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Core principles for successfully implementing and upscaling Nature-based Solutions

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ABSTRACT

Despite substantial increases in the scope and magnitude of biodiversity conservation and ecological restoration, there remains ongoing degradation of natural resources that adversely a□ects both biodiversity and human well-being. Nature-based Solutions (NbS) can be an e□ective framework for reversing this trend, by increasing the alignment between conservation and sustainable development objectives. However, unless there is clarity on its evolution, definition and principles, and relationship with related approaches, it will not be possible to develop evidence-based standards and guidelines, or to implement, assess, improve and upscale NbS interventions globally. In order to address this gap, we present the definition and principles underpinning the NbS framework, recently adopted by the International Union for Conservation of Nature, and compare it to (1) the Ecosystem Approach that was the foundation for developing the NbS definitional framework, and (2) four specific ecosystem-based approaches (Forest Landscape Restoration, Ecosystem-based Adaptation, Ecological Restoration and Protected Areas) that can be considered as falling under the NbS framework. Although we found substantial alignment between NbS principles and the principles of the other frameworks, three of the eight NbS principles stand out from other approaches: NbS can be implemented alone or in an integrated manner with other solutions; NbS should be applied at a landscape scale; and, NbS are integral to the overall design of policies, measures and actions, to address societal challenges. Reversely, concepts such as adaptive management/governance, effectiveness, uncertainty, multi-stakeholder participation, and temporal scale are present in other frameworks but not captured at all or detailed enough in the NbS principles.

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Humanity and other life on the planet may be approaching a catastrophic tipping point (Rockström et al., 2009; Ste□en et al., 2015; IPCC, 2018), creating an urgent need for innovative approaches to ecological restoration, nature conservation, and addressing global societal challenges to meet society's needs. Current approaches to restoration and conservation are not occurring at a scale that can redress degradation (Holl, 2017). To address global societal challenges[1] at the required scale, it is necessary to develop specifically designed large-scale, innovative and policy coherent solutions. One way to do so is by implementing a rigorous, evidence-based *Nature-based Solutions* (NbS) framework.

NbS are defined by the International Union for Conservation of Nature (IUCN) as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges e□ectively and adaptively, simultaneously providing human well-being and biodiversity benefits" (Cohen-Shacham et al., 2016)[2] . The NbS framework emerged from the Ecosystem Approach, which underpins the Conv)2nera

targeted, the lower the capacity to maximize the delivery of each service and simultaneously fulfil the specific needs of all stakeholder groups.

The European Commission defined NbS as “solutions inspired and supported by nature, designed to address societal challenges which are cost-e□ective, simultaneously provide environmental, social and economic benefits, and help build resilience” (European Commission, 2016; Raymond et al., 2017a

conservation measures).

that di□erent categories of stakeholders are involved in the NbS, that the NbS in place provides benefits to a□ected actors, from local communities to infrastructure managers/private sector up to national level, and ensure that loss of local opportunities is avoided. For example, when a community maintains a forested watershed to supply water downstream, fair and transparent processes as well as an explicit understanding of the local politics of negotiations and implementations are needed. This understanding should reflect the values of the watershed to the forest community and help determine the nature of compensation-based mechanisms for the supply of ecosystem services, such as through Payment for Ecosystem Service schemes (Wendland et al., 2010; Kovacs et al., 2016), provided the services are maintained.

Principle 5: NbS maintain biological and cultural diversity and the ability of ecosystems to evolve over time.NbS need to be developed and implemented in a manner that is consistent with the temporal dynamics and complexity of ecosystems, in order to support biological and cultural diversity, so that the services provided by the ecosystem are sustainable and, as far as possible, resilient to future environmental change.

Principle 6: NbS are applied at a landscape scale.Many NbS are implemented over large spatial scales - such as watersheds or large forests - which usually combine several ecosystems (agricultural, inland waters, coastal, forest, etc.), and that might in some cases, be transboundary. This principle is linked to NbS4 and NbS8. Even when an NbS is implemented at a specific site level (linked to NbS3), it is important to consider the wider landscape-scale context and consequences, aiming at upscaling where appropriate.

Principle 7: NbS recognize and address the trade-o□s between the production of a few immediate economic benefits for development, and future options for the production of the full range of ecosystem services. NbS should avoid changing or simplifying an ecosystem, in favor of a particular service or resource, such as replacing natural mixed woodland with a monoculture tree plantation. Instead, a thorough understanding of tradeo□s between current and future benefits is important when deciding among di□erent NbS activities. Understanding and providing a process for fair and transparent negotiation of trade-o□s are essential for ensuring successful NbS (Maginnis et al., 2004). Landscapes may contain di□erent stakeholder groups that use resources for their livelihood, which may result in complex and conflictual relationships that need to be identified and negotiated. Hence the need for NbS8 to support NbS7 and the complexity of negotiating trade-o□s.

Principle 8: NbS are an integral part of the overall design of policies, and measures or actions, to address a specific challenge. For NbS interventions to have broad influence, it is important to make sure that they are not only practically undertaken in the field, but are also incorporated in policy and related actions. The implementation of this principle will support large scale interventions (NbS6) and it includes the potential for adaptive management (as the interventions' outcomes can inform and adapt natural resource management policy).

4. Comparison of NbS principles and those in related ecosystem-based approaches

4.1. Method

To identify published frameworks for ecosystem-based management approaches, we conducted expert consultations and a literature review. Experts from IUCN CEM, who work on di□erent types of approaches (e.g. ecosystem-based disaster risk reduction, ecological restoration, forest landscape restoration, ecosystem-based mitigation and adaptation, ecosystem services, resilience, green infrastructure, natural infrastructure, etc.), were consulted individually and through the CEM NbS Thematic Group, to identify ecosystem-based and ecosystem-related approaches. Once relevant approaches (17) had been identified through the consultation process, we searched Google and Google Scholar to identify which of the identified approaches had published operational frameworks, including principles. We searched for publications, documents, and web pages that had the name of one of the identified approaches and one of the following words related to principles and standards: "principles", "operational framework", "standard" or "guidelines". We then screened the collected information to select those approaches that met the following criteria: 1) had a clearly articulated set of principles; 2) had principles that were operational (as opposed to more general, or theoretical types of principles); 3) had principles that were comprehensive enough, to cover a wide range of aspects; to be

global societal challenges.

Principle 8, **on the need for NbS to be an integral part of the overall design of policies, measures and actions to address societal challenges,** only overlaps with EbA1 and EbA2, which refer to "ensuring that national institutions and key decision-makers at different levels promote EbA" and to "multi-stakeholder processes being established when developing adaptation policy", respectively.

When comparing the wording used in the NbS principles with those

potential for management success. Despite widespread agreement about the importance of planning and implementing ecosystem management approaches at the landscape scale, there are several obstacles to successfully working at this scale, including limited available funding, legal and mandate limitations, administrative boundaries, human capacity, technical limitations including data and institutional hierarchies.

Finally, a third novel aspect of NbS is the focus on coordinated efforts (NbS8), that addresses the complex interactions between ecological, social, legal, institutional and political systems that transcend site-level approaches. The integration is there to ensure that global societal challenges are addressed at the scale of the problem and promote broader programmatic and policy interventions than piecemeal projects.

In sum, the NbS principles allow for the integration of solutions (*e.g.,* use of grey infrastructure, public awareness tools), landscape-scale planning and policy coherence, all in one single framework. An example of a successful, integrated NbS intervention is Medmerry's

framework was originally discussed. We also thank Penelope Lamarque

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