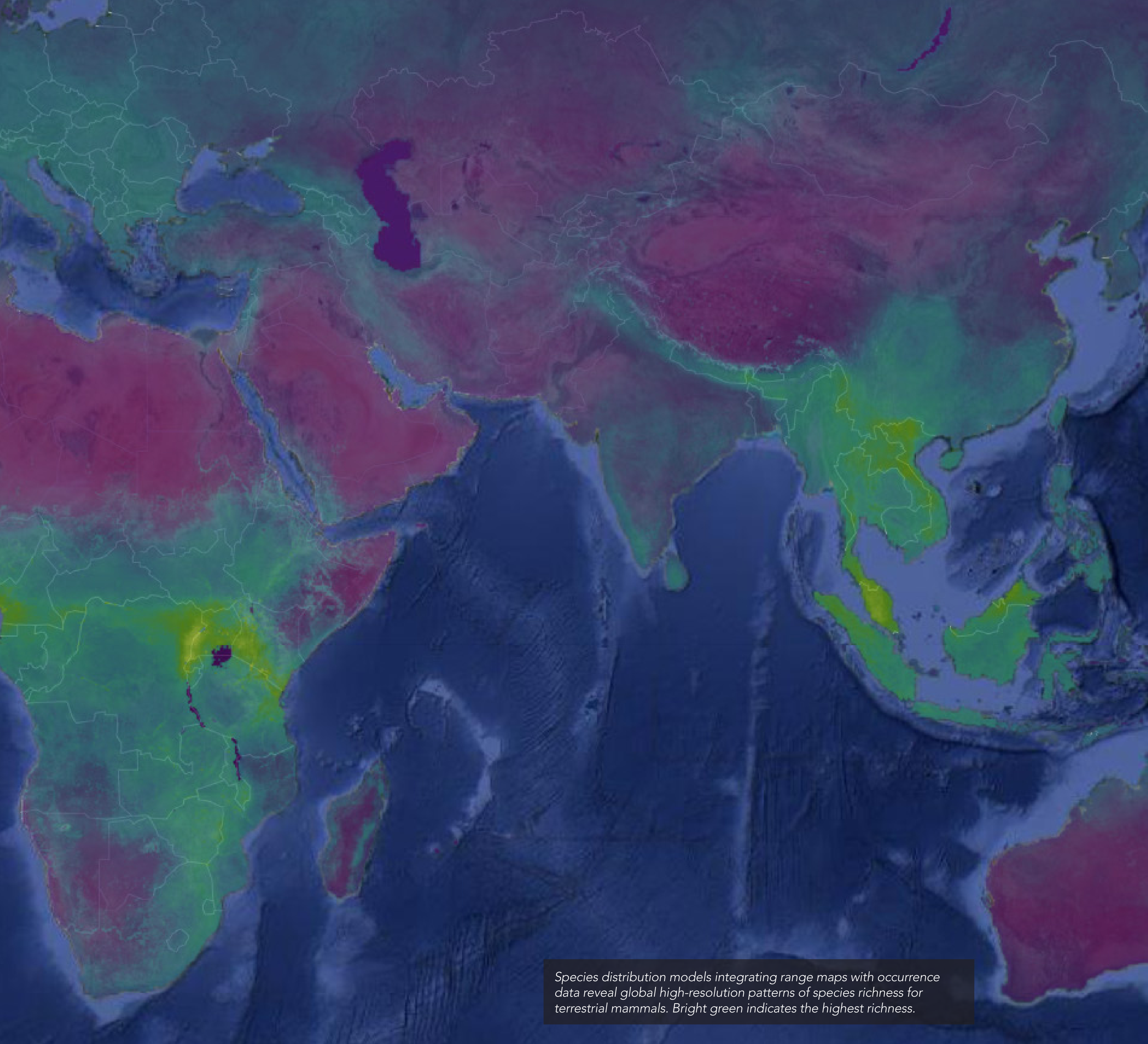
MAPPING HALF-EARTH

Spatial biodiversity knowledge is vital for effective conservation planning. The Half-Earth Project has created a comprehensive map of our planet's biodiversity to inform and track conservation efforts and ensure that no species is driven to extinction from lack of knowledge.

By D. Scott Rinnan, **Yale University**; Greta C. Vega, Estefanía Casal, Camellia Williams, **Vizzuality**; and Joel Johnson and Chris Heltne, **E.O. Wilson Biodiversity Foundation**



Species distribution models integrating range maps with occurrence data reveal global high-resolution patterns of species richness for terrestrial mammals. Bright green indicates the highest richness.

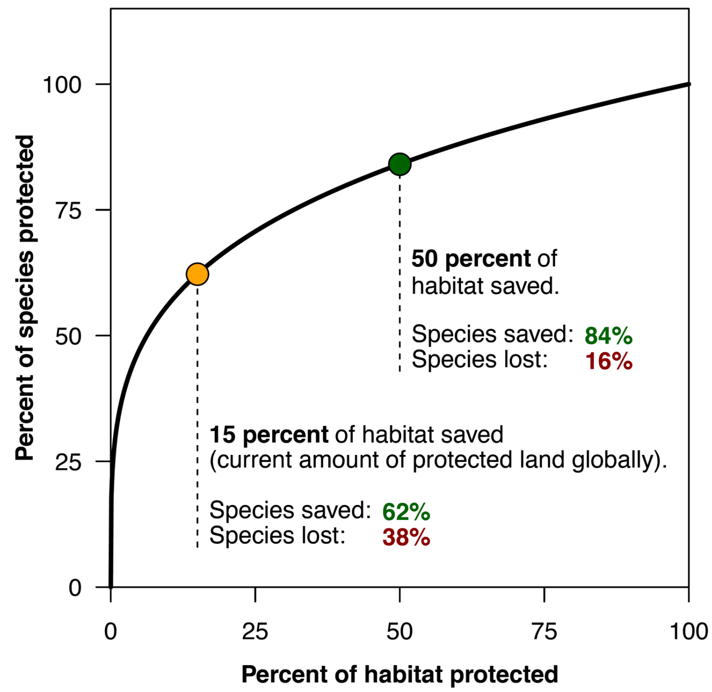
THE NEED FOR SPATIAL BIODIVERSITY DATA

"We are drowning in information, while starving for wisdom. The world henceforth will be run by synthesizers, people able to put together the right information at the right time, think critically about it, and make important choices wisely."

—Edward O. Wilson

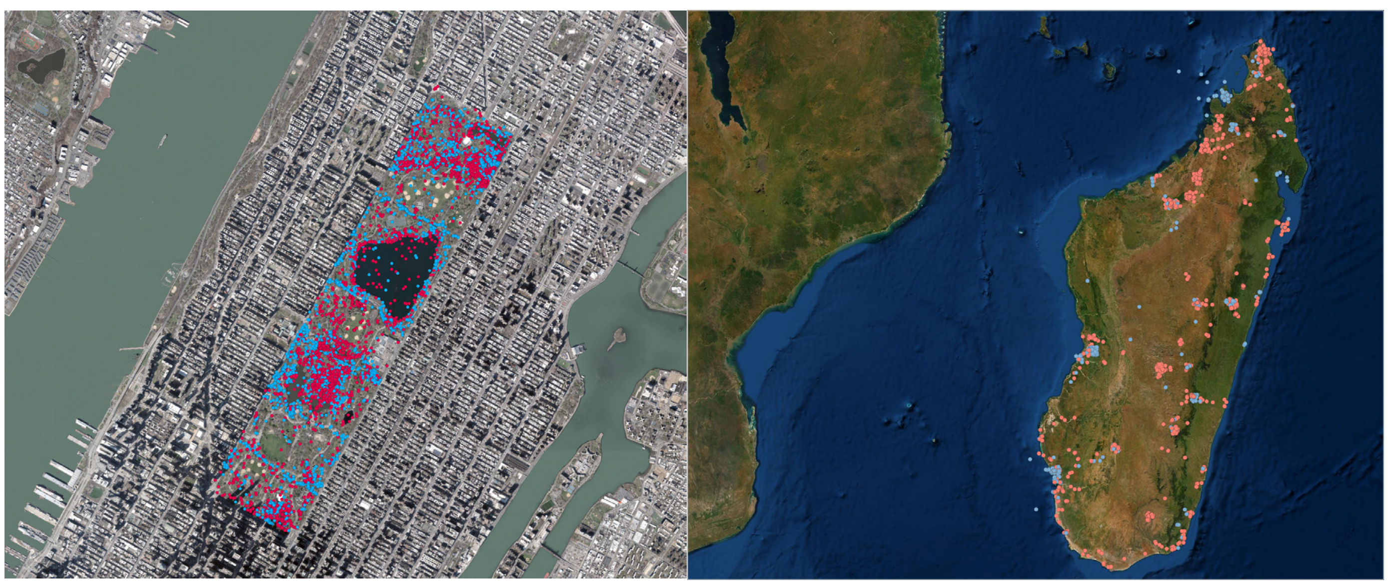
When people are introduced to the concept of Half-Earth, two questions invariably arise: "Why half?" and "Which half?" The answer to the first question is derived from the principles of island biogeography, which explain the relationship between the amount of habitat and the number of species that habitat can sustain. The curve predicted by this relationship indicates that if we protect half the land and sea, we can safeguard the bulk of the biodiversity. At its core, Half-Earth is about raising our conservation ambition to an easily understood goal that inspires collaborative action and addresses the urgent need for comprehensive, global biodiversity protection to sustain the health of our planet.

Identifying which half will sustainably support the bulk of biodiversity requires a clear picture of how and where species are distributed across the globe, their habitat needs, how they move, and how they depend on one another. These are some of the most fundamental questions in ecology, but for all the simplicity in stating them, the answers remain astonishingly elusive. By some estimates, more than 85% of the planet's eukaryotic species (in other words, plants, animals, fungi, and protists) have yet to be scientifically described. Moreover, for only a small percentage of species described so far do we have the most rudimentary descriptions of their spatial distributions.



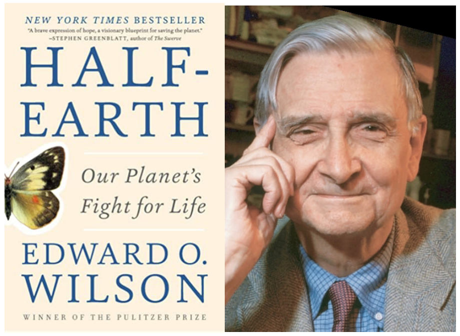
The island biogeographic principles behind the Half-Earth concept. Protecting 15% of the land could be enough to sustain roughly 60% of terrestrial species, while protecting 50% of the land could sustain the bulk of biodiversity.

Paradoxically, the large gaps in spatial and taxonomic coverage have persisted through the recent explosion of available spatial biodiversity data that resulted from the proliferation and increasing accessibility of citizen science tools coupled with the ubiquity of portable technology. This proliferation is partly due to the underlying sampling effort of the data itself: in 2020, the Global Biodiversity Information Facility (GBIF) added almost 28 million user-contributed species occurrence records, but some geographic locations and taxa are much better represented in these data than others. Central Park in New York City, for example, contained almost 3 times the number of reported observations as the entirety of Madagascar, and almost 10 times the number of animal observations. What is needed, then, is not simply more data, but rather a systematic approach to cataloguing our planet's life and synthesizing available data into knowledge useful for guiding conservation decisions.



Spatial occurrence data of plant (red) and animal (blue) species contributed to GBIF in 2020. Central Park in Manhattan (left) contains 9,104 unique observations in an area of only 3.4 km², compared to just 3,846 unique observations in the entirety of Madagascar (right), with an area of 587,041 km².

THE HALF-EARTH PROJECT



Inspired by E.O. Wilson's sweeping call to action in his book *Half-Earth: Our Planet's Fight for Life*, the E.O. Wilson Biodiversity Foundation launched the Half-Earth Project© in 2016. Together with its partners, the Half-Earth Project is driving research to better understand the species of our planet and how they interact with their ecosystems. The project provides conservation management leadership by mapping biodiversity, identifying the best opportunities to protect the most species and engaging with people globally to care for our planet, with the goal of protecting Earth's biodiversity.

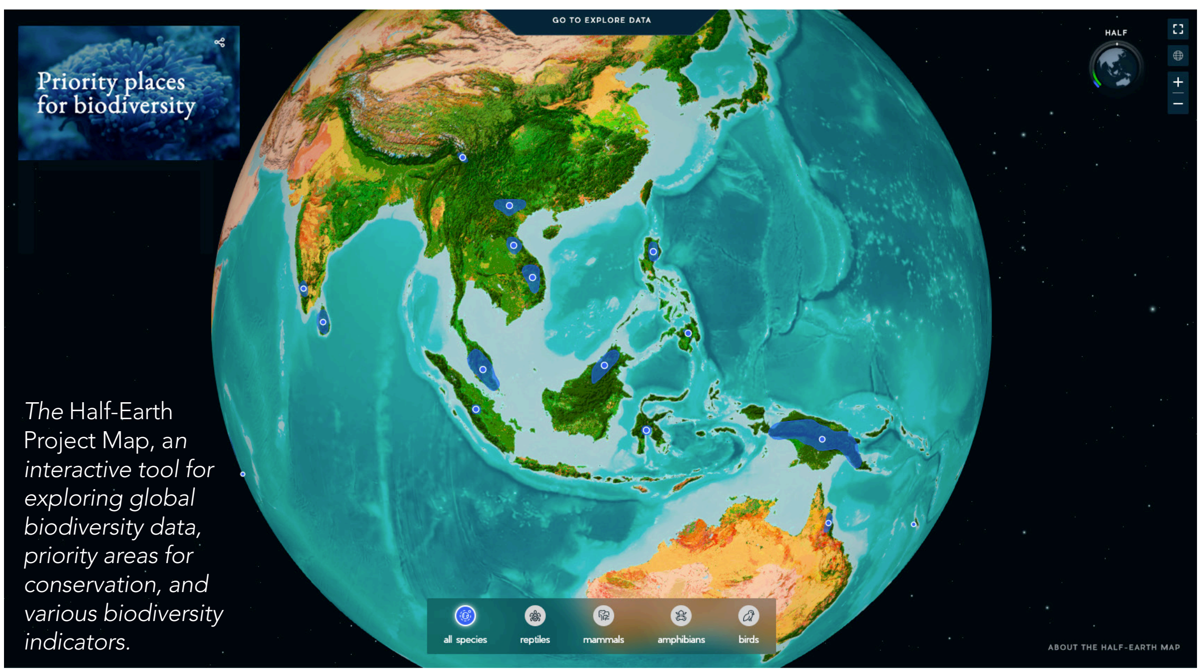
A pillar of the Half-Earth Project is the *Half-Earth Project Map*, a tool for scientific communication and planning that is collaboratively designed and maintained by four core organizations. Map of Life—the flagship project of Yale University's Center for Biodiversity and Global Change—leads the scientific research, contributing the information needed for informed conservation planning. Vizzuality—a company of scientists, developers, and data visualization specialists—leads the user-centered design and development aspects, along with Esri, which provides additional cartographic basemap design, spatial analysis, and data management funtionality. And finally, the E.O. Wilson Biodiversity Foundation provides the leadership and vision for the map and other programs such as educational initiatives and the annual Half-Earth Day, bringing the focus and voice of E.O. Wilson to this endeavor.

"The foundation for a new way of understanding the beautiful intricacy of our planet and how we can best steward its enduring stability is science," says Dr. Paula Ehrlich, president and CEO of the E.O. Wilson Biodiversity Foundation. "When E.O. Wilson conceived of Half-Earth, he imagined that we would bring together our scholarship in many walks of life, many areas of expertise and experience, and work together within the spirit of a moonshot. He imagined that by driving significant scientific innovation, we would provide leadership regarding the most effective path forward for protection of endangered species and endangered ecosystems."

Science teacher and Half-Earth Educator Ambassador Lucretia Smith leads a group of middle-school students in a biodiversity mapping exercise.

As E. O. Wilson noted, the Half-Earth solution does not place biodiversity protection at odds with human activity. Rather, Half-Earth reminds us that if we lose species, we lose the ecosystems that sustain nature and sustain us as part of nature. Effective global conservation strategies will necessarily comprise many approaches and strategies tailored to the needs of different people, landscapes, activities, and interests.

The science of the Half-Earth Project places species as the core unit of conservation concern. "Species are the absolute key in all of this," says Dr. Walter Jetz, scientific chair of the E.O. Wilson Biodiversity Foundation and lead principal investigator of Map of Life. "They are the critical elements underpinning the ecosystems that constitute our landscapes. They're the nodes on this very intricate web of life that are ultimately behind nature's benefits to people." Ensuring that species are represented in our characterizations of the planet's biodiversity is a necessary first step in safeguarding them from extinction. The Half-Earth Project tracks conservation progress at the species level and aggregates this information to identify places where additional conservation actions will best contribute to the preservation of biodiversity. One of its primary goals is to provide a globally and taxonomically comprehensive mapping of species distributions for use in conservation planning.



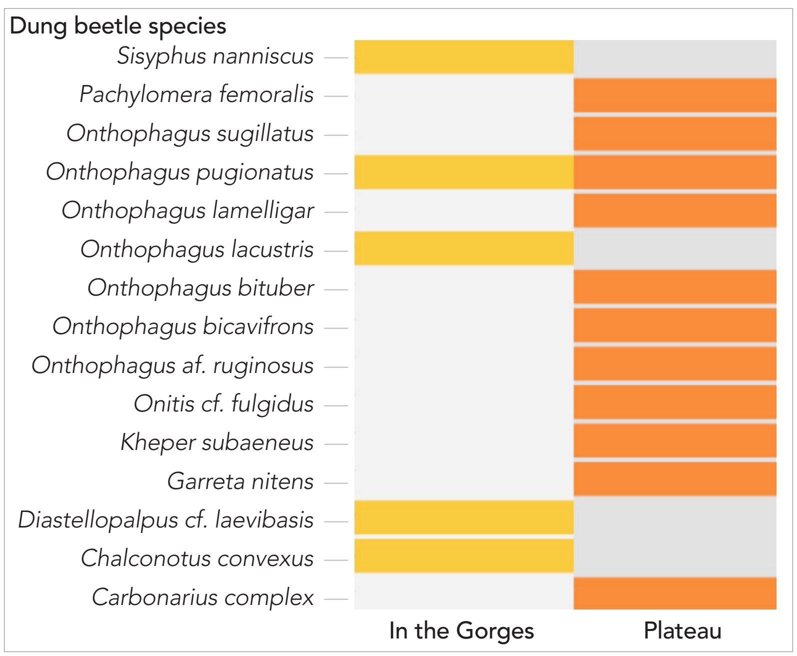
The Half-Earth Project Map, an interactive tool for exploring global biodiversity data, priority areas for conservation, and various biodiversity indicators.

COLLECTING SPECIES DATA

With more than 1,200 terrestrial vertebrate species (including 22 that are uniquely endemic), Mozambique is historically rich in biodiversity. But from 1977 to 1992, a civil war ravaged the country, destroying critical infrastructure, killing more than a million people through fighting and starvation, and taking a toll on species populations as well. Inside Gorongosa National Park—the jewel of Mozambique's incredible landscape—populations of large animals decreased by 90% as people turned to hunting bushmeat to survive. Fortunately, Mozambique's wild places remained relatively intact.

After the war ended, the Gorongosa Restoration Project began its efforts to restore the park's biodiversity, led by a team of local conservationists and philanthropist Greg Carr. The E.O. Wilson Biodiversity Laboratory at Gorongosa National Park was established to train a new cadre of Mozambican biologists and conservationists to support restoration efforts and to carry out comprehensive surveys of biological diversity in the park. The laboratory is directed by Dr. Piotr Naskrecki, entomologist, conservation biologist, author, photographer, and Half-Earth Chair, based at the Museum of Comparative Zoology at Harvard University.

Gorongosa National Park in Mozambique is one of Africa's most ambitious wildlife restoration stories.



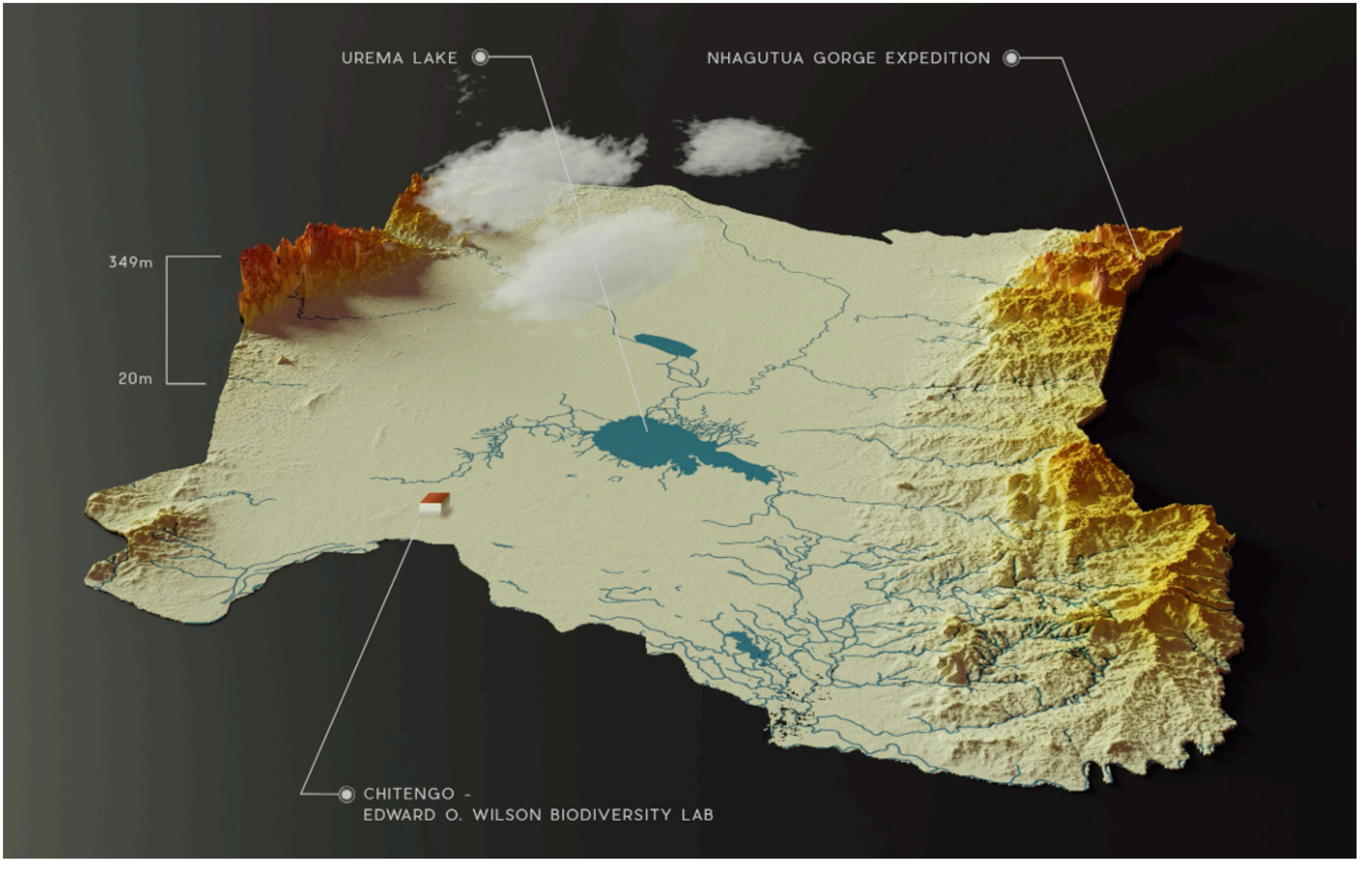
The sampled composition of dung beetle species between the gorge and its adjacent plateau was almost disjoint, with only one species found in common between both habitats. Many of the individuals gathered have not yet been identified to the species level.

Dung beetles in Gorongosa National Park. Image by Piotr Naskrecki.

Today, Gorongosa National Park is a spectacular 6,700 km^2 preserve located at the southern end of the Great East African Rift Valley. Gorongosa encompasses almost all types of habitat found in southern Africa, with a variety of microclimates and environments created by unique biogeographical features and a range of altitudes. Fed by rivers originating on Mount Gorongosa, the floodplain of Gorongosa National Park supports some of the densest wildlife populations in all of Africa, including charismatic carnivores, herbivores, and 475 bird species. Populations of many species of large mammals such as waterbuck (*Kobus ellipsiprymnus*), impala (*Aepyceros melampus*), and sable antelope (*Hippotragus niger*) have either returned to or exceeded pre-war levels, and other species such as the African bush elephant (*Loxodonta africana*) and African buffalo (*Syncerus caffer*) are quickly approaching them. Other species have been successfully reintroduced, such as African wild dogs (*Lycaon pictus*). Yet there is much still to be learned about many of the park's lesser-known species that build and support the ecosystems in which these high-profile examples of charismatic megafauna reside.

In March 2013, an expedition led by Dr. Naskrecki set out to conduct a survey of the Nhagutua Gorge (accessible only by helicopter), with a focus on detecting differences in species composition across an elevational gradient in smaller species not detectable by aerial surveys. Equipped with Sherman traps, mist nets, and pitfall traps, Dr. Naskrecki and his team gathered samples of rodents, bats, and dung beetles. The dung beetles alone comprised hundreds of specimens belonging to 12 separate genera, illustrating the astonishing diversity that individual regions can hold.

This single population survey exemplifies the extraordinary amount of coordination and effort to collect species data and the diverse historical contexts that surround each datum. Mapping the planet's biodiversity is only possible because of the blood, sweat, and tears of the countless thousands of individuals who have dedicated their time in gathering data, observations, and samples in the field, and make that information available to others. You can read more about the E.O. Wilson Biodiversity Laboratory and Gorongosa's community-based natural resource management efforts in this volume's online resources at GISforScience.com.

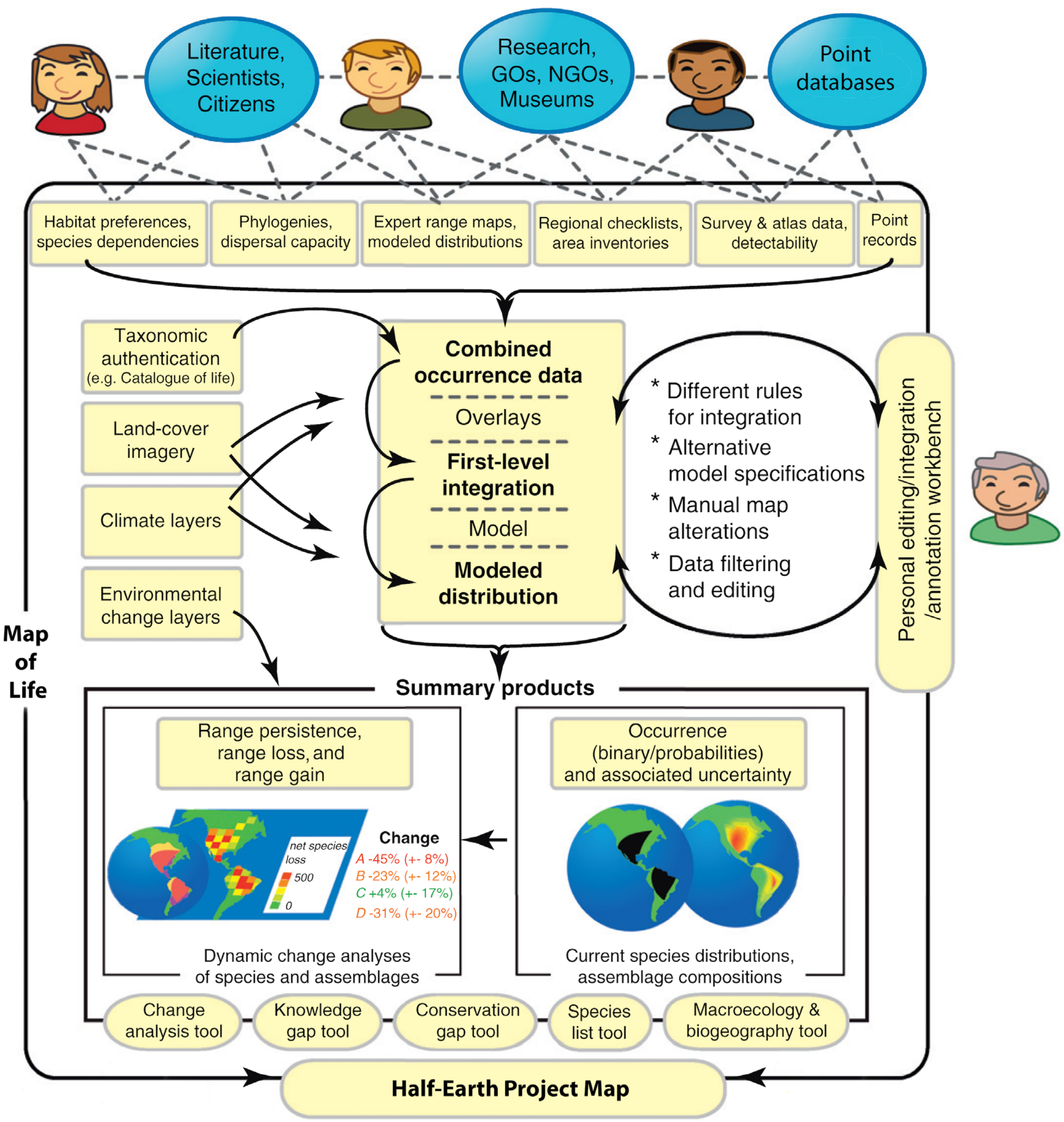


Located at the southern end of the Great East African Rift Valley in the heart of central Mozambique in Southeast Africa, Gorongosa National Park includes more than 4,000 km^2 (1,500 sq mi) of protected park on the valley floor and parts of surrounding plateaus. Rivers flowing from nearby Mount Gorongosa irrigate the plain.

AGGREGATING AND INTEGRATING DATA

Spatial biodiversity data comes in many forms: reported observations of individuals from citizen scientists and wilderness enthusiasts through popular apps such as Map of Life and iNaturalist; presence/absence records of individuals from scientific surveys such as Dr. Naskrecki's work in Gorongosa; museum records; range maps that delineate general habitat preferences of species; inventory lists of a geographic area generated by "BioBlitz" activities; and larger regional checklists, often at the national level. Each of these data varieties vary in spatial accuracy, the amount and type of information that can be gleaned from them, and the value and utility of this information to inform conservation. Furthermore, within each of these categories, biodiversity data can vary in its availability (bird enthusiasts outnumber ant enthusiasts by at least an order of magnitude), amount (in New York City versus Madagascar), confidence (was that a chipping sparrow or an American tree sparrow?), accuracy (how accurate are my GPS coordinates?), and precision (did I see two chipping sparrows, or was it the same one twice?).

It's not surprising, then, to speak of the challenges of aggregating these disparate data types and integrating them to yield an accurate portrait of species distributions in space and time. Data aggregation is a continually ongoing cycle of identifying new data sources and potential collaborators, building partnerships, creating data-sharing agreements, ingesting new data, identifying what is usable, harmonizing taxonomies, updating datasets, and managing databases. This work is the nuts-and-bolts basis of building a comprehensive picture of biodiversity and often slips by underappreciated in the shadow of splashy, high-profile scientific publications that focus on the results of this work. Informatics underpins virtually every aspect of biodiversity research, and it would be folly to understate the importance of its role in facilitating our understanding of the biosphere.



Schematic diagram (adapted from Jetz et al. 2012), showing Map of Life's data integration process. Map of Life facilitates the uploading of species distribution information from many organizations and sources, including data on habitat preferences, point occurrences, and expert range maps. The infrastructure stores this data and provides a workbench for integrating them for one or many species. The data compiled, resulting summary information such as binary and probabilistic occurrence maps, and products from analysis tools, including ArcGIS Pro and ArcGIS API for Python, are then used for various types of modeling. Model outputs are displayed in the Half-Earth Project Map.

Methodology

As one of the Half-Earth Project's core teams, Map of Life (www.mol.org) leads the biodiversity informatics research that informs the *Half-Earth Project Map*. Map of Life comprises a group of more than 25 data scientists, ecologists, taxonomic experts, postdoctoral associates, technicians, and students led by Jetz, and Robert Guralnick, a scientist at the Florida Museum of Natural History. "Our role in the Half-Earth Project is to deliver the science and information for effective conservation decision-making, to ensure that species are not unknowingly left behind," Jetz said.

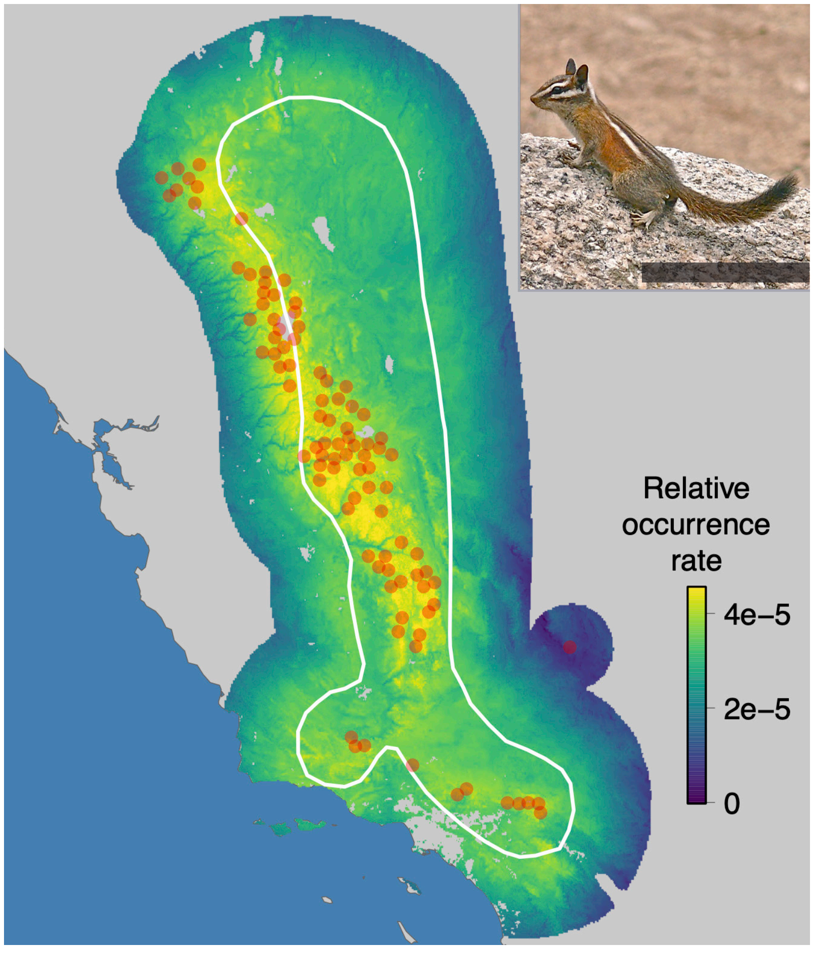
Map of Life has developed a complex and sophisticated process for integrating different datasets into a common modeling framework. The outputs of this framework provide a type of space-time-species data array known as an essential biodiversity variable (EBV), in which each datum specifies the occurrence probability of a given species in a given location at a given point of time. These EBVs can be used to infer a variety of ecological patterns such as species richness and change in community composition over time, and are what ultimately provide the high-resolution spatial information needed to guide conservation efforts.

Three measures of biodiversity

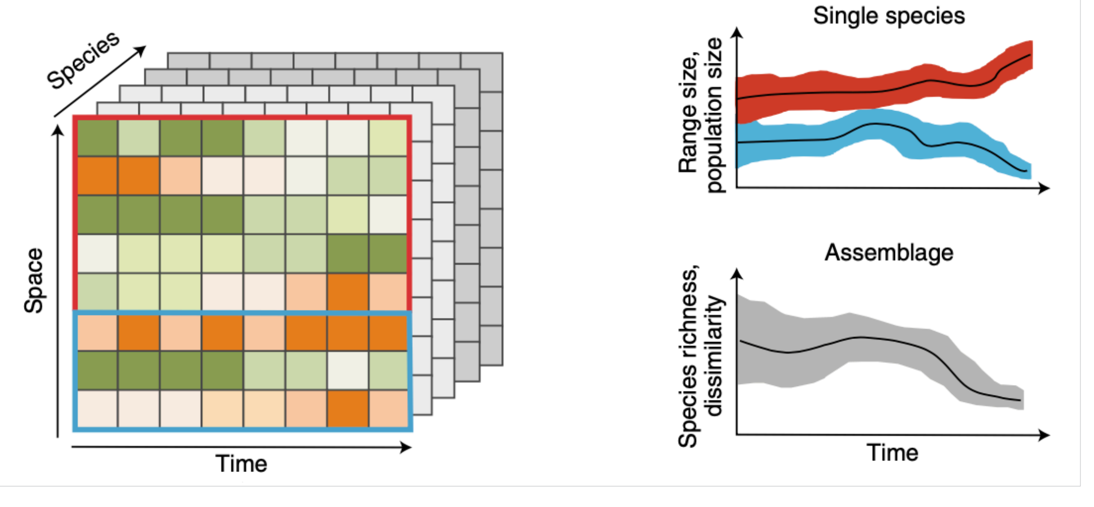
1. **Species richness** is a measure of the number of different species in a given region. This quantity can be summarized by distinct geographic regions such as countries or protected areas or by equal-area grids to reveal global patterns.

2. **Species endemism** is the proportion of the distribution of a species found in a given region, summed across all species in that region. This term is also known as **total range-size rarity, rarity score, or weighted endemism**.

3. **Species rarity** is simply species endemism divided by species richness, and is a measure of average geographic range-restrictedness of species in a given region. This is also known as **average range-size rarity** or simply **range-size rarity**.



*An occurrence model for the lodgepole chipmunk (*Neotamias speciosus*) in California. This model uses Map of Life's infrastructure for data integration to combine range map (white outline) and observation data (orange points) with environmental variables and remotely sensed land-cover products to predict where the lodgepole chipmunk is most likely to occur.*

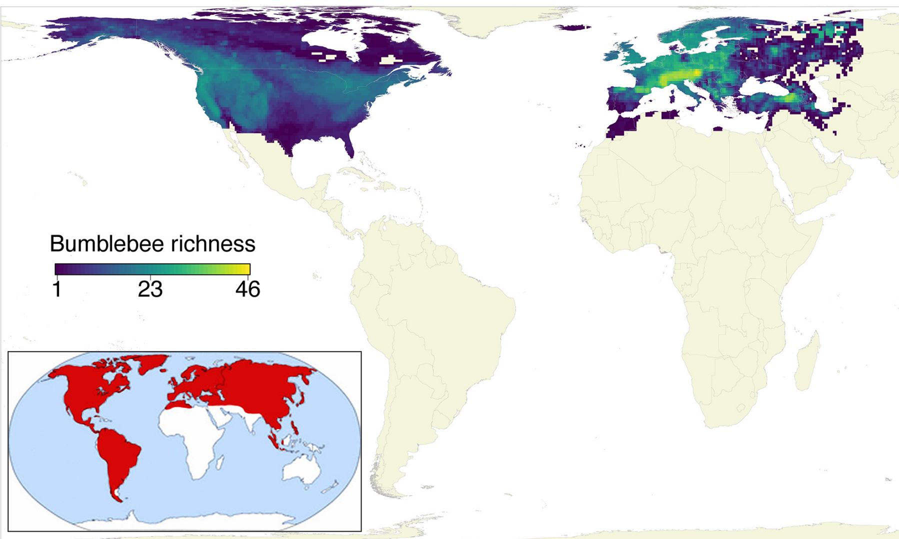


A space-time-species essential biodiversity variable (EBV) of occurrence probabilities. When data is aggregated for single cells, the EBV informs about community change in, for example, species richness or compositional similarity, or—through ancillary data—functional or phylogenetic turnover. Adapted from Jetz et al. (2019).

TAXONOMIC REPRESENTATION AND DATA GAPS

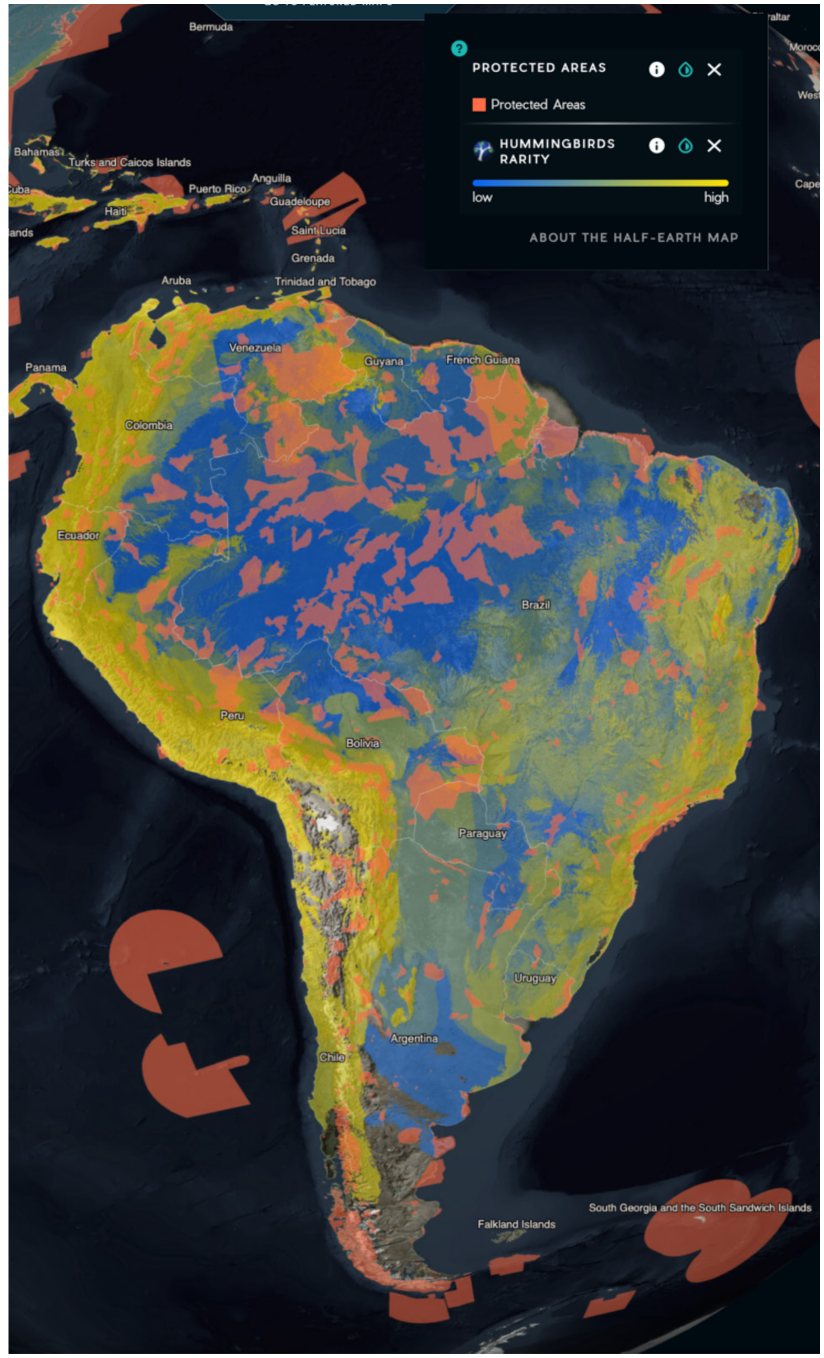
To date, the *Half-Earth Project Map* includes global patterns of richness and rarity for all known species of amphibians, birds, mammals, reptiles, cacti, and conifers. These groups are displayed because of their comprehensive representation, i.e., every known species is accounted for. The Half-Earth Project is engaged in expanding the taxonomic coverage of the map to other groups such as ants, bees, butterflies, dragonflies, vascular plants, marine fishes, and crustaceans.

Because the *Half-Earth Project Map* is intended to inform and guide conservation planning, its patterns of richness and rarity must account for any spatial biases that may be present in the species data. At the continental scale, for example, the extent of the genus *Bombus* (bumblebees) is fairly well known, but sizable disparities can be observed when mapping individual species at finer spatial resolutions: while most North American and European distribution data is readily available and comprehensive, Asia and South America are currently relatively data poor and incomplete by comparison. As such, using the higher-resolution but taxonomically incomplete map to guide management decisions may lead to erroneous conclusions about the distribution and importance of bumblebee habitat.



A map of bumblebee species richness in North America and Europe, compared to the global extent of bumblebees (inset). Biodiversity patterns inferred from taxonomically unrepresentative, incomplete, or spatially biased data may lead to erroneous conclusions about the conservation importance and value of different regions.

Although large, under-sampled portions of the world remain for bumblebees, many other taxonomic groups show more diffuse and scattered data gaps. Many of these gaps are best understood by acknowledging the socioeconomic differences between countries and the political histories associated with different regions. Data coverage maps provide information about where more data and sampling efforts are needed. The key to filling these knowledge gaps resides in international collaboration and capacity-building between organizations linking local communities. Until these gaps are filled, other modeling approaches are needed to map biodiversity patterns that can be used in global planning, such as constructing representative subsets of species that are sampled across genera.



The Half-Earth Project Map *is a high-resolution, dynamic world map and decision-support tool that guides where place-based species conservation activities are needed the most to save the bulk of Earth's species, including humans. This view shows taxonomically complete rarity patterns (high rarity in yellow) for the world's 276 known species of hummingbirds, overlaid with currently protected areas (red areas).*

PRIORITY AREAS FOR CONSERVATION: WHICH HALF?

Once equipped with the necessary species data, the project uses spatial conservation planning tools to answer how much habitat is needed for global biodiversity protection and where to direct conservation efforts. Spatial conservation planning describes the process of converting spatial data into a mathematical problem, using an optimization algorithm to solve this problem, and then translating the solution back into a spatial conservation network. When used effectively, solutions adhere to the four specific principles of conservation planning: comprehensive, adequate, representative, efficient solutions (CARE).

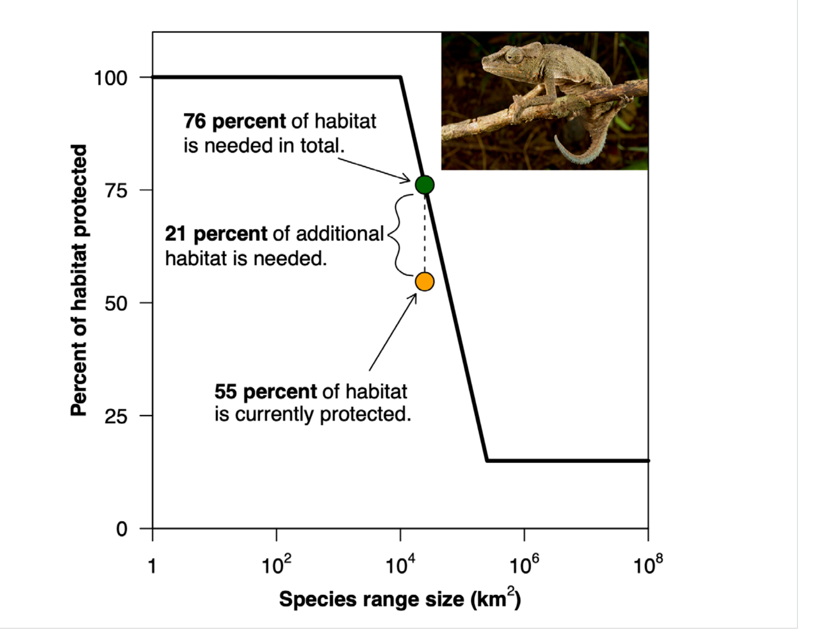
CARE principles of spatial conservation planning

Comprehensiveness—Solutions should comprise as many facets of biodiversity as possible (e.g., habitat diversity, species composition, and ecological function).

Adequacy—Solutions should ensure the persistence of species through time.

Representativeness—Solutions should sample across the full range of variation for each species (e.g., nesting, breeding, and foraging habitat).

Efficiency—Solutions should achieve conservation objectives at minimal cost. Cost can reflect acquisition costs, operational costs, total area, opportunities lost (e.g., commercial or industrial activity), sociopolitical values, or any number of other characterizations.

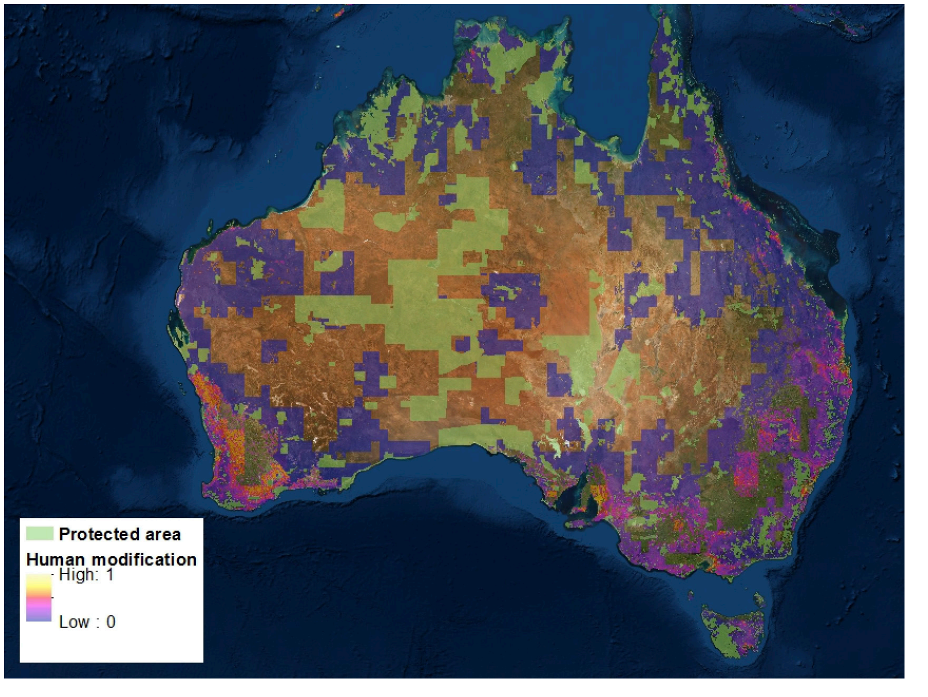


*An example of how species conservation targets are calculated for spatial conservation planning. The Gorongosa pygmy chameleon (*Rhampholeon gorongosae*) is a species endemic to Mozambique, with a range area of about 25,000 km^2. Of this range, 55% is already protected, and an additional 21% of its habitat is needed to ensure that its area-based target (black line) is met.*

What amount of habitat is adequate to ensure population persistence? A variety of methods determine the habitat needs of species, but one common method expresses areal conservation targets as a simple function of a species' range size that specifies up to 100% of habitat protected for species with smaller ranges, and 15% of habitat protected for the most common and widespread species. While habitat quantity alone is insufficient to guarantee persistence, it is a necessary baseline condition for species to thrive and a useful proxy that can be inferred for any species with distributional data.

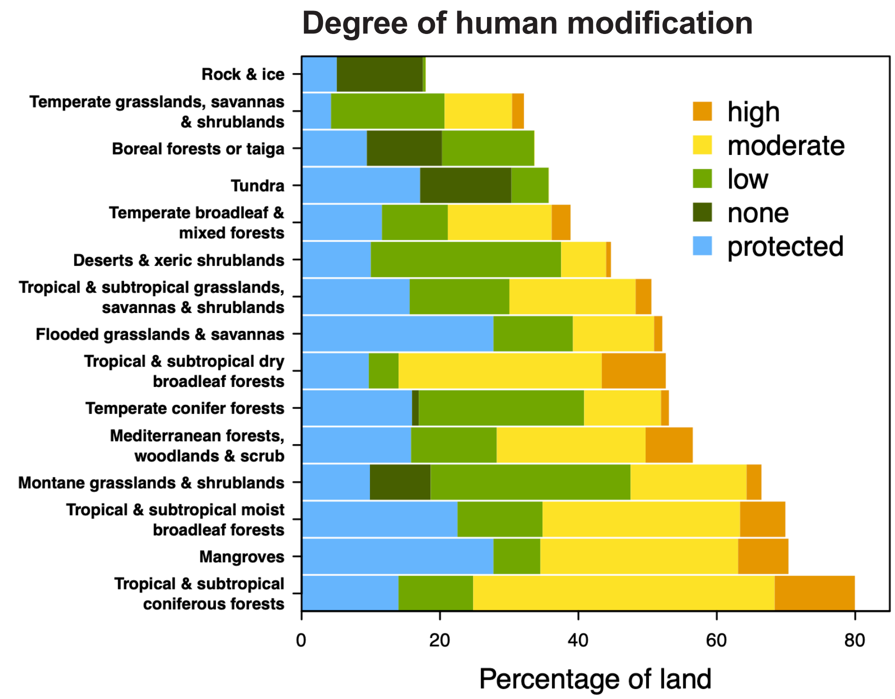
Guided by these CARE principles, the Half-Earth Project employs spatial planning to explore various configurations of the areas needed to achieve the goal of comprehensive biodiversity conservation. Beginning with currently protected regions, these models minimize the amount of additional area needed to meet species conservation targets, while prioritizing intact habitat wherever possible. The *Half-Earth Project Map* features layers in the terrestrial and marine realms that illustrate one possible configuration of a global conservation network, in addition to the supporting layers of human impacts and protected areas. This featured network provides habitat for all species of amphibians, birds, mammals (terrestrial and marine), reptiles, and marine fish.

Once the conservation network is identified, this information is then aggregated in several different ways to yield further insights crucial for decision-making. Most critically, the amount of area needed within different political regions, biomes, and ecoregions provides our first estimates of differential conservation needs that reflect the heterogeneous distribution of the planet's biodiversity. These individualized targets exemplify one of the core principles of international conservation policies such as the Convention on Biological Diversity, currently in negotiation for 2020–2030 and beyond.



A conservation network highlighted in the Half-Earth Project Map, *comprising 56% of Australia's land, including the 19.5% that is currently protected. This network ensures that species targets are efficiently met while minimizing the amount of human modification in the additional selected areas.*

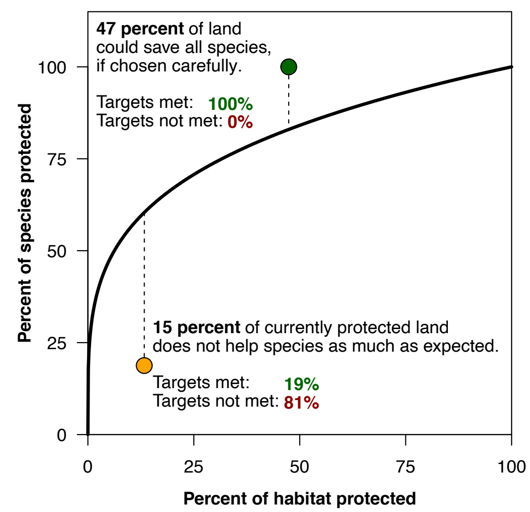
Likewise, aggregating across species reveals differences in conservation area priorities between taxonomic groups. These patterns can also be explored in the *Half-Earth Project Map*.



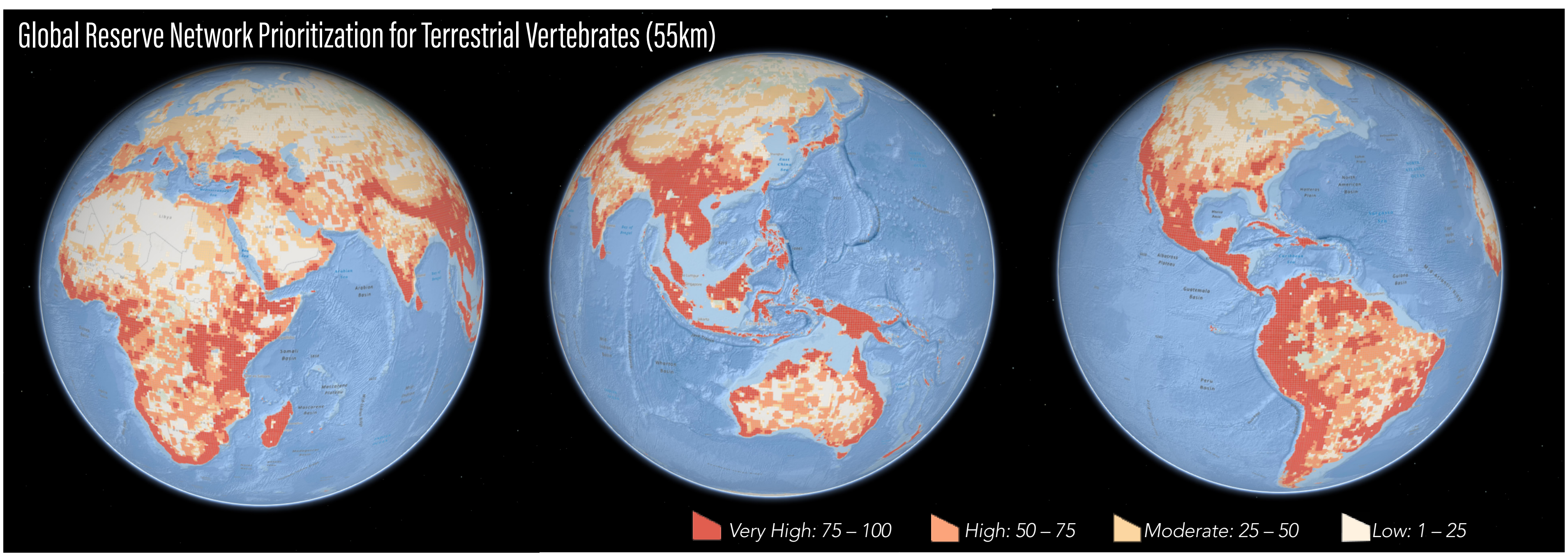
Composition of global conservation network shows the percentage of each biome needed to meet species conservation targets, the amount of human modification contained in the network, and the amount currently protected.

Takeaways

These results reveal two key takeaways. First, established protected areas do not adequately safeguard global biodiversity to the extent predicted by island biogeographic theory. This result may be discouraging although not surprising. Because biodiversity positively correlates with resource availability, many protected areas were historically placed in regions that did not inhibit resource exploitation and economic interests, which results in areas with less biodiversity protected. In contrast, the second key takeaway should be quite encouraging: by offering a systematic, strategic approach to global biodiversity conservation, spatial planning can help us drastically outperform the expectations of island biogeography. In our terrestrial example, 47.4% of land was needed to meet conservation targets for all species modeled.



Spatial conservation planning helps us to outperform the expectations of island biogeographic theory. Although our current protection of the planet's biodiversity is inefficient and insufficient, rapid gains in comprehensive conservation of the biosphere are possible with a strategic, global approach. The results shown here are derived from a model that accounts for all terrestrial vertebrate species.



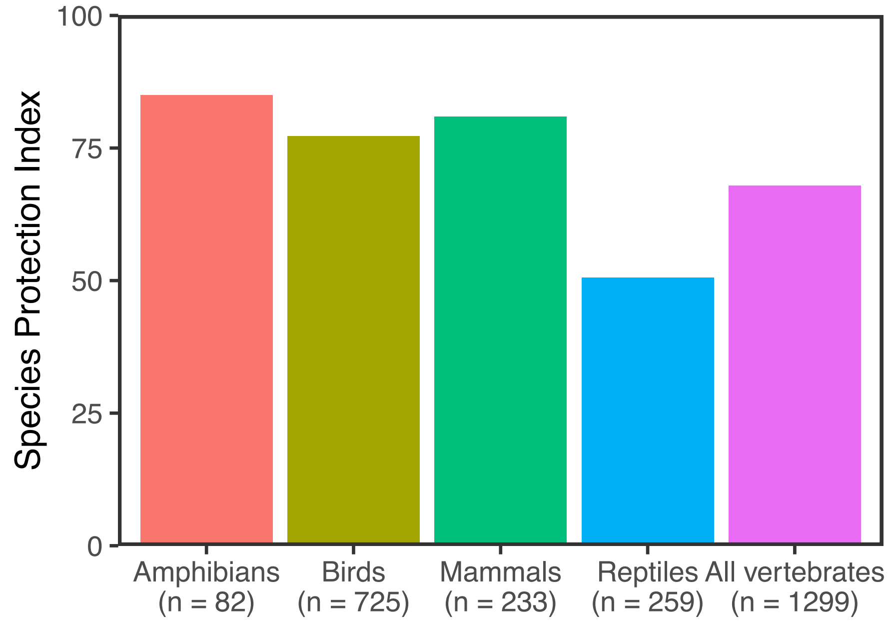
This feature layer shows global priority areas of conservation importance for all terrestrial vertebrate groups. Values are summarized within an equal-area grid, with a grid cell area of ~3,025 km² (approximately 55 km x 55 km in the tropics). This cell size represents the finest resolution at which currently available range map data can be used to accurately infer species presence without further habitat modeling.

BIODIVERSITY INDICATORS

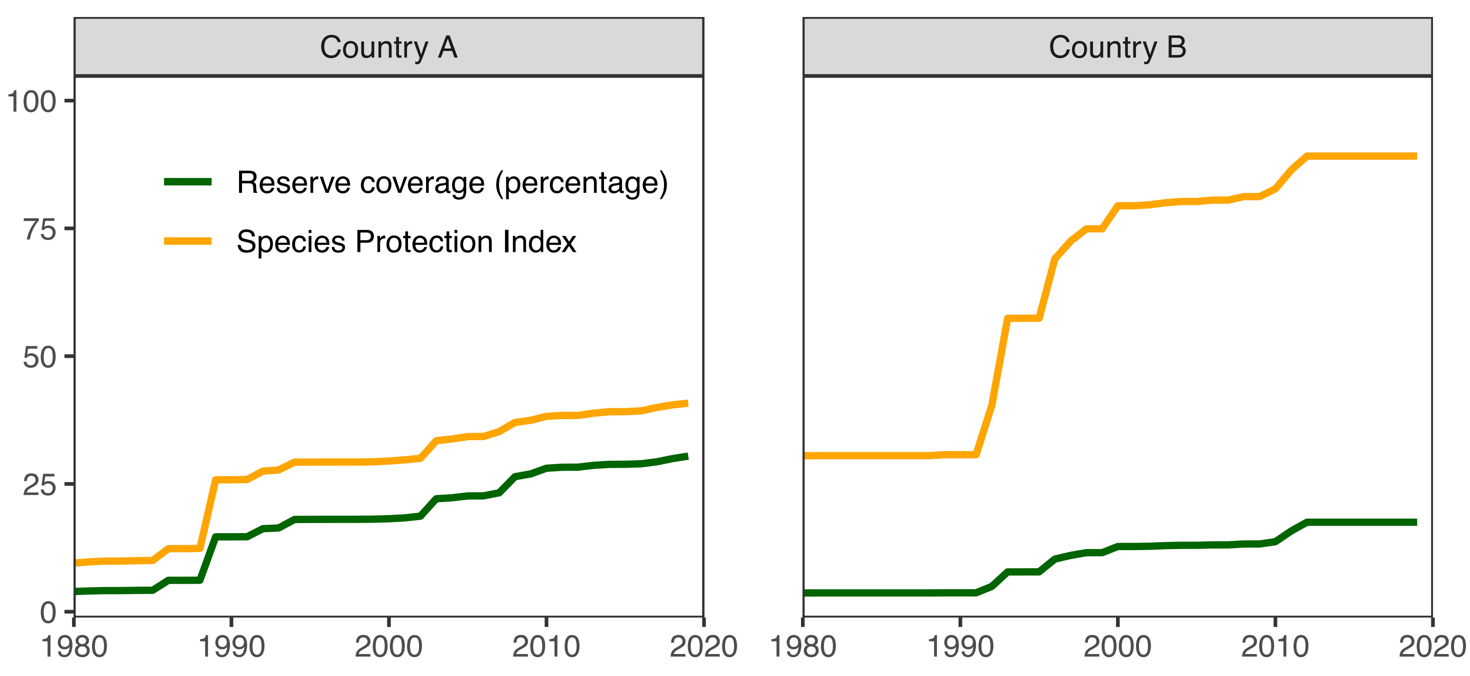
Although spatial conservation planning identifies the amount of protection needed and where, there is a big difference between identifying a mathematically optimal solution and turning that solution into action through conservation policies and resource management. This process is slow and messy (in the best of times) due to myriad additional considerations that may not have been accounted for in the modeling process, such as budgets, time horizons, conflicts with existing policies, and competing sociopolitical interests. Even with unanimous agreement on a united path toward global biodiversity conservation, it would take years to implement the policy needed to close the gap between where we are at today and what is needed to achieve Half-Earth. Consequently, it's unknown whether the path taken today would accomplish the same goals in the future. To complement spatial planning, we turn to methods for tracking conservation progress through time and global change.

Biodiversity indicators are measurements derived from biodiversity data that enable us to study, report, and manage biodiversity change. One prominent example featured on the Half-Earth Project Map's National Report Cards is the Species Protection Index (SPI). Map of Life developed this metric to quantify the extent of species habitat conserved by protected areas. When measured at the national level, the SPI reflects the average amount of area-based conservation targets met across all indigenous species within a given country in a given year, weighted by the country's stewardship. With a range of 0–100, the SPI is based on the amount and location of currently protected land and the number and location of species found inside and outside the protected areas. An SPI of 100, for example, reflects a country practicing good stewardship and promoting equitable conservation efforts within its borders.

As a biodiversity indicator, the SPI helps ensure that our conservation actions reflect and achieve our conservation goals over time by prioritizing areas where biodiversity protection is most needed. The SPI can be updated regularly to reflect additions to protected area networks and enhancements in our understanding of species distributions. Additionally, the SPI can be aggregated at different spatial scales (e.g., globally or by country) and for different taxonomic groups. For countries with low SPI values, the layers of priority areas for conservation show where efforts can be directed to make the most rapid gains in species protection.



National SPI of Mozambique aggregated by taxonomic group and calculated for 2019, illustrating disparities in current protection levels between species groups.



Two example countries that provide stewardship for a similar number of terrestrial vertebrate species (A = 488, B = 521) and have similar percentages of protected area, yet country B's SPI is much higher than country A's due to the location of its protected areas in areas of biodiversity value and the extent to which they provide habitat for country B's species.

NATIONAL REPORT CARDS

This chapter has explored how the Half-Earth Project integrates local scale knowledge into a global portrait of the biosphere and uses this information to coordinate a global conservation strategy. To facilitate local conservation action, however, these results must be interpretable and meaningful at the scale in which policy and decision-making is implemented, which means translating them back into local scale knowledge. The National Report Cards in the *Half-Earth Project Map* summarize various aspects of conservation efforts at the national level. They can be used to explore various national indicators measuring conservation needs and progress and to understand different challenges faced by each country. Once a country is selected on the map for exploration, the rest of the world map falls away and exposes an interactive 3D map.

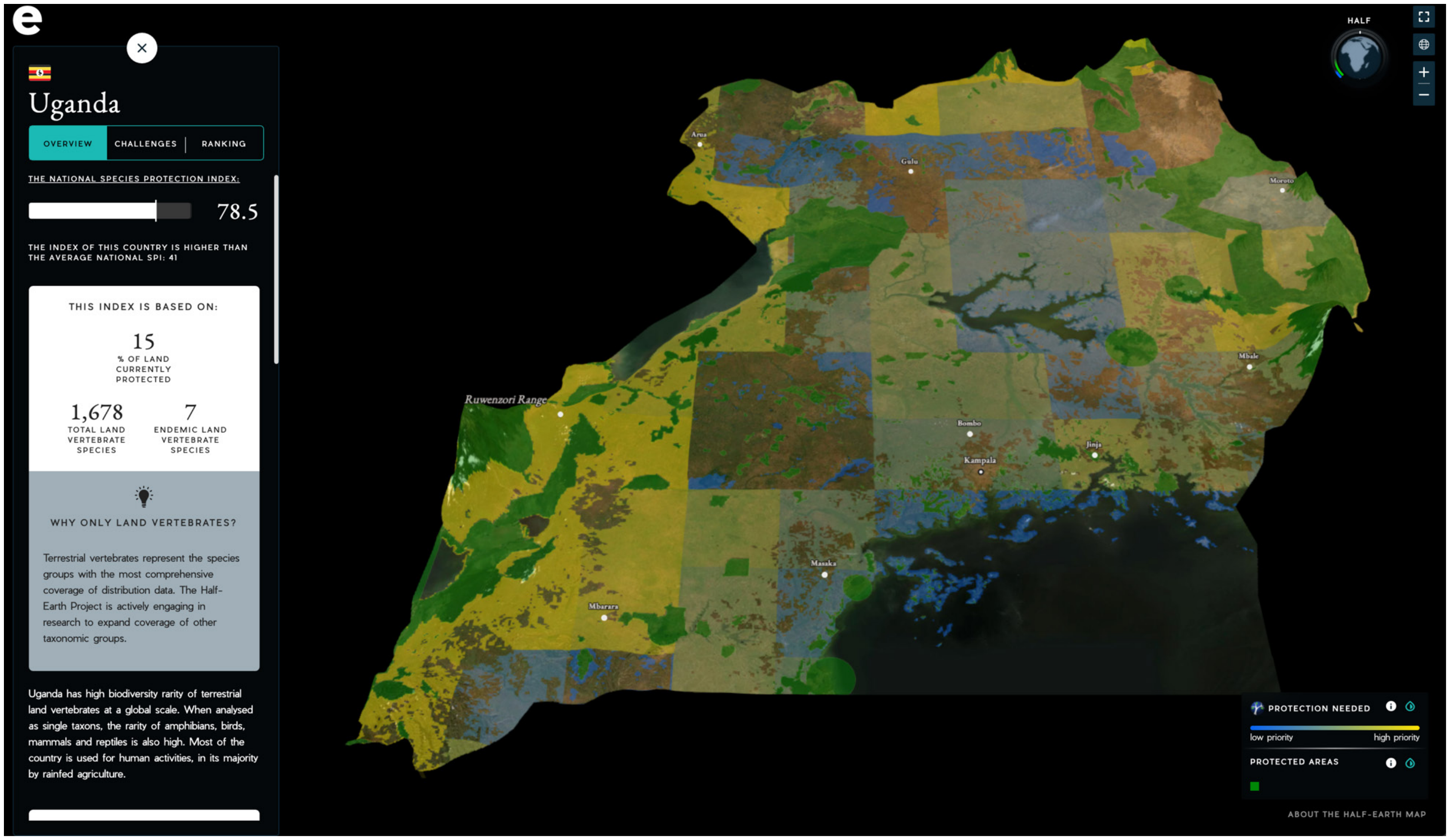
In addition to details about national SPI values and priority areas for conservation, the report cards feature information about each country's species composition, including downloadable tables of indigenous species and various species-specific metrics such as stewardship and a Species Protection Score (SPS). The species stewardship element of the National Report Card scales up the concept of joint responsibility for a species by considering all of the land vertebrates in each country. Through this approach, it's possible to see the number of countries that share the stewardship of a species. The SPS goes deeper into that concept by providing an assessment of the protection accomplished per species, per country.

The SPS differs from the SPI in that it reflects the level of protection an individual species receives within a given country. An SPS value indicates how close a country is to meeting a species' conservation target relative to the amount of species habitat it has stewardship over. A single species will therefore have a unique SPS for each country that overlaps with its global range. SPS values are presented as ranges (e.g., 75–100) to reflect some of the spatial uncertainty associated with species distributions.

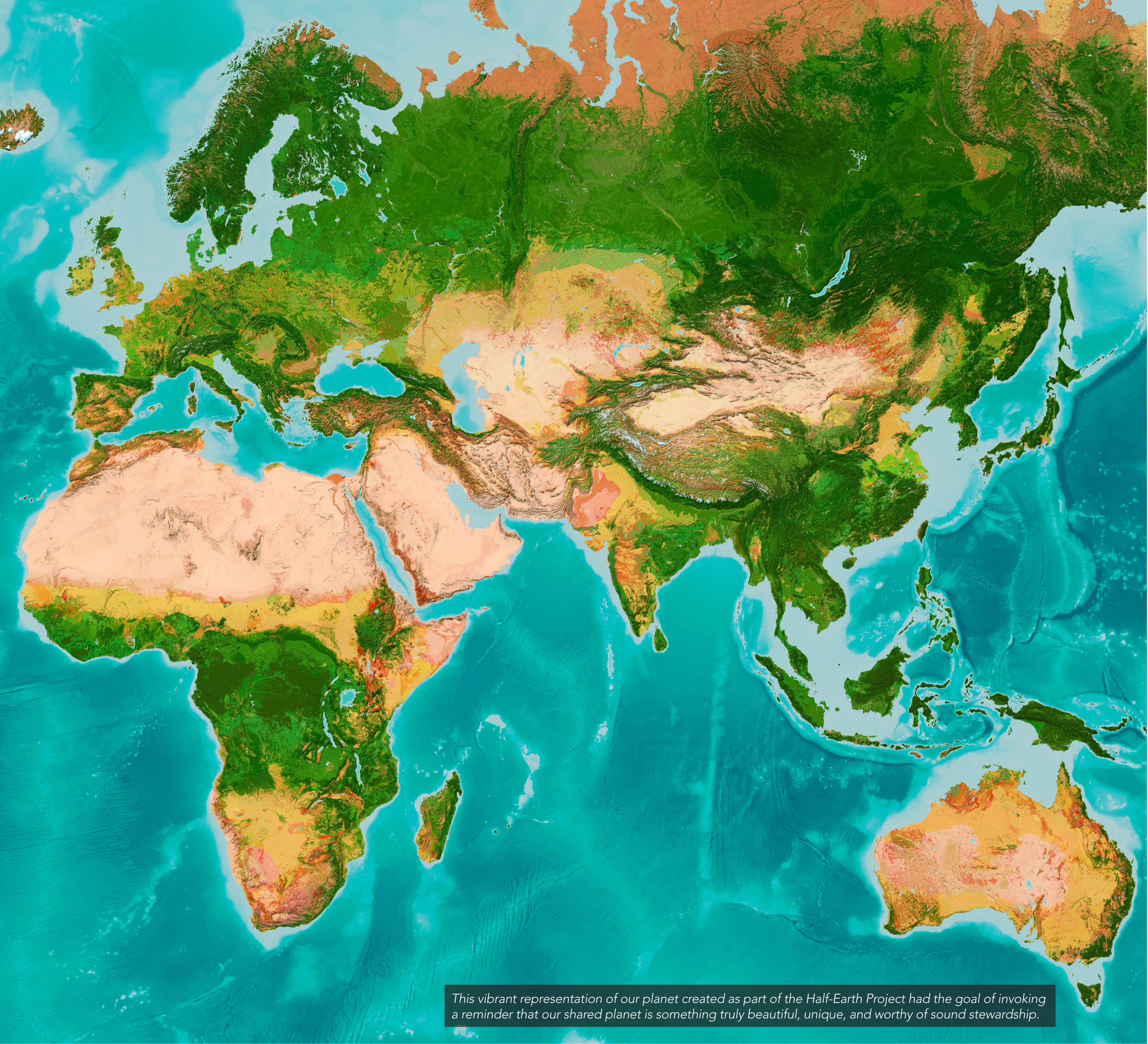
The Challenges panel of the National Report Cards explores the relationships between the SPI and the various sociopolitical and biodiversity indicators of different nations. Scatter plots can be filtered to emphasize similarities between countries and the social challenges they face in ensuring equitable global biodiversity conservation. By grouping countries by their similarities, this feature of the National Report Cards could make it easier for countries to learn from one another and replicate each other's successes. Countries can be filtered by stewardship to reveal the 10 countries with the greatest number of species in common. This capability provides insight into which countries could work together to give to the largest number of species the best level of protection possible. Because individual species are often found in many countries, the entire global population of each species needs protection wherever they are found.

The Ranking panel of the National Report Cards provides a concise overview of each country's species composition, human modification, protection status, and SPI ranking, further facilitating comparisons between countries.

As the National Report Cards continue to be updated regularly, the Half-Earth Project plans to expand the concept to summarize regional areas such as states and provinces.



National Report Card for Uganda.

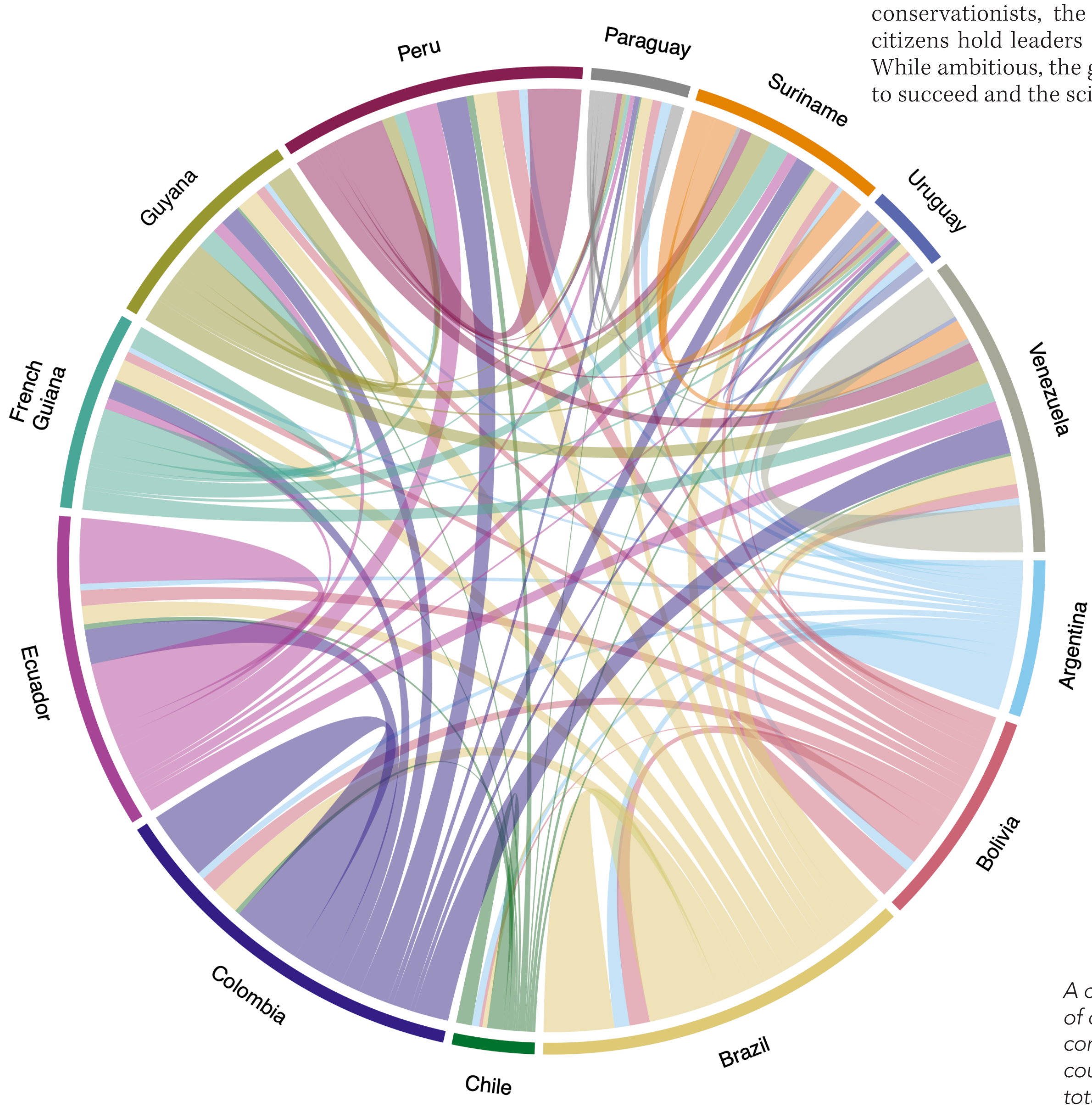


This vibrant representation of our planet created as part of the Half-Earth Project had the goal of invoking a reminder that our shared planet is something truly beautiful, unique, and worthy of sound stewardship.

CONCLUSION

The Half-Earth Project recognizes the urgent need for comprehensive, global biodiversity protection to sustain the health of our planet and uses the best available science to help guide a coordinated global response. With the help of countless biologists and conservationists working around the world, GIS powers a synthesis of information that advances our understanding of biodiversity. This knowledge is used to identify the places best suited to safeguard species, prioritize conservation actions, promote equitable decision-making, and track our conservation progress.

The *Half-Earth Project Map* provides tools for use by international organizations such as UN Environment Programme World Conservation Monitoring Centre, The Group on Earth Observations Biodiversity Observation Network, and The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services to characterize the current state of biodiversity conservation and to facilitate collaborative, coordinated global action plans through mechanisms such as the Convention on Biodiversity. By synthesizing and making more accessible the scientific evidence obtained through the joint effort of many researchers and conservationists, the *Half-Earth Project Map* also provides information to help citizens hold leaders accountable for their promises and push for further action. While ambitious, the goal of Half-Earth is achievable because of our determination to succeed and the science to guide us.



A chord diagram illustrating the amount of overlap in terrestrial vertebrate species composition between South American countries, representing 8,850 species in total.

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Image credits: Charles Marsh, Dennis Liu, Piotr Naskrecki, Peter Schoen, and Lisa Tanner.

The authors would like to thank Ajay Ranipeta, Yanina Sica, John Wilshire, and Charles Marsh for their data contributions to this chapter, and Walter Jetz and Paula Ehrlich for their helpful reviews.

Puzzle image by Sergio Cerrato from Pixabay.