Net positive outcomes for nature

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Much research and policy effort is being expended on seeking ways to conserve living nature while enabling the economic and social development needed to increase global equity and end poverty. We propose that this will only be possible if the language of policy shifts away from setting conservation targets that focus on avoiding losses and towards developing processes that consider net outcomes for biodiversity.

The principle that nature conservation should be delivered alongside improvements to human wellbeing is well established in international policy [1,2]. It is therefore no surprise that widespread agreement emerged from the 2018 conference of the parties to the Convention on Biological Diversity (CBD; CoP14) and at the 2019 World Economic Forum that biodiversity must be conserved for the sake of both people and planet [3,4]. Two questions dominated discussions at CoP14: what activities can be counted towards meeting biodiversity conservation targets (throughout this article, we assume the nomenclature from the CBD [2]); and can conservationists outline a global target, analogous to the 1.5-2^{0}C global warming limit, as a rallying-point for biodiversity conservation? We consider that addressing these questions requires recognition that everything which results in desirable biodiversity outcomes (i.e., retention or restoration) should count and a shift of focus away from top-down global targets [5] and towards finding a process-based framework within which to capture progress towards desired outcomes [6].

Shifting the focus to net outcomes

Biodiversity persists or even regenerates in all manner of places: not only in primary habitats, but also in abandoned farmlands, human-made marine structures, intact areas licensed by industry but not yet exploited, urban green spaces, and so on. Areas managed by Indigenous peoples often provide refuges for biodiversity [7], as can production areas that aspire to conservation co-benefits if well-managed [8]. These areas sit alongside interventions specifically targeted to conservation, such as national protection around strongholds for threatened species. All such interventions and 'non-interventions' take place within land- and seascapes often dominated by a kaleidoscope of human activities.

While conserving biodiversity and achieving human development are therefore not necessarily in opposition, and indeed can be compatible [9], there are inevitably trade-offs. But economic development activities could – under the right circumstances – lead to positive biodiversity outcomes. The key is to ensure that any biodiversity losses are not ecologically irreplaceable, that they are socially acceptable and that they are more than fully compensated for, so that overall, nature is retained or restored in net terms. This necessitates losses and gains being quantified in an integrated framework that permits transparency as to whether biodiversity goals are being achieved.

With the date looming for governments to agree a post-2020 strategy that succeeds the CBD's Strategic Plan for Biodiversity 2011-2020 and Aichi Targets, it is time that the language of net outcomes – for example an objective

to have a net positive impact on biodiversity – makes its way into global conservation policy discussions. If the high-level language of even the current Aichi Targets shifted focus further towards net outcomes, this would have major implications for the way in which conservation could be delivered (Fig. 1). A strategy requiring net positive outcomes – above and beyond targets for preventing further declines – would encourage wider engagement in nature conservation. Contingent upon certain practicalities (see below) it would allow countries, cities, companies and individuals to make their own commitments, based on their ability and resources to deliver conservation objectives efficiently through varying routes and in line with human development goals.

A framework for capturing losses and gains

The challenge with net outcomes is how to track whether biodiversity is hanging on, recovering, or thriving across the enormous variety of competing and overlapping human activities. This requires quantifying negative and positive biodiversity impacts of economic activities wherever they occur such that losses and gains can be scaled up and treated cumulatively. That conceptual logic underpins the Conservation Hierarchy concept, which several of us previously proposed [10]. The Conservation Hierarchy is a framework for enabling tracking of progress towards an agreed overarching objective, based upon net conservation outcomes. All direct and indirect impacts caused by anthropogenic activities anywhere would be quantified, and all conservation efforts categorised into a hierarchy of preventative or compensatory actions: starting with avoidance of impacts, such as enforcing strictly protected areas or forgoing mining rights; then minimisation, meaning ongoing actions that reduce

the severity of impacts, such as sustainable fisheries management and low-intensity farming; and finally compensation for impacts, either by remediating the impacts that have occurred, for example by restoring quarry sites, or through offsets for unrelated impacts, such as investing in reforestation. ‘Over-compensation’ for biodiversity loss, for example through philanthropic investments, should also be incorporated. Overall, all actions generating biodiversity gains or losses should contribute towards sectoral, national and global targets.

Prioritising preventative measures is an important safeguard, as some biodiversity impacts cannot be reversed and might be considered unacceptable at any cost [11]. Further, minimisation requires actors to confront and continuously seek to reduce impacts at the scales and locations where they occur, limiting their potential to focus only on gains from impact-independent conservation actions. Evaluating, mitigating and over-compensating for cumulative development impacts at landscape scales [12] helps shift conservation actions from being reactive and localised, to proactive and aligned with national or international conservation planning.

Though bottom-up, this approach still requires an overarching objective, such as seeking a ‘positive net outcome for nature’ (possibly even through area-based targets). But this does not preclude ongoing development. It can incorporate multiple stakeholders and sectors, biodiversity at all levels from genes to ecosystems, and operate at spatial scales from individual plots of land to continent-wide flyways. The key requirements are spatial and sectoral

scalability, adaptability to different countries' circumstances, equitability, comprehensiveness, and measurability (Box 1). For example, some countries or sectors may not be required to commit to net positive biodiversity outcomes due to their economic development stage or role in improving the wellbeing of vulnerable groups, whereas others may have the capacity and obligation to do much more [13].

Box 1: Net outcomes on the Belt and Road

Some 75% of the infrastructure that will exist on the Earth by 2050, by investment, has yet to be built [14]. One component of this coming infrastructure boom, China's 'Belt and Road Initiative' (BRI; Extended Data Figure 1), will build cultural and trade links across the world, but is likely to exacerbate biodiversity losses [15, 16]. Imagine that the BRI sought, instead, to achieve a net positive outcome for biodiversity. The Conservation Hierarchy could track demonstration of net biodiversity gain wherever BRI infrastructure was constructed. For example, each stretch of road could include measures to safeguard against unacceptable losses (such as re-routing to avoid habitat of restricted-range species), as well as compensatory measures (such as off-site restoration to offset residual damage). Although specific compensatory measures would be delivered locally, net outcomes could be evaluated across all BRI infrastructure within a country, or even throughout the approximately 60 BRI countries. At larger scales, countries would evaluate conservation outcomes of the BRI across sectors, considering not only direct biodiversity impacts of infrastructure, but also secondary impacts (such as increased natural resource extraction), alongside voluntary interventions to mitigate impacts (for example by conservation NGOs).

Map of China and Central Asia. Areas potentially targeted for various forms of nature conservation include avoidance of most impacts in protected areas safeguarding key biodiversity areas [data from 17], minimisation of impacts on intact habitats with a relatively low human footprint [data from 18,19], and compensation for residual impacts through restoration of other areas (e.g. forest restoration opportunities [data from 20])

One possible indirect impact from the BRI will be to facilitate the illegal wildlife trade, particularly as planned BRI corridors will pass through biodiverse areas that are known sources of traded wildlife [21]. Similarly, maritime routes will link Southwestern China to Indonesia, where species such as sharks and rays are supplying growing markets in China and neighboring countries [22]. Incorporating such impacts and associated conservation mechanisms into the same overarching framework as direct habitat impacts from construction is challenging but possible. Interventions to address illegal wildlife trade may include improved enforcement, alternatives to wild-sourced products, or approaches that reduce consumer demand through behaviour change (Supplementary Table 1, Extended Data Figure 2).

Implementing a net outcomes approach

Under the Conservation Hierarchy all countries might agree to, say, a net-positive outcomes objective, the precise nature of which would be set through CBD negotiation processes and linked to the CBD 2050 vision. But they would

approach that objective in markedly different ways, dependent upon circumstances. For example, countries with extensive remaining intact ecosystems might focus on retention policies; those with many threatened species might focus on their active conservation. Countries for which most biodiversity impacts are exported in trade could invest in mitigating these losses throughout international supply chains, while those with largely impoverished biodiversity may focus on national-scale restoration. Countries, companies and individuals with enough financial resources could also support actions in other countries as additional compensatory measures beyond their own net gain targets, and have those actions recognised. However, this would need to be a point of detailed international policy discussion.

There are substantial practical challenges to tracking biodiversity outcomes of a wide range of measures, arising from different policies, and implemented by various actors, at multiple scales [23]. These challenges include how to confirm compliance with agreed policies, and how to carry out the substantive long-term monitoring necessary to ensure that overarching objectives are met and net biodiversity loss reversed. A shift from policy commitments to demonstrable implementation requires effective monitoring at a national scale, twinned with penalties for non-compliance. The challenge of ensuring compliance plagues environmental policy more broadly, and it becomes even more fiercely debated when biodiversity losses are supposedly counterbalanced by gains. The challenge of monitoring, reporting and evaluating effectiveness has proven particularly acute for net outcome policies [24]. Our approach aims to catalyse improved transparency in clarifying the intended outcomes of conservation

interventions, and ensuring these are monitored and reported. One benefit of the Conservation Hierarchy, therefore, is that its requirement to quantify gains and losses leads to an emphasis on the importance of monitoring. Nonetheless, success is contingent upon cumulative disparate biodiversity losses and gains being closely and transparently tracked at landscape and national scales by governmental authorities.

Tracking losses and gains would require considerable resources – for data collection, maintenance of data platforms, design and implementation of monitoring protocols, and managing incentive mechanisms. This requires investment in human and institutional capacity; one way to enable this would be to align implementation with boosting support for existing processes such as National Biodiversity Strategies and Action Plans. Each country's ability to implement the framework would need to be assessed, and financial support might be necessary for some. It is worth noting that additional resourcing is likely to be required for any post-2020 biodiversity framework.

In many countries, the requisite institutional and legislative machinery for net conservation approaches is already in place. For example, 133 parties to the CBD either have regulatory requirements for impact mitigation measures with a net biodiversity objective, or are developing related policies, although the likelihood of legal compliance is highly variable by country (Extended Data Figure 3; [25-27]). Meanwhile, comparable machinery is in place for leading international lenders. The World Bank Group requires preventative or compensatory impact mitigation measures with net positive biodiversity

outcomes for lending on large-scale infrastructure projects. Current net biodiversity outcome policies typically relate to site-level impacts in certain economic sectors; the Conservation Hierarchy's aim to apply a comparable process to all cumulative human impacts on biodiversity is more ambitious. Furthermore, current policies are typically implemented through environment departments, with less input from often more-influential departments such as finance, planning, agriculture and energy; these departments should be actively involved with policy implementation.

A net outcomes approach requires actors to specify metrics for monitoring biodiversity losses and gains. The Conservation Hierarchy framework is not prescriptive about which metric or group of metrics to use, given that different metrics suit different applications (such as economic sector or geographic region) and scales. A choice is needed between whether assessments of loss and gain should be required to be scalable and fungible, or whether the different scales and sectors could report on net outcomes in a more qualitative way, with actors able to use whatever metric is appropriate to their circumstances. The latter would have the benefit of allowing a plurality of metrics; for example, Indigenous communities may have their own culturally and practically appropriate metrics, while specifically tested and scalable metrics should be used for large corporations reporting about the impacts of their international supply chains. This might include selected metrics from the existing set of CBD indicators, where those are consistent with the CH framework.

Some metrics are more scalable than others. For instance, gains and losses in the ecological condition, areal extent and connectivity of a specific habitat type at local sites could be aggregated to measure overall progress towards net gain for that habitat type at the landscape level. Similarly, indices such as the IUCN's Red List and Green List of threatened species could be aggregated to show how species are progressing towards overall recovery [28]. Conversely, net gains in local species richness could not be presumed to translate into net gains over larger scales [29], and so would not be an appropriate metric.

Specifying a reference scenario is fundamental to evaluating net conservation outcomes. Counterfactual scenarios, which assess trends in the absence of intervention, are sometimes used when evaluating effectiveness [23,30], but the Conservation Hierarchy seeks to compare all losses associated with human activities against all gains, and to engender the retention or restoration of biodiversity in comparison to current levels. Here, the appropriate reference scenario is a fixed baseline, with a requirement for net gain. The time point at which the baseline was fixed would require negotiation, probably between countries party to the CBD.

Finally, there are other major global challenges that represent opportunities for policy coherence with conservation, perhaps most crucial being climate change mitigation [31,32]. A major aspiration for environmental policy in 2020 is to unify climate change and nature conservation targets. If the language of net outcomes appears in a post-2020 biodiversity strategy, humanity might aspire towards a combined objective like ‘net gain in biodiversity, alongside no net

gain in atmospheric greenhouse gases, by 2050'. A major operational link between biodiversity and climate is land use change [33,34]: conversion of natural habitats to human-dominated landscapes is a leading driver of both species loss [35] and greenhouse gas emissions [36]. At the same time, retaining intact ecosystems is crucial to efforts to adapt to the rapidly changing climate [37]. Applying a net outcomes framework that ensures zero net conversion of natural habitats or better (combining retention and restoration efforts, and based on metrics that account for ecological condition and extent of habitat) would contribute heavily towards objectives for both global biodiversity conservation and greenhouse gas emissions reductions. The language of net outcomes raises the possibility of a wider aspiration for tackling the challenges of biodiversity loss, climate change and human development together. Doing so will require the whole earth, and the combined will of all of humanity.

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Author contributions

JWB, JEMW, EJM-G, MJB and SPS conceived the manuscript. JWB wrote the manuscript, with support from JEMW and EJM-G. PFEA, WNSA, JB, TMB, MJB, AH, MM, JGR, NS, SPS, SNS and SOSEE provided substantive insights and gave comment and review.

Competing Interests

The authors declare no competing interests.

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***Figure 1**: Paraphrased key content of the Aichi Biodiversity Targets [2], valid until 2020, alongside some possible variations that would shift the focus towards net conservation outcomes. Green shade = no modification (already aligned with a net outcomes approach); amber shade = minor modifications; red shade = major modifications or replacement.*