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Perspective

A Singular Concept of Biodiversity Remains the Best Way to Address the Plural Values of Nature in Conservation Planning

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Abstract: The term "biodiversity" generally refers to living variation. Biodiversity has recognized anthropocentric values of insurance and investment. Values of "nature" include those of biodiversity and also many other aspects reflecting the scope of human-nature relationships. Systematic conservation planning methods can integrate this range of local to global values. Early case studies in Australia and Papua New Guinea show the potential for such approaches. Recently, there have been calls for a recasting of the concept of biodiversity to capture plurality of values. However, balance among sometimes conflicting values of nature is best-served by a singular biodiversity concept and definition focused on variety, because this enables effective integration with other values of nature. Attempts at pluralistic recastings of biodiversity in fact may promote neglect of global biodiversity values. Further, an extended analysis of the Papua New Guinea case study shows that it cannot be argued that focusing on localized values of nature for conservation will effectively address regional/global scale conservation needs.

Keywords: biodiversity; pluralism; systematic conservation planning; Intergovernmental Platform for Biodiversity and Ecosystem Services; IPBES; biodiversity option value; Papua New Guinea; multi-criteria analysis

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1. Introduction

The journal *Conservation* reflects the broad scope of conservation in integrating biological, sociological, ethical, economic, and other dimensions of nature conservation [1]. The popularity of the term, "biodiversity" (and "biodiversity conservation") seems to build on the natural appeal of an umbrella term that can capture any-and-all aspects of living nature (and nature conservation). However, science and policy for biodiversity conservation also has continued an historical focus on the challenges of conserving biodiversity-as-variety (for review see [2]). Here, a focus on the "biodiversity crisis" and species extinctions—the concerns of "biodiversity"—sits alongside other important concerns of broader nature conservation, such as wilderness, ecosystem health, and local people's various relationships with nature. In this framing, "biodiversity" has a singular focus on living variation (at multiple levels), while "nature" appropriately is pluralistic, covering many ways in which humans perceive/relate to nature [2,3]. While it remains challenging to integrate all these nature-related benefits and values into planning and decision-making, foundational local-to-global approaches are found, for example, in the early case studies exemplifying the principles of systematic conservation planning ([4]; see below). This framing of biodiversity, as living variation that is of value to humanity, and as one important aspect of broader nature conservation, has origins tracing back at least 50 years (see [2]). These roots were apparent in the early "World Conservation Strategy" produced in 1980 by the International Union for Conservation of Nature (IUCN) [5], and building on perspectives from at least the decade before. The Strategy referred to conservation of "nature" or "living resources", including ecological processes and life support systems. Alongside these, the Strategy captured ideas, developed over the previous decade, about the importance of conservation of biotic diversity (referring to "the range of genetic material found in the

world's organisms"). IUCN referred to preservation of genetic diversity (their stand-in for the not-yet-defined "biodiversity") as both a matter of insurance and investment to keep open options for future generations (for discussion see [6]).

This core perspective, in which biodiversity as variety is one aspect of broader nature conservation, continues to be influential in current science/policy work. For example, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) refers to biodiversity as one aspect of nature, and its definition of "biodiversity" focusses on the core idea of living variety (https://ipbes.net/glossary/; accessed on 1 December 2021). IPBES indicators of nature's contributions to people include those for the maintenance of options for future generations. This includes "biodiversity option value" (related to IUCN's "investment" value)—the global benefit/value of biodiversity/variety in providing possible benefits for future generations (for discussion, see [2,6]). This benefit/value of biodiversity also is apparent in the definitions, goals, targets, and indicators for the post-2020 framework of the Convention on Biological Diversity (CBD; https://www.cbd.int; accessed on 1 December 2021) [2,6].

It appears that "biodiversity" might continue to serve as a popular catch-all umbrella term, without excluding its service also as the term reflecting the framing, developed over the past 50 years, for the benefit/value of biotic diversity (variety). However, there always will be a danger that the flexible broad use of the term can mean that core values of biodiversity as variety will be neglected. Faith [2] documented this problem, as found in several recent framings related to the concept of biodiversity. An ecosystem services framing typically has adopted broad ecological definitions of biodiversity that have favoured a focus on "biodiversity" benefits/values at the ecosystem, not global, level. Faith also critiqued an emerging "socio-ecological framing" in which the concept/definition of "biodiversity" requires a pluralistic recasting in order to better capture the pluralism of context-dependent values of various aspects of nature.

In this paper, I focus on recent proposals that have extended these socio-ecological framing ideas. In the first section below, I describe the most recent calls for a pluralistic recasting of "biodiversity", and suggest that two misrepresentations are made—first, the claim that the traditional singular biological definition of biodiversity is a barrier to full integration across plural values of nature; and second, the claim that an understanding of global conservation needs can be constructed from the 'ground up'. Here, I counter these claims by briefly describing (in the second section) the long-standing existing framework for integrating global biodiversity values with the many other possible values of nature. Then, in the third section, I revisit one of the foundational case studies for such integrated planning, from Papua New Guinea, (PNG), to show that measures reflecting global values of biodiversity must be "on the table" in order to be integrated with plural values of nature in conservation planning.

2. Biodiversity-Pluralism

Faith [2] describes how proponents of a socio-ecological framing of "biodiversity" have proposed that the term should be recast to better reflect, in different contexts, what society values about nature—encompassing the many ways that society and nature can be inter-linked. This framing sees a singular biological concept of biodiversity (e.g., focused on biological variety) as inadequate, in reinforcing a human-nature dichotomy and in neglecting aspects of justice. Faith [2] suggests that this argumentation appears to ignore the long historical development of anthropocentric arguments for conservation of biotic diversity (the insurance and investment benefits/values of variety, referred to above), and their links to intergenerational justice.

An under-appreciation of the history of argumentation about the meaning and value of biotic diversity as variety also appears to have made it easy to saddle the term "biodiversity" with the need to capture all nature-related values. Recent work suggests this is a deliberate characterisation. For example, Lele [7] cites Sandbrook's [8] "What is conservation?" paper to support a claim that "'Biodiversity conservation' spans a variety of objects of

and rationales for conservation." In reality, Sandbrook's discussion never used the term "biodiversity"; it talked about many aspects of nature. A focus on recasting "biodiversity" as pluralistic, reflecting local context, (rather than simply ensuring we appreciate "nature" pluralistically) seems intended to help counter a perceived unjust domination of global values of biodiversity in conservation policy.

This is reinforced in a recent important paper by Pascual et al. [9], "Biodiversity and the challenge of pluralism". Pascual et al. argue "In view of its many different interpretations, biodiversity should be conceptualized in a pluralistic way. This should be seen as an opportunity to acknowledge people's different perspectives on what should be conserved and why."

Pascual et al. suggest that there is a current bias: "As long as policymakers see only urban (often rather rich and rather vocal) conservationists as 'the' voice of conservation, and uncritically accept their particular understanding and values about biodiversity as the only ones that are valid, they will continue to rely on a narrow set of policy approaches . . . ". They refer to "reducing biodiversity to a set of singular indices, reflecting a desire to let science drive policy at the expense of opening space for other ways of understanding the natural world and thus for deliberation" and conclude "an agenda for conservation science, practice, and policy derived from a singular conceptualization of biodiversity will necessarily be narrow, creating a weak foundation for more effective collaborations between conservation professionals and people".

Wyborn et al. [10] in their recent paper, "Conservation needs to break free from global priority mapping", paint a similar picture of current bias in biodiversity science and policy: "When those creating the global maps emanate from privileged Western institutions, maps perpetuate a neo-colonial legacy . . . ". Both studies see the solution as pluralism through more local, contextualised interpretations of "biodiversity". Pascual et al. argues for more place-based research: "Even if declining trends of biodiversity is a global problem, the form it takes, the interests that define it and the combination of processes that shape it are context specific". Wyborn et al. argue "This 'view from everywhere' misrepresents local contexts and operates at a granularity that means global maps cannot support the development of contextually relevant solutions that build on the knowledge, experience and values of local actors", suggesting that "an understanding of global conservation needs can be constructed from the 'ground up'. Wyborn et al. suggest that "global maps are not needed".

The proposal that global maps are not needed suggests that interest in local contextual values could lead to neglect of global biodiversity values (and the maps of global priority conservation areas). This problem is apparent in recent proposed strategies for integrating plural values. For example, Soto-Navarro et al. [11] develop a "multidimensional biodiversity index" for national application that is to provide policy-makers with pluralistic measures of biodiversity. However, global option value of biodiversity is neglected; biodiversity is only considered for its intrinsic value and to "enable the provision of biological processes such as production". This same problem is found in the recent proposed framework for integrating all "natural capital" into decision-making [12]. "Biodiversity" here is interpreted as having plural aspects, reflecting all of nature. Unfortunately, this claimed integrative framework ignores global biodiversity option value.

A less combative, either-or, pathway may be supported by side-stepping the call to recast the concept/definition of "biodiversity" and focus more on positive net outcomes for plural values of nature. The recent "Territories of Life: 2021 Report" [13] argues that "there is a groundswell of evidence that Indigenous peoples and local communities are critical to sustaining the diversity of life on Earth". The Report suggests supporting "Indigenous peoples and local communities to secure their human rights in general and particularly their rights to self-determined governance systems, cultures and collective lands and territories . . . Specifically, it would be a feasible, cost-effective and equitable way to meet nature conservation commitments, including under the forthcoming post-2020 global biodiversity framework."

The Report embraces several global maps as relevant — informative both about indigenous lands and about key (global) biodiversity areas.

This raises a constructive question, would conservation focused on all these locally-important places on its own provide that "feasible, cost-effective and equitable way" to meet global biodiversity conservation commitments? That would mean that conservation, focused on those contextually determined values of nature, not only conserves local elements of biodiversity but also collectively achieves the CBD post-2020 commitments related to global biodiversity conservation. Alternatively, these areas may be important to conserving multiple values of nature, but need to be supplemented by other protected areas in order to achieve global biodiversity conservation targets. In the next sections, the scope for such integrative local to global planning is reviewed, and then the question examined by revisiting an early case study for PNG.

3. Integrating a Singular Biodiversity Concept and a Plurality of Other Values of Nature

Pascual et al. [9] argued the acceptance of a pluralistic perspective (on biodiversity) "would require the modern-day conservation movement to . . . place its notion of what to conserve and why alongside other understandings of the value of nature". In reality, we can argue that it is the acceptance of a singular perspective on biodiversity that has allowed conservation to place the value of biodiversity alongside other understandings of the value of nature.

In Australia, this integration of multiple values into decision support traces back to "Mediation Support" approaches described in Cocks and Ive [14]. Cocks and Ive recognised that mediation support systems for addressing natural resources conflicts need to draw on all the different values related to the conflict, and that this had to cover both "ecological" knowledge and various community values. They also recognised that local stakeholders have an incentive to participate in the search for a compromise because if they do not, "government will impose a solution which could be quite insensitive to stakeholders' perceptions of the relative values of different parts of the area under contention".

The Australian conservation planning case study described in Cocks and Ive [14] illustrated the breadth of values considered. In the study, the allocation of lands between competing uses (conservation versus forestry production) attempted to satisfy a range of guidelines representing the preferences and values of different stakeholders. The proposed conservation areas were recognized as satisfying "guidelines" relating not only to biodiversity, but also to various nature-related values including fresh water, recreation, aesthetic appreciation and wilderness value.

In that original case study, "biodiversity" was measured in a way that reflected local quantities (e.g., number of species). A companion extension of the study [15] explicitly added regional biodiversity to this multi-criteria process. Here, the broader regional biodiversity reflected (through a surrogate measure) the representation in protected areas of the total species richness of the region. The biodiversity contribution of a given area then was not its local total richness, but the degree to which it represented species that would complement (add to) those species protected elsewhere. Thus, planning for protected areas in the region for the first time could reflect both a broad regional biodiversity value and a wide range of local perceived values of nature. The case study documented the gains in meeting these multiple values of society as a result of such integrated multi-criteria analysis (see [15]).

The multi-criteria tools developed for this initial case study later were applied to a more "real-world" planning context in PNG ([16] and references within). This PNG "Rapid Biodiversity Appraisal Pilot Project" was commissioned by the Global Environment Fund of the World Bank, as a way to help support PNG's contributions to the CBD. Again, a critical property of the land-use conservation planning was the integration of local nature-related values and broad regional values of biodiversity.

This early study is relevant to the idea that indigenous lands can contribute significantly to broader biodiversity conservation and CBD commitments, as advocated in the "Territories of Life: 2021 Report" discussed above. In the PNG study, existing "Wildlife Management Areas" (WMAs) were recognized as supporting a range of benefits/values of nature for the traditional owners, including hunting and subsistence agriculture. Leary and Mamu [17] refer to the many values of WMAs: "Customary ownership does not relate just to the land, but to all the things that it contains, such as water, plants, animals, and rocks. Customary ownership also extends to things such as knowledge and rituals." Kwapena [18] also summarized the importance of WMAS: "Unfortunately, some traditional practices are particularly destructive to wildlife, and as human populations have increased, their impact has become greater. However, the major threat to wildlife is the massive habitat destruction which is associated with population resettlement schemes and agricultural and mining developments. The formation of Wildlife Management Areas initiated at the request of landowners is a most encouraging movement which has the potential to retain traditional practices of wildlife conservation".

In the PNG study [16], these areas also were judged to make potential complementarity contributions to regional biodiversity conservation, depending on their presence of various biotic types used as biodiversity surrogates information (see below and [16]). The study derived a priority set of conservation areas consisting of Wildlife Management Areas plus additional nominated protected areas, which together maximized regional biodiversity representation, secured the many nature-related values within WMAs, while minimizing opportunity costs of conservation (related to forestry and agricultural production).

The nominated set of protected areas was seen as a starting point, given that the set of priority areas could be expected to change as knowledge and social and economic conditions change. The project supported this ongoing process by providing training and transfer of the toolbox to relevant PNG government officers. The flexibility of the approach is seen as an advantage given that landowner interest and commitment to conservation is an important factor for long-term success of conservation areas.

4. Revisiting the PNG Case Study

The PNG study [16] is presented as an exemplar study for Systematic Conservation Planning [4]. Because the study effectively integrates local values of nature with regional values of biodiversity, this exemplar is timely in illustrating why the concept of "biodiversity" does not need to be recast in order to capture plural values in decision-making. It is the capacity to work with a well-defined singular concept of biodiversity that enables its effective integration with multiple local nature-related values.

Additionally, the study may be a good exemplar to understand that having many local areas that conserve their local elements of biodiversity does not guarantee achieving a regional biodiversity conservation target. This links to the constructive question proposed earlier: would conservation focused on all these places on its own provide that "feasible, cost-effective and equitable way to meet global biodiversity conservation commitments?" In the context of the PNG study, we refine this question to ask how well conservation of the WMAs promotes regional biodiversity conservation. If the answer is that these areas largely satisfy regional biodiversity conservation needs, then there is some support for the proposal for bottom-up approaches that focus on local values. If the WMAs on their own do not satisfy regional biodiversity conservation needs, then the PNG case study provides an important exemplar study illustrating how local nature values and regional biodiversity values must be integrated in order to balance all values in conservation planning.

First, I summarise the basic PNG analysis. Resource Management Units (4470 RMUs; see [16]) were adopted as the planning allocation units, given that they are widely used by government agencies in PNG. Planning then allocated the RMUs to either conservation or production land uses (including potential for forestry production and agriculture). The study recognised the internationally-agreed 10% target and converted this to a biodiversity goal by first determining how many environmental domains/groups and vegetation types

could be represented if any 10% of PNG could be selected (see [16]). The amount of this variation (as the surrogate for biodiversity) that could be represented was 608 environmental domains and 564 vegetation types.

The actual planning study [16] then addressed the objective of meeting this biodiversity representation target, while taking into account factors including human population pressure, demands for timber and agricultural products, plus constraints including inclusion of the existing WMAs. achieving this same goal given costs, constraints and preferences meant that approximately 16.8% of the country was required. The original study went on to explore another version of the analysis — one without the constraint of including the WMAs. In both analyses, weights on competing criteria, including forestry production were reduced just enough to ensure that the biodiversity target could be met.

The nominated set with WMA constraint achieved the 10%-based target with a cost of 93,218 timber volume units, but that cost would have been only 71,280 units if the WMAs were not included up front as commitments. The cost from the 172 existing wildlife management areas alone is 34,771 units (see Table 5 in [16]). The total area of the current priority set follows the same pattern. Without committing existing WMAs, the total area needed to achieve the 10%-base target would not be 16.8%, but just 12.9% of total PNG area. These results suggest that constrained inclusion of WMAs may imply greater cost (e.g., in total area protected), but do not reveal much else. To explore this further, I revisited the archive of all analyses performed in the project, to examine results in which the biodiversity target was not achieved (Figure 1).

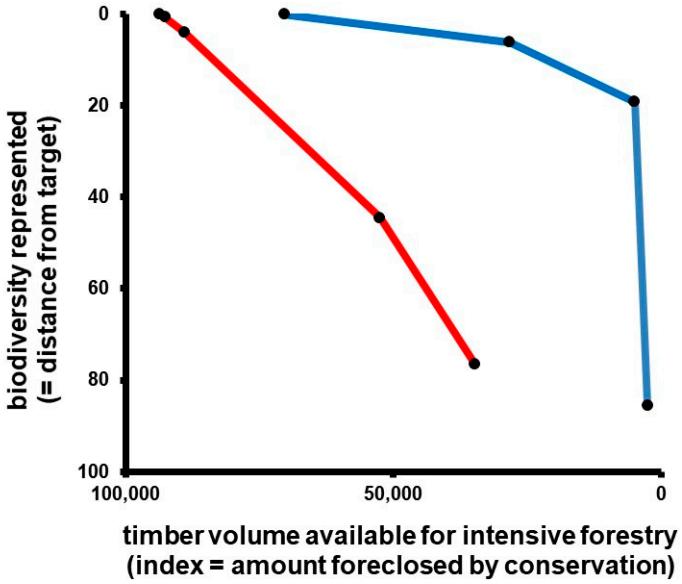

Figure 1. Efficiency-frontier curves for PNG indicating best possible combinations of biodiversity conservation level (vertical axis) and total timber volume available to forestry (horizontal axis). Points along the curves represent different allocations of the country's RMUs to either conservation or (availability for) forestry production. Allocations of RMUs offering both high biodiversity conservation and high forestry production are towards the upper right corner. Red curve: approximate efficiency frontier curve under all constraints, following [16], including required inclusion of all WMAs in the selected set. Upper point corresponds to the set discussed in [16] (Table 5), where the biodiversity target is met, with forestry-related opportunity cost of conservation of approximately 93,000 units. Other points along the curve correspond to reduced importance weight on biodiversity, relative to forestry. The blue curve represents the approximate efficiency frontier curve under all constraints, but without required inclusion of all WMAs in the selected set. The upper point corresponds to a set where the biodiversity target is met, with forestry-related opportunity cost of conservation of approximately 71,000 units. Other points along curve again correspond to reduced importance weight on biodiversity, relative to forestry.

The red curve indicates the best-possible outcomes for biodiversity, constrained to include all WMAs, and then giving more or less importance to forestry. The blue curve is for no WMA constraint. Of interest is the lower point in the red curve as this approximates the case where no additional areas are added to the set of WMAs (because high weight is given to forestry production). The level of achievement of the biodiversity target is much lower. In contrast, for the blue (unconstrained) curve, even very high importance weights on forestry permit high achievement of the biodiversity target. Of course, the WMAs represent satisfaction of multiple local nature-related values, and absence of the WMA constraint permits some of this to be lost. These trade-offs suggest general lessons in integrating local and global/regional values.

If the set of protected areas is built-up from the bottom-up in including all places (WMAs) with various local values of nature, then overall biodiversity conservation needs to be considered explicitly, or it may miss out. This is a danger in any region where high importance is also given to forestry (or other) production. But it is also true that a focus only on finding areas to satisfy the biodiversity target could mean poor conservation of localised nature values — both kinds of values must be on the table for decision-making.

5. Conclusions

Pascual et al. [9] argued that "an agenda for conservation science, practice and policy derived from a singular conceptualization of biodiversity will necessarily be narrow, creating a weak foundation for more effective collaborations between conservation professionals and people".

By revisiting long-standing planning strategies that integrate local to global values, this study shows that finding balance among different values of nature actually is well-served by a *singular* biodiversity concept focused on variety; clear recognition of biodiversity as variety enables effective integration with other values of nature. This PNG-revisited study also suggests that attempts at pluralistic recastings of biodiversity in fact may promote neglect of global biodiversity values, producing an unfortunate faux-pluralism. My extended analysis of the PNG case study suggests that such neglect may have unfortunate consequences — focusing only on localised values of nature for conservation (e.g., in WMAs) may not effectively address regional/global scale conservation needs. The PNG integrative case study may provide a useful exemplar to communicate the challenges involved in a broad conservation framing that considers not only global biodiversity values but also many other values related to nature (see also [6,19]).

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