

Net positive outcomes for nature

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Much current research and policy effort is being expended on seeking ways to conserve living nature while enabling the economic and social

development required to enhance 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, 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: (1) what activities can be counted towards meeting biodiversity conservation targets (throughout this article, we assume the nomenclature from the CBD [2]); and, (2) can conservationists outline a global target, analogous to the 1.5-2°C global warming limit, as a rallying-point for biodiversity conservation? We consider that addressing these questions requires (1) recognition that *everything* which results in desirable biodiversity outcomes (i.e., retention or restoration) should count; and, (2) a shift of focus away from top-down global targets [5] 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 (dependent on context) 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 important refuges for biodiversity [7], as can production areas that aspire to conservation co-benefits if well-managed [8]. These inadvertent conservation areas sit alongside traditional interventions, such as national regimes that proactively protect 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 directly in opposition, and indeed can be compatible [9], there are inevitably trade-offs. But synergies between biodiversity conservation and human wellbeing do exist, and biodiversity losses through economic development activities could – under the right circumstances – lead to positive outcomes. The key is to ensure that any such 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*. In turn, 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 current Strategic Plan for Biodiversity 2011-2020 and Aichi Targets, it is time that the language of net outcomes (e.g. an objective to have a ‘net positive impact on biodiversity’) made 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 into 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.

Figure 1: key content (paraphrased) 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.

	Current targets (paraphrased)	If targets based on <i>net outcomes</i>
Managing losses of biodiversity        	<p>Eliminate or reform harmful incentives (including subsidies)</p> <p>Reduce loss of natural habitats and pressures on vulnerable habitats</p> <p>Ensure sustainable use (marine stocks, agriculture, aquaculture and forestry)</p> <p>Reduce pollution and invasive species to low levels</p> <p>Prevent extinction, and loss of genetic diversity</p>	<p>Reform incentive structures to focus on net outcomes</p> <p>Seek no net loss of habitats or better, including those that are vulnerable</p> <p>Same (sustainable use based on net outcomes)</p> <p>Same outcome, with results for pollution and invasive species evaluated in net terms</p> <p>Same (e.g. extinction considered unacceptable and avoided under a net outcomes approach)</p>
Seeking gains in biodiversity    	<p>Increase protected area coverage to meet target</p> <p>Enhance ecosystem service provision and resilience, including habitat restoration</p> <p>Implement Nagoya Protocol</p>	<p>Replace with target focused on net positive outcomes for biodiversity</p> <p>Same, but based on net habitat restoration</p> <p>Same</p>
Framework for implementation      	<p>Incorporate biodiversity values into planning and accounting</p> <p>Governments and businesses implement plans for sustainable use and safeguards</p> <p>Develop and finance a national biodiversity strategy and action plan</p> <p>Integrate traditional knowledge, and science and technology, into policy</p>	<p>Same, with accounting via the Conservation Hierarchy</p> <p>Same, with decision-making via the Conservation Hierarchy and safeguards maintained</p> <p>Same, with tracking of commitments across plans to ensure net gain at global scale</p> <p>Same</p>

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’ (CH), which several

of us previously proposed [10]. The CH is a framework within which progress towards an agreed overarching objective, based upon net conservation outcomes, can be tracked. 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 (e.g. enforcing strictly protected areas, forgoing mining rights), then minimisation (ongoing actions that reduce the severity of impacts e.g. sustainable fisheries management, low-intensity farming), and finally compensation for impacts either where the impact occurred (remediation, e.g. restoring quarry sites) or elsewhere (offsets, e.g. investing in reforestation). ‘Over-compensation’ for biodiversity loss (e.g. philanthropic investments) should also be incorporated. Overall, all actions generating biodiversity gains or losses should contribute towards sectoral, national and global targets.

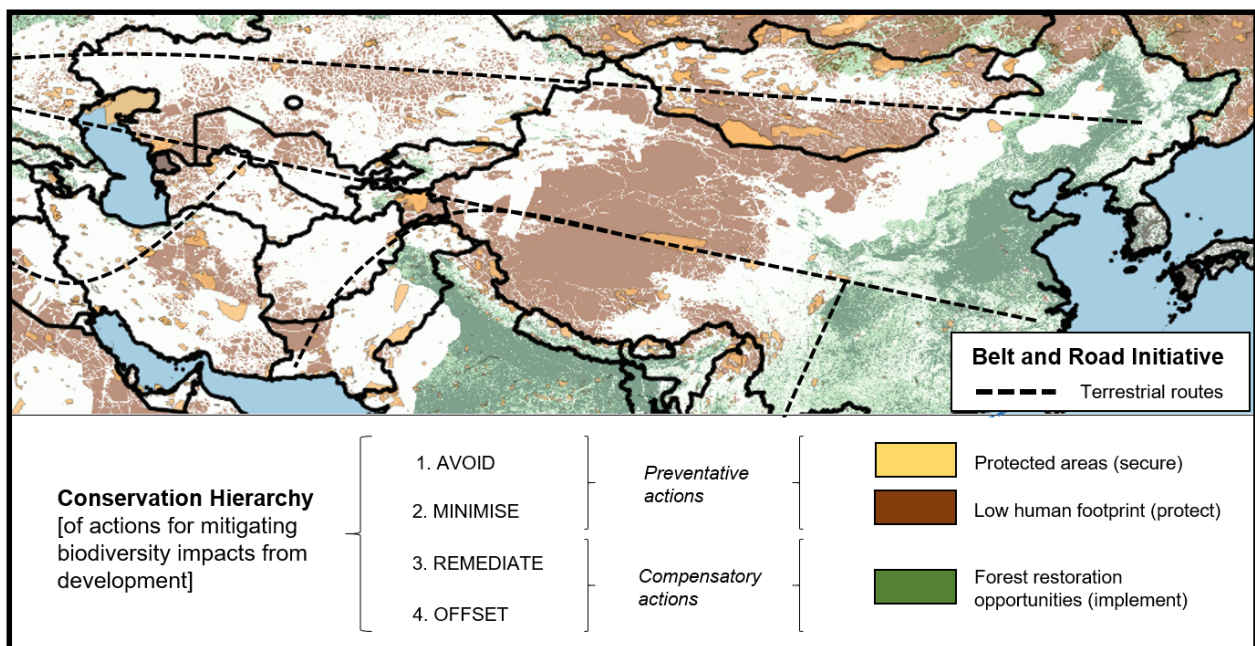
Focusing on preventative measures as priorities is an important safeguard, as some biodiversity impacts cannot be reversed and might be considered unacceptable at any cost [11]. Further, minimisation requires actors who impact nature to confront and continuously seek to reduce those impacts at the scales 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 incorporates multiple stakeholders and sectors, biodiversity at all levels from genes to ecosystems, and at all spatial scales from people's individual plots of land to continent-wide flyways. The keys are spatial and sectoral scalability, adaptability to different countries' circumstances, equitability, comprehensiveness, and measurability. For example, some countries or sectors should not necessarily 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 more [13].

Illustration: construction and wildlife trade 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]. Consider one component of this coming infrastructure boom: China's 'Belt and Road Initiative' (BRI; Fig. S1), which is a means for building cultural and trade links across the world, but is likely to exacerbate biodiversity losses [15,16]. Let us imagine (it has not yet been proposed) that the BRI sought, instead, to achieve a net positive outcome for biodiversity. The CH 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 (e.g. re-routing to avoid habitat of restricted-range species), as well as compensatory measures (e.g. off-site restoration to offset residual damage). Though specific compensatory measures would be delivered locally, net outcomes could be *evaluated* across all BRI infrastructure within a country, or even throughout the ~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 (e.g. 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 (Table S1, Fig. S2).

Implementation of a 'net outcomes' approach

Under the CH, all countries might have a net-outcomes objective (e.g. a 'positive net biodiversity outcome', with the precise nature of the objective set through CBD negotiation processes and linked to the CBD 2050 vision) but 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 supply chains (i.e. internationally), 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 various policies, and implemented by various actors, at multiple scales [23]. Not least, 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, although it becomes

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 the relevant authorities.

Tracking losses and gains would have considerable resource implications – 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. Assessment would be needed as to which countries had the practical ability to implement the framework, and whether financial support would be necessary for those who did not. This is likely to be true for any approach to a post-2020 biodiversity framework, however.

In many individual nation states, the requisite institutional and legislative machinery for net conservation approaches is in place. For example, 133

parties to the CBD either have regulatory requirements to follow a hierarchy of impact mitigation measures with a net biodiversity objective, or are developing related policies (Fig. S3; [25-27]) – together occupying territories representing almost three quarters (73.4%) of the global terrestrial surface [28]. Meanwhile, comparable institutional machinery is in place for leading international lenders. The World Bank Group – who committed USD 66.86bn of finance globally in 2018 [29] – require preventative or compensatory impact mitigation measures with net positive biodiversity outcomes as a pre-requisite for lending on large-scale infrastructure projects. Current net biodiversity outcome policies typically relate to site-level impacts in certain economic sectors; applying a comparable process to *all cumulative* human impacts on biodiversity (i.e. the CH) is somewhat more ambitious. Further, the likelihood of legal compliance is highly variable by country (Fig. S3). Finally, current policies are often implemented through environment departments with less buy-in from powerful and influential departments such as finance, planning, agriculture and energy; this would need to change, with those departments proactively brought into the discussion around policy implementation.

A net outcomes approach requires actors to specify metrics for monitoring outcomes (biodiversity losses and gains). The CH framework is not prescriptive about which metric or group of metrics to use, given that different metrics suit different applications (e.g. economic sector, 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 dependent on what was important for the actor concerned and their impacts (e.g. Indigenous and local communities may have their own culturally and practically appropriate metrics). However, for some sectors (e.g. corporations reporting about the impacts of their international supply chains) internationally-recognised, robustly tested scalable metrics should be required. 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 independent local sites could be aggregated to produce metrics measuring 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 in principle be aggregated to show how species are progressing towards overall recovery [30]. Conversely, net gains in local species richness could not be presumed to translate into net gains over larger scales [31], and so would not be an appropriate metric.

Fundamental to evaluating net conservation outcomes (at whatever scale and for whatever biodiversity component) is the specification of a reference scenario (i.e. a baseline or counterfactual). A growing body of literature points towards using counterfactual scenarios (i.e. trends in the absence of intervention) when evaluating effectiveness [23,32]. However, the CH 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. The appropriate reference scenario is a fixed baseline, with a requirement for net gain (further developing the logic from [10]). The exact point in time at which the baseline was fixed would require substantial negotiation, probably between countries party to the CBD.

Finally, there are other major global challenges that represent opportunities for policy coherence with conservation, e.g. climate change mitigation [33,34]. 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 then 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 [35,36]: conversion of natural habitats to human-dominated landscapes is a leading driver of both species loss [37] and greenhouse gas emissions [38]. At the same time, retaining intact ecosystems is crucial to efforts to adapt to the rapidly changing climate [39]. Consequently, applying a net outcomes framework that ensured zero net conversion of natural habitats or better (combining retention and restoration efforts, and based upon e.g. metrics that account for ecological condition and extent of habitat) alongside economic development 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 and human

development together. Doing so will require the whole earth, and the combined will of the whole of humanity.

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Author contributions

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

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Supplementary Information

Figure S1: Map of the full extent of the Belt and Road Initiative (BRI). Included: latest estimate of the spatial distribution of anthropogenic impacts upon nature, the terrestrial 'human footprint' [data from Venter et al. (2016) di Marco et al. (2018)], against proposed development corridors for BRI (Losos et al. 2019). Note that the human footprint addresses the 'ecosystems' dimension of biodiversity only. Yellow border = area displayed in Text Box 1 (China and Central Asia).

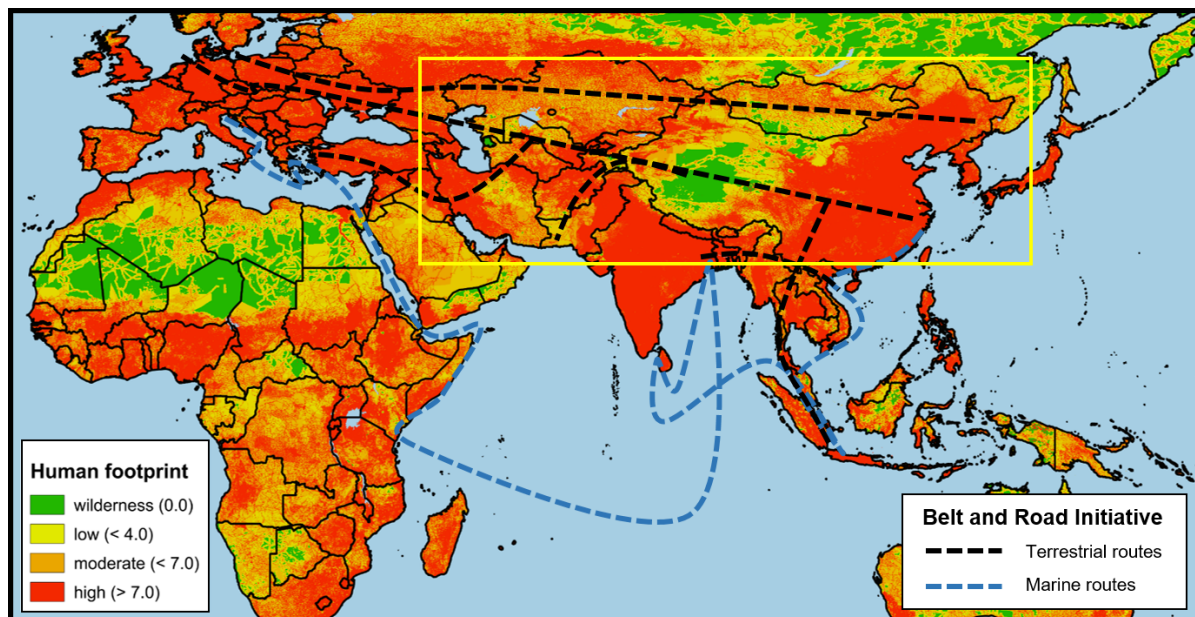


Table S1: potential conservation interventions associated with illegal wildlife trade (IWT) in the BRI region, categorised according to the CH.







C Category	H Conservation intervention	Specific example	
AVOID	Develop farmed, synthetic or otherwise alternative products to the unsustainable wild versions, and promote their use through policy regulation	Banning sales of elephant ivory whilst simultaneously shifting the traditional carving industry to use other raw materials (e.g. nut kernels; Martin & Vigne, 2015)	
	Seek to encourage behaviour change in consumer countries through social marketing targeted at specific networks	Social marketing targeted directly at consumers and at their personal or professional networks (e.g. reducing consumption of pangolin meat and scales; Challender et al., 2015)	
MINIMISE	Strengthen current enforcement activities where risk of increased IWT is greatest, to limit trade on both the supply and demand ends of the trade	Anti-poaching forest patrols and sting operations for tiger poachers and traders in Indonesia, alongside bilateral agreements on exchange of wildlife trafficking data between Indonesia and China (Linkie et al., 2018)	
		Enhanced funding and resources for existing ranger programmes (e.g. trade of rare furs in the Russian Far East), and efforts to tackle organised crime (trade in falcons from Russia to the Middle East; Wyatt, 2009)	
		Improve CITES implementation by building capacity for high-risk BRI states that currently lack adequate national legislation to implement the Convention (which have already been identified; CITES, 2019)	
REMEDIAL	Invest in restorative in-situ conservation of highly traded species impacted by BRI activities	Implement programmes of sustainable use for the legal side of trade in arctic fox in the Russian Far East, associated with species and habitat restoration	
OFFSET	Support the growth of, and subsequently protect, populations of highly traded species inhabiting non-BRI countries	Investment in programmes to expand and protect populations of African elephants west of the BRI (which connects primarily to Eastern Africa)	

Figure S2: (accompanying Table S1) a map of the central and eastern BRI region featuring examples of primarily illegally traded wildlife products, along with the approximate direction of trade. Overlaid onto the human footprint and main BRI corridors displayed in Figure S1.

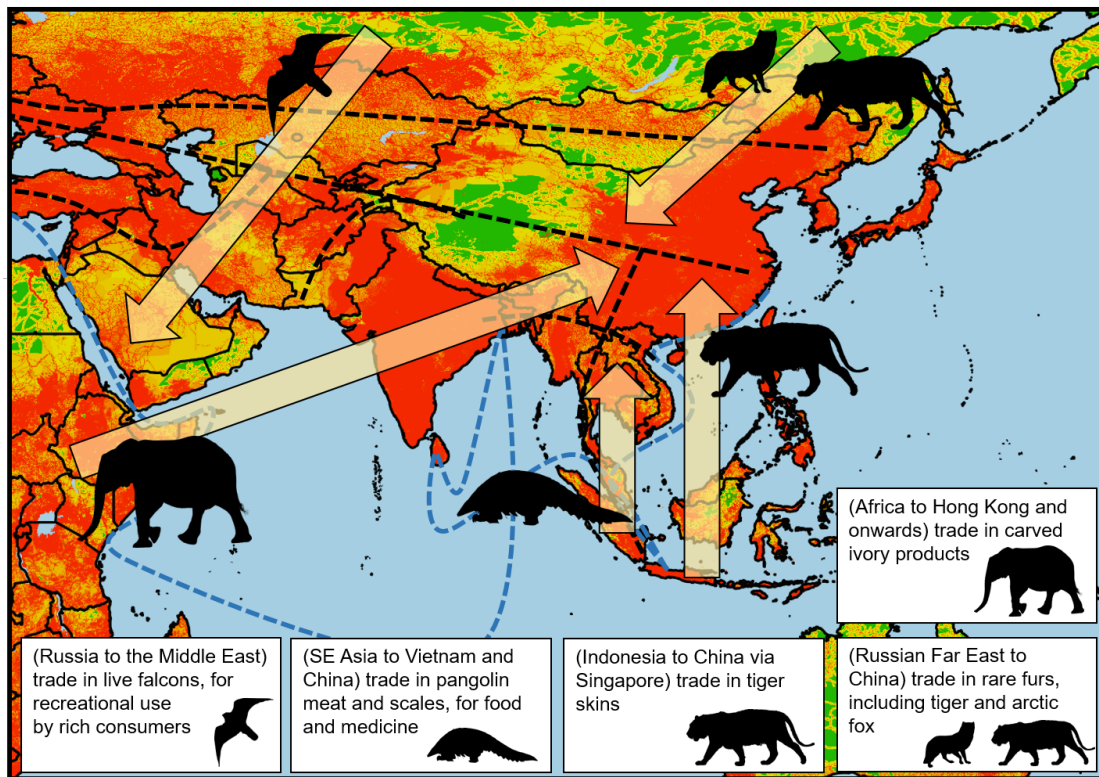
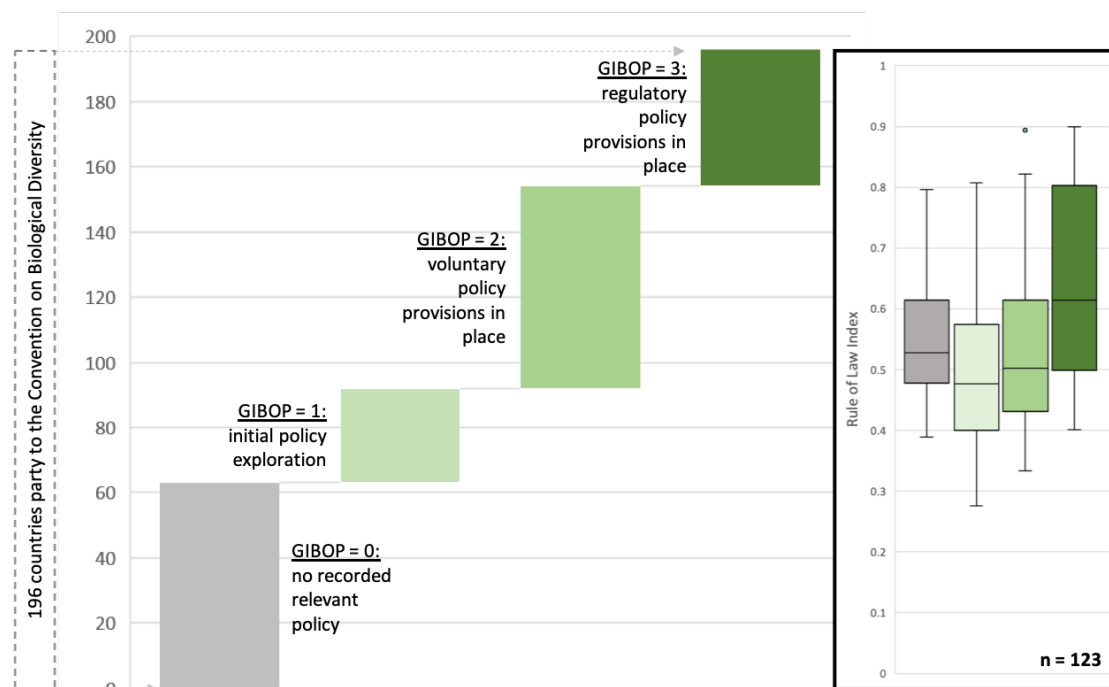


Figure S3: Global Inventory of Biodiversity Offset Policies (GIBOP) policy scores (0 – 3) for the 196 parties to the CBD. The recently developed GIBOP reports the results of the most comprehensive global analysis of national net outcomes conservation policies. The interpretation of GIBOP policy score, in terms of the existence of national policies applying a mitigation hierarchy to biodiversity impacts, is given in the figure. Inset: Rule of Law index (World Justice Project, 2019) scores against GIBOP policy score for the 123 of those countries for which data are available, giving an indication of the likelihood of legal compliance, grouped again by GIBOP policy score.



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