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On the potential policy use of biodiversity indicators

Limitations of some currently used indices at the country level based on the Hungarian example and recommendations for improvement

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On the potential policy use of biodiversity indicators

Limitations of some currently used indices at the country level based on the Hungarian example and recommendations for improvement

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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; therefore I evaluate their current use and performance in Hungary as a model country. 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. I recommend some improvements which may potentially increase their applicability. First, as not all the ecosystems suggested globally for monitoring (forests and marine habitats) are present in all the countries, 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. In case of species-based indicators, the overlap between indices (e.g. involvement of birds in all of them) should be reduced. In the long run ecosystem-based indicators that account for ecosystem processes should be used in policy making instead of static lists as not biodiversity per se is important but the related ecosystem services.

Keywords: Indicator, Convention on Biological Diversity, environmental policy, policy making, ecosystem services, Hungary

JEL classification: F53, Q23, Q57

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Highlights:

- Performance of CBD-indices was evaluated in Hungary as a model country.
- Indices of gene and species level have not yet been applied (except Bird Indices).
- Current ecosystem-level indices are not good measures;
- Way of habitat selection for monitoring should be standardized not habitat types.
- Original cover should be used as a baseline to evaluate the current situation.

Biodiverzitás indikátorok környezetpolitikai alkalmazhatósága

A jelenleg használt globális mutatók nemzeti szintű alkalmazásának korlátai a magyarországi tapasztalatok tanulsága alapján és továbbfejlesztési javaslatok

Benedek Zsófia

Összefoglaló

Természeti környezeti szempontból kívánatos lenne, hogy a biodiverzitás indikátorait is figyelembe vegyék gazdaságpolitikai döntéshozatalkor. Ehhez azonban arra van szükség, hogy kisszámú, gondosan kiválasztott, releváns mutató álljon rendelkezésre. A Biológiai Sokféleség Egyezmény indikátorai az egyezmény széles nemzetközi támogatottsága okán alkalmasak lehetnek erre a feladatra. Jelen tanulmány áttekinti, hogy mely mutatók természetvédelmi használata jellemző már ma is nemzeti szinten, és magyarországi esettanulmányból kiindulva sorra veszi, hogy milyen nehézségek léphetnek fel ezek környezetpolitikai alkalmazásakor. Az eredmények azt mutatják, hogy elsősorban az ökoszisztéma szintű mutatók használata (más célokra) már most is jellemző, de ezek jelenlegi formájukban nem alkalmasak arra, hogy a biodiverzitás állapotát általánosságban jelezzék, ezért javaslatokat fogalmazunk meg, amelyek segíthetik a környezetpolitikai adaptációt. Először is a globális szinten monitoringra javasolt ökoszisztémák (erdők és tengeri élőhelyek) nem feltétlenül jellemzőek egy adott országban, ezért bizonyos ökoszisztémák kijelölése helyett célszerűbb lenne a kiválasztás módját standardizálni. Ezen túlmenően a kiválasztott élőhelytípusok aktuális kiterjedésén túl viszonyítási alapként az eredeti borítást is érdemes lenne figyelembe venni. A jelenleg globálisan használt faj alapú mutatók esetében jelentős átfedés figyelhető meg az indexek között (például a madarak esetében, amelyek mindhárom vizsgált mutatóban szerepelnek). A relevancia növelése érdekében az átfedések kiküszöbölése lenne kívánatos. Hosszú távon olyan, dinamikus ökoszisztéma-indexek bevezetése javasolt, amelyek az ökológiai folyamatok épségén keresztül nyújtanak információt az ökoszisztémák – velük összefüggésben pedig az ökoszisztéma szolgáltatások - állapotáról.

Tárgyszavak: Indikátor, Biológiai Sokféleség Egyezmény, környezetpolitika, döntéshozatal, ökoszisztéma szolgáltatás, Magyarország

JEL kód: F53, Q23, Q57

1. INTRODUCTION

There is an increasing agreement that biodiversity, contributing so much to human well-being via providing and maintaining diverse ecosystem services should be considered in policy making. Selection of a proper measure (or a set of measures) is inevitable in order to ensure biodiversity to be taken into account. Though it is not possible to characterize all the aspects with a single index (Vačkář et al. 2012), there is a limited number of indices that can be directly used to vindicate a policy (Mace and 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 most of the government leaders – its indicators may seem an appropriate choice for policy application. Biodiversity Indicators Partnership was established under the aegis of CBD to facilitate and coordinate development of indicators that are classified into 7 focal areas; Focal area 1 collects ten indices describing the 'Status and trends of the components of biodiversity' (2010 Biodiversity Indicators Partnership, 2010). Performance, application and present status of CBD biodiversity indices in the country level are still up-to-date questions; they are in the focus of the paper. 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 evaluate the direct applicability and reliability of indices in their current form I compared the related statistics to other available scientific results.

2. INDEX PERFORMANCE 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 in parenthesis.

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, Global Wild Bird Index and Red List Index. National guides are relatively new in all the cases (McRae et al., 2008; Sheehan et al., 2010; and Bubb et al., 2009a; respectively), therefore they have not been applied yet in Hungary (though a similar composite Common Bird Index is calculated for EUROSTAT).

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 (BirdLife International, 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.

At the ecosystem level, currently forests and marine habitats are in the centre of attention globally. The latter is not relevant in Hungary, which is a country without access to any sea. The extent of forests and forest types is based on the FAO's Global Forest Resources Assessment, which is repeated at five-yearly intervals (the baseline is 1990). The extent of forests in Hungary is 23% (FAO, 2010). Based on the estimations about the potential (original) vegetation of Hungary, original forest cover was 85-87% (Zólyomi, 1989). This information, which is missing from the FAO database, would be also important in evaluating the state of biodiversity. According to the details of FAO 2010, Hungary does not have primary forests, and the ratio of naturally regenerated forests is only 4.8% (21% of the above-mentioned 23%). All of these forests are located in protected areas. The proportion of introduced species cover is high (over 32% of total planted species). The rest of planted forests is under strict management which means mostly clearcutting that has serious consequences on biodiversity (Paillet et al, 2010). Naturalness of Hungarian forests based on several criteria was estimated between 2001 and 2004 with the result of 48.57% on average, protected areas included (Bartha et al., 2005).

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. However, future application is forecasted as most of the data are available. According to the World Database on Protected Areas by UNEP-IUCN, Coverage of protected areas in Hungary is 5.14%. The coverage of naturally regenerated forests is 4.8% (FAO 2010), which is 93.39% of the total protected areas. The ratio of forests in the original vegetation was 85-87% (Zólyomi, 1989); therefore, forests are slightly overrepresented among protected habitats.

3. GENERAL CONSIDERATIONS ABOUT THE INDICES

Regarding the indices of the species level there is a remarkable overlay: 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, overlapping should be avoided. Furthermore, threatened species are accounted both in LPI and RLI, of which population sizes are more subjected to drastic changes due to stochastic events in demography, local catastrophes, etc. Therefore, such populations are not necessarily good and sensitive indicators of the changes in the state of ecosystems (Collen et al., 2009).

As for 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. However, one or both of these habitats may not be relevant for some countries (like the extent of marine habitats in case of Hungary). Therefore, the arbitrary selection of forests and marine habitats may not reveal the states of a country's ecosystems; monitoring of the two most relevant habitats, according to the original cover would be more accurate. This way the logic of selection should be standardized not the actual measures. Expression of current extent compared to the original cover would mean a further clarification of these indices: $E_i = c_1 / c_0$, where E_i is the extent of the *i*th habitat type (assuming that *i* is the most abundant or second abundant habitat type in the original vegetation), c_1 is the current cover, c_0 is the original cover. Table 2 displays the calculations about Hungary and shows a better 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 (E)

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 latter is nonexistent in Hungary.

References: [1]: Zólyomi, 1989; [2]: FAO, 2010; [3]: Molnár et al., 2008.

Originally the second most abundant habitat type was that of grasslands (mostly on loess soil); however the majority of those areas today are 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, earth works, county-boundaries, but most of the stands are heavily degraded" (Molnár et al., 2008).

The index of habitat extent can be further modified to incorporate information about the naturalness, following e.g. the logic of Natural Capital Index of ten Brink (2000): NCI = ecosystem quantity × ecosystem quality. Using the data about the naturalness of forests in Hungary (48.57% on average) gives NCI_{forest} as 13%.

4. DISCUSSION AND CONCLUSIONS

Biodiversity, as an important factor in the establishment and maintenance of ecosystem services should be involved in policy making by means of a limited number of 'ecologically meaningful' indices. The paper studies the performance of the indices of the Convention on the Biological Diversity describing of the status of biodiversity (Focal area 1) at the country level; Hungary was chosen as a model country. Indicators of gene level are globally under development. Indices focusing on species are widely used by international NGOs; however, national adaptation has not happened yet (guides for national use have been recently published) but it is forecasted. Overlap between indices may be problematic in keeping the number of indices applied in the policy arena low. Moreover, current indices focus on mostly charismatic species (vertebrates). Conversely, adaptation of ecosystem perspective in 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 in maintaining ecological flows, functioning and stability (Jordán and Scheuring, 2002). These species are not necessarily rare at the moment; the task in their cases is to prevent future decline (Gaston and Fuller, 2008).

Indices of the ecosystem level have been already used in Hungary. However, not all of the CBD-indices can be directly applied as not all of the globally concerned ecosystem types are present. Therefore I would suggest selecting the two most abundant ecosystems in the original cover for monitoring; in the Hungarian example it means forests and grasslands. The original cover should also be incorporated as a baseline to better understand current processes and threats.

Use of standardized indices is needed to facilitate international comparisons. Also, there are other 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 and Beyeler, 2001). As requirements are often inconsistent, selection criteria should be decided first (Heink and Kowarik, 2010). In environmental policy, ecosystem "healthiness" (proper functioning, functional diversity, integrity) and maintenance of ecosystem services is what matters the most (Haslett et al., 2010). Therefore, inclusion of naturalness as was suggested above requires caution as further research is needed to reveal the relationship between naturalness and ecosystem services.

Instead of the use of static lists about some components of natural capital a functional, ecosystem-based indicator that accounts for ecosystem processes (and thus ecosystem healthiness) should be concerned. This way the state of ecosystem services could be monitored directly; which is probably of higher interest among policy makers than

biodiversity itself (but can be used as an 'umbrella concept' for biodiversity, though). There are remarkably well-established ecosystem healthiness indices. For example, Finn's cycling index (Finn, 1976; Allesina and Ulanowicz, 2004) derived from economic input-output analysis could be a promising candidate as it is simple, easy to calculate and it is expressed in percentages, which allows direct ecosystem comparison (or trend analysis, Heymans et al., 2004) possible. Such a process-based integrity index should be combined with indices that are sensitive for spatial dimensions, like the measure of ecosystem quantity in Natural Capital Index (ten Brink, 2000). However, ecosystem integrity measures are rather data demanding; therefore long-term, systematic monitoring programmes in conjunction with the aims of environmental policy should be established in the near future.

REFERENCES

2010 Biodiversity Indicators Partnership, 2010. Biodiversity indicators and the 2010 Target: Experiences and lessons learnt from the 2010 Biodiversity Indicators Partnership. Secretariat of the Convention on Biological Diversity, Technical Series No. 53, Montréal, Canada. p. 196.

Allesina, S., Ulanowicz, R.E., 2004. Cycling in ecological networks: Finn's index revisited. Computational Biology and Chemistry 28, 227–233.

Bartha, D., Bodonczi, L., Szmorad, F., Aszalós, R., Bölöni, J., Kenderes, K., Ódor, P., Standovár, T., Tímár, G., 2005. Az erdők természetességének elemzése tájak és erdőtársulások szerint. (Evaluation of the naturalness of the forests by regions and forest associations.) Erdészeti Lapok 140, 198–201.

Bubb, P.J., Butchart, S.H.M., Collen, B., Dublin, H., Kapos, V., Pollock, C., Stuart, S.N., Vié, J-C., 2009a. IUCN Red List Index - Guidance for National and Regional Use. IUCN, Gland, Switzerland. p. 11.

Bubb, P.J., Fish, L. Kapos, V. 2009b. Coverage of Protected Areas – Guidance for National and Regional Use. UNEP-WCMC, Cambridge, UK.

CBD SBSTTA, 2005. Indicators for Assessing Progress towards the 2010 Target: Trends in Extent of Selected Biomes, Ecosystems and Habitats. Vol. UNEP/CBD/SBSTTA/10/INF/10.

Collen, B., Loh, J., Whitmee, S., McRae, L., Amin, R., Baillie, J.E., 2009. Monitoring change in vertebrate abundance: the living planet index. Conservation Biology 23, 317–327.

Dale, V.H., Beyeler, S.C., 2001. Challenges in the development and use of ecological indicators. Ecological Indicators 1 (1), 3–10.

FAO, 2010. Global Forest Resources Assessment 2010. Main report. FAO, Forestry paper No. 163, Rome, Italy. p. 340.

Finn, J.T., 1976. Measures of ecosystem structure and function derived from analysis of flows. Journal of Theoretical Biology 56 (2), 363–380.

Gaston, K.J., Fuller, R.A. 2008. Commonness, population depletion and conservation biology. Trends of Ecology and Evolution 23 (1), 14–19.

Haslett, J.R., Berry, P.M., Bela, Gy., Jongman, R.H.G., Pataki, Gy., Samways, M.J., Zobel, M., 2010.Changing conservation strategies in Europe: a framework integrating ecosystem services and dynamics. Biodiversity Conservation 19, 2963–2977.

Heink, U., Kowarik., I., 2010. What criteria should be used to select biodiversity indicators? Biodiversity Conservation 19, 3769–3797.

Heymans, J.J., Shannon, L.J., Jarre, A., 2004. Changes in the northern Benguela ecosystem over three decades: 1970s, 1980s, and 1990s. Ecological Modelling 172 (2-4), 175–195.

Jordán, F., Scheuring, I., 2002. Searching for keystones in ecological networks. Oikos 99, 607–612.

Mace, G.M., Baillie, J.E.M., 2007. The 2010 biodiversity indicators: challenges for science and policy. Conservation Biology 21, 1406–1413.

McRae, L., Loh. J., Bubb, P.J., Baillie, J.E.M., Kapos, V., Collen, B. 2008. The Living Planet Index - Guidance for National and Regional Use. UNEP-WCMC, Cambridge, UK. p. 11.

Molnár, Zs., Biró, M., Bölöni, J., Horváth, F., 2008. Distribution of the (semi-)natural habitats in Hungary I. Marshes and grasslands. Acta Botanica Hungarica 50(Suppl.): 59–105.

Paillet, Y. (and 23 others), 2010. Biodiversity differences between managed and unmanaged forests: meta-analysis of species richness in Europe. Conservation Biology 24, 101–112.

Sheehan, D.K., Gregory, R.D., Eaton, M.A., Bubb, P.J., Chenery, A.M. 2010. The Wild Bird Index – Guidance for National and Regional Use. UNEP-WCMC, Cambridge, UK. p. 25

ten Brink, B., 2000. Biodiversity indicators for the OECD Environmental Outlook and Strategy. Globo Report Series No. 25, RIVM, Bilthoven. p. 52.

Vačkář, D., ten Brink, B., Loh, J., Baillie, J.E.M., Reyers, B., 2012. Review of multispecies indices for monitoring human impacts on biodiversity. Ecological Indicators 17, 58–67.

Wilson, E.O., 1987. The little things that run the world (the importance and conservation of invertebrates). Conservation Biology 1, 344–346.

Zólyomi, B., 1989. Magyarország természetes növénytakarója (Map of the potential natural vegetation of Hungary). In: Pécsi, M. (ed.) Nemzeti Atlasz (National atlas), Kartográfia Vállalat, Budap