Nature-Based Solutions

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Introduction and 'State-of-the-art'

The idea of 'nature-based solutions' (NBS) is now being used to reframe policy debates on biodiversity conservation, climate change adaptation and mitigation strategies, and the sustainable use of natural resources, among other issues. While interesting and potentially useful for those debates, it is a concept that still needs to be clearly defined; its use is not confined to discussions about ecosystem services and natural capital. For example, it is also used to describe such things as soft engineering approaches designed to enhance resilience and reduce risk to people in large settlements (e.g. Marton-Lefevre, 2012; van Wessenbeeck, 2014), and to work in the field of biomimicry and industrial design[2] (e.g. Neves and Francke, 2012) – learning from nature, rather than finding strategies based on nature that would contribute to its conservation.

However, by emphasising the utilitarian aspect of natural capital and ecosystem services, the idea of 'nature-based solutions' is clearly eye-catching and relevant to current debates about the links between people and nature. It is therefore wise to ask what new insights it brings. Is it intended to re-package the demand for sustainable development and nature conservation in a way that concepts of *biodiversity* and *ecosystem services* do not? Does it represent an approach to policy and management distinctly different from those already being applied? It is not altogether clear that it does. For example, the idea of NBS can be seen to encompass existing concepts such as 'nature-based interventions', 'ecosystem-based solutions', and particularly 'ecosystem-based adaptation' (see for example Rizvi et al, 2015; Andrade *et al.*, 2011). A report from the Horizon 2020 Expert Group on NBS suggests that the concept "builds on and supports other closely related concepts, such as the ecosystem approach, ecosystem services, ecosystem-based adaptation/mitigation, and green and blue infrastructure" (EC, 2015). From another perspective, however, the use of the term 'NBS' might prompt positive changes in how some of these existing concepts are framed. It could refocus attention on sustainable development and encouraging consideration of biodiversity and ecosystems *within* solutions to wider societal challenges including climate change adaptation, food security, water crises etc. (EC, 2015).

Development of NBS as a concept

The term NBS first entered the mainstream scientific literature in the early 2000s, in the context of solutions to agricultural problems – including integrated pest management, use of habitats to mitigate farm run-off etc. Blesh and Barrett (2006), for example, discussed integrating ecology into agricultural education and practice as a means of enhancing sustainability of food production. At around the same time, the idea of NBS began to appear in discussions on land-use management and planning and water resource management – including use of wetlands for waste water treatment (see Guo et al., 2000; Kayser and Kunst, 2002). For TEEB, ten Brink et al. (2012) highlighted the value of harnessing ecosystem services from wetlands as a form of nature-based solution for watershed management issues.

From the mid-2000s, the concept also began to appear in literature on industrial design, though it had been suggested in earlier work on biomimicry by Benyus (1997). For example, Singh et al. (2007) explored the hydrophobic and friction-reducing properties of artificial surfaces designed to mimic the topographies of water-repellent leaves as a solution to problems of wear in mechanical systems, and so promoted the search for 'nature-based solutions' to industrial design challenges. The term "biomimicry" has also been

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[2] www.biomimicry.org, and www.biomimicry.net

used for green infrastructure and other soft engineering approaches used as nature-based solutions to urban water management problems (e.g. Grant, 2012).

From 2009, the term became more widely used in literature relating to methods for increasing resilience to the impacts of climate change – often synonymous with 'ecosystem-based adaptation', a term which had emerged in the 1990s in discussions of the role of biodiversity in reducing climate-related risks, including soft engineering approaches. The role of NBS has been actively promoted by the Nature Conservancy in the US and the IUCN (IUCN, 2012), and has also been a focus of World Bank investment in climate mitigation and adaptation projects (Word Bank, 2008). Elsewhere, the UN Secretary General has referred to NBS in the context of improving urban planning - for increasing urban quality of life, addressing water resource management etc. (UN, 2013), and the World Economic Forum has highlighted the potential of NBS to support innovation in the travel and tourism sector (Marton-Lefevre and Borges, 2011).

In terms of thinking through more formal definitions of the NBS term, the work of the IUCN on climate change adaptation strategies is potentially helpful. The Jeju Declaration arising from the IUCN World Congress in 2012, explored the theme of 'Nature+', which highlighted the importance of nature to enhancing societal resilience. It introduced the idea of 'nature-based solutions' as a means of dealing with challenges linked to climate change, sustainable energy, food security, and economic and social development[3]. Since 2013, NBS has been made a priority programme area for the IUCN, who state: *nature-based solutions build upon the proven contribution of well-managed and diverse ecosystems to enhance human resilience and to provide additional development opportunities for men and women in poor communities*.[4] Also: '*nature-based solutions' is a way of applying the strength, resources, and abundance of nature to global environmental and social challenges*. It is worth noting, however, that the IUCN's conceptualisation of NBS has received some pushback from commentators who see it as part of wider efforts to link conservation with neoliberal economics (Fletcher, 2012).

Nature-based solutions has also emerged as a priority area for the EU's Horizon 2020 Research Programme (Maes and Jacobs, 2015), though more than one definition of NBS can be found in related literature. For example, the Advisory Group Report for H2020's Societal Challenge 5 (EC, 2014) speaks of NBS in the context of using biomimicry to position the EU as a world leader in the development of industrial and technological solutions "inspired by, using, copying from or assisted by nature"[5]. This idea is included in the EC Expert Group on Nature-based solutions' definition "They therefore involve the innovative application of knowledge about nature, inspired and supported by nature" (EC, 2015). Focusing on innovation, Maes and Jacobs (2015) define NBS as "any transition to a use of ecosystem services with decreased input of non-renewable natural capital and increased investment in renewable natural processes". The report also states that industrial challenges and environmental problems caused by human activities can be resolved "by looking to nature for design and process knowledge", but these aspects are not strongly emphasised. The EU BiodivERsA programme (Balian et al., 2014) and the IUCN also view NBS as being a way to "conserve and use biodiversity in a sustainable manner"[6]. There is, however, some difference in emphasis on the components and aims of NBS.

Whilst these different perspectives are largely compatible, it is not clear how NBS might be distinguished from the other concepts associated with the opportunities for improving human well-being by managing ecosystem services and natural capital in appropriate ways. Yet, a clear link between NBS and these concepts is needed to ensure consistency and avoid redundancy or confusion. For example, according to the BiodivERsa Report (Balian et al., 2014), NBS can be used to build adequate green and blue infrastructure, but green infrastructure can also be part of a (broader) NBS. On the other hand, open concepts like NBS that can be interpreted in different ways, can be useful because they may encourage stakeholders to take part in the dialogue. Perhaps one answer is to consider it as an umbrella term for all related applications of ecosystem services, natural capital and 'lessons from nature'. To put it more pragmatically, when considering any response to a challenge, whether it be one of industrial or engineering

3 http://iucnworldconservationcongress.org/news___press/?11090/Towards-a-New-Era-of-Conservation-Sustainability-and-Nature-based-Solutions

4 http://www.iucn.org/?uNewsID=11090

5 http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetailDoc&id=14223&no=1

6 www.biodiversa.org/687/download

design, or the management of a resource at local or global scales, it may be useful to simply ask 'is there a nature-based solution?', and in this way broaden the range of options that are considered.

Thus operationally one can explore the scope of a 'nature-based solution' by unpacking its different elements, where:

- *Nature* - relates to biodiversity in aggregate, individual elements of biodiversity (individual species, habitats, ecosystems), and/or ecosystem services.
- *Nature-based* – refers to ecosystem approaches, ecosystem-based approaches, biomimicry, or direct utilisation of elements of biodiversity.
- *Solutions* – refers to a specific problem or challenge that for which some recognisable solution or more beneficial outcome exists.

Inclusion of the idea of a 'solution' in the concept explicitly recognises that people agree that there must be *a problem that needs to be solved*. This problem focus is, perhaps, a key characteristic that distinguishes it from more neutral ideas about management or policy based on general notions of an ecosystem approach, or from more positive framings of ecosystem services as sustaining or enhancing well-being. Therefore, the identification of problems or challenges that could be effectively addressed by NBS is a key aspect of this approach.

Open Problems/Issues to be discussed

Whilst most of the uses of NBS follow similar themes – responding to increasing and emerging environmental, social and economic challenges, there is, we suggest, a need for some clarification on how the concept is framed and applied. A useful starting point is the report from the BiodivERsA workshop (Balian et al., 2014) which suggested that three types of NBS can be identified (our italics) involving:

- Type 1: better using *existing* ecosystems by minimising the intervention on the systems themselves.
- Type 2: modifying *existing* ecosystems to better deliver selected ecosystem services.
- Type 3: creating *new* ecosystems (e.g. through ecological engineering, green roofs, etc.)

The extent to which this typology can accommodate the work being undertaken in OpenNESS is therefore a question that we might now take forward. The BiodivERsA types are fairly narrow, given the wide range of meanings that we have identified above, because they do not explicitly address the dimension of 'biomimicry', nor fully account for solutions involving restoration of degraded ecosystems (though by some interpretations this might be included within Type 2). Yet they do provide a useful basis for discussion. If NBS is a concept that includes ES and NC, then it underpins everything which OpenNESS seeks to achieve in trying to operationalising the concepts of ES and NC.

Significance to OpenNESS and specific Work Packages[7]

WP1 **(Key challenges and conceptual frameworks)** Develop a definition that is useful in the context of the OpenNESS project and an understanding of its relationship to other concepts (e.g., green infrastructure). Show how the application of the concept might be unpacked in relation to the suite of 'solutions' that are possible responses to the four Challenges.

WP2 **(Regulatory frameworks and drivers of change):** There is an opportunity to explore whether a typology of NBS could or should be formalised and integrated into policy, as a way to enhance sustainability and improve outcomes in for example, sustainable development, climate change mitigation and adaptation, whilst also supporting technical and commercial innovation.

WP3 **(Biophysical control of ecosystem services):** For adaptation/mitigation scenarios, understanding and mapping biophysical control of ecosystem services will be vital to development of sound NBS. Alternatives to NBS also could be explored such that trade-offs (e.g. between grey and green infrastructure) could be identified and the benefits of NBS quantified.

WP4 **(Valuation of the demand for ecosystem services):** Economic values of NBSs can be addressed through valuation methods like 'avoided costs' (e.g. if green infrastructure is used to buffer coastal

[7] For a brief description of the OpenNESS Work Packages see: http://openness-project.eu/about/work-packages

cities from climate extremes like storms and hurricanes, thereby protecting built infrastructure and property, and avoiding the economic costs that would result from them being damaged). Non-economic values from NBS may include health benefits (e.g. if green infrastructure is retained and maintained in cities to promote physical and mental health), which may be addressed through metrics like improvement in recovery from illness or life expectancy.

WP5 (Place-based exploration of ES and NC concepts): Case studies will have an opportunity to highlight if/how NBS have been applied to each situation and enrich the debate on the clarification of a concept with place-based examples.

WP6 (Integration: Synthesis and Menu of Multiscale Solutions): Linking with WP2 – how might NBS be included in regulations? For example, does it link with EU responses to the CBD Strategic Plan under the Aichi Targets?

Relationship to four challenges[8]

Human well-being: NBS to economic, social and environmental risks/challenges can help to strengthen, enhance, and secure human well-being, through ecosystem-based strategies for risk reduction, climate change adaptation and mitigation, sustainable (green) urbanisation, mitigation of pollution, and 'one health' approaches to disease outbreaks.	**Sustainable Ecosystem Management:** Current concepts of NBS often include discussion of stakeholder engagement, and the restoration/use and management of ecosystems to ensure essential ecosystem services are preserved and enhanced.
Governance: IUCN identifies governance as a key area for promoting NBS– along with education, investment and capacity building. Engagement with stakeholders and users of ecosystem services are important considerations for managing and implementing NBS.	**Competiveness:** NBS are relevant to issues of industrial / business competitiveness and innovation (e.g. biomimicry), as well as to wider social and environmental competitiveness (e.g. resilience & adaptation to economic, environmental and social challenges).

Recommendations for the OpenNESS consortium

OpenNESS should engage widely with external experts on the issue of NBS to collate knowledge, opinion and perspectives on definitions and implementing NBS, and how it relates to existing policy drivers across various sectors. Also OpenNESS should use NBS as an umbrella concept encapsulating the variety of ecosystem-based or nature-based approaches, including the operationalization of ES and NC.

'Must-read' Papers

EC (2015): Nature-Based Solutions & Re-Naturing Cities Final Report of the Horizon 2020 Expert Group on Nature-Based Solutions and Re-Naturing Cities. Available: ec.europa.eu/research/environment/pdf/renaturing/nbs.pdf

Maes, J. and S. Jacobs (2015): Nature-Based Solutions for Europe's Sustainable Development. Conservation Letters. (online ahead of print, available at: onlinelibrary.wiley.com/doi/10.1111/conl.12216/pdf)

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[8] There are certainly more societal challenges; the reduced number presented here is due to the four major challenges mentioned in the work programme of FP7 to which OpenNESS responded.

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Review Editor: Kurt Jax (UFZ)

Suggested Citation: Potschin, M.; Kretsch, C.; Haines-Young, R., E. Furman, Berry, P., Baró, F. (2016): Nature-based solutions. In: Potschin, M. and K. Jax (eds): *OpenNESS Ecosystem Services Reference Book*. EC FP7 Grant Agreement no. 308428. Available via: www.openness-project.eu/library/reference-book

Acknowledgements: The following OpenNESS partners have further contributed to the SP: J. Dick (CEH), J. Niemelä (UH), E. Stange (NINA), S. Jacobs (INBO), C. Liquete (JRC), H. Keune (INBO), L. Kopperoinen (SYKE), B. Czucz (MTA ÖK).

Disclaimer: This document is the final version of the Synthesis Paper on the topic within the OpenNESS project. It has been consulted on formally within the consortium in 2015 and updated in 2016.