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Short Letter

Higher-Level Targets for Ecosystem Services and Biodiversity Should Focus on Regional Capacity for Effective Trade-Offs

Daniel P. Faith

The Australian Museum, 6 College St, Sydney 2010, Australia; E-Mail: dan.faith@austmus.gov.au; Tel.: +61-02-9320-6357

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Abstract: The Convention on Biological Diversity has adopted 20 targets as part of its new Strategic Plan. Perrings *et al*. have proposed that such targets should focus solely on critical ecosystem services. Such a strategy may neglect the need to conserve overall biodiversity and corresponding option values. It also may neglect the important role of ecosystem services in systematic conservation planning strategies that seek effective regional trade-offs and synergies among different needs of society. Parties to the Convention have an opportunity to address not only conventional lists of individual targets for ecosystem services and overall biodiversity, but also higher-level targets that focus directly on how well the country achieves—and maintains its capacity to achieve—effective trade-offs among different needs of society.

Keywords: biodiversity; trade-offs; ecosystem services; option value; Convention on Biological Diversity; targets; systematic conservation planning; sustainability; Papua New Guinea; TEEB; IPBES

1. Introduction

The Convention on Biological Diversity (CBD) has adopted 20 headline targets as part of its new Strategic Plan [1]. The new targets include, for example, reducing the rate of loss of all natural habitats, eliminating incentives harmful to biodiversity, conserving target percentages of terrestrial and marine areas, maintaining ecosystems that provide essential services, restoring a target percentage of degraded lands, and improving our biodiversity knowledge base. These are to serve an overall Mission of the Strategic Plan to "take effective and urgent action to halt the loss of biodiversity in order to ensure that

by 2020 ecosystems are resilient and continue to provide essential services" [1]. The Strategic Plan also incorporates a flexible framework in which individual countries are to devise their own goals and targets. These will take into account specific national needs, as well as anticipated contributions to the broader global targets of the Strategic Plan.

The recent debates about the nature and priority of new CBD targets therefore remain timely. Important discussions have focused on the key concerns and criteria for practical, achievable, targets, in light of the apparent failure to achieve the 2010 target of a significant reduction in the rate of loss of biodiversity. Mace *et al*. [2] proposed colour–coded targets, capturing both urgent targets, with immediate links to human well-being, and more conventional conservation targets. Perrings *et al*. [3] more recently argued that, if there are to be 20 targets, then "they should address the 20 highest-priority threats to critical ecosystem services." Their rationale focused on the idea that "what and how much biodiversity should be targeted for conservation depends on what services are important". Concerns about biodiversity, according to this argument, can be addressed using ecosystem services—because these are "grounded in the real interests that people have in benefits provided by biodiversity" [3]. These arguments therefore raise the prospect that Parties to the Convention might address the Mission primarily through targets and actions focused on perceived critical ecosystem services.

The Perrings *et al*. proposal, however, appears to under-value both biodiversity and ecosystem services. First, biodiversity conservation requires consideration of more than currently-perceived critical services. Perrings *et al*. draw on the Millennium Ecosystem Assessment's (MA's) ecosystem services framework [4], in which biodiversity is an underpinning factor and is not itself a service. The MA stated that global biodiversity loss is "more a concern about long-term option values, and hence defines a critical knowledge gap that goes beyond current perceived services." Option values refer to the idea that maintaining variety maintains our options to benefit from future uses of elements of biodiversity. In focusing primarily on currently perceived "important", "critical", ecosystem services, Perrings *et al*.'s proposal risks neglecting overall, wholesale, biodiversity and its option values. These, often un-anticipated, future benefits constitute "real interests" of tomorrow that are not even on the radar today [5].

Second, currently recognized, critical, ecosystem services have an important role in biodiversity conservation that goes beyond just conserving those local elements of biodiversity that support those services. When we consider conservation of overall regional or global biodiversity, the relationship between ecosystem services and biodiversity is more complex, reflecting both local and regional aspects. Regionally, perhaps the most important gain from recognition of benefits of ecosystem services is that this provides a reduced cost of retaining relatively intact localities. Studies have quantified how the estimated economic value of the ecosystem services exceeds the economic value to be gained by non-conservation activities [6,7]. For example, the opportunity cost of conservation, defined by the potential for commercial forestry production, may be less than the value of the intact locality in providing ecosystem services.

Consideration of such opportunity costs of conservation is central to the well-established "systematic conservation planning" methods for exploring effective regional trade-offs and synergies between overall biodiversity and other needs of society [8-10]. One approach, "regional sustainability analysis", draws on multi-criteria analyses to explore efficiency frontier or trade-offs curves in a

regional trade-offs space [11,12]. Here, when recognized ecosystem service benefits imply a lower cost of retaining a relatively intact locality, this does more than support some locally important elements of biodiversity. It lowers the cost of gaining that locality's potential contribution to overall regional biodiversity conservation (its "complementarity value" [10,11]). Thus, ecosystem services valuation importantly indicates reduced costs of relatively intact land [6,7], potentially providing regional, not just local, biodiversity gains. Of course, this valuation does not on its own provide information about the actual contribution of the intact locality to regional biodiversity conservation. We need additional information about patterns of overall biodiversity in the given region [5,10-13].

There is some evidence that the collective contributions of localities conserved based on ecosystem services, even while conserving local elements of biodiversity, provide only limited representation of broader regional biodiversity. A Papua New Guinea study [14] showed that the country's extensive network of Wildlife Management Units, assigned protection for traditional hunting, subsistence agriculture, and other ecosystem services, performed poorly in representing the country's overall biodiversity. A global study [15] showed that a set of ecoregions selected for ecosystem services conservation could result in relatively poor representation of species. Thus, ecosystem services conservation may make a contribution to regional biodiversity conservation, but biodiversity measures must enter into regional planning in order to achieve representativeness.

These arguments do not mean that targets should focus on overall biodiversity and neglect current critical ecosystem services. Clearly, ecosystem services valuation does not just reduce opportunity costs of localities potential contributions to overall biodiversity conservation. Valuation helps to overcome the fact that ecosystem services are undervalued by markets, and so allows these benefits to quantitatively contribute to the trade-offs and synergies of systematic conservation planning and other decision-making. Ecosystem services benefits in a given locality will not always be taken-up as a result of such balanced planning; full conversion of that locality might provide a better regional outcome [16,17].

While individual targets for different goals and needs will be useful, countries or regions must address the inevitable trade-offs among ecosystem services, biodiversity, and other needs of society. Of course, trade-offs have long been recognized [4,10,11], and this reality was again well-highlighted by Perrings *et al*. Nevertheless, there does not seem to have been much attention to how anticipated trade-offs and synergies might be constructively and explicitly translated into practical global or national targets and indicators. Next, I consider a proposed approach that has focused directly on how well a region is achieving (or maintaining a capacity to achieve) new effective trade-offs and synergies.

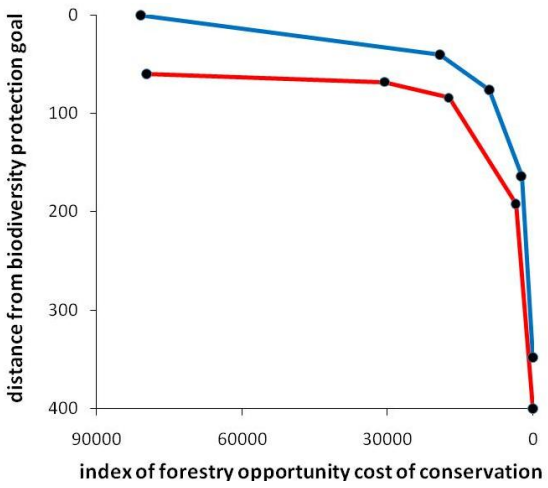
2. Trade-Offs and Targets

As a complement to a list of targets focused on 20 or more individual goals, higher-level targets/goals could focus directly on the need to better balance overall biodiversity conservation, ecosystem services, and other needs of society [17]. Faith and Ferrier [18] proposed that an effective higher-level goal might focus directly on achieving new implementations of systematic conservation planning that deliver more effective trade-offs and synergies, compared to "business as usual". According to their argument, a country then could "credit any new take-up of strategies providing effective regional trade-offs/synergies" [18], including, for example, balanced planning for new

protected areas, or efficiently targeted conservation payments to private land-owners. Biodiversity losses, arising from society's pursuit of various non-conservation land-uses, are reduced through these effective trade-offs and synergies developed through systematic conservation planning. Case studies have illustrated how achieving this higher-level goal can deliver a reduced rate of regional biodiversity loss, even for a constant rate of conversion to non-conservation land uses [18,19].

That basic higher-level target could be expanded to call for, not only new balanced-planning achievements, but also ongoing decision-making that preserves the region's capacity for effective trade-offs in the future. Scenarios concerning capacity for effective trade-offs have been explored through simple regional sustainability analyses; these report on shifts in trade-off or efficiency frontier curves in regional trade-offs space [11]. As an example, we can re-examine a systematic conservation planning study for Papua New Guinea that identified effective trade-offs between biodiversity conservation and forestry production [14]. In a follow-up scenarios analysis, Faith *et al*. [20] plotted the original trade-offs curve used for that systematic conservation planning exercise, and also calculated a new, alternative, trade-offs curve. This new curve was based on a land-use scenario in which those localities already having some high land-use intensity [14] were now assumed to be lost to biodiversity conservation, because of continued intensive land-use [20]. The resulting shift in the trade-offs or efficiency frontier curve indicated a reduction in the capacity of the region for effective trade-offs (Figure 1).

Figure 1. A trade-offs space for Papua New Guinea, modified from the Faith *et al*. study [20]. Any point in the space corresponds to an overall regional score for biodiversity conservation (vertical axis) and for forestry production (horizontal axis). "Distance from biodiversity protection goal" means that higher values correspond to lower biodiversity conservation, and "forestry opportunity cost of conservation" refers to total regional lost opportunities for forestry production as a consequence of conservation, measured using a timber-volume index [14]. Blue frontier curve assumes no land-use constraints. Red curve represents a scenario in which all localities already having high land-use intensity in 1% or more of their area are now assumed to be lost to biodiversity conservation, through further intensive land-use. Each curve, defining best-possible trade-offs, was approximated by calculating priority-area sets with maximum net benefits (black dots) for 5 different weightings on forestry and biodiversity, using TARGET software [14,19-21].



In extreme cases, such a new curve would be much worse than the original, because the land-use changes in the region mean that flexibility in the region for balanced planning and "regional sustainability" [11] has been lost. Scenarios analyses that try to anticipate such a loss in capacity for trade-offs would be useful. A regional goal or target could call for decision-making on land-uses that demonstrably maintains the capacity for effective trade-offs. Such a strategy might help to avoid regional sustainability tipping points, where accumulated small changes in regional land use/condition ultimately mean that the opportunity to balance competing needs of society has all but disappeared.

3. Conclusion

Targets that focus only on current, critical, ecosystem services would miss the opportunity to address the loss of overall biodiversity and its option values. Such targets also might limit opportunities to explicitly address trade-offs and synergies among different needs of society. The development of national goals and targets by Parties to the CBD could address not only the conventional lists of individual targets, but also novel higher-level targets that focus directly on how well the country achieves—and maintains its capacity to achieve—effective trade-offs among different needs of society. Such targets are relevant also to the CBD Strategic Plan's [1] call for the "development of comprehensive national accounting, as appropriate, that integrates the values of biodiversity and ecosystem services into government decision-making." An effective national accounting system might include efforts to track the impacts of ongoing land-use decisions on the country's capacity to achieve effective trade-offs among biodiversity conservation, ecosystem services, and other needs of society.

These considerations contrast with Perrings *et al.*'s exclusive focus on critical ecosystem services. That approach, while simple in concept, would not given sufficient attention to overall biodiversity and the need for effective trade-offs with other needs of society. Future assessments, including those for the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) [22], face the difficult challenge of understanding trade-offs and synergies, from local to global scales, among ecosystem services and overall biodiversity.

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16. In one example, a locality offered either complete conversion to commercial forestry production, or take-up of an ecosystem services option with partial biodiversity retention. Adopting the ecosystem services option (equated with low-level timber harvesting) would lower opportunity costs of conservation, and would maintain some biodiversity in that locality. However, this option also would imply greater regional biodiversity loss for a given target level of regional forestry production. For further explanation, see Figure 9b in [11].
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