








Three Key considerations for biodiversity conservation in multilateral agreements

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Abstract

It is nearly three decades since the world recognized the need for a global multilateral treaty aiming to address accelerating biodiversity loss. However, biodiversity continues to decline at a concerning rate. Drawing on lessons from the implementation of the current strategic plan of the Convention on Biological Diversity and the 2010 Aichi Targets, we highlight three interlinked core areas, which require attention and improvement in the development of the post-2020 Biodiversity Framework under the Convention on Biological Diversity. They are: (1) developing robust theories of change which define agreed, adaptive plans for achieving targets; (2) using models to evaluate assumptions and effectiveness of different plans and targets; and (3) identifying the common but differentiated responsibilities of different actors/states/countries within these plans. We demonstrate how future multilateral agreements must not focus only on what needs to be done but also on how it should be done, using measurable steps, which make sense at the scales at which biodiversity change happens.

KEYWORDS

Aichi Targets, biodiversity policy, Convention on Biological Diversity, environmental law, Multilateral Environmental Agreements, sustainable development goals

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1 | INTRODUCTION

Around 150 Multilateral Environmental Agreements (MEAs) are concerned directly with biodiversity (Velázquez Gomar, 2016). These include global agreements such as The Convention on Biological Diversity (CBD), adopted in 1992 to address accelerating biodiversity loss, and regional agreements such as the EU Nature Directives. However, rapid biodiversity loss continues, suggesting that many agreements have failed and others such as the Aichi Targets set by the CBD are unlikely to be met (IPBES, 2019). Suggested causes include insufficient effort and resource allocation from Parties (Tittensor et al., 2014), a lack of understanding of the objectives and aspirations of stakeholders (Maxwell et al., 2015), time lags between implementation of actions and their outcomes (Leadley et al., 2013), the complex and ambiguous nature of the wording of the targets, and a lack of development of meaningful indicators with which to gauge actual progress (Butchart, Di Marco, & Watson, 2016).

There remains considerable opportunity to translate lessons learnt over the past three decades into meaningful and actionable recommendations for future biodiversity MEAs, to give a better chance of success. This is of particular relevance as at the 15th Conference of the Parties to the CBD in 2021, governments will negotiate a new biodiversity framework to replace the current 2011–2020 Strategic Plan and Aichi Targets (Convention on Biological Diversity, 2020). A comprehensive and participatory process to develop the post-2020 framework is already underway. Here, we focus on three interlinked core areas that are critical to the process of developing global biodiversity MEAs, and in particular a post-2020 framework, that could support significant improvement in outcomes for biodiver-

sity. They are: (1) formulating robust theories of change to define agreed, adaptive plans for achieving each target; (2) using models to evaluate assumptions and effectiveness of different plans and targets; and (3) identifying common but differentiated responsibilities of different actors/states/countries within these plans.

2 | FORMULATING ROBUST THEORIES OF CHANGE TO LINK OUTCOMES AND ACTIONS

The Aichi Targets included a mix of both result-oriented biodiversity targets (specified in terms of desired states, e.g., reduce extinction risk of threatened species), and intervention-based targets (e.g., improve protected area management), with links between them only identified post hoc (Marques et al., 2014). Consequently, implementation by countries has been sporadic and ad hoc, with certain targets gaining more traction than others, particularly those considered to be more straightforward or more easily measured targets, such as increasing protected area coverage and putting institutions in place (Buchanan, Butchart, Chandler, & Gregory, 2020). The more fundamental, but more challenging, targets have drawn less effort and attention, meaning the overall aim of the Strategic Plan has not been met (Secretariat of the Convention on Biological Diversity, 2016; Tittensor et al., 2014). While there is much attention to the wording of future targets, we contend that a guiding structure would help implementation, which signatories are currently struggling with (Hagerman & Pelai, 2016; Sarkki et al., 2016).

Theories of Change (ToC) (Mayne, 2015, 2017) are conceptual tools used to effectively plan and evaluate how

desired results are achieved through a series of interventions following an impact pathway, making the underlying assumptions and risks explicit for example, making clear what has to happen for the causal linkages to be realized. They can include a wide range of relationships, influences and pathways as well as feedback loops. ToC helps users to clearly articulate an underlying plan of action which stipulates clear results (including a final “impact” and subsequent outcomes and outputs necessary to achieve this) and the interventions necessary to achieve them (Mayne, 2015). Quantitative or qualitative targets can be set for impact, outcomes, outputs, as well as interventions. Without a clear plan underpinning a set of targets, there is a risk of calling for interventions that may not effectively lead to the desired consequences or highlighting desired results with no clear pathway of how to achieve them. ToC are widely used by a plethora of organizations, including governments, particularly in international development for planning and evaluating complex challenges (Mayne, 2017; Vogel, 2012). They have been used in conservation to identify intermediate targets and indicators for monitoring (e.g., Game et al., 2018) and to determine whether conditions and administrative structures are in place to enable successful implementation of interventions (Biggs et al., 2017). They offer a wide range of benefits to bring a more integrated approach to programme scoping, design and strategy development but also in implementation, evaluation, and impact assessment (See Supplementary Materials). No headline multilateral biodiversity treaties to date have been underpinned by ToC, whether explicit or implicit. While the CBD Zero Draft includes a limited ToC model within it. The approach and pathways identified by it have not yet been clearly articulated in subsequent monitoring framework drafts. Expanding on this approach prior and subsequent to COP 15 would help to ensure that all actors are aware of the rationale behind, and links between, the actions agreed by parties and the hoped-for positive outcomes for biodiversity and society (Convention on Biological Diversity, 2020).

The Aichi Targets, as negotiated compromises, have been criticized for containing too many elements; those with fewer elements and formulated to be “SMART” (Specific, Measurable, Agreed, Realistic, Timebound) have seen more progress (Butchart et al., 2016). A ToC approach would help to organize targets into concise headlines with linked additional components to facilitate clear action and evaluation. For example, Aichi Target 6 is “By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem-based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts

of fisheries on stocks, species and ecosystems are within safe ecological limits.” Figure 1 illustrates how applying ToC allows core themes of Aichi Target 6 to be explicitly incorporated into actions, outputs and outcomes necessary to achieve what could then be a more straightforward headline target of “By 2030, marine species are harvested within sustainable limits and marine ecosystems are within safe ecological limits.” Interventions could have their own targets such as 30% Marine Protected Areas, or be left more flexible for countries to determine through their own more detailed ToC planning. ToCs for different targets can also be integrated, allowing interactions between targets to be considered explicitly, including potential synergies (where actions can benefit multiple targets) and trade-offs (where targets may conflict, and cannot be met simultaneously) (Figure 2). For example, undertaking a ToC process for a sustainable fisheries target (Figure 1) also clarifies how potential interactions with SDG Target 14.6 on Illegal, Unreported, and Unregulated fishing could impact outcomes, and allows interactions to be explicitly incorporated into planning can be incorporated in the ToC. Highlighting assumptions is critical for ToC development. This adds transparency and allows for clear discussion on how best to achieve results. As a ToC is put into practice, assumptions might not hold, and thus iterative revision and continual improvement are necessary, making it a dynamic practical tool. Assumptions are usually either causal link assumptions, explaining how and why the causal link works, or rationale assumptions that identify the underlying evidence or hypothesis on which the intervention is founded (Mayne, 2017).

A ToC is not only useful from a global perspective, but could also be adapted by Parties for their own internal planning, giving them a clearer pathway of how to translate overall goals into their national context and contribute to the overall vision of the CBD. Once a global ToC is agreed, Parties could follow the same outline to set their own national agenda for contributions to global targets based on their own local contexts. The scope for ToC development is endless, particularly when dealing with “messy problems” such as biodiversity and ecosystem services. It is important that ToCs do not become overwhelming however; tiers of ToC will be necessary that are communicable and general at higher levels but connect in a meaningful way to action on the ground. Nesting ToCs is one way this can be done (Mayne, 2017). Figure 2 explores how a nested ToC approach could be used to ensure the assumption made in Figure 1 is met. In this case, it involves the development of an effort management system in the fishery but recognizes that strengthening of legislation is also required. It also notes how even if perfected, it would not cover the country’s distant water fleet (see Section 3). Such a process could be demonstrated within countries’

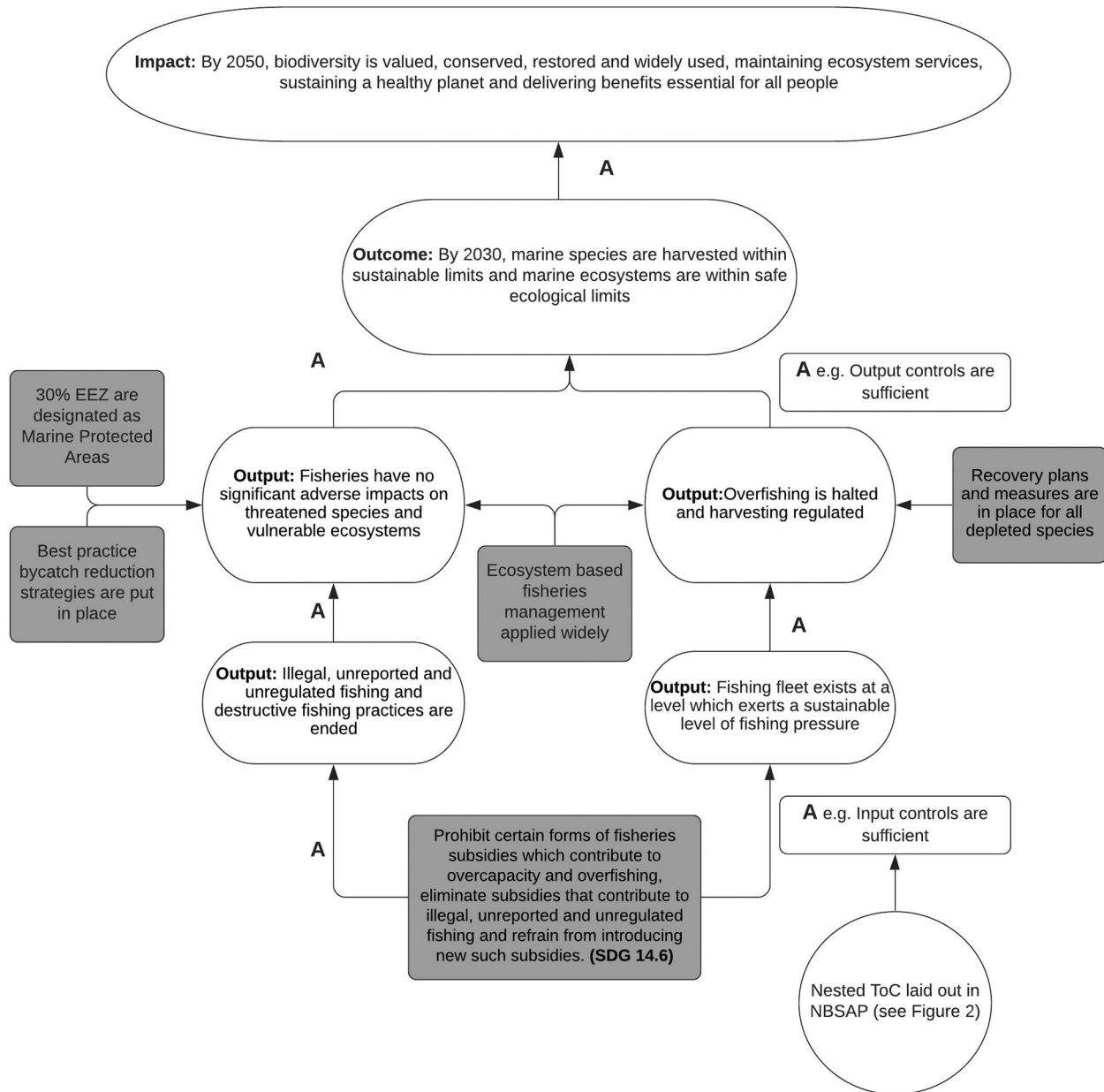


FIGURE 1 Example Theory of Change, exemplifying how a ToC approach might be used for sustainable fisheries. Although relatively high-level, it shows how different targets relate to overall impact for the CBD and possible interventions required to reach them. Outcome targets are based on key results required to meet the CBD 2050 Vision (“Impact”). The Theory of Change is worked through backward to first understand the outputs necessary to achieve the Outcome Target and subsequently the possible interventions required. Assumptions are required for all linkages along the impact pathway. Individual countries can then use this as a starting point to produce their own ToCs within their National Biodiversity Strategies and Action Plans, including for clarifying assumptions. Gray boxes = interventions. **A** = Assumptions

National Biodiversity Strategy Action Plans (NBSAPs) and would not only provide a transparent pathway to achieving results but also help hold countries to account and iteratively diagnose issues. The ToC development process can also greatly assist with explicitly planning for target evaluation, something that the Aichi Targets struggled with, relying instead on post hoc evaluation (Mcowen et al., 2016).

3 | UNDERPINNED BY MODELS TO INTEGRATE COMPLEXITY AND UNCERTAINTY

Models are simplified, abstract representations of processes or systems, and can be powerful tools for projecting plausible futures and assisting decision-making at a range of scales (Nicholson et al., 2019). Models range from

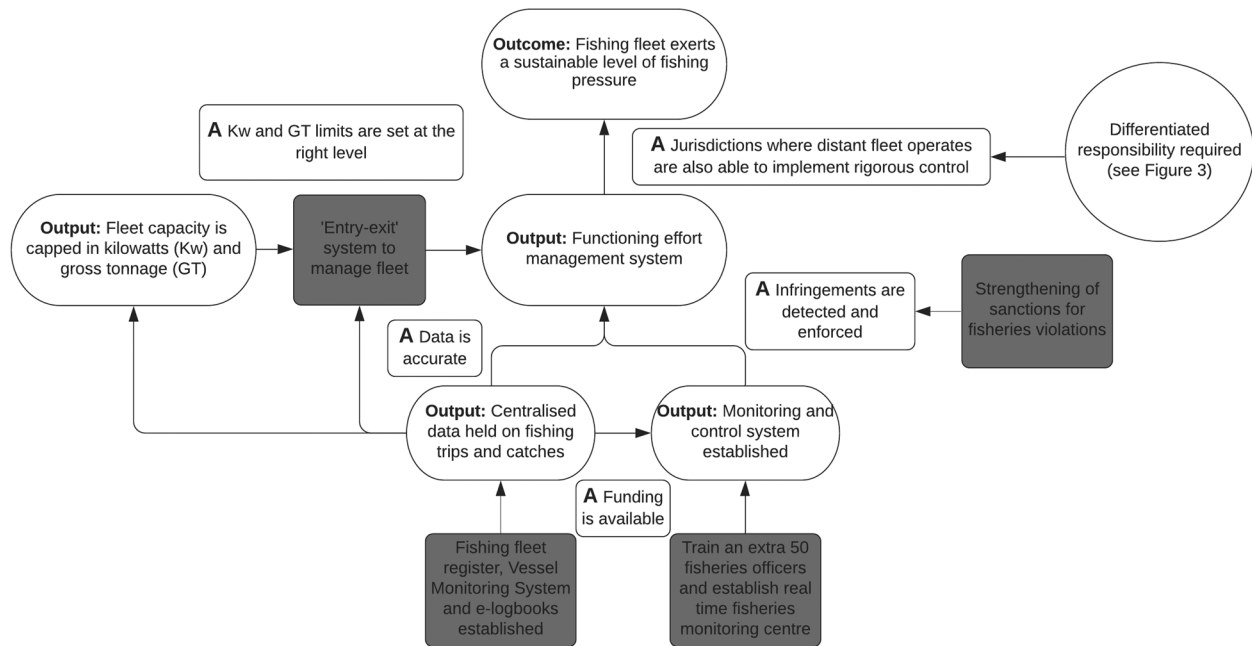


FIGURE 2 Example of a potential Theory of Change showing how assumptions in Figure 1 would be met by an individual country. This is a theoretical example of how a country might produce a ToC centered around input controls to ensure its fishing fleet exerts a sustainable fishing pressure. ToC approach helps identify different actions and further assumptions necessary to achieve the overall goal. An important assumption is made regarding the country's distant-water fleet, for which further action will be required. Gray boxes = interventions. A = Assumptions. Kw = Kilowatt, GT = Gross Tonnage

qualitative conceptual models to quantitative process-based models. They assist with characterization of complex systems and help to constrain and explore uncertainty around future trends.

Underpinning the post-2020 framework with both conceptual and quantitative models would provide substantial benefits, as seen by the influence of model-based projections on policy in the climate sphere (IPCC, 2014; Nicholson et al., 2019). Models are used by the CBD to explore global pathways for achieving its 2050 Vision (Convention on Biological Diversity, 2017), but have seen much less uptake and integration into the CBD 2011–2020 Strategy and national-level policymaking. Yet models of varying scales and complexity are widely used to inform decision-making, including predicting future trends and status of biodiversity, setting quantitative targets, developing relevant indicators, predicting the likely outcomes of proposed policy or management alternatives and evaluating the effectiveness of actions (Nicholson et al., 2019). More recently, integrative models of multiple processes have been developed to better inform ecosystem-based management (Punt, Butterworth, de Moor, De Oliveira, & Haddon, 2016).

Models can be used to project possible outcomes of different scenarios, supporting science-based target setting, which can help to garner political support. This has been seen for climate change, where models have proven valu-

able in projecting future climate change. This is not without challenges (Weaver et al., 2013), but models have supported, but models have supported significant progress for action under the United Nations Framework Convention on Climate Change (UNFCCC) aligned to a specific target (van der Sluijs, van Est, & Riphagen, 2010). This success is due to their constant evolution and improvement, translation into practice at a range of scales and clear quantification of uncertainty, including adopting an ensemble approach (projections given by multiple different models) (Hausfather, Drake, Abbott, & Schmidt, 2020). Model ensembles are beginning to provide an exciting and powerful insight into future ecosystem trajectories and their associated uncertainties (Tittensor et al., 2018), meaning potential future opportunities for the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) to play a role akin to the Intergovernmental Panel on Climate Change (IPCC) in generating multi-model projections (IPBES, 2016).

The use of models cannot guarantee effective conservation actions, or success in achieving desired outcomes. However, effective integration of modeling into decision-making processes can improve the likelihood of success. CBD targets are set by negotiation, but models can still be used to provide information to support that political process (Nicholson et al., 2019) and inform post hoc assessment of policies reaching agreed targets.

TABLE 1 Examples of how models could be integrated into Theory of Change (ToC) planning for sustainable fisheries management (Fig. 1 and 2). The use of models can be guided through a ToC in order to be most effective. Models can also test assumptions of the ToC and help with its iterative development

Component of theory of change	Model type	Usage
Outcome Target—By 2030, marine species are harvested within sustainable limits and marine ecosystems are within safe ecological limits	Marine ecosystem models (mortality, food webs, etc.).	Model used as a basis to help understand ecosystem benefits of sustainable harvesting. Alternatively, could be used to scope out ecosystem effects from different fishing levels to set a specific target that produces desired outcomes (e.g., a particular rate of fishing that maximizes economic returns and ecosystem resilience).
Output 1—Fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems Interventions/actions Various (biological, industrial and socioeconomic) Predict effects of interventions, cost-benefit analysis, etc. E.g., economic models to predict impact of changing subsidies.	Ecosystem models, including those linked with ocean circulation and climate models (e.g., Atlantis, EcoSim).	Explore ecosystem effects of fishing, including on community structure/ abundance of nontarget species, in combination with potential drivers like climate change.
Output 2—Overfishing is halted and harvesting regulated	Stock assessment models/bioeconomic models	Stock assessment models (ideally in combination with marine ecosystem models with an ecosystem-based management approach) used to determine sustainable fishing levels for individual stocks. Bioeconomic explore how fishers/fleets change behavior in response to changes in their environment.
Interventions/actions	Various (biological, industrial and socioeconomic)	Predict effects of interventions, cost-benefit analysis, etc. E.g., economic models to predict impact of changing subsidies.

Quantitative models can be particularly useful when used to quantify the qualitative structure of a ToC (Table 1). They can assist in validating the assumptions underlying the ToC as well as helping uncover unintended consequences of dynamic feedbacks.

Combining quantitative models with more qualitative, participatory, ToC design creates opportunities for adaptive management that is responsive and relevant to emerging unforeseen changes. Management strategy evaluation (MSE), for example, incorporates multistakeholder consultation, modeling, scenario evaluation, and monitoring to allow for structured, adaptive and defensible decision-making in fisheries management. For example, evidence-based harvest control rules and thresholds have been successful in the responsive management for species characterized by highly variable abundance, such as the Pacific sardine (*Sardinops sagax caerulea*) (Punt et al., 2016). Using systems thinking and providing practical guidance to embrace uncertainty and complexity could guide management and support progress toward biodiversity targets (Hill et al., 2015). Such an approach has been demon-

strated by Stephens, Lewis, and Reddy (2018), who provide the theoretical background and practical tools to use systems thinking for transformative change in gender equality. Building on the lessons learnt from such advances in other fields might help better integrate the undeniable complexity of socioecological systems within large-scale biodiversity agreements.

4 | TRANSCENDING SCALES TO SUPPORT MEANINGFUL DEVOLVED ACTION

Biodiversity, and its benefits to people, are distributed unevenly across the world. For example, 70% of the world's terrestrial wilderness within national borders is contained within just five countries (Watson et al., 2018) and other important elements of biodiversity such as coral reefs or tropical forests are limited in their geographical distribution. These elements require direct local intervention to ensure their persistence, meaning differentiated action is

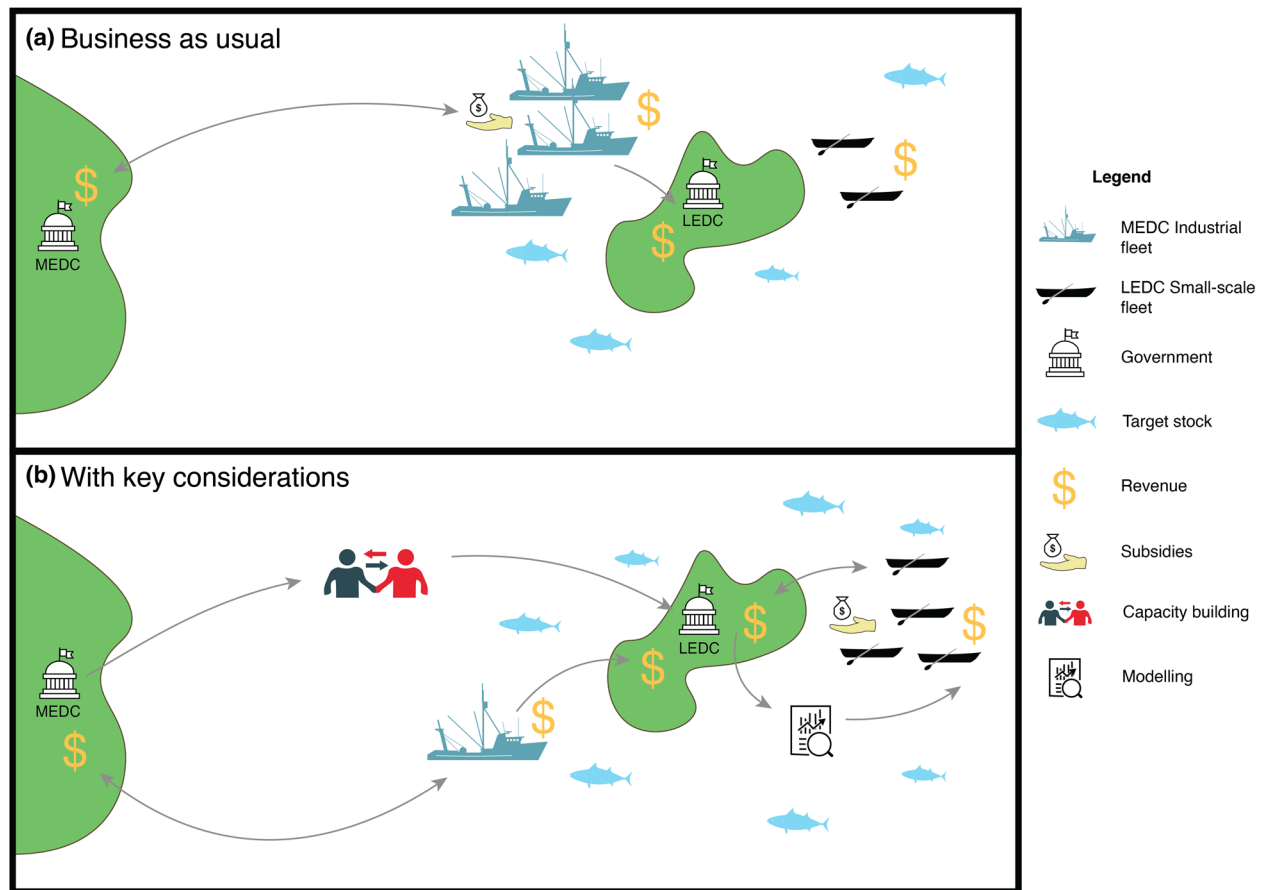


FIGURE 3 Conceptualization of key recommendations in stylized example on sustainable fisheries. The diagram further illustrates the case study in Figure 2, where a More Economically Developed Country (MEDC) has a distant-water fleet operating in the Exclusive Economic Zone of a Least Economically Developed Country (LEDC) with poor legislation and control, leading to overfishing at the expense of LEDC small-scale fishers. To correct this, the MEDC redirects subsidies away from its distant fleet and engages in capacity building with the LEDC. This allows the introduction of modeling approaches and improved management as well as additional funds directed to small-scale fishers boosting economic output within the LEDC as well enabling the recovery of fish stocks through sustainable practices and management

inherently necessary. Reaching the Aichi Targets, however, relies on action by all Parties, and some targets (e.g., Target 11) set blanket aspirations regardless of the ecological and economic situation of individual countries (Convention on Biological Diversity, 2018).

Threats to biodiversity are also complex and multifaceted, requiring differentiated action. For example the illegal wildlife trade must be tackled in multiple ways, including reducing consumer demand, improving detection and knowledge in transshipment countries, and better enforcement and community empowerment at the source (t Sas-Rolfes, Challender, Hinsley, Verissimo, & Milner-Gulland, 2019). Yet, such differentiated action is not well supported by current target structures, which largely encourage countries to act uniformly. Aichi Target 5, for example, requires countries to halve or bring close to zero the rate of habitat loss, but how best to achieve this will depend on the current rate of loss of habitat in different countries, and which habitats are under most pressure.

The target's impacts will also be very different in countries with low versus high rates of loss: highly biodiverse countries may favor ensuring critical areas for biodiversity are maintained, whereas degraded countries may implement large-scale restoration. Whilst the CBD does allow flexibility in terms of the opportunity for individual Parties to develop their own approaches (e.g., developing NBSAPs), relying solely on national actions to achieve global outcomes without clear pathways or prioritization of actions risks unequal or unjust effort, leading to an overall failure to reach global goals (Hagerman & Pelai, 2016).

The UNFCCC has been committed to the principle of "common but differentiated responsibilities" since as far back as 1992. Operationalizing such a commitment has proved challenging due to disagreement over responsibilities (Althor, Watson, & Fuller, 2016). However, it has provided the opportunity, through Intended Nationally Determined Contributions (INDCs), to identify gaps between national commitments and the global goal; the

“emissions gap” (UN Environment, 2018). The CBD’s reliance on NBSAPs has not enabled it to garner the required commitments, and countries have struggled with the implementation of their commitments (Sarkki et al., 2016). If differentiated voluntary actions could be summed up toward overarching global goals, progress toward the CBD’s targets would be clearer, and there would be scope for a fairer process of allocating responsibilities. This is only likely to be possible if action toward a global target is guided through an overarching framework that considers the complexity of monitoring and reporting on biodiversity. Using conceptual and quantitative models, as described in the first two sections, provides a basis for thinking about how this might be achieved.

The process of determining devolved and differentiated activity would need to ensure equity, which has been challenging for international agreements (Hill et al., 2015). However, addressing equity issues up front means there is a higher likelihood of better outcomes for people and nature (Steffen & Stafford Smith, 2013). The UNFCCC Clean Development Mechanism has provided a platform for developed countries to assist with clean development in least developed countries. The Global Environment Facility provides a mechanism for the fair distribution of financial resources to assist countries in implementing the CBD. However, given the complexity of the CBD’s aims, such a process must go beyond simply transferring capital. Figure 3 shows a conceptualization of how the key considerations in this article might be operationalized using a fisheries-based example. A ToC approach as identified in Figures 1 and 2 helps the More Economically Developed Country (MEDC) in this example understand that its subsidies are supporting unsustainable operation of its distant-water fleet at the expense of the Least Economically Developed Country (LEDC). By using further ToC development (Figure S1) the MEDC is able to redirect existing subsidies into capacity building efforts, which help meet its obligations under SDG 14.6 (removal of harmful subsidies) and SDG14.7 (increased economic benefits to Small Island Developing States [SIDS]). The LEDC meanwhile uses modeling and stock assessment improvements gained through capacity building as well as its own ToC approach, to achieve a key aim under SDG 14.B to sustainably develop its small-scale fisheries. In turn, all parties contribute toward the various international obligations for improved fish stocks and biodiversity. Finding a balance between global efforts to advance effective action in the right locations and local efforts that allow communities and nations to use the natural resources they need to develop economically is a key challenge. Improved guidance about how actions lead to outcomes (Point 1) and addressing issues of equity at the country and local level, can allow for better alignment of priorities across scales,

informed by scenario modeling (Point 2). Together, these approaches would allow countries to contribute targeted, effective actions toward global biodiversity outcomes, and ensure biodiversity is not just the responsibility of those countries that contain intact or unique biodiversity.

5 | CONCLUSION

Global biodiversity is rapidly declining. If we are serious about protecting and restoring it, then actions will need to be wide-reaching in scope and geography—merely formulating new targets as updates of the existing targets is unlikely to create meaningful change. It is essential that future MEAs, and the post-2020 framework in particular, focus not only on what needs to be done but also on how it should be done, using measurable steps which make sense at the scales at which biodiversity change happens. A Theory of Change approach would provide a useful overarching framework at the global scale to link result and intervention-based targets in a transparent format, which would help parties implement the overall vision of the CBD. Such a framework could integrate recent advances in modeling and decision science to ensure that system linkages and underlying assumptions are explored and exposed, interventions have a sound basis, and evaluation is planned up front and in a way that goes beyond simple target/indicator relationships. This would help greatly in understanding the role of enabling conditions in achieving overall results and where greater capacity building efforts will need to be focused. Importantly, such a framework would also need to support differentiated action at a range of scales, to ensure mechanisms are put in place that can assess how national contributions scale up to global outcomes, whilst protecting the most vulnerable in society.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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