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Biodiversity Indicators: the accounting point of view

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Abstract

According to the Convention on Biological Diversity, biodiversity is 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. The key value of biodiversity lies in its role in ensuring the functioning of ecosystems and their ability to provide services to humans and other living organisms that comprise them. For that reason, maintaining a sufficient degree of biodiversity is the key to the continued delivery of essential ecosystem services and the need to ensure the conservation of biological diversity is now widely accepted. In spite of this global sentiment, there is not a national or international convergence towards a framework to report to different stakeholders' groups the performance of organizations like protected areas and national parks, in terms of their biodiversity and the conservation activities they are achieving. After describing the concept of biodiversity, its value and the information needs of the community related to it, the main purpose of the paper is to propose a theoretical and systemic framework for its reporting by public sector organizations established for the protection of the natural capital, by means of some specific indicators deduced mainly by the literature concerning biological sciences. Following the GRI (*Global Reporting Initiative*) guidelines, these indicators, interpreted in terms of KPI (*Key Performance Indicators*), should lead to an increase in the transparency and in the accountability of Protected Areas.

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1. Introduction

The term biodiversity refers to the variety of life on Earth at all its levels, from genes to ecosystems, and the ecological and evolutionary processes that sustain it. Biodiversity includes not only species we consider rare, threatened, or endangered, but every living thing —even organisms we still know little about, such as microbes, fungi, and invertebrates.

The 1992 United Nations Earth Summit defined "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*". This definition is used in the United Nations Convention on Biological Diversity.

Biodiversity is under increasing pressure. Habitats available to wildlife have undergone dramatic modifications, and significant biodiversity has already been lost over modern times. In order to counter global biodiversity loss and consequent impacts on human well-being, there have been several recent high-profile international political commitments to improve biodiversity conservation. These have mainly consisted of goal setting, in the form of conservation targets to which governments, decision-makers, and the international community are committed; the most notable example of which are the targets set by the Convention on Biological Diversity (CBD; Convention on Biological Diversity, 2011). However, because of the complexity of biological systems, and a lack of long-term biodiversity data, nations are hampered not only in assessing progress towards such targets, but also in developing appropriate policy and legislative responses to reverse biodiversity declines.

Global commitments to stemming biodiversity loss have contributed to the development of methods to track changes in many metrics of biodiversity, and addressing biodiversity information requirements has become one of the fastest growing areas of research in the field of conservation biology.

It has been suggested that effective conservation requires addressing three fundamental questions (Salafsky *et al.*, 2002), namely:

- what should our goals be and how do we measure progress in reaching them?
- how can we most effectively take action to achieve conservation?
- how can we learn to do conservation better?

The effectiveness of biodiversity conservation therefore depends on our ability to define, measure, and monitor biodiversity change, and on adaptive responses to biodiversity loss of a wide group of stakeholders and actors, including governments, local communities, and international society.

The objective of this paper is to evaluate the best way to report and to monitor the biodiversity level and conservation activities in Protected Areas, according to the GRI guidelines, in terms of different metrics that will assume the nature of *Key Performance Indicators* (KPI).

After the introduction, the first paragraph will first underline the need to consider and to value biodiversity and then the issue of its reporting to various stakeholders. The second paragraph will present the GRI approach to biodiversity reporting. The third paragraph will be focused on the presentation of some indicators, useful to assess the Biodiversity in Protected Areas. Finally, the fourth paragraph will be devoted to discussion and conclusions, with some indications for future research.

2. Biodiversity: valuation and reporting issues

The combination of unsustainable consumption in developed countries and persistent poverty in developing nations is destroying the natural world and the biodiversity they encompass. Extinction is the gravest consequence of the biodiversity crisis, since it is irreversible. The road to extinction is made even more perilous to people by the loss of the broader ecosystems that underpin our livelihoods, communities, and economies (McNeely et al., 2009). Loss of biodiversity on land in the past decade alone is estimated to be costing the global economy $500 billion annually (TEEB, 2009). Reduced diversity may also reduce resilience of ecosystems and the human communities that depend on them.

One of the most important issue before deciding what is the best way to value and to report biodiversity, is how to identify it. How do we know whether biodiversity has changed? Scientists use different methods to assess biodiversity. Biodiversity among areas can be compared with statistical indexes of species diversity (Magurran,

1988). Most indices combine two different metrics: the total number of species and the relative abundances of all species (evenness) in a sample. The simplest measure of diversity, the number of species in a given area, is called within-area diversity or, technically, alpha diversity. Ecologists generally call this measure species richness; they imply no economic value by using *rich* or its opposite, *poor*. Only their presence (not their abundance) is taken into consideration in counting the number of species in an area.

After the identification step, it is important to recognize the value that can be attributed to the biodiversity. The starting point to take into consideration is the strict connection between biodiversity and the services provided by ecosystems. The key value of biodiversity lies in its role in ensuring the functioning of ecosystems and their ability to provide services to humans and other living organisms that comprise them. As the foundations of ecosystems and habitats, biodiversity supports the provision of basic human needs such as food, shelter and medicines. It allows ecosystems to maintain oxygen in the air, enrich the soil, provide a habitat for flora and fauna, protect them against storm damage and regulate climate. Consequently, maintaining sufficient biodiversity is key to the continued delivery of essential ecosystem services. Because most ecosystem services are provided freely by natural systems, we typically become aware of their value and importance only when they are lost or diminished. Genes, species, and ecosystems of direct, indirect, or potential use to humanity are often referred to as "biological resources" (McNeely and others,1990; Reid and Miller, 1989; Wood, 1997). That is the reason why biodiversity can be valued in different ways. In particular, it can be attributed a biological value, deriving from the components which are the source of all our food and many of our medicines, fibers, fuels and industrial products. The direct uses of the components of biodiversity contribute substantially to the economy. But it is possible to consider even the social and cultural values: many people develop a deep aesthetic appreciation for biodiversity and its components. This appreciation has several dimensions, including an appreciation of how biodiversity reveals the complex and intertwined history of life on Earth and a resonance with important personal experiences and familiar or special landscapes. Interest in nature is manifest in many hobby activities, including bird-watching and butterfly-watching; keeping reptiles, tropical fish, and other "exotic" species as pets; raising orchids or cacti; participating in native-plant societies; viewing nature photographs and reading nature writing; and watching nature televisions shows.

It is possible to conclude that biodiversity provides a wide array of services and amenities for people who might or might not value its individual components—individual genes, species, and ecosystems—and the diversity of components. Some aspects of biodiversity are valued directly; while others are valued for their contributions to ecosystem support and, hence, to sustainable production of things that are valued directly. The economic value of biodiversity has its place in the policy-making process. Economic valuation is an attempt to provide an empirical account of the value of services and amenities or of the benefits and costs of proposed actions (projects or policies) that would modify the flow of services and amenities. Economic valuation provides a utilitarian account, that is, an account of contribution to the satisfaction of human preferences (Committee on Noneconomic and Economic Value of Biodiversity, Board on Biology Commission on Life Sciences, National Research Council, 2003).

The issue of biodiversity's identification and valuation is strictly related to the reporting and the monitoring ones. The last two gain a greater value in the case of threats to the biodiversity in a specific area (or hotspot). As a matter of fact, extinction is a global phenomenon, with impacts far beyond nearby administrative borders. More practically, biodiversity, the threats to it, and the ability of Countries to pay for its conservation vary around the world. But, in most cases, conservation is much more a local issue. People generally care more about the biodiversity in the place in which they live. They also depend upon these ecosystems the most – and, broadly speaking, it is these areas over which they have the most control. The "control issue" is of primary importance, as stakeholders (in a very broad sense) wish to know what is the biodiversity value of the areas where they live and all activities Institutions that are in charge for them are undertaking to conserve and improve the ecosystems services. In the transparency era, all Organizations and Institutions will be expected to demonstrate their proactive commitment towards a sustainable future through reporting and other disclosures, which will have to clearly explain their contributions to tackling society's real issues, such as food and water security issues, wealth distribution issues and climate change. This will be accomplished, in great measure, through regulated and non-regulated disclosure formats as well as other forms of external communication. Aiming to prepare reports and communications that express real efforts towards concrete and sustainable solutions, new metrics will be created where there is a specific unmet need. A large number of metrics has been created in recent decades; consequently, in the next decade, companies and other players could focus on working with partners to build on what already exists to create solutions to improve the planning and

decision-making processes (GRI, 2015a). All Protected Areas (Hanna, et al., 2008), in the same way, should be accountable (Mintz, 2014) and consider all strategically (materially) relevant issues connected to biodiversity in their reports.

The next paragraph will be devoted to the illustration of GRI guidelines for biodiversity reporting, interpreted as a useful tool in the understanding of the topic.

3. GRI Guidelines to Biodiversity reporting and Indicators

According to the GRI (GRI, 2007; GRI, 2015b), the report should be prepared according to some specific principles:

- Stakeholder inclusiveness: the organization should identify its stakeholders, and explain how it has responded to their reasonable expectations and interests;
- Sustainability context: The report should present the organization's performance in the wider context of sustainability;
- Materiality: The report should cover aspects that reflect the organization's significant economic, environmental and social impacts or substantively influence the assessments and decisions of stakeholders;
- Completeness: The report should include coverage of material aspects and their boundaries, sufficient to reflect significant economic, environmental and social impacts, and to enable stakeholders to assess the organization's performance in the reporting period.

The Guidelines contain two categories of Performance Indicators: Core (relevant to most reporting organizations) and Additional (of interest to most stakeholders). In the first category, each organization should report a description of significant impacts of activities, products and services on biodiversity in Protected Areas and Areas of high biodiversity value outside Protected Areas.

In particular, it should be important to report the nature of significant direct and indirect impacts on biodiversity with reference to one or more of the following:

- Construction or use of manufacturing plants, mines and transport infrastructure;
- Pollution;
- Introduction of invasive species, pests and pathogens;
- Reduction of species;
- Habitat conversion;
- Changes in ecological processes outside the natural range of variation.

The location and size of land owned, leased, managed in, or adjacent to, Protected Areas and Areas of high biodiversity value outside Protected Areas, should be reported too.

Moreover, significant direct and indirect, positive and negative impacts with reference to the following should be reported:

- Species affected;
- Extent of areas affected;
- Duration of impacts;
- Reversibility or irreversibility of the impacts.

The Additional Indicators can be identified in the following:

- Habitats protected or restored;
- Strategies, current actions and future plans for managing impacts on biodiversity;
- Number of IUCN Red List species and national conservation list species with habitats in Areas affected by operations, by level of extinction risk.

In the light of the previous points, it is possible to underline the necessity to integrate the GRI Guidelines and Standards of Disclosure with some other metrics, in particular for Protected Areas. A tentative integration will be illustrated in the next paragraph. General Guidelines of reporting remain valid and represent the main conceptual framework, useful for each Organization.

4. Biodiversity Indicators: a tentative integration for Protected Areas

Biodiversity reporting, by some metrics/indicators, is nowadays used mainly at a National level (for example: Department for Environment, Food and Rural Affairs, UK, 2014). But, as pointed out in the previous paragraphs, this kind of reporting is very useful for stakeholders of each organization, private or public, whose activities impact, in a direct or indirect way, on biodiversity loss and/or conservation. It is particularly valid for Protected Areas. One of the main, and more general, indicator, is the one proposed by the IUCN Red List (IUCN, 2009). The IUCN Red List Index (RLI) measures trends in the overall extinction risk ('conservation status') of sets of species, as an indicator of trends in the status of biodiversity. Extinction is a key measure of biodiversity loss that has resonance with the public and decision makers, and that has clear relevance to ecological processes and ecosystem function. The RLI is calculated from the number of species in each Red List Category (Least Concern, Near Threatened, Vulnerable, Endangered, Critically Endangered), and the number changing Categories between assessments as a result of genuine improvement or deterioration in status.

The RLI falls under the CBD Biodiversity 2010 Target focal area: *Status and Trends of the Components of Biological Diversity*. It is the only indicator that has been adopted for immediate testing under the CBD headline indicator: *Change in status of threatened species*. Disaggregations of the RLI are relevant to three other CBD 2010 target focal areas:
1. Under Threats to biodiversity and the headline indicator Trends in Invasive Alien Species, an RLI can be calculated to show trends in the impacts of invasive species and their management on biodiversity;
2. Under the focal area Sustainable Use, RLIs showing trends in the impacts of use and its management provide a useful measure;
3. Under the focal area Ecosystem integrity and ecosystem goods and services and the headline indicator Biodiversity for food and medicine, an RLI showing trends in the status of species used for food and medicine is relevant.

The CBD, in its 2010 report (CBD, 2010), illustrates some provisional indicators for assessing progress towards the 2006 targets. It is important to underline that CBD distinguishes among "measures", "metrics" and "indicators", defining:
- measure: a value that is quantified against a standard at a point in time;
- metric: a set of measurements;
- indicator: metrics presented in a meaningful way, usually by adding context.

In the view of CBD, the current framework of global indicators should be modified and simplified into four 'focal areas': Threats to Biodiversity; State of Biodiversity; Ecosystem services; and Policy Responses. Existing indicators should be re-aligned with the new framework, as appropriate, in order to maintain continuity and enhance their use. The relationships between the focal areas and between indicators and targets should be clearly explained and documented, including their scientific basis (Armon, Hanninen, 2015) and assumptions.

Main strategic goals can be:
- Addressing the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society;
- Reducing the direct pressures on biodiversity and promote sustainable use;
- Improving the status of biodiversity by safeguarding ecosystems, species and genetic diversity;
- Enhancing the benefits to all from biodiversity and ecosystem services;
- Enhancing implementation through participatory planning, knowledge management, and capacity building.

For each of the previous goals it will be possible to identify new indicators, for both national and local levels.

5. Discussion and conclusions

Biodiversity conservation is one of the main challenges that Governments and Institutions will face in next years. The reporting of its value and of all activities that are accomplished in Protected Areas to interested stakeholders is of primary importance in the building of a public awareness of this issue. In fact, the concept of public accountability is valid also for this kind of Organizations and for their effective management. The GRI represents one of the most relevant examples of successful ventures in this sense. The general framework represented by its

Guidelines is a valid tool for all Institutions interested in giving a valid picture of all Capitals (also the Natural Capital) producing value for an Organization and for the society. But this framework shall be implemented, adapted and improved, according to the specific goals fixed. In this way, the IUCN Red List Index and the CBD Indicators are very important metrics used to report Biodiversity. One of the main challenges related to their consideration is that some of them, because of the lack of available information, could suffer from difficulties of calculation.

In the future, it will be important to raise the strategic priority of biodiversity conservation. Probably, one of the best way to reach this goal, will be the communication of the fact that biodiversity underpins the delivery of ecosystem services for human benefit and that future costs of not conserving biodiversity could be even greater than the current (insufficient) investment in conservation. Moreover, it is important to present some possible criteria for useful and effective indicators. They should be:

- measurable;
- sensitive over time;
- scaleable between global and national levels;
- as far as possible, based on data that already exist, or for which there are realistic and   feasible programmes to bring the data together.

In conclusion, I want to point the main limitation of the paper, as it is only a theoretical one. The aim, in the future, is to integrate it with an empirical analysis based on the collection and the analysis of a sample of Protected Areas reporting activities, at the national and at the international level.

References

Armon, R. H., Hanninen, O. (2015). *Environmental Indicators*, Springer.
CBD (2010). CBD Technical Series n. 53. *Biodiversity Indicators & the 2010 biodiversity target: outputs, experiences and lessons learnt from the 2010 Biodiversity Indicators Partnership*.
Committee on Noneconomic and Economic Value of Biodiversity, Board on Biology Commission on Life Sciences, National Research Council (2003). *Perspectives on biodiversity. Valuing its role in an everchanging world*, National Academy Press, Washington D.C.
Convention on Biological Diversity (2010). *Global Biodiversity Outlook 3*. UNEP. Available at: http://www.cbd.int/gbo3/.
Convention on Biological Diversity (2011). *Strategic Plan for Biodiversity 2011–2020, including Aichi Biodiversity Targets*. Available at: http://www.cbd.int/sp/.
Department for Environment, Food and Rural Affairs, UK (2014). *UK Biodiversity Indicators 2014, Measuring progress towards halting biodiversity loss*.
GRI (2007). *Biodiversity. A GRI reporting resource*.
GRI (2015a). *Sustainability and Reporting trends in 2025, Preparing for the future*.
GRI (2015b). *G4 Sustainability Reporting Guidelines, Reporting Principles and Standard Disclosures*.
Hanna, K., Clark, D., Slocombe D. S. (2008). *Transforming Parks and Protected Areas, Policy and Governance in a changing world*, Routledge, New York and London.
IUCN (2009). International Union for Conservation of Nature and Natural Resources, *IUCN Red List Index, Guidance for National and Regional Use*. Version 1.1.
Magurran, A. E. (1988). *Ecological diversity and its measurement*, Princeton NJ, Princeton University Press.
McCullough D. R. (ed). (1996). *Metapopulations and wildlife conservation*, Washington DC, Island Press.
McNeely, J. A., Miller, K. R., Reid, W. V., Mittermeier, R. A., Werner, T. B. (1990). *Conserving the world's biological diversity*. Available at: IUCN, World Resources Institute, Conservation International, World Wildlife Fund-US, World Bank.
McNeely, J. A., Mittermeier, R. A., Brooks, T. M., Boltz, F., Ash, N. (2009). *The wealth of nature: ecosystem services, biodiversity, and human well-being*, CEMEX, Mexico City.
Mintz, S. (2014). *Accounting for the Public Interest, Perspectives on accountability, professionalism and role in society*, Springer.
Reid, W. V., Miller, K. R. (1989). *Keeping options alive: the scientific basis for conserving biodiversity*, Washington DC, World Resources Institute.
Salafsky, N., Margoluis, R., Redford, K. H., Robinson, J. G. (2002). Improving the practice of conservation: a conceptual framework and research agenda for conservation science, *Conservation Biology*, 16, 1469-1479.
TEEB (2009). *The economics of Ecosystems and biodiversity for National and International Policy Makers*, UNEP, Bonn.
Wood, P., M. (1997). Biodiversity as the source of biological resources: a new look at biodiversity values. *Environmental Values*, 6, 251-268.