A Comparison of National Biodiversity Strategies: Strengths, Weaknesses, and Implementation Issues

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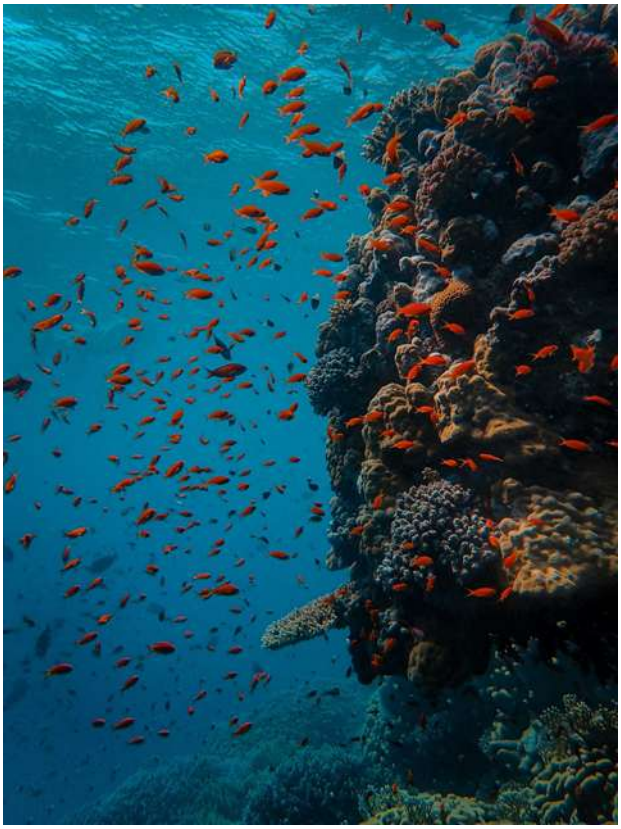

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Abstract

Maintaining healthy and diverse communities of wildlife and plants is essential for ensuring the long-term health and resilience of ecosystems and sustaining nature's contributions to people. Yet we are in the middle of a sixth mass extinction, primarily because of human activities such as habitat destruction, overexploitation, invasive species introductions, climate change, and pollution. The Convention on Biological Diversity (CBD) was adopted in 1993 to conserve and sustainably use biodiversity and its components. Since then, as required by the Convention, member countries have written National Biodiversity Strategy and Action Plans (NBSAPs) to mainstream biodiversity across government and society, reduce the drivers of biodiversity loss, improve the status of species and ecosystems, and build capacity to implement solutions.

We evaluated the NBSAPs of the 30 most biodiverse countries plus five others to determine how well they 1) assessed the status of their species and habitats, 2) developed effective conservation-related strategies with measurable indicators, and 3) planned to implement these strategies. We also examined the countries' National Reports and compared reported progress to a suite of independent environmental and social variables.

We found both strengths and weaknesses throughout the NBSAPs. Importantly, NBSAP strength had no significant effect on slowing biodiversity loss. Further, the countries that reported greater overall progress toward reducing extinction risk tended to have worse biodiversity declines. However, habitat protections, sustainable forest management, and other ecosystem initiatives seemed to help stem the decline. Social data implied that countries require a free press (i.e., public watchdogs), a decent standard of living, and measures to combat corruption to effectively implement their NBSAPs and protect biodiversity. These metrics were intercorrelated.

The CBD is evolving as lessons are learned. At the international level, implementation assistance, sufficient funding, and independent progress assessments are needed, and biodiversity protection must be integrated more effectively into the Sustainable Development Goals. At the national level, both NBSAPs and their implementation need improved communication, coordination, funding, monitoring, accountability and enforcement. We provide suggestions and examples in this report.

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Introduction

The biodiversity crisis

We are experiencing Earth's sixth mass extinction, primarily because of human activity (Cowie et al. 2022, Ceballos and Ehrlich 2023). An estimated 18% of vertebrate species, 23% of invertebrates, and 38% of plants are currently threatened with extinction (IUCN 2024), and average population sizes of wildlife dropped by 73% between 1970 and 2020 (WWF 2024). According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), 75% of the terrestrial environment, 40% of the marine environment, and 50% of streams manifest severe impacts of degradation (IPBES 2019). In the U.S., 34% of plant species and 40% of animal species are at risk of extinction, and 41% of ecosystems are at risk of range-wide collapse (NatureServe 2023).

Healthy and diverse populations of wildlife and plants are essential for ensuring the long-term health and resilience of ecosystems and sustaining nature's contributions to people (Isbell et al. 2022, WWF 2024). Ecosystem services delivered by biodiversity were worth an estimated USD $125-140 trillion in 2011, more than 1.5 times the global GDP (Costanza et al. 2014). But the loss of species can also significantly impact ecosystem functioning and resilience (Dobson et al. 2006, Harrison et al. 2014, Tilman et al. 2014, Biggs et al. 2020, Schmitz et al. 2023), and global biodiversity loss could decrease ecosystem services to humans by up to 70% (Isbell et al. 2022). When species disappear from an ecosystem, those that depend on them for food, pollination or other needs also begin to disappear (Gross 2023). At a certain point, it becomes a "Jenga effect"– lose too many pieces, and eventually the structure collapses, resulting in significant losses of ecosystem function. Examples include forest transitioning to savanna or grassland (Payette and Delwaide 2003, Lindenmayer et al. 2016, Flores et al. 2024), benthic-dominated aquatic systems turning to pelagic-dominated (Almunia et al. 1999, Brush 2001, Kemp et al. 2005), and diebacks of coral reefs (Mumby et al. 2006, Riegl and Purkis 2015) and kelp forests (Schultz et al. 2016, Burt et al. 2018).

The underlying causes of the biodiversity crisis are often consolidated into five direct drivers: changes in land and sea use, the overexploitation of organisms, climate change, pollution, and invasive species (Bongaarts 2019, IPBES 2019, Niederman et al. 2025). These drivers are underpinned by societal values and behaviors that include production and consumption patterns, human population dynamics and trends, trade, technological innovations, and governance (IPBES 2019).

The Convention on Biological Diversity

To tackle biodiversity loss, countries meet every two years at the Convention of Biological Diversity Conference of the Parties to discuss progress and plan for how to move forward. The Convention on Biological Diversity (CBD) was first opened to signing at the Rio Earth Summit in 1992 and entered into force in 1993. It has been ratified by 196 parties and continues to serve as the primary international agreement on biodiversity protection. The CBD addresses three main objectives: 1) the conservation of biological diversity, 2) the sustainable use of the components of biological diversity, and 3) the fair and equitable sharing of the benefits arising from the utilization of genetic resources (SCBD 2011). To accomplish these goals, the CBD mandates that signatories create a National Biodiversity Strategy and Action Plan (NBSAP) in Article 6. NBSAPs are critical for establishing national visions for biodiversity conservation, guiding national biodiversity policies and conservation activities by NGOs and the private sector, mobilizing resources and legitimacy for projects, and providing frameworks for evaluation and accountability (Cardona Santos et al. 2023).

Within the NBSAP, the text of the CBD directs that signatories should plan to accomplish the following tasks "as far and as possible as appropriate":[1]

- Develop a National Biodiversity Strategy and Action Plan (NBSAP);
- Inventory and monitor components of biological diversity;
- Identify threats and minimize adverse impacts;
- Establish protected areas and other conservation measures;
- Develop or maintain necessary legislation and/or other regulatory provisions for the protection of threatened species and populations;
- Adopt economic incentives and increase public awareness;

[1] This is a condensed subset of obligations under the treaty.

- Integrate the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programs, and policies;
- Rehabilitate and restore degraded ecosystems;
- Promote the recovery of threatened species;
- Control harmful alien species;
- Respect and incorporate Indigenous and local knowledge;
- Cooperate with other countries; and,
- Report on measures which the signatory has taken (SCBD 2011).

The directives on how the signatories should approach their national biodiversity strategies have changed throughout the CBD's history. The first of these changes was after the 10th Conference of the Parties (COP10), held in 2010 in Nagoya, Japan (Aichi Prefecture), where parties agreed to adopt an updated strategic plan that included a new list of 20 targets called the Aichi Targets. The goals of these targets included incorporating biodiversity conservation throughout government and society, reducing the pressures on biodiversity loss, improving the status of ecosystems and species, and building capacity for the implementation of solutions. The targets (Box 1) included ambitious goals, such as halving habitat loss and preventing all extinctions. Signatories were to develop, adopt as a policy instrument, and commence implementing "an effective, participatory and updated" NBSAP by 2015 (Target 17). Only 90 of the 196 parties met this deadline, but as of August 22, 2023, the number had increased to 167(SCBD 2025). Markandya (2014) calculated that the economic benefits of meeting at least two of these goals (reducing the loss of coral reefs by 50% and forest by at least 50%) would far exceed the costs of implementation.

COP15, held in Montreal in 2022, followed a similar framework, wherein parties agreed to adopt a new framework known as the Kunming-Montreal Global Biodiversity Framework. The Kunming-Montreal framework expanded the Aichi goals, including by calling for conserving at least 30% of lands and waters by 2030, restoring 30% of degraded ecosystems, reducing harmful subsidies by $500 billion annually, and calling for greater engagement with Indigenous communities (SCBD 2022a). CBD members also adopted a decision at COP15 to request nations submit an updated NBSAP by COP16 in October of 2024. As of summer 2024 when we began this study, less than 10% of parties had done so, and only about 20% met the October deadline.[2]

Efficacy of the CBD and NBSAPs

Unfortunately, the CBD's goals have not been met and it has not prevented the decline of species and ecosystems. Since the CBD was ratified in 1993, the global Red List Index (RLI), which measures the overall extinction risk for species as a metric between one (no species at risk of near-term extinction) and zero (all species extinct), has dropped from 0.81727 to 0.72127 (IUCN 2024). Wildlife populations also continue to drop (WWF 2024). Between 2002 and 2023, 763,000 km^2 (7.4%) of humid primary forest were lost globally (Global Forest Watch 2025). The global area of natural wetlands declined by 20% between 1990-2015, and this loss is accelerating (Ramsar Convention on Wetlands 2018).

[2] From CHM Online Reporting Tool, 11 April 2025, status = "Final" or "Approved" and date of completion and adoption prior to the suspension of COP 16 on 2 November 2024. Includes 9 countries with no date information, so this percentage may be an overestimate.

Box 1. The Aichi Biodiversity Targets (www.cbd.int/sp/targets).

Strategic Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society

By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.

By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.

By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio-economic conditions.

By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.

Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use

By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.

By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem-based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.

By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.

By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.

By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.

By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, to maintain their integrity and functioning.

Strategic Goal C: To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity

By 2020, at least 17% of terrestrial and inland water, and 10% of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures and integrated into the wider landscapes and seascapes.

By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.

By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.

Strategic Goal D: Enhance the benefits to all from biodiversity and ecosystem services

By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, Indigenous and local communities, and the poor and vulnerable.

By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15% of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.

By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation.

Strategic Goal E: Enhance implementation through participatory planning, knowledge management and capacity building

By 2015 each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.

By 2020, the traditional knowledge, innovations and practices of Indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of Indigenous and local communities, at all relevant levels.

By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied.

By 2020, at the latest, the mobilization of financial resources for effectively implementing the Strategic Plan for Biodiversity 2011-2020 from all sources, and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization, should increase substantially from the current levels. This target will be subject to changes contingent to resource needs assessments to be developed and reported by Parties.

According to Swiderska (2002) and Chandra and Idrisova (2011), the main challenges in early implementation of the CBD were:

- Lack of coherence between the NBSAPs, national regulatory instruments, and the CBD Strategic Plans;
- Difficulties in translating the various CBD articles into national targets;
- The increasing economic power of transnational corporations;
- Lack of incorporation of Indigenous issues;
- Social conflicts around protected areas and benefit-sharing;
- Low level of public knowledge and awareness regarding biodiversity;
- The increasing rate of degradation of biodiversity and ecosystem services;
- Lack of commitment to biodiversity objectives amongst political leaders and departments;
- Entrenched sectoral thinking, structures and approaches, and lack of incentives for different departments to work together (silo effect);
- Weak influence and capacity of environment departments; and,
- Failure to mainstream biodiversity values into different sectors.

As part of their obligation under the CBD, parties track their progress toward meeting national targets and publish their assessments in periodic National Reports. Chandra and Idrisova (2011) analyzed 20 Third National Reports and found that limited capacity in developing countries and transition economies undermined conservation initiatives. On-the ground implementation was hindered by lack of capacity in science, coordination, administration, legislation, and monitoring. Chandra and Idrisova (2011) concluded that conservation measures should be supported by multiple sectors and secure high-level political support, and national strategies should include:

- Reviews of existing regulatory processes;
- Educational programs, including incentives for skilled practitioners to enter the biodiversity conservation field;
- Communication strategies, including making information available online through user-friendly websites that provide key audiences the ability to take relevant action;
- A resource mobilization strategy;
- Sustainable financing schemes, including market-based instruments such as payments for ecosystem services and fair trading schemes;
- Consulting key stakeholders and local communities to better understand their problems and opportunities and build support for mutual actions on conservation;
- Developing and formalizing partnership initiatives with the scientific community; and,
- Mainstreaming and integration of biodiversity, e.g., engaging national planners, statisticians, and finance staff for setting national targets and allocating direct budgetary support for CBD implementation.

An analysis of Fourth National Reports found that 86% of the Parties were taking concrete measures toward biodiversity mainstreaming, and 80% of the Parties indicated that biodiversity is important for the human well-being of their country. 72% reported integration of biodiversity in national-level, sectoral and cross-sectoral strategies, plans and programs, particularly into poverty reduction and sustainable development strategies and the forestry and agriculture sectors. Only 30% reported biodiversity integration into sub-national or local plans, but 91% had mechanisms in place for environmental impact assessments and 38% for strategic environmental impact assessments. Despite this progress, 77% of Parties acknowledged only limited mainstreaming of biodiversity, mainly because of fragmented decision making and limited communication between stakeholders. In many cases, the lack of economic valuations of biodiversity impaired interest in conservation (Leadley et al. 2014).

Whitehorn et al. (2019) reviewed 144 NBSAPs and found the majority acknowledged the contribution of biodiversity to the national economy. 43% of the NBSAPs provided specific details. Developing countries, particularly in Africa, had a higher awareness of the importance of biodiversity mainstreaming than developed countries. Developing countries were also more likely to involve a greater range of stakeholders in the NBSAP development process, and more likely to include specific details about the monetary contributions of biodiversity to their economies (Whitehorn et al. 2019). Dupuis et al. (2023) assessed the effectiveness of France's third NBSAP and noted numerous weaknesses, including incomplete mapping of ecosystems and actors; a lack of systemic cohesion; an emphasis on limiting impacts rather than avoiding them from the outset; using a top-down, non-transparent approach rather than capitalizing on scientific expertise and local knowledge; a

lack of implementation details; a heavy reliance on voluntary measures with insufficient consideration of regulatory and legal reform; a continued utilitarian vision of nature; and low ambitions with vague measures.

According to the CBD Secretariat's 2022 assessment of NRs, only about 30% of national targets were on track to being met, and only 9% of targets that matched Aichi goals were on track (SCBD 2022b). Further findings included:

- As of 17 October 2022, 193 Parties had developed at least one NBSAP. 177 had submitted updated versions;
- 107 Parties included capacity development strategies in their NBSAP;
- Only 73 revised NBSAPs were adopted as "whole-of-government" instruments, with another 18 countries intending to do so. 9 NBSAPs were adopted as instruments applying only to the environmental sector. 75 Parties had not provided sufficient evidence to know if their NBSAPs were adopted as a policy instrument or not;
- Only 45 Parties included Indigenous and local communities in the NBSAP revision process;
- Few NBSAPs contained resource mobilization strategies (25 Parties) or communication and public awareness strategies (39 Parties) as the NBSAP guidance recommends;
- Only a few NBSAPs demonstrated that biodiversity is being mainstreamed significantly into cross-sectoral plans and policies, poverty eradication policies, or into sustainable development plans; and,
- The majority of NBSAPs contained targets related to the Aichi Biodiversity Targets. However, for some Aichi Targets, such as Targets 3 (halting harmful subsidies), 6 (managing and recovering fisheries), 10 (protecting coral reefs from climate change), and 14 (protecting access to ecosystem services), many NBSAPs (>30%) lacked associated national targets or commitments.

U.S. interest in a NBSAP

With 196 signatories at the time of this analysis, CBD had been ratified by all United Nations (U.N.) member states except the United States, which consequently lacks a nationwide strategy to conserve biodiversity. The U.S. does have a solid legal foundation for extinction prevention and the recovery of imperiled species: the Endangered Species Act (ESA). As of 2024, the ESA remained one of the strongest biodiversity conservation laws in the world. While the ESA has been extraordinarily successful at preventing extinctions of listed species, chronically insufficient funding and other implementation challenges have hampered efforts to halt declines, recover listed species, and extend ESA protections to the full suite of imperiled species (Evans et al. 2016). As of 2024, numerous other biodiversity-related statutes also protected specific taxa or habitats, such as the Marine Mammal Protection Act, the National Wildlife Refuge System Improvement Act, and the Bald and Golden Eagle Protection Act.

Through legislation like the ESA and the National Environmental Policy Act, as well as participation in international discussions, the U.S. has indicated that protecting biodiversity is a national priority. Polls consistently show strong public support for wildlife and nature protection (Defenders of Wildlife 2022, Defenders of Wildlife 2023, NPCA 2023, Pew Research Center 2023, Shumaker 2024). However, the U.S. lacks a coordinated policy that indicates where biodiversity takes precedence over other goals, creating a responsibility gap between stated objectives and outcomes for biodiversity (Gerber et al. 2023). An NBSAP can help the U.S. clarify how they plan on achieving biodiversity goals in the context of other national priorities such as security and public health, as well as develop new policies and actions to further these strategies.

Prospects for a U.S. NBSAP

Given the decades of opposition to international treaties in the Senate, U.S. ratification of the CBD is unlikely in the foreseeable future. At the time of this publication, neither an executive order nor enabling legislation is politically feasible, but conditions may change in the future. Congressional Resolutions calling for a strategy have already been introduced (Merkley 2023, Neguse 2023), and a corresponding Executive Order would likely resemble those proposals (Gerber et al. 2023). The NBSAP would be developed by a task force composed of academics and other non-governmental experts, representatives from across federal agencies, convened perhaps by the USGS, U.S. Global Change Research Program (USGCRP), or the White House Council on Environmental Quality. Congressional action that supports the executive order can ensure the task force best fulfills its responsibilities.

The National Nature Assessment (NNA), as conceived in a 2022 executive order by President Biden (Executive Order 14072, 2022) might provide a useful blueprint for a U.S. National Biodiversity Strategy. Initiated an Prior to its cancellation by a subsequent Trump action (Executive Order 14154) the NNA was intended to evaluate how the environmental management systems are functioning and the status of nature, a key first step to the development of a National Biodiversity Strategy. If revived, the NNA, combined with existing legal frameworks like the ESA and other bedrock environmental laws, can lay the groundwork for a U.S. NBSAP to be successful in enacting conservation changes.

As a laggard in the development of an NBSAP, the U.S. does have the opportunity to take lessons from other nations' strategies on how to develop a maximally effective and implementable strategy.

Project goals

Our main objectives were to identify strengths and weaknesses in completed NBSAPs, as well as implementation issues and possible solutions. To that end, we analyzed and scored the NBSAPs from the 30 most biodiverse parties to the CBD. We also compared environmental and social variables of all CBD nation-state signatories with their progress in biodiversity protection. Based on the results of our analysis, we make recommendations for future NBSAPs and identify ways the CBD might be strengthened.

Methods

Pilot study

To examine what an effective National Biodiversity Strategy could look like, we first assessed the NBSAPs from ten CBD signatories: Antigua and Barbuda, Australia, Brazil, Canada, China, France, Germany, Philippines, Scotland, and South Africa. We chose these ten for a variety of reasons, with availability of an English version being an essential criterion. Countries like Canada, China, and Brazil are similar in size to the U.S. and encompass diverse habitats and species. Other countries, like the Philippines and South Africa, were chosen because of their high biodiversity, and Germany, Antigua and Barbuda, and Scotland because of their ambitious plans and ideas. Seven of the countries (France, China, Canada, South Africa, Australia, Brazil, and the Philippines) have Indigenous populations in their mainland or territories, which should be an important consideration in any U.S. plan.

We evaluated the plans based on three categories of criteria: status assessment, strategy, and implementation. We created rubrics for each of the three categories and assigned points using the CBD NBSAP guidelines referenced in the introduction (Fig. 1). The status assessment score evaluated how well the country inventoried the status of its species and ecosystems, the threats they face, and the current legal framework. The strategy score reflected the detail and inclusiveness of the country's strategies to address the drivers of biodiversity loss. Finally, the implementation score assessed planned actions, including capacity building, monitoring, funding, accountability, enforcement, tracking progress, level of commitment, involvement throughout society, sustainable development, and equitable access to nature.

All three categories included points for addressing Indigenous and local community priorities in status assessment, strategy development, and implementation. Countries without distinct Indigenous groups, such as Germany, Scotland, and Antigua and Barbuda, were not assessed for these factors, and the maximum possible score was reduced accordingly. For this reason, we ranked countries using a percentage of the total possible points. Two to three of the authors scored each NBSAP separately, then discussed them to derive a consensus score.

Fig. 1. Scoring Sheet for National Biodiversity Strategies and Action Plans

STATUS	0 Points	1 Point	2 Points	Notes
Assessment of current status of key species	Not discussed	General discussion	Specific and detailed; discusses multiple species	
Assessment of current status of key habitats and ecosystems	Not discussed	General discussion	Specific and detailed; discusses terrestrial, freshwater, and/or marine	
Mapping	No mapping of biodiversity	Mapped distribution of biodiversity OR key conservation areas	Mapped distribution of biodiversity AND key conservation areas	
Drivers of Crisis				
Habitat Change	Not discussed	Discussed generally (e.g. 1 paragraph)	Discussed in detail, with specific examples, trends, etc.	
Climate Change	Not discussed	Discussed generally (e.g. 1 paragraph)	Discussed in detail, with specific examples, trends, etc.	
Invasive Species	Not discussed	Discussed generally (e.g. 1 paragraph)	Discussed in detail, with specific examples, trends, etc.	
Overexploitation	Not discussed	Discussed generally (e.g. 1 paragraph)	Discussed in detail, with specific examples, trends, etc.	
Pollution	Not discussed	Discussed generally (e.g. 1 paragraph)	Discussed in detail, with specific examples, trends, etc.	
Interactions between drivers	Not discussed	Discussed generally (e.g. 1 paragraph)	Discussed in detail, with specific examples, trends, etc.	
Accounts for range shifts and other ecosystem responses to change	Not discussed	General mention or one example	Discussed in detail, with specific examples, trends, etc.	
Ecosystem Services to people	Not discussed	General discussion with 1-2 examples	Detailed discussion with multiple examples	
Indigenous and local biodiversity status knowledge & priorities	Not discussed	Discusses Indigenous OR local knowledge and conservation priorities	Discusses Indigenous AND local knowledge and conservation priorities	
Legal Framework	Not discussed	Discussed generally (e.g. 1 paragraph), or limited to national laws	Discusses/lists national AND subnational (provincial, state or local) laws	
TOTAL POINTS				

STRATEGY	0 Points	1 Point	2 Points		Notes
Indigenous and local community involvement in strategy development	No	Includes Indigenous OR local input	Includes Indigenous AND local input		
International cooperation and relationship to other conventions	Not discussed	General discussion	Detailed discussion with multiple examples		
Strategies to Address Drivers of Crisis	Give one point each for GOALS/OBJECTIVES, STRATEGIES/ACTIONS (including general progress measures), MEASURABLE INDICATORS (with numeric targets and timelines)				Notes
Habitat Protection	Not discussed	GOALS/OBJECTIVES	STRATEGIES/ ACTIONS	MEASURABLE INDICATORS	
Habitat Restoration & Management	Not discussed	GOALS/OBJECTIVES	STRATEGIES/ ACTIONS	MEASURABLE INDICATORS	
Climate Change Mitigation	Not discussed	GOALS/OBJECTIVES	STRATEGIES/ ACTIONS	MEASURABLE INDICATORS	

STRATEGY	0 Points	1 Point	2 Points		Notes
Climate Change Adaptation	Not discussed	GOALS/OBJECTIVES	STRATEGIES/ ACTIONS	MEASURABLE INDICATORS	
Invasive/Damaging Species Management	Not discussed	GOALS/OBJECTIVES	STRATEGIES/ ACTIONS	MEASURABLE INDICATORS	
Overexploitation Reduction	Not discussed	GOALS/OBJECTIVES	STRATEGIES/ ACTIONS	MEASURABLE INDICATORS	
Pollution Reduction	Not discussed	GOALS/OBJECTIVES	STRATEGIES/ ACTIONS	MEASURABLE INDICATORS	
Other recovery measures (captive breeding, reintroduction, etc.)	Not discussed	GOALS/OBJECTIVES	STRATEGIES/ ACTIONS	MEASURABLE INDICATORS	
TOTAL POINTS					

IMPLEMENTATION	0 Points	1 Point	2 Points	Notes
Accountability	Not discussed	General discussion but no legal or administrative mandates	Contains legal or administrative mandates	
Tracking and reporting progress, successes and failures	Not discussed	General discussion	Detailed discussion and commitments	
Capacity building				
Science	Not discussed	Specific plan to increase capacity		
Coordination	Not discussed	Specific plan to increase capacity		
Administration	Not discussed	Specific plan to increase capacity		
Legislation	Not discussed	Specific plan to increase capacity		
Monitoring	Not discussed	Specific plan to increase capacity		
Enforcement	Not discussed	Specific plan to increase capacity		
Training	Not discussed	Specific plan to increase capacity		
Education	Not discussed	Specific plan to increase capacity		
Information sharing	Not discussed	Specific plan to increase capacity		
Local collaboration	Not discussed	Specific plan to increase capacity		
Biodiversity emergency/disaster planning and response	Not discussed	Specific plan to increase capacity		
Monitoring status of species, habitats, and ecosystems	Not discussed	General discussion	Detailed discussion and commitments	
Funding	Not discussed	General discussion	Detailed discussion and commitments	
Enforcement	Not discussed	General discussion	Detailed discussion of commitments and/or limitations	
Level of Commitment	Not discussed	Just environment ministries or departments	Whole-of-government approach, legislation,	

IMPLEMENTATION	0 Points	1 Point	2 Points	Notes
			environmental impact assessments, etc.	
Involvement of diverse sectors of society in implementation (mainstreaming)	Not discussed	General discussion	Detailed discussion including economic, social, and cultural sectors (e.g. incentives)	
Sustainable Development and Use	Not discussed	Discusses sustainable development OR sustainable use of organisms and genetic resources	Discusses sustainable development AND sustainable use of organisms and genetic resources	
Indigenous and local community involvement in implementation	Not discussed	Includes Indigenous OR local people	Includes Indigenous AND local people	
Access to Nature	Not discussed	General discussion	Detailed discussion and strategies for ensuring equitable access to nature	
TOTAL POINTS				

Subtotals and Totals	Points	Notes
Assessment		(max 26)
Strategy		(max 28)
Implementation		(max 31)
TOTAL POINTS		(max 85)

NBSAPs of the 30 most biodiverse countries

Based on the pilot study, we analyzed and scored the NBSAPs of the 30 most biodiverse parties to the CBD (Table 1). Biodiversity scores were obtained from Butler (2023). We lacked the resources to analyze all 193 signatories to the CBD, but the top 30 countries are located on all continents except Europe and Antarctica, and collectively contain the majority of the world's species. Most are located at least partly in the tropics, and most have developing economies. As in the pilot study, two to three of the authors scored each NBSAP separately, then discussed them to derive a consensus score.

Table 1. List of the 30 most biodiverse parties to the CBD, excerpted from Butler (2023), with the number of amphibian, bird, fish, mammal, reptile, and plant species. Ranks are based on a weighted index using five groups of animals (amphibians, birds, fish, mammals, and reptiles) and one group of plants (vascular plants). Each country is ranked by its percentage of species in each group relative to the total global number of species for each group. Plant data came from the World Conservation Monitoring Centre of the U.N. Environment Programme, fish from Fishbase, birds from Birdlife International, amphibians from AmphibiaWeb; mammals from IUCN and The Mammal Diversity Database of the American Society of Mammalogists, and reptiles from the Reptile Database.

Rank	Country	Amphibians	Birds	Fish	Mammals	Reptiles	Plants (WCMC)	Plants (Updated)
1	Brazil	1,175	1,864	4,930	776	868	56215	34387
2	Indonesia	393	1,791	5,014	777	799	29375	19232
3	China	604	1,330	3,838	710	631	32200	31362
4	Colombia	832	1,917	2,182	525	657	51220	24025
5	Peru	672	1,892	1,661	567	542	17144	19812
6	Mexico	424	1,137	2,671	582	1,015	26071	23385
7	Australia	251	833	5,189	381	1,145	15638	19324
8	India	454	1,271	2,860	436	889	18664	15000
9	Ecuador	688	1,684	1,148	441	493	19362	18466
10	Venezuela	365	1,420	1,801	407	419	21073	15381
11	South Africa	132	832	2,165	323	569	23420	21250
12	Papua New Guinea	426	780	2,979	291	410	11544	10973
13	Bolivia	260	1,446	434	410	324	17367	14729
14	Vietnam	279	866	2,608	355	537	10500	8500
15	Malaysia	279	787	2,055	355	519	15500	14060
16	Congo (DRC)	230	1,155	1,599	508	316	11007	8860
17	Tanzania	207	1,103	1,875	404	356	10008	10100
18	Thailand	161	987	2,351	344	495	11625	6600
19	Myanmar	138	1,090	1,152	353	373	7000	16000
20	Argentina	177	1,041	1,130	407	475	9372	10221
21	Philippines	115	647	3,730	234	371	8931	10107
22	Kenya	115	1,127	1,115	410	284	6506	6765
23	Panama	230	981	1,464	257	284	9915	10462
24	Cameroon	226	951	1,108	370	289	8260	6883
25	Japan	107	593	4,294	153	106	5565	5600
26	Costa Rica	215	895	1,151	252	269	12119	11000
27	Madagascar	412	278	1,253	257	454	9505	11832
28	Angola	109	956	1,026	333	319	5185	2262
29	Mozambique	93	717	1,965	266	225	5692	4095
30	Guatemala	165	742	921	243	283	8681	8763

Comparison of national environmental and social variables

The success of biodiversity protection falls within the broader social, economic, and political context of a country and region. We therefore examined data for predictors of protection effort and success. We compiled metrics of national biodiversity, environmental conditions, biodiversity and nature protection, and social factors for all CBD nation-state signatories with complete datasets (Table 2).

We imported the data into R (version 4.4.2; R Core Team 2024) and examined the variables for normality, both visually and by conducting Shapiro-Wilk normality tests. We transformed variables with skewed distributions to ones with more normal distributions, taking the square root or natural logarithm. We then performed a pairwise Pearson correlation analysis with p-values adjusted for multiple comparisons using Holm's method (package: *RcmdrMisc*; Fox et al. 2023) on the transformed variables (Table 3).

We examined all possible linear model formulations for four different response variables: the 2024 RLI, the Red List decline from 2010-2024, forest area change between 2010 and 2020, and the Ecosystem Vitality Index (Table 4; package: *OLSRR*; Hebbali 2024). Our approach focused less on attempting to identify the direct mechanisms of conservation success and failure and more on finding unifying themes that could direct future research and action, and as such our model development included all variables in our dataset that were reasonably independent and complete for most countries. We excluded the area of certified forest and the proportion of forest with long-term management plans, as they had a large proportion of missing data. Sixteen countries (out of 156) were removed from the linear modelling analysis due to missing data that prevented model comparison (Table 5).

Finally, we fit Generalized Additive Models (GAM; package: *mgcv*; Wood 2025) for the best variable combinations to see if curve fitting and smoothing could improve predictive power.

Data analyses of the 30 most biodiverse countries

We performed the same analyses for the 30 most biodiverse CBD parties as were performed for all signatories. Two countries (Dem. Rep. of Congo and Papua New Guinea) were removed from the regression models because of missing data. We then compared the variables in Table 4 to the countries' NBSAP score and sub-scores (status, strategy, and implementation) and their progress toward reaching national biodiversity targets. For the GAMs, we reduced k (the maximum degrees of freedom for the smoothing term) to 8, as the program default gave an error for this smaller dataset.

Table 2. List of national variables.

Variable	Variable Description	Source
LA	Land area (thousands of hectares) in 2020	UNDESA 2024
FOR_PCT	Forest area as a percentage of total land area in 2020	UNDESA 2024
AGB_F	Above-ground biomass in forest (tonnes per hectare) in 2020	UNDESA 2024
VERT_SPP	Vertebrate species richness by country	Butler 2023
FOR_CHG	Forest area change (%/year, 2010-2020)	UNDESA 2024
ECO_PROT	Ecosystem Vitality Score from Yale University's 2024 Environmental Performance Index. The Ecosystem Vitality Score measures how well countries manage their natural resources and conserve their biodiversity and natural ecosystems.	Block et al. 2024
BIA_PROT	Protection of biologically important areas (integers 0-10: 0 = <5% of biologically important areas protected; 10 = >95% protected)	Dinerstein et al. 2020
FA_CERT	Forest area certified under an independently verified certification scheme (thousands of hectares) in 2023	UNDESA 2024
FOR_PROT	Percentage of forest area within legally established protected areas in 2020	UNDESA 2024

Variable	Variable Description	Source
FA_LTMP_PERC	Percentage of forest area with a long-term management plan in 2020	UNDESA 2024
TKBA_PA_PERC	Average percentage of Terrestrial Key Biodiversity Areas (KBAs)[3] covered by protected areas in 2023	UNDESA 2024
FWKBA_PA_PERC	Average percentage of Freshwater Key Biodiversity Areas (KBAs) covered by protected areas in 2023	UNDESA 2024
RLI_2024	2024 Red List Index	IUCN 2024
RLI_2010_2024	2010-2024 change in Red List Index (avg %/year)	calculated from IUCN 2024
HDI	Human Development Index for 2022	UNDP 2024
SDG	Sustainable Development Goals score for 2024	Sachs et al. 2024
POLITICAL_ CORRUPTION	Political Corruption Index for 2023	Coppedge et al. 2024
CORRUPT_ PERCEPTION	Corruption Perceptions Index for 2023	Transparency International 2024
PRESS_FREEDOM	Press Freedom Index for 2024	Reporters Without Borders 2024
WOOD_EXPORT	Exported unfinished wood in 2023 (m3)	FAO 2025
AG_EXPORT_TONS	Total crop and livestock products exported in 2023 (tons)	calculated from FAO 2025
PCT_POP_CHANGE_2010-2023	% population change 2010-2023	calculated from UN Population Division 2025
CORRUPTION_CONTROL	Control of Corruption: perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.	World Bank Group 2025
GOVT_EFFECTIVENESS	Government Effectiveness: perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.	World Bank Group 2025
POLITICAL_STABILITY	Political Stability and Absence of Violence/Terrorism: perceptions of the likelihood of political instability and/or politically motivated violence, including terrorism.	World Bank Group 2025
RULE_OF_LAW	Rule of Law: perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.	World Bank Group 2025
REGULATORY_QUALITY	Regulatory Quality: perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.	World Bank Group 2025
VOICE_AND_ACCOUNTABILITY	Voice and Accountability: perceptions of the extent to which a country's citizens can participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.	World Bank Group 2025

[3] The criteria for what can qualify as a KBA is one or more of the following: contains a significant number of endangered species relative to the global population; contains ecosystems that are threatened on a global scale; contains species, taxonomic groups, or ecosystems that are confined to small geographic zones; is relatively untouched by human activity; holds congregations of species at important life stages, such as "breeding, feeding or during migration" or the spawning of offspring; is a "refuge" where species retreat from temporary negative environmental conditions; or has a high level of irreplaceability, or "how close a site is to being essential for achieving conservation targets."

Table 3. National variables examined for correlation.

Variable	Description
log_LA	Natural log of land area (thousands of hectares) in 2020
sqrt_FOR_PCT	Square root of forest area as a percentage of total land area in 2020
sqrt_AGB_F	Square root of above-ground biomass in forest (tonnes per hectare) in 2020
log_VERT_SPP	Natural log of vertebrate species richness
FOR_CHG	Average annual forest area change rate 2010-2020 (%)
ECO_PROT	2024 Ecosystem Vitality Score, which measures how well countries manage their natural resources and conserve their biodiversity and natural ecosystems.
BIA_PROT	Protection of biologically important areas (integers 0-10: 0 = <5% of biologically important areas protected; 10 = >95%)
log_FA_CERT	Natural log of forest area certified under an independently verified certification scheme (thousands of hectares) in 2023
sqrt_FOR_PROT	Square root of percentage of forest area within legally established protected areas in 2020
FA_LTMP_PERC	Percentage of forest area with a long-term management plan in 2020
TKBA_PA_PERC	Percentage of Terrestrial Key Biodiversity Areas covered by protected areas in 2023
FWKBA_PA_PERC	Percentage of Freshwater Key Biodiversity Areas covered by protected areas in 2023
sqrt_RLI_2024	Square root of 2024 Red List Index
RLI_2010_2024	2010-2024 Change in Red List Index (avg %/year)
HDI	2022 Human Development Index
SDG	2024 Sustainable Development Goals score
POLITICAL_CORRUPTION	2023 Political Corruption Index
CORRUPT_PERCEPTION	2023 Corruption Perceptions Index
PRESS_FREEDOM	2024 Press Freedom Index
sqrt_WOOD_EXPORT	Square root of exported unfinished wood in 2023 (m3)
sqrt_AG_EXPORT_TONS	Square root of total crop and livestock products exported in 2023 (tons)
PCT_POP_CHANGE_2010-2023	% population change 2010-2023
CORRUPTION_CONTROL	Control of Corruption: perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.
GOVT_EFFECTIVENESS	Government Effectiveness: perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.
POLITICAL_STABILITY	Political Stability and Absence of Violence/Terrorism: perceptions of the likelihood of political instability and/or politically motivated violence, including terrorism.
RULE_OF_LAW	Rule of Law: perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.
REGULATORY_QUALITY	Regulatory Quality: perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.
VOICE_AND_ACCOUNTABILITY	Voice and Accountability: perceptions of the extent to which a country's citizens can participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.

Table 4. List of national variables included in model development for all CBD nation-state parties and the 30 most biodiverse.

Variable	Variable Description [transformation]	Used to model:
LOG_LA	Land area (thousands of hectares) in 2020 [log]	RLI_2024, FOR_CHG, RLI_2010_2024, ECO_PROT
SQRT_FOR_PCT	Forest area as a percentage of total land area in 2020 [square root]	RLI_2024, FOR_CHG, RLI_2010_2024, ECO_PROT
SQRT_AGB_F	Above-ground forest (2020) [square root]	RLI_2024, FOR_CHG, RLI_2010_2024, ECO_PROT
LOG_VERT_SPP	Vertebrate species richness by country [log]	ECO_PROT
FOR_CHG	Forest area change (%/year, 2010-2020)	RLI_2024, RLI_2010_2024, ECO_PROT
ECO_PROT	Ecosystem Vitality Score from Yale University's 2024 Environmental Performance Index. The Ecosystem Vitality Score measures how well countries manage their natural resources and conserve their biodiversity and natural ecosystems.	RLI_2024, FOR_CHG, RLI_2010_2024
BIA_PROT	Protection of biologically important areas (integers 0-10: 0 = <5% of biologically important areas protected; 10 = >95% protected)	RLI_2024, FOR_CHG, RLI_2010_2024, ECO_PROT
TKBA_PA_PERC	Percentage of Terrestrial Key Biodiversity Areas covered by protected areas in 2023	RLI_2024, FOR_CHG, RLI_2010_2024, ECO_PROT
FWKBA_PA_PERC	Percentage of Freshwater Key Biodiversity Areas covered by protected areas in 2023	RLI_2024, FOR_CHG, RLI_2010_2024, ECO_PROT
HDI	Human Development Index for 2022	RLI_2024, FOR_CHG, RLI_2010_2024, ECO_PROT
SDG	Sustainable Development Goals score for 2024	RLI_2024, FOR_CHG, RLI_2010_2024, ECO_PROT
POLITICAL_ CORRUPTION	Political Corruption Index for 2023	RLI_2024, FOR_CHG, RLI_2010_2024, ECO_PROT
CORRUPT_ PERCEPTION	Corruption Perceptions Index for 2023	RLI_2024, FOR_CHG, RLI_2010_2024, ECO_PROT
PRESS_FREEDOM	Press Freedom Index for 2024	RLI_2024, FOR_CHG, RLI_2010_2024, ECO_PROT
PCT_POP_CHANGE_ 2010-2023	% population change 2010-2023	RLI_2024, FOR_CHG, RLI_2010_2024, ECO_PROT
POLITICAL_STABILITY	Political Stability and Absence of Violence/Terrorism: perceptions of the likelihood of political instability and/or politically motivated violence, including terrorism.	RLI_2024, FOR_CHG, RLI_2010_2024, ECO_PROT
RULE_OF_LAW	Rule of Law: perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.	RLI_2024, FOR_CHG, RLI_2010_2024, ECO_PROT
VOICE_AND_ ACCOUNTABILITY	Voice and Accountability: perceptions of the extent to which a country's citizens can participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.	RLI_2024, FOR_CHG, RLI_2010_2024, ECO_PROT

Table 5: Countries removed from linear modelling analyses because of missing data.

Country	Missing Data	Removed from:
Afghanistan	Aboveground Forest Biomass	Full analysis
Albania	Aboveground Forest Biomass	Full analysis
Azerbaijan	Aboveground Forest Biomass	Full analysis
Bahrain	Aboveground Forest Biomass, Freshwater KBA	Full analysis
Congo (DRC)	Freshwater KBA	Full Analysis, Top 30 Analysis
Guinea-Bissau	Freshwater KBA	Full analysis
Kuwait	Aboveground Forest Biomass, Freshwater KBA	Full analysis
Lesotho	Freshwater KBA	Full analysis
Maldives	Freshwater KBA	Full analysis
Malta	Aboveground Forest Biomass, Freshwater KBA	Full analysis
Mauritius	Freshwater KBA	Full analysis
Papua New Guinea	Freshwater KBA	Full Analysis, Top 30 Analysis
Qatar	Forest Change, Freshwater KBA	Full analysis
Singapore	Freshwater KBA	Full analysis
Tajikistan	Aboveground Forest Biomass	Full analysis
Togo	Freshwater KBA	Full analysis

Examination of National Reports of the 30 most biodiverse countries

We manually examined the Sixth National Reports (NRs) of the 30 most biodiverse countries, which provided a final review of their progress in implementing the 2011-2020 Strategic Plan for Biodiversity and achieving the Aichi Biodiversity Targets. These reports were submitted between 2018-2020 and made available on the CBD website (https://www.cbd.int/).

Progress toward achieving national biodiversity targets

For each country that reported their progress toward achieving their national biodiversity targets, we tabulated the following:

- Number of National Targets on track to be exceeded;
- Number of National Targets on track to be achieved;
- Number of National Targets with progress but at an insufficient rate;
- Number of National Targets with no progress, unknown, or not reported;
- Number of National Targets moving away from goal;
- % of targets on track to meet or exceed the goal;
- % of targets making at least some progress; and,
- Average progress toward reaching national targets, using the following scores:
  - 3 = On track to surpass target
  - 2 = On track to achieve target
  - 1 = Progress toward target but at an insufficient rate
  - 0 = No progress, unknown, or not reported.

We were especially interested in reported progress toward reaching Aichi Target 12 ("By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained"). We then compared progress toward national biodiversity targets to the strength of the country's NBSAP, as well as to the other environmental and social variables we compiled.

Large Language Model review

After reviewing the NRs manually, we consolidated them into three large documents (the maximum document size possible) and prompted Microsoft Copilot (Microsoft 2025) to identify the following:

- Common strategies to address the five key drivers of biodiversity loss;
- Sample actions to address the five key drivers of biodiversity loss;
- Common institutional, social, organizational, political, etc. barriers to biodiversity conservation success;
- Examples of each of these barriers;
- Possible solutions to these barriers; and,
- Examples of actions that overcame or avoided those barriers.

We searched the NRs to verify Copilot's accuracy. In the summary tables, we changed wording where needed and omitted examples entirely if erroneous, vague, or redundant. We added strategies, solutions, and actions from the manual review to replace omissions. For representativeness, we included at least two sample actions per country.

Results

Pilot study

Table 6 summarizes the ten NBSAP scores from the pilot study. Our initial report (O'Connor et al. 2024) contains further details. Assessment scores were typically lower than strategy and implementation scores (mean = 64%, lowest = 42%, highest = 96%). Strategies averaged 79% (lowest = 67%, highest = 96%). Implementation scores were generally the highest (mean = 88%, lowest = 65%, highest = 97%). Total scores varied between 60% (Australia) and 92% (Canada), with an average of 78%. There was no apparent relationship between the year the NBSAP was submitted and the score ($r = 0.07$).

Most plans contained only cursory discussions of how the five main drivers of biodiversity loss were impacting habitats and species. However, countries also consistently missed other important components. Only two countries, Brazil and the Philippines, included maps of conservation areas, and only the Philippines mapped existing areas of high biodiversity. Further, only five of the ten countries accounted for range shifts and other ecosystem responses to change, with only two countries doing so in detail (the Philippines and Germany). The Philippines had the best status assessment among the ten we assessed, scoring all but one point and providing a detailed assessment of the current state of biodiversity and how past conservation actions were funded and supported by policy.

In terms of strategy development, many of the plans stated their goals and the problems they wanted to solve, but failed to include concrete action plans, which is an essential component of an NBSAP. Australia, Antigua and Barbuda, and Scotland were examples of this; on the other hand, Brazil's plan included a wealth of detail. Further, many countries failed to include measurable indicators for many of their goals. Only five of the ten plans had measurable indicators for more than half of the eight categories we assessed, with Brazil and France including the most, scoring seven out of eight possible points.

Most of the countries scored high on implementation. Notable strengths included Scotland's monitoring section and Antigua and Barbuda's funding plan. Four of the ten plans did not discuss sustainably managing genetic resources, which is an area emphasized in five of the CBD articles, with Article 15 dedicated to access to genetic resources. Additionally, some large countries with Indigenous or ethnic minority populations in biodiverse areas, such as France (in territories), Australia, and China, failed to mention Indigenous priorities in their strategies and did not consult Indigenous people in their assessments.

Table 6. NBSAP scores by country.

Country	NBSAP year	Assessment score	Strategy score	Implementation score	Total score
Canada	2024	85%	93%	97%	92%
Philippines	2016	96%	79%	97%	91%
Brazil	2017	54%	96%	94%	82%
Germany	2014	76%	81%	87%	82%
Antigua and Barbuda	2014	72%	67%	87%	76%
China	2024	42%	82%	97%	75%
France	2023	46%	86%	90%	75%
South Africa	2015	54%	75%	90%	74%
Scotland	2023	64%	67%	80%	71%
Australia	2019	46%	68%	65%	60%
AVERAGE SCORE		**64%**	**79%**	**88%**	**78%**

NBSAPs of the 30 most biodiverse countries

For the 30 most biodiverse countries, the mean NBSAP score was 77% (*SD* = 9%). For Assessment, the mean was 65% (*SD* = 19%); for Strategy, 74% (*SD* = 14%); and for Implementation, 89% (*SD* = 7%). Fig. 2 shows the detailed breakdown.

While some countries provided detailed descriptions of key species, habitats, ecosystems, and the threats they face, many countries provided only generalizations; and some countries, little or no information at all. Of the drivers of biodiversity loss, habitat loss and degradation were discussed by all countries (63% in detail, 37% in general terms). On the other hand, pollution was only discussed by 30% of countries in detail, with 53% in general terms and 17% not at all. Climate change was similar: 40% in detail, 47% generally, and 13% not at all. Only 7% of countries discussed driver interactions in detail, with 60% including brief mentions and 33% not at all. Likewise, few countries accounted for species range shifts or ecosystem responses to climate change and other changes, with the majority of NBSAPs lacking this entirely. Most countries (70%) discussed the importance of ecosystem services and included Indigenous and local biodiversity status knowledge and priorities. Almost all countries (97%) also listed relevant national environmental laws, but few referred to provincial or sub-national laws.

Most countries included goals and strategies to address each of the five main drivers of biodiversity loss. Climate change was the most frequently omitted, with 20% of countries not addressing climate change mitigation and 10% omitting adaptation. However, most NBSAPs lacked measurable indicators, with the exception of habitat protection (77%) and restoration and management (67%). Most countries with Indigenous populations did not involve them in strategy development (52%). Twenty percent of countries not only excluded Indigenous people, but local communities as well.

Implementation scored higher than the assessment and strategy sections, especially in capacity building (with the exception of biodiversity emergency planning and response), level of commitment, mainstreaming, and sustainable development. Of the 30 most biodiverse countries, 28 adopted their NBSAP as a "whole-of-government" instrument, and all 30 planned to involve multiple sectors of society in implementation. All 30 countries had existing environmental laws of some kind, and 28 suggested additional legislation. 27 countries had either Rights of Nature (in the case of Ecuador) or other nature protections (e.g., the right to a healthy environment) written in their Constitutions.[4] Most countries (83%) had legal or administrative mandates supporting their National Targets. Most NBSAPs contained tracking and reporting commitments (77%), detailed species and ecosystem monitoring plans (77%), and detailed funding plans (73%). Enforcement and access to nature were the weakest implementation categories, with 57% of countries including detailed enforcement commitments and 50% having strategies for ensuring equitable access to nature. Most countries (78% of those applicable) included plans for Indigenous and local community involvement.

[4] National Constitutions queried and examined at https://www.constituteproject.org/constitutions?key=env . The countries not including the environment were Australia, Japan, and Malaysia.

Fig. 2. Overall scores of National Biodiversity Strategies and Action Plans of the 30 most biodiverse CBD parties.

STATUS	0 Points	1 Point	2 Points
Assessment of current status of key species	Not discussed	General discussion	Specific and detailed; discusses multiple species
% of countries	10%	17%	73%
Assessment of current status of key habitats and ecosystems	Not discussed	General discussion	Specific and detailed; discusses terrestrial, freshwater, and/or marine
% of countries	7%	30%	63%
Mapping	No mapping of biodiversity	Mapped distribution of biodiversity OR key conservation areas	Mapped distribution of biodiversity AND key conservation areas
% of countries	47%	27%	27%
Drivers of Crisis			
Habitat Change	Not discussed	Discussed generally (e.g. 1 paragraph)	Discussed in detail, with specific examples, trends, etc.
% of countries	0%	37%	63%
Climate Change	Not discussed	Discussed generally (e.g. 1 paragraph)	Discussed in detail, with specific examples, trends, etc.
% of countries	13%	47%	40%
Invasive Species	Not discussed	Discussed generally (e.g. 1 paragraph)	Discussed in detail, with specific examples, trends, etc.
% of countries	7%	37%	57%
Overexploitation	Not discussed	Discussed generally (e.g. 1 paragraph)	Discussed in detail, with specific examples, trends, etc.
% of countries	7%	43%	50%
Pollution	Not discussed	Discussed generally (e.g. 1 paragraph)	Discussed in detail, with specific examples, trends, etc.
% of countries	17%	53%	30%
Interactions between drivers	Not discussed	Discussed generally (e.g. 1 paragraph)	Discussed in detail, with specific examples, trends, etc.
% of countries	33%	60%	7%
Accounts for range shifts and other ecosystem responses to change	Not discussed	General mention or one example	Discussed in detail, with specific examples, trends, etc.
% of countries	57%	37%	7%
Ecosystem Services to people	Not discussed	General discussion with 1-2 examples	Detailed discussion with multiple examples
% of countries	0%	30%	70%
Indigenous and local biodiversity status knowledge & priorities	Not discussed	Discusses indigenous OR local knowledge and conservation priorities	Discusses indigenous AND local knowledge and conservation priorities
% of countries	13%	23%	70%
Legal Framework	Not discussed	Discussed generally (e.g. 1 paragraph), or limited to national laws	Discusses/lists national AND subnational (provincial, state or local) laws
% of countries	3%	57%	40%

Colors	% of countries
Green	>90
Yellow	75-90
Orange	50-74.99
Red	<50

STRATEGY	0 Points	1 Point	2 Points	
Indigenous and local community involvement in strategy development	No	Includes indigenous OR local knowledge and conservation priorities	Includes indigenous AND local knowledge and conservation priorities	
% of countries	20%	37%	48%	
International cooperation and relationship to other conventions	Not discussed	General discussion	Detailed discussion with multiple examples	
% of countries	0%	10%	90%	
Strategies to Address Drivers of Crisis	Give one point each for GOALS/OBJECTIVES, STRATEGIES/ACTIONS (including general progress measures), MEASURABLE INDICATORS (with numeric targets and timelines)			
Habitat Protection	Not discussed	GOALS/OBJECTIVES	STRATEGIES/ ACTIONS	MEASURABLE INDICATORS
% of countries	0%	90%	100%	77%
Habitat Restoration & Management	Not discussed	GOALS/OBJECTIVES	STRATEGIES/ ACTIONS	MEASURABLE INDICATORS
% of countries	0%	100%	100%	67%
Climate Change Mitigation	Not discussed	GOALS/OBJECTIVES	STRATEGIES/ ACTIONS	MEASURABLE INDICATORS
% of countries	20%	67%	77%	17%
Climate Change Adaptation	Not discussed	GOALS/OBJECTIVES	STRATEGIES/ ACTIONS	MEASURABLE INDICATORS
% of countries	10%	83%	87%	30%
Invasive/Damaging Species Management	Not discussed	GOALS/OBJECTIVES	STRATEGIES/ ACTIONS	MEASURABLE INDICATORS
% of countries	3%	97%	93%	33%
Overexploitation Reduction	Not discussed	GOALS/OBJECTIVES	STRATEGIES/ ACTIONS	MEASURABLE INDICATORS
% of countries	0%	100%	90%	30%
Pollution Reduction	Not discussed	GOALS/OBJECTIVES	STRATEGIES/ ACTIONS	MEASURABLE INDICATORS
% of countries	7%	83%	87%	37%
Other recovery measures (captive breeding, reintroduction, etc.)	Not discussed	GOALS/OBJECTIVES	STRATEGIES/ ACTIONS	MEASURABLE INDICATORS
% of countries	10%	83%	83%	30%

IMPLEMENTATION	0 Points	1 Point	2 Points
Accountability	Not discussed	General discussion but no legal or administrative mandates	Contains legal or administrative mandates
% of countries	0%	17%	83%
Tracking and reporting progress, successes and failures	Not discussed	General discussion	Detailed discussion and commitments
% of countries	7%	17%	77%
Capacity building			
Science	Not discussed	Specific plan to increase capacity	
% of countries	0%	100%	
Coordination	Not discussed	Specific plan to increase capacity	
% of countries	0%	100%	
Administration	Not discussed	Specific plan to increase capacity	
% of countries	3%	97%	
Legislation	Not discussed	Specific plan to increase capacity	
% of countries	7%	93%	
Monitoring	Not discussed	Specific plan to increase capacity	
% of countries	0%	100%	
Enforcement	Not discussed	Specific plan to increase capacity	
% of countries	10%	90%	
Training	Not discussed	Specific plan to increase capacity	
% of countries	10%	90%	
Education	Not discussed	Specific plan to increase capacity	
% of countries	0%	100%	
Information sharing	Not discussed	Specific plan to increase capacity	
% of countries	3%	97%	
Local collaboration	Not discussed	Specific plan to increase capacity	
% of countries	0%	100%	
Biodiversity emergency/disaster planning and response	Not discussed	Specific plan to increase capacity	
% of countries	57%	43%	

IMPLEMENTATION	0 Points	1 Point	2 Points
Monitoring status of species, habitats, and ecosystems	Not discussed	General discussion	Detailed discussion and commitments
% of countries	0%	23%	77%
Funding	Not discussed	General discussion	Detailed discussion and commitments
% of countries	3%	23%	73%
Enforcement	Not discussed	General discussion	Detailed discussion of commitments and/or limitations
% of countries	10%	33%	57%
Level of Commitment	Not discussed	Just environment ministries or departments	Whole-of-government approach, legislation, environmental impact assessments, etc.
% of countries	0%	7%	93%
Involvement of diverse sectors of society in implementation (mainstreaming)	Not discussed	General discussion	Detailed discussion including economic, social, and cultural sectors (e.g. incentives)
% of countries	0%	0%	100%
Sustainable Development and Use	Not discussed	Discusses sustainable development OR sustainable use of organisms and genetic resources	Discusses sustainable development AND sustainable use of organisms and genetic resources
% of countries	0%	7%	93%
Indigenous and local community involvement in implementation	Not discussed	Includes indigenous OR local people	Includes indigenous AND local people
% of countries	0%	30%	78%
Access to Nature	Not discussed	General discussion	Detailed discussion and strategies for ensuring equitable access to nature
% of countries	13%	37%	50%

Comparison of national environmental and social variables

Variable correlations

Fig. 3 shows significant correlations between national variables for all CBD nation-state signatories with available data (n=156). Very strong correlations ($r > 0.8$, $p < 0.0001$; Chan 2003) existed between the Red List Index (RLI) and its change over time, the Human Development Index (HDI) and Sustainable Development Goals score (SDG), between the three corruption indices, and among the World Bank governance indicators. Correlations (all with $p < 0.0001$) also existed between the protection percentage of terrestrial and freshwater key biodiversity areas (0.74); press freedom and the three corruption indices (0.62-0.64); the development and corruption indices (0.64-0.73); the ecosystem protection score and the protection of key terrestrial biodiversity areas (0.61); and between ecosystem protection and lack of corruption ($r = 0.52$-0.58), press freedom (0.57), SDG (0.55), voice and accountability (0.55), rule of law (0.54), regulatory quality (0.53), and HDI (0.52). HDI and SDG were negatively correlated with population growth ($r = -0.56$ to -0.69, $p < 0.0001$); countries with higher rates of population growth tended to have lower levels of development and vice-versa.

The RLI and its change over time were negatively correlated with the number of vertebrate species ($r = -0.44$ to -0.51, $p < 0.0001$); the more species a country had, the more at-risk species it had. The RLI and its changes were somewhat positively correlated with ecosystem protection ($r = 0.33$-0.40, $p < 0.005$) and terrestrial key biodiversity area protection ($r = 0.33$, $p < 0.01$). Forest change was somewhat correlated with HDI and SDG (0.36, $p < 0.005$), with more developed countries exhibiting less forest loss.

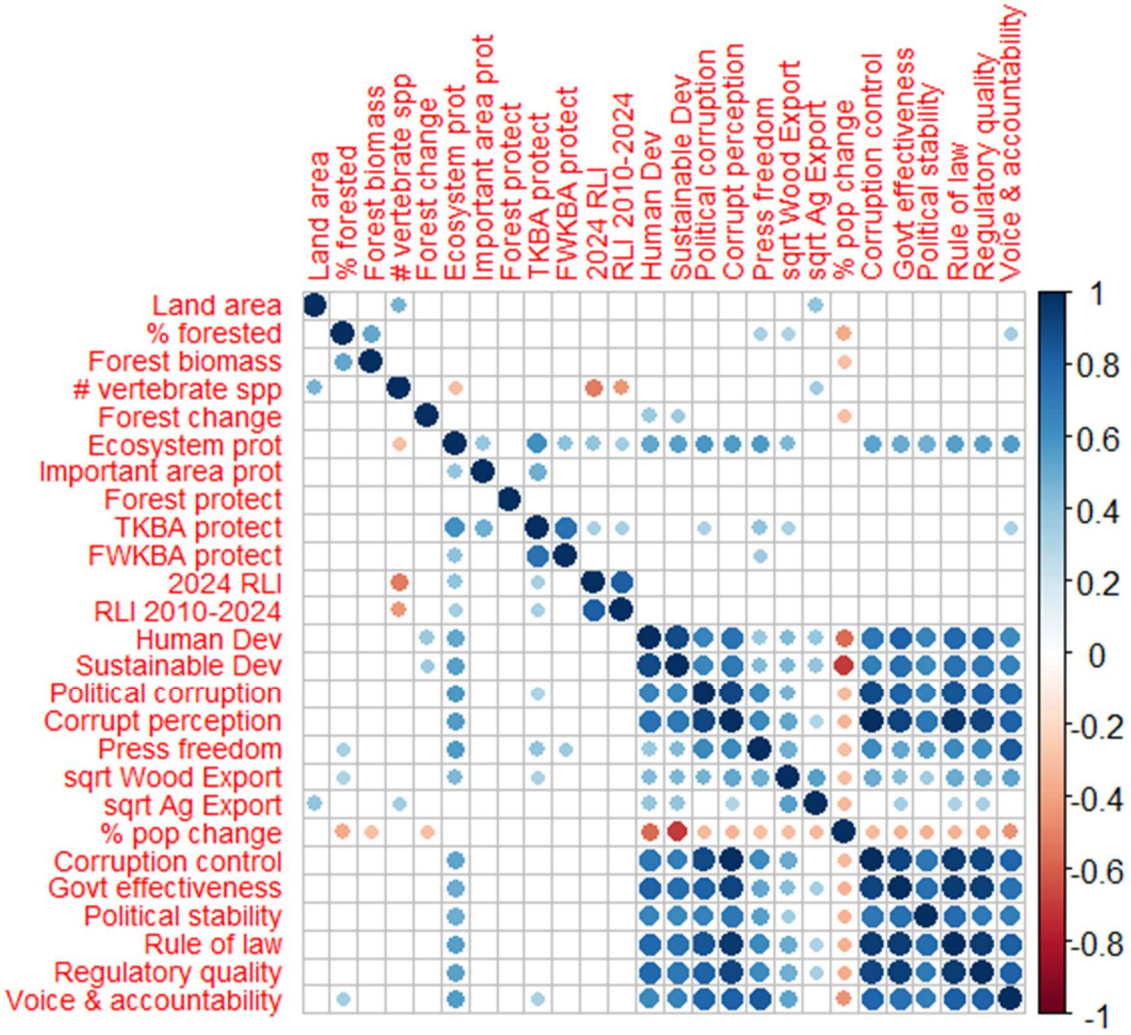


Fig. 3 Correlations between national variables for all countries (R package corrplot). After correcting for multiple comparisons, correlations with $p \geq 0.05$ were removed.

Model results

Table 7 lists the best linear models for all countries. Individual variable regressions and residual plots for the top models are contained in Appendix A (Figs. A1-A8). RLI and RLI decline were inversely proportional to the area of forest (similar to the inverse correlation with species richness) and positively related to ecosystem protection and press freedom. The forest change model was weakly associated with ecosystem protection, corruption perception, and rate of population increase. The ecosystem protection models were much stronger than the other models, showing positive relationships with protection of important biodiversity areas, progress toward sustainable development goals, and press freedom. GAM fitting improved all but one of the models, but not dramatically.

Table 7. Top models of biodiversity decline, forest loss, and ecosystem protection for CBD nation-state signatories.

Dependent variable	Top models	Linear model R^2	Linear model AIC	GAM R^2
2024 Red List Index	$\sqrt{Forest\ Percent} + Ecosystem\ Vitality\ Score + Press\ Freedom + Voice\ \&\ Accountability$	0.320	-459.9	0.303
	$\sqrt{Aboveground\ Forest\ Biomass} + Ecosystem\ Vitality\ Score + Press\ Freedom + Voice\ \&\ Accountability$	0.311	-458.2	0.335
Red List decline 2010-2024	$\sqrt{Forest\ Percent} + Ecosystem\ Vitality\ Score + Press\ Freedom + Rule\ of\ Law$	0.222	-1401.8	0.244
	$\sqrt{Aboveground\ Forest\ Biomass} + Ecosystem\ Vitality\ Score + Press\ Freedom + Voice\ \&\ Accountability$	0.221	-1401.7	0.240
Forest loss 2010-2020	$Global\ Safety\ Net\ Protection + Corruption\ Perception + Pop.Change\ 2010-23$	0.184	334.1	0.244
	$Global\ Safety\ Net\ Protection + Corruption\ Perception + Population\ Change\ 2010-23 + Rule\ of\ Law$	0.187	334.5	0.240
Level of ecosystem protection	$Global\ Safety\ Net\ Protection + Terrestrial\ KBA\ Protection + Sustainable\ Development\ Goals + Press\ Freedom$	0.591	-286.9	0.606
	$Terrestrial\ KBA\ Protection + Sustainable\ Development\ Goals + Press\ Freedom + Population\ Change\ 2010-23$	0.584	-284.8	0.599

Data analyses of the 30 most biodiverse countries

Biodiversity trends

The most biodiverse countries lost 0.17% of their forest area per year since the 2010 Nagoya summit, which was down from the prior decade (0.27%/year). Unfortunately, species losses in these countries accelerated, with the RLI decreasing 0.24%/year on average between 1993-2010 and 0.29%/year between 2010-2024. Globally, the RLI decreased 0.35%/year on average between 1993-2010 and 0.44%/year between 2010-2024, to a score of 0.72127. On average, key biodiversity areas were ~40% protected as of 2023.

Variable correlations

Fig. 4 shows significant correlations between national variables for the 30 most biodiverse CBD signatories. The smaller sample size reduced the number of significant correlations compared to the set of all CBD nation-state signatories. Similar to the case of all countries, highly significant correlations ($p < 0.0001$) existed between HDI and SDG ($r = 0.93$); between the three corruption indices (0.85-0.99); among the World Bank governance indicators (0.71-0.94); between the protection percentage of terrestrial and freshwater key biodiversity areas (0.75); the RLI and its change over time (0.74); and HDI and corruption perception (0.70). HDI and SDG were negatively correlated with population growth ($r = -0.76$ to -0.82, $p < 0.001$); countries with higher rates of population growth tended to have lower

levels of development and vice-versa. This relationship was stronger for the top 30 countries than for the set of all countries. The NBSAP scores and sub-scores did not significantly correlate with other variables.

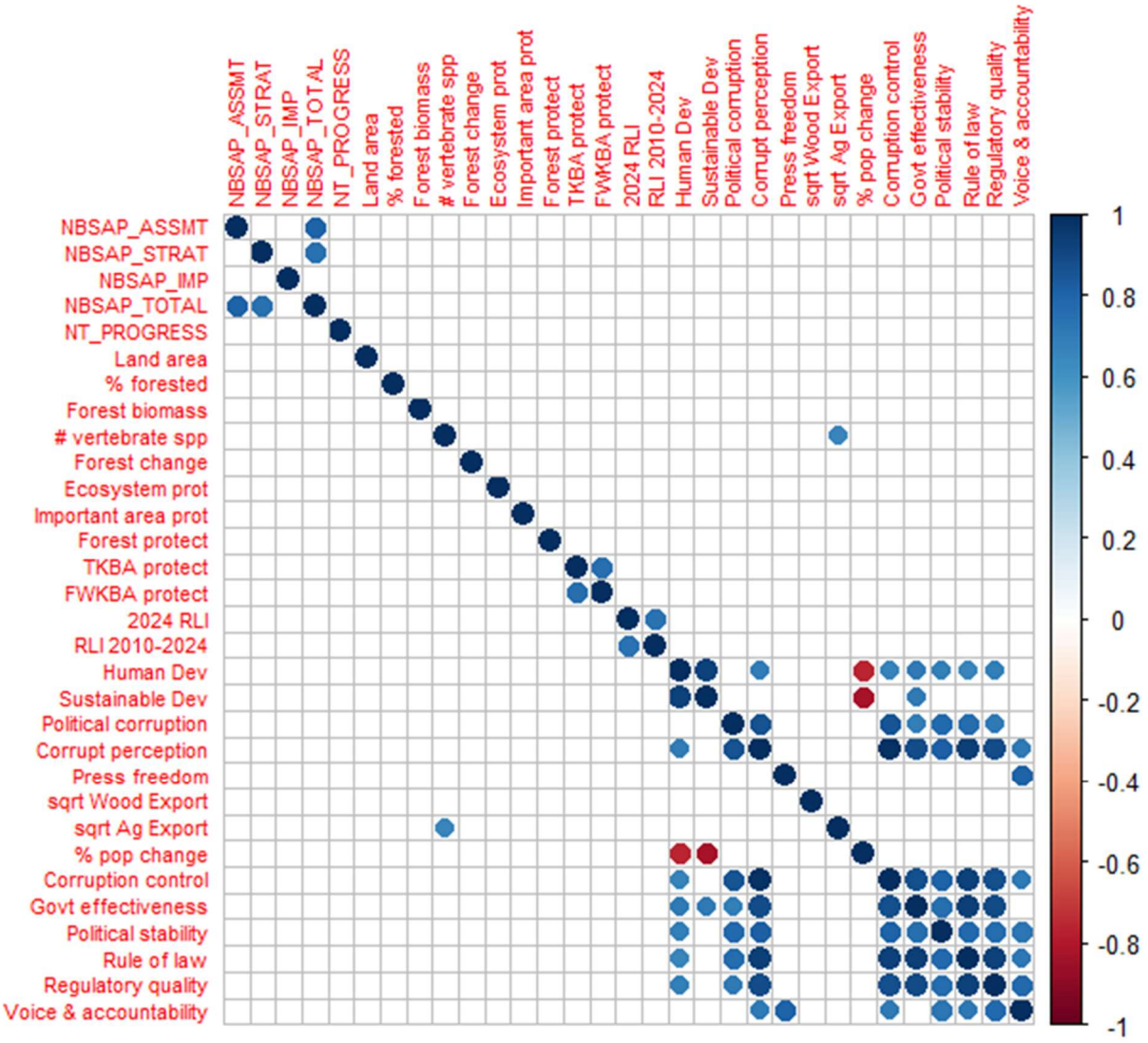


Fig. 4 Correlations between national variables for the 30 most biodiverse CBD signatories (R package corrplot). After correcting for multiple comparisons, correlations with $p \geq 0.05$ were removed.

Model results

Table 8 lists the best models for the 30 most biodiverse signatories. Appendix A contains associated variable regressions and residual plots (Figs. A9-A16). RLI was positively related to terrestrial KBA protection and press freedom and negatively related to freshwater KBA protection and legal system strength. Red List decline was lower with greater degrees of ecosystem protection, but was inversely related to biologically important area protection and corruption perception. Forest loss was greater in countries with more forest and greater press freedom, but lower in countries with more political stability and stronger legal systems. As with all countries, the ecosystem protection models were stronger than the other models, and showed positive relationships with biologically important area protection, human and sustainable development, and press freedom. It was negatively related to legal system strength, but the data was highly scattered. Unlike the case for all countries, GAM fitting improved the biodiversity and forest loss models quite a bit, although we did not attempt to interpret the curves and make no associated inferences.

Two countries were notable outliers. Angola had the highest RLI among the 30 most biodiverse countries, but relatively low conservation, governance, and social indices. Ecuador had the lowest RLI and greatest decline since 2010 but had mid-range scores for conservation and governance.

Table 8. Top models of biodiversity decline, forest loss, and ecosystem protection for the 30 most biodiverse CBD signatories.

Dependent variable	Top models	Adjusted R^2	Model AIC	GAM R^2
2024 Red List Index	$Press\ Freedom + Voice\ \&\ Accountability$	0.193	-100.5	0.313
	$Terrestrial\ KBA\ Protection + Freshwater\ KBA\ Protection + Press\ Freedom + Rule\ of\ Law$	0.239	-100.5	0.439
Red List decline 2010-2024	$Ecosystem\ Vitality\ Score + Global\ Safety\ Net\ Protection + Corruption\ Perception$	0.336	-275.9	0.383
	$Ecosystem\ Vitality\ Score + Global\ Safety\ Net\ Protection + Political\ Corruption + Corruption\ Perception$	0.349	-275.65	0.535
Forest loss 2010-2020	$\sqrt{Forest\ Area\ Pct} + Press\ Freedom + Political\ Stability + Rule\ of\ Law$	0.466	28.86	0.691
	$\ln(Land\ Area) + \sqrt{Forest\ Area\ Pct} + Press\ Freedom + Rule\ of\ Law$	0.528	29.87	0.735
Level of ecosystem protection	$Global\ Safety\ Net\ Protection + Human\ Development\ Index + Press\ Freedom + Rule\ of\ Law$	0.714	-68.90	0.683
	$Global\ Safety\ Net\ Protection + Sustainable\ Development\ Goals + Press\ Freedom + Rule\ of\ Law$	0.681	-65.82	0.673

Examination of National Reports of the 30 most biodiverse countries

Progress toward achieving national biodiversity targets

All of the 30 most biodiverse CBD parties submitted Sixth NRs between 2018 and 2020. Of these, 26 of these countries graded their progress toward achieving their national biodiversity targets. On average, countries reported that 41% of their national targets were on track to meet or exceed their goal (SD = 29%), and that they were making at least some progress on 88% of targets (SD = 16%).

For Aichi Target 12 ("By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained"), six countries reported being on track, 14 reported making progress but at an insufficient rate, one country reported no progress, and nine countries did not report on this metric.

Reported progress toward national biodiversity targets, which was normally distributed, was uncorrelated with the strength of the country's NBSAP, nor was it significantly correlated with other variables (e.g., biodiversity change, forest loss, or ecosystem protection). In fact, the countries reporting being on track to reducing extinction risk all had Red List declines between 1.4 and 7.2% since the Aichi Targets were adopted, averaging worse (-5.15%; n = 6) than countries that reported not being on track (-3.77%; n = 15).

Large Language Modeling review and manual examinations of National Reports

Copilot was much better at summarizing information from the NRs than reporting individual sample actions, which tended to be inaccurate or vague. We replaced these with actions gleaned from the manual reviews. Table 9 lists potential strategies and sample actions reported by countries in their Sixth NRs to address the five key drivers of biodiversity loss. Table 10 lists common barriers to biodiversity conservation success, some possible solutions to these barriers, and sample actions reported by countries in their Sixth NRs. Copilot queries of NRs were informative but not always accurate. Inaccurate information was deleted and replaced by other relevant actions reported in NRs.

Table 9. Sample strategies and actions to address the five key drivers of biodiversity loss. These lists are not exhaustive, and the sample actions may have been taken by countries in addition to those listed in parentheses.

Driver of biodiversity loss	Strategies	Sample actions
Habitat loss and degradation	• Establish, expand, and manage protected areas (e.g., national parks, nature and marine reserves). • Large-scale reforestation and other ecological restoration projects. • Implement policies for sustainable land use planning and management practices,and habitat impact avoidance, minimization, and mitigation. • Recognize and support Indigenous and local community land stewardship. • Create Indigenous and local community forest reserves. • OECMs (Other Effective area-based Conservation Measures: managed areas that deliver effective conservation of biodiversity regardless of whether that is the goal). • Create a national land monitoring system using remote imagery, GIS, and on-the-ground reporting. • Enforce bans on illegal mining and clearcutting. • Require restoration of mined and otherwise disturbed areas. • Recognize the value of nature in law, regulations, policy, and society. • Require environmental impact assessments for projects with significant possible habitat effects.	• Expansion of protected areas (e.g., Brazil, Costa Rica, DRC). • Protection and management of imperiled species habitat (Indonesia). • A Policy on Protected Areas supports the development and management of a National Protected Area Network (Papua New Guinea). • Use of OECMs, e.g., biosphere reserves, community conserved areas, known sacred groves, notified eco-sensitive zones (India). • Indigenous Community Conserved Areas (Philippines). • Territorial and environmental management plans on Indigenous lands (Brazil, Colombia). • Creation of corridors linking protected areas (India). • Eco-sensitive zones around national parks to limit human impact (India). • Community forest management (Thailand). • Regular satellite monitoring to detect illegal logging and fires (Brazil). • When areas with higher illegal deforestation risk are identified, rural landowners are monitored and receive alert messages about the need to require prior authorization before clearing any vegetation, along with the administrative, civil and criminal consequences of illegal deforestation (Brazil). • Peatland Restoration Agency created to restore 2.4 million ha of peatland habitat between 2016-2020 (Indonesia). • Moratorium on permits for the utilization of primary natural forests and peatlands (Indonesia). • Provided environmental guidelines to mining companies and identified areas closed to mining (Philippines). • Intensive and permanent program, including local communities, to combat illegal logging in the Monarch Butterfly Biosphere Reserve (Mexico). • Payment for ecosystem services to local farmers to prevent logging and incentivize reforestation (Mexico, Costa Rica). • Management effectiveness evaluation of protected areas (India). • Ecotourism and sustainable harvesting programs supporting livelihoods (Madagascar, Costa Rica). • Rights of nature enshrined in law (Bolivia, Ecuador, Panama).
Overexploitation of species	• Protect endemic species by legislation and regulations. • Strengthen and enforce anti-poaching laws and fisheries management (e.g., quotas, bans on illegal trade). • Encourage eco-friendly hunting, fishing, and harvesting practices. • Enforce the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) to regulate wildlife trade.	• Pass legislation protecting at-risk species (e.g., India's Wild Life Protection Act). • Establish Marine Protected Areas (MPAs) and MPA networks, with community participation in protection (Philippines). • Create a statutory body to combat organized wildlife crime in the country (e.g., India's Wildlife Crime Control Bureau).

Driver of biodiversity loss	Strategies	Sample actions
	• Monitor at-risk species. • Support communities that rely on wildlife exploitation with sustainable income sources. • Involve local communities in habitat and wildlife monitoring. • Require sustainable forestry, including tagging logs with origin coordinates and inspecting logging trucks to ensure compliance. • International and regional fishing management organizations. • Use of technology like satellite imagery, drones, GPS collars, cameras, and artificial intelligence.	• Heightened security and penalties against poaching (Kenya). • Illegal Fishing Eradication Task Force established under presidential authority, including elements of the armed forces. Vessels caught fishing illegally are burned and sunk (Indonesia). • Prohibition on the use of trawls and seine nets (Indonesia). • Intensified surveillance of illegal fishing practices, particularly dynamite fishing and use of illegal fishing gear (Tanzania). • Fishing bans to protect the reproduction and growth of fish in marine areas and rivers (China). • Prohibit harvest of threatened and endangered tree species (Tanzania). • Take strict control measures to regulate import, export and reexport of economically valuable but rare plant species like rosewood, teak, and orchids (Thailand, Myanmar). • Collect and propagate species of imperiled plants and reintroduce them into natural habitats (Thailand).
Climate change	• Pass legislation and adopt regulations and policies to reduce GHG emissions, capture CO_2, and increase resilience. • Promote renewable energy. • Protect mangroves, forests, and wetlands to store carbon and reduce climate impacts like flooding. • Integrate biodiversity protection into Nationally Determined Contributions under the Paris Agreement. • Assisted migration and genetic conservation of vulnerable species. • Reforestation and other ecosystem-based carbon sequestration projects. • Integrate climate adaptation and mitigation strategies into biodiversity conservation efforts. • Encourage waste reduction, recycling, and sustainable production and consumption patterns (circular economy). • Implement nature-based solutions for humans such as reforestation, wetland restoration, and agroecology. • Implement nature-based solutions to enhance ecosystem resilience. • Expand protected area networks. • Restore degraded habitats. • Integrate climate adaptation measures into biodiversity strategies and vice-versa.	• Use of REDD+ to reduce emissions from deforestation and forest degradation, while also fostering conservation, sustainable management of forests, and enhancement of forest carbon stocks. Developing countries can receive results-based payments for emission reductions when they reduce deforestation (e.g., Brazil, Colombia, DRC, Peru). • Include biodiversity considerations in climate change mitigation and adaptation strategies and plans (DRC). • A General Law on Climate Change aligns government entities on climate, incentivizes the development of renewable energies, and funds actions (Mexico). • Reducing deforestation and reforesting 12 million hectares by 2030 (Brazil). • Committed to restore 5.1 million ha of degraded landscapes, a 50% reduction of greenhouse gases from the forest sector by 2030 as part of its Nationally Determined Contribution to climate change, and to achieve land degradation neutrality by 2030 (Kenya). • Grassroots tree-planting initiatives, including a National Tree Planting Day (Kenya). • Partnering with carbon credit programs to fund mangrove and other forest restoration (Kenya). • Develop community-based restoration programs for key ecosystems, including protected areas, conservation areas, and sustainable use zones, to strengthen climate adaptation and mitigation capacity (Madagascar). • Control crown-of-thorns starfish to improve Great Barrier Reef resilience (Australia).

Driver of biodiversity loss	Strategies	Sample actions
		• Restoration and maintenance of mangrove and beach forests to protect against storm surges and erosion (Philippines, Thailand). • Relocation of climate-threatened species to more suitable habitat (Australia). • Environmental Fiscal Strategy to improve the quality of public expenditure, finance the improvement of environmental quality and the fight against climate change, and incorporate green fiscal policies (Guatemala).
Pollution	• Implement policies and practices to reduce pesticide and fertilizer use. • Improve waste collection and management. • Treat wastewater and other pollutants to non-harmful levels before allowing their discharge into waterways. • Capture, detain, and filter stormwater and farm field runoff before it enters waterways (e.g., using riparian buffers or restored or created wetlands). • Ban or restrict single-use plastics and improve recycling systems. • Strengthen regulations on industrial pollution and emissions. • Implement the Stockholm Convention on hazardous chemicals and persistent organic pollutants. • Educate the public about the impacts of pollution and encourage sustainable practices.	• Reforestation, wetland restoration and riparian buffers to reduce agricultural runoff and improve water quality in the Yangtze River Basin (China). • Green labeling to encourage production and consumption of products that use resources and energy efficiently (Vietnam). • National River Conservation Plan to reduce the pollution load of rivers and improve water quality (India). • Freshwater quality standards set and enforced (Cameroon). • Water quality surveys to monitor effects of controlling pollutant loads (India, Japan). • Ban on polystyrene containers in national parks, along with a campaign to reduce single-use plastic bags, bottles, spoons and straws (Thailand). • Control of particulate emissions from coal plants (China). • The Indigenous community of Terian practices “use and care” of water catchments and opposes pollution and dams (Malaysia). • Removal of abandoned, lost or discarded fishing nets in the Upper Gulf of California (Mexico).
Invasive species	• Implement biosecurity measures at ports and borders. • Create other early detection programs. • Remove invasive species from key ecosystems (e.g., rats from island habitats) and invasive species with significant impacts. • Restrict the movement of high-risk invasive species through laws and agreements. • Educate the public and stakeholders on preventing the spread of invasive species. • Conduct regular monitoring and eradication programs. • Enhance international cooperation to address cross-border threats. • Ballast water control and management to prevent the spread of invasive marine species.	• Inspections for alien pest species at border crossings (South Africa). • Early warning systems to detect and respond quickly to species invasions (Chile). • Monitoring and control of invasive species in protected areas (Argentina). • Legislation passed to require all state-owned land and municipalities to develop invasive species monitoring, control and eradication plans (South Africa). • Over 500 species listed and categorized according to risk as species to be combatted/ eradicated by landholders (South Africa). • Feral cat culling programs (Australia). • Eradicate invasive alien species from the Galapagos and monitor ecosystems during restoration (Ecuador). • Awareness and inspection programs at ornamental fish outlets to curb the illegal trade of aquatic endangered species and invasive alien species (Malaysia).

Table 10. Barriers to conservation success, possible solutions, and sample actions reported by countries in their Sixth National Reports. These lists are not exhaustive, and the sample actions may have been taken by countries in addition to those listed in parentheses.

Barriers to success	Possible solutions	Sample actions by countries
Weak governance and policy implementation: • Ineffective governance and lack of coordination among various governmental and non-governmental entities impede the implementation of biodiversity policies. • Gaps between biodiversity policies and their implementation. • In some regions, the legal and regulatory frameworks for biodiversity protection are either weak or poorly enforced. • Outdated or inconsistent legal frameworks that fail to support effective conservation measures. • Insufficient political support and commitment to biodiversity goals. • Lack of political will to prioritize biodiversity issues in national development agendas. • Balancing economic growth with conservation efforts is challenging, as development often takes precedence over environmental protection. • Shifts in political priorities can lead to fluctuating support for biodiversity conservation.	• Enshrine biodiversity and nature protection in law. • Establish governmental institutions or task forces dedicated to biodiversity governance. • Enhance governance structures and improve coordination among different sectors and levels of government. • Establish clear roles and responsibilities. • Integrate biodiversity considerations into other policy areas, such as agriculture, forestry, and urban planning, to create more cohesive and effective strategies. • Develop comprehensive policy and governance frameworks to improve coordination among various sectors and levels of government. • Implement stricter laws and regulations to protect endangered species and habitats. • Strengthen environmental laws and enforcement mechanisms to combat illegal deforestation, wildlife trafficking, and habitat destruction. • Implement anti-corruption measures to improve transparency and governance in conservation efforts. • Ensure that conservation initiatives are durable and survive political changes.	• Biodiversity protection/stewardship enshrined in Constitution (e.g., Bolivia, Ecuador, India, Papua New Guinea, Mozambique). • Conservation regulations established to protect critical habitats (Philippines). • Dedicated education, awareness, discussion and negotiation to gain a strong community and governance consensus (Papua New Guinea). • Workshop of experts from government, academia and civil society convened to assess progress for National Report (Mexico). • The Environmental Sector Local Government Support Strategy provides a coordinated and structured approach to strengthening environmental governance, sustainability, and climate resilience at the local government level (South Africa). • Monitoring of biodiversity initiatives at three levels: local government, by environment coordinators at sector ministries, and the Vice President's Office, which provides overall monitoring and evaluation (Tanzania). • Environmental strategies and action plans evaluated every five years, aimed at improvements and inclusion of new issues (Tanzania). • Adaptive management of protected areas (Mozambique). • Ensure conservation continuity through long-term planning (Kenya).
Insufficient institutional capacity and technical expertise: • Many countries report a lack of technical expertise and institutional capacity to effectively manage and implement biodiversity conservation programs. • Lack of trained personnel and expertise in biodiversity management.	• Training programs for government officials and staff in biodiversity conservation, ecosystem-based management, GIS mapping, and conservation finance. • Other initiatives to enhance the skills and technical expertise of personnel involved in biodiversity conservation. • Train conservation practitioners and local communities in biodiversity management and sustainable practices. • Expand national biodiversity databases and species monitoring programs.	• Establish training centers for conservation practitioners (Mexico, Indonesia). • Technicians, students, and community members trained in taxonomy and conservation (Mozambique). • Professional qualification through courses on biodiversity-related themes (Brazil). • Teach remote sensing techniques to combat deforestation (Brazil). • Technical assistance programs to support local conservation efforts (India).

Barriers to success	Possible solutions	Sample actions by countries
• Inadequate data collection, monitoring, and reporting systems make it difficult to track progress and adapt strategies effectively. • A lack of technical expertise and capacity within institutions can hinder the development and implementation of effective biodiversity strategies. • Inadequate research and data collection infrastructure to support evidence-based policymaking. • Limited use of technology and modern monitoring tools for biodiversity conservation.	• Enhance knowledge sharing and technology transfer. • Strengthen partnerships with universities and research institutions. • Support scientific studies to inform policy decisions. • Offer and fund university degrees in biology, ecology, environmental science, conservation, environmental law, and related topics. • Integrate traditional knowledge of Indigenous peoples and local communities.	• Groen Sebenza brings youth from disadvantaged backgrounds together with experienced biodiversity professionals to learn, grow and eventually embark on biodiversity careers (South Africa). • Environmental and biodiversity related issues mainstreamed in school programs and with specific technical focus in higher education (Cameroon). • Post-graduate courses in conservation biology offered at universities (Myanmar). • Dialogue with Indigenous peoples on knowledge of biodiversity in their territories (Colombia). • Competitive research funds (Japan). • Publish open-access biodiversity journals (Venezuela).
Poor coordination among government agencies: • Poor coordination and cooperation among different government agencies and levels of government (national, regional, local) can lead to inconsistent policies and ineffective implementation. • Fragmentation of responsibilities across multiple ministries (e.g., environment, agriculture, fisheries) without clear coordination leads to inefficiency, duplication of efforts, and strategy incoherence. • Conflicting mandates between agencies, leading to ineffective decision-making. • Limited collaboration between national, regional, and local authorities.	• Define a responsible entity (e.g., President's office or environment ministry) to coordinate implementation, with an advisory body (e.g., commission) serving as the central body for advice and monitoring. • Create inter-ministerial/interagency committees or task forces to improve coordination between government agencies, private sectors, and civil society. • Place biodiversity coordinating and implementation bodies with knowledgeable personnel in all sector ministries and local government bodies. • Strengthen local governance structures to empower regional and municipal authorities in conservation efforts. • Develop integrated conservation strategies to enhance collaboration. • Develop partnerships across sub-national jurisdictions.	• A ministry (MINAM) leads the NBSAP implementation process and a commission (CONADIB) serves as the central body for advice and monitoring (Peru). • Revised NBSAP attempts to harmonize the legal and regulatory frameworks at all levels of government to support institutions and coordinate functions, with citizen participation (Mexico). • The Biodiversity Management Bureau coordinates the implementation and mainstreaming of the NBSAP into the plans and programs of national government agencies, local government, government-owned corporations, government financial institutions, and state universities (Philippines). • The Strategic Investment Framework for sustainable land management addresses land management issues through multi-sectoral, multi-stakeholder partnerships and collaboration (Kenya). • Eight Amazonian states participate in the Governors' Task Force for Climate and Forest, an international body that seeks synergy of actions for reducing emissions of greenhouse gases from deforestation and forest degradation (Brazil). • The Amazon Program strengthens collaboration and coordination between government entities as well as with the private sector, coordinates territorial planning, promotes more sustainable and deforestation-free agricultural practices, promotes sustainable forest management, conservation and

Barriers to success	Possible solutions	Sample actions by countries
		restoration in forested areas, and supports the application of regulations and traceability systems (Ecuador).
Insufficient integration of biodiversity into other sectors: • The existence of fragmented and sometimes conflicting policies across different sectors (e.g., agriculture, forestry, urban development) creates challenges in integrating biodiversity goals. • Biodiversity concerns are often sidelined in key sectors like agriculture, urban planning, and industry. • Weak inclusion of biodiversity considerations in national economic and development policies. • Conflicting land use priorities has led to the conversion of natural habitats into agricultural land. • Urban development projects have encroached on protected areas, leading to habitat loss. • Competition between conservation and industrial development has resulted in the degradation of critical ecosystems. • Conflicts between conservation and tourism development can affect the integrity of protected areas.	• Integrate biodiversity considerations into other policy areas (e.g., agriculture, forestry, economic, and urban planning) to create more cohesive and effective strategies. • Integrate biodiversity conservation and recovery into national development and work plans. • Make environmental impact assessments and strategic environmental assessments mandatory for large-scale projects, and require that biodiversity impacts be avoided, minimized, or mitigated. • Develop cross-sectoral coordination mechanisms. • Promote the valuation of ecosystem services in decision-making. • Promote sustainable agriculture and forestry practices that conserve biodiversity. • Adopt nature-based solutions that incorporate biodiversity into climate adaptation strategies, reforestation programs, and sustainable agriculture initiatives.	• Integrate NBSAP into the national development plan (Indonesia, Venezuela, Bolivia). • Integrate NBSAP into the annual Government Work Plan (Indonesia). • Natural capital accounting and valuation of ecosystem services add values provided by nature to decision and policy making (South Africa). • Biodiversity conservation was integrated in the planning, implementation, and monitoring of all development projects and tenurial instruments issued by the Department of Environment and Natural Resources (Philippines). • Integrated biodiversity conservation into policies, strategies, plans, and programs of relevant sectors, as well as inter-sector areas (Vietnam). • Integrate biodiversity into development and poverty reduction programs in all sectors of economic activity (Angola). • Integrate the NBSAP within sector strategies and fund associated projects, coordinated by MINEPDED (Cameroon). • Establish zoning regulations to manage land use and protect biodiversity (Kenya). • The Integrated Environmental Management process integrates environmental assessment and management into decision-making (South Africa). • Reduce diver and snorkeler impacts on corals by installing tie-up buoys in dispersed locations (Panama).
Weak enforcement of laws and regulations: • Ineffective implementation and enforcement of biodiversity-related laws. • Lack of enforcement of environmental laws results in illegal logging and poaching in protected areas. • Ineffective enforcement of regulations contributes to habitat destruction.	• Ensure that agencies have the necessary tools, personnel, and financial resources to effectively enforce laws. • Introduce stricter penalties for non-compliance and illegal activities like deforestation, poaching, and pollution. • Improve coordination among different government agencies and sectors to help streamline enforcement efforts. This involves creating clear communication channels and collaborative frameworks.	• Increased penalties for poaching (Kenya). • 24-hour hotline to report poaching and illegal destruction of forest and other natural ecosystems (Thailand). • Strengthening legal frameworks and monitoring systems enhanced the effectiveness of biodiversity conservation (Malaysia). • Partnerships between local residents and law enforcement agents (Brazil).

Barriers to success	Possible solutions	Sample actions by countries
• Corruption and lack of transparency and accountability in governance can undermine conservation efforts. • Shortage of trained forest rangers and game wardens. • Shortage of available resources (transportation, fuel, etc.) to monitor remote areas.	• Strengthen legal frameworks and monitoring systems. • Ensure that environmental laws are clear, comprehensive, and enforceable. This may involve updating existing laws, closing legal loopholes, and establishing strong penalties for violations. • Increase community and civil society involvement in enforcement efforts. This includes participatory monitoring and community-based enforcement initiatives. • Hire rangers from local communities to patrol protected areas, and provide the necessary tools, training, and compensation. • Establish transparent processes and accountability mechanisms to ensure that enforcement actions are fair and effective. This includes regular reporting, independent audits, and public access to information. • Implement anti-corruption measures within environmental agencies and enforcement bodies. This can involve strict ethical guidelines, whistleblower protections, and robust oversight mechanisms. • Leverage technology, such as remote sensing, drones, and data analytics to improve monitoring and enforcement capabilities. These tools can help detect violations and gather evidence more efficiently.	• The intensified enforcement of national and local forest laws and regular biodiversity assessments have improved the protection and management of forests (Philippines). • The National Integrated Strategy to Combat Wildlife Trafficking helps consolidate and coordinate law enforcement efforts against wildlife trafficking (South Africa). • The National Strategy to Reduce Illegal Wildlife Trafficking aims to reduce illegal wildlife trade by disseminating information to raise awareness, creating conditions for stricter law enforcement, strengthening multisector alliances, and collaborating with border countries and transit or destination countries (Peru). • Established the Forest Traceability and Control System, oriented toward the use of advanced technological tools, to strengthen the control of illegal logging and transport of forest products (Panama). • The Programa Nacional de Protección de los Bosques Nativos provides enforcement authorities with technical capacities to formulate, monitor, supervise and evaluate the Sustainable Management Plans for the native forests present in their territories (Argentina).
Data gaps and monitoring challenges: • Insufficient data to assess species locations, population status, suitable habitat, and trends. • Data deficiency makes it difficult to assess the status of biodiversity and monitor the impact of conservation efforts. • Inadequate data collection and management systems have hindered effective conservation planning. • Lack of comprehensive biodiversity data can impede the formulation of evidence-based conservation policies. • Inadequate measurements of progress.	• Enhance data collection, monitoring, and reporting systems to better track progress and adapt strategies as needed. • Expand biodiversity monitoring programs. • Set up indicators, regular reporting requirements, and independent reviews. • Create centralized systems to collect and share data on species and ecosystems. • Invest in biodiversity monitoring and research programs. • Develop standardized indicators and reporting frameworks. • Incorporate and promote citizen science. • Increase use of satellite imagery, drones, GIS, big data, citizen science, and artificial intelligence for habitat monitoring, tracking deforestation and fires, identifying	• Conducts floral and faunal surveys for taxonomic identification and enumeration (India). • Uses satellite and field data to survey and report forest cover, carbon stocks, and changes every two years (India). • Uses satellite imagery and drones to help monitor forest loss and fires (Brazil). • Collected comprehensive biodiversity-related data in online platforms to support scientific knowledge, public policy development and decision making (Brazil). • Use of video cameras to monitor wildlife (Indonesia). • Digitization and systematization of biological collections (Mexico).

Barriers to success	Possible solutions	Sample actions by countries
	illegal mining, poaching, and fishing, and species population trends. • Establish open-access biodiversity databases and national clearing-house mechanisms to facilitate information and data sharing and improve transparency and decision-making.	• The State Studies on Biodiversity compiles and analyzes all aspects related to nature conservation at the local scale, which constitutes the baseline for local action plans (Mexico). • Expansion of national biodiversity databases and species monitoring programs enhanced data collection and analysis (Australia). • Support for citizen science monitoring projects (South Africa). • Development of online flora databases (e.g. eFlora of India) provides information for conservation management in specific regions (India). • The National Biodiversity Information System is intended to harness, organize, refine, synthesize and manage biodiversity information and knowledge, to ensure that it is widely accessible and supports research, policy-development and decision-making (South Africa). • Research on functional ecology and the functional attributes of species allows greater precision in biodiversity management (Colombia).
Insufficient funding: • Many countries struggle with inadequate financial resources to support biodiversity conservation efforts. This includes both domestic funding and international financial support. • Underfunded environmental ministries and biodiversity programs. • Budget cuts impact the ability to maintain and expand protected areas, as well as monitoring, enforcement, research, education, habitat restoration and management, and other priorities. • Dependency on short-term or donor-driven funding instead of sustainable financial mechanisms. • Bureaucratic inefficiencies in fund allocation and use.	• Increase domestic budget allocations for biodiversity conservation, restoration, and management. • Create dedicated environmental funds to support conservation projects. • Redirect subsidies that harm biodiversity, such as those for fossil fuels or unsustainable agriculture, toward conservation efforts. • Mobilize additional financial resources through public-private partnerships. • Encourage businesses to invest in biodiversity-friendly practices and corporate social responsibility initiatives. • Explore innovative financing mechanisms such as biodiversity trust funds, payments for ecosystem services, carbon credits, biodiversity offsets, and green bonds to support conservation efforts. • Obtain financial assistance from international organizations such as the Global Environment Facility , the Green Climate Fund, UNDP, World Bank, and private sector investors.	• The Global Environment Facility is a multilateral environmental fund that provides grants and blended finance for projects related to biodiversity and the environment. • The Biodiversity Finance Initiative is developing a methodology for quantifying biodiversity finance, improving cost effectiveness of conservation through mainstreaming of biodiversity in national development and planning, and suggesting ways to mobilize additional resources. • The Green Climate Fund provides financial support to developing countries for climate change mitigation and adaptation projects. • Pro-environment tax structure to reduce pollution, internalize negative externalities, and encourage more sustainable production and consumption (Guatemala). • Payment for ecosystem services frameworks to generate funding for conservation initiatives and habitat restoration (Brazil, Costa Rica, Mexico).

Barriers to success	Possible solutions	Sample actions by countries
	• Encourage philanthropic contributions from foundations and individuals.	• Biodiversity or conservation trust funds to ensure sustainable financing for biodiversity projects (Costa Rica). • Redirect damaging agricultural subsidies toward more sustainable practices (Ecuador). • The Biodiversity Offset Market Platform facilitates the mobilization of private sector resources for biodiversity (Colombia).
Inadequate public and stakeholder engagement and participation: • Public understanding of biodiversity's importance is often limited, leading to insufficient support for conservation initiatives. • Lack of public awareness contributes to habitat destruction, illegal logging and wildlife trade, and other negative impacts. • Inadequate involvement of local communities, Indigenous peoples, and other stakeholders in decision-making processes weakens the effectiveness of biodiversity initiatives. • Limited involvement of Indigenous communities, local organizations, and the private sector in biodiversity governance. • Weak mechanisms for community-based conservation initiatives. • Insufficient public participation in environmental decision-making. • Disputes over land ownership and use rights can complicate conservation efforts, particularly in areas where Indigenous and local communities have traditional land claims. • Integrating local values and Indigenous knowledge into biodiversity conservation efforts remains a challenge.	• Run national campaigns to raise awareness about biodiversity conservation and sustainable practices. • Educational programs to inform the public about the importance of biodiversity and encourage community involvement. • Promote community-based conservation initiatives. • Engage stakeholders, including Indigenous peoples and local communities, and involve them in the decision-making processes to ensure more inclusive and effective biodiversity conservation efforts. This also promotes ownership and ensures that diverse perspectives are considered. • Grant legal recognition to Indigenous and Community-Conserved Areas. • Strengthen mechanisms for citizen engagement, participatory decision making, and public awareness campaigns. • Strengthen capacity building programs and training for local communities and other stakeholders. • Open-access publication of biodiversity-related reports and scientific papers.	• Conducted nationwide public awareness campaigns to educate people about the importance of biodiversity and conservation (Brazil). • Public opinion polls to gauge the effectiveness of biodiversity awareness campaigns (Brazil). • Community development program for conservation area buffer villages, especially in assisting area protection and surveillance activities (Indonesia). • Civil society organizations promote environmental education (Mexico). • Organize biodiversity-related events and contests (Mexico). • Under law, environmental education is integrated into education policy at all levels (Peru). • Train teachers on conservation issues (Argentina). • Utilize TV programs, radio, and social media to disseminate information about biodiversity issues (Kenya, Angola, Tanzania). • Environmental education is integrated into Early Years Education, Middle School Education, and Senior School (Kenya). • Involved local communities in the conservation of dugongs and seagrass habitats in the Sahamalaza Biosphere Reserve, including community monitoring, participation in capacity building, and patrols (Madagascar). • Community-based natural resource management via Wildlife Management Areas and Participatory Forest Management (Tanzania). • Empowered communities by recognizing their land rights and involving them in conservation planning (Kenya).

Barriers to success	Possible solutions	Sample actions by countries
		• Involvement of local communities in forest protection and restoration (Philippines, Thailand).
Slow adaptation to international commitments: • Delays in translating international biodiversity agreements into national policies. • Weak compliance with CBD targets due to institutional inertia and slow bureaucratic processes. • Delayed progress toward achieving CBD targets. • Delayed biodiversity conservation efforts.	• Draft and pass legislation that adopts the NBSAP as a legal framework for biodiversity conservation. This can involve creating new laws or amending existing ones to incorporate NBSAP goals, strategies, and actions. • Integrate the NBSAP into national and sub-national policies, plans, and programs. This helps align biodiversity goals with broader development objectives and ensures consistency across different sectors. • Countries within the same region can work together to address shared biodiversity challenges. This can involve joint conservation projects, sharing best practices, and coordinating efforts to protect transboundary ecosystems. • Form partnerships with international organizations, such as the U.N. Environment Programme and the Global Environment Facility, which can provide technical assistance, funding, and capacity-building resources. • Platforms for knowledge exchange allow countries to share experiences, tools, and successful strategies. Initiatives like the NBSAP Forum facilitate this kind of collaboration. • Collaborating on research and monitoring programs can help countries gather and analyze data more effectively. • Countries can collaborate on capacity-building initiatives, such as training programs and workshops.	• Established the National Biodiversity Commission as a deliberative and consulting multi-sectoral body that coordinates the implementation of the national commitments under the CBD (Brazil). • Integrated environmental and biodiversity treaties into various programs and action plans (Vietnam). • Strengthened data collection, statistical analyses and information sharing to monitor and report its Sustainable Development Goals progress (Kenya). • The signed international treaties on biodiversity have the character of Supreme Law (Mexico). • Adopted policies and legal instruments to implement the international conventions and treaties (e.g., CBD, CITES) it ratified (Angola). • The Deforestation Monitoring and Control Program implements international commitments to eradicate illegal deforestation, control fires, and restore forests in degraded areas, as part of its Nationally Determined Contribution under the UNFCCC (Bolivia).

Discussion

NBSAP strengths and weaknesses

Lessons from the Aichi Framework

Generally, the NBSAPs we examined aligned their National Targets with the global Aichi Targets (Box 1). They were most effective at addressing implementation issues, especially capacity building, mainstreaming across the government and multiple sectors, and sustainable development. They were less effective at status assessment or strategy development, and typically poor at providing measurable indicators.

Most countries discussed the importance of ecosystem services and included Indigenous and local biodiversity status knowledge and priorities. However, most countries did not involve Indigenous people in strategy development, and some did not involve local communities either. Almost all countries covered the legal and administrative context of their NBSAP, but few included subnational laws and regulations.

Most NBSAPs contained only cursory discussions of how the five key drivers of biodiversity loss are impacting habitats and species, and few contained maps of biodiversity distribution. Without this information, conservation planning is likely to be inadequate. In the continental U.S., Dreiss and Malcom (2022) found that current protected lands had little overlap with biodiversity hotspots, and 80% of the highest biodiversity areas were unprotected. Similarly, designated critical habitat for endangered and threatened U.S. species lies mostly outside protected areas (Delach et al. 2024). It is likely that at least some of the countries lacking biodiversity maps in their NBSAP have species distribution information elsewhere (global datasets are available at IUCN, GBIF, BirdLife International, and Map of Life) but unless that information is in the hands of decision makers, it may not help conservation efforts.

Only two of the 30 most biodiverse countries (Philippines and Japan) included in-depth discussion of species range shifts or ecosystem responses to climate change, with the majority of NBSAPs lacking this entirely. Countries not planning for changing conditions may find their conservation efforts insufficient (Dreiss et al. 2022). Climate change is the most rapidly accelerating driver of biodiversity loss (IPBES 2019, McElwee et al. 2023), and areas once managed under assumptions of climate stationarity now face potential ecologically transformative change (Magness et al. 2022). In the U.S., over 99% of endangered or threatened plant and animal species have life history traits that render them potentially vulnerable to the effects of climate change (Delach et al. 2019, Weber et al. 2023, Wrobleski et al. 2023). Many species' survival will depend upon their ability to "persist in place or shift in space" in response to changing conditions (Thurman et al. 2020), and will require protection of areas that are "relatively buffered" from exposure to altered climatic and ecological conditions (i.e., climate-change refugia) or track climate across space and time (i.e., climate corridors) (Morelli et al. 2020, McGuire et al. 2016).

Regarding strategy, most NBSAPs contained objectives and actions addressing the drivers of biodiversity loss. All strategies addressed habitat protection, restoration, and management. Almost all addressed invasive species and overexploitation. Climate change and pollution were addressed by most countries, but less often than the other drivers. As discussed above, climate change is one of the biggest threats to biodiversity, and is exacerbating the other drivers (IPBES 2019, McElwee et al. 2023). Pollution, the other least-addressed threat, is especially problematic for aquatic species (Gangloff et al. 2016, Malik et al. 2020). Globally, over 80% of urban and industrial wastewater is released to freshwater systems without adequate treatment, and runoff from farm fields causes eutrophication, hypoxia, and erosion in waterways (IPBES 2019). Sensitive aquatic species like salmonids, stoneflies (*Plecoptera*), caddisflies (*Trichoptera*), and mayflies (*Ephemeroptera*) are quickly extirpated from impaired waterways (Boward 1999, Malik et al. 2020). Fertilizer runoff impacts freshwater and marine biodiversity around the world (Jwaideh et al. 2022).

Following Aichi Targets 11 and 15, most NBSAPs included measurable indicators for habitat protection and restoration, but few countries had indicators corresponding to the other drivers. Effective metrics, such as the widely-used framework of specific, measurable, achievable, relevant and time-bound (SMART) indicators (Doran 1981), provide clear and measurable benchmarks for assessing progress toward goals and objectives (Bjerke and Renger 2017). Without them, there is no tangible outcome to try to achieve. The ambiguous wording of the Aichi Targets and their lack of quantifiable elements in most cases is partly to blame (Butchart et al. 2016). The Kunming-Montreal 2030 Targets added numeric global targets for invasive species (reduce their introduction by 50%), reducing harmful

incentives (at least $500 billion/year), and mobilizing finance ($200 billion/year), but most of the global targets remain without numeric indicators. The CBD should develop measurable indicators for climate change mitigation and adaptation, overexploitation reduction, pollution reduction, and other conservation and recovery strategies, and help countries apply them to national targets. In addition, indicators warning of pending species extinction and ecosystem collapse are needed to trigger action before permanent change occurs (Stevenson et al. 2021). These could be based on IUCN's Red List Index, Red List of Ecosystems, etc., but tailored to the individual country.

The NBSAPs we examined were generally strong on implementation, especially in capacity building, level of commitment, mainstreaming, and sustainable development. Consistent with Aichi Target 2, almost all countries adopted a whole-of-government approach and planned to integrate biodiversity into the relevant sectors. The majority of NBSAPs contained tracking and reporting commitments, detailed species and ecosystem monitoring plans, detailed funding plans, and plans for Indigenous and local community involvement. Enforcement and access to nature were the weakest implementation categories. The latter is probably an oversight at the international level. While nearly all countries had National Targets corresponding to the Nagoya Protocol on Access to Genetic Resources, no Aichi Targets cover equitable access to nature in a more general sense.

Enforcement of conservation laws is key to compliance. Without strong and effective enforcement, poaching, illegal fishing, and illicit wildlife trade (including sophisticated crime syndicates) thrive, pushing species closer to extinction (Byers and Noonburg 2007, Bennett 2011, Salum et al. 2018, Afriyie et al. 2021, Moore et al. 2021). Similarly, illegal logging, mining, and land encroachment can destroy or degrade habitat and ecosystems, even in protected areas (Nolte 2016, Boakye 2020, Espin and Perz 2021, Kleinschmit et al. 2021, Dekiawati 2022, Basu and Basu 2023, Hifume et al. 2024, Prayitno et al. 2025). Insufficient enforcement of biosecurity laws can facilitate the introduction and spread of invasive species (Burgiel et al. 2006, IPBES 2023). Poorly enforced environmental regulations contribute to higher pollution levels (Franz 2011, Clayton et al. 2021, Mensah et al. 2022). Weak enforcement can open the way for land grabs from Indigenous and local communities, who play a key role in conservation (Gilbert 2017, Hak et al. 2018, Mueller 2022).

Gaps in implementation

Despite generally strong implementation scores, there was little relationship between the NBSAP strength and biodiversity outcomes. Countries with higher strategy scores (typically because they included measurable indicators) tended to have more of their key terrestrial biodiversity areas protected. But there was no corresponding impact on other protection metrics, forest loss, or species viability.

Theorists offer different explanations for poor implementation of the CBD, including power dynamics, self-interest, lack of resources, lack of mainstreaming to production sectors, lack of coordination, and a lack of prioritization (Smallwood et al. 2022). In a study of eight NBSAPs, Cardona Santos et al. (2023) concluded that the 2011–2020 Strategic Plans for Biodiversity helped generate awareness and national political support, but were largely confined to the environmental sector at national levels. The noncommittal language throughout the CBD and Aichi Targets, and lack of a compliance mechanism, mean there is no real consequence for failing to meet biodiversity goals (Smallwood et al. 2022). Although the NBSAPs we examined proposed actions to address many of these issues, results are not yet apparent in the field. Nonetheless, we have summarized various ways countries can improve their biodiversity outcomes (Tables 9 and 10).

The Kunming-Montreal Global Biodiversity Framework

The Kunming-Montreal Global Biodiversity Framework (GBF) was adopted at COP 15 and is supported by a comprehensive package of decisions. It includes four goals for 2050 and 23 targets for 2030. These include conservation of at least 30% of land, waters and seas by 2030, especially areas of particular importance for biodiversity and ecosystem functions and services (Target 3), and restoration of at least 30% of all degraded ecosystems by 2030 (Target 2). Target 12 adds nature access in urban areas and Target 23 is meant to ensure gender equality in access to land and natural resources, addressing two of the Aichi oversights. The GBF also includes a monitoring framework, an enhanced mechanism for planning, monitoring, reporting and reviewing implementation, financial resources for implementation, and strategic frameworks for capacity development and technical and scientific cooperation (SCBD 2024). All in all, the GBF represents a significant improvement over the 2011–2020 Strategic Plans for Biodiversity and the Aichi Targets.

All Parties committed to setting national targets to implement the GBF (SCBD 2024). As of April 11, 2025, 43 Parties (22%) had submitted NBSAPs in alignment.[5] Of the 30 most biodiverse countries, only China's NBSAP followed the GBF at the time of our analysis.

The following section distills some of the best examples we examined to construct an ideal NBSAP. While aimed at informing a future U.S. NBSAP, it could be relevant to improvements by any country.

Best NBSAP examples and relevance for a U.S. NBSAP

In the pilot study, Canada had the overall highest-scoring National Biodiversity Strategy and ranked in the top three for each of the three subsections. Canada is not only a neighbor of U.S. with historically close economic and cultural ties, it has a similarly large landmass, multiple biomes, and a significant Indigenous population. These considerations make the Canadian NBSAP the best overall model for a U.S. strategy. Canada's inclusion of Indigenous people and tribal priorities in every aspect of their plan is an excellent example of how the U.S. should approach its strategy.

Each other plan, regardless of score, offered at least one strength that the U.S. (Table 11) and other countries (Table 12) could use as a model. Tanzania's status assessment was one of the best: well-organized and thorough, looking at not only all five drivers of extinction, but the reasons behind them. It also included lessons learned since their prior NBSAP (published in 2001). The Philippines also had an excellent status section, with a detailed assessment of the current state of biodiversity and how past conservation actions have been funded and supported by policy. Cameroon's NBSAP also contained exemplary coverage of key species and habitats, with a section dedicated to each major ecosystem type, lists of species, degrees of threat, and biodiversity hotspots. The Philippines, Costa Rica, and Ecuador were among the few countries that included comprehensive sets of maps. Costa Rica included a map of climate refugia and corridors—essential information for planning long-term biodiversity conservation, restoration, and management. The U.S. is in the process of drafting a legally mandated Biodiversity and Climate Assessment, and had begun a National Nature Assessment under the Biden Administration. If finalized, these could help inform the assessment section of a U.S. NBSAP, and should strive for completeness, conservation relevance, and detail.

The vision and motivation behind a NBSAP are essential for contextualizing its strategies. Germany explained the economic, social, and ecological reasons for conserving biodiversity and built on these ideas throughout their strategy. France included a diagram of different human needs, corresponding pressures on biodiversity, impacts on biodiversity, and corresponding risks to humans. South Africa's breakdown of their biodiversity legislative

[5] From CHM Online Reporting Tool, 11 April 2025, status = "Final" or "Approved."

framework included past policy accomplishments, recent amendments, and what is needed in the coming years. This information was frequently cited in their strategies, and it is essential for a U.S. plan to follow this model so policymakers can understand their role in conservation. The Democratic Republic of the Congo's NBSAP also contained detailed coverage of the country's legal and institutional framework for biodiversity protection, including weaknesses requiring reform.

In terms of strategy development, the U.S. should address all the drivers of biodiversity loss and include measurable indicators with target dates and numerical goals. Brazil's plan included a wealth of detail. Myanmar's NBSAP, published in 2015 during a period of democratic reform, contained goals, strategies, and measurable indicators addressing all the drivers. Mozambique's National Targets also contained numeric indicators and timelines, although they did not cover all the drivers.

The majority of NBSAPs we examined included strong plans for implementing strategies and building capacity. Plans like Brazil's and the Philippines', which consolidate their implementation plans into a single section, were easy to navigate and may serve as good models. China's and France's plans, which addressed implementation within each individual strategy, also scored high.

For a plan to succeed, there must be accountability. Like many countries, Mozambique's environment ministry (MITADER) is responsible for coordinating environmental action, including the NBSAP. Other countries assign a committee (e.g., Myanmar's National Biodiversity Conservation Committee) or commission (e.g., Costa Rica's ENB2 Management and Monitoring Commission) to coordinate implementation. Peru included both, with a ministry (MINAM) leading the implementation process and a commission (CONADIB) serving as the central body for advice and monitoring. This may be a good model for the U.S., with an office or council in the President's Office (e.g., CEQ) serving as lead together with an advisory committee from the relevant departments, academia, civil society, tribes, and the private sector. Tanzania has one of the strongest frameworks, with its Vice President's Office and environment ministry taking the lead, a committee (NEAC) advising, as well as Environmental Coordination Units in all sector ministries and designated Environmental Management Officers in Local Government Authorities at city, municipality, district, township, ward, village, street and hamlet levels. Collaboration with the rest of the national government, sub-national governments, NGOs, the private sector, and local communities is also critical. Brazil's Action Plan, for example, assigns specific tasks to a comprehensive suite of ministries, agencies, secretariats, institutes, local agencies, NGOs, academia, financial institutions, and the private sector. Canada's NBSAP strives to include the full breadth of society (e.g., individuals, Indigenous Peoples, governments, other institutions and organizations, academia, the private sector, etc.), given that halting and reversing biodiversity loss demands a whole-of-government, whole-of-society approach. It also includes a section (Annex 3) listing provincial and territorial strategies and actions. China is building a system of biodiversity-related laws and regulations, meant to be completed by 2030. Also planned is a coordinated governance mechanism for biodiversity conservation, which will promote inter-departmental coordination at the national and local levels, implement management and supervision responsibilities, and encourage scientific research institutions, enterprises, social organizations and the public to participate in the decision-making process of biodiversity legislation, management and supervision. Madagascar's objectives include recognizing and integrating biodiversity values, opportunities, and benefits from its conservation and its sustainable use, into the country's socio-economic development activities by 2025. Malaysia had similar objectives and included numerous actions. Bolivia, which has strong Indigenous cultures, enshrines nature stewardship ("Living Well in Harmony with Mother Earth") in law, and embeds the rights of nature in its comprehensive economic and development plans. Similarly, Ecuador enshrines the Rights of Nature in its Constitution and considered biodiversity as a key factor for good living and a strategic national resource.

All the NBSAPs we examined contained actions to increase the country's capacity for biodiversity conservation. Strategies included education, training, legislation, information sharing, and more. The Philippines', Mexico's, and Malaysia's NBSAPs were good examples. Myanmar had more proposed legislation than most others we reviewed (perhaps because the country was undergoing a period of democratization at the time of plan development). DRC was working to implement previously passed laws, including the Forest Code, the law on nature conservation and the Water Code; and was preparing a law on fisheries to replace the old colonial version.

Canada is developing a Domestic Biodiversity Monitoring Framework to integrate existing and proposed indicators of species and ecosystem status and change, as well as other indices related to their NBSAP. Scotland's monitoring plan stands out because they plan to use citizen science to cover any funding gaps in their monitoring efforts. Their NBSAP presents data already accumulated through citizen science and explains how they plan to integrate it further. The U.S., with its wealth of birders, naturalists, and monitoring volunteers, can also use citizen science to fill gaps.

For tracking progress, Cameroon's monitoring and evaluation plan was the most detailed we examined, with criteria, indicators, verifiers, responsible institutions, and measurement frequencies for each biodiversity target. Indonesia provided a detailed tracking and reporting system, carried out in accordance with a law on Environmental Protection and Management, conducted for expected activity outcomes, obstacles faced, and implementation improvements that need to be made. Brazil articulated the technical, human, and financial requirements needed. France included numeric milestones to achieve by years ranging from 2022 to 2030.

Antigua and Barbuda's NBSAP includes one of the most comprehensive funding plans of those we assessed. The plan includes a clear description of how their funding system (SIRF) will operate. Following Aichi Target 3, France and Canada, among others, plan to phase out subsidies harmful to biodiversity and increase funding to implement their NBSAPs. Canada committed to mobilizing at least US$200 billion/year for biodiversity, with at least US$30 billion/year of this earmarked for developing countries. Costa Rica listed budgets needed to implement projects planned under their NBSAP. They are developing a Resource Mobilization Plan to fill the gap in financing and seek to improve spending efficiency.

Malaysia's NBSAP was among the strongest regarding enforcement. It sought to double resources for enforcement; strengthen capacity and improve collaboration; improve standards, training and support for rangers, other frontline staff, police, and prosecutors; enforce high penalties for poaching, illegal logging and illegal wildlife and plant trade; develop forensic tools such as DNA profile databases to improve the detection, arrests and prosecution of offenders; strengthen inter-agency and inter-governmental initiatives to counter illegal cross-border trade; and improve mechanisms and procedures to regulate pet and medicinal trades and private collections. Myanmar and the Philippines urged stronger fisheries and natural area enforcement. Canada is working to address illegal harvest and international trade in forest products, including through the development of science, data, and tools that support wildlife enforcement officers and customs and border officials. Kenya's NBSAP, the only pre-Aichi plan among the most biodiverse countries, recommended building law enforcement capacity, including the police, judiciary, administration, and other regulatory agencies, to enhance and streamline implementation and enforcement of environmental policies and legislation. It also recommended strengthening monitoring and enforcement of water pollution, controlling introductions of alien species, and crackdowns on corruption in the timber industry. Tanzania established a Special Environmental Police Unit in the national police force to strengthen enforcement of relevant laws.

All 35 NBSAPs we examined wove in sustainable development. Among developed countries, Japan focuses on both the local and global scale, e.g., sustainable development of local communities as well as promotion of sustainable forest management and other biodiversity-friendly practices throughout Asia and beyond. Canada's 2030 Agenda National Strategy seeks to implement the U.N. 2030 Agenda for Sustainable Development and identify actions to achieve the 17 Sustainable Development Goals (SDGs) at home and abroad. Australia seeks to use and develop natural resources in an ecologically sustainable way. Germany's National Programme for Sustainable Consumption was developed to educate the general public about the negative impacts of consumption and lifestyle on biological diversity worldwide, and how people can lessen these impacts. Brazil and Canada, among other countries, integrated genetic resource management throughout their strategies and implementation.

In terms of organization, implementation actions are best organized in tables, with each action corresponding to a strategy and a National Biodiversity Target. Each action should have numeric indicators and goals, the responsible agencies and parties, and a timeframe. Ideal indicators are SMART: specific, measurable, achievable, relevant, and time-bound (for natural resource and environmental management, see Aldridge and Colvin 2024). Madagascar's Action Plan is a good example, with actions organized under national targets and strategic objectives, and each containing a justification, numeric indicators, a timetable, the project manager, and partners. Mozambique's Actions Matrix included priority actions, the timeframe, performance indicators, the responsible

party, collaborating institutions, and a budget. Annex 1 of Myanmar's NBSAP lists SMART indicators for many (but not all) targets. Peru had a well-organized matrix of objectives, goals, actions, baselines, indicators, and timelines; with guidance from an overall vision and guiding principles and management approaches. It did not include the responsible party for each action, though. Tanzania's priority actions contained a timeline, indicators, deliverables, and responsible entities, although numeric targets were generally lacking.

To note, between the pilot and top 30 studies, we only examined 35 of the 179 NBSAPs written at the time. It is likely other plans contain exemplary information. The framers of a U.S. NBSAP should examine all of them, especially those in alignment with the GBF.

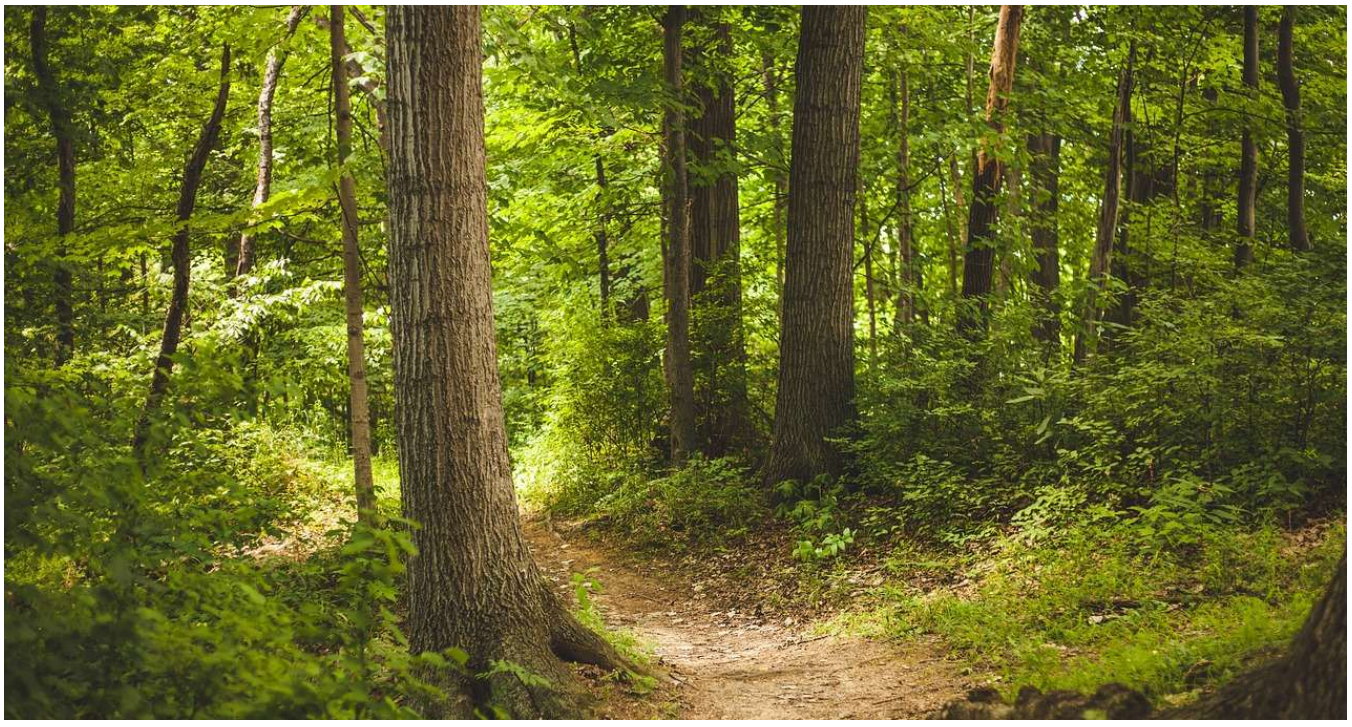
Table 11. Exemplary and relevant NBSAP sections and approaches that the USA could use as a model.

NBSAP element	Examples to draw from
Assessment of current status of key species, habitats, and ecosystems	Cameroon, Tanzania
Mapping	Philippines, Costa Rica, Ecuador
Assessment of biodiversity threats (drivers of crisis)	Tanzania
Accounting for range shifts and other ecosystem responses to change	Japan is closest, but no countries covered this sufficiently.
Discussion of ecosystem services	Germany, France
Discussion of the legal and institutional framework for biodiversity protection, including weaknesses needing reform	South Africa, DRC
Indigenous and local community involvement in strategy development and implementation	Canada, Ecuador
Strategies to address the drivers of biodiversity loss	Myanmar, Mozambique, Brazil
Action plan	Madagascar, Mozambique, Myanmar, Peru, Tanzania, Brazil, Costa Rica
Accountability measures	Peru, Tanzania, Costa Rica
Tracking and reporting progress	Cameroon, Indonesia, France, Canada
Capacity building	Mexico, Philippines, Malaysia
Monitoring the status of species, habitats, and ecosystems	Canada, Scotland
Funding	Canada, Costa Rica, Antigua and Barbuda
Enforcement	Malaysia, Philippines, Myanmar, South Africa
Integration throughout the government	Brazil, China, Mexico, Tanzania
Integration into economic, social, and cultural sectors	Canada, Panama, China, Malaysia, Mozambique, South Africa, Tanzania, Thailand
Sustainable development and use	Germany, Australia
Fair use of genetic resources	Brazil, Canada
Access to nature	Australia
Overall plan organization	Brazil, Philippines

Table 12. Exemplary post-Aichi NBSAP sections that might serve as models for other countries. We found additional notable examples and expect many more among those NBSAPs we did not assess.

NBSAP element	Example	Country
Assessment of current status of key species, habitats, and ecosystems	Exemplary coverage of key species and habitats, with a section dedicated to each major ecosystem type, lists of species, degrees of threat, and biodiversity hotspots.	Cameroon
Assessment of biodiversity threats and lessons learned	Well-organized and thorough, including all five drivers of extinction and the reasons behind them. Also includes lessons learned since prior NBSAP.	Tanzania
Mapping	Comprehensive set of maps, including a map of climate refugia and corridors.	Costa Rica
Accounting for range shifts and other ecosystem responses to change	No countries covered this sufficiently. Japan's was the best of those we assessed.	Japan
Discussion of ecosystem services	Explains the economic, social, and ecological reasons for conserving biodiversity and builds on these ideas throughout their strategy.	Germany
Optional diagram of relationship between biodiversity and humans	Diagram of different human needs, corresponding pressures on biodiversity, impacts on biodiversity, and corresponding risks to humans.	France
Discussion of the legal and institutional framework for biodiversity protection, including weaknesses needing reform	Breakdown of the country's biodiversity legislative framework that includes past policy accomplishments, recent amendments, and what is needed in coming years.	South Africa
Indigenous and local community involvement in strategy development and implementation	Indigenous worldviews (e.g., a harmonious relationship with nature), traditional knowledge and local needs are embedded throughout the NBSAP. Included a representative sample of viewpoints when drafting the plan, discusses gender equity, and local communities would be involved in planned actions.	Ecuador
Strategies to address the drivers of biodiversity loss	Goals, strategies, and measurable indicators that address all key drivers.	Myanmar
Action plan	Organizes actions under national targets and strategic objectives, with each containing a justification, numeric indicators, a timetable, the project manager, and partners.	Madagascar
Accountability measures	The Vice President's Office and environment ministry lead, along with an advisory committee. Sector ministries contain Environmental Coordination Units and Environmental Management Officers are placed in city, municipality, district, township, ward, village, street and hamlet governments.	Tanzania
Tracking and reporting progress	Detailed monitoring and evaluation plan with criteria, indicators, verifiers, responsible institutions, and measurement frequencies for each biodiversity target.	Cameroon
Capacity building	All necessary factors of NBSAP implementation (science, coordination, legislation, etc.) are targeted for capacity building, and detailed actions are proposed.	Mexico
Monitoring the status of species, habitats, and ecosystems	Developing a Domestic Biodiversity Monitoring Framework to integrate existing and proposed indicators of species and ecosystem status and change, as well as other indices related to their NBSAP.	Canada
Funding	Lists budgets needed to implement projects planned under the NBSAP, developing a Resource Mobilization Plan to fill the gap in financing, and seeking to improve spending efficiency.	Costa Rica
Enforcement	Double resources for enforcement; strengthen capacity and improve collaboration; improve standards, training and support for	Malaysia

	rangers, other frontline staff, police, and prosecutors; enforce high penalties for poaching, illegal logging and illegal wildlife and plant trade; develop forensic tools such as DNA profile databases to improve the detection, arrests and prosecution of offenders; strengthen inter-agency and inter-governmental initiatives to counter illegal cross-border trade; and improve mechanisms and procedures to regulate pet and medicinal trades and private collections.	
Integration throughout the government	Builds a system of biodiversity-related laws and regulations, and plans a coordinated governance mechanism for biodiversity conservation which will promote inter-departmental coordination at the national and local levels, implement management and supervision responsibilities, and encourage scientific research institutions, enterprises, social organizations and the public to participate in the decision-making process of biodiversity legislation, management and supervision.	China
Integration into economic, social, and cultural sectors	Enshrines nature stewardship ("Living Well in Harmony with Mother Earth") in law and embeds the rights of nature in national economic and development plans.	Bolivia
Sustainable development and use	Recognizes and integrates biodiversity values, opportunities, and benefits from its conservation and its sustainable use, into the country's socio-economic development activities.	Madagascar
Fair use of genetic resources	Integrates genetic resource management throughout the NBSAP strategies and implementation actions.	Brazil
Access to nature	Integrates access to nature throughout the plan. Examples of connecting people with nature include promoting public park visits, citizen science initiatives, and environmental education.	Australia
Overall plan organization	The NBSAP document follows the standard order and is easy to navigate. Responsible parties and necessary capacity building are proposed in detail. National Targets are crosswalked with the Aichi Targets, responsible agencies, and thematic areas, with detailed programs, targets, indicators, time frames, responsible parties, and budget estimates presented in tables.	Philippines



Relationships between environmental and social conditions

Results from all countries

Many of the linear models had an $R^2 < 0.5$, but because we sought only to identify potentially important conservation factors, we did not examine interactions between variables. That caveat aside, our correlation and regression analyses suggested a number of relevant themes.

Biodiversity imperilment, as measured by the RLI, tended to be greater in countries with more species to lose. However, protecting habitat seemed to make a difference: countries with greater ecosystem protections (as measured by the Ecosystem Vitality Score) and higher proportions of protected key biodiversity areas tended to have lower biodiversity declines. Press freedom was also a significant factor.

The Sustainable Development Goals (SDG) score (Sachs et al. 2024) was strongly correlated with the Human Development Index (HDI), which is a composite of life expectancy at birth, years of schooling, and the logarithm of gross national income per capita (UNDP 2024). Of the two, the SDG score includes metrics of environmental protection and was slightly more correlated than HDI with ecosystem protection. Both the HDI and SDG scores, as well as press freedom, were correlated with the corruption variables. More corrupt, less open, and less developed countries were less likely to protect ecosystems and habitat. Less developed countries also had higher rates of forest loss.

Our results imply that protecting biodiversity requires a legally and socially accountable government, a free press, and attention to education, health care, and living standard. Democratic and transparent governance systems provide security and longevity to conservation investments and mainstreaming (Huntley 2014). Zhang et al. (2023) found that effective governance and economic and social development require anti-corruption supervision. Corruption undermines fair competition, public trust, and the beneficial allocation of resources (Zhang et al. 2023). Research has shown that corruption may lead to: 1) increased bureaucratic inefficiency, 2) deterioration of the investment climate, 3) reduced civil and political rights, 4) diminished levels of economic growth and foreign investment, 5) exacerbated poverty and income inequality, 6) reduced international trade, 7) compromised political legitimacy of the state, 8) larger shadow economies and thus reduced tax bases, 9) higher levels of brain drain, 10) larger fiscal deficits, and 11), poorer education, health and socioeconomic outcomes (Crombach and Smits 2024).

Tacconi and Williams (2020) found that corruption also impacts the environment and natural resources, which in turn can be expected to worsen social welfare. In the case of illegal wildlife trade, one of the key drivers of biodiversity decline, criminal networks bribe officials to commit and hide wildlife poaching and trafficking, avoid prosecution, and prevent convictions (Mozer and Prost 2023). Corruption is also the most significant enabling factor behind illegal logging (UNODC 2012).

Unfortunately, only 28 of the 180 countries measured by Transparency International (2024) have improved their corruption levels since 2012, and 34 countries have significantly worsened. The other countries have made no notable progress. For some countries, a trend toward greater authoritarianism has weakened mechanisms that keep governments in check (Transparency International 2024).

A free and independent press can help keep governments and corporations accountable. Ollerton et al. (2019) also found a relationship between press freedom and environmental protection. Countries that suppressed media activities tended to have low Environmental Performance Index values, meaning less protection of the environment. Conversely, countries with a culture of press freedom tended to have higher scores. The relationship was non-linear, with environmental protection generally improving only after the press freedom index passed a threshold equivalent to the top third of scores.

In a survey of 905 journalists from 129 countries, over 70% reported being subject to attacks, threats or pressure while covering environmental issues (UNESCO 2024). Forty-four journalists reporting on environmental issues were killed in 15 different countries between 2009 and 2023, with only five cases resulting in convictions (UNESCO 2024). Nearly half of the journalists polled said they have practiced self-censorship driven by fears of potential attacks, having their sources exposed to harm, or being aware that their environmental coverage might conflict with the interests of their employers or advertisers (UNESCO 2024).

Historically, economic development has often come at the price of environmental destruction. More sustainable development pathways are possible, though. In 2015, all U.N. member states adopted the 2030 Agenda for

Sustainable Development and 17 SDGs. These goals recognize the connections between people and the environment: economic growth and ending poverty must go hand-in-hand with strategies that protect nature and tackle the climate crisis (U.N. A/RES/70/1). Achievement of human well-being depends on nature's support (Waage et al. 2015).

The U.N., African Union, European Union, CITES, and G20 have passed resolutions, strategies, and action plans to combat corruption in the environmental sector. Sabri Zain, TRAFFIC Director of Policy, stated that efforts to address corruption should focus on areas such as streamlining and auditing permitting processes and controls; engaging the transport sector; strengthening stockpile management systems; improving traceability systems; addressing vulnerabilities in special economic zones; and employing behavior change approaches (Zain 2020). Countries can strengthen integrity through policy revisions, corruption prevention boards, government-wide ethical and integrity training, and more vigorous enforcement (Lemaître 2023). Civil society and the media also play key roles as watchdogs (Lemaître 2023). Strong whistleblower protections are also critical to address corruption (Kohn and Kostyack 2021).

Results from the 30 most biodiverse countries

The results from the 30 most biodiverse CBD parties mirrored those from all CBD nation-state signatories. Rather than declining, species loss accelerated after the Aichi Targets were adopted in 2010. The rate was lower for the most biodiverse countries than for the rest of the world, but the pool of species was larger. Greater levels of ecosystem and habitat protection were associated with lower levels of biodiversity decline. More corrupt countries tended to have lower levels of development and vice-versa. Countries with greater press freedom and attention to human well-being tended to be better at conservation.

Regarding the outliers, Angola's RLI may deserve a closer examination, since poaching and forest clearing were rampant during the 1975-2002 civil war and continue today (Learn 2020, Truscott 2022). Ecuador has the second highest number of endangered species (2778) in the world after Madagascar (3971) (IUCN 2025) and includes the Galapagos Islands and other hotspots of endemism. Forest loss is the main threat, with Ecuador having the second highest deforestation rate in Latin America (SCBD 2025b).

The strength of a country's NBSAP had no significant effect on biodiversity or forest loss, nor on protection of habitat and ecosystems. It did not slow biodiversity decline, which is the intent of the CBD, although there could be a lag between forming strategies and implementing them. Our results suggest that a country requires a free press (i.e., public watchdogs) and measures to combat corruption to effectively implement its NBSAP and protect biodiversity. Such measures, according to the data, may also benefit a country's standard of living.

Lack of progress on biodiversity conservation

According to self-reported progress in National Reports, the world continues to fall short of the goals of the CBD. While making some progress toward the Aichi Targets, this was mostly at an insufficient rate. None of the 20 Targets were achieved globally, although some were partially achieved (SCBD 2020). Only 20% of the 30 most biodiverse CBD signatories reported being on track to prevent species extinctions, and the global RLI continues to decline. Perhaps more discouraging, the countries that reported greater overall progress toward reducing extinction risk tended to have worse biodiversity declines.

Recommendations to strengthen the CBD

International level

The disparities between strategy development, self-reported progress, and actual biodiversity outcomes point to a need for implementation assistance and independent progress assessments. World Wildlife Fund is tracking GBF NBSAP submissions, evaluating NBSAPs and National Targets, and collaborating on advocacy with partners to hold governments to account and drive further improvement (WWF 2025). The CBD Secretariat's Global Biodiversity Outlooks, published periodically, assess global progress toward the CBD targets. They are largely dependent on NRs provided by countries, but also draw from independent indicators, research studies and assessments like the IPBES Global Assessment on Biodiversity and Ecosystem Services and the FAO's Global Forest Resources Assessment (SCBD 2020). Such independent, science-based assessments are needed systematically at the national and sub-national levels, using comparable and quantitative metrics. To assist implementation, funding and technical assistance from international bodies and developed countries must be scaled up.

A more integrated international agenda including biodiversity, sustainable development, climate change, and other related issues would help countries to mainstream biodiversity without diluting efforts into fragmented silos (Cardona Santos et al. 2023). For example, the joint IPBES-IPCC workshop on biodiversity and climate change pointed out how intertwined the biodiversity and climate crises are. Neither can be solved without the other and addressing them together offers numerous synergies and benefits to society (Pörtner et al. 2021). Climate change poses and amplifies threats to biodiversity and ecosystems; at the same time, ecosystems and the species within them play a key role in greenhouse gas fluxes and supporting adaptation to climate change effects (Pörtner et al. 2021).

On the other hand, the U.N. Sustainable Development Goals have little correlation with biodiversity conservation, focusing primarily on socioeconomic development (Zeng et al. 2020). Zeng et al. (2020) found that only 7% of correlations between the SDG indicators and independent measures of biodiversity and environmental protection were significantly positive, while 14% had a negative relationship with conserving biodiversity and the rest were not significant. As nature and biodiversity support life on Earth and human well-being, it is vital that biodiversity conservation be better integrated into the SDGs and include data-informed numeric indicators and implementation support. Smallwood et al. (2022) suggested that global biodiversity governance could be improved by better integrating the CBD with other international agreements; more purposeful and accountable engagement with nonstate actors; strengthening compliance, transparency, peer review and addressing indirect drivers; and tailoring approaches to local priorities and ecosystems.

On 23 July 2025, the International Court of Justice (ICJ) stated unanimously that all UNFCCC parties are obligated under international law to protect the global climate system. Given that CBD signatories are not improving the status of biodiversity as per the agreement, and that its decline is instead accelerating, the U.N. General Assembly should request an ICJ opinion on this matter. This could be initiated by a U.N. organ like UNEP. A favorable ICJ opinion, for which there is now precedence, could give the CBD additional weight.

National level

At the national level, NBSAPs should provide more complete assessments and strategies that address all the drivers of biodiversity loss, together with measurable indicators and a corresponding action plan with numeric goals, a timeframe, the responsible agencies and parties, collaborating institutions, and the necessary budget and resources. As detailed in previous sections, there are numerous examples of best practices that could be adopted by all countries.

Effective implementation, though, will require both high-level and grassroots commitment. NBSAPs need legal and administrative backing and full integration into relevant national policies and programs. Table 10 in the Results section lists numerous issues regarding current biodiversity conservation and governance, but also solutions to these problems and actions that countries have taken. Cardona Santos et al. (2023) recommended the following levers for harnessing the role of future NBSAPs to achieve the goals and targets of the Kunming-Montreal Global Biodiversity Framework: improving communication strategies and effort; translating targets into concrete measures; defining clear responsibilities; fostering cross-sectoral commitment; strengthening NBSAPs' legal status and/or enshrining specific targets into national laws; ensuring adequate public funding for implementation; reforming and redirecting subsidies harmful to biodiversity; ensuring coordination among sectors and levels of governance; strengthening accountability frameworks; providing data and evaluations to enable learning; monitoring biodiversity outcomes and progress on implementation; and establishing accountability structures.

Embedding biodiversity considerations into economic sectors is critical, since the economic sectors of society (e.g., agriculture, forestry, and fisheries) exert the strongest pressures on biodiversity. Karlsson-

Vinkhuyzen et al. (2017) constructed a mainstreaming framework that identifies barriers and levers in specific governance contexts such as forestry. This includes not only institutional dimensions such as policies, norms, and interactions, but also motivational (interests, values, framing, and leadership) and means (knowledge, time, and financial resources) dimensions. Mainstreaming cannot rely on government laws and regulations alone, but must also consider voluntary standards developed by multi-stakeholder partnerships, as long as there are strong evidence-based accountability frameworks to ensure compliance and positive outcomes. Key social elements include collaboration, trust building, information sharing, flexibility, innovation, and motivation. Conversely, mainstreaming strategies may run the risk of watering down the issue of biodiversity if not accompanied by necessary nature protection policies and political support (Karlsson-Vinkhuyzen et al. 2017).

Conclusions

Maintaining healthy and diverse communities of wildlife, plants, and other biota are essential for ensuring the long-term health and resilience of ecosystems and sustaining nature's contributions to people. We are in the middle of an extinction crisis, and action is urgently needed to reverse the trend. The Convention on Biological Diversity (CBD) was adopted in 1993 to conserve and sustainably use biodiversity. Since then, member countries have written National Biodiversity Strategy and Action Plans (NBSAPs) to mainstream biodiversity across government and society, reduce the drivers of biodiversity loss, improve the status of species and ecosystems, and build capacity to implement solutions.

Examining the NBSAPs of the 30 most biodiverse countries, we found both strengths and weaknesses. Unfortunately, the strength of a country's NBSAP had no significant effect on slowing biodiversity or habitat loss. Further, the countries that reported greater overall progress toward reducing extinction risk tended to have worse biodiversity declines. On the bright side, protecting ecosystems and habitat seemed to help stem the decline. The data implied that a free press (i.e., public watchdogs), governance transparency, measures to combat corruption, and attention to human well-being are critical factors to implement a NBSAP and protect biodiversity.

The CBD is evolving as lessons are learned. At the international level, implementation assistance, sufficient funding, and independent progress assessments are needed, and biodiversity protection must be integrated more effectively into the Sustainable Development Goals. At the national level, both NBSAPs and their implementation need improvement. NBSAPs should address all the drivers of biodiversity loss. For each strategy, they should include numeric outcome goals, implementation timeframes, responsible parties, and the resources needed. Successful implementation requires unwavering support from national leadership, legal and administrative instruments, local participation, and integration into relevant national policies, programs, and economic sectors. We provide suggestions and examples in this report.

Working together, the countries and people of the world can halt the extinction of species and the loss of nature and ecosystem services, and build a sustainable, flourishing future.

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Appendix A. Individual variable regressions and residual plots for the top linear models for biodiversity loss, forest loss, and level of ecosystem protection.

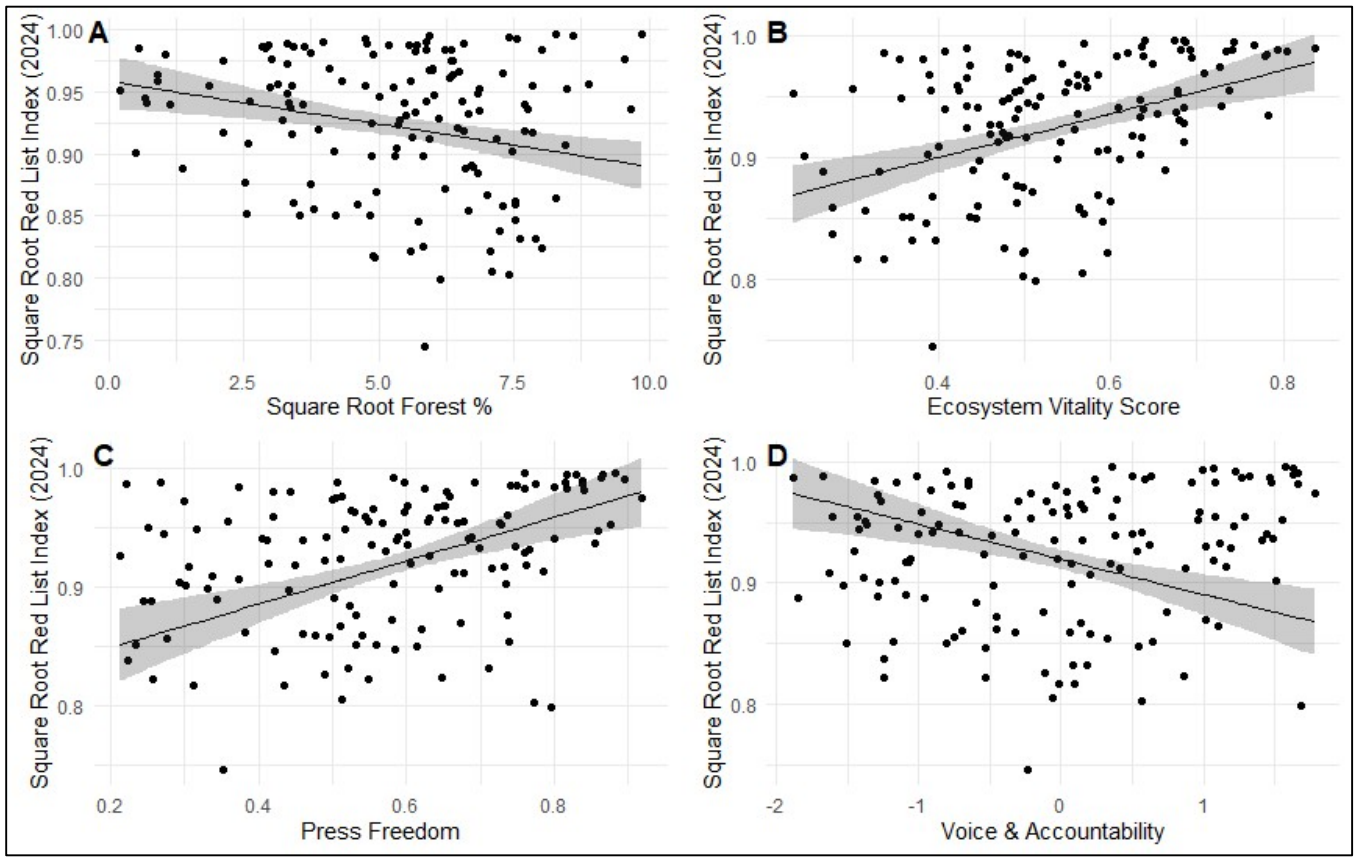

Fig. A1 Red List Index 2024 added-variable plot for the model RLI2024 ~ SQRT_FOR_PCT + ECO_PROT + PRESS_FREEDOM + Voice_and_Accountability for all CBD parties. Adjusted R^2 was 0.320.

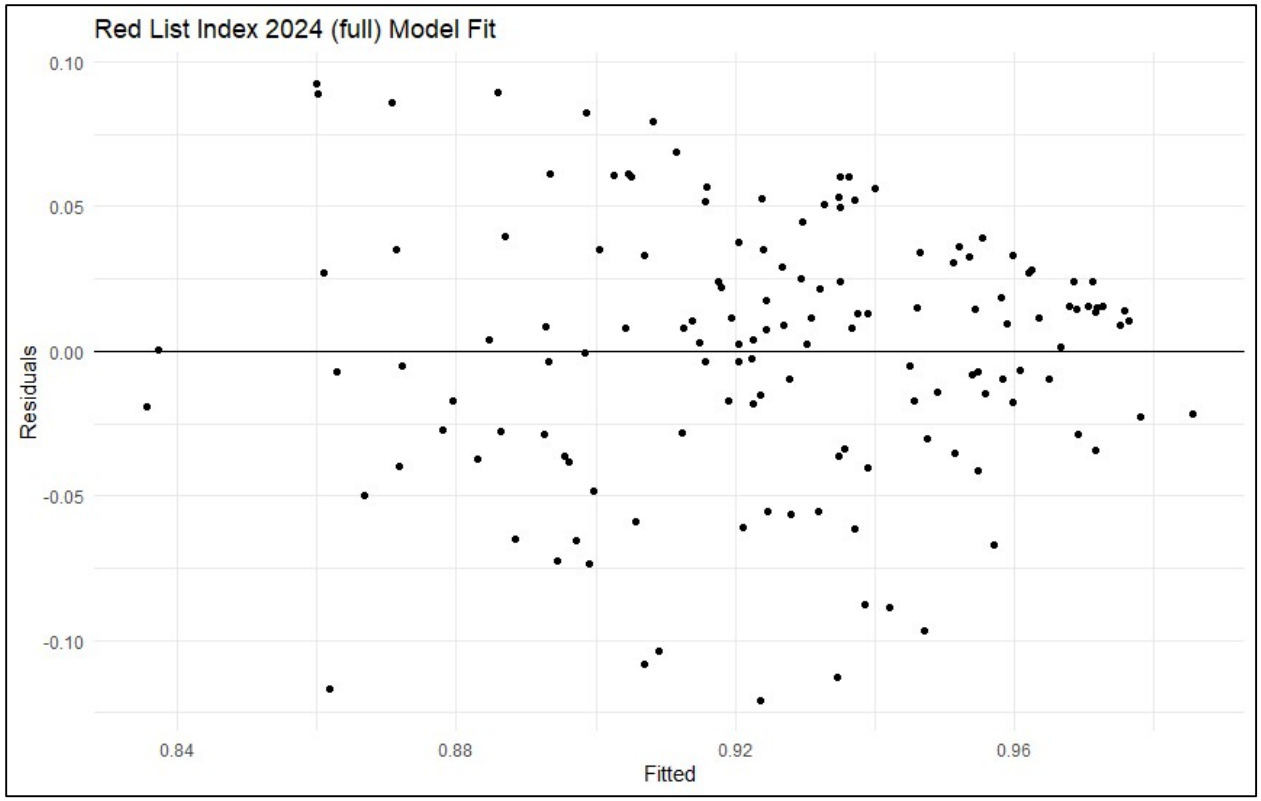

Fig.A2 Residuals plot for the fitted RLI2024 model.

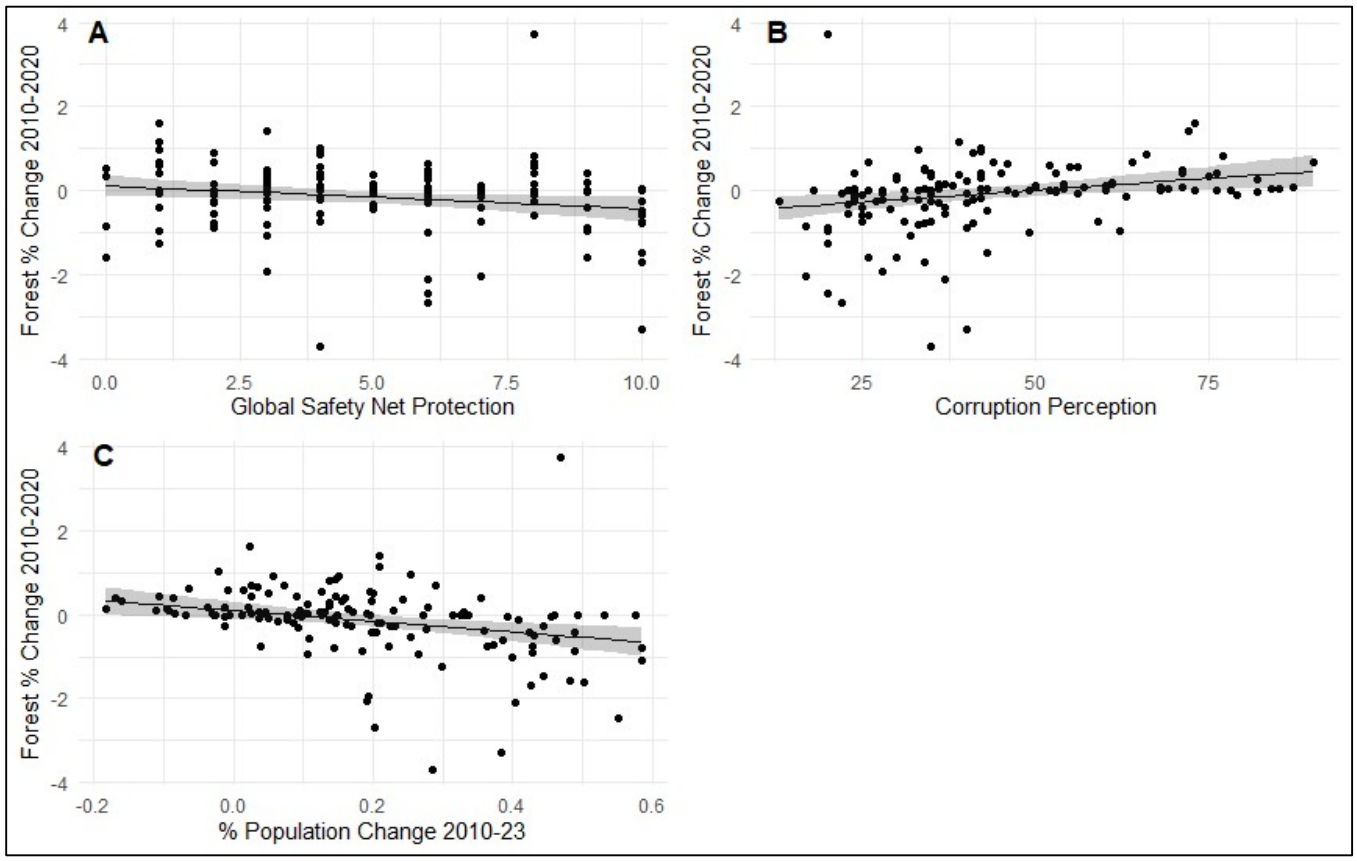

Fig. A3 Forest area change (2010-2020) added-variable plot for the model FOR_CHG ~ BIA_PROT + CORRUPT_PERCEPTION + PCT_POP_CHANGE for all CBD parties. Adjusted R^2 was 0.184.

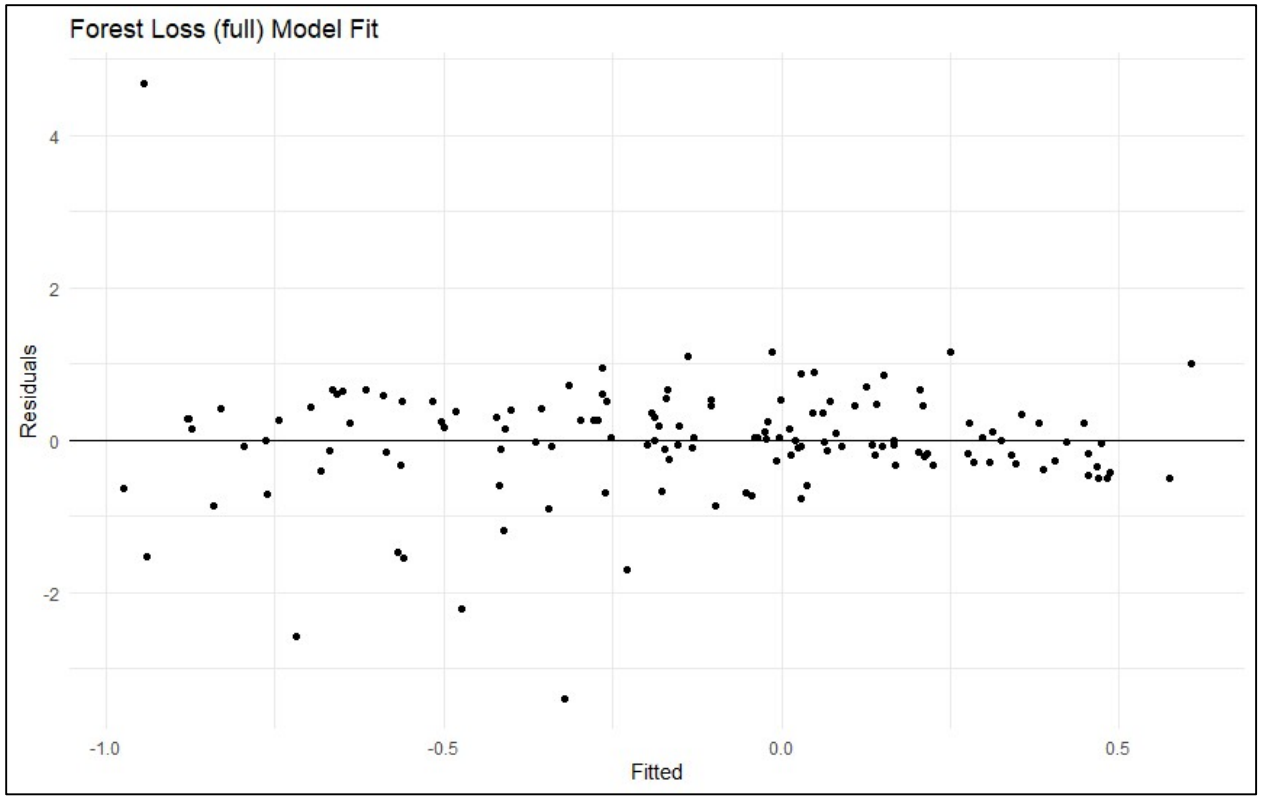

Fig. A4 Residuals plot for the fitted FOR_CHG model.

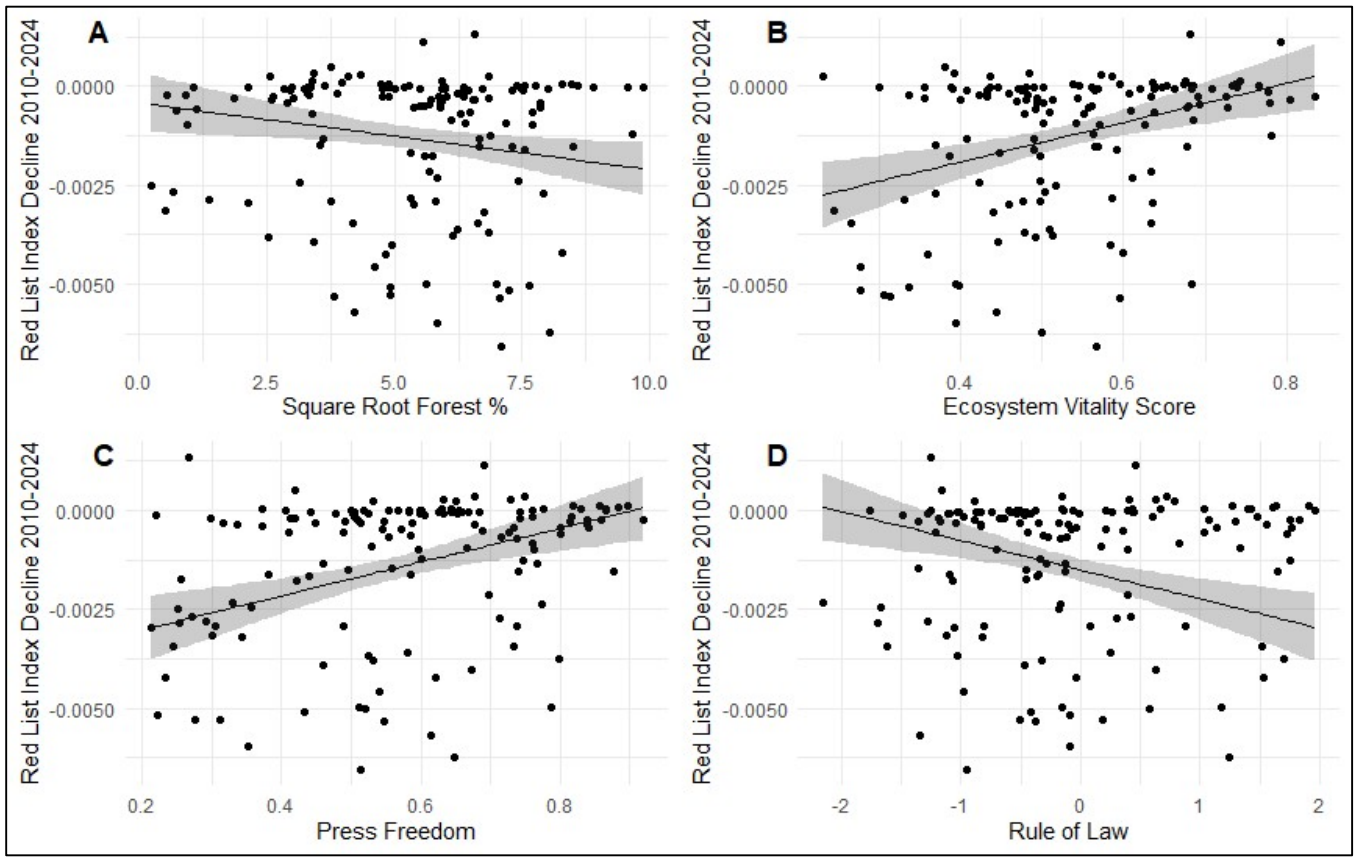

Fig. A5 Red List Decline (2010-2024) added-variable plot for the model RLI_2010_2024 ~ SQRT_FOR_PCT + ECO_PROT + PRESS_FREEDOM + Rule_of_Law for all CBD parties. Adjusted R^2 was 0.222.

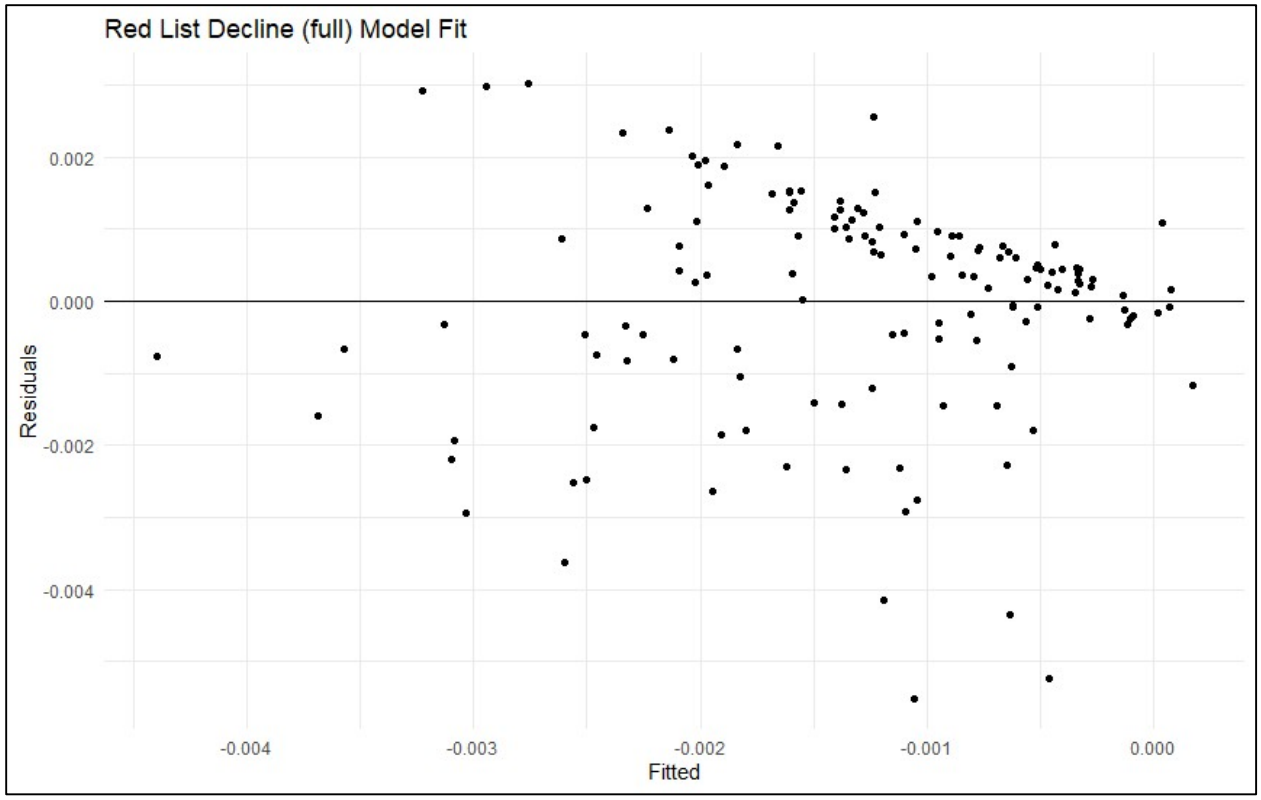

Fig. A6 Residuals plot for the fitted RLI_2010_2024 model.

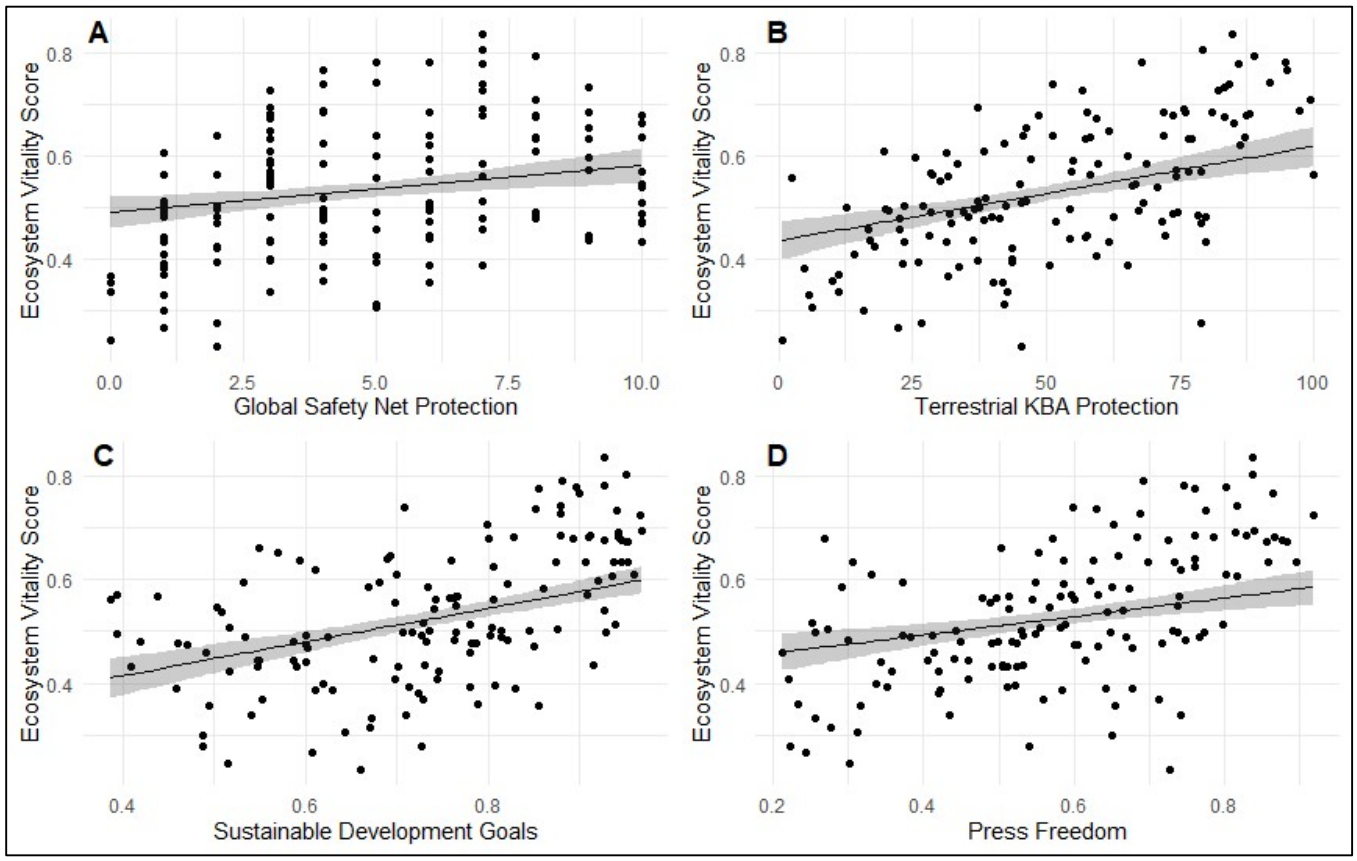

Fig. A7 Ecosystem Protection Score added-variable plot for the model ECO_PROT ~ BIA_PROT + TKBA_PA_PERC + SDG + PRESS_FREEDOM for all CBD parties. Adjusted R^2 was 0. 591.

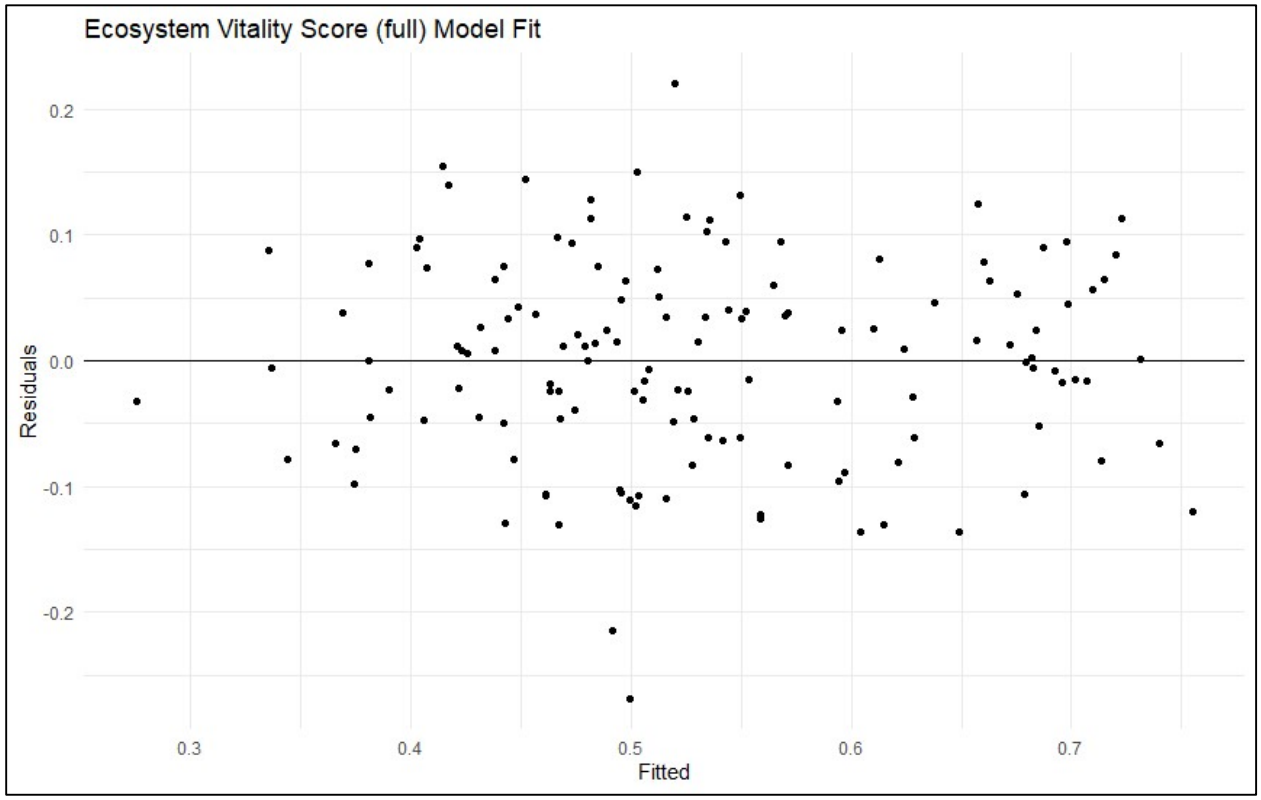

Fig. A8 Residuals plot for the fitted Ecosystem Vitality Score model.

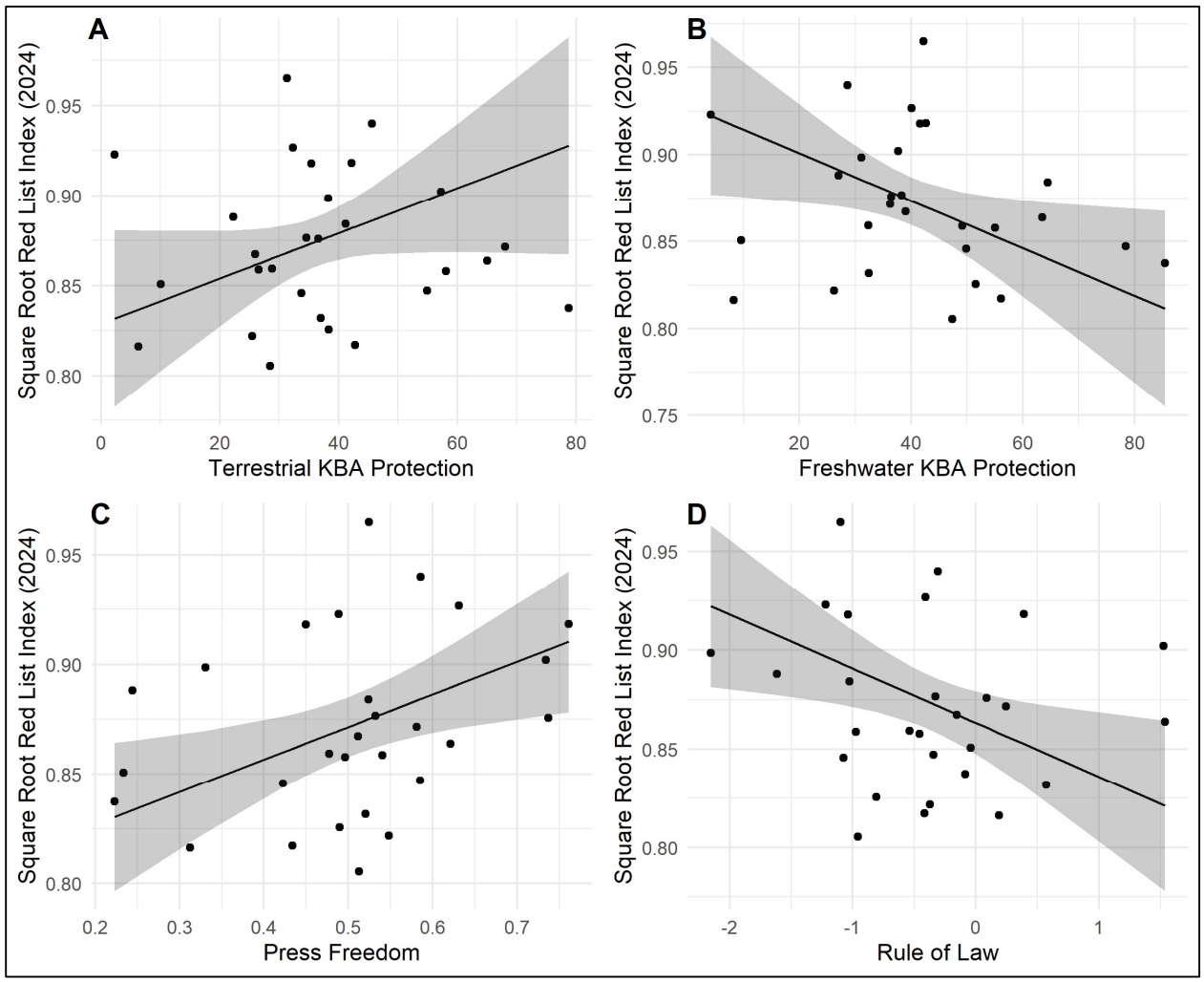

Fig. A9 Red List Index added-variable plot for the 30 most biodiverse CBD parties for the model SQRT_RLI_2024 ~ PRESS_FREEDOM + Rule_of_Law. Adjusted R^2 was 0.193.

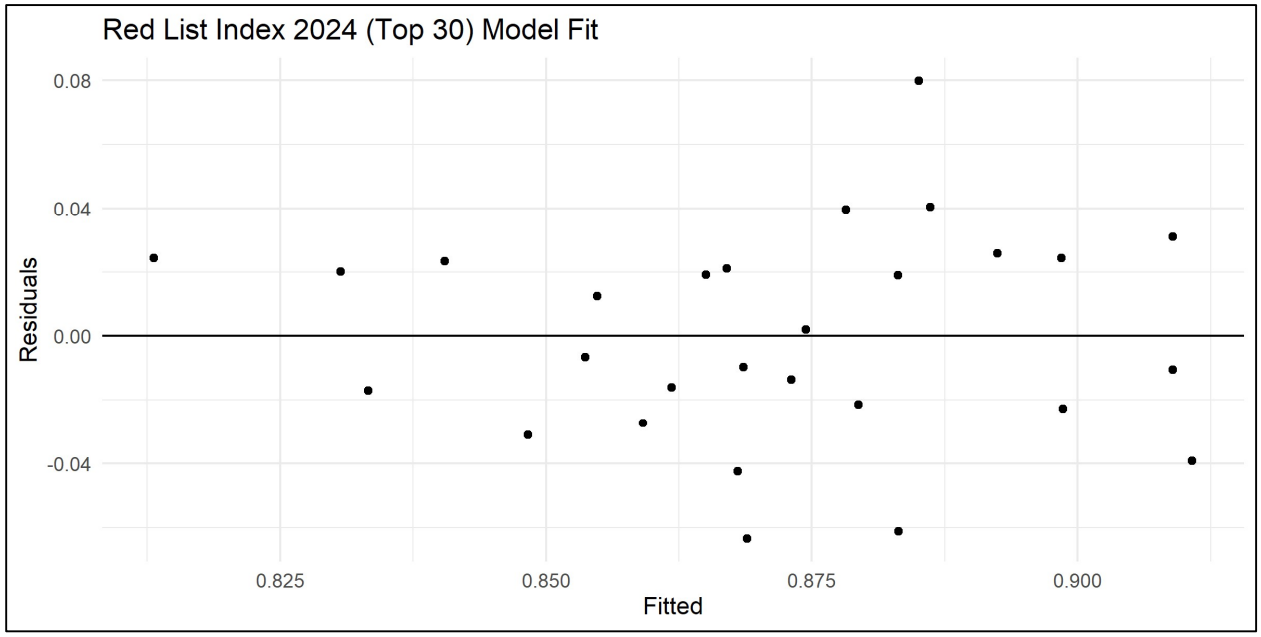

Fig. A10 Residual plot for the Red List Index model for the 30 most biodiverse CBD parties.

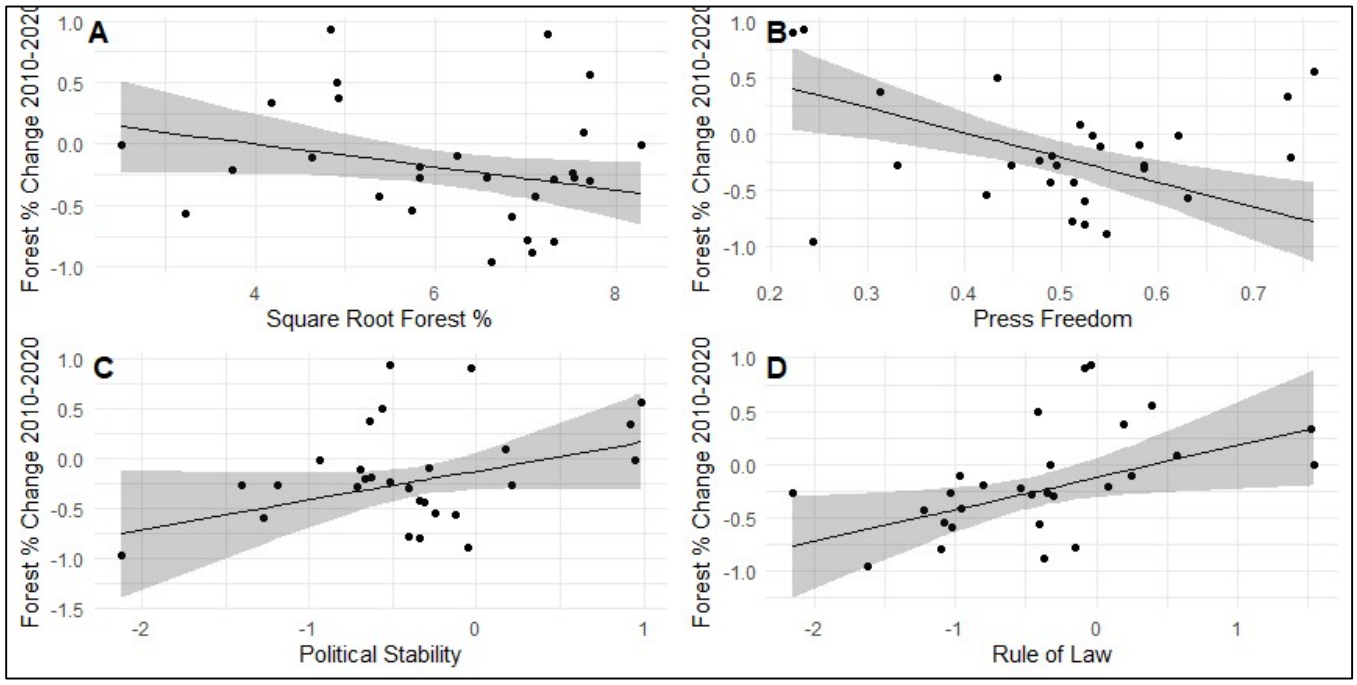

Fig. A11 Forest Change (2010-2020) added-variable plot for the 30 most biodiverse CBD parties for the model FOR_CHG ~ SQRT_FOR_PCT + PRESS_FREEDOM + Political_Stability + Rule_of_Law. Adjusted R^2 was 0.466.

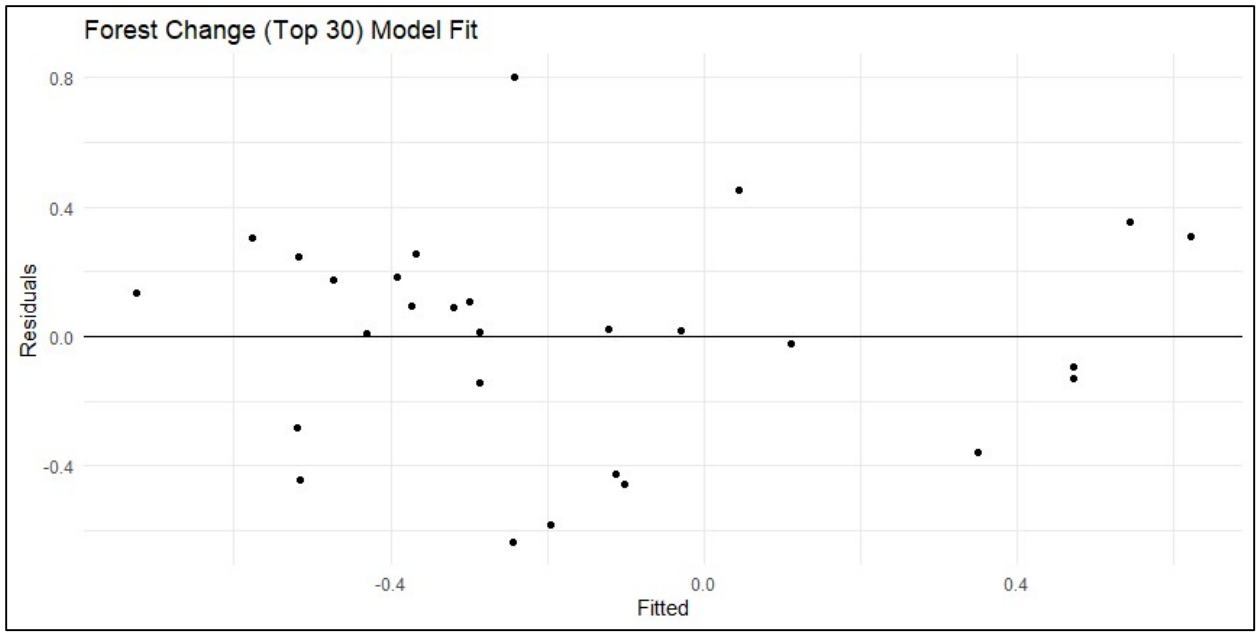

Fig. A12 Residuals plot for the fitted Forest Change model for the 30 most biodiverse CBD parties.

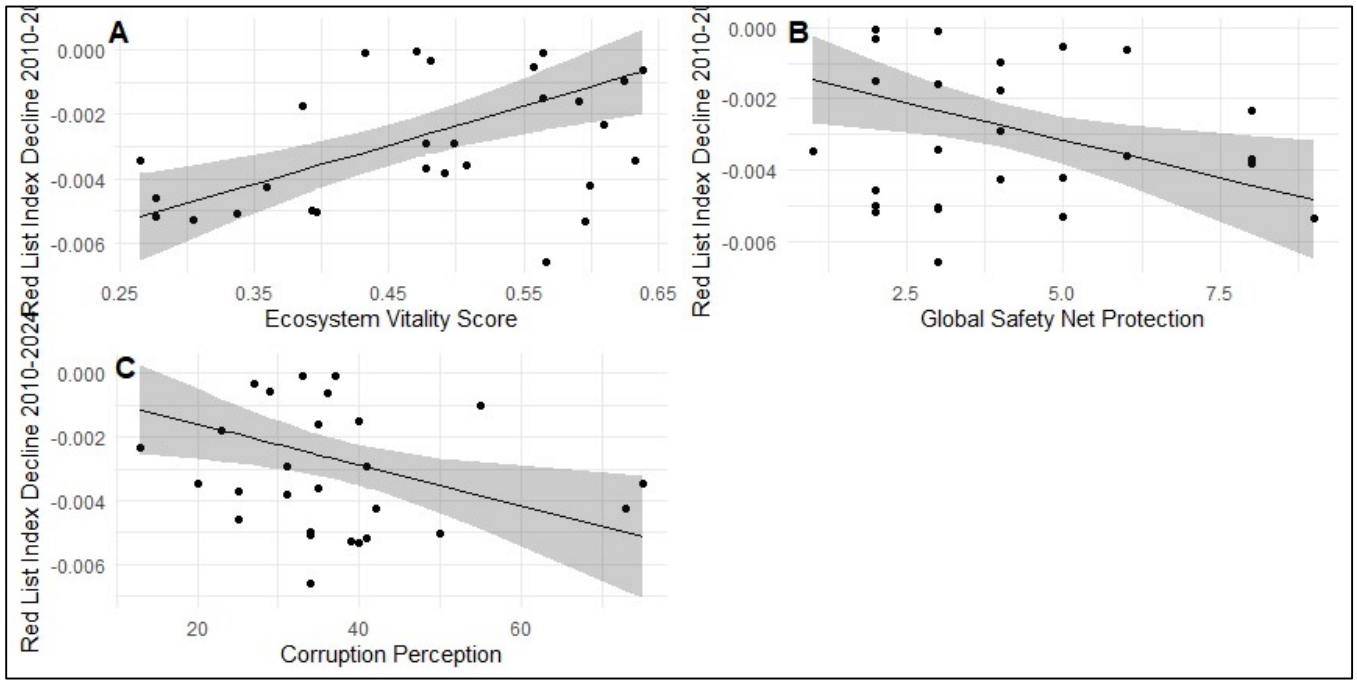

Fig. A13 Red List Decline (2010-2024) added-variable plot for the 30 most biodiverse CBD parties for the model RLI_2010_2024 ~ ECO_PROT + BIA_PROT + CORRUPTION_PERCEPTION. Adjusted R^2 was 0.336.

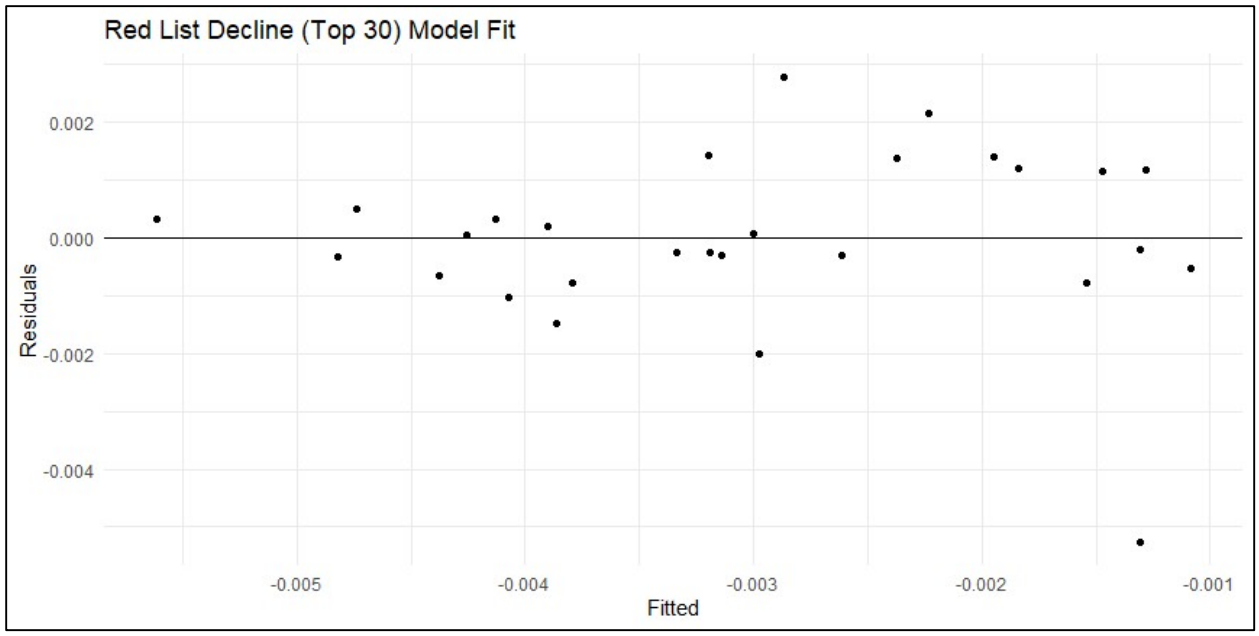

Fig. A14 Residual plot of the fitted model for Red List Decline (2010-2024) for the 30 most biodiverse CBD parties.

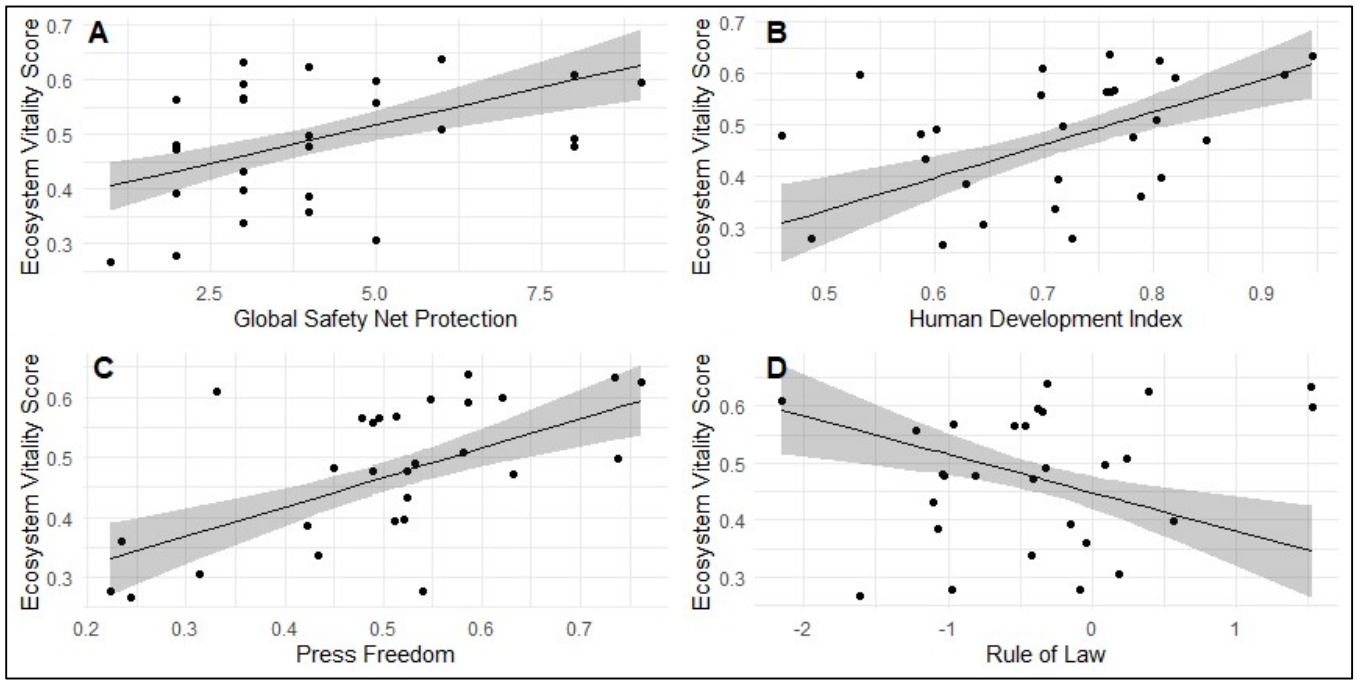

Fig. A15 Ecosystem Protection Score added-variable plot for the 30 most biodiverse CBD parties for the model ECO_PROT ~ BIA_PROT + HDI + PRESS_FREEDOM + Rule_of_Law. Adjusted R^2 was 0.714.

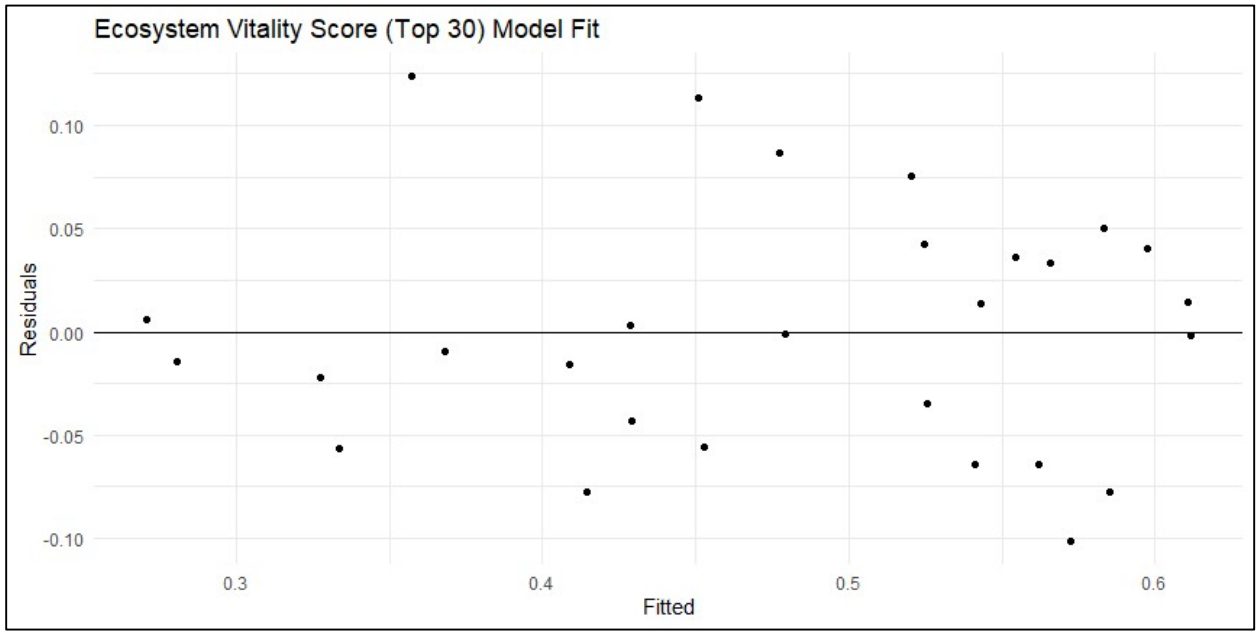

Fig. A16 Residual plot for the fitted model of Ecosystem Vitality Score for the 30 most biodiverse CBD parties.