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Mainstreaming the Ambition, Coherence, and Comprehensiveness of the Post-2020 Global Biodiversity Framework Into Conservation Policy

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Parties to the Convention on Biological Diversity are finalizing a new Global Biodiversity Framework (GBF) to more effectively guide efforts by the world's nations to address global loss of biodiversity and ecosystem services. Each party is required to mainstream the new framework and its component targets into national conservation strategies. To date, such strategies have been criticized as largely aspirational and lacking clear linkages to national policy mechanisms, which has contributed to the world's general failure to meet the Convention's previous targets. We use the United States and European Union as examples to compare and contrast opportunities and barriers for mainstreaming the GBF more effectively into policy. The European Union and United States have unique relationships to the Convention, the former being the only supranational party and the latter, having signed but never ratified the treaty, adopting Convention targets on an *ad hoc* basis. The contrasting conservation policy frameworks of these two polities illustrate several conceptual issues central to biodiversity conservation and demonstrate how insights from the GBF can strengthen biodiversity policy even in atypical contexts. We focus on three characteristics of the GBF which are essential if policy is to effectively motivate and guide efforts to halt and reverse biodiversity loss: comprehensiveness, coherence, and ambition. Statutes in both the United States and European Union provide a strong foundation for mainstreaming the GBF's comprehensiveness, coherence, and ambition, but policy development and implementation falls short. We identify six common themes among the reforms needed to successfully achieve targets for reversing biodiversity loss: broadening conservation focus to all levels of biodiversity, better coordinating conservation strategies that protect sites and landscapes with those focused on biodiversity elements (e.g., species), coordinating biodiversity conservation with efforts to safeguard ecosystem services including ecosystem-based climate mitigation and adaptation, more coherent scaling of targets from global to local extents, adoption of a more ambitious vision for recovery of biodiversity, and development of effective tracking and accountability mechanisms.

Keywords: biodiversity monitoring, convention on biological diversity, ecosystem services, endangered species act, global biodiversity framework, habitats directive
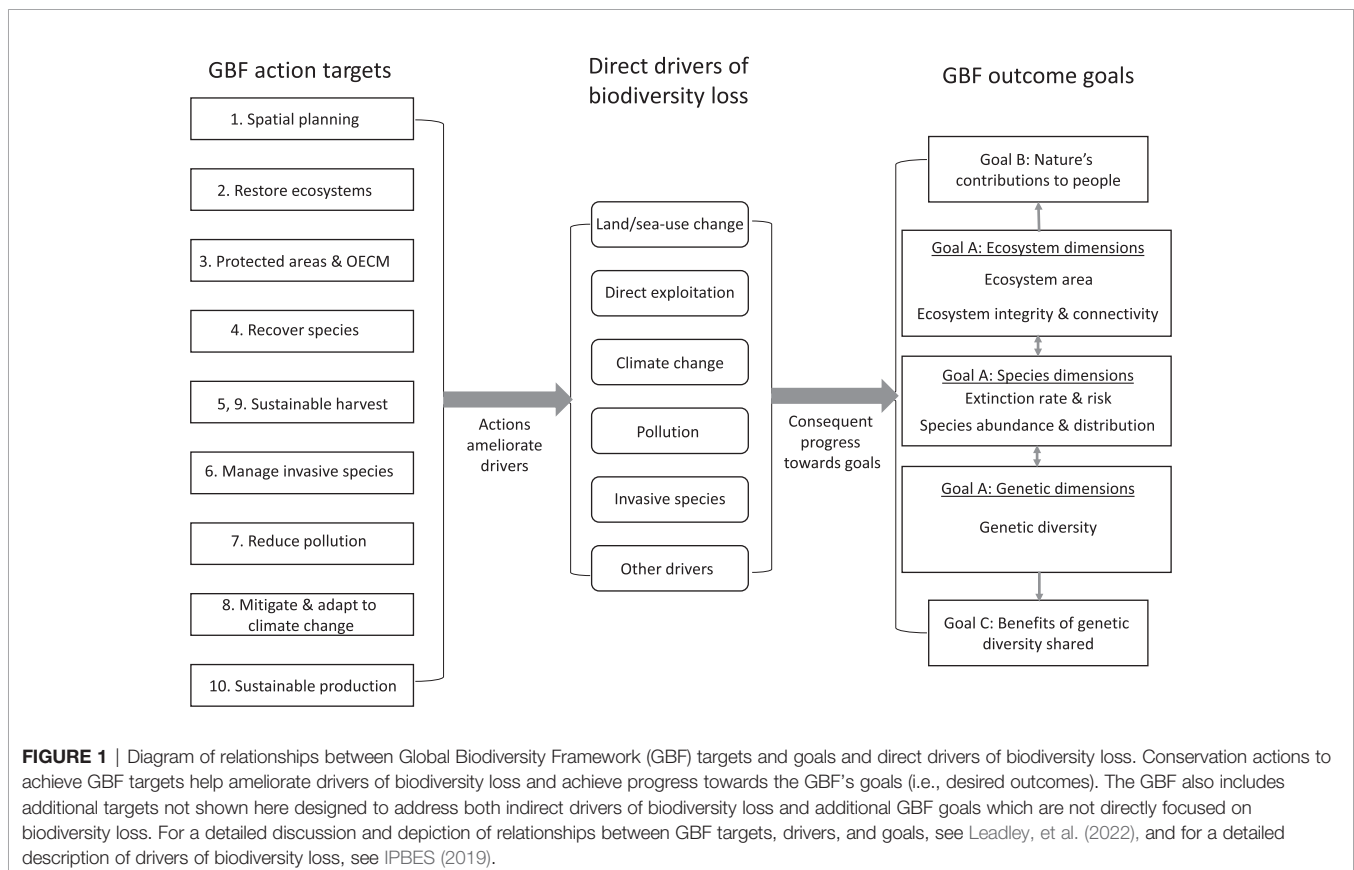
INTRODUCTION

The accelerating global loss of biodiversity is, along with the climate crisis, one of the great challenges facing humanity (IPBES, 2019). The primary global biodiversity treaty, the Convention on Biological Diversity (CBD), aims to reduce the rate of biodiversity loss and safeguard ecosystem services (frequently categorized among "Nature's Contributions to People" in the context of the GBF), while also considering equity issues (Díaz et al., 2020; CBD, 2021). The CBD commits its 196 parties to integrate and mainstream consideration of biodiversity conservation targets across all sectors of their policy-making framework (CBD, 2021). Each CBD party is required to develop a national biodiversity strategy and action plan (NBSAP), which describes how the national government intends to fulfill the CBD targets and what specific steps it will take to do so.
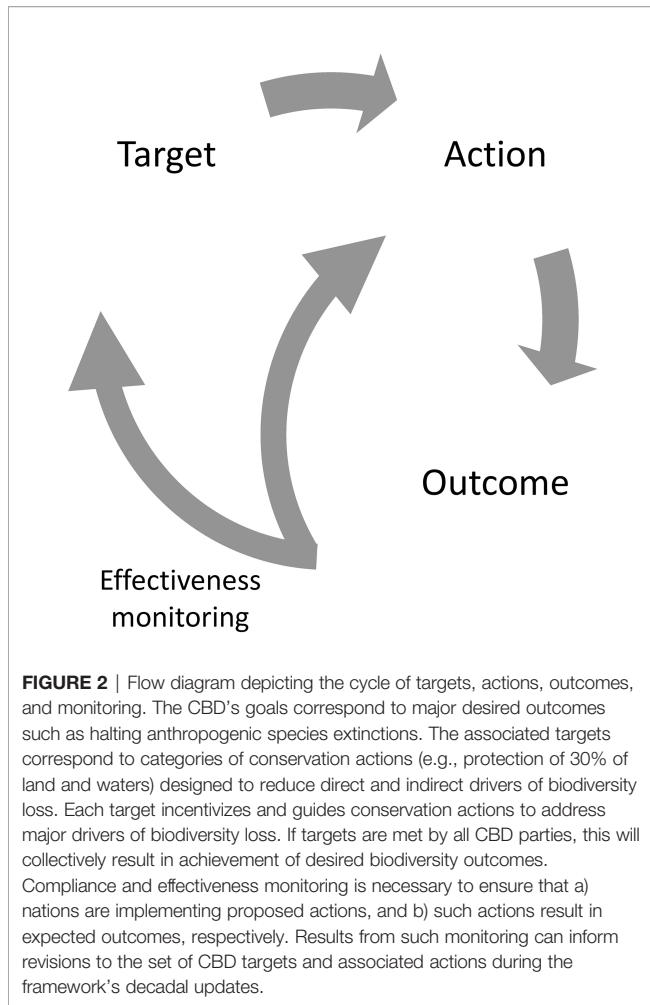
However, existing NBSAPs have been criticized as primarily aspirational, and suffer from a lack of clear linkages to enforceable policy mechanisms in signatory states (Perino et al., 2021; Ray et al., 2021; Xu et al., 2021). This disconnect has contributed to the general failure of the world's nations to meet past CBD biodiversity targets (CBD, 2020). The gap between biodiversity protection plans and realities parallels that seen in combating climate change, as Nationally Determined Contributions established under the Paris Agreement are demonstrably inadequate to achieve ambitious climate goals due in part to their disconnect from enforceable national policies (Liu and Raftery, 2021).

CBD parties are expected to revise their NBSAPs following the CBD's 2022 COP15 meeting, where the parties are expected to adopt the Global Biodiversity Framework (GBF), (CBD, 2021). The draft GBF contains a new set of targets designed to comprehensively reflect the status of global biodiversity, along with elements aimed at maintenance of ecosystem services, equitable sharing of benefits from genetic resources, and development of adequate funding for achieving these goals (**Figure 1**). The GBF is structured as sets of long-term goals (to be achieved by 2050), each with one or more interim (2030) milestones and associated targets and indicators (CBD, 2021).

The CBD's goals correspond to major desired outcomes such as halting anthropogenic species extinctions (**Figure 1**). The associated targets correspond to categories of conservation actions (e.g., protection of 30% of land and waters) designed to motivate and guide conservation actions to address major drivers of biodiversity loss (**Figure 1**). If targets are met by all CBD parties, the GBF proposes that this will collectively result in achievement of desired biodiversity outcomes (**Figure 2**; **Table 1**). Compliance and effectiveness monitoring is necessary to ensure that a) nations are implementing proposed actions, and b) such actions result in expected outcomes, respectively (**Figure 2**). Results from such monitoring can inform revisions to the set of CBD targets during the framework's decadal updates. For a more detailed explication of the relationships

FIGURE 1 | Diagram of relationships between Global Biodiversity Framework (GBF) targets and goals and direct drivers of biodiversity loss. Conservation actions to achieve GBF targets help ameliorate drivers of biodiversity loss and achieve progress towards the GBF's goals (i.e., desired outcomes). The GBF also includes additional targets not shown here designed to address both indirect drivers of biodiversity loss and additional GBF goals which are not directly focused on biodiversity loss. For a detailed discussion and depiction of relationships between GBF targets, drivers, and goals, see Leadley, et al. (2022), and for a detailed description of drivers of biodiversity loss, see IPBES (2019).

FIGURE 2 | Flow diagram depicting the cycle of targets, actions, outcomes, and monitoring. The CBD's goals correspond to major desired outcomes such as halting anthropogenic species extinctions. The associated targets correspond to categories of conservation actions (e.g., protection of 30% of land and waters) designed to reduce direct and indirect drivers of biodiversity loss. Each target incentivizes and guides conservation actions to address major drivers of biodiversity loss. If targets are met by all CBD parties, this will collectively result in achievement of desired biodiversity outcomes. Compliance and effectiveness monitoring is necessary to ensure that a) nations are implementing proposed actions, and b) such actions result in expected outcomes, respectively. Results from such monitoring can inform revisions to the set of CBD targets and associated actions during the framework's decadal updates.

between the GBF's components, we refer readers to recent reviews (Hoban et al., 2020; Nicholson et al., 2021; Williams et al., 2021; Leadley et al., 2022).

In this review, we compare and contrast the core concepts embedded in the GBF's biodiversity goals and targets with the statutes and policies that govern biodiversity conservation in the United States (US) and European Union (EU); we also discuss the nexus between policies addressing biodiversity and ecosystem services. The draft GBF currently includes 21 or more targets (CBD, 2021). We discuss only the first 10, which are most directly related to biodiversity (**Figure 1**). We specifically focus on three characteristics of the GBF which we propose are essential if such a policy framework is to effectively incentivize and guide efforts to halt biodiversity loss: comprehensiveness, coherence, and ambition.

The GBF embodies all three of these essential elements. The diversity of life is commonly recognized as being expressed at several levels or scales: diversity among ecosystems, among species, and genetic diversity within species. The GBF contrasts with most national environmental statutes in that it includes comprehensive targets directly related to the desired outcome of halting or reversing loss of biodiversity at each of these three

levels (the three elements of GBF Goal A; **Figure 1**) (Díaz et al., 2020; CBD, 2021). The GBF is coherent in that the targets associated with various outcomes (e.g., differing levels of biodiversity and ecosystem services) are interlinked and mutually reinforcing (**Figure 1**). It aims to motivate an inclusive whole-of-society approach that fully integrates biodiversity values into policies and planning processes, and reforms or eliminates incentives harmful to biodiversity. Finally, the GBF is ambitious in that it aims not only to slow or halt biodiversity loss but to secure a "Nature Positive" future in which past damage to biodiversity is reversed *via* restoration (Locke et al., 2021). For example, the GBF aims for net gain in the area, connectivity, and integrity of native ecosystems, and an increase in abundance and distribution of plant and animal populations depleted by anthropogenic impacts.

Previous globally-comprehensive comparisons of national implementation of CBD goals, while valuable, have necessarily been limited in their ability to explore in detail the policies of any one nation (Perino et al., 2021; Priyadarshini et al., 2022). Both of the polities considered here (the US and EU) would merit stand-alone analysis on this topic, as both are major jurisdictions which contrast in their relationship to the CBD and in the structure of their biodiversity statutes. By considering them jointly, we retain the ability to explore their respective policies in detail while adding the benefits of a comparative approach that provides insights not evident from examining a single party.

Our review of GBF-related policy mechanisms is timely for several reasons despite the fact that the GBF is as of mid-2022 still a work in progress and consensus on many details has proved elusive. First, it is likely that the overall structure of goals and targets in the draft GBF will be preserved in the final version. Second, the EU and US as well as other polities are moving ahead with developing GBF-related policies (European Commission, 2020a; White House, 2021). Third, the magnitude of the biodiversity crisis requires a rapid response by the world's nations (IPBES, 2019).

The EU and US have a unique relationship with the CBD, albeit for different reasons. The EU is the only supranational CBD party. Although it has developed a biodiversity strategy, the EU depends on its 27 members states to implement most conservation actions (European Commission, 2011; European Commission, 2020a). This contrasts with the US, where the federal government directly manages a substantial proportion (~30%) of the nation's lands (CRS, 2020) and has regulatory authority over all of its territory. Although the US is not formally a CBD party (having signed but never ratified the agreement), the CBD's goals and targets indirectly influence policy proposals generated by lawmakers and NGOs (White House, 2021). For example, the US has, as part of the G7 group of major developed nations and the High Ambition Coalition for People and Nature, endorsed goals related to the GBF, such as protecting 30% of its land and marine areas by 2030 (the GBF's "30x30" target) (UNEP, 2020). Because US policy often tracks and reflects global treaties to which it is not a party (e.g., the Convention on Migratory Species and portions of the CBD itself such as the Cartagena Protocol on Biosafety), it is relevant to identify areas in which US policy could be more effective in stemming biodiversity loss by incorporating CBD goals (Snape, 2009).

TABLE 1 | Relevant US and EU laws and policies corresponding to the 10 categories of Global Biodiversity Framework (GBF) targets shown in **Figure 1**.

GBF Target	Relevant US laws and policies	Relevant EU laws and policies
1. Spatial planning	National Forest Management Act (NFMA) Federal Land Policy and Management Act (FLPMA) National Wildlife Refuge System Improvement Act State and local land use codes	EU forest strategy for 2030 Maritime Spatial Planning Directive National measures
2. Restore ecosystems	Infrastructure Investment and Jobs Act of 2021 Land and Water Conservation Fund	2030 Biodiversity Strategy Marine Strategy Framework Directive Proposed Regulation on Nature Restoration
3. Protected areas and OECM	Antiquities Act (designations of National Monuments) Wilderness Act 30x30/America the Beautiful Initiative Special federal land designations (e.g. Forest Service Roadless Rule, BLM designations of Areas of Critical Environmental Concern) Land and Water Conservation Fund	Natura 2000 network
4. Recover species	Endangered Species Act (ESA) Migratory Bird Treaty Act Bald and Golden Eagle Protection Act Marine Mammal Protection Act	Habitats Directive Birds Directive
5, 9. Sustainable harvest of wild species	State fish and game regulations Magnuson-Stevens Fishery Conservation and Management Act	Habitats Directive, Birds Directive Common Fisheries Policy
7. Reduce pollution	Clean Water Act Clean Air Act Toxic Substances Control Act Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)	Water Framework Directive Ambient Air Quality Directive Zero Pollution Action Plan for air, water and soil
8. Manage invasive species	Executive Order 13112 Lacey Act State invasive species management councils	Invasive Alien Species Regulation
8. Mitigate and adapt to climate change	National Flood Insurance Program Federal fire policies Clean Air Act	European Climate Law Land Use and Forestry Regulation (LULUCF)
10. Sustainable production systems	Farm Bill Conservation Reserve Program (CRP) USDA National Organic Program Voluntary product labeling schemes and certifications	Common Agricultural Policy Plant Protection Products Regulation Directive on the Sustainable Use of Pesticides

The GBF includes additional targets designed to address indirect drivers of biodiversity loss and the additional GBF goals (goals B, C, and D) which are not directly focused on biodiversity loss.

We chose the US and EU as examples because their contrasting policy frameworks illustrate conceptual issues central to biodiversity conservation, because their approaches to natural resources management often influence other countries' policies, and because this comparison demonstrates how insights from the GBF can strengthen biodiversity policy even in atypical contexts such as these. The primary US biodiversity-related statute (the Endangered Species Act; ESA) is a half-century old and focuses primarily on a single level of biodiversity (species, specifically a subset listed as protected) (Rohlf, 1989; Goble, 2005). In contrast, the EU's primary biodiversity directives focus on two levels of biodiversity (species and ecosystems) (Born et al., 2015). Both the US and EU policy frameworks encompass a range of mechanisms as detailed below, including reactive measures (regulatory standards for development, penalties, policies affecting import and export of species of concern) and proactive measures (financial incentives, planning and implementation focused on recovery of species of concern) (**Figure 1**; **Table 1**) (Rohlf, 1989; Born et al., 2015).

Comparing the US and EU conservation policy frameworks with the GBF's mandate can help policymakers move beyond parochial perspectives and generate ideas for more effective policy mechanisms. We recognize that the US and EU, as examples of relatively wealthy polities with strong rule of law, are not fully representative of the diversity of CBD parties. Moreover, implementation of GBF measures in many countries will likely depend on commitments by the US and EU to provide new funding for global biodiversity conservation. Nonetheless, as we describe below, our comparison of the US and EU provides globally-relevant policy insights into common barriers to GBF implementation that can help decision-makers elsewhere create an effective and coherent linkage between global targets and national policies.

COMPARING COMPREHENSIVENESS AND COHERENCE ACROSS LEVELS OF BIODIVERSITY IN THE GBF, US AND EU POLICY

Both scientific and social perceptions of what aspects of the natural world are worth saving (i.e., what should be the object of conservation attention) have evolved over time (Nijhuis, 2021). Whereas the species concept dates to at least the 1700s, the term ecosystem dates only to 1935. Early biodiversity conservation

statutes such as the US ESA arose primarily from public awareness of charismatic species' risk of extinction. The shift from a focus on protecting species to conservation of biodiversity at multiple levels occurred during the 1980s and 1990s (Gaston and Spicer, 2013), with a focus on genetic diversity as a distinct conservation target gaining prominence only in subsequent decades (Mace, 2004; Hoban et al., 2020).

The GBF adopts a muti-level conservation focus that recognizes that preventing loss of diversity at levels besides species is both an important goal in its own right and helps prevent species loss (**Figure 1**) (Leadley et al., 2022). Proposed GBF outcome goals and milestones include net gain in the extent, connectivity, and integrity of ecosystems compared to a 2020 baseline; reduction in species extinction rates and extinction risk, alongside maintenance of species abundance and distribution; and retention of genetic diversity within species (**Figure 1**) (Díaz et al., 2020; CBD, 2021).

Species as the Focus of Conservation

We compare the conservation focus embodied in the GBF with that in US and EU policies beginning at the species level because this remains the most fundamental and widely acknowledged facet of biological diversity enshrined in national conservation statutes. Species targets have also been a central but not exclusive focus of the GBF's development (Rounsevell et al., 2020; Williams et al., 2021). The GBF's proposed species-level 2030 milestones specify that, compared to a 2020 baseline, a) increase in the extinction rate is halted or reversed, b) extinction risk across all taxonomic groups is reduced by at least 10 per cent, c) the proportion of species that are threatened decreases, and d) the abundance and distribution of populations of species is enhanced or at least maintained (CBD, 2021). Longer-term (2050) species-level goals seek to ensure that a) healthy and resilient populations exist of all species; b) extinction rate has been reduced at least tenfold; and c) extinction risk across all taxonomic and functional groups is halved (CBD, 2021).

The first listed purpose of the US Endangered Species Act (ESA; 16 U.S.C. §§ 1531-44) is to "provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved". However, only species—a term legally defined to include species, subspecies, and "distinct population segments" of vertebrates – are eligible for protection under the Act, and only to those listed as "threatened" or "endangered" under a prescribed legal process receive such protections. The ESA's regulatory mechanisms are complemented by a variety of additional federal statutes that contain conservation-focused elements, such as laws governing protection of specific types of species (such as bird and marine mammals) and management of habitats on federal lands (Rohlf, 1989).

The GBF's species-level targets are comprehensive and multi-faceted, encompassing extinction rate and risk for all species, as well as their abundance and distribution (Díaz et al., 2020). This contrasts with the US ESA, which focuses on protecting species identified as presently at an unacceptable risk of extinction. The ESA does not specify further goals regarding the desired abundance, distribution, or extinction risk of non-listed

species, although federal agencies, state and local governments, and even private landowners commonly develop species-focused candidate conservation strategies to prevent additional listings (Rohlf, 1989).

The EU's primary biodiversity statutes are the Birds and Habitats Directives, which were enacted in 1979 and 1992, respectively (Born et al., 2015). In part because of this timing, the Habitats Directive incorporated emerging science on the importance of conserving biodiversity at multiple levels (Mehtälä and Vuorisalo, 2007). The Habitats Directive confers protection on 'natural and semi-natural habitat types' as well as species, based on the concept of bringing both species and habitat types to 'Favourable Conservation Status' (FCS) (Epstein et al., 2016). The EU statutes propose to achieve this goal primarily through creation of a well-sited system of protected areas termed the Natura 2000 network, although regulatory mandates, especially for species protection, also impact the management of lands outside the network (Romão, 2015). The EU Biodiversity Strategy for 2030 additionally calls for new legislation to complement the Habitats Directive focused on restoring ecosystems (European Commission 2020a). As of this writing, new legislation has not been enacted, but is expected to focus on the ecosystem level and aim to ensure the connectivity of a "Trans-European Nature Network" (European Commission 2020a).

The Habitats Directive mandates that EU-protected species be maintained or restored to FCS, which is achieved when a) population dynamics data indicate that the species is maintaining itself on a long-term basis as a viable component of its natural habitats; b) the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and c) there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis (Habitats Directive article 1(i)). Like the GBF goal and milestones, the species-level FCS definition is multi-faceted, integrating extinction risk, abundance, and distribution goals. The concept of FCS resembles elements of the GBF more closely than does the US ESA in that it is expressed in a positive sense as distance from a favorable state rather than primarily in a negative sense as distance from extinction.

Conservation of Intraspecific Diversity

The GBF also aims to conserve diversity below the species level, with the goal that all species will retain >=90% of their 2020 levels of genetic diversity in 2030 and thereafter (Hoban et al., 2020). Such an explicit quantitative target for intraspecific genetic diversity is a recent development in conservation policy (Hoban et al., 2020; Laikre et al., 2020). However, earlier statutes incorporated a more general conceptual awareness of the importance of retaining abundant well-distributed populations, which facilitates retention of genetic diversity. Although the GBF envisions direct monitoring of genetic diversity where feasible, it also incorporates general principles linking intraspecific diversity to distribution and abundance goals (CBD, 2021).

US agencies evaluate whether a regional population merits conservation focus under the ESA based on whether it

contributes to a species' resilience, redundancy and representation (Shaffer and Stein, 2000; Carroll et al., 2021). Although not fully reflected in ESA implementation to date, these '3R' criteria suggest that a species, to be considered recovered, should be present in many large populations located across a range of ecological settings (Shaffer and Stein, 2000). EU agencies have also attempted to clarify what the Habitats Directive and FCS imply in terms of requirements for conservation of genetic diversity (European Commission, 2021). In the *Tapiola* decision regarding the Finnish gray wolf (*Canis lupus*) population, the Court of Justice of the European Union (CJEU) indicated that wolf populations should at a minimum be conserved within all European biogeographic regions in which they occur (Case C-674/17 (2019)).

Although neither the US ESA nor the EU FCS concept contains quantitative targets for intraspecific diversity, both embody conceptual elements (e.g., representation) analogous to those in the GBF. However, these concepts are less explicit in national policies, and are still a topic of active debate and litigation in both the US and EU. For example, US agencies have interpreted the ESA as focusing conservation efforts within the present range rather than the historic range of protected species, and ESA recovery plans increasingly target a single secure population rather than broader distribution of multiple populations (Carroll et al., 2021). This increasingly prominent 'museum-piece' approach (Vucetich and Nelson, 2014) may be insufficient to effectively conserve intraspecific diversity, especially for formerly-widespread species such as the gray wolf (Carroll et al., 2021).

In the EU, as the CJEU clarified in the *Tapiola* decision, populations of species protected by the Habitats Directive must be maintained at FCS not only at the level of Member States, but wherever they occur in their natural range (Epstein and Kantinkoski, 2020). Natural range is defined as a "dynamic concept" that describes the rough area where the species currently occurs at some point during its lifecycle, including areas where the species expands to without being deliberately introduced (European Commission, 2021). By maintaining healthy populations throughout the species' range, this framing, like the 3R criteria, is in principle protective of intraspecific diversity. The challenge in both the EU and US lies in the practical implementation of such general guidelines, but this can be aided by recent research on delineating spatial units for conserving genetic diversity (Andrello et al., 2022).

Conservation of Ecosystems

The GBF contains well-developed goals and milestones for ecosystem conservation, including an increase in the area, connectivity, and integrity of natural ecosystems of at least 5% by 2030 and of at least 15% by 2050, although specific percentages are still under debate (CBD, 2021). Inclusion of specific ecosystem-level targets has been made feasible by recent advances in conservation science including classification, mapping, and risk assessment of over 3000 ecosystems globally (Nicholson et al., 2021). The Red List of ecosystems, although not completed, provides information on the decline and protection status of ecosystem types (Keith et al., 2015; Comer et al., 2020).

The EU Habitats Directive contains analogous goals, although in less specific terms. Conservation goals for each habitat type include maintaining stable or increasing distribution, retention of ecosystem structure and functions, and favorable conservation status of the ecosystem's component species (Habitats Directive Article 1(e)). The EU Biodiversity Strategy for 2030 calls for new legislation, as mentioned above, containing quantitative targets for ecosystem conservation and restoration in line with the GBF, which would be legally binding on the Member States (European Commission 2020a; Hermoso et al., 2022). If enacted and fully implemented, this new law would directly implement the ecosystem goal of the GBF throughout the EU.

Perhaps because it was among the earliest of the modern national conservation statutes, the US ESA lacks references to ecosystems beyond the single clause in its preamble quoted above. Administrative policy encourages ecosystem-based ESA listings and recovery plans, but such approaches have been relatively rare in practice (Evans et al., 2016).

ENSURING COHERENT CONSERVATION ACTION ACROSS LEVELS OF BIODIVERSITY IN US AND EU LAW AND POLICIES

Recognizing that coordinated action addressing multiple levels of biodiversity can strengthen the effectiveness of conservation strategies, the GBF attempts to develop a coherent framework that is more than a collection of disparate targets (**Figure 1**). As Leadley et al. (2022) have observed, "all dimensions of biodiversity … show interlinked responses to human drivers. Efforts to mitigate the effects of drivers on one dimension … will depend on action on other dimensions."

Generally speaking, ecosystem-level conservation can secure gains at all three levels of biodiversity. The extent of intact native ecosystems and consequently habitat for native species influences species extinction risk (although this varies dependent to what extent habitat loss was the major threat for a particular species), retention of intraspecific diversity, and the level of ecosystem services provided by native ecosystems (Nicholson et al., 2021; Leadley et al., 2022).

The GBF also declares that conserved areas should fulfill representation and connectivity objectives designed to contribute to retention of diversity at both the species and intraspecific level (CBD, 2021). Whereas population abundance objectives contribute to retention of diversity within a subpopulation, setting conservation goals for representing each ecotype or bioregional population helps retain diversity between subpopulations (Carroll et al., 2021). Retention of genetic diversity and reduction in loss of populations also contributes to reduction in species extinctions (**Figure 1**) (Hoban et al., 2020).

The GBF is based on the premise that coherent, comprehensive strategies directed towards conservation at multiple levels of biodiversity will be more effective and resilient than a focus solely on one level (e.g., species) (Díaz

et al., 2020; Leadley et al., 2022). However, most of the details of how conservation efforts directed at different levels will be coordinated are not yet specified, and may only be described during NBSAP development by individual CBD parties. We describe below how US and EU statutes and policies can be implemented to better support coordinated action to conserve biodiversity at all levels.

Species

Although existing US and EU statutes already reflect the GBF's goal of halting species loss, time lags between conservation intervention and outcomes make it inherently difficult to evaluate to what extent these policies have been effective in lowering extinction rates to levels that meet GBF targets (Leadley et al., 2022). Globally, Bolam et al. (2021) concluded that extinction rates for birds and mammals would have been 2.9–4.2 times greater without conservation action since 1993. There is also evidence that the US, and perhaps the EU, have slowed their rates of species extinction since passage of major species conservation statutes (Romão, 2015; Greenwald et al., 2019; European Commission, 2020b). Greenwald et al. (2019) concluded that of 1747 species listed under the ESA, the statute prevented extinction of 291 species during 1973-2019.

Recent increases in US threatened and endangered species declared recovered are also consistent with the GBF's goal to reduce the proportion of species considered threatened (i.e., extinction risk; **Figure 1**), (Greenwald et al., 2019). However, this interpretation is qualified by the trend for US agencies to lower the threshold defining recovery by requiring fewer and less widely-distributed populations, contrary to the GBF's goals to maintain and enhance species' abundance and distribution (Carroll et al., 2021). US federal agencies could adopt an ESA recovery policy that better reflected current understanding of drivers of biodiversity loss by emphasizing greater abundance and distribution in defining recovery, perhaps tying this threshold to consistent biologically-based standards analogous to the IUCN's Red List criteria (Rodrigues et al., 2006).

Conservation strategies designed to reduce extinction risk broadly (e.g. habitat protection) often differ from the intensive interventions (e.g., captive breeding) used to prevent extinction of highly threatened species (Leadley et al., 2022). Since the ESA provides no protections to species not on its protected lists, US agencies must emphasize other policy approaches to meet the GBF's goal of reducing overall species extinction risk. For example, interpreting the Migratory Bird Treaty Act to ban unintentional as well as intentional bird killings – coupled with a permit scheme to allow limited incidental take with appropriate avoidance and mitigation measures – would reduce extinction risk for many avian species not listed under the ESA (USFWS, 2021). Increased funding for state fish and wildlife agencies – most of which have ambitious plans for non-game species conservation but lack funds for implementation – would also widely benefit species not covered by the ESA (Davis et al., 2008); proposed legislation to accomplish this goal has been introduced in the US Congress (Recovering America's Wildlife Act, H.R. 2773, 117th Cong., 2021).

The EU Habitats and Birds Directives demand high levels of protection from the Member States, as has been repeatedly confirmed by EU courts (Epstein and Kantinkoski, 2020). However, as Member States are responsible for implementing and enforcing the goals of the Directives, results are dependent on their will and capacity. During the last evaluation period, 27% of listed species were judged to have FCS, but more than 60% were judged to have poor or bad status (Röschel et al., 2020). Although this represented a 4% improvement in number of species with good status from the prior six-year period, the apparent improvement was likely due to a change in measuring methods rather than factual improvement (Röschel et al., 2020).

Clearly, the current implementation of the Directives is not sufficient to meet the GBF targets (Hermoso et al., 2022). At the same time, legal action by the EU to enforce compliance by the Member States has sharply decreased and depends almost entirely on NGO lawsuits (Hofmann, 2019). To meet GBF goals, the EU should provide enhanced support and enforcement to encourage Member States to contribute to meeting species conservation targets. Environmental NGOs often drive the judicial enforcement of the wildlife directives due to limited enforcement by the European Commission. Involvement by the Commission is also needed however, to ensure that public enforcement promotes the full implementation of the Birds and Habitats Directives and potential new regulations on ecosystem restoration and other environmental initiatives.

As with the US ESA, the protective mechanisms of the Habitats Directive are generally not applied to species not explicitly listed in the annexes of the Directive (Born et al., 2015). As the EU environmental laws constitute a floor, not a ceiling, for protection, many Member States afford national protection to additional species. The protection of even non-listed species is potentially ameliorated by area conservation measures (i.e., Natura 2000 and expected ecosystem restoration measures) and national measures. However, as it is very hard to update the lists of protected species, incentives and support to Member States to monitor and protect non-listed species that may be at risk should be strengthened.

Intraspecific Diversity

The ESA incorporates multiple tools for conserving genetic diversity within species, including statutory authority to protect "distinct populations segments" as well as species within a "significant portion of their range"; administrative policy allows for conservation of identified "recovery units" (Carroll et al., 2021). However, as mentioned above, recent trends in how agencies interpret such policies have weakened efforts to conserve intraspecific diversity; the agencies have narrowly construed their authority to protect populations and moved away from broad distribution over species' historic range as an indicia of conservation success (Vucetich and Nelson, 2014). Reforming restrictive interpretations of these policies and adopting recovery goals that place more emphasis on greater abundance and broader distribution would improve the ESA's ability to conserve genetic diversity within listed species. Such changes would also incentivize a broader focus for candidate conservation strategies for non-listed but declining species that aim to prevent their eventual listing.

In the EU, the need to protect the genetic diversity of species is implied by the Habitats Directive's requirements and

supported by court decisions. The aforementioned *Tapiola* decision clarifies the requirement to protect species at the population level as well as the level of member states and biogeographic regions, even if other healthy populations exist elsewhere in the EU (Epstein and Kantinkoski, 2020). However, more guidance on monitoring and protecting the genetic diversity of populations is needed, including in determining the "favourable reference value" of populations (EEA, 2017). The protection of geographically marginal and transboundary populations should be better supported in order to improve genetic diversity and allow at-risk species to expand their distribution, e.g. in the face of climate change (Gibson et al., 2009).

On a positive note, both governmental and non-governmental actors in the US and EU have taken steps to protect and restore genetic diversity by mitigating habitat fragmentation. US infrastructure legislation enacted in 2021 provides $350 million USD in highway funding for wildlife crossings and fencing that will reduce animal and human mortality due to vehicle collisions and help safeguard genetic diversity by improving connectivity between populations (Bipartisan Infrastructure Law – U.S. Public Law 117-58). Some individual US states are also passing planning requirements and providing funding for vehicle collision avoidance and connectivity measures along roads and highways. NGO efforts such as the Yellowstone to Yukon Conservation Initiative have set out a vision for connected habitat across much of North America and made significant progress through advocacy efforts and fostering on-the-ground conservation on private lands (Hebblewhite et al., 2022). Better integrating federal and state land management decisions with science-based wildlife corridor planning would significantly enhance protection for intraspecific diversity.

In the EU, the Habitats Directive and court decisions concerning protection of species' populations imply the need to maintain population connectivity, *via* both corridors of intact habitat and protection of individuals that occur in human inhabited areas. Given the intensity of land use in most of Europe, protections for populations of conservation concern should apply in human-modified as well as "wild" habitats, as indicated in the Romanian Wolf decision (CJEU C- 88/19), which would help maintain connectivity in human-dominated environments. Threats to connectivity would also be addressed by the passage and implementation of the expected ecosystem restoration law that would require increased protection for connectivity between species' habitats.

Ecosystems

While lawmakers pointed to ecosystem conservation as a key biodiversity protection strategy when they passed the ESA in 1973, most of the statute's implementation has been focused at the species level. However, both policy and precedent provide tools for using this powerful law to provide greater benefits at the ecosystem level. Agency policy dating to 1994 calls for agencies to make listing decisions and develop recovery plans at the ecosystem level through inclusion of multiple species within the same ecosystem (Evans et al., 2016). Along these lines, the

recovery strategy for northern spotted owls (*Strix occidentalis caurina*) in the Pacific Northwest created an ecosystem-based reserve system for owls as well as other species dependent on region's mature temperate rainforest ecosystem (Spies et al., 2019).

Compared to the US context, current EU policy contains the seeds of a multi-level approach similar to that of the GBF, as embodied in the FCS concept (Born et al., 2015). As indicated by the EU's 2016 "Fitness Check" of the Birds and Habitats Directives, these instruments contain the necessary elements to protect species and habitats, but fuller clarification and enforcement are needed (European Commission, 2016). More enforcement and incentives are needed in the EU to meet current as well as new EU and CBD requirements. In order to protect ecosystems according to EU and GBF goals, development within the 18% of the EU's land area that is currently part of the Natura 2000 network must be limited as currently required, and exceptions, which are allowed in the public interest, must be limited. For example, alternative energy projects should not automatically override the need to protect ecosystems. The protection of species' habitats outside of Natura 2000 areas must also be enforced, which will necessitate the protection of additional ecosystems throughout the EU (Zisenis, 2017). In summary, the general qualitative elements linking actions at different levels of biodiversity in both US and EU policy must be made more explicit and actionable if they are to effectively address the current extinction crisis.

ENSURING COHERENCE BETWEEN ELEMENT AND SPATIAL TARGETS IN US AND EU POLICY

In addition to broadening the focus of national policies to encompass all elements of biodiversity, it is also important to strengthen policy mechanisms that enhance coherence between other factors essential to comprehensive biodiversity conservation strategies such as the GBF. Although there are aspects of conservation which do not involve protection of specific areas (e.g., control of illegal wildlife trade or pollution; **Figure 1**), place-based conservation actions are a critical facet of strategies to protect most elements of biodiversity (Carroll and Noss, 2021). A core assumption of the GBF is that spatial (place-based) targets and targets directed at biodiversity elements (e.g., species) are complementary and mutually supporting.

The GBF's target to protect 30% of lands and waters by 2030 (Target 3; **Figure 1**) specifies that protected areas should be ecologically representative, well-connected, and sited in areas of particular importance for biodiversity such as Key Biodiversity Areas (KBA), intact ecosystems, and hotspots of endemic species (CBD, 2021). The GBF's Target 3 is complemented by Target 1, which commits CBD parties to ensuring that "all areas globally are under integrated biodiversity-inclusive spatial planning" (CBD, 2021). Target 1 is designed to ensure that the role of the protected area network in achieving biodiversity-related and other outcomes is complemented by rather than compromised

by activities in the surrounding landscape, and is also a critical tool for targeting restoration and sustainable development.

The EU Habitats Directive established a general link between place-based targets (involving both protected areas and landscape-wide biodiversity planning) and element-based targets through the FCS concept, which is defined in terms of both habitat and species. The Habitats Directive is based on the premise that Natura 2000, the EU system of protected areas, will be a primary means of ensuring FCS for habitat types and species (Romão, 2015). However, the FCS concept also involves the wider landscape because it requires that Natura 2000 sites not only be well-sited in relation to threatened ecosystems and species habitat, but also to form a connected system (Schoukens and Woldendorp, 2015). EU courts have concluded that land use that compromises the connectivity within and between Natura 2000 sites violates the Habitats Directive [Case C-404/09 European Commission v Spain (Alto Sil) (2011)]. Requirements that are expected to follow from laws to implement the 2030 Biodiversity Strategy focusing on connectivity between protected areas and ecosystem restoration will also contribute to meeting the spatial planning target of the GBF.

The protection of species and habitats is closely linked in the Habitats Directive, in that the conservation status of a habitat is in part defined by the health of its typical species, and the conservation status of a species is in part defined by the status of its range and habitat (Born et al., 2015). This coherence is further promoted by requiring the protection of habitat in order to protect species that are listed in a special annex to the directive (Habitats Directive, Annex II), though in practice this is underutilized. Further, the breeding sites and resting places of "strictly protected" species are protected whether or not they occur in a designated area, leading to potentially extensive area protection outside of the Natura 2000 network (Habitats Directive, Article 12). However, although this strict protection of sites used by protected species has been confirmed by the courts in the Skydda Skogen case [C-473/19 and C 474/19 (2021)], further guidance should be provided by the European Commission on how agriculture and forestry land are impacted by the presence of strictly protected species.

The EU's Biodiversity Strategy to 2030 calls for protection of 30% of the EU's lands and waters (Hermoso et al., 2022). As the Strategy notes, 18% of land and 8% of sea are currently part of Natura 2000, with an additional 8% of land and 3% of sea protected under national laws. Case studies examining nationally protected lands in Austria and the Netherlands have concluded that these areas have the potential to increase connectivity between Natura 2000 sites (Verschuuren, 2015). If nationally protected lands are to be counted towards the EU's 30x30 commitment, they should be further evaluated based on Natura 2000 requirements that sites form part of a representative and connected network.

The Maritime Spatial Planning Directive (2014/89/EU) requires EU Member States to implement and report maritime spatial plans that promote biodiversity and sustainable development, and to cooperate on transborder issues. Specific spatial planning decisions in the EU on both land and water are typically made at the local and subnational level. However, the EU can incentivize local authorities and landowners to give biodiversity greater weight in planning via a variety of programs that fund and incentivize conservation, restoration, and green infrastructure (Verschuuren, 2015). This can allow policymakers to ensure protection of biodiversity without creating disincentives to use of agricultural and forestry practices that maintain the types of habitat that encourage biodiversity and the presence of strictly protected species. However, such funding should ideally be allocated based on transparent methods for estimating where conservation efforts would provide the most biodiversity and societal benefits; this in turn suggests the need for spatial planning to occur at broader as well as local extents.

Similar challenges are evident in the US context. The few US conservation laws and policies that explicitly link place-based and element-based conservation actions include reactive regulatory tools such as the ESA's Section 7 (requiring that federal agencies ensure their planned actions do not harm protected species) as well as tools for proactive protection of priority areas, including the ESA's provisions for critical habitat designations and Habitat Conservation Plans (HCPs) prepared by non-federal landowners to seek incidental take permits (Goble, 2005; Evans et al., 2016).

As in the EU, most US land use planning affecting non-federal lands occurs at local levels, and may not be "biodiversity-inclusive" in the sense of the GBF's Target 1. Recent congressional approval of greater funding for land acquisition for conservation (e.g., the Land and Water Conservation Fund; **Tables 1**, **2**) provides additional resources for state and local governments and federal agencies to purchase privately-held parcels that can enhance ecosystem protection or restoration. Additionally, more vigorous enforcement of the ESA's ban on incidental harm to listed species on non-federal land would encourage landowners to formulate HCPs, which often benefit many species – especially when the "carrot" of additional funding is provided by the federal government to assist in designing and carrying out such plans (Tasso, 1997). The US Department of Agriculture also funds conservation benefits through its Conservation Reserve Program, which pays farmers to take land out of intensive production in part to protect sensitive habitat (Szentandrasi et al., 1995). Putting additional resources into this program would allow increasing its coverage over the 8.5 million hectares already enrolled.

On private lands, a more expansive interpretation of wetlands subject to federal protection under the Clean Water Act would improve conservation of wetland ecosystems and the species that depend on them. On the other hand, reducing federal subsidies for flood insurance that encourage both development of wetlands and rebuilding in sensitive habitats after flood events would also increase species protections and enhance community resilience in the face of increasingly destructive storm events (Narayan et al., 2017). Some NGOs are also working with private landowners toward greater economic and ecological resilience through innovative strategies such as "quantified conservation" –

TABLE 2 | Policy mechanisms discussed in this review that can aid the mainstreaming of the Global Biodiversity Framework's comprehensiveness, coherence, and ambition into US and EU biodiversity policy.

Objective	US policy reforms	EU policy reforms
Broaden conservation focus and coordinate actions across all levels of biodiversity	Develop consistent standards for conservation of intraspecific diversity under the ESA Expand use of ecosystem-based ESA listing and recovery planning Use infrastructure funding to improve connectivity	Clarify relationship between favourable conservation status of habitats and species under the Habitats Directive Develop data (e.g., on ecosystem area and integrity) to support implementation of ecosystem-level targets
Coordinate site-based and element-based conservation	Expand ecosystem/regional planning by land management agencies under NFMA/FLPMA Create effective 30x30 conservation definition and prioritization strategy Broaden definition of protected wetlands Increase incentives for private land conservation	Rigorously assess effectiveness, representativeness, and connectedness of Natura 2000 network and nationally protected areas
Coordinate conservation of biodiversity and ecosystem services	Implement ecosystem-based climate mitigation strategy Integrate environmental justice priorities into place-based conservation Improve biodiversity focus of existing agriculture conservation programs Improved wetland conservation regulations/incentives Limit federal subsidies for flood insurance	Coordinate enforcement of mandates across EU Reform Common Agricultural Policy to address biodiversity Improve data on valuation of natural capital and ecosystem services
Develop coherent scaling of targets and implementation from global to local extents	Federal financial support for State Wildlife Action Plans, coordinated with 30x30 policies Targeted habitat acquisition using Land and Water Conservation Fund	Enact regulation with binding targets at the Member State level to meet the 30x30 goal
Adopt more ambitious recovery vision	Revise concept of ESA recovery (e.g., to address the concept of ecologically-effective populations) Improve ESA Section 7 consultation outcomes Levy carbon tax and use fraction of funds for biodiversity conservation	Design and implement strategic incentives for restoration Strengthen enforceable mechanisms related to biodiversity conservation directives
Develop tracking and accountability mechanisms	Develop comprehensive and regularly updated National Nature Assessment which includes assessment of representation and connectivity of protected area network and valuation of natural capital and ecosystem services Develop National Biodiversity Strategy	Require regular Member State reporting of conservation and restoration progress Make existing databases of national reports more user-friendly Support capacity building for NGO-led enforcement

outcome-focused techniques that identify opportunities for resource use efficiencies with habitat restoration, such as converting to more efficient irrigation techniques and using water savings to restore flows for vulnerable fish populations (Whitworth, 2015).

The current US (Biden) administration's embrace of the 30x30 target offers an opportunity for improvement, if the US 30x30 effort (now named the "America the Beautiful" initiative) can be better linked to biodiversity targets and outcomes (White House, 2021). In addition to increasing conservation on non-federal lands as described above, the US could deploy a number of existing federal authorities and legal tools to increase place-based protections for species and ecosystems on the ~30% of US lands directly managed by the federal government. The US Antiquities Act, which allows the President to designate new protected areas, has been increasingly used to advance biodiversity conservation goals, although this approach has also generated litigation and political controversy (**Table 2**). National monument designations offer opportunities for co-management between the federal government and Indigenous communities, such as recently occurred *via* designation of the Bears Ears National Monument, an area in the western US encompassing important Indigenous cultural landscapes (Creadon and Bergren, 2019). Other legal authorities could be used to increase biodiversity protection emphasis through designating national wildlife refuges and establishing Areas of

Critical Environmental Concern on land managed by the Bureau of Land Management (Blumm and Allen, 2022).

Unfortunately, initial agency discussions of the 30x30 target suggest that the US may include substantial areas of federal land with modest or limited protections for biodiversity as counting toward its 30% terrestrial area conservation goal without site-specific assessment of the lands' actual conservation value (Yachnin, 2021). For example, millions of acres of federal land leased for livestock grazing do not presently meet even relatively modest standards for rangeland health and ecosystem function, and management agencies have not even assessed the current condition of many more areas (Blumm et al., 2022). The US federal government needs to develop a system to objectively evaluate and monitor the condition of biodiversity elements on US lands and waters, as well as establish clear standards for identifying areas that should count toward the 30% conservation goal (Carroll et al., 2022). Such standards must consider both the land's existing and potential biological resources and the legal protections accorded to those resources.

Ambitious biodiversity-inclusive spatial planning efforts in the US have often led to political backlash. In the late 1990s, the Interior Columbia Basin Ecosystem Management Plan outlined a management strategy that cut across scores of administrative boundaries covering over 60 million acres of public land in parts of eight western states. The plan aimed to protect and restore biodiversity generally instead of solely focusing on ESA-listed

species (Quigley et al., 1998), but was ultimately derailed by lack of funding and political support. The 2015 planning process for conservation of the greater sage grouse (*Centrocercus urophasianus*), which resulted in new protections on 67,000 km^2 of habitat "strongholds" in 10 western states (Pidot, 2018), and the Desert Renewable Energy Conservation Plan (DRECP), which coordinated biodiversity conservation in in California's southeastern desert with expansion of solar, wind, and geothermal infrastructure (Kreitler et al., 2015), were subsequently weakened by the Trump administration's focus on resource development. However, with political resolve, new efforts could employ similar templates to advance regional and landscape-level conservation planning, including that designed to achieve ecosystem-based carbon mitigation goals, while at the same time efficiently protecting individual species facing extinction (Carroll and Ray, 2021). President Biden took one such step in 2022, issuing an executive order requiring the U.S. Forest Service and Bureau of Land Management to inventory mature and old-growth forests on federal land and develop "climate-smart management and conservation strategies" to address threats to those forest ecosystems (White House, 2022).

There are scientific as well as practical challenges that add difficulty to efforts to link element-based and place-based targets and actions. Elements of intraspecific diversity such as ecotypes often do not map to contiguous geographic regions. As a general principle, increasing representation of diverse geographies within well-connected networks of protected areas increases retention of intraspecific diversity and lowers extinction risk (Carroll and Noss, 2021). However, there are many factors that limit the strength of this relationship. The GBF proposes assessing progress towards reduction of extinctions in part by comparing the extent and integrity of species habitat with expert-based thresholds which categorize species by threat level (e.g., endangered, vulnerable) based in part on the modeled extent of remaining habitat (CBD, 2021; Leadley et al., 2022). A portion of the evidence base for the GBF's area-based targets (e.g., 30%) is drawn from species-area relationships, i.e., models based on island biogeography which predict the proportion of species lost as the landscape is transformed from native landcover (Wilson, 2016). However, these simple models cannot fully incorporate the complexities of population dynamics in real-world landscapes (Carroll and Noss, 2021).

Similarly, ecosystems, while a useful classification tool, have fuzzy boundaries both in terms of the species they share and their geographic boundaries. Ecoregions typically encompass diverse ecosystems. The diversity of habitat types and their arrangement on the landscape necessary for ensuring persistence of individual species is often complex (Schmitz, 2013). Individual species which require cryptic or rare habitat elements in addition to broader habitat types pose additional challenges to ecosystem conservation as a multi-species conservation approach (Noss and Cooperrider, 1994). These issues related to the complexity of ecological systems have challenged attempts to link element-based and place-based conservation targets in both the CBD and national law and policy (Nicholson et al., 2021). Such complexity implies that while general metrics such as connectivity and

representation indices are useful in estimating potential contribution of sites to protection, more effective prioritization of place-based actions requires comprehensive planning at regional or ecoregional extents (Carroll and Noss, 2021).

Policymakers and NGOs have recently proposed that the US, although not a CBD party, should nonetheless develop a comprehensive National Biological Strategy (US House of Representatives, 2021). The Strategy could be informed by the recently announced National Nature Assessment, which is analogous to the existing quadrennial national assessment of climate change impacts (White House, 2022). Such an effort could build on existing biodiversity monitoring data (e.g., Hamilton et al., 2022) to inform place-based conservation efforts and help reduce long-standing uncertainties in tracking impacts on species targeted for conservation and increase accountability by monitoring compliance with existing species and ecosystem protection goals (Carroll et al., 2022).

This type of biodiversity data could also address what has been a criticism of the GBF: the lack of specificity (when compared to e.g., the Paris climate agreement) regarding mechanisms to track achievement of targets by CBD parties. Recent proposals have highlighted the need for national-level biodiversity status reports and indicators similar to the IPBES report (Xu et al., 2021), including indicators that track both biodiversity and sustainable development goals (Soto-Navarro et al., 2021). Given existing bias and gaps in global biodiversity databases, such reporting will be an even greater challenge for most CBD parties than for the US and EU, pointing to the need for increased funding to support CBD implementation worldwide, especially in megadiverse nations of the global South.

ENSURING COHERENT LINKAGES BETWEEN POLICIES TO PROTECT BIODIVERSITY AND ECOSYSTEM SERVICES

Biodiversity conservation is gaining momentum in significant part due to recognition that other species and their (intact or restored) habitat are also crucial to human persistence (Díaz et al., 2019). Since implementation has always been the biggest hurdle for species conservation and restoration initiatives, tying GBF goals and implementation to related human-centered policies and programs could improve the likelihood for implementation of necessary conservation measures.

The GBF calls for protecting benefits to people stemming from biodiversity by sustainably managing direct uses of other species, particularly emphasizing sustainable use by Indigenous and local communities. It also identifies sustainably managing biodiversity as a means of enhancing the productivity of agricultural and forested land, and recognizes the role of natural systems in protecting water and air quality, and providing people with protection from extreme natural events, including by improving human health and well-being within the

urban environment and reducing threats from emerging zoonotics (CBD, 2021). Spatial planning that considers both biodiversity and ecosystem services, the focus of GBF Target 1, is a key tool in meeting such goals.

Biodiversity policy in the US has in recent years moved in directions identified by the GBF. Efforts to address environmental justice issues (e.g., lack of access to parks and other urban green spaces) are a central element of US 30x30 ("America the Beautiful") effort (White House, 2021). Another new initiative aims to develop information on the economic value of natural assets and nature-based solutions (White House, 2022). Recent legislation increasing the federal Land and Water Conservation Fund includes funding for acquiring land for parks and open spaces, and the 2021 infrastructure bill also includes funds for "green infrastructure" such as managing urban stormwater through wetlands and groundwater infiltration [U.S. Public Law 117-58 (2021)]. Evidence that areas with more intact wetlands suffered less flooding and storm surge damage in extreme events has encouraged many jurisdictions to prioritize wetland conservation and restoration and prompted moves at a national level to lessen flood insurance subsidies that encourage development in floodplains (Klein, 2019).

Reforms in fire management and land use policies to protect local communities from wildfire provides a substantial opportunity to simultaneously incorporate biodiversity goals (e.g. through support of prescribed fire programs). In urban and suburban environments (where about one third of imperiled species have at least some habitat) creation of additional parks and open spaces can reduce urban "heat island" effects, improve residents' health, and increase wildlife habitat and movement corridors. The federal government should develop explicit criteria to ensure that decisions on land acquisition for these purposes with federal funding from the sources noted above take into account biodiversity benefits (Ewing et al., 2005).

In 2021 the USDA announced an initiative to better quantify and improve the Conservation Reserve Program's carbon storage benefits [USDA (2021)], which the agency could extend to biodiversity as well in order to more effectively tailor subsidies to species and ecosystem restoration. Finally, increases in governmental programs to prevent introductions of invasive species and reduce problematic invaders would provide significant benefits to native species and reduce mitigation expenditures and business losses suffered by farmers and many other landowners and businesses in the US (McNeely, 2001).

The EU has been working to integrate the ecosystem services concept into policy since 2009, and currently many existing laws and policies in the EU do incorporate consideration of ecosystem services (Bouwma et al., 2018). The EU Biodiversity Diversity Strategy for 2020 aimed "to maintain and restore ecosystems and their services by including green infrastructure in spatial planning and restoring at least 15% of degraded ecosystems." Actions associated with this goal include mapping EU ecosystems and restoring ecosystems and their services (Maes et al., 2014). While not explicitly part of the Habitats Directive, the European Commission's 2013 communication on "Enhancing Europe's Natural Capital" connects Natura 2000 and ecosystem services, stating that the services provided by the economic value of the network "has been estimated at EUR 200-300 billion per annum" (European Commission, 2013). However, while many EU policy instruments relating to the environment incorporate the ecosystem services concept in some way, most do not impose any binding obligations on Member States (Bouwma et al., 2018).

The 2030 Biodiversity Strategy commits to better integrating ecosystem services into planning by developing standardized criteria for evaluating the "services, values, and sustainable use" of biodiversity, mapping ecosystem services, and promoting green infrastructure (Hermoso et al., 2022). While properly valuing ecosystem services may help clarify the value of maintaining ecosystems rather than converting them to commercial purposes, the Habitats Directive currently protects species and ecosystems regardless of the services they provide. Ecosystem services should be considered an added benefit from nature protection, whether inside or outside of currently protected areas, but should not be allowed to undermine the mandate for "strict protection" for areas and species already in place (Bouwma et al., 2018).

ENSURING AN AMBITIOUS NATURE-POSITIVE APPROACH IN US AND EU LAW AND POLICY

The GBF embodies a paradigm shift in society's approach to protecting biodiversity, analogous to recent shifts in perspective regarding the necessary pace of change to respond to the climate crisis (Watson et al., 2021). The GBF frames its goals and targets within what has been termed a "Nature Positive" paradigm, whose overarching goal is to reverse rather than merely slow or even halt biodiversity loss (Locke et al., 2021). This ambition is especially evident in the GBF's ecosystem-level targets, which aim for net gain in the area, connectivity and integrity of natural systems, and restoration of degraded freshwater, marine and terrestrial ecosystems (CBD, 2021).

At the level of species, the desired outcome if all GBF targets are met is not only that species no longer face extinction but that healthy, resilient populations of all species persist at (at least) their current abundance and distribution. In comparison to the concept of recovery embodied in US and EU statutes, the GBF implies an increased focus on restoring historical abundance and ecologically effective populations of species and the historical distribution of ecosystems using all available policy mechanisms (Leadley et al., 2022).

This nature-positive paradigm aligns with an increased focus on restoration and rewilding in EU conservation programs (Hermoso et al., 2022). The EU 2030 Biodiversity Policy and legislation expected to follow from it include an expanded focus on habitat and ecosystem-level restoration. While specific targets are still being developed, this policy commits to restoring "significant" areas of degraded ecosystems in order to bring at least 30% of habitats and species to FCS, among other restoration

measures. Although these commitments are strongly stated, it is not yet clear how they will be achieved, especially given that the Biodiversity Strategy for 2020 target to restore at least 15% of degraded ecosystems has had limited success (Cortina-Segarra et al., 2021). Coordinated and binding measures must be taken by the EU to ensure that Member States successfully contribute to meeting ambitious restoration targets, which should also be coordinated with ecosystem-based climate mitigation efforts (Carroll and Noss, 2020; Carroll and Ray, 2021).

Thus far, EU laws intended to protect biodiversity have suffered from a lack of enforceable mechanisms. For example, a directive on the sustainable use of pesticides enacted in 2009 (2009/128/EC) intended to discourage the use of pesticides and encourage Integrated Pest Management seems to have little impact on agricultural practices because it lacks binding measures and indicators (Helepciuc and Todor, 2021). More effective regulations on ecosystem restoration and pesticide reduction, as called for by the EU Biodiversity Strategy for 2030, are essential for meeting the GBF and EU biodiversity goals.

Even for EU laws that are, at least in part, clearly prescriptive, enforcement has been lacking. As noted above, there is currently little centralized enforcement of the Habitats and Birds Directives, with nearly all enforcement cases being brought by NGOs. This lack of implementation and enforcement is noted by the Biodiversity Policy, which also expresses a goal of improving these shortcomings, particularly with regard to completing the Natura 2000 network (Hermoso et al., 2022). Further, the Strategy commits the European Commission, the EU's administrative body, to working with Member States to improve compliance and enforcement, and pledges the Commission to assist NGOs and other members of the public in bringing about compliance through national and EU courts. The Commission does support NGO litigation through filing observations and participating in hearings. However, this process is not transparent, especially to the NGOs themselves (Epstein and Kantinkoski, 2020). It is understandable that the Commission prioritizes supporting the enforcement of EU law through the national courts, but this decentralized approach, because it depends on diverse NGOs with particular agendas, may not result in a coherent system of enforcement.

In the US, there is less statutory and policy support for ambitious species and ecosystem recovery targets. Recovery plans for imperiled species developed by US agencies aim to reduce extinction risk of those species, yet an increasing number of recovery plans emphasize a single population abundance or set recovery goals at levels below the population abundance or distribution of species at the time they were listed as threatened or endangered (Neel et al., 2012; Carroll et al., 2021). Biodiversity conservation advocates argue that because the ESA includes a clause supporting recovery of ecosystems, the law should be interpreted as an ambitious mandate to secure abundant and ecologically-effective populations (Soulé et al., 2003). However, federal agencies that implement the law have been reluctant to include ecosystem-level criteria (e.g., considering the role a listed species plays within an ecosystem

as a factor in prioritizing species for protection) in species protection efforts (Robbins, 2007). Policy mechanisms addressing ecosystem conservation on non-federal lands through mechanisms such as broad-scale HCPs under the ESA have also proven relatively ineffective to date, with the possible exception of a few single-landowner models (Camacho, 2007).

Aside from the ESA, the law governing the US federal wildlife refuge system, which calls for planning continued growth of the system to contribute to ecosystem conservation, is one of the only explicit mandates in federal law to build a conservation network of representative ecosystems (**Figure 1**) (USFWS, 1997). In more than two decades since it was enacted, however, this requirement has made a relatively modest contribution toward building ecosystem-based reserves because proposals for new wildlife refuges usually focus on relatively small areas and require congressional approval and funding, which typically occurs on an opportunistic rather than systematic basis. Federal administrative policy sets out an ambitious vision for the nearly 80 million hectares of federally-owned national forests and national grasslands, requiring that individual administrative units' management plans include standards that maintain or restore the ecological integrity of terrestrial and marine ecosystems (36 CFR 219.8(a)). However, the slow process of creating site-specific plans, coupled with inconsistent governmental support for emphasizing ecosystem conservation goals over commodity production, has inhibited these lands from realizing their significant potential contributions to biodiversity protection.

The US has expressed its support for the 30x30 goal in the context of supporting global efforts to combat climate change, appropriately linking protection and restoration of species and the ecosystems that support them with carbon sequestration and increased ecological resilience to adapt to ongoing and inevitable changes in climate (White House, 2021; White House, 2022). The US could also connect its greenhouse-gas reduction strategy with protections for biodiversity by taxing activities that emit carbon and reduce carbon sinks, then allocating a portion of the resulting revenue to biodiversity conservation and restoration strategies such as those discussed above. While levying a tax on emissions and allocating its proceeds raise challenging political, economic, and equity issues, dedicating a portion of such revenue to protecting and restoring ecosystems and their function would benefit biodiversity while at the same time enhancing carbon storage and making communities better able to adapt to increasingly frequent extreme climate events (Barbier et al., 2020). Whereas US national carbon tax policy is unlikely in the near future, such outcomes are possible in some US states. The state of California – the world's fifth largest economy – currently has a cap and trade scheme to limit greenhouse gas emissions that incentivizes reforestation as a carbon sink (CNRA, 2022).

The US should also learn from EU approaches by moving toward a "first do no harm" approach to biodiversity conservation. For example, the ESA permits continued adverse impacts to threatened and endangered species and their designated critical habitat from federal actions as long as the

expert agency determines such impacts are not so great as to jeopardize the continued existence of the entire species or destroy the ability of an entire critical habitat designation to support the species' recovery. This low protection standard has allowed continued incremental harms to most listed species and their habitat, increasing their extinction risk and making recovery increasingly difficult over time. By shifting to (at least) a "no net adverse impact" standard to listed species and other species and habitats of concern, the US would move toward meeting the GBF's goal of enhancing or maintaining abundance and distribution of populations, as well as reducing extinction risk for species overall (Rohlf and Reynolds, 2022). Similar to the Clean Water Act's "no net loss" mandate for covered wetlands, a no net harm approach to listed species and other targeted species and habitats would create private markets and mitigation banks focused on biodiversity enhancement and restoration.

Finally, governmental authorities in the US should also look to broad-scale efforts by NGOs to help mold ambitious and science-based biodiversity restoration initiatives. For example, the Yellowstone to Yukon Conservation Initiative has developed blueprints for connecting ecosystems across many jurisdictional and even international boundaries (Hebblewhite et al., 2022). Efforts to increase public-private partnerships with such organizations could help the US meet GBF targets by building on substantial expertise and relationships assembled by private sector organizations.

COMMON CHALLENGES AND BARRIERS TO GBF IMPLEMENTATION IN US AND EU POLICY

Although in this review we focused on the ways in which the GBF represents an advance over existing US and EU policies, we recognize that the GBF itself is a work in progress. Many of the broader challenges we have identified, such as ensuring policy coherently reflects the complex linkages between drivers of biodiversity loss, have been identified as areas where the GBF can be furthered strengthened (Watson et al., 2021; Leadley et al., 2022). One of the benefits of our focus on both the US and EU rather than on a single CBD party is the ability to highlight common challenges and barriers to implementation. Identifying such cross-cutting themes in the diverse opportunities and barriers to GBF implementation (**Table 2**) is often more widely relevant than identifying the specific policy mechanisms that correspond to individual GBF targets (**Figure 1**; **Table 1**). Although national policies of other CBD parties can also be categorized based on the six themes highlighted here (**Table 2**), other barriers, especially related to funding and capacity, may assume equal or greater importance.

Although commitments by CBD parties imply that each party has a responsibility to meet the GBF targets, this direct global to national scaling does not reflect the fact that global biodiversity is not distributed uniformly over the globe. An analogous issue common to any CBD party with a federal structure is how

responsibility for achieving targets will be scaled downward to smaller (e.g., subnational) geographies. Should each US state or EU member aim to meet the same area-based target of 30%, or do more biodiverse areas or areas with more intact habitat merit a larger extent of protection? Global targets need to be supplemented by regional conservation plans that determine targets necessary to achieve biodiversity and other goals. Appropriate conservation targets in a region with abundant remaining wild area may differ from those in a region dominated by intensive agricultural or urban land uses. Relatedly, some nations bear greater responsibility for past and current drivers of biodiversity loss outside their borders *via* teleconnections (i.e., as markets for trade in endangered species) (Hickel et al., 2022; Leadley et al., 2022). This has motivated inclusion within the GBF of commitments to financial support to nations that encompass biodiversity hotspots but lack corresponding conservation capacity (CBD, 2021).

In polities with federal governance structures such as the US and EU, any changes to biodiversity policy occur in the context of the existing division of responsibilities between supranational, national and subnational governments. In the US, for example, a more ambitious interpretation of the ESA's mandate for recovery would potentially exacerbate conflict between federal actions and the authority of subnational (state) wildlife agencies that have traditionally managed wildlife within their jurisdictions. This conflict has been particularly evident, in both the US and EU, in the case of large carnivores such as the gray wolf whose recovery may be opposed by rural agricultural sectors (Carroll et al., 2021). Globally, CBD parties have debated the appropriate governance model for incentivizing expansion of protected area networks without usurping control from conservation initiatives led by Indigenous and local communities. In both the EU and US, top-level (supranational or national, respectively) mandates are in theory merely a floor for ambition (i.e., lower-level governments can establish more ambitious targets for protection) but are in practice often viewed as a ceiling. However, some US states and EU Member States, as well as other entities such as Indigenous communities, are initiating creative and ambitious strategies to address drivers of biodiversity loss (CNRA, 2022), whose success should inform future revisions of higher-level US, EU, and global strategies.

In both the US and EU, there is a need to improve linkages between place-based (e.g., 30x30) and element-based conservation strategies (Carroll and Noss, 2021). Although this linkage is central to the EU Habitats Directive and its FCS concept, there is currently insufficient information on the degree to which place-based conservation *via* the Natura 2000 system achieves GBF targets for establishing a representative connected network of sites that conserves native ecosystems and species. Although the US has less formal statutory support for targets analogous to those in the GBF, practical opportunities for building such a network are enhanced by the fact that the federal government directly manages ~30% of the US land base, over which it has the authority to initiate comprehensive biodiversity-inclusive land use planning processes (Carroll and Ray, 2021).

In a positive sense, the nexus between GBF commitments and obligations under climate treaties can provide a key incentive for ecosystem-based climate mitigation strategies. Such an all-of-government approach to biodiversity conservation must also address financial mechanisms by reforming existing trade policies and subsidies that contribute to drivers of biodiversity loss such as agricultural intensification. For example, reform of the EU Common Agricultural Policy and US federal agricultural subsidies could tie agricultural subsidies to less carbon-intensive production methods that are compatible with biodiversity (Pe'Er et al., 2019).

Although it is difficult to envision in the current political context, US ratification of the CBD would allow the US to fully participate as a party in CBD negotiations, and advocate for needed reforms at the international level (Snape, 2009). For example, the US led efforts to push international development banks to reduce or eliminate their support for projects that rely on fossil fuels, such as constructing coal-fired electrical power plants (Trillo, 2021). The US should similarly push international financing institutions to effectively assess biodiversity impacts of proposed projects, and fund only those consistent with GBF goals.

We have identified common themes among the reforms needed to successfully achieve targets for reversing biodiversity loss: broadening conservation focus to all levels of biodiversity, coordinating conservation strategies that protect sites with those focused on biodiversity elements and ecosystem services, coherent scaling of targets from global to local extents, and adoption of a more ambitious vision for recovery of biodiversity. Although these themes are globally relevant, we acknowledge that many of the 196 CBD parties will face greater barriers to GBF implementation than do our examples from the relatively wealthy US and EU.

For this reason, Goal D of the GBF focuses specifically on building necessary capacity of all CBD parties to implement the GBF *via* increased funding, scientific cooperation and technology transfer (CBD, 2021). High-income polities, especially the US and EU, are the primary drivers of global ecological degradation (at 27% and 25% of recent global excess material use, respectively; Hickel et al., 2022). The US and EU thus have an ethical and practical responsibility to both reduce their own excess resource use and support biodiversity conservation globally.

CONCLUSION: ACHIEVABILITY OF THE GBF'S GOALS IN THE CONTEXT OF US AND EU POLICY

It is fair to ask whether the targets set forth in the GBF are achievable, given that the world's nations generally failed to meet the CBD's previous and less ambitious Aichi targets (CBD, 2020). The debate over the degree of ambition necessary to halt and reverse biodiversity loss is in many ways analogous to the debate over the level of ambition necessary to address

anthropogenic climate change. The decision at UNFCCC global climate negotiations as to whether to allow 1.5 vs. 2 degree C of global heating is values-based, in that achieving the lower threshold is technically feasible but demands greater political will. Global biodiversity targets and goals (**Figure 1**) are science-informed, but similarly involve a values-based societal decision regarding the desired future status of biodiversity, motivated by the instrumental value of biodiversity to humans and the proposition that biodiversity has intrinsic value and ought to be conserved (Carroll and Noss, 2021). There is increasing recognition that sustainability of human society requires a healthy biosphere as the context for all life, including humans, and that increasing quality of human well-being can be decoupled from drivers of biodiversity loss (Otero et al., 2020; Locke et al., 2021). However, navigating a just and equitable transition to a sustainable society in which biodiversity can thrive is among the greatest challenges facing humanity.

The CBD is in several respects a weaker instrument for motivating policy change than is the UNFCCC, the analogous global mechanism addressing the climate crisis. The desired biodiversity outcomes negotiated by the CBD are more complex than is the UNFCCC's topline goal of limiting global heating to a specific threshold. This complexity has slowed progress at recent meetings in preparation for CBD COP15. The CBD also has less well-developed tracking and compliance mechanisms for national biodiversity commitments than does UNFCCC for climate-related commitments (Koh et al., 2022). One avenue for strengthening such mechanisms at national and subnational extents is accountability legislation modeled on existing laws aimed at improving a jurisdiction's ability to meet international climate commitments. A leading example is Canada's Bill C-12, which directs the federal government, with the help of an expert advisory body, to set short and long-term climate targets consistent with Canada's Nationally Determined Contribution, submit plans to meet those targets, and periodically report on progress (Geselbracht and Hazell, 2021).

Halting and reversing biodiversity loss will require coordinated policy mechanisms that comprehensively addresses the interlinked drivers of biodiversity loss (Leclère et al., 2020; Leadley et al., 2022). Although we focus in this review primarily on law and policy specifically relevant to biodiversity, such law and policy alone will not be sufficient even to achieve the GBF's biodiversity-focused goal (Goal A; **Figure 1**). Other GBF targets associated with goals such as safeguarding ecosystem services (**Figure 1**) must be supported by a much wider array of laws than we review here (Ray et al., 2021). IPBES is currently developing a global assessment of the underlying causes of biodiversity loss and potential pathways for the transformative societal change required to address these causes (Stevance et al., 2020). Consideration of biodiversity must be mainstreamed across agencies to create a whole of government response acting in concert with a broader societal transformation toward membership in, rather than dominance over, the biotic community (Leopold, 1949). In this effort, coherent science-informed policies such as we propose here are a necessary

foundation but will not be sufficient in themselves in achieving effective conservation outcomes absent transformative social change (Leclère et al., 2020; Grumbine and Xu, 2021; Priyadarshini et al., 2022).

AUTHOR CONTRIBUTIONS

CC designed the study. CC, DR, and YE contributed to writing the initial drsaft and revising the manuscript. All authors contributed to the article and approved the submitted version.

REFERENCES

Andrello, M., D'Aloia, C., Dalongeville, A., Escalante, M. A., Guerrero, J., Perrier, C., et al. (2022). Evolving Spatial Conservation Prioritization With Intraspecific Genetic Data. *Trends Ecol. Evol.* 37, 553–564. doi: 10.1016/j.tree.2022.03.003

Barbier, E. B., Lozano, R., Rodríguez, C. M., and Troëng, S. (2020). Adopt a Carbon Tax to Protect Tropical Forests. *Nature* 578, 213–216. doi: 10.1038/d41586-020-00324-w

Blumm, M. C., and Allen, G. (2022). The 30 by 30 Proposal, Areas of Critical Environmental Concern, and the Protection of Tribal Cultural Lands. *Environ. Law Rep.* 52, 10366–10373.

Blumm, M. C., Hovden, K., and Allen, G. (2022). Federal Grazing Lands and Their Suitability as 'Conservation Lands' in the 30 by 30 Program. *Environ. Law Rep.* 52, 1–38. doi: 10.2139/ssrn.4024699

Bolam, F. C., Mair, L., Angelico, M., Brooks, T. M., Burgman, M., Hermes, C., et al. (2021). How Many Bird and Mammal Extinctions Has Recent Conservation Action Prevented? *Conserv. Lett.* 14 (1), e12762. doi: 10.1111/conl.12762

Born, C., Cliquet, A., Schoukens, H., Misonne, D., and Van Hoorick, G. (2015). *The Habitats Directive in Its EU Environmental Law Context* (London, UK: Routledge).

Bouwma, I., Schleyer, C., Primmer, E., Winkler, K. J., Berry, P., Young, J., et al. (2018). Adoption of the Ecosystem Services Concept in EU Policies. *Ecos. Serv.* 29, 213–222. doi: 10.1016/j.ecoser.2017.02.014

Camacho, A. E. (2007). Can Regulation Evolve-Lessons From a Study in Maladaptive Management. *UCLA. L. Rev.* 55, 293.

Carroll, C., and Noss, R. F. (2020). Rewilding in the Face of Climate Change. *Conserv. Biol.* 35, 155–167. doi: 10.1111/cobi.13531

Carroll, C., and Noss, R. F. (2021). How Percentage-Protected Targets Can Support Positive Biodiversity Outcomes. *Conserv. Biol.* doi: 10.1111/cobi.13869

Carroll, C., Noss, R. F., and Stein, B. A. (2022). US Conservation Atlas Needs Biodiversity Data. *Science.* 376, 144–145. doi: 10.1126/science.abo0526

Carroll, C., and Ray, J. C. (2021). Maximizing the Effectiveness of National Commitments to Protected Area Expansion for Conserving Biodiversity and Ecosystem Carbon Under Climate Change. *Global Change Biol.* 27 (15), 3395–3414. doi: 10.1111/gcb.15645

Carroll, C., Rohlf, D. J., VonHoldt, B. M., Treves, A., and Hendricks, S. A. (2021). Wolf Delisting Challenges Demonstrate Need for an Improved Framework for Conserving Intraspecific Variation Under the Endangered Species Act. *BioScience* 71 (1), 73–84. doi: 10.1093/biosci/biaa125

CBD [Convention on Biological Diversity] (2020). *Global Biodiversity Outlook 5* (Montreal: Secretariat of the Convention on Biological Diversity).

CBD (2021). *First Draft of the Post-2020 Global Biodiversity Framework* (Montreal: Secretariat of the Convention on Biological Diversity).

CNRA [California Natural Resources Agency] (2022) *Pathways to 30x30: Accelerating Conservation of California's Nature.* Available at: www.californianature.ca.gov.

Comer, P. J., Hak, J. C., Josse, C., and Smyth, R. (2020). Long-Term Loss in Extent and Current Protection of Terrestrial Ecosystem Diversity in the Temperate and Tropical Americas. *PloS One* 15 (6), e0234960. doi: 10.1371/journal.pone.0234960

Cortina-Segarra, J., García-Sánchez, I., Grace, M., Andrés, P., Baker, S., Bullock, C., et al. (2021). Barriers to Ecological Restoration in Europe: Expert Perspectives. *Restor. Ecol.* 29 (4), e13346. doi: 10.1111/rec.13346

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Creadon, S., and Bergren, E. C. (2019). Bears Ears National Monument: Politics, Controversy, and Potential Remedies. *Case Stud. Environ.* 3, 1–9. doi: 10.1525/cse.2019.001990

CRS (2020). *Federal Land Ownership: Overview and Data* (Washington, DC: Congressional Research Service). Available at: https://crsreports.congress.gov.

Davis, F., Griffith, B., Henke, S., Maguire, L., Meretsky, V., Scott, J. M., et al. (2008) *Initial Implementation of the State Wildlife Action Plans: Conservation Impacts, Challenges and Enabling Mechanisms.* Available at: https://www.biogeog.ucsb.edu/publications/initial-implementation-state-wildlife-action-plans-conservation-impacts-challenges-and.

Díaz, S., Settele, J., Brondízio, E. S., Ngo, H. T., Agard, J., Arneth, A., et al. (2019). Pervasive Human-Driven Decline of Life on Earth Points to the Need for Transformative Change. *Science* 366 (6471), eaax3100. doi: 10.1126/science.aax3100

Díaz, S., Zafra-Calvo, N., Purvis, A., Verburg, P. H., Obura, D., Leadley, P., et al. (2020). Set Ambitious Goals for Biodiversity and Sustainability. *Science* 370 (6515), 411–413. doi: 10.1126/science.abe1530

EEA [European Environment Agency] (2017). *Reporting Under Article 17 of the Habitats Directive* (Brussels, Belgium: European Enviroment Agency).

Epstein, Y., and Kantinkoski, S. (2020). Non-Governmental Enforcement of EU Environmental Law: A Stakeholder Action for Wolf Protection in Finland. *Front. Ecol. Evol.* 11. doi: 10.3389/fevo.2020.00101

Epstein, Y., López-Bao, J. V., and Chapron, G. (2016). A Legal-Ecological Understanding of Favorable Conservation Status for Species in Europe. *Conserv. Lett.* 9 (2), 81–88. doi: 10.1111/conl.12200

European Commission (2011). *Our Life Insurance, Our Natural Capital: An EU Biodiversity Strategy to 2020: Communication From the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions* (Brussels, Belgium: European Commission).

European Commission (2013). *Green Infrastructure (GI) - Enhancing Europe's Natural Capital* (Brussels, Belgium: European Commission).

European Commission (2016). *Fitness Check of the EU Nature Legislation (Birds and Habitats Directives) Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the Conservation of Wild Birds and Council Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora* (Brussels, Belgium: European Commission).

European Commission (2020a). *Bringing Nature Back Into Our Lives: EU Biodiversity Strategy for 2030: Communication From the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions* (Brussels, Belgium: European Commission).

European Commission (2020b). *The State of Nature in the European Union: Report on the Status and Trends in 2013 - 2018 of Species and Habitat Types Protected by the Birds and Habitats Directives*, COM(2020) 635 final. (Brussels, Belgium: European Commission).

European Commission (2021). *Guidance Document on the Strict Protection of Animal Species of Community Interest Under the Habitats Directive* (Brussels, Belgium: European Commission).

Evans, D. M., Che-Castaldo, J. P., Crouse, D., Davis, F. W., Epanchin-Niell, R., Flather, C. H., et al. (2016). Species Recovery in the United States: Increasing the Effectiveness of the Endangered Species Act. *Issues Ecol.* 20, 1–28.

Ewing, R., Kostyack, J., Chen, D., Stein, B., and Ernst, M. (2005). *Endangered by Sprawl: How Runaway Development Threatens America's Wildlife*

(Washington, D.C: National Wildlife Federation, Smart Growth America, and NatureServe).

Gaston, K. J., and Spicer, J. I. (2013). *Biodiversity: An Introduction* (Oxford, UK: John Wiley & Sons).

Geselbracht, D., and Hazell, S. (2021) *Canada has Biodiversity Targets. Now It Needs Accountability.* Available at: https://thenarwhal.ca/canada-biodiversity-aichi-targets/.

Gibson, S. Y., van der Marel, R. C., and Starzomski, B. M. (2009). Climate Change and Conservation of Leading-Edge Peripheral Populations. *Conserv. Biol.* 23 (6), 1369–1373. doi: 10.1111/j.1523-1739.2009.01375.x

Goble, D. (2005). *The Endangered Species Act at Thirty: Vol. 1* (Washington, DC: Island Press).

Greenwald, N., Suckling, K. F., Hartl, B., and Mehrhoff, L. A. (2019). Extinction and the U.S. Endangered Species Act. *PeerJ* 7, e6803. doi: 10.7717/peerj.6803

Grumbine, R. E., and Xu, J. (2021). Five Steps to Inject Transformative Change Into the Post-2020 Global Biodiversity Framework. *BioSci.* 71, 637–646. doi: 10.1093/biosci/biab013

Hamilton, H., Smyth, R. L., Young, B. E., Howard, T. G., Tracey, C., Breyer, S., et al. (2022). Increasing Taxonomic Diversity and Spatial Resolution Clarifies Opportunities for Protecting US Imperiled Species. *Ecol. Appl.* 32(3), e2534. doi: 10.1002/eap.2534

Hebblewhite, M., Hilty, J. A., Williams, S., Locke, H., Chester, C., Johns, D., et al. (2022). Can a Large-Landscape Conservation Vision Contribute to Achieving Biodiversity Targets? *Conserv. Sci. Pract.* 4 (1), e588. doi: 10.1111/csp2.588

Helepciuc, F.-E., and Todor, A. (2021). Evaluating the Effectiveness of the EU's Approach to the Sustainable Use of Pesticides. *PloS One* 16 (9), e0256719. doi: 10.1371/journal.pone.0256719

Hermoso, V., Carvalho, S. B., Giakoumi, S., Goldsborough, D., Katsanevakis, S., Leontiou, S., et al. (2022). The EU Biodiversity Strategy for 2030: Opportunities and Challenges on the Path Towards Biodiversity Recovery. *Environ. Sci. Policy* 127, 263–271. doi: 10.1016/j.envsci.2021.10.028

Hickel, J., O'Neill, D. W., Fanning, A. L., and Zoomkawala, H. (2022). National Responsibility for Ecological Breakdown: A Fair-Shares Assessment of Resource Use 1970-2017. *Lancet Planet. Health* 6 (4), e342–e349. doi: 10.1016/S2542-5196(22)00044-4

Hoban, S., Bruford, M., D'Urban Jackson, J., Lopes-Fernandes, M., Heuertz, M., Hohenlohe, P. A., et al. (2020). Genetic Diversity Targets and Indicators in the CBD Post-2020 Global Biodiversity Framework Must Be Improved. *Biol. Conserv.* 248, 108654. doi: 10.1016/j.biocon.2020.108654

Hofmann, A. (2019). Left to Interest Groups? On the Prospects for Enforcing Environmental Law in the European Union. *Environ. Politics* 28 (2), 342–364. doi: 10.1080/09644016.2019.1549778

IPBES (2019). *Summary for Policymakers of the Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services* (Bonn, Germany: IPBES secretariat).

Keith, D. A., Rodríguez, J. P., Brooks, T. M., Burgman, M. A., Barrow, E. G., Bland, L., et al. (2015). The IUCN Red List of Ecosystems: Motivations, Challenges, and Applications. *Conserv. Lett.* 8 (3), 214–226. doi: 10.1111/conl.12167

Klein, C. A. (2019). The National Flood Insurance Program at Fifty: How the Fifth Amendment Takings Doctrine Skews Federal Flood Policy. *Georgetown Environ. Law Rev. (GELR)* 31, 19–18.

Koh, N. S., Ituarte-Lima, C., and Hahn, T. (2022). Mind the Compliance Gap: How Insights From International Human Rights Mechanisms Can Help to Implement the Convention on Biological Diversity. *Transnat. Environ. Law* 11 (1), 39–67. doi: 10.1017/S2047102521000169

Kreitler, J., Schloss, C. A., Soong, O., Hannah, L., and Davis, F. W. (2015). Conservation Planning for Offsetting the Impacts of Development: A Case Study of Biodiversity and Renewable Energy in the Mojave Desert. *PloS One* 10 (11), e0140226. doi: 10.1371/journal.pone.0140226

Laikre, L., Hoban, S., Bruford, M. W., Segelbacher, G., Allendorf, F. W., Gajardo, G., et al. (2020). Post-2020 Goals Overlook Genetic Diversity. *Science* 367 (6482), 1083–1085. doi: 10.1126/science.abb2748

Leadley, P., Obura, D., Shannon, L., Cecilia, M., Millette, K., Rankovic, A., et al. (2022) *Expert Input to the Post-2020 Global Biodiversity Framework: Transformative Actions on All Drivers of Biodiversity Loss are Urgently Required to Achieve the Global Goals by 2050.* Available at: https://www.cbd.int/doc/c/16b6/e126/9d46160048cfcf74cadcf46d/wg2020-03-inf-11-en.pdf.

Leclère, D., Obersteiner, M., Barrett, M., Butchart, S. H., Chaudhary, A., De Palma, A., et al. (2020). Bending the Curve of Terrestrial Biodiversity Needs an Integrated Strategy. *Nature* 585 (7826), 551–556. doi: 10.1038/s41586-020-2705-y

Leopold, A. (1949). *A Sand County Almanac: And Sketches Here and There* (New York: Oxford University Press).

Liu, P. R., and Raftery, A. E. (2021). Country-Based Rate of Emissions Reductions Should Increase by 80% Beyond Nationally Determined Contributions to Meet the 2 °C Target. *Commun. Earth Environ.* 2 (1), 29. doi: 10.1038/s43247-021-00097-8

Locke, H., Rockström, J., Bakker, P., Bapna, M., Gough, M., Hilty, J., et al. (2021) *A Nature-Positive World: the Global Goal for Nature.* Available at: https://www.naturepositive.org/.

Mace, G. M. (2004). The Role of Taxonomy in Species Conservation. *Philos. Trans. R. Soc. London. Ser. B.: Biol. Sci.* 359 (1444), 711–719. doi: 10.1098/rstb.2003.1454

Maes, J., Teller, A., Erhard, M., Murphy, P., Paracchini, M. L., Barredo, J. I., et al. (2014) *Mapping and Assessment of Ecosystems and Their Services: Indicators for Ecosystem Assessments Under Action 5 of the EU Biodiversity Strategy to 2020.* Available at: https://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/pdf/2ndMAESWorkingPaper.pdf.

McNeely, J. (2001). Invasive Species: A Costly Catastrophe for Native Biodiversity. *Land Use and Water Resources Research.* 1(2), 1–10. doi: 10.22004/ag.econ.47850

Mehtälä, J., and Vuorisalo, T. (2007). Conservation Policy and the EU Habitats Directive: Favourable Conservation Status as a Measure of Conservation Success. *Eur. Environ.* 17 (6), 363–375. doi: 10.1002/eet.458

Narayan, S., Beck, M. W., Wilson, P., Thomas, C. J., Guerrero, A., Shepard, C. C., et al. (2017). The Value of Coastal Wetlands for Flood Damage Reduction in the Northeastern USA. *Sci. Rep.* 7 (1), 1–12. doi: 10.1038/s41598-017-09269-z

Neel, M. C., Leidner, A. K., Haines, A., Goble, D. D., and Scott, J. M. (2012). By the Numbers: How Is Recovery Defined by the US Endangered Species Act? *BioScience* 62 (7), 646–657. doi: 10.1525/bio.2012.62.7.7

Nicholson, E., Watermeyer, K. E., Rowland, J. A., Sato, C. F., Stevenson, S. L., Andrade, A., et al. (2021). Scientific Foundations for an Ecosystem Goal, Milestones and Indicators for the Post-2020 Global Biodiversity Framework. *Nat. Ecol. Evol.* 5 (10), 1338–1349. doi: 10.1038/s41559-021-01538-5

Nijhuis, M. (2021). *Beloved Beasts* (New York: WW Norton).

Noss, R. F., and Cooperrider, A. (1994). *Saving Nature's Legacy: Protecting and Restoring Biodiversity* (Washington, DC: Island Press).

Otero, I., Farrell, K. N., Pueyo, S., Kallis, G., Kehoe, L., Haberl, H., et al. (2020). Biodiversity Policy Beyond Economic Growth. *Conserv. Lett.* 13 (4), e12713. doi: 10.1111/conl.12713

Pe'Er, G., Zinngrebe, Y., Moreira, F., Sirami, C., Schindler, S., Müller, R., et al. (2019). A Greener Path for the EU Common Agricultural Policy. *Science* 365 (6452), 449–451. doi: 10.1126/science.aax3146

Perino, A., Pereira, H. M., Felipe-Lucia, M., Kim, H., Kühl, H. S., Marselle, M. R., et al. (2021). Biodiversity Post-2020: Closing the Gap Between Global Targets and National-Level Implementation. *Conserv. Lett.*, 15(2), e12848. doi: 10.1111/conl.12848

Pidot, J. R. (2018). Public-Private Conservation Agreements and the Greater Sage-Grouse. *Pub. Land. Resour. L. Rev.* 39, 165.

Priyadarshini, P., Bundela, A. K., Gasparatos, A., Stringer, L. C., Dhyani, S., Dasgupta, R., et al. (2022). Advancing Global Biodiversity Governance: Recommendations for Strengthening the Post-2020 Global Biodiversity Framework. *Anthropocene Sci.* 1, 195–203. doi: 10.1007/s44177-022-00013-5

Quigley, T. M., Haynes, R. W., Hann, W. J., Lee, D. C., Holthausen, R. S., and Gravenmier, R. A. (1998). ICBEMP: Using an Ecoregion Assessment for Integrated Policy Analysis. *J. Forest.* 96 (10), 33–38. doi: 10.1093/jof/96.10.33

Ray, J. C., Grimm, J., Olive, A., and Beazley, K. (2021). The Biodiversity Crisis in Canada: Failures and Challenges of Federal and Sub-National Strategic and Legal Frameworks. *FACETS* 6, 1044–1068. doi: 10.1139/facets-2020-0075

Robbins, K. (2007). Missing the Link: The Importance of Keeping Ecosystems Intact and What the Endangered Species Act Suggests We Do About It. *Environ. Law* 37(3), 573–594.

Rodrigues, A. S., Pilgrim, J. D., Lamoreux, J. F., Hoffmann, M., and Brooks, T. M. (2006). The Value of the IUCN Red List for Conservation. *Trends Ecol. Evol.* 21 (2), 71–76. doi: 10.1016/j.tree.2005.10.010

Rohlf, D. J. (1989). *The Endangered Species Act: A Guide to its Protections and Implementation* (Palo Alto, CA: Stanford Environmental Law Society).

Rohlf, D., and Reynolds, C. (2022). Restoring the Emergency Room: How to Fix Section 7(a)(2) of the Endangered Species Act. *Environ. Law*, in press. Available at: https://ssrn.com/abstract=4126387.

Romão, C.. (2015). The Added Value of the Habitats Directive: Is Biodiversity Better Protected Since the Directive Entered Into Force? in *The Habitats Directive in Its EU Environmental Law Context* (London, UK; Routledge), 39–46.

Röschel, L., Noebel, R., Stein, U., Naumann, S., Romão, C., Tryfon, E., et al. (2020). *State of Nature in the EU-Methodological Paper. Methodologies Under the Nature Directives Reporting 2013-2018 and Analysis for the State of Nature 2000* (Paris, France: European Topic Centre on Biological Diversity).

Rounsevell, M. D. A., Harfoot, M., Harrison, P. A., Newbold, T., Gregory, R. D., and Mace, G. M. (2020). A Biodiversity Target Based on Species Extinctions. *Science* 368 (6496), 1193–1195. doi: 10.1126/science.aba6592

Schmitz, O. J. (2013). *Ecology and Ecosystem Conservation* (Washington, DC: Island Press).

Schoukens, H., and Woldendorp, H. E. (2015). Site Selection and Designation Under the Habitats and Birds Directives: A Sisyphean Task? in *The Habitats Directive in its EU Environmental Law Context* (London, UK: Routledge), 49–73.

Shaffer, M. L., and Stein, B. A. (2000). "Safeguarding Our Precious Heritage," in *Precious Heritage: The Status of Biodiversity in the United States* (New York: Oxford University Press), 301–321.

Snape, W. J. (2009). Joining the Convention on Biological Diversity: A Legal and Scientific Overview of Why the United States Must Wake Up. *Sustain. Dev. L. Pol'y* 10, 6.

Soto-Navarro, C. A., Harfoot, M., Hill, S. L. L., Campbell, J., Mora, F., Campos, C., et al. (2021). Towards a Multidimensional Biodiversity Index for National Application. *Nat. Sustainabil.* 4 (11), 933–942. doi: 10.1038/s41893-021-00753-z

Soulé, M. E., Estes, J. A., Berger, J., and Del Rio, C. M. (2003). Ecological Effectiveness: Conservation Goals for Interactive Species. *Conserv. Biol.* 17 (5), 1238–1250. doi: 10.1046/j.1523-1739.2003.01599.x

Spies, T. A., Long, J. W., Charnley, S., Hessburg, P. F., Marcot, B. G., Reeves, G. H., et al. (2019). Twenty-Five Years of the Northwest Forest Plan: What Have We Learned? *Front. Ecol. Environ.* 17 (9), 511–520. doi: 10.1002/fee.2101

Stevance, A.-S., Bridgewater, P., Louafi, S., King, N., Beard, T. D.Jr., Van Jaarsveld, A. S., et al. (2020). The 2019 Review of IPBES and Future Priorities: Reaching Beyond Assessment to Enhance Policy Impact. *Ecosys. People* 16 (1), 70–77. doi: 10.1080/26395916.2019.1702590

Szentandrasi, S., Polasky, S., Berrens, R., and Leonard, J. (1995). Conserving Biological Diversity and the Conservation Reserve Program. *Growth Change* 26 (3), 383–404. doi: 10.1111/j.1468-2257.1995.tb00177.x

Tasso, J. P. (1997). Habitat Conservation Plans as Recovery Vehicles: Jump Starting the Endangered Species Act. *UCLA. J. Envtl. L. Pol'y* 16, 297.

Trillo, T. (2021). Using Multilateral Development Banks to Achieve Paris Climate Goals. *Envtl. L. Rep.* 51, 10762.

UNEP [United Nations Environmental Programme] (2020) *Leaders' Pledge for Nature: United to Reverse Biodiversity Loss by 2030 for Sustainable Development*. Available at: https://www.leaderspledgefornature.org.

USDA [US Dept of Agriculture] (2021) *USDA Announces New Initiative to Quantify Climate Benefits of Conservation Reserve Program*. Available at: https://www.fsa.usda.gov/news-room/news-releases/2021/usda-announces-new-initiative-to-quantify-climate-benefits-of-conservation-reserve-program.

USFWS [US Fish and Wildlife Service] (1997). *National Wildlife Refuge System Improvement Act* (Public Law), 105–157. (Washington, DC: US Fish and Wildlife Service).

USFWS (2021) *Migratory Bird Permits; Authorizing the Incidental Take of Migratory Birds Federal Register*. Available at: https://www.govinfo.gov/content/pkg/FR-2021-10-04/html/2021-21474.htm.

US House of Representatives (2021). *Expressing the Need for the Federal Government to Establish a National Biodiversity Strategy for Protecting Biodiversity for Current and Future Generations*, H. Res. 69, 117th Congress. (Washington, DC: House of Representatives).

Verschuuren, J. (2015). "Connectivity: Is Natura 2000 Only an Ecological Network on Paper?," in *The Habitats Directive in Its EU Environmental Law Context* (London, UK: Routledge), 303–320.

Vucetich, J. A., and Nelson, M. P. (2014) *Conservation, or Curation?* Available at: www.nytimes.com/2014/08/21/opinion/conservation-or-curation.html.

Watson, J. E. M., Simmonds, J. S., Narain, D., Ward, M., Maron, M., and Maxwell, S. L. (2021). Talk is Cheap: Nations Must Act Now to Achieve Long-Term Ambitions for Biodiversity. *One Earth* 4 (7), 897–900. doi: 10.1016/j.oneear.2021.06.012

White House (2021) *Executive Order on Tackling the Climate Crisis at Home and Abroad*. Available at: https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/.

White House (2022) *Executive Order on Strengthening the Nation's Forests, Communities, and Economies*. Available at: https://www.whitehouse.gov/briefing-room/presidential-actions/2022/04/22/executive-order-on-strengthening-the-nations-forests-communities-and-local-economies/.

Whitworth, J. (2015). *Quantified: Redefining Conservation for the Next Economy* (Washington, DC: Island Press).

Williams, B. A., Watson, J. E. M., Butchart, S. H. M., Ward, M., Brooks, T. M., Butt, N., et al. (2021). A Robust Goal is Needed for Species in the Post-2020 Global Biodiversity Framework. *Conserv. Lett.* 14 (3), e12778. doi: 10.1111/conl.12778

Wilson, E. O. (2016). *Half-Earth: Our Planet's Fight for Life* (New York, NY: WW Norton & Company).

Xu, H., Cao, Y., Yu, D., Cao, M., He, Y., Gill, M., et al. (2021). Ensuring Effective Implementation of the Post-2020 Global Biodiversity Targets. *Nat. Ecol. Evol.* 5 (4), 411–418. doi: 10.1038/s41559-020-01375-y

Yachnin, J. (2021) *Does Biden's '30 × 30' Plan Trade Science for Popularity?* Available at: https://www.eenews.net/stories/1063734011.

Zisenis, M. (2017). Is the Natura 2000 Network of the European Union the Key Land Use Policy Tool for Preserving Europe's Biodiversity Heritage? *Land. Use Policy* 69, 408–416. doi: 10.1016/j.landusepol.2017.09.045