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On the potential policy use of some selected biodiversity indicators: limitations and recommendations for improvements – Short Communication

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ABSTRACT: In order to facilitate the use of biodiversity indicators in policy making at the country level, a few and well-established indices should be suggested. Promising candidates include biodiversity-related indices of the Convention on Biological Diversity; their current use and performance are evaluated through a Hungarian case study. Especially indices of the ecosystem level have already been in use, but they are not necessarily useful measures of the state of biodiversity in their current form. For example, ecosystems suggested globally for monitoring (forests and marine habitats) are not present in all the countries, thus the way of ecosystem selection should be standardized, not the actual ecosystem types. Besides the information on the extent of some selected habitats, the original cover should also be considered to evaluate the present situation. Recommendations are demonstrated in the case study. With the use of existing data, the applicability of certain indices can be improved, but in the long run, ecosystem-based indices of the natural capital should be favoured.

Keywords: convention on biological diversity; environmental policy; policy making; ecosystem services; Hungary; document analysis

There is increasing knowledge of the limits of commonly used indicators of economic performance. GDP (Gross Domestic Product) is the most typically used index, which summarizes the monetary value of all final goods and services that are produced in a country within a given period. From the aspect of environmental sustainability, its main shortcoming is that it does not take into account the aspects influencing the total national capital, such as the depletion of natural resources that serve as the basis for economic growth. Despite the fact that environmental indices have been used for the longest period among sustainability indicators (Jeníček 2013), a lot is still to be done until their general acceptance and policy incorporation. "Ecological footprint" (Wackernagel, Rees 1996) is probably the most acknowledged and widely used environmental sustainability index; however it focuses mostly on the consumption of natural resources. Supply (stock) is considered in the subindex "*Biocapacity*"; however, area (global hectare) is used as the common baseline, without distinguishing between characteristic differences that heavily influence the functioning of ecosystems, such as the ratio of introduced species, naturalness of ecosystems, functioning connections along food webs, etc.

Biodiversity contributes to human well-being via providing and maintaining several ecosystem services (MEA 2005; Kumar 2010; Mace et al. 2012), so its status should be closely monitored and taken care of. Therefore, this paper focuses on biodiversity indices. Though some biodiversity indicators do exist, little is known about their applicability in the policy arena.

Selection of a proper measure (or a set of measures) is required in order to ensure biodiversity to be taken into account. Even if it is not possible to characterize all aspects by a single index (Vačkář et al. 2012), there is a limited number of indices that can be direct-

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ly used to vindicate a policy (Mace, Baillie 2007). For international comparison, similar, standardized indices should be chosen.

Due to the political significance of the Convention on Biological Diversity (CBD) – it was signed by the majority of the government leaders – its indicators may seem appropriate choices for policy application. The aim of this paper is to evaluate the performance, present status and applicability of CBD biodiversity indices at the country level. Hungary is used as a model country, which has been a member of the European Union since 2004 and so it is required to publish national environmental statistics regularly. To assess the direct applicability and reliability of indices in their current form, the related statistics were compared to other available scientific results.

The paper is connected to the 2010 target aiming to halt biodiversity loss, and the Pan-European SEBI (Streamlining European Biodiversity Indicators) initiative that aims to develop a European set of biodiversity indicators to evaluate the progress towards the European 2010 target. Although the policy agenda is constantly evolving (e.g. the Aichi targets have been introduced), previous targets should be remembered and monitored, especially as the lessons learnt may be important sources during fine-tuning.

MATERIALS AND METHODS

Biodiversity Indicators Partnership (in which SEBI is also involved) was established under the aegis of CBD to facilitate and coordinate development of indicators that are classified into seven focal areas. Focal area 1 collects ten indices describing the "Status and trends of the components of biodiversity" (Biodiversity Indicators Partnership 2010), they are in the focus of this paper.

Document analysis, which is a well-established technique within qualitative research, was the main method used. Science generally prefers quantitative techniques in order to confirm hypotheses; however, the flexibility of qualitative methods (e.g. data collection and research questions are adjusted according to what is learnt, see Mack et al. 2005) can be fruitfully exploited especially when social sciences are also involved and an interdisciplinary approach is needed, like in the case of environmental policy. Though in most cases document analysis is combined with other methods (such as in-depth interviews, focus groups, participant observations etc.), it can also stand alone (Bowen 2009).

For all CBD indices, the presence of guidelines for national applications was looked for. Also, it was checked whether the indices have already been reported by the Hungarian Central Statistical Office, or any central governmental body (such as the Ministry of Rural Development, which is responsible for the environmental affairs as well) or other international organizations (such as WWF or FAO, which prepare country reports related to biodiversity or certain ecosystems, like forests). Emphasis was placed on ecosystem-level indicators; statistics and academic sources of the current and original patterns were analysed and compared.

RESULTS AND DISCUSSION

Most of the indicators cannot be used or have not been applied yet or simply are not relevant at the country level. Table 1 shows Focal area 1 indices. Global application and the use in Hungary are also shown, with the responsible organisation.

Gene and species level indicators

The two indicators of gene level, "Genetic diversity of terrestrial domesticated animals" and "Ex-situ crop collections" are under methodological review; development of national guides for standardized use is expected in the future.

There are three indices based on species data: Living Planet Index (*LPI*), Global Wild Bird Index and Red List Index (*RLI*). National guides are relatively new in all the cases (Bubb et al. 2009a; McRae et al. 2009; Sheehan et al. 2010; respectively), they have not been applied in Hungary yet (though a similar composite Common Bird Index is calculated for EUROSTAT).

There is a remarkable overlay between the species level indices: e.g. birds are accounted in all of them, in spite of the fact that the selected indices aim to measure different aspects of biodiversity (Vačkář et al. 2012). However, as a limited number of indices should be chosen in policy making, overlaps should be avoided. Furthermore, threatened species are accounted for both in *LPI* and *RLI* (conservation biologists collect data mostly about them); their population sizes are more subjected to drastic changes due to stochastic events in demography, local disasters, etc. Therefore, such populations are not necessarily good and sensitive indicators of the changes in the state of ecosystems (Collen et al. 2009).

A major problem with species-based indices emerges from a community-based perspective: species level indices focus mostly on charismatic

Table 1. Application status of CBD biodiversity indices globally and in Hungary

Headline indicators	Component	Global status	Status in Hungary
Trends in genetic diversity	ex-situ crop collections	under development	under development
	genetic diversity of terrestrial domesticated animals	under development	
Trends in abundance and distribution of selected species	Living Planet Index	in use (WWF)	–
	global Wild Bird Index	in use nternational (EUROSTAT)	common bird index is in use (HONCS)
Change in status of threatened species	IUCN Red List Index	in use (IUCN)	–
Trends in the extent of selected biomes, ecosystems, and habitats	extent of forests and forest types	in use (FAO)	in use (CAOFD)
	extent of marine habitats	in use (FAO, UNEP)	not relevant
Coverage of protected areas	coverage of protected areas	in use (IUCN, UNEP)	in use (Ministry of Rural Development)
	protected area overlays with biodiversity	in use (IUCN, UNEP)	–
	management effectiveness of protected areas	under development	under development

The responsible organization is shown in parenthesis. HONCS: Hungarian Ornithological and Nature Conservation Society (MME). Its data are used for national statistics that are reported for EUROSTAT. The Central Agricultural Office Forestry Directorate (CAOFD, formal State Forest Service) is the national forest authority responsible for inventory, forestry statistics and management planning. The former Ministry of Environment and Water (that prepared the last National Report to the CBD in 2009) has been involved within the Ministry of Rural Development since 2010

species (vertebrates). Adaptation of an ecosystem approach to species selection would be needed: the examination of community structure and functions to choose those key species (often invertebrates, Wilson 1987) for monitoring that are the most important ones in maintaining ecological flows, functioning and stability (Jordán, Scheuring 2002). However, this approach is highly data-demanding, which imposes a barrier to general use.

Ecosystem level indicators

At the ecosystem level, seven thematic programmes were established within CBD that focus on some of the major biomes and ecosystems on the planet: agricultural systems, dry and sub-humid lands, forests, inland waters, islands, marine and coastal ecosystems, mountains (CBD SBSTTA 2005). Out of these seven biomes and ecosystems, only two are monitored by standardised indicators: forests and marine habitats, as they are the most important ones in terms of biodiversity at the global scale. The latter is not relevant in Hungary, which is a landlocked country, and similarly, one or both of the selected habitats need not be relevant for some other countries. Therefore, their selection need not reveal the state of a country's ecosystems. Instead, monitoring of the two most relevant habitats would be more accurate. "Relevance" can be defined in many ways, what is important is that the logic of selection should be standardized, not the actual measures. The use of the original cover as a baseline can be an example that is often used for conservation purposes to reflect the magnitude of changes caused by human activity (Brink 2000), and indirectly, the status of naturalness and biodiversity. Using climate data, original vegetation cover can be estimated relatively easily and cheaply (e.g. by means of Delphi method, through the aggregation of expert opinions, see Landeta 2006). Thus, the following index is suggested to clarify current patterns (Eq. 1):

$$E_i = c_1/c_0 \quad (1)$$

where:

E_i – extent of the i^{th} habitat type (assuming that i is the most abundant or second most abundant habitat type in the original vegetation),

c_1 – current cover,

c_0 – original cover.

Table 2 displays the calculations for Hungary and shows a clearer picture about the state of the selected ecosystems (in terms of their extent).

Table 2. Current extent of the originally most abundant habitat types in Hungary (in %)

Habitat type	c_0	c_1	E
i_1: forests	86[1]	23[2]	26.7
i_2: grasslands (on loess)	7.5[1]	0.27[3]	3.6

c_0 – original cover, c_1 – current cover; at the moment current cover of forests and marine habitats is used by the CDB, the letter is non-existent in Hungary ([1]Zólyomi 1989; [2]FAO 2010 and [3]Molnár et al. 2008)

Originally forests were the most abundant habitats; they covered 85–87% of the country area (Zólyomi 1989). Therefore, the CBD-indicator Extent of forests and forest types may be a meaningful measure for Hungary, when the current cover is compared to a baseline as it was suggested above. The CBD-index is based on the FAO's Global Forest Resources Assessment and is regularly reported; the index value in the Hungarian case is 23% (FAO 2010).

Originally the second most abundant habitat type was that of grasslands (mostly on loess soil); however, the majority of those areas are today subjected to agricultural activity. Only a small portion has been preserved, mostly as "loess islands of saline pusztas, as well as on the road verges, earthworks, county boundaries ... but most of the stands are heavily degraded" (Molnár et al. 2008, p.95). Results shown in Table 2 reveal that from a conservation perspective, Hungary performs slightly better than if the current status was reported alone – but only if the extents are regarded. The index can be further modified to incorporate also information about the naturalness, following the logic of Natural Capital Index (Brink 2000), for instance:

$$NCI = \text{ecosystem quantity} \times \text{ecosystem quality}$$

Naturalness of Hungarian forests was estimated between 2001 and 2004 with the result of 48.57% on average, protected areas included (Bartha et al. 2005), which gives NCI_{forest} as 13%. In other words, 13% of the (baseline) natural capital (interpreted as supporting ecosystem services, Czúcz et al. 2008) has been preserved.

The remaining three indices under the headline indicator "Coverage of protected areas" are to reflect how policy makers react to the worries about biodiversity loss. Management effectiveness of protected areas is under development; while protected area overlays with biodiversity is newly introduced (Bubb et al. 2009b); it has not been used yet in the current form. Future application is forecasted as most of the data are available. Coverage of protected areas in Hungary is 5.14% (World Database on Protected Areas, UNEP-WCMC, IUCN 2011). Details of FAO (2010) reveal that Hungary does not have any primary forests, and the ratio of naturally regenerated forests is only 4.8%. All of these forests are located in protected areas. Knowing that the ratio of forests in the original vegetation was 85–87% (Zólyomi 1989), the conclusion is that forests are slightly overrepresented (93.39%) among protected habitats.

CONCLUSIONS

Besides the fact that the public is becoming more and more interested in conservation measures (Drábková, Šišák 2013), there is an urgent need to incorporate biodiversity-related information in policy-making, due to the depletion of natural resources. However, the number of indices that can be used for such purposes is strictly limited. There are some general criteria for a "good" (ecological) indicator: it should be sensitive for any changes in the system, easily measured, integrative, have low variability in the response, easy to communicate etc. (Dale, Beyeler 2001; Jeníček 2013). Also, within the context of environmental policy, the use of standardized indices is needed to facilitate international comparisons. As requirements are often inconsistent, selection criteria should be decided first (Heink, Kowarik 2010).

Indicators that have been developed under the aegis of the widely accepted Convention on Biological Diversity to monitor the progress towards the 2010 biodiversity targets are in the focus of this paper. Results show that however useful and important measures they are globally, they cannot be suggested for policy application at the country level. In the case of Hungary, though, the extent of forests can be easily improved with existing data to be a meaningful measure.

For societies, ecosystem "healthiness" (proper functioning, functional diversity, integrity) and maintenance of ecosystem services are what matters the most (Haslett et al. 2010). In the long run, indices reflecting the status of the whole natural capital (such as the *NCI*) should be favoured; which requires an international agreement about the calculation as well as data collection methods. NGOs may have an important role in facilitating such an agreement, but scientific input is evidently needed to construct a meaningful and unbiased index.

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