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Valuing nature conservation

A methodology for quantifying the benefits of protecting the planet's natural capital

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A note on social responsibility and environmental sustainability

Our purpose as a firm is to help create positive, enduring change in the world. Our approach to social responsibility includes giving back to our communities, managing our firm in socially and environmentally sustainable ways, and intentionally addressing societal challenges across our client work.

As a participant in the United Nations Global Compact, we support and respect the Ten Principles on human rights, environment, labor, and anti-corruption, and we reflect these principles throughout our policies and practices. We bring this commitment to life through our values, our code of professional conduct, and our policies and practices related to the environment, our supply chain, our people, and our professional standards. As a firm, we have been carbon neutral since 2018. (See our Social Responsibility Report.)

One key area in which McKinsey & Company has engaged extensively to achieve such positive change is environmental sustainability. Through our own internal practices, our work with clients, and published research, McKinsey helps businesses and governments reduce risk, manage disruption, and capture opportunities in the transition to a low-carbon, sustainable-growth economy (see also our recent publication, *Climate risk and response: Physical hazards and socioeconomic impacts*). In writing this report we hope to provide a rigorous approach and a valuable fact base for decision makers across the public, private and nonprofit sectors to assess and potentially expand investments in the natural capital that will aid in that transition.

Contents

The analytics contained in this report are based on global data sets and do not take into account local geographic detail not included in such data sets or recent local developments (political or otherwise). Although our analytics can provide useful directional guidance, any local conclusions will require detailed local studies.

Executive summary

Rigorous analysis of opportunities to expand nature conservation can help determine where natural capital could have the biggest impact on climate, jobs, and health.

Much of the global economy depends on natural capital—the world's stock of natural assets. Acting as the planet's balance sheet, natural capital provides critical services and resilience. It supports water cycles and soil formation while protecting our communities from major storms, floods, fires, and desertification. By absorbing CO_2, it limits the pace of climate change. Biodiversity, a core component of natural capital, supports activities as wide-ranging as pharmaceutical innovation, ecotourism, and crop pollination. These are just a few of the numerous "co-benefits" that make nature so valuable. Yet the complexity of natural capital makes its benefits hard to quantify, leading many to overlook nature as an investment opportunity. In this report, we describe and apply a methodology that can help quantify some of the costs and benefits of conserving natural capital.

Multiple scientific studies have found that human activity is eroding the value generated by natural capital. For example, deforestation is responsible for approximately 14 percent of global carbon emissions, accelerating climate change and increasing the frequency of extreme weather events.[1] The destruction of natural marine reefs and mangroves threatens the protection of coastal human populations against storms and flooding.[2] At the same time, ecosystem fragmentation, habitat loss, and climate change have caused wildlife populations to decline on average by two-thirds in the past 50 years, decreasing biodiversity worldwide.[3] The wildlife that remains comes in ever-closer contact with society, raising the risk of zoonotic diseases, such as COVID-19.[4]

The scale of these pressures has led scientists to conclude that we may have a limited window of opportunity to protect and stabilize nature.[5] To reduce the erosion of natural capital, scientists and policy makers have called for the permanent conservation of at least 30 percent of the planet's surface by 2030, nearly doubling nature conservation on land and in national waters.[6]

To pursue the 30 percent target, decision makers would need rigorous data-driven analysis to help them evaluate strategies and design conservation[7] efforts while capturing benefits and managing risks. Methodologies to evaluate the full spectrum of co-benefits from nature conservation could help stakeholders make informed trade-offs. This report seeks to contribute to such efforts, providing a fact base and methodology to help decision makers start this journey, as well as a set of actionable recommendations for further work.

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[1] P. Friedlingsteing et al., "Global Carbon Budget 2019," *Global Carbon Project* December 4, 2019, globalcarbonproject.org.
[2] H. P. Jones et al., "Global hotspots for coastal ecosystem-based adaptation," *PLOS ONE*, May 29, 2020, Volume 15, Number 5, journals.plos.org.
[3] R.E.A. Almond et al., Living Planet Report 2020- *Bending the curve of biodiversity*, Gland, Switzerland: WWF, 2020.
[4] Zoonotic diseases are those passed from animals to humans.
[5] E. Dinerstein et al., "A global deal for nature: Guiding principles, milestones, and targets," *Science Advances*, April 19, 2019, Volume 5, Number 4, advances.sciencemag.org.
[6] Conserving 30 percent of the planet's surface would also imply a significant increase in the 2 percent of international waters that are protected today. We do not include these in our analysis. The current protection figures of 16 percent of land and 17 percent of national waters include International Union for Conservation of Nature (IUCN) categories only—excluding other effective area-based conservation measures (OECMs).
[7] When referring to conservation in this report, we mean either the conservation of intact ecosystems or restoration of degraded ecosystems.

Our methodology

We employed advanced geospatial analytics to create and evaluate alternative nature conservation scenarios and explore trade-offs.

Natural capital is distributed unevenly across the Earth's surface, so conservation costs and feasibility at the local level also vary—sometimes dramatically. We tackled some of those superlocal considerations by dividing the planet's surfaces into "pixels"—land areas of 5 kilometers by 5 kilometers and marine areas of 30 kilometers by 30 kilometers—for a total of around 6 million pixels. We then overlaid this global map with thousands of spatial data layers covering a range of variables (such as biodiversity, carbon stock, and human footprint) to establish a baseline for nature conservation and define six alternative scenarios to maximize the value from expanded conservation. As an example, one of these scenarios is illustrated in Exhibit 1.[8]

In each scenario, we assessed the impact of expanded conservation on climate change, jobs, GDP, zoonotic disease risk, and biodiversity and calculated the additional operating costs of conservation that may be required.

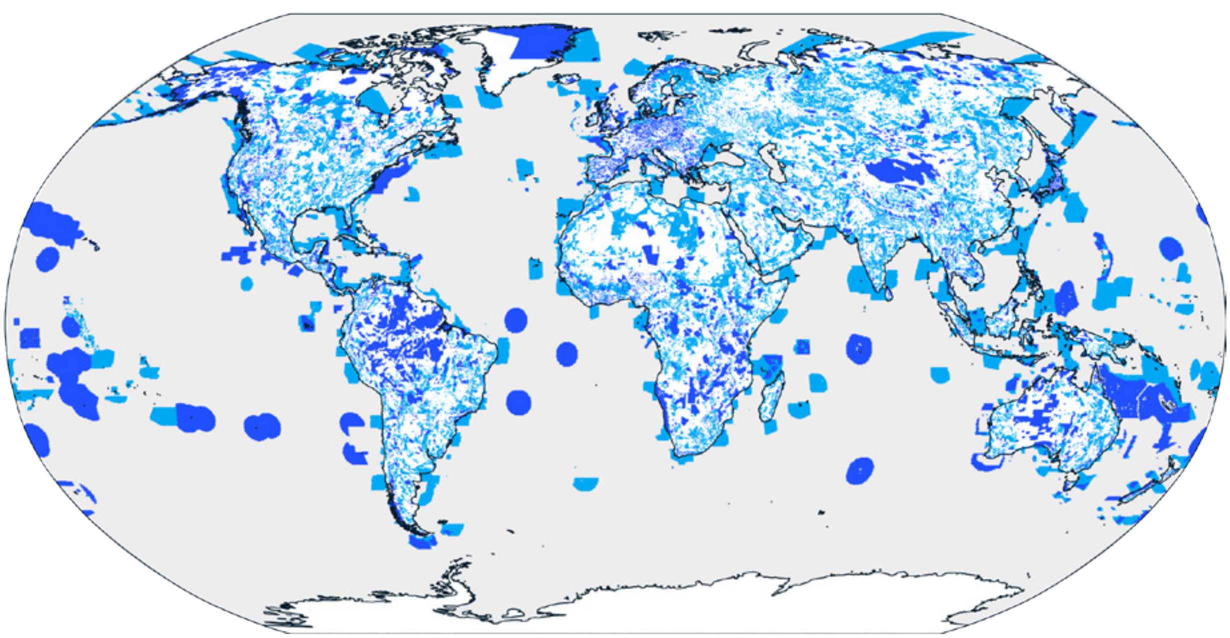
[8] The map shows scenario 2, which conserves 30 percent of each ecoregion and optimizes for species protection and CO_2 abatement. Scenario 2 was selected for this purpose based on a highly simplified scoring methodology (see chapter 2).

Exhibit 1

The highlighted areas would conserve 30 percent of land and national waters.

Areas identified to conserve 30 percent of land and national waters

Existing protected areas[1]



[1]Protected Area data downloaded from the Integrated Biodiversity Assessment Tool (IBAT) (http://www.ibat-alliance.org). Provided by BirdLife International, Conservation International, IUCN and UNEP-WCMC. Please contact ibat@ibat-alliance.org for further information.

Applying this methodology suggests that doubling nature conservation on land and in national waters by 2030 could have a measurable impact and could make a compelling case for investment. Benefits could include:

— *Reduction in atmospheric CO_2 by 0.9 gigatons to 2.6 gigatons annually*[9] through avoided deforestation and natural forest regrowth. This range is equal to 4 to 12 percent of the annual CO_2 emissions reductions needed by 2030 to limit global warming to 1.5°C.[10] Progress could, in turn, have a measurable impact on natural-capital stocks. For example, ocean warming threatens much of the world's coral, placing today's $36 billion reef-tourism industry at risk.[11, 12] Ocean warming is expected to reduce the global fish catch by about 8 percent by 2050.[13]

— *Creation of approximately 400,000 to 650,000 jobs* in conservation-management fields such as wildlife management and area infrastructure. Through adjacent nature-dependent markets, natural capital could also support local economic growth, generating or safeguarding on the order of *$300 billion to $500 billion in GDP and 30 million jobs in ecotourism and sustainable fishing alone*.[14]

— *Lowering the risk of new zoonotic diseases emerging* by slowing ecosystem fragmentation. Depending on the scenario, the average risk of a zoonotic-disease transmission event in prioritized areas could be up to 80 percent higher than in remaining areas of unprotected nature. Slowing ecosystem fragmentation in these prioritized areas could be particularly beneficial in the fight against pandemics.

Although biodiversity has immeasurable value in its own right, it also underpins each of these benefits. Depending on the scenario, doubling nature conservation could expand the protected habitat of species threatened with extinction by 2.2 to 2.8 times.

This report inevitably underestimates the value of nature conservation. The above impact areas are limited to what we could quantify in detail at a global scale—and likely materially underestimate the total potential impact of doubling nature conservation. For example, intact ecosystems do more to protect against climate change than just sequestering CO_2: mangroves and natural reefs protect coastal areas and populations against the physical risk from storms, floods, and other extreme weather events that increase in frequency with climate change.[15] Harder yet to quantify are potentially substantial health and culture benefits such as the preservation of cultural diversity in large, uninterrupted rainforest areas (which are home to as many as 25 percent of the world's languages).[16]

If conservation projects are implemented to optimize benefits, many of those benefits could flow to underserved and Indigenous communities living in or close to natural areas. Researchers estimate that

[9] Spread of potential impact reflects the different conservation scenarios analyzed.
[10] Kimberly Henderson, Dickon Pinner, Matt Rogers, Bram Smeets, Christer Tryggestad, and Daniela Vargas, "Climate math: What a 1.5-degree pathway would take," *McKinsey Quarterly*, April 30, 2020, McKinsey.com.
[11] "Coral reefs and climate change," International Union for Conservation of Nature (IUCN), November 2017, iucn.org; M. D. Spalding et al., "Mapping the global value and distribution of coral reef tourism," *Marine Policy*, August 2017, Volume 82, pp. 104–13, sciencedirect.com.
[12] In one example, the Great Barrier Reef lost half of its coral from 2016 to 2017 as a result of rising sea temperatures and a strong El Niño event, see T. P. Hughes et al., "Ecological memory modifies the cumulative impact of recurrent climate extremes," *Nature Climate Change*, December 10, 2018, Volume 9, pp. 40–3.
[13] V. W. Y. Lam et al., "Projected change in global fisheries revenues under climate change," *Scientific Reports*, September 7, 2016, Volume 6, Article Number 32607.
[14] We assume a rebound in tourism to pre-COVID-19 levels in three years.
[15] For more information, see "Climate risk and response: Physical hazards and socioeconomic impacts," McKinsey Global Institute, January 16, 2020, on McKinsey.com.
[16] T. E. Lovejoy and J. Reid, "How big forests solve global problems," *New York Times*, April 19, 2018, nytimes.com.

Indigenous Peoples' lands account for 37 percent of all remaining natural land—underscoring the point that Indigenous People are critically important stakeholders in conservation decisions.[17]

Financing the conservation of natural capital

Doubling the amount of conserved land and national waters could require an additional operating expenditure of $20 billion to $45 billion a year, depending on the conservation scenario.[18] In more than half of the conservation areas identified, the economic benefits from ecotourism and sustainable fishing alone could outweigh these costs by at least three times.

Despite these findings, the business case for individual nature conservation projects is often not straightforward to unravel. Co-benefits tend to be both opaque and dispersed, making accounting for the impact difficult—often more so than for an alternative use of the same land or marine area. The opportunity costs of alternative use can be significant, particularly in the short term, and affect some sectors of local economic activity. The challenge of fully unpacking short- and long-term trade-offs and of supporting people through transitions and job losses may be significant.

Further, large conservation projects require significant up-front financing as well as complex legal frameworks to secure these benefits. A range of conservation approaches have emerged in recent decades to help overcome these challenges. For example, Project Finance for Permanence (PFP) has an impressive track record in long-term nature conservation (see chapter 3, "How to start").

Taking action

Expanding natural-capital conservation locally and globally would require concerted action by multiple stakeholders. Each stakeholder group has a unique role to play and challenges to consider.

1. ***Private-sector organizations*** could expand efforts to understand the growing risks to supply chains and operating assets from the loss of natural capital. This could also help companies identify nature-conservation investments to help mitigate these risks.

- *Where could natural capital provide the most value in reducing physical asset risk?*
- *What role should insurers play to better transfer and mitigate risk?*
- *How can investments in natural capital be amplified through cross-sector collaboration methodologies such as the jurisdictional approach or Project Finance for Permanence?*

[17] S. T. Garnett et al., "A spatial overview of the global importance of Indigenous lands for conservation," *Nature Sustainability*, July 16, 2018, Volume 1, Number 7, pp. 369–74, nature.com.
[18] This estimate of annual operating cost does not include any additional spending required to effectively conserve existing protected areas. It does not include opportunity costs, initial investments, land acquisition costs (where applicable), or the costs of expanding conservation in international waters.

2. ***National governments*** could use this methodology to better understand the investment case for expanding nature conservation.

» *Where does the erosion of natural capital put populations or livelihoods at risk?*

» *Where can the conservation of nature help to maximize net benefits, while accounting for opportunity costs?*

» *What is needed for these benefits to flow to underserved and Indigenous communities living in or near new conservation areas?*

3. ***Intergovernmental organizations*** can use analytics to identify conservation targets, support national governments in making conservation investment decisions, and promote international dialogue.

» *What standards could be in place to help analyze and account for the co-benefits of natural capital?*

» *Where would conservation require transnational effort and financing, and which frameworks can help?*

» *What conservation targets are required to stop the erosion of natural capital and maximize nature's co-benefits?*

4. ***Conservation practitioners and donors*** could use this approach to identify areas to invest in. By forming alliances, they can pool the expertise and funding required to build on this geospatial approach with detailed in-country feasibility assessments and implementation support. Effective alliances could go further to play the role of an "accelerator," engaging a range of stakeholders to increase the number of conservation projects worldwide, while ensuring their implementation according to best practices along shortened timelines.

» *Where are the highest-impact opportunities to deploy philanthropic resources?*

» *How can the donor and practitioner community work together with the public and private sectors to expand conservation?*

1.

The case for expanding nature conservation

This report describes a methodology of valuing nature conservation, comparing the potential benefits of natural capital with the costs of protecting it.

Natural capital is the planet's stock of natural assets—its biodiversity, air, soil, and water, as well as other natural resources. Investment in the conservation of natural capital was already on the agendas of policy makers well before the COVID-19 pandemic began. The year 2020 was meant to be the Super Year for Nature, packed with summits focused on natural capital, including the UN Climate Change Conference (COP26) in Glasgow, the IUCN World Conservation Congress in Marseille, the UN Convention on Biological Diversity (COP15) in Kunming, and the UN General Assembly in New York City.

On the agenda at these meetings were proposed targets for conserving natural capital. For example, the UN Convention on Biological Diversity's "30 by 2030" proposal calls for the protection of 30 percent of our planet's surface area by 2030, nearly doubling the amount of conserved land and national waters (see sidebar "The 30 by 2030 proposed target").[19] This level of nature conservation has been proposed as necessary to mitigate climate change, protect communities from extreme weather, prevent the destruction of "ecosystem services" such as crop pollination or water filtration for nearby cities, and halt the mass extinction of species.[20]

COVID-19 postponed these discussions and target setting. However, the urgency of the debate and the need for a data-driven methodology to evaluate conservation decisions remain. Without assessing the validity of the specific 30 percent target, we anchor our analytics on that number to evaluate the potential impact of conservation at a global scale.

Our approach

In this report, we propose an analytical methodology to help decision makers evaluate alternative ways to expand nature conservation. Using highly detailed geospatial analytics, we compared thousands of data layers and assessed around 6 million pixels[21] of the Earth's surface. Through this analysis, we seek to:

— establish a baseline of existing Protected Areas

— identify a variety of scenarios that would result in the conservation of 30 percent of the planet

— quantify the potential impact of expanded nature conservation on climate, the economy, human health, and biodiversity

— calculate the potential operating costs of expanded nature conservation

[19] The target would also imply a significant increase in the 2 percent of international waters that are protected today. We do not include these in our analysis. The current protection figures of 16 percent on land and 17 percent of national waters include IUCN categories only—excluding other effective area-based conservation measures (OECMs).

[20] For example, 15,000 scientists cosigned an article by William J. Ripple and others in which the authors argue that nature preservation and conservation is a critical tool alongside others in mitigating the "collision course" that humans are on with the natural world. In their epilogue, the authors note that "[a]s far as we know, this is the most scientists to ever co-sign and formally support a published journal article." For more, see W. J. Ripple et al., "World scientists' warning to humanity: A second notice," *BioScience*, December 2017, Volume 67, Number 12, pp. 1026–8, academic.oup.com.

[21] We divided the Earth's surface into 5 km by 5 km land areas and 30 km by 30 km marine areas, referred to as pixels.

Our analysis encompasses a diverse set of potential effects to provide an end-to-end examination of the benefits and costs of conserving the Earth's land and national waters at scale. This report presents the results of our analysis, aggregated at a global level. The approach could also be applied to any local area. Conserving nature has many benefits that we did not quantify—such as the value of protecting against physical climate risk for coastal communities or crop pollination—leaving opportunities to take this analysis further. For an overview of our analysis, see sidebar "About the methodology"; full details can be found in the technical appendix.

What this report is and is not

What this report is:

— A geospatial analytical approach using McKinsey & Company's ACRE solution to consider a sample of co-benefits from expanding area-based nature conservation.

— A "superlocal" approach at a resolution of 5 km x 5 km for land and 30 km x 30 km for oceans, applying approximately 35,000 spatial data layers covering a range of variables (such as biodiversity, carbon stock, and human footprint).

— An assessment of six global scenarios to increase nature conservation on land and in national waters, anchored in the proposed UN target of protecting 30 percent of the planet by 2030.

— An anecdotal exploration of the broader benefits and costs of conserving nature.

— An identification of actions and questions for stakeholders to consider.

What this report is not:

— A comprehensive global analysis of all of the benefits and costs (including opportunity costs) of expanding nature conservation.

— An assessment of whether 30 by 2030 is the right target or an assessment of which conservation scenario to achieve 30 by 2030 is optimal overall or preferable for any specific stakeholder.

— An analysis of the co-benefits, efficacy, or funding level of existing conservation areas.

— An assessment of ways to conserve natural capital other than through area-based conservation.

— A recommendation for any specific area-based conservation approach, IUCN, or OECM[22] category for areas that we identified as potential priorities for conservation.

— A comprehensive assessment of conservation financing mechanisms and their viability.

[22] November 2019 IUCN guidance on "recognising, reporting and supporting 'other effective area-based conservation measures.'"

About the methodology

We divided the planet's land and marine surfaces into 5 km by 5 km and 30 km by 30 km pixels respectively, for a total of around 6 million pixels. We then overlaid this global map with a series of spatial data layers covering a range of variables (such as biodiversity, carbon stock, and human footprint) to execute the following four steps:

1. **Establish the baseline of existing Protected Areas**

We analyzed existing Protected Areas[23] at a resolution of 1 km by 1 km to identify those where increasing human pressure may be impeding their ability to achieve their potential biodiversity, climate, economic, and health effects. We considered that these Protected Areas at potential risk of human pressures, amounting to 0.8 percent of land and national waters, could be priority candidates for enhanced conservation.[24] As a result, the benefits and costs of conservation associated with these areas were analyzed together with potential new conservation areas identified.

2. **Generate six scenarios for identifying new areas to reach 30 percent conservation of land and national waters**

The six scenarios, outlined in Exhibit 2, are intended to simulate a range of different conservation choices.

We used integer linear programming to select pixels amounting to 30 percent conservation of land and national waters.[25] We excluded areas with a high human footprint, using the Human Footprint[26] and Cumulative Human Impact[27] indices.

For each of our potential spatial constraints (whether to conserve 30 percent of each country, ecoregion, or ecozone), we considered the conserved habitat range of the world's threatened species by setting a defined minimum coverage target for each species. This exercise used around 35,000 data layers,[28] each representing the habitat range of a single species. We locked in marine critical habitats to account for the greater migratory behavior of marine animals.

For each spatial constraint we defined two solutions: one that maximizes biomass and soil carbon stock protection[29] (with a climate change mitigation focus) and one that minimizes the potential impact on existing human activity.

The three global spatial constraints and two prioritization methods generated six conservation scenarios (Exhibit 2).

3. **Assess the impact on climate change mitigation, jobs and GDP, species protection, and zoonotic disease risk from new and enhanced conservation areas**

We measured all effects at the 2030 horizon, in line with the proposed 30 by 2030 target.

The CO_2 abatement potential was measured as a combination of avoided deforestation resulting from conservation[30] and the possibility for reforestation through natural regrowth.[31] Areas considered to be at risk of deforestation by 2030 were identified using a recently published model that included various area

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[23] Protected Area data downloaded from the Integrated Biodiversity Assessment Tool (IBAT) (http://www.ibat-alliance.org). Provided by BirdLife International, Conservation International, IUCN and UNEP-WCMC. Please contact ibat@ibat-alliance.org for further information. Existing Protected Areas, as defined under IUCN categories, were considered for this baseline analysis. OECMs were not considered when establishing the baseline due to lack of sufficient data. As of January 2019, the area analyzed—covering 16 percent of land and 17 percent of national waters—comprised 99 percent of the global Protected Area footprint. The remaining 1 percent was not considered due to the resolution of the analysis.

[24] We used satellite-derived data on the trends in human activities as a proxy to assess whether each existing Protected Area is facing increased pressure (see technical appendix). While such global data is able to measure threats to Protected Area durability and efficacy to some extent (for example, through forest loss and fragmentation), it does not accurately account for other local threats, such as poaching.

[25] The locations of existing Protected Areas were not assessed, and these were considered a part of the 30 percent global conservation.

[26] O. Venter et al., "Global terrestrial Human Footprint maps for 1993 and 2009," *Scientific Data*, August 23, 2016, Volume 3, Article Number 160067, nature.com.

[27] Benjamin S. Halpern et al., "Recent pace of change in human impact on the world's ocean," *Scientific Reports*, August 12, 2019, Volume 9, Article Number 11609, nature.com.

[28] The IUCN Red List of Threatened Species downloaded from the Integrated Biodiversity Assessment Tool (IBAT) (http://www.ibat-alliance.org). Provided by BirdLife International, Conservation International, IUCN and UNEP-WCMC. Please contact ibat@ibat-alliance.org for further information; Reptile distribution data from U. Roll et al., Nature Ecology & Evolution, 2017, Volume 1, pp. 1677–82.

[29] On terrestrial Protected Areas only. Here, we put a higher weighting on carbon in the tropics that is considered at risk of deforestation. Deforestation in the tropics accounts for the majority of emission risk due to deforestation by 2050, and the underlying drivers of deforestation are more applicable to conservation as an intervention. For more, see J. Busch et al., "Potential for low-cost carbon dioxide removal through tropical reforestation," *Nature Climate Change*, May 27, 2019, Volume 9, Number 6, pp. 463–6, nature.com.

[30] Conservation efforts were assumed to be 80 percent effective at preventing deforestation based on expert input. We did not consider "leakage" (the potential displacement of deforestation to other areas) or "blockage" (the potential decrease in deforestation surrounding a conserved area), due to a lack of reliable data or estimates on these effects at scale.

Exhibit 2

Six scenarios have been developed to identify the range of potential benefits and costs of conserving 30 percent of the planet.

		Spacial constraints			Optimization criteria		
		Country	Ecoregion	Ecozone	Species	Carbon stocks	Human activity
1	Conserving 30% of each country, while maximizing protection of species and carbon stocks	●	○	○	●	●	○
2	Conserving 30% of each ecoregion, while maximizing protection of species and carbon stocks	○	●	○	●	●	○
3	Conserving 30% of each ecozone (similar to continents), while maximizing protection of species and carbon stocks	○	○	●	●	●	○
4	Conserving 30% of each country, while maximizing protection of species and minimizing human activity opportunity costs	●	○	○	●	○	●
5	Conserving 30% of each ecoregion, while maximizing protection of species and minimizing human activity opportunity costs	○	●	○	●	○	●
6	Conserving 30% of each ecozone (similar to continents), while maximizing protection of species and minimizing human activity opportunity costs	○	○	●	●	○	●

characteristics such as agriculture revenue potential, elevation, initial forest cover, protected status, and slope.[32]

The potential of carbon offsets as a source of conservation funding was calculated based on combined avoided deforestation and possible reforestation. It assumes demand growth will be sufficient to absorb increased supply. Pricing was conservatively assumed at $5 per tonne of CO_2 and based on expert interviews.

The potential to create and safeguard jobs and GDP was measured for ecotourism in land areas and for both ecotourism and sustainable fishing in marine areas.

Land-based ecotourism potential was estimated using a regression model that drew on various area-specific (size, attractiveness, Human Footprint Index, remoteness) and country-specific (GDP per capita, global peace indices, tourist visits, and violent crime) variables and calibrated using data from around 500 Protected Areas.[33] We then projected the 2030 market size for Protected Area–based tourism by using growth forecasts and distributed projected tourist spending for each country that included both existing and newly identified areas for conservation. Marine ecotourism was estimated

[31] Across this report, we use conservation as a shorthand for either conservation or restoration.

[32] J. Busch et al., "Potential for low-cost carbon dioxide removal". Deforestation outside the tropics is predominately caused by wildfires and managed forest. Many factors affect deforestation patterns that are not considered by the model, including but not limited to changes in political leadership and commodity prices.

[33] A. Balmford et al., "Walk on the wild side: Estimating the global magnitude of visits to protected areas," *PLOS BIOLOGY*, February 24, 2015, Volume 13, Number 2, journals.plos.org; E. Viveiros de Castro, T. Beraldo Souza, and B. Thapa, "Determinants of tourism attractiveness in the national parks of Brazil," *PARKS*, November 2015, Volume 21, Number 2, pp. 51–62; *South African National Parks annual report 2016/17*, South African National Parks Annual Report 2016/2017," *South African National Parks*, July 31, 2017, sanparks.org; CONAF, Government of Chile, accessed February 3, 2020, www.conaf.cl; "National

using data from multiple global locations, considering both coral reef tourism[34] and marine life observation[35] (for example, whale watching).

Revenues from species protection such as sustainable fishing were estimated for areas we identified as overfished,[36] calculating the maximum sustainable yield in each identified area, excluding an assumed no-take zone of 30 percent of the conservation area.[37]

The GDP and jobs generated from ecotourism and sustainable fishing were calculated using country- and industry-specific expenditure multipliers.[38] These multipliers estimate the additional GDP and jobs generated for every dollar of spending in selected industries (for example, tourism spending and the purchase of fish), adjusted by country. To calculate the number of direct jobs created in conservation management, we first performed a regression analysis on 18 real-world examples. The parameters were the total conservation spending per employee and GDP per capita. For each country we then used our quantification of conservation area operating costs (covered below) and GDP per capita for each country to estimate direct jobs created.

The risk of zoonotic disease transmission in each pixel was estimated based on the predicted locations of potential zoonotic diseases and proximity to areas of high human density, following a recent study.[39]

4. Calculate the operating cost of conservation for each new and enhanced conservation area

Costs were calculated using established published models[40] for land and marine Protected Areas and considered the size of the area and the country's gross national product and purchasing-power parity. Assuming the proposed 30 percent target as a fixed constraint, opportunity costs of alternative area use were not included in our analysis. Similarly, potential land acquisition and up-front infrastructure costs were not included in our analysis.

Throughout this report, we have sought to build on existing published work where available. Further details can be found in the technical appendix.

Parks," Ministry of Environment and Forestry of the Republic of Indonesia; see technical appendix for details.
[34] M. D. Spalding et al., 2017.
[35] S. O'Connor et al.,"Whale watching worldwide: Tourism numbers, expenditures, and expanding economic benefits. A special report from the International Fund for Animal Welfare," June 2009; A. M. Cisneros-Montemayor et al., "Global economic value of shark ecotourism: Implications for conservation," *Oryx*, July 2013, Volume 47, Number 3, pp. 381–8, cambridge.org.
[36] Based on R. A. Watson and A. Tidd, "Mapping nearly a century and a half of global marine fishing: 1869–2015," *Marine Policy*, July 2018, Volume 93, pp. 171–7, sciencedirect.com; Sea Around Us; Ocean Health Index (website), accessed April 6, 2020, oceanhealthindex.org.
[37] L. Pet-Soede et al., "Benefits of marine protected networks: An overview in support of the Coral Triangle Initiative," *World Wildlife Fund*, June 2009; F. Vandeperre et al., "Effects of no-take area size and age of marine protected areas on fisheries yields: A meta-analytical approach," *Fish and Fisheries*, December 22, 2010, Volume 12, Number 4, pp. 412–26, onlinelibrary.wiley.com.
[38] GDP and jobs multiplier data were obtained from Oxford Economics (ecotourism), World Input-Output (fishing), or selected projects (PA management); see technical appendix for details. Continent-specific multipliers were used in cases where country-level data was unavailable.
[39] T. Allen et al., "Global hotspots and correlates of emerging zoonotic diseases," *Nature Communications*, October 24, 2017, Volume 8, Article Number 1124, nature.com.

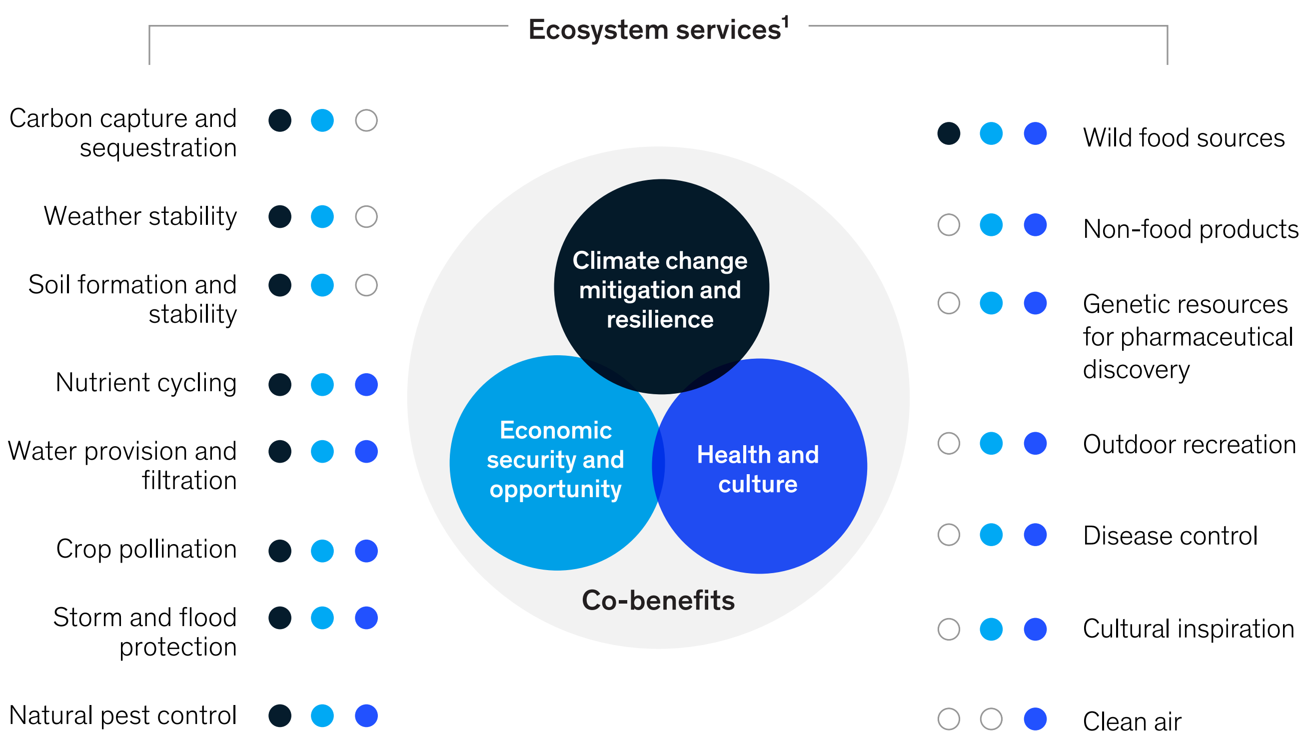
The critical need for investments in natural capital

Natural capital supports a significant share of global economic activity[41]—and it does so in myriad ways (Exhibit 3). These ecosystem services mitigate climate change, increase economic security and opportunity,[42] and sustain health and culture. However, the number and complexity of ecosystem services may cause many to overlook and undervalue investment opportunities in natural capital. For instance, it can take years of research to account for the exact value of a single forest's water filtration, rainfall generation, soil formation, recreational opportunities, pest control, and agricultural pollination. Yet it is precisely this large stack of co-benefits that makes intact ecosystems so valuable.

[40] A. Balmford and T. Whitten, "Who should pay for tropical conservation, and how could the costs be met?," *Oryx*, April 2003, Volume 37, Number 2, pp. 238–50, cambridge.org; A. Balmford et al., "The worldwide costs of marine protected areas," *PNAS*, June 29, 2004, Volume 101, Number 26, pp. 9694–7, pnas.org.

Exhibit 3

Natural capital—the world's stock of natural assets—provides a wide range of ecosystem services with direct benefits to humanity.



[1]Ecosystem services listed are not exhaustive. Colors show first-order co-benefits.

The 30 by 2030 proposed target

In April 2019, scientists from around the world published a plan to address the extinction crisis and avert the worst effects of climate change. The "Global Deal for Nature," featured in the journal *Science Advances*, proposed a fact-based target to increase nature conservation to 30 percent of the world's surface by 2030.[43]

Since the publication of that report and others, various groups have joined in their support for this target. The UN Convention on Biological Diversity, responsible for the development of the Post-2020 Global Biodiversity Framework, included the 30 percent target for the protection and conservation of the planet by 2030 in its most recent draft paper.[44]

We use this proposed target as a reference point for our analysis, seeking to evaluate possible pathways and the benefits and costs to meet this proposed target given its scientific foundation and inclusion in a draft post-2020 global biodiversity framework. We do not seek to assess the underlying science or evaluate potential alternative targets.

[43] E. Dinerstein et al., "A global deal for nature: Guiding principles, milestones, and targets," *Science Advances*, April 19, 2019, Volume 5, Number 4, advances.sciencemag.org
[44] *Update of the zero draft of the post-2020 global biodiversity framework*, UN Convention on Biological Diversity, August 17, 2020, cbd.int.

Co-benefit 1: Climate-change mitigation and resilience
Conserving natural capital could be critical to slowing climate change. From forests to oceans, natural capital underpins carbon sequestration through processes such as tree growth, soil carbon storage, and maintenance of marine kelp, seagrass, and algae resources. Destroying intact ecosystems releases this carbon. Cutting down a growing tree can change it quickly from being carbon negative (absorbing atmospheric CO_2) to being carbon positive (potentially releasing CO_2 into the atmosphere). This is particularly immediate when forests are burned. Scientists estimate that deforestation releases 5.5 gigatons of CO_2 each year—approximately 14 percent of global emissions.[45, 46] In addition to trees and other vegetation, soil also has an important role to play in mitigating climate change. Protecting and expanding existing soil carbon stocks is estimated to represent 25 percent of natural climate solution potential.[47]

Natural capital can not only slow down climate change but also improve our resilience in the face of extreme weather events, which will become increasingly frequent as the climate changes. For example, coral reefs reduce wave energy by an average of 97 percent, providing protection from extreme storm damage for almost 200 million people in India, Indonesia, the Philippines, and elsewhere.[48] The alternative—constructing artificial tropical breakwaters—could cost around 15 times as much as restoring

[45] This figure refers to net CO_2 emissions from land use and land-use change during 2009–2018, which are primarily due to deforestation.
[46] Global carbon budget, 2019.
[47] D. A. Bossio et al., "The role of soil carbon in natural climate solutions," *Nature Sustainability*, May 2020, Volume 3, Number 5, pp. 391–8.
[48] F. Ferrario et al., "The effectiveness of coral reefs for coastal hazard risk reduction and adaptation," *Nature Communications*, May 13, 2014, Volume 5, Number 3794, nature.com.

or protecting natural reefs.[49] While we quantify only nature's impact on climate-change mitigation in our analysis, its contribution to climate resilience is significant as well.

Co-benefit 2: Economic security and opportunity

Food security depends directly on healthy natural capital. The $5 trillion global agriculture sector relies on evaporation from forests, soil processes, and bodies of water to create rainfall.[50] Pollination (for example, when insects from nearby natural areas pollinate agricultural fields) supports $235 billion to $577 billion of the world's annual crop output.[51] Fish catch, worth $150 billion annually, also depends on effective conservation in the face of overfishing and damaged ecosystems.[52]

Nature's services also support the nonfood economy, including the production of timber, natural rubber, and genetic materials used to develop antibiotics and other pharmaceutical products. For example, around 75 percent of today's

[49] Ferrario et al., 2014.
[50] Lutz Goedde, Maya Horii, and Sunil Sanghvi, "Global agriculture's many opportunities," *McKinsey on Investing*, June 1, 2015, McKinsey.com.
[51] S. G. Potts, V. Imperatriz-Fonseca and H. T. Ngo (eds.), *The Assessment report on pollinators, pollination and food production*, Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), January 1, 2017, ipbes.net.
[52] *The state of world fisheries and aquaculture 2020: Sustainability in action, Rome: Food and Agriculture Organization (FAO), 2020.*

Case study

Mangrove conservation creates value

Mangrove forests offer a particularly impressive and versatile example of the value of nature. The trees and shrubs that grow in coastal intertidal zones in tropical and subtropical latitudes provide many ecosystem services. They serve as nurseries for commercial fishing, housing spawn and young fish, and are a source of raw materials such as chipboard, pulpwood, and construction poles. Mangroves are also effective carbon sinks, containing as much as four times more carbon when compared with other forest systems.[53]

Mangroves act as natural barriers against cyclones, hurricanes, tsunamis, and waves. Multiple studies have found that communities with intact mangroves are exposed to significantly less damage from these weather events than those with degraded or converted mangroves.[54] This function alone is estimated to generate $82 billion of annual value globally; this figure may increase over time as coastal communities face more extreme weather events.[55]

A review of approximately 150 different studies found that each hectare of mangrove creates around $5,800 of value in water and air purification, $3,600 in coastal protection, and $1,000 in recreation and tourism annually. In addition, mangroves generate hundreds of dollars per hectare each year from carbon sequestration, fishing, and forestry.[56, 57]

[53] D. C. Donato et al., "Mangroves among the most carbon-rich forests in the tropics," *Nature Geoscience*, April 3, 2011, Volume 4, pp. 293-7. researchgate.net.
[54] D. Evan Mercer and Marwa Salem, "The economic value of mangroves: A meta-analysis," *Sustainability*, March 7, 2012, Volume 4, Number 3, pp. 359–83, mdpi.com.
[55] I. J. Losadaet al., *The global value of mangroves for risk reduction*, Nature Conservancy, May 2018, conservationgateway.org.
[56] This is the median value for each category. This metric is used since means were significantly higher, indicating a leftward skew in the data set.
[57] Salem and Mercer, 2012.

antibiotics are derived from naturally occurring, genetically diverse material.[58] Forests are particularly important ecosystems as a source of food and nonfood services: roughly one-third of people around the world depend heavily on forests and forest products.[59]

Conserving nature can also avoid costs. In the early 1990s, for example, New York City officials collaborated with upstate farmers on an effort to improve water quality. The farmers set aside land for conservation and introduced sustainable farming practices, resulting in a large watershed-filtration area providing approximately 1.2 billion gallons of clean water daily for New York City. The alternative option available to policy makers at the time was to build a large-scale water filtration system that would have required around $5 billion in initial capital and $250 million in annual operating costs.[60]

Co-benefit 3: Health and culture

Nature contributes significantly to human health. For example, it supports food security, as outlined above, and can help to reduce disease risk by filtering air and water. Conserving intact ecosystems may also be a key factor in avoiding future pandemics (see sidebar "Conservation has a role to play in preventing pandemics").[61] The fragmentation of ecosystems and the encroachment of human activity into natural areas have increased the risk that humans will come into contact with zoonotic diseases.[62]

Well-preserved nature also sustains human cultural diversity around the world. For example, approximately one-quarter of the world's languages are indigenous to its three great tropical forest regions—the Amazon, New Guinea, and the Congo Basin—which together cover only 6 percent of the globe's land area.[63]

Although biodiversity has immeasurable value in its own right, it also underpins each of these co-benefits. For example, intact biodiverse forests sequester more carbon than their monoculture equivalents.[64] Biodiversity also has a stabilizing effect on ecosystems, making them more resilient against stressors such as climate change.[65] Similarly, the diversity of fauna and flora drives much of ecotourism, and pharmaceutical scientists mine the soil of diverse ecosystems for next-generation antibiotics.

The global risk to natural capital

According to a 2019 UN report,[66] nature is disappearing globally at unprecedented rates: species are becoming extinct at around 1,000 times the natural level (before human influence).[67] As a result, on the

[58] L.F. Nothias, R. Knight and P. C. Dorrestein, "Antibiotic discovery is a walk in the park," *PNAS*, December 20, 2016, Volume 113, Number 51, pp. 14477–9, pnas.org.
[59] *The state of the world's forests 2020: Forests, biodiversity and people*, Rome: Food and Agriculture Organization (FAO), 2020.
[60] A. F. Appleton, *How New York City used an ecosystem services strategy carried out through an urban-rural partnership to preserve the pristine quality of its drinking water and save billions of dollars and what lessons it teaches about using ecosystem services*, Katoomba Conference, Tokyo, Japan, November, 2002, cbd.int.
[61] *COVID 19: Urgent call to protect people and nature*, World Wide Fund for Nature, June 17, 2020, worldwildlife.org.
[62] Some animal viruses cause disease in their hosts, and a smaller subset can jump to other species, causing disease in their new hosts. These are known as zoonotic diseases.
[63] Lovejoy and Reid, 2018.
[64] J. Lecina-Diaz et al., "The positive carbon stocks–biodiversity relationship in forests: co-occurrence and drivers across five subclimates," *Ecological Applications*, September 2018, Volume 28, Number 6, pp. 1481–93.
[65] B. J. Cardinale et al., "Biodiversity loss and its impact on humanity," *Nature*, June 7, 2012, Volume 486, Number 7401, pp. 59–67.
[66] "UN Report: Nature's Dangerous Decline 'Unprecedented'; Species Extinction Rates 'Accelerating,'" Sustainable Development Goals, May 6, 2019, un.org.
[67] J. M. De Vos et al., "Estimating the normal background rate of species extinction," *Conservation Biology*, April 2015, Volume 29, Number 2, pp. 452–62, conbio.onlinelibrary.wiley.com.

Conservation has a role to play in preventing pandemics

Animal species can host thousands of viruses. These zoonotic diseases have a number of potential transmission mechanisms to jump from animals to humans. The evidence suggests the risk of zoonotic diseases being found in humans rises in line with the frequency of human contact with wildlife.[68] Research also suggests when biodiversity decreases, animals that tend to do well in close quarters with human populations, such as bats and rats, proliferate—and may be particularly prone to transmit diseases to humans.[69] The transmission of viruses between species has been the cause of several major public health episodes, including HIV/AIDS, SARS, Ebola, West Nile virus, and Lyme disease. Indeed, scientists estimated that almost half of all new zoonotic diseases between 1940 and 2010 could be linked to changes in land use, agriculture, and wildlife hunting.[70]

While it is too soon to know for certain which transmission mechanism the novel coronavirus followed, genetic research indicates that COVID-19 is a zoonotic disease.[71] Conservation can help limit reductions in biodiversity and ecosystem fragmentation that may lead to the spread of zoonotic diseases.[72]

[68]C. K. Johnson et al., "Global shifts in mammalian population trends reveal key predictors of virus spillover risk," *Proceedings of the Royal Society B*, April 8, 2020, Volume 287, Number 1924, royalsocietypublishing.org.
[69]J. Tollefson, "Why deforestation and extinctions make pandemics more likely," *Nature*, August 7, 2020, nature.com.
[70]F. Keesing et al., "Impacts of biodiversity on the emergence and transmission of infectious diseases," *Nature, December 1, 2010*, Volume 468, Number 7324, pp. 647–52,
nature.com.
[71]Maciej F. Boni et al., "Evolutionary origins of the SARS-CoV-2 sarbecovirus lineage responsible for the COVID-19 pandemic," *Nature Microbiology*, July 28, 2020, Volume 5, pp. 1408–17, nature.com..
[72]*COVID 19: Urgent call to protect people and nature*, World Wide Fund for Nature, June 17, 2020, worldwildlife.org.

order of 1 million species are now threatened with extinction.[73] The size of wildlife populations has also been impacted, declining by two-thirds since 1970.[74] This decline is caused by ecosystem fragmentation, habitat destruction, pollution, climate change, the spread of invasive species, and other factors.

For example, the world's stock of intact forest land, which has taken hundreds or even thousands of years to develop, decreased by 7 percent from 2000 to 2013—the equivalent of around 36,000 football fields every day for those 13 years.[75, 76] Mangrove cover is estimated to have declined by 50 percent since 1950.[77] Meanwhile, rising sea temperatures together with a strong El Niño event led to the death of half of the Great Barrier Reef's remaining intact coral from 2016 to 2017.[78, 79]

[73]S. Díaz et al.(eds.), *"Global assessment report on biodiversity and ecosystem services," IPBES*, May 6, 2019, ipbes.net.
[74]World Wildlife Fund, 2020.
[75]P. Potapov et al., "The last frontiers of wilderness: Tracking loss of intact forest landscapes from 2000 to 2013," *Science Advances*, January 4, 2017, Volume 3, Number 1, advances.sciencemag.org.
[76]McKinsey analysis based on an American football field.
[77]I. C. Feller et al., "Biocomplexity in mangrove ecosystems," *Annual Review of Marine Science*, January 15, 2010, Volume 2, pp. 395–417, annualreviews.org.
[78]T. P. et al., 2018.
[79]For more on the impact of climate change on natural capital stocks, see our recent climate risk and response case study,"Reduced dividends on natural capital," McKinsey Global Institute, June 29, 2020, on McKinsey.com.

These trends have reduced the value that natural capital generates. Recent scientific analysis has quantified the extent of some of the damage:

- The ability of tropical forests to absorb carbon has declined by one-third since the 1990s from the effects of warmer temperatures and drought.[80]
- Over half of the world's fish stocks are in a state of collapse, rebuilding, or overexploited.[81]
- Certain areas of the world, such as parts of the Mediterranean region and parts of the United States and Mexico, are projected to see a decrease in mean annual surface water supply of more than 70 percent by 2050. Such changes could cause or exacerbate chronic water stress and increase competition for resources across sectors.[82]

Climate change does not only erode natural capital and its co-benefits—the changing temperatures and weather patterns may also shift where certain collections of ecosystems, or biomes, can exist on earth. As outlined in our recent report, *Climate risk and response: Physical hazards and socioeconomic impacts*, around 25 percent of the earth's land area has already experienced biome shifts compared with the 1901–25 period. That figure is projected to rise to about 45 percent by 2050. [83, 84] These shifts may present major challenges: species habitats may be altered, while critical ecosystem services to people, such as water catchment, could be lost in one region and gained in another.[85]

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[80] W. Hubau et al., "Asynchronous carbon sink saturation in African and Amazonian tropical forests," *Nature*, March 4, 2020, Volume 579, Number 7797, pp. 80–7, nature.com.

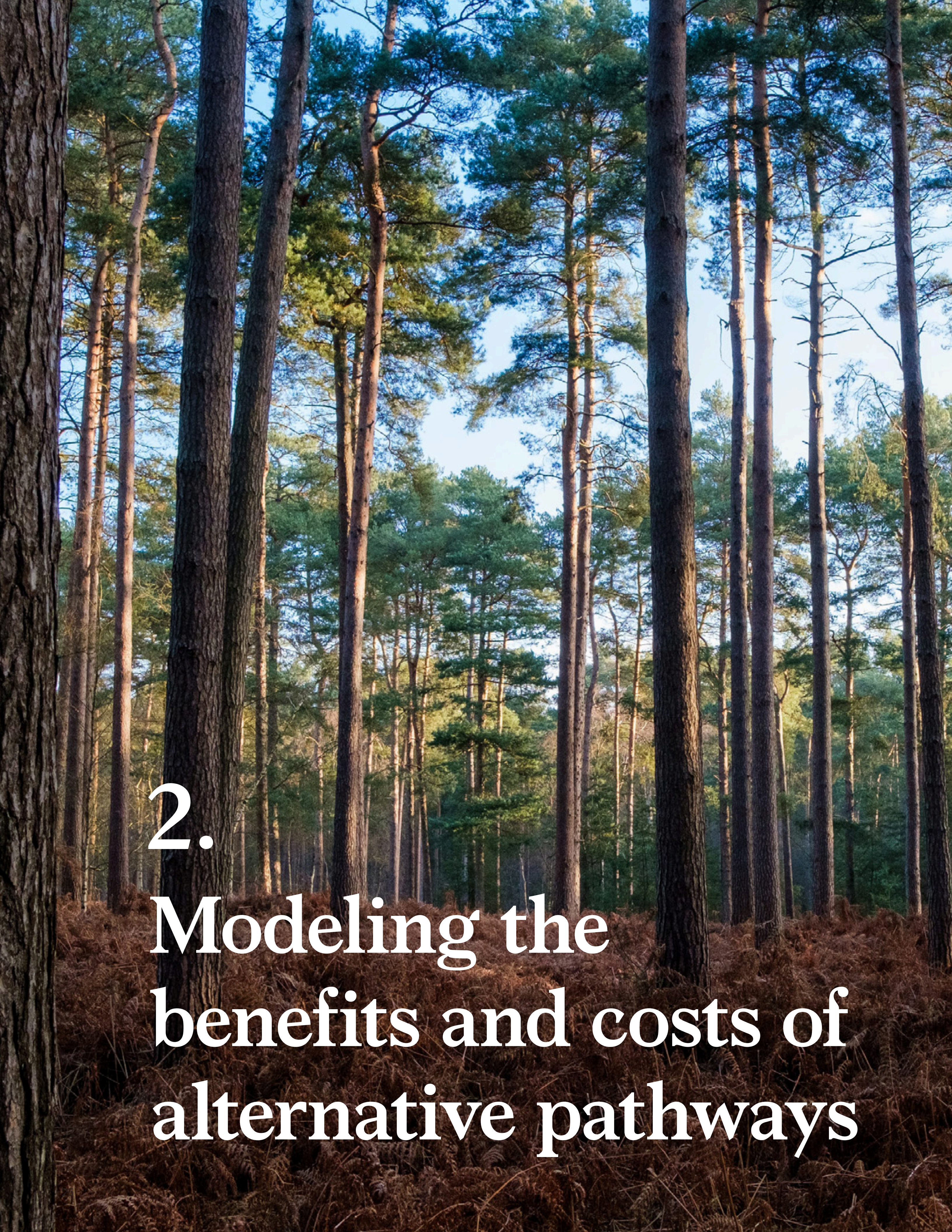
[81] D. Pauly and D. Zeller (eds.), *So long, and thanks for all the fish:* The Sea Around Us*, 1999-2014, A Fifteen-Year Retrospective,* Sea Around Us, 2014, seaaroundus.org.

[82] Based on a Representative Concentration Pathway (RCP) 8.5 scenario. The higher-emission scenario it portrays enables an assessment of physical risk in the absence of further decarbonization, and thus an assessment of the full inherent risk. Data from World Resources Institute. For more information, see "Climate risk and response," January 2020.

[83] Biome shift was measured using the Köppen climate classification system. The Köppen climate system divides climates into five main groups, with each group further subdivided based on seasonal precipitation and temperature patterns. This is not a perfect system for assessing the location and composition of biomes; however, these two characteristics do correlate very closely with climate classification, and therefore this was assessed as a reasonable proxy for risk of disruptive biome changes

[84] Biome shift data were taken from F. Rubel and M. Kottek, "Observed and projected climate shifts 1901–2100 depicted by world maps of the Köppen-Geiger climate classification," *Meteorologische Zeitschrift (Contributions to Atmospheric Sciences)*, April 2010, Volume 19, Number 2, pp. 135–41.

[85] Biome shifts were not considered as part of our analysis of the impacts of expanded conservation by 2030.



2. Modeling the benefits and costs of alternative pathways

Our models suggest that doubling nature conservation could reduce atmospheric CO_2 by 0.9 gigatons to 2.6 gigatons and secure 27 million to 33 million jobs in ecotourism and sustainable fishing alone.

Making headway on nature conservation requires stakeholders to reach consensus about which areas to prioritize for protection. One of the primary challenges in achieving alignment is that the costs and benefits of expanding conservation vary from one type of area to another. An area of forest, for example, could be more expensive to conserve than an equivalent area of desert or coastal waters, while a hectare of intact tropical forest reduces greenhouse gases more than a hectare of boreal forest.

To inform the discussion of these costs and benefits, we have created six scenarios suggesting a range of ways to conserve 30 percent of land and national waters.[86] For each scenario, we conducted a highly granular geospatial analysis to calculate the potential impact on climate, jobs, GDP, zoonotic disease risk, and species protection of expanded conservation.[87]

Co-benefit 1: Climate-change mitigation and resilience. A global effort to double nature conservation could reduce atmospheric CO_2 by 0.9 gigatons to 2.6 gigatons annually by 2030. This is equivalent to about 2 to 6 percent of all human-caused CO_2 emissions and 4 to 12 percent of the emissions reductions needed by 2030 to limit global warming to 1.5°C.[88, 89] As much as 90 percent of this CO_2 reduction may be attributable to avoided deforestation, with the remainder primarily from natural forest regrowth.[90] For an overview of physical climate risk, see our recent report *Climate risk and response: Physical hazards and socioeconomic impacts*.[91]

Co-benefit 2: Economic security and opportunity. Across scenarios, our analysis suggests that doubling nature conservation could create or safeguard 27 million to 33 million jobs and $290 billion to $470 billion in GDP from ecotourism and sustainable fishing.

We find that in 2019, tourism linked to Protected Areas, a subset of the overall ecotourism market, was worth approximately $300 billion in revenues. Tourism, including nature-based tourism, has seen a dramatic decline this year due to the pandemic. In our calculations, we assumed tourism levels would return to pre-COVID-19 levels three years from now and then grow at rates forecast before the crisis.

Doubling nature conservation could also secure significant revenues in sustainable fishing. No-take zones and regulated fishing in marine protected areas can help preserve fish stocks, reversing declines and often increasing yields (see sidebar, "Conservation trade-offs"). Doubling conservation areas in national waters could safeguard $12 billion to $24 billion of GDP and one million to two million jobs.

[86] Our analysis also includes Exclusive Economic Zones.
[87] An overview of our methodology can be found in the callout box, while detailed notes can be found in the technical appendix.
[88] Global Carbon Project, 2019.
[89] "Climate math," April 2020.
[90] The scenarios that double conservation in this report would provide up to one-half the reduction in deforestation required to achieve a 1.5°C pathway. This is because projected deforestation tends to be concentrated. Outside of areas identified for conservation, approximately one-half the remaining carbon stocks at risk of tropical deforestation by 2030 are found within approximately 2 percent of land surface (excluding Antarctica). Preserving these forests may require localized conservation strategies supported by global collaboration that go beyond the proposed 30 by 2030 target. In addition, a diverse set of interventions ranging from shifts in global consumption to agricultural productivity increases to changes in regulation may also be required to achieve climate targets.
[91] For the full McKinsey Global Institute report, see "Climate risk and response," January 2020.

Conservation trade-offs

Area-based conservation, such as the proposed 30 percent target by 2030, would inherently involve trade-offs. A hectare of forest permanently conserved means that the same hectare cannot be used for crop agriculture (although the rise of shade-grown coffee and other crops does show that mixed use is possible in some situations). Similarly, a marine "no-take zone" means that fishing activity is not possible in that area, even if the yield from neighboring areas improves.

Such trade-offs can have significant short-term consequences for individuals and local communities. Consequently, conservation programs can lead to job losses and the decline of local economic activity. It is therefore critical for decision makers to carefully assess the benefits and opportunity costs of any conservation project and take action to address the impact of expanded conservation.

In many cases the dynamic of individual or short-term conservation trade-offs changes when assessed at a regional level or across a longer time horizon. Marine Protected Areas (MPAs) and their no-take zones are good examples of conservation trade-offs that can vary by time horizon. Studies have shown that the establishment of marine no-take zones can actually increase fish catch in adjacent areas, in some cases by as much as 90 percent within five years.[92] By allowing fish to mature and reproduce in a no-take zone (where researchers find total fish biomass is, on average, 670 percent greater than in unprotected areas[93]), the spillover of fish into adjacent areas can increase the overall area's yield.

The Goukamma MPA on the South African coast is an example of this effect. It is home to a range of wildlife, including the southern right whale, the bottlenose dolphin, and a variety of turtles. In 1990, the coastline received protected status as an MPA. Researchers found that after ten years, the catch per unit of effort rate (a measure of yield) had doubled in the immediate vicinity of the MPA. In areas nearby but further from the MPA, the catch rate remained constant, meaning the MPA led to an increase in total fish yield.[94]

An example in which local conservation trade-offs change when assessed at a regional scale is cutting down forests to establish agricultural areas. This action increases the local agricultural productivity of the land, but it may also significantly decrease agricultural productivity of adjacent areas. These effects can be substantial: depending on the region, 40 to 70 percent of rainfall on which agriculture depends may originate from forest and vegetation evapotranspiration.[95] In tropical rainforests, a significant portion of nutrients is locked up in living vegetation rather than the soil; a large share of the nutrients are lost following the conversion of rainforest to agricultural land.[96]

[92] E. Sala et al., "A general business model for marine reserves," *PLOS ONE*, April 3, 2013, Volume 8, Number 4, journals.plos.org.
[93] E. Sala and S. Giakoumi, "No-take marine reserves are the most effective protected areas in the ocean," *ICES Journal of Marine Science,* August 31, 2017, Volume 75, Number 3, pp. 1166–8.
[94] S. E. Kerwath et al., "Marine protected area improves yield without disadvantaging fishers," *Nature Communications*, August 20, 2013, Volume 4, Article Number 2347, nature.com.
[95] D. Ellison et al., "Trees, forests and water: Cool insights for a hot world," *Global Environmental Change*, March 2017, Volume 43, pp. 51–61, sciencedirect.com.
[96] C. W. Runyan, P. D'Odorico and D. Lawrence, "Physical and biological feedbacks of deforestation," *Reviews of Geophysics*, December 2012, Volume 50, Number 4, onlinelibrary.wiley.com.(December 2012).

There are many nature-dependent markets, such as sustainable forestry and sustainable agriculture, that we did not quantify, primarily because of the limited availability of global data. These opportunities could generate further benefits and merit more analysis.[97] Beyond the jobs indirectly created or safeguarded through nature-dependent markets such as ecotourism, we find that doubling nature conservation could directly create 400,000 to 650,000 jobs in conservation management itself.

Co-benefit 3: Health and culture. We find that one-half of the global risk of zoonotic disease transmission is concentrated in currently unprotected nature. Conserving such areas of high zoonotic risk can play a role in the fight against future pandemics by preventing ecosystem fragmentation and human practices that increase the risk of disease transmission. Doubling nature conservation can help toward this goal: the areas prioritized for conservation in this report currently have a 10 to 80 percent higher risk of a zoonotic disease transmission event than natural areas not prioritized for conservation.

Doubling nature conservation could also help to safeguard biodiversity. Depending on the scenario, it could expand the protected habitat of species threatened with extinction by 2.2 to 2.8 times.[98]

Comparing benefits and costs across six scenarios

Our goal in generating the six scenarios was to give stakeholders a better understanding of the choices and trade-offs involved in a range of possible outcomes. The six scenarios vary both in how they prioritize one potential conservation area over another and in the interpretation of spatial constraints—for example, whether the target is interpreted as a goal to conserve 30 percent of each country, each ecoregion, or each ecozone.[99]

In addition to the range of spatial constraints, three scenarios prioritize areas where CO_2 is at risk of emission through projected land-use change, while three prioritize for conservation where there is currently a minimum of human activity (in effect minimizing some opportunity costs).

Each of the six scenarios identifies areas for conservation to meet predefined targets for protecting at-risk species habitat. The resulting benefits and costs are outlined in Exhibit 4.

Comparing scenarios generates important insights. Among them are the following:

— *Minimizing conservation's opportunity costs could result in reduced benefits.* At a global scale, minimizing the impact of conservation on existing human activity—considered here as a proxy for some opportunity costs—could come at the expense of certain co-benefits. Exhibit 5 highlights the variation in benefits between scenarios that optimize for lower impact on existing human activity and those that do not.

— *Minimizing conservation's opportunity costs could lead to higher operating costs.* Minimizing opportunity costs could result in a more fragmented mosaic of smaller conserved areas. This has the potential to decrease economies of scale and result in higher operating costs of conservation (Exhibit 6).[100]

[97] We also did not quantify the potentially significant economic consequences of mitigating climate change.
[98] See "IUCN Red List of Threatened Species," International Union for Conservation of Nature, accessed September 16, 2020, iucnredlist.org. Species listed as "critically endangered," "endangered," and "vulnerable" are considered at risk of extinction.
[99] An ecoregion, of which there are about 1,000 on land and oceans, is a distinct assemblage of ecosystems. An ecozone (or biogeographic realm), of which there are eight on land and 12 in oceans, is the broadest division of the earth's surface, based on the distribution of organisms. Maps of the world's ecoregions and ecozones can be found in the technical appendix.
[100] The degree to which this effect is true could depend on the economies of scale that can be captured within central conservation-management functions, which are not included in our analysis.

Exhibit 4

Six scenarios for conserving 30 percent of land and national waters vary by benefits and costs.

Least attractive — Most attractive

		1	2	3	4	5	6
Spatial constraints	Country	●	○	○	●	○	○
	Ecoregion	○	●	○	○	●	○
	Ecozone	○	○	●	○	○	●
Optimization criteria	Species	●	●	●	●	●	●
	Carbon stocks	●	●	●	○	○	○
	Human activity	○	○	○	●	●	●
Benefits	**Increase in conserved habitat of species threatened with extinction**	2.4x	2.3x	2.8x	2.2x	2.2x	2.2x
	CO_2 abatement, gigatons per year	1.8	1.8	2.6	0.9	1.1	1.0
	GDP created or safeguarded, $ billion per year[1]	408	469	421	411	466	292
	Jobs created or safeguarded, millions[1]	30	33	28	30	33	27
	Zoonotic disease risk vs. remaining unprotected nature, average[2]	1.7x	1.8x	1.5x	1.3x	1.5x	1.1x
Costs	**Aggregated index of human pressure,** average[3]	0.88	0.92	0.93	0.56	0.65	0.50
	Additional operating cost of conservation, $ billion per year	28	33	29	35	45	20

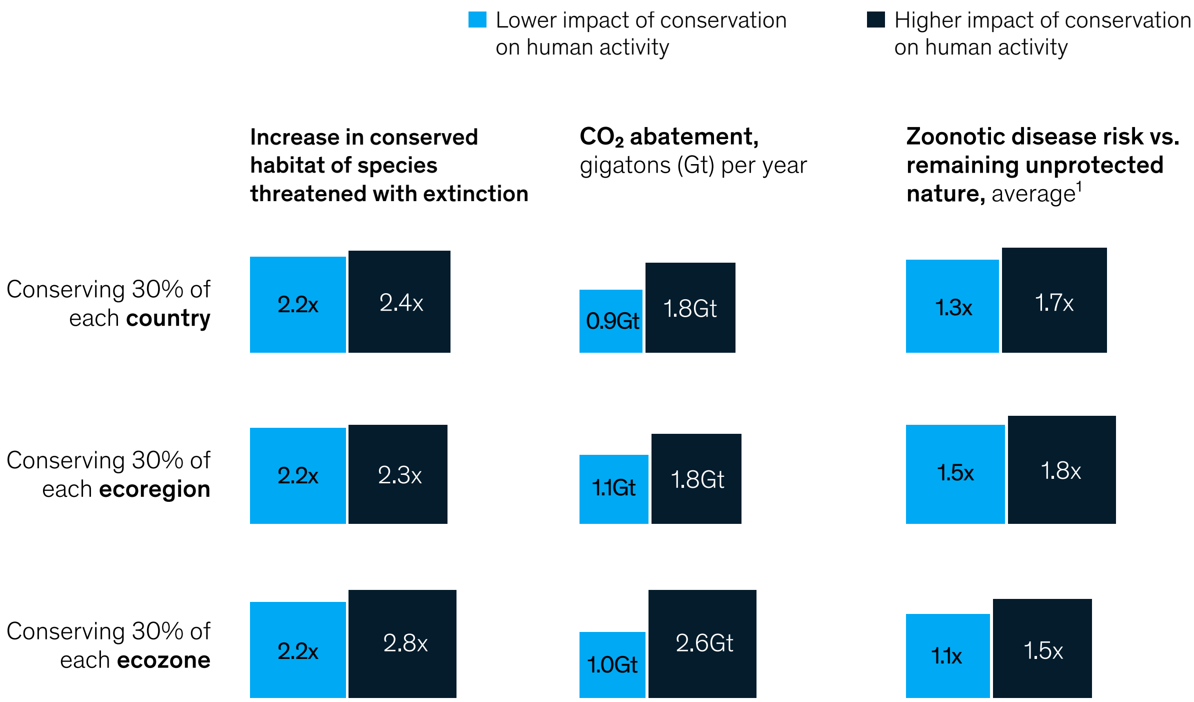
[1]Covers ecotourism, sustainable fishing and conservation management.

[2]Average zoonotic disease transmission risk in potential new conservation areas, relative to the risk in remaining areas of unprotected nature. A higher risk increases the potential positive impact of conservation.

[3]Average of the Human Footprint and Cumulative Human Impact indexes, each re-based to the highest value being equal to 1. This is considered as a proxy for opportunity costs on existing human activity.

Exhibit 5

The trade-off between the benefits of conservation and impact on existing human activity can result in much different outcomes.



[1]Average zoonotic disease transmission risk in potential new conservation areas, relative to the risk in remaining areas of unprotected nature. A higher risk increases the potential positive impact of conservation.

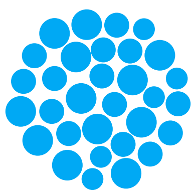
— *Higher impact could mean a greater need for international collaboration.* If the proposed 30 by 2030 target were interpreted to mean that every country sought to conserve 30 percent of its surface area, the potential benefits could be significantly reduced relative to scenarios that optimize across country borders. For example, CO_2 abatement potential could be approximately 50 percent higher in scenario 3 (conserving 30 percent of each ecozone) relative to scenario 1 (conserving 30 percent of each country). This comparison implies that optimizing co-benefits may require international collaboration and perhaps co-financing of conserved areas. In fact, scenario 3, with the highest benefits, may prove the most difficult to execute.

Exhibit 6

Decision makers can face trade-offs between minimizing short-term opportunity costs and ongoing operating costs.

Annual operating costs of two scenarios for conserving 30 percent of each country
Degree of area fragmentation vs operating cost, $ billion annually

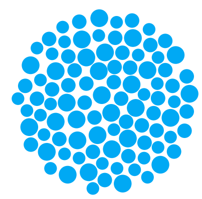
Maximized protection of species and carbon stocks



$28 billion

Less fragmentation

Maximized protection of species and minimized opportunity costs[1]



$35 billion

More fragmentation

[1]Opportunity costs from existing human activities.

Sequencing conservation initiatives

An examination of the six scenarios suggests that doubling nature conservation in ten years could be a tall order. Decision makers at global, country, and local levels would need to consider how to sequence regions and areas and prioritize their resources accordingly. To illustrate some of the trade-offs involved, we considered three factors that may inform the sequence of expansion efforts: the degree to which nature is at risk, the co-benefits of conservation, and the cost of capturing those benefits. While we examined these factors for each global land biome,[101] a similar approach could be applied to help inform the sequencing of local conservation efforts—for example, ten local conservation projects in one province.

The results of this analysis for CO_2 abatement demonstrate that biomes where nature is most immediately at risk not only contain most of the potential for CO_2 abatement[102, 103] but also are the most cost-efficient places to capture that potential (Exhibit 7).

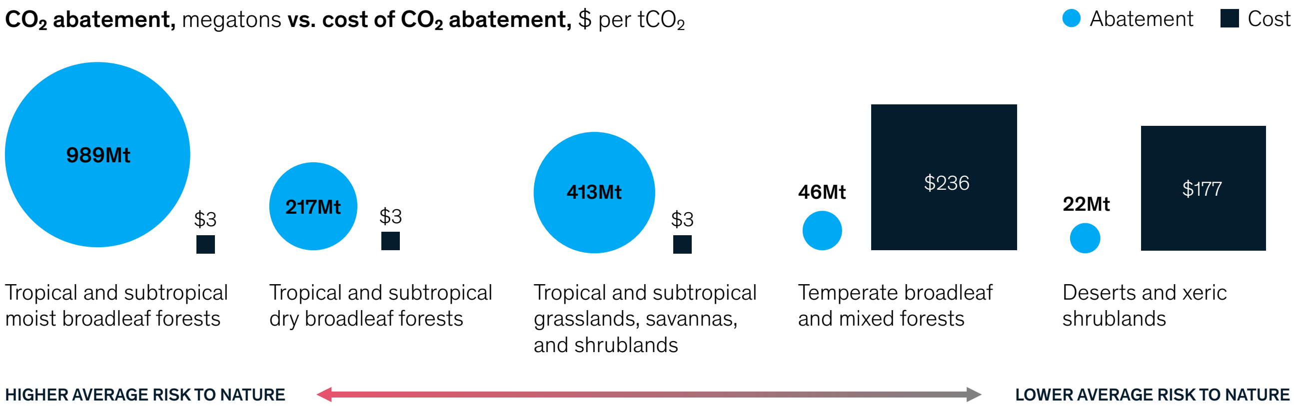
[101]There are 14 land biomes, each a collection of similar ecosystems. A map of these biomes can be found in the technical appendix.
[102]For the purposes of selecting one conservation scenario to share this analysis, we have scored each in a purposefully simplistic way. Each scenario was given a score of between zero and one for each quantified metric of positive impact and cost. Scenario 2 scored highest and is used for the data shown in Exhibits 1, 7, and 8.
[103]A simplified risk index considered an equally weighted combination of human pressure, species at risk of extinction and carbon at risk of deforestation. Cost per unit of impact considered only operating costs of conservation.

Exhibit 7

Biomes most at risk account for the majority of CO_2 abatement potential and deliver this impact at a significantly lower cost.[1]

CO_2 abatement

CO_2 abatement, megatons **vs. cost of CO_2 abatement,** \$ per tCO_2



[1]Land biomes shown that account for the top 97 percent of potential impact in each of CO^2 abatement, jobs, zoonotic-disease risk, and species protection.

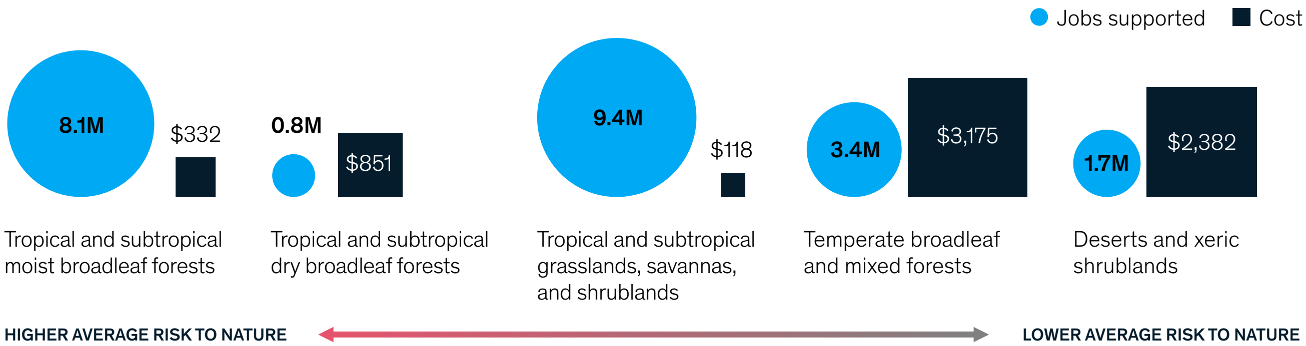
A similar theme illustrates the impact of expanded conservation on species protection, employment, and zoonotic disease risk (Exhibit 8). The biomes where nature is most at risk tend to contain some of the highest-impact opportunities at the lowest costs.

A leading example of this pattern can be seen in tropical and subtropical moist broadleaf forests. Areas identified for conservation in this biome account for one-tenth of the world's land area, yet generate more than one-half of the total CO_2 abatement potential of expanding conserved species habitat. They also generate a quarter of employment and zoonotic disease risk impact, which comes at a relatively low price: the biome's cost effectiveness is in the top quartile for every co-benefit metric.

Exhibit 8

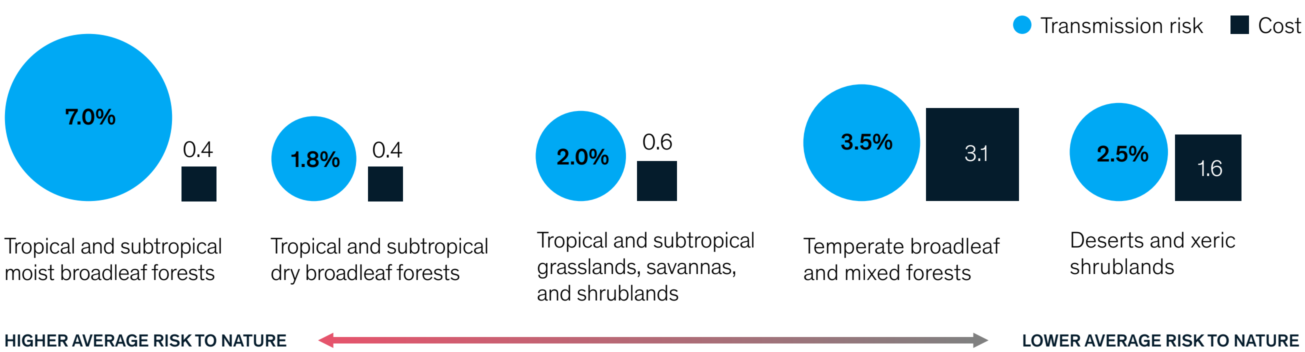
A similar theme can be seen across species protection, employment, and zoonotic disease risk.[1]

Jobs created or safeguarded, million[2] **vs. cost,** $ per job



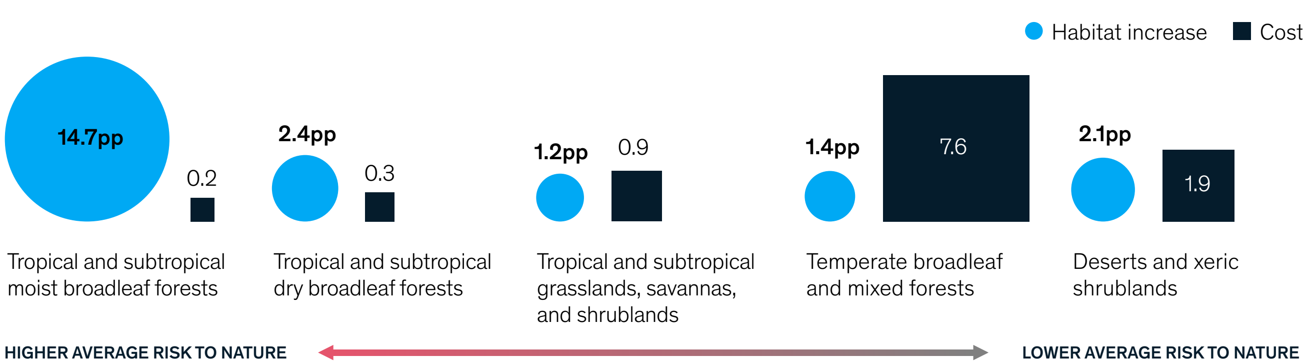
Zoonotic disease risk mitigation

Transmission risk, % global total[3] **vs. cost,** $ billion per percentage point of transmission risk



Species protection

Increase in conserved habitat of threatened species, percentage points (pp) **vs. cost,** $ billion per pp increase



[1]Land biomes shown that account for the top 97 percent of impact in each of CO_2 abatement, jobs, zoonotic-disease risk, and species protection.
[2]Covers ecotourism, sustainable fishing, and conservation management.
[3]Total zoonotic-disease-transmission risk in potential new conservation areas as a percentage of total global risk. A higher risk increases the potential positive impact of conservation.

3. How to Start

Giving decision makers the information they need to assess the business case for conservation, including all of its co-benefits, is a key step toward progress on nature conservation. However, the next step—financing and implementing new conservation projects—is perhaps equally challenging. Each category of stakeholders has a vital role to play in the process.

Securing sustainable conservation financing

Currently, an estimated $24 billion—about 40 percent of global ice cream sales[104]—is spent each year on global conservation efforts. This total includes the cost of employing staff to manage and operate conserved areas and maintain the associated infrastructure.[105, 106]

Our analysis indicates that the annual operating cost to double the conservation of land and national waters could be an additional $20 billion to $45 billion, depending on the scenario.[107] While this investment is substantial, we find that in more than one-half of the land and marine areas we have identified, the GDP impact from increased ecotourism and fishing can offset these costs by at least three times. Entry fees, concessions, and tax revenues from nature-dependent markets could further contribute to the sustainable long-term funding of expanded conservation.[108]

Several emerging sources of funding could also play a role, although the extent of that role remains uncertain.

— *Carbon offsets*. The carbon offset market has generated increasing interest in recent years. Our analysis suggests the market for voluntary forestry and land-use offsets (the segment that is most relevant to conserved areas) grew by around 45 percent annually from 2016 to 2019.

  Depending on the scenario, the annual carbon sequestration value of expanded conservation could be worth $4 billion to $10 billion.[109] Company pledges amounting to about $3 billion a year by 2030 suggest that carbon offsets may become a material source of conservation funding.[110] To meet this growing demand, the market will need to scale rapidly. The evolution of a well-functioning carbon market at

[104] "Global ice cream market trends, share, size, growth, opportunity and forecast 2019–2024," GlobeNewswire, March 1, 2019, globenewswire.com.
[105] A. Waldron et al., "Protecting 30% of the planet for nature: costs, benefits and economic implications," *Campaign for Nature*, July 8, 2020, campaignfornature.org.
[106] Based on findings by Waldron et al. (2020) and others, this is likely a significantly lower level of funding than is required for effective conservation of existing areas.
[107] This estimate excludes opportunity costs (see sidebar "Conservation trade-offs" in chapter 2) and establishment costs, which can vary significantly depending on the cost of land acquisition. It also excludes the costs of conserving international waters, which were not considered in this analysis. It is therefore likely to represent an underestimate of the all-in costs of expanding effective conservation to 30 percent of the planet.
[108] Tax revenues from increased or safeguarded economic activity can be difficult to quantify and allocate to conservation funding. Innovative approaches to measuring economic impacts of conservation are needed to help address this challenge.
[109] This potential revenue has not been netted off against the identified additional $20 billion to $45 billion annual global operating cost of doubling nature conservation. Pricing was assumed at $5 per tonne of CO_2. If demand continues to grow rapidly, this is considered to be moderately to highly conservative (based on expert input), implying the value of carbon offset sales could be multiple times higher than $4 billion to $10 billion annually. It should be noted that future supply and demand in the carbon offset markets remains extremely difficult to forecast.
[110] Our analysis suggests publicly stated pledges to date would result in the voluntary carbon offset market reaching 0.6 gigatons by 2030. In line with our assessment of carbon offset revenues from doubling nature conservation, pricing was assumed at $5 per tonne.

such scale will require multiple challenges to be overcome.[111] For example, efficient verification of offset markets at this scale will require the development of digital geospatial certification and audit solutions.

Further, carbon markets could be strengthened to account for the non-carbon benefits of all nature-based solutions.[112] This evolution, together with the growth of solutions that primarily target non-carbon benefits, could present a sizable financing opportunity for conservation.[113]

— *Direct payments for ecosystem services.* Historically, the preservation of ecosystem services—such as flood protection—has rarely been financed directly by the recipients of those services. With the accelerating erosion of natural capital, direct financing may become attractive in more situations and serve as a catalyst to form more capital around adaptation and resilience.

  Insurance for natural capital is one such example. In Mexico, the Quintana Roo government and tourism industry stakeholders have purchased an insurance policy on the local coral reefs. A headline attraction for the region, the reefs support the country's $9 billion tourism industry and protect beaches and coastal developments. Past hurricanes have demonstrated the reefs' value in reducing storm damage. Funds for the policy are covered through a fee paid by beachfront property owners and through other public and private sources. In what is known as a parametric policy, payouts are made after a triggering event—in this case, when wind speeds exceed 100 knots—and used to replant and restore the reef.[114] With extreme weather events increasing in frequency as the climate changes, such initiatives may become more prevalent. Indeed, global reef tourism is estimated to be worth $36 billion a year.[115]

  Other examples of direct financing of natural capital conservation could include investment by agricultural producers in conservation of water catchment or forest areas.[116] Hydropower operators could invest in upstream forest conservation, resulting in increased water flow, reduced sedimentation, and improved water regulation.[117]

— *Debt-for-nature swaps*. The COVID-19 crisis has created potential opportunities to explore the role of investment through debt relief. About one-half of the areas we identified as a high priority for conservation are in emerging economies. Market analysts suggest that 37 percent of emerging- and frontier-market sovereign external debt could be at risk of default in the next year.[118] Given this context, debt-for-nature swaps—in which creditors forgive loans in exchange for commitments to conserve nature—could be a way for the world to pay for the global benefits (such as climate-change mitigation) that can accrue from nature conservation.

  Debt-for-nature swaps have been successfully applied in the past. For example, the Nature Conservancy brokered a deal between the Seychelles government and creditors to convert $22 million in foreign debt into investment in marine conservation, helping the country achieve its own goal of 30 percent marine protection.[119]

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[111] The Taskforce on Scaling Voluntary Carbon Markets, launched by Mark Carney, UN special envoy for climate action and finance advisor to UK Prime Minister Boris Johnson for COP26, is chaired by Bill Winters, group chief executive, Standard Chartered, and sponsored by the Institute of International Finance (IIF) under the leadership of IIF President and CEO Tim Adams. Annette Nazareth, a partner at Davis Polk and former Commissioner of the US Securities and Exchange Commission, will serve as operating lead for the task force.

[112] IUCN defines nature-based solutions as actions to protect, sustainably manage, and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.

[113] McKinsey is working with the World Economic Forum to scope the market and investment opportunities for nature-based solutions. The findings will be published in the third report of the World Economic Forum's New Nature Economy Report Series.

[114] "Insuring nature to ensure a resilient future," *The Nature Conservancy*, September 3, 2019, nature.org.

[115] M. D. Spalding et al., 2017.

[116] "The Upper Tana-Nairobi Water Fund: Improving water for millions in Kenya," *The Nature Conservancy*, nature.org.

[117] R. Narvaez, J. Mabe and A. Falconer, "Cloud Forest Blue Energy Mechanism," *Global Innovation Lab for Climate Finance*, September 2017, climatefinancelab.org.

[118] J. Wheatley, "Developing nations squeezed as virus fuels public spending," *Financial Times*, July 19, 2020, ft.com. This article included a reference to Adam Wolfe of Absolute Strategy Research.

[119] "Seychelles hits 30 percent marine protection target after pioneering debt restructuring deal,"*The Nature Conservancy* , March 26, 2020, nature.

Innovative approaches to conservation challenges

Despite the compelling value and relative cost-effectiveness of nature conservation, governments and other stakeholders face significant challenges when expanding conservation efforts.

— *Complex business case.* Conservation requires funding for initial setup and ongoing operational costs. To justify that funding, decision makers often look for a business case that is difficult to construct. As described above, the co-benefits of nature conservation are complex and often opaque. Even though benefits such as the jobs and GDP supported by a conservation project can be (partially) quantified, it is often impossible to assess downstream effects, such as higher local agricultural productivity or lower water treatment costs.

— *Uneven accrual of the business case.* The benefits of conservation can often accrue unevenly to different stakeholders, referred to as the "tragedy of the commons." For example, a country facing even the most severe climate risks will reap only a small share of the benefits from increasing carbon sequestration. Similarly, an agricultural entity investing in conservation to help safeguard soil quality, nutrient cycling, pollination, and local rainfall patterns will share these and other ecosystem service benefits with their neighbors.

— *Significant opportunity costs.* In contrast to quantifying the benefits of nature conservation, opportunity costs are often more straightforward. For example, deforestation for the purposes of logging or conversion to agricultural land supports numerous jobs and economic opportunities around the world, and these benefits can typically be quantified more easily than those supported by conservation. Although case examples (see also sidebar "Conservation trade-offs," on p. 27) show that the benefits of conservation may often outweigh those of land conversion, the challenge of fully unpacking this trade-off and of supporting people through transitions and job losses may be significant.

— *Lack of implementation expertise.* Even if the business case is made and funding is available, conservation can be difficult to execute well. Successful projects require deep ecological expertise to maximize their benefits. A changing climate makes navigating which areas to conserve particularly challenging. As outlined in chapter 1, many ecosystems are likely to experience geographic shifts in the coming decades, affecting the ecosystem services they provide and where they provide them.

A typical project may require expertise and buy-in from Indigenous and local communities, government, nongovernmental organizations (NGOs), and the private sector, and may be financed by a similarly diverse group of stakeholders. Such projects require effective and inclusive stakeholder management. In addition, durable legal frameworks are needed to guarantee ecosystem conservation in perpetuity but are not always in place: approximately 3,750 cases have been identified where changes to legal status have resulted in either weaker protection or loss of protection in areas equivalent to the size of South Africa.[120]

In recent decades, many innovative approaches have emerged to help mitigate the challenges faced in conservation efforts. For example, the nonprofit group African Parks works with governments to develop long-term public–private partnership agreements to manage and operate conservation areas. This structure can help to overcome challenges that public decision makers face in the absence of such partnerships, including conservation management expertise and global funding opportunities.[121]

[120] R. E. Golden Kroner et. al, "The uncertain future of protected lands and waters," *Science*, May 31, 2019, Volume 364, Number 6443, pp. 881–6, science.sciencemag.org.
[121] "The African Parks Model," African Parks, africanparks.org.

The jurisdictional approach brings together stakeholders across sectors, including companies and nonprofits, and is implemented within government administrative boundaries and with government involvement. This approach, still in relative infancy, could help to address challenges related to the uneven accrual of benefits, bridging the gap between market-based and policy-based decision making.[122]

Another example, the Project Finance for Permanence (PFP) approach, requires multiple stakeholders to commit all necessary funds and construct legal frameworks in advance to ensure a project's permanent viability (see sidebar "Case Study: Project Finance for Permanence"). This preparation can help to crystallize the business case up front, building confidence among stakeholders.

Conservation challenges are unique to each context. Fortunately, an ever-expanding menu of innovative approaches—many of which could be combined—are emerging for decision makers. To conserve natural capital at scale, both replicability and adaptability of these approaches could become key factors to success.

[122] J. Buchanan et al., "Exploring the reality of a jurisdictional approach as a tool to achieve sustainability commitments in palm oil and soy supply chains," *Conservation International*, March 2019, conservation.org.

Case study

Project Finance for Permanence

The PFP approach, which borrows from traditional infrastructure project-financing methodologies, seeks to address many historic barriers to conservation. For example, the inclusion of experienced practitioners enables a PFP project team to quantify its benefits, audit its results, and secure legal frameworks and funding commitments up front. Inherent to PFPs is the engagement of local communities and other stakeholders in the pre-deal phase to ensure all objectives and commitments are included in planning before financing is released.

Common PFP design principles

Although the various PFPs differ in the details, the majority of successful projects have five common characteristics:

1. A single deal moment and initiative launch (including a holistic deal structure, a single closing that lends urgency and creates leverage, and a single deal broker to ensure cross-stakeholder collaboration).

2. Full long-term financing secured up front, as well as sustainable revenue streams to support permanent funding.

3. Clearly articulated objectives agreed to by all stakeholders, including a long-term conservation plan with well-defined goals and activities, and a business plan that quantifies financial and nonfinancial co-benefits.

4. A defined governance structure and active use of all stakeholder capabilities, such as the continuation of responsible stewardship by local or Indigenous communities where applicable.

5. Performance-based financing using regularly tracked, measurable outcomes.

Canada's Great Bear Rainforest initiative

One of the first large-scale, multiparty PFP initiatives was implemented in Great Bear Rainforest, which spans 250 miles along the coast of British Columbia, Canada. In the late 20th century, Great Bear also became a key region for Canada's logging industry. Campaigners argued that the activities of logging companies were causing significant environmental damage to a critical ecosystem. This campaign—which, in the 1990s, became known as the "War in the Woods"—included boycotts of consumer companies whose products were sourced from the region. Facing this pressure, some companies expressed a desire for their forestry suppliers to commit to improved sustainability practices.

The campaign dovetailed with efforts by First Nations governments to claim their decision-making rights for traditional lands. The result was a new era of negotiations between the provincial government and Indigenous governments.

In 2006, the provincial government, Indigenous governments, and environmental groups reached an initial agreement using PFP methods to conserve 2 million hectares of the rain forest. Underpinning this agreement was Coast Funds, an $89 million fund to conserve the region in perpetuity. Philanthropic donors committed CAD 58 million to the fund, and the federal and provincial governments each allocated CAD 30 million.

Over the subsequent decade, further negotiations culminated in a 2016 agreement that preserved 7.4 million hectares of the Great Bear Rainforest and the Haida Gwaii archipelago. This accord preserves 85 percent of Great Bear, with the remaining 15 percent allocated for sustainable forestry under a new regime referred to as "ecosystem-based management."

As part of this agreement, First Nations governments secured codecision-making authority alongside the provincial government for new Protected Areas. They now enjoy greater influence over Indigenous lands as well as an increased role in community development and environmental stewardship.

The Great Bear case study highlights the important role that Indigenous communities living in or close to natural areas play in conservation. Researchers estimate that the lands inhabited by Indigenous Peoples account for 37 percent of all remaining intact natural areas across the earth.[123] Indigenous Peoples are key contributors to the effective maintenance of well-preserved natural capital and are the first to suffer the consequences of the loss of natural capital.

[123] S. T. Garnett et al., "A spatial overview of the global importance of Indigenous lands for conservation," *Nature Sustainability*, July 16, 2018,, Volume 1, Number 7, pp. 369–74, nature.com.

Taking action: Extending this analysis

Accounting for the diversity of natural capital's co-benefits is complex. A structured approach to understanding the risks of inaction, together with the benefits and costs of conservation interventions, will be required to inform decisions on trade-offs. To extend this analysis, we suggest actions and questions for organizations to consider.

The private sector can play an active role in conserving natural capital by:

1. ***Understanding the risk*** faced by your industry and company by determining which ecosystem services provide the greatest benefits and where those benefits might be reduced through the erosion of natural capital. Companies can analyze this risk pixel by pixel, throughout the supply chain, and for each individual operating asset.

» *What are the risks that industries, companies, and supply chains face from the erosion of natural capital?*

2. ***Assessing opportunities*** to mitigate the exposure or contribution to natural capital erosion risk, including how supply chain decisions and alternative commodities could enhance resilience and productivity.

» *Where could natural capital provide the most value in reducing physical asset risk?*

» *What role should insurers play to better transfer and mitigate risk?*

3. ***Evaluating opportunities to preserve and expand natural capital,*** including investing in nature conservation or restoration with positive business outcomes, developing natural capital markets that more effectively price in positive and negative externalities, and building a natural capital budget.

» *How can investments in natural capital be amplified through cross-sector collaboration methodologies such as the jurisdictional approach or Project Finance for Permanence?*

National governments could consider:

1. ***Leveraging analytics to quantify*** the benefits that natural capital provides in protecting communities from physical climate risk and safeguarding livelihoods. Explore the effects that pressures such as land use change and climate change may have on the erosion of natural capital.

» *Where does the erosion of natural capital put populations or livelihoods at risk?*

2. ***Establishing how conservation approaches can be developed or further strengthened,*** so that benefits flow to communities living in or near conserved areas. Carefully consider the trade-offs of alternative land and ocean use and develop plans to support communities with transitions.

» *What is needed to maximize the benefits for underserved and Indigenous communities living in or near new conservation areas?*

3. ***Substantially increasing commitment to and funding for nature conservation*** based on a robust assessment of both the benefits and costs of specific areas in a granular way. Invest in sustainable revenue streams and develop innovative solutions to account for disbursed benefits and costs in national budgets.

» *Where can the conservation of nature help to maximize net benefits, while accounting for opportunity costs?*

Intergovernmental organizations could use analytics to consider:

1. ***Creating frameworks*** that help systematically account for the co-benefits of natural capital.

» *What standards could be in place to help analyze and account for the co-benefits of natural capital?*

2. ***Mobilizing cooperative efforts*** to conserve critical transnational natural capital or optimize the overall impact of global nature conservation (see scenarios 3 and 6, chapter 2).

» *Where would conservation require transnational effort and financing, and which frameworks can help?*

3. ***Defining international ambition levels*** that account for the global benefits of nature conservation, including climate change mitigation and the containment of zoonotic disease risk.

» *What conservation targets are required to stop the erosion of natural capital and maximize nature's co-benefits?*

Conservation practitioners and donors could explore:

1. ***Harnessing analytics*** to identify critical areas to conserve that could maximize biodiversity and co-benefits to humanity.

» *Where are the highest-impact opportunities to deploy philanthropic resources?*

2. ***Initiating or supporting alliances*** to rapidly increase nature conservation. An effective alliance may play the role of an "accelerator," increasing the number of conservation projects worldwide and ensuring their implementation according to best practices along shortened timelines. In a study we conducted with the Bill & Melinda Gates Foundation to assess the value of global alliances, we found that the ability of such collaborations to physically or virtually pool resources means that they can rapidly deploy funds when an opportunity arises. An alliance can also help avoid duplication of efforts, bringing together the technical expertise and scale to conduct detailed, in-country assessments that build on geospatial findings, such as those presented in this report, in preparation for any decisions on conservation expansion.[124]

» *How can the donor and practitioner communities work together with public and private sectors to expand conservation efforts?*

In this report, we have outlined a range of potentially viable pathways to implement new conservation initiatives. We hope these findings will help decision makers undertake the complex task of assessing the value of conservation expansion.

[124] "Developing Successful Global Health Alliances," *Bill & Melinda Gates Foundation*, April 2002, gatesfoundation.org.

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