include the precautionary principle and an intergenerational justice perspective.

In order to fully operationalise the precautionary principle, it has to be framed as call for action, with the active participation of different stakeholders. The scientific community is a key stakeholder in this process by providing the world with the best information available and by recognising what it is still unknown (IUCN, 2005). There are many suggestions for a correct way to set effective SDGs, most of them referring to the relation between society and ecology and the system dynamics involved (Norström et al., 2014). In order to make an effective impact in the post-2015 global biodiversity governance, a well-structured SDG is needed, with a clear definition of indicators and means of implementation.

Box 3:

Ecosystem Diversity Benefits – Stop the Spread

Biodiversity also plays an important role at an ecosystem level. Diverse ecosystems are more resilient against external and internal threats, and that can ultimately have a crucial impact on humans. Losses of biodiversity can increase the incidence of infectious diseases (Keesing et al., 2010), and their prevalence (Wood et al., 2014). Ticks from the genus *Borrelia burgdorferi* which can cause the commonly known Lyme disease. These arachnids can acquire the infection if they feed on an infected host and can then pass it on to the next host - including humans (Hough, 2013).



Image 3: Adult Deer Tick*

In North East USA, ticks feeding on white-footed mice can move to another host and eventually to humans. Other rodents, such as opossums, have a high chance of grooming and then killing ticks that are parasitising them. Therefore, an ecosystem containing opossums reduces the prevalence of Lyme disease in the ecosystem, as well as its incidence in nearby human populations (Keesing et al., 2010). This is what has been coined as 'dilution effect' of biodiversity, by which "infection rates among vectors and disaster risk will be lower in highly diverse host communities" (Hough, 2013, p. 274).

* See Photo Credit Section

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