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Perspective

Four steps for the Earth: mainstreaming the post-2020 global biodiversity framework

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SUMMARY

The upcoming Convention on Biological Diversity (CBD) meeting, and adoption of the new Global Biodiversity Framework, represent an opportunity to transform humanity's relationship with nature. Restoring nature while meeting human needs requires a bold vision, including mainstreaming biodiversity conservation in society. We present a framework that could support this: the Mitigation and Conservation Hierarchy. This places the Mitigation Hierarchy for mitigating and compensating the biodiversity impacts of developments (1, avoid; 2, minimize; 3, restore; and 4, offset, toward a target such as "no net loss" of biodiversity) within a broader framing encompassing all conservation actions. We illustrate its application by national governments, sub-national levels (specifically the city of London, a fishery, and Indigenous groups), companies, and individuals. The Mitigation and Conservation Hierarchy supports the choice of actions to conserve and restore nature, and evaluation of the effectiveness of those actions, across sectors and scales. It can guide actions toward a sustainable future for people and nature, supporting the CBD's vision.

THE NEED FOR TRANSFORMATIVE CHANGE FOR BIODIVERSITY

There is overwhelming evidence that human actions are driving a crisis for biodiversity, and that transformative change is needed.[1,2] The post-2020 Global Biodiversity Framework should be agreed at the UN Convention on Biological Diversity's (CBD) upcoming 15th Conference of the Parties. The Global Biodiversity Framework will hopefully provide the necessary impetus for transformative change not just for nations but for corporations, industries, and the general public. The idea of integrating a "net outcomes" ambition into this global plan has gained ground,[3–5] with conservation organizations calling for a "nature-positive" Global Goal for Nature by 2050 (https://www.naturepositive.org).

Ambitious conservation goals must translate into real-world action.[6,7] Very few elements of the CBD's existing Strategic Plan for Biodiversity for 2011–2020 have been successfully

implemented,[8] although there is some evidence of positive outcomes for biodiversity (such as averted species extinctions[9]). Key challenges impeding success have included: the difficulty of defining clear conservation actions to flow from the targets set[7,8]; lack of clarity about how national contributions, framed by National Biodiversity Strategies and Action Plans (NBSAPs), scale up to global outcomes[10]; insufficient progress on incorporating local and non-State perspectives and accounting for their contributions to NBSAPs[11]; and shortcomings in integrating NBSAPs into broader economic and development processes.[12]

These CBD-specific challenges relate to a broader disconnect between actions to conserve nature and actions leading to loss of nature.[13] Conservation actions are generally carried out by different organizations to those damaging nature, and tend not to address the drivers or to target the sectors causing the greatest impacts.[14] They are often reactive, responding to the accrued effects of human activities, sometimes years later and far from where the impacts occurred.[15,16] Moreover, proposed impacts are often assessed, and actions to reduce them carried out, at the project level. This means that their indirect and cumulative effects at broader scales are not addressed, even when required by policy.[17] Overall, conservation actions and impact reduction are often uncoordinated and unmonitored, and thus their success in addressing biodiversity loss is unclear.[7] Meanwhile, practices with positive conservation outcomes, including by local communities and Indigenous peoples, may be overlooked or displaced by more damaging activities, to the detriment of both the environment and human wellbeing.[18,19]

The "mainstreaming" of biodiversity can help address these challenges by translating high-level goals into meaningful and inclusive actions at multiple scales throughout society. Biodiversity mainstreaming is defined as "the process of embedding biodiversity considerations into policies, strategies, and practices of key public and private actors that impact or rely on biodiversity, so that biodiversity is conserved, and sustainably used, both locally and globally."[20] An example of mainstreaming is Strategic Environmental Assessment for new developments, which is now used in at least 90 countries.[21] At the CBD's 13th and 14th Conferences of the Parties, decisions XIII/3 and XIV/3 called for Parties and other stakeholders to mainstream biodiversity, recognizing that unless businesses, investors, all government ministries (particularly finance and trade), and the general public are engaged, nature conservation will remain a niche interest and biodiversity will continue to decline.[2] An important part of mainstreaming is putting in place preconditions for effective biodiversity conservation; these include enabling conditions, such as functional institutions, adequate funding, and the requisite knowledge to guide effective biodiversity conservation actions.[20,21]

If implemented effectively, mainstreaming biodiversity can produce a shared sense of responsibility among diverse stakeholders, empower a proactive and preventative response to biodiversity loss, and help businesses and investors manage risk and opportunity.[22] This can help translate the high-level aspirations of international agreements into practical actions on the ground.[23] In turn, local actions can be reported and accounted for at national and international levels,[12,24] thereby demonstrating society's cumulative progress toward global outcome goals. A critical element of an effective shared response is reporting by non-State actors (such as businesses) using a framework consistent with that used by governments. To date, however, success in mainstreaming biodiversity into economic policy has been patchy at best, which helps explain the lack of progress in stemming biodiversity losses under the current CBD Strategic Plan.[6,8]

Here, we introduce a new conceptual framework, the Mitigation and Conservation Hierarchy (MCH), and highlight how it could contribute to mainstreaming biodiversity and support the implementation of the post-2020 Global Biodiversity Framework. We show how the MCH enhances the well-established Mitigation Hierarchy by adding a Conservation Hierarchy stream. This enables more consistent and structured accounting for biodiversity actions across countries, sectors, and scales. We also show how it could be applied by countries in the context of their commitments to biodiversity-relevant Multilateral Environmental Agreements. We illustrate its transformative potential for use by a range of other actors: business; sub-national government (the City of London); a specific natural resource sector (fisheries); stakeholder groups (Indigenous Peoples and Local Communities [IPLCs]); and individuals. Finally, we discuss where further development is needed.

SUPPORTING MAINSTREAMING

One reason why biodiversity mainstreaming has been challenging is the lack of a framework that includes both specific impact mitigation measures and the broader actions needed to achieve net gains in biodiversity. Such a framework would need to be scalable, cross-sectoral, and grounded in existing practice, allowing countries, organizations, communities, and individuals in all sectors to understand what actions and outcomes they can contribute toward global biodiversity targets. This framework would require not only a clear articulation of the outcome goals and targets at the global scale, but also of the actions necessary to achieve them at the local, national, and regional scales, and a mechanism to measure biodiversity gains and losses toward a net outcome.

The MCH can address this gap, providing a framework that can be used at all scales and by all actors for coordinating, prioritizing, and tracking the many and various actions that collectively contribute to biodiversity goals. It builds on an original proposal by Arlidge et al.,[25] and further developed by Bull et al.[3] Its starting point is the well-established Mitigation Hierarchy for addressing biodiversity impacts,[26] with its precautionary four-step approach to mitigating the direct, attributable biodiversity impacts of a development project (step 1: avoid the impact; step 2: minimize the impact; step 3: restore/remediate the biodiversity affected by the impact; step 4: offset any residual impact to achieve "no net loss" or "net gain" of biodiversity overall; Box 1). However, to fulfill the ambitious goal of restoring nature, the MCH adds a parallel pathway, the "Conservation Hierarchy," which applies the same "Four Steps" framing to conservation actions (Table 1; Figures 1A and 1B) to produce better overall biodiversity outcomes by including aspects not addressed by project-specific mitigation measures (Figure 1C). The hierarchical element of the MCH is important, such that prevention of impacts (steps 1 and 2) is prioritized over compensation (steps 3 and 4). We modify the language (from avoid/minimize/

Box 1. The Mitigation Hierarchy

The Mitigation Hierarchy is a conceptual framework for addressing biodiversity loss from human development activities in an iterative manner.[27] It is widely used either explicitly or implicitly as a principle underlying biodiversity policy, both regulatory and voluntary, worldwide,[28] and has led to the widespread implementation of biodiversity impact mitigation measures.[29] It is implemented as part of the Environmental Impact Assessment process,[26,30] and more recently is starting to be incorporated into Strategic Environmental Assessments at the landscape scale.[31,32] It is often required for projects funded by international financing bodies, such as the World Bank and the International Finance Corporation, and by some governments. Use of the Mitigation Hierarchy has transformed project-level mitigation of biodiversity impacts in three ways:

(1) By setting an objectively verifiable and measurable target (such as "no net loss" or "net gain" of biodiversity[33]) against which projects evaluate and justify their biodiversity outcomes.
(2) By providing a framework to facilitate assessment of whether sufficient attention has been given to each step, especially the earlier steps of Avoidance and Minimization.
(3) By providing a clear distinction between additional conservation actions—positive actions which do not directly compensate for project impacts—and biodiversity offsets, which specifically aim to compensate for project impacts by generating gains at least equivalent to the biodiversity impacts.

There has been an increase in policies applying Mitigation Hierarchy principles to address the environmental impacts of companies and governments,[34] and in the association of the Mitigation Hierarchy with quantitative targets, such as no net loss of biodiversity.[35–37] Despite its extensive use, issues remain with the application of the Mitigation Hierarchy, including an over-reliance on offsetting rather than avoidance,[38] lack of monitoring and compliance,[39] poor design,[40] and insufficient institutional knowledge and capacity, leading to non-equivalence between biodiversity gains and losses.[41] There is also an increasing recognition of the need to integrate the application of no net loss or net gain targets for biodiversity with social considerations, such that people affected by development impacts and biodiversity mitigation actions are left no worse off (and preferably better off), particularly with respect to their values for nature.[42,43] Beyond its use in the infrastructure and extractives sectors, the Mitigation Hierarchy has started to be applied to human impacts on biodiversity associated with the primary production sectors, such as fisheries and agriculture.[44–47] Arlidge et al.[25] made the leap of suggesting that the Mitigation Hierarchy could be used to account for losses and gains in nature from all human activities.

remediate/offset to the "Four Rs" of Refrain/Reduce/Restore/Renew) partly to underline the evolution of the Mitigation Hierarchy into the MCH and partly to highlight the "Renew" step, which goes beyond offsetting to encompass proactive conservation actions.

The MCH, therefore, expands on the established Mitigation Hierarchy approach in two key ways:

First, it is designed to be used by sectors, and for impacts, where the Mitigation Hierarchy has not yet been widely applied. This includes use by entities, such as city councils, community groups and individuals, and sectors, including natural resource exploitation (e.g., agriculture, fisheries, and forestry), where the impacts are sometimes geographically dispersed through long, complex value chains, and where environmental licensing does not require an Environmental Impact Assessment or consideration of the Mitigation Hierarchy. Consequently, it goes beyond mitigating biodiversity impacts that are direct by-products of development (e.g., habitat destruction by an infrastructure project) to also address the impacts of resource exploitation (e.g., the effect of timber extraction on a forest ecosystem).

Second, it adds a conservation element that goes beyond mitigating direct negative impacts to encompass *any* activities affecting nature (positive or negative, attributable to specific entities or not, past or current). This means that conservation actions to address historical, systemic, and non-attributable biodiversity loss can be accounted for in the same framework as actions to mitigate specific impacts. In addition, the fourth step of the MCH expands beyond offsetting to encompass proactive actions beyond those directly tied to redressing current attributable impacts, to achieve an overall net positive outcome (such as greening cities). This fourth step, therefore, supports the transformational change required to reset humanity's relationship with nature.[1]

Demonstrably—and, where appropriate, quantitatively—mitigating impacts through the Mitigation Hierarchy remains a fundamental priority, applying the "polluter pays" principle. But there is also a need to recognize positive contributions that institutions, groups, and individuals can make for conservation, so that we can track overall progress toward recovering nature. By adding an additional conservation component to the Mitigation Hierarchy (Table 1), we aim to enable negative impacts and conservation gains to be considered together at a range of scales. For example, at least a quarter of the land's surface is managed by Indigenous peoples, including about 40% of terrestrial protected areas and ecologically intact landscapes.[48] Biodiversity outcomes from positive forms of management by IPLCs are occasionally included as offsets within Mitigation Hierarchies. However, the MCH gives IPLCs much more scope to demonstrate contributions toward global biodiversity goals via the Conservation Hierarchy stream, e.g., by quantifying biodiversity gains from actions such as forest protection (step 1), management for sustainable non-timber forest product extraction (step 2), managed fire regimes to restore vegetation (step 3), or restoring forest on historically degraded land (step 4).

The MCH is, therefore, an overarching framework for unifying direct impact mitigation with traditional conservation, which could make a major contribution as part of the delivery of an aspirational, outcomes-based, and measurable post-2020

Table 1. Selected examples of existing biodiversity conservation actions and processes, categorized into each of the four sequential steps of the MCH

Step 1 (retain biodiversity, avoid impacts)	no-take zones; conservation set-asides/easements; zero deforestation commitments; safeguarding critical habitat; restrictions to international trade in certain vulnerable species (through CITES); gene banks for landraces/traditional livestock breeds; avoiding damage to intact ecosystems; biosecurity to prevent introduction or establishment of invasive alien species
Step 2 (minimize and reduce impacts)	sustainable use; agri-environment schemes; organic and low chemical input agriculture; agroforestry and non-intensive shifting agriculture; shifting from passive non-selective gear to actively targeted gear in fisheries; shifting from reliance on virgin raw materials toward products that are produced via circular processes; demand reduction for unsustainable wildlife products; control or management of the impacts of invasive alien species
Step 3 (restore and remediate impacts)	species conservation translocations (including reinforcements and reintroductions); degraded ecosystem restoration; natural flooding of wetlands; reforestation; chemical decontamination; invasive alien species eradication; better bycatch handling and release practices; fish stock replenishment
Step 4 (renew biodiversity)	species introductions for conservation purposes (including assisted colonization and ecological replacements); rewilding; ecosystem creation, such as artificial reefs; greening cities and urban areas; developing innovative technologies and systems to enable sustainable consumption.

These examples illustrate the Conservation Hierarchy component of the MCH. Biodiversity offsets occur at step 4, but are used to mitigate current, attributable impacts (rather than for proactive conservation) and so are not included in this table.

Global Biodiversity Framework (Figure 2). The intuitive simplicity of the Four Steps framing, and its broad applicability to a range of users and circumstances, is designed to foster broad ownership. Applying this standardized framework to all positive and negative impacts on biodiversity would allow for seemingly disparate actions to be accounted for across sectors, scales, and nations. As examples of the first novel element (expanding the Mitigation Hierarchy to new sectors and impacts), the MCH could incorporate actions to mitigate direct biodiversity impacts of clearing biodiverse forest for cattle, the longer-term and potentially more diffuse indirect impacts that result from the introduction of new forestry infrastructure (e.g., illegal hunting and informal clearance for settlement), and the transboundary impacts from air pollution from land clearance fires. Examples of the second novel element (adding a parallel hierarchy for conservation actions) are given in Table 1.

BIODIVERSITY METRICS

Monitoring losses and gains in biodiversity requires specification of metrics. Biodiversity metrics are the units in which the biodiversity of interest is measured, and in which losses, gains, and net outcomes are expressed. The MCH is not prescriptive about which metrics to use, given that different metrics suit different applications and scales.[50] The Mitigation Hierarchy is designed to address a specific set of impacts with a requirement to demonstrate no net loss or net gain of biodiversity. Therefore, metrics for this component of the MCH are usually quantifiable. Metrics which allow consistent comparison of biodiversity gains and losses enable net outcomes to be calculated, although qualitative indicators can also be appropriate; for example, when assessing people's values for nature.[48] One strategy might be to use appropriate metrics for a specified biodiversity feature (e.g., habitat area-condition scores for loss of ecosystems to land conversion, or density of particular invasive species in areas affected by ballast water discharge) to assess the net outcomes from particular efforts targeting that feature, and then scale up outcomes from disparate contributions to the national or international level by aggregating many different net outcome assessments.

Either way, the metrics chosen should relate meaningfully to the goals and targets that have been set.[51] This is particularly important for the impact mitigation stream, where quantifiably demonstrating at least no net loss would ideally be a requirement for all new development. However, impact mitigation needs to evolve beyond having the final step as traditional best practice offsetting to reach no net loss with respect to an already-degraded, or degrading, system. Instead, it needs to move toward requiring gains in biodiversity that relate meaningfully to the overall goal.[52,53] It also needs to be clear that any loss of irreplaceable natural features cannot be offset to achieve net gain, or even no net loss, outcomes.[26,54,55] There are no "counterbalancing" conservation actions that can offset such losses, only actions that can to some extent reduce them and seek to compensate for them in some "out of kind" way. The fact that the MCH sets impact mitigation within a broader set of conservation actions, and encourages meaningful allocation of contributions toward an overarching goal, should help in making explicit what these losses are, and what actions are addressing them.

EXAMPLES OF APPLICATION

The MCH can be applied by any group seeking to be accountable for their biodiversity losses and gains, or seeking to enhance biodiversity that has been degraded by others. This means it can support actions at scales from the national or multilateral levels to local areas, individuals, or groups. This could help address the issues of leakage that arise when project-level avoidance or minimization actions displace damage to other areas or biodiversity features, thereby hindering progress at larger scales.[53,56] Potential mechanisms

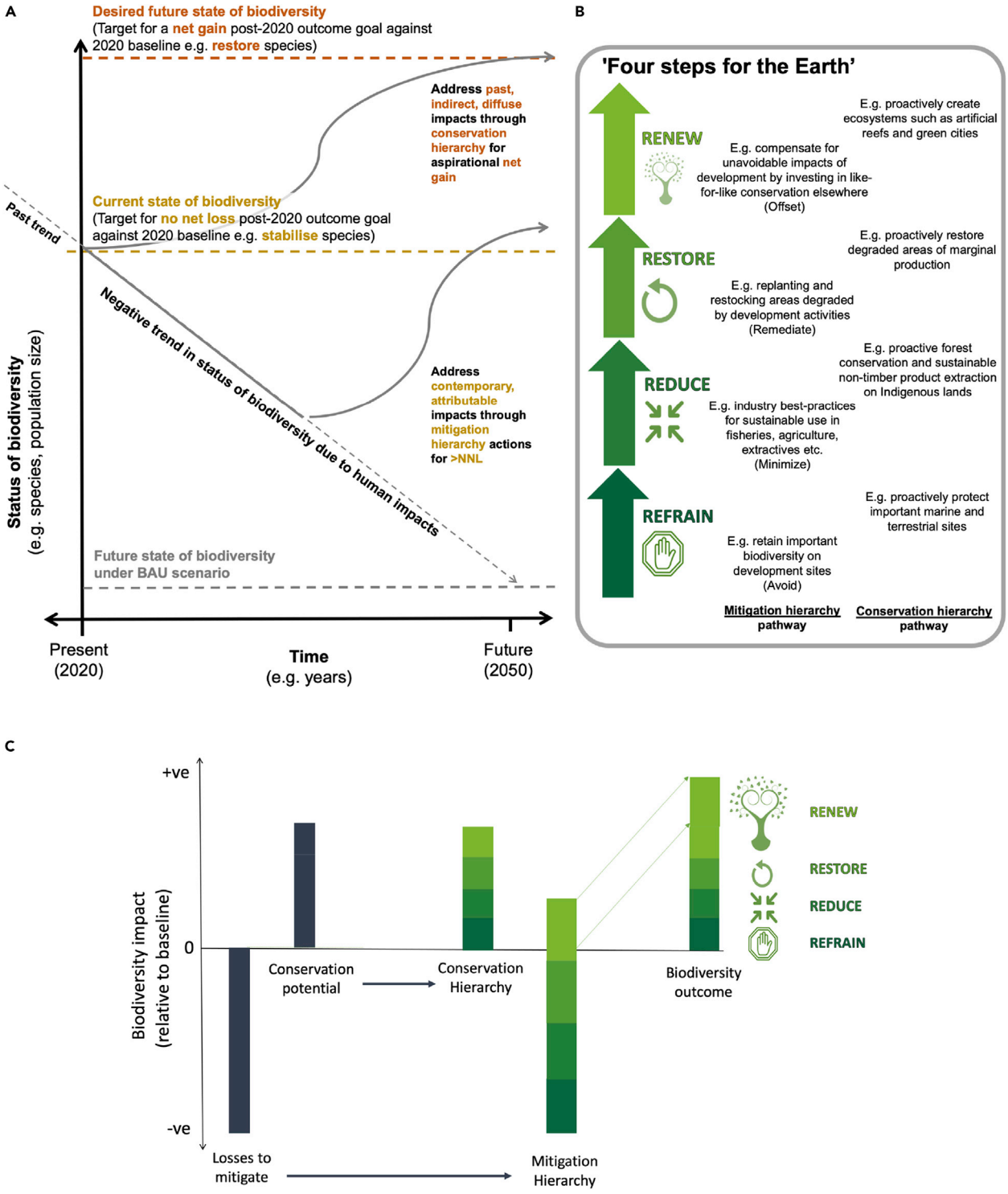

Figure 1. Representation of the Mitigation and Conservation Hierarchy concept

(A) In the absence of conservation action, biodiversity will continue to decline due to ongoing human impacts. The Mitigation Hierarchy stream of the Mitigation and Conservation Hierarchy compensates for contemporary, attributable impacts toward a goal of "biodiversity net gain," while the Conservation Hierarchy stream recovers nature to a desirable future endpoint through addressing past, indirect, and diffuse impacts.

(B) The "Four Steps for the Earth" framing of the Mitigation and Conservation Hierarchy has four consecutive steps of: refraining from causing negative impacts; reducing the impacts that are caused; restoring impacted nature; and renewing our relationship with nature through offsets and proactive conservation actions.

(legend continued on next page)

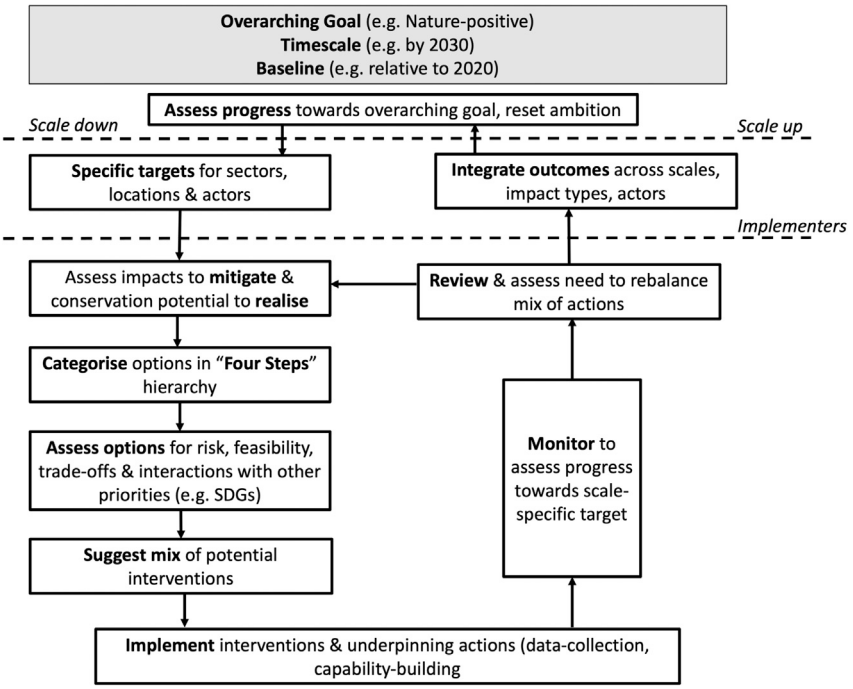

Figure 2. Illustrating the application of the MCH, within a Plan-Do-Check-Act or adaptive management approach to implementation of conservation targets

An overarching goal is set with a timeline and a baseline (illustrated for one potential manifestation of the post-2020 Global Biodiversity Framework). This is scaled down to specific targets for different sectors, locations, and actors. The relevant implementers use the Four Steps approach to support planning of actions to implement targets, monitor outcomes, and review and revise actions. Outcomes are integrated across scales, impact types, and actors, and goal progress is assessed (cf. the Convention on Biological Diversity[49]).

for translating global targets to equitable local or individual targets include NBSAPs and voluntary commitments for nations and jurisdictions, and Science-Based Targets[57] for non-jurisdictional actors, such as businesses. This scalability allows for differentiated commitments toward common goals, with accounting in a unified framework.

Application by national governments

Under the CBD, countries with biodiversity already heavily affected by anthropogenic activities are still required to focus on step 1 of the MCH—avoiding loss and retaining nature—even if such opportunities are more limited within their national borders. They could identify and protect areas of high relative value for biodiversity and contributions to people, even in heavily converted landscapes.[58] Such countries (e.g., in western Europe) may also have the resources to commit to an ambitious and clearly articulated net gain target with respect to their biodiversity impacts at home and abroad.

Current commitments on biodiversity from nation states do not typically include supply chain impacts beyond their borders, although these may be significant.[59–61] Therefore, especially given an emerging focus on due diligence in global supply chains, countries wishing to address their total current biodiversity impact need to incorporate supply chain impacts into their assessments of the level of action required. Countries may wish to move beyond their current impacts to address past impacts or systemic issues, for which they may well have disproportionate responsibility. For example, to fulfill a net gain biodiversity target with respect to an agricultural landscape within an already heavily impacted country, a mixture of direct and indirect impact mitigation and proactive conservation could involve a government: refraining from converting biodiverse native woodland to agricultural production; reducing impacts by investing in reducing the footprint of existing food systems at home and overseas; restoring previously degraded areas of marginal productivity; and developing biodiversity-inclusive nature-based solutions to tackle climate change, at home and in other countries.

In some circumstances, countries may propose a "managed net loss" of certain ecosystems,[54] provided that the sum of different countries' ambitions combine to deliver global targets, and the ecosystems and their dependent species are widespread and of relatively low conservation concern. Any commitments countries make are likely to be voluntary, as was the case for climate change under the Paris Agreement, but the means for determining the appropriate level of ambition for countries with different circumstances have been discussed (e.g., Maron et al.[62]). Processes to motivate countries to enhance their ambition toward net gain, perhaps through funding transfers, would be required if suitably ambitious international targets are set at CBD CoP15.

Other factors that influence the strategic distribution of mitigation measures and conservation actions across the MCH include the feasibility of different actions in different situations in terms of ecological, social, political, logistical, and financial constraints.[27,46] While the MCH would encourage the use of the preferred option of avoidance of impact, circumstances (i.e., adherence to the Sustainable Development Goals) may dictate an option with higher biodiversity risk but which is more socially acceptable; this trade-off needs to be made transparently so that countries can be held accountable, and so that environmental safeguards are still met. Iterative action to address constraints and improve capacity would enable implementers to shift over

(C) The Mitigation Hierarchy compensates for losses incurred, while the Conservation Hierarchy realizes conservation potential; together they produce a positive impact on biodiversity. Impact mitigation can lead to net gain through offsets; the additional biodiversity gain over-and-above "no net loss" is added to Renew actions under the Conservation Hierarchy (see Table 1) to form the Renew step of the MCH (green arrows).

Table 2. Examples of how the Mitigation and Conservation Hierarchy relates to different international environmental policy instruments

	CITES	UNCLOS	UNCCD	SDGs
Goal	"no species of flora or fauna is threatened because of international trade"	e.g., "no significant harm to biodiversity through deep-sea mining"	"No net loss of 'land productive capacity' (by 2030, relative to 2015 levels)"	e.g., "SDG2: sustainable food production and doubling productivity by 2030"
1: Refrain	Appendix I species listing prohibits international commercial trade in species threatened by trade	strict closures for "irreplaceable" areas, with full ecological representation	avoid planting crops in areas where environmental conditions are not appropriate, informed by good spatial planning	avoid loss of sensitive areas through spatial planning and securing land tenure for IPLCs to secure their food production systems
2: Reduce	sustainable use via Appendix II species listing; monitor and regulate trade; prevent harvesting and trade in critical habitat/of vulnerable life history stages	spatial, temporal, and technological rules of operation; ensure use of precautionary principle in mining operations	adopt best practices in farming and land use to reduce soil loss and maintain vegetation cover	more sustainable food production by eliminating harmful subsidies and incentivize water and soil retention, and integrated pest management; reduce pollution and agrochemicals; support IPLCs to practice sustainable land management and wildlife use
3: Restore	actions to promote species recovery through sustainable trade (e.g., vicuna, Nile crocodile)	restore damaged areas within footprint of any deep-sea mining activities	apply regenerative agricultural techniques	restore degraded agricultural lands
4: Renew	habitat restoration to enhance and extend habitat for traded species	[may be unfeasible to offset in the deep sea, or to do like-for-like biodiversity conservation]	build capacity for restoration and application of regenerative agricultural techniques on similar land elsewhere	novel techniques: vertical farming, greenhouses

This shows how it could support synergies with the post-2020 Global Biodiversity Framework under the Convention on Biological Diversity. CITES, Convention on International Trade in Endangered Species of Wild Fauna and Flora; UNCLOS, United Nations Convention on the Law of the Sea; UNCCD, UN Convention on Combatting Desertification; SDGs, Sustainable Development Goals.

time toward lower risk (avoidance-focused) options as their capacity to act increases (Figure 2).

The MCH can help in framing and identifying both actions that could simultaneously achieve multiple policy objectives[63] and trade-offs when policy goals might be conflicting.[46] Although, in general, preventative measures are more precautionary, they may not always be more cost-effective than compensatory measures.[64] For example, Gjertsen et al.[65] explored different strategies for mitigating sea turtle bycatch in US longline and gillnet fisheries. They demonstrated how compensatory actions (i.e., bycatch taxes invested in nesting habitat) could produce significantly higher conservation outcomes per unit cost for Pacific Leatherback Turtles than avoidance actions (i.e., fishery closures). In exceptional cases, therefore (e.g., relating to conflicts with poverty alleviation goals), the MCH steps could be deployed not as a hierarchy, but in a "least-cost" analysis that identifies management strategies that achieve desirable conservation benefits at lowest total cost to society.[45,46]

The flexibility of the MCH framework, and its ability to help operationalize any target, means that it can be applied across multiple conventions and policy processes (Table 2). It is critical to ensure cohesion between targets under the post-2020 Global Biodiversity Framework and those under other conventions, such as the UN's Framework Convention on Climate Change and Convention to Combat Desertification, while avoiding duplication and with explicit consideration of the potential for unintended negative feedbacks. Interventions designed to mitigate climate change and improve the productive capacity of land could also protect or restore biodiversity (and vice versa[66]), reducing the risk that the imperative to conserve biodiversity is overlooked while addressing climate change.[67] More positively, nature-based solutions to climate change are potentially some of the most powerful approaches available (e.g., Maxwell et al.[68]). The MCH aligns well with greenhouse gas emission reduction strategies (which are also, conceptually, designed to achieve net outcomes targets[3]). It would support implementation of the call, made by groups of conservation and development organizations and world leaders ahead of the UN Summit on Biodiversity in September 2020, for a Global Goal for Nature, that envisages an "equitable, carbon-neutral, nature-positive world" by 2050.

Application by companies

With its roots in the Mitigation Hierarchy, the MCH builds on familiar territory for many primary industry companies. The application of the Mitigation Hierarchy is already embedded in best practice for the extractives and infrastructure sectors.[35] As such, the MCH can provide a transparent framework for helping businesses understand their impacts on nature and explore different pathways to mitigate these impacts throughout their operations. The hierarchy of the four steps prioritizes lower biodiversity risk options first, supporting better integration of

biodiversity risk management into corporate decision making and governance. In addition, many businesses fund various nature conservation activities and report these qualitatively,[50] but do not currently have a systematic framework to account for how these activities contribute toward their overarching goals. The MCH can provide a means to comprehensively consider total impact through recognizing proactive conservation actions alongside impact mitigation and supporting analysis of which actions would have the best return on investment.

Finding a way to support business engagement with the post-2020 Global Biodiversity Framework is critical for its success. For example, global supply chains—particularly those of transnational corporations—play a huge role in shaping international resource use, impacting both nature and sustainable development. Since 1980, the value of global trade has increased more than 6-fold and the volume of trade has more than doubled.[69] A relatively small number of organizations hold a disproportionate influence over the impacts of these supply chains.[70] Within companies, there is increasing recognition that business models are fundamentally tied to well-functioning ecosystems, and it is estimated that as much as $44 trillion (or half of global GDP) is moderately or highly dependent on nature.[71] Given this context, the MCH could play a pivotal role in helping businesses to engage, by allowing translation of internal corporate pledges into transparent public actions, understandable by customers, funders, stakeholders, and the media. It could also provide businesses with a way of demonstrating their alignment with and contributions toward global conservation goals and actions, and encourage and support the disclosure of company impacts using a commonly understood framework. This could help consumers, employees, business partners, and investors make informed decisions about how they interact with and differentiate between businesses.

Disclosure could be particularly transformative if integrated into standardized reporting frameworks that are aligned with regulation and help "level the playing field." Such reporting can then encourage a "race to the top" as companies seek a competitive advantage. The Taskforce on Climate-related Financial Disclosures provides a model (with a similar Taskforce on Nature-related Financial Disclosures now being developed), but effective reporting relies on companies knowing what their biodiversity impacts are; there is still much work to be done to produce standardized methods to track and quantify biodiversity impacts, especially for companies with long global supply chains. However, even in the absence of full quantification, the MCH still provides a useful structuring approach for commitments and disclosure, aligned with international priorities.[72] Indeed, the fashion/luxury sector multinational company Kering S.A. published a new global biodiversity strategy in 2020, formulated around an MCH framework that combines mitigation with positive conservation actions (albeit with different words to describe the stages of the hierarchy).[73]

Application at sub-national levels

There is a plethora of opportunities for creative application of the MCH by sub-national and non-governmental actors. We illustrate this potential using three multi-actor examples: cities, small-scale fisheries, and IPLCs.

Cities not only have large impacts on nature through their typically extensive supply chains, they also often represent a concentration of social and financial capital that could be bought to bear in tackling biodiversity loss, as well as acting as beacons of inspiration with the power for national (and international) influence. For instance, just under half of the physical area directly occupied by London is green space (comprising ~33% open "natural" habitats and an additional ~14% private gardens[74]), providing immediate opportunities for impact mitigation and proactive conservation, particularly within step 4 (Renew). But the total footprint associated with the provision of resources (e.g., food, energy, and water) to the millions of people who inhabit London, as well as the hundreds of thousands who commute there for work, represents a wider set of supply chain impacts that could be targeted for interventions at each of the MCH's steps. Perhaps more significant with respect to national, and even international, conservation outcomes would be cascading the MCH along supply chains upstream and downstream of the key economic sectors within the city, such as the finance, media, and tourism sectors.

The London-hosted 2012 Olympic Games provides a useful illustration of some of these ideas in microcosm, although at the time the Games did not explicitly use a Mitigation Hierarchy approach. The overall biodiversity objective for the Games was: "to enhance the ecology of … 2012 venues, and to encourage the sport sector generally to contribute to nature conservation and enhancing the natural environment"[75]; which approximates to a target of net positive outcomes for biodiversity on site, alongside the proactive conservation action of supporting future sporting events to incorporate consideration of biodiversity. Biodiversity Action Planning for the development of London 2012 sites consequently incorporated efforts to prevent impacts upon species (which could be categorized as Refrain/Reduce), remediate areas following construction (Restore), and enhance the ecological value of the sites through habitat creation (Renew). But the Games also implemented initiatives that targeted sustainable outcomes offsite throughout the value chain, e.g., by choosing sustainable suppliers, low carbon energy sources, and minimizing waste sent to landfill (measures that sought to reduce indirect impacts [Refrain/Reduce under MCH terminology]). With respect to the Renew step, the wider influence of the event continues to be felt in the form of the ISO:20121 international standard on "sustainable events," which was directly inspired by the 2012 Games[76] and is now a blueprint for sustainable sporting events. Thus, the Games sought to go beyond their own impacts and help drive a move toward sustainability more broadly.

The MCH concept has already been applied to a small-scale fishery in Peru by Arlidge et al.[47] and in India by Gupta et al.[77] In the Peruvian example, the MCH played a distinctive role, in conjunction with existing decision-making frameworks, such as Management Strategy Evaluation[78] and Ecological Risk Assessment,[79] in supporting the integration of management of sea turtle captures in a particular fishery into the wider conservation agenda for these wide-ranging species. This was achieved by clearly linking a quantitative bycatch reduction target for each sea turtle species captured at the local level, to risks to the regional population and overarching biodiversity goals (sea turtle population recovery). The MCH also helped to identify

and fill knowledge gaps and encouraged the integrated and simultaneous consideration of a wider suite of data and management actions than is usually considered. In particular, it helped to highlight that incentive-based actions, such as reduced effort (step 2), safe-handling and release (step 3), and bycatch taxes (step 4), could lead to positive outcomes for turtles without the major socio-economic costs of implementing fisheries closures (step 1). The framework was also useful in exposing overlooked uncertainties, particularly concerning the socio-economic consequences of the management measures. In India, Gupta et al.[77] explored the use of the MCH in a data-poor situation with vulnerable fishing communities. They found that the "Restore" action of safe release of wedgefish would be a socially acceptable first entry-point into working with local fishers to mitigate their bycatch impacts, which would have some positive outcomes for biodiversity while not representing a major cost to fishers.

Much terrestrial biodiversity is on the lands of IPLCs,[19] and many communities are struggling to prevent environmental degradation by opposing large-scale external interventions, many of which also contravene national and international law and policy on rights.[80] Many communities are also working actively to maintain and restore biodiversity on their lands, using a mixture of traditional and science-based knowledge (e.g., the Forest People's Programme[11]). They are doing so through a rights-based approach involving securing legal tenure over customary lands, and also through gaining recognition for their contributions to area-based conservation (for example, as Indigenous and Community Conserved Areas[81]) and Other Effective area-based Conservation Measures.[82] The MCH offers a tool to integrate different kinds of community contributions to conservation into decision making, by communities themselves and by other interest groups, both with respect to specific interventions and in regional and national planning. This includes IPLCs' actions toward avoidance and minimization (e.g., community measures to control wildfires or limit hunting or fishing to sustainable levels) and toward positive gain (e.g., community tree planting, habitat enrichment or restoration, or control of invasive alien species). However, if external actors apply the four steps in the context of areas managed by Indigenous peoples, this will need to be nuanced and compatible with international law and policy on rights. For instance, refraining from disrupting established territorial management systems may not only be a legal requirement, but also a sensible approach where such systems are delivering results. Collaborating to reduce the external pressures on Indigenous groups which lead to negative impacts on conservation and wellbeing may also be an important and highly effective approach.

Application by the general public

Transformative change for biodiversity requires public buy-in. Providing a clear connection between individual choices and the ambitious goals of the post-2020 Global Biodiversity Framework could raise awareness of the CBD's vision for 2050 of living in harmony with nature and motivate and empower societal action. A public that vocally and actively engages with the MCH could generate support for government and business actions toward net gain biodiversity outcomes, as well as empowering people to contribute themselves. The simplicity of the core concepts of the MCH allows individuals to apply these principles to their daily lives, replicating the success of "reduce, reuse, recycle" campaigns with wording, such as "The 4 R's" (Refrain, Reduce, Restore, Renew; Figure 3). The MCH thereby provides an intuitive framework that supports individuals to understand the impacts of their own lifestyle choices, choose potential lower-impact alternatives, and account for their contributions toward larger societal biodiversity goals. Such an approach could be enhanced through public-facing campaigns using behavioral science methods.[83]

Increasingly, data on the environmental impacts of lifestyle choices are readily available, allowing people to translate intentions into genuine biodiversity and climate mitigation improvements.[84,85] For example, the MCH can guide actions toward more environmentally and socially responsible food (e.g., Poore and Nemecek[84,86] and Clark et al.[84,86]) and consumer goods purchases (Figure 3). This could encourage people to prioritize actions at step 1 of the MCH (avoiding high-impact consumption), and move away from reliance on recycling, which does not fully "close the loop" of a product's life cycle.[87,88] There is potential for highlighting the co-benefits of biodiversity-friendly consumer choices that also mitigate climate change and have higher standards with respect to human rights and wellbeing. Understanding such contributions, and having a positive and empowering way to account for them, can be a key motivator of pro-conservation lifestyle choices (e.g., Hanss et al.[89]), and could, therefore, drive widespread change in consumer behavior across society. Building public support for biodiversity conservation could put pressure on businesses and governments toward system change, as has been demonstrated for climate change.[90] Using the same consistent framework could enhance dialogue between consumers, companies, and local/national governments.

CONCLUSION

The imperative to mainstream biodiversity conservation into economic decision making at all levels and in all sectors of society is undeniable,[1] particularly now that the connections between nature and human wellbeing are becoming more obvious. The global COVID-19 pandemic is one strong reminder of the need for effective mainstreaming of the post-2020 Global Biodiversity Framework. Although the risks of pandemics are well known, to date humanity has largely dismissed the relationship between biodiversity and disease, as well as the associated needs for public health, disease surveillance, and societal capacity to respond to disease outbreaks. The ongoing and future changes in global economies and societies driven by the COVID-19 pandemic are likely to be profound. The repercussions of these changes for the environment are difficult to ascertain, but they are the subject of intense societal discussion. The ideas presented here to support mainstreaming of biodiversity conservation could form part of efforts to restore nature post-pandemic.

As the post-2020 Global Biodiversity Framework is finalized, much attention is focused on ensuring that it has the appropriate level of ambition, and robust targets and metrics to measure progress.[5,91,92] However, attention must also be paid to putting in place mechanisms to support actors to implement the

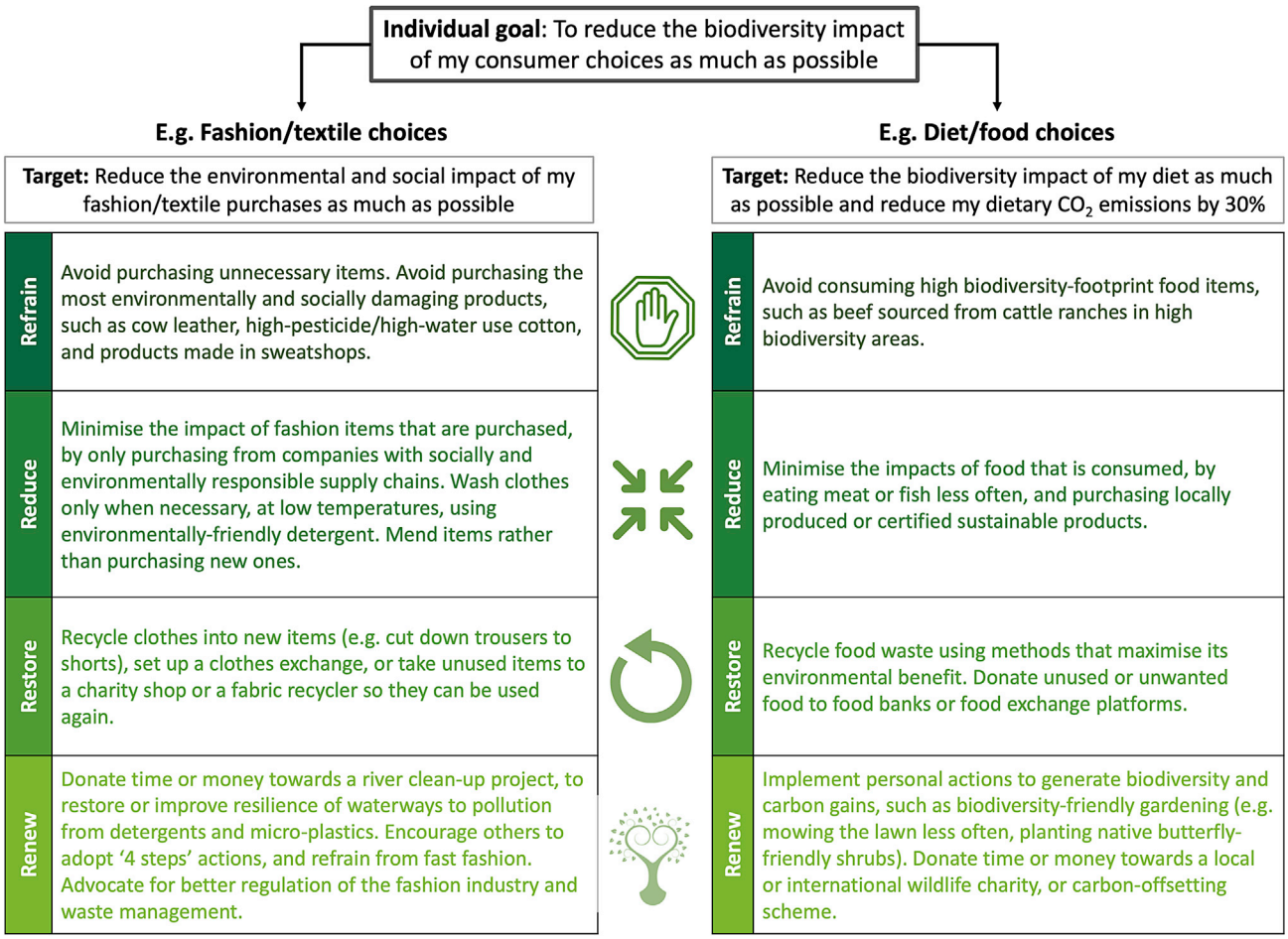

Figure 3. Examples of how the Mitigation and Conservation Hierarchy could be applied by individuals

This would help them to structure their contributions toward a broader societal biodiversity goal. The examples include qualitative targets that are weaker than quantitative targets, and individual contributions could not meaningfully be tracked, but positive change at the individual level would be quantifiable at the system level. Differential shading of the steps and the pictograms are suggestions for designs that might appeal to a broad audience.

Framework and contribute explicitly to the desired outcomes; otherwise, in 10 years' time, we will find that, yet again, the gap between ambition and reality has proved to be too wide.

The MCH is a framework that could support the implementation of actions to mainstream biodiversity, which covers both the accounting element (of biodiversity losses and gains toward net outcomes) and the accountability element (allocation of responsibility) of mainstreaming. The fact that the MCH is rooted in the Mitigation Hierarchy means that it builds on familiarity and an evidence base in both principle and practice (e.g., The Biodiversity Consultancy[27,37] and the Business and Biodiversity Offsets Programme[27,37]). Granted, the Mitigation Hierarchy (and in particular the last step, offsetting) has been very challenging to implement effectively, often due to a lack of institutional capacity (e.g., Quétier et al.[93]). However, it is a relatively young mechanism, which has been in national law and practice in vanguard countries over the last 30 years. The first International Financial Safeguard (IFC PS6) was set in 2012. It is in wide and growing use by governments and businesses worldwide, and examples of effective implementation now exist.[39] Recent experience of applying it in novel contexts demonstrates its potential for broader application (e.g., Heiner et al.'s[63] application to proactively supporting Free Prior and Informed Consent with respect to development for Indigenous communities). By uniting impact mitigation with broader conservation, the MCH could allow actors to account for both their reactive and proactive actions toward a unified target. It could thus facilitate recognition and support for community-level environmental actions while also incentivizing businesses and governments to invest beyond just mitigating their own biodiversity impact.

The full potential of the MCH will only be clear when it is implemented in practice, at a range of scales, for different sectors, impacts, and circumstances. Pilot studies already suggest its usefulness for the diagnosis and framing of potential conservation actions.[46,47,94] To support its role in accounting for actions, more work needs to be done to define how losses and gains can be aggregated in a consistent manner across disparate contexts, and to more explicitly incorporate people's values for nature. A key challenge is deciding when enough has been done at one step of the MCH and it is appropriate to move on to the next step, and how to iterate between steps and between decision stages to achieve optimal outcomes (cf. The

Biodiversity Consultancy[27]). Appropriate platforms will need to be established to document intended contributions and allow transparency in tracking progress toward these. For governments, such a platform would need to bring together explicit contributions and commitments, documented through NBSAPs and elsewhere across government.[49] It would need to support monitoring of progress through National Reports, harnessing a core set of consistent headline indicators, such as those already used for tracking progress toward the Sustainable Development Goals and a subset of those being developed for the post-2020 Global Biodiversity Framework. Coordinated agreements between countries will be required so that their joint actions lead to a net gain outcome for biodiversity overall even as some continue to reduce their biodiversity in the short term. Institutions, such as the International Union for Conservation of Nature (IUCN), whose Members recently adopted Resolution WCC-2020-Res-048, which formally establishes the MCH in IUCN policy, may be able to provide a platform for non-State actors, especially for non-governmental and Indigenous peoples' organizations. How such platforms might emerge for sub-national governments, cities, and the private sector requires further consideration.

With the development of appropriate platforms, the MCH could point all elements of society in a consistent direction with respect to international and jurisdictional goals, while allowing flexibility with respect to individual economic, social, cultural, and biological situations. Such a design would aid governments greatly in their quest to mainstream biodiversity throughout different sectors. In this way, the MCH provides a unifying, aspirational framework that enables societies to move beyond restoring damaged ecosystems or protecting species and habitats, to build an Earth where the needs and aspirations of people are met and nature is thriving, at all levels and in all spaces.

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AUTHOR CONTRIBUTIONS

E.J.M.-G. led the conceptualization and writing. All other authors contributed variously to the conceptualization, writing, editing, and review of the paper. H.B. created the graphics.

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