



PROTECTING EARTH'S IRREPLACEABLE SPECIES—THE TIME IS NOW!

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YOUNG REVIEWERS:



ANAGHA
AGE: 9



ANVITHA
AGE: 12



HUGO
AGE: 12



ITZAMNÁ
AGE: 11



SRINIKA
AGE: 12

During five previous mass extinction events, many of Earth's species died out in a relatively short period of time—like the dinosaurs did 66 million years ago. Scientists believe that Earth is currently experiencing another mass extinction, the sixth such event, but the first to be caused by human activities. This is a wake-up call: over a million species could vanish during our lifetimes! But there is hope: we can save many species by protecting their homes, especially in tropical places where many unique animals and plants live. This article will explain how some of the spots that are currently protected fail to capture all of the places where these at-risk species actually live. To complete the safety net of protection, we must focus on other important areas, called Conservation Imperatives sites, which contain many threatened species but only cover a tiny part of the Earth's surface. Saving these spots is urgent, and luckily it is not as expensive as you might think. Time is running out, and the sooner we start, the better our chances of preventing many animals and plants from disappearing forever.

EXTINCTIONS PAST AND PRESENT

What first comes to mind when you think about species going extinct? Do you immediately picture giant dinosaurs that used to roam the Earth? Or maybe you think about woolly mammoths, the large, hairy elephant relatives that lived during the last ice age? Or perhaps you picture the flightless dodo, a unique-looking bird that died off due to human actions in the late 1600s. These species are just a few well-known examples—countless animals and plants have become extinct since life first began on Earth (Figure 1A). In fact, there have been five **mass extinction** events in Earth's history. During each of these events, many species died out in a relatively short time. The last mass extinction occurred about 66 million years ago, when a large asteroid impact wiped out about 75% of Earth's species, including most of the dinosaurs (to read more about the extinction of large mammals, see [this Frontiers for Young Minds article](#)).

Unfortunately, mass extinctions are not just events in the long-ago past that you might experience through your science lessons. Many scientists believe that Earth is experiencing a sixth mass extinction right now [1]! The first extinction events can be traced to natural causes, and they happened before the earliest humans appeared. The current extinction event is unique because not only are humans around to witness it, but our actions are actually *causing* this environmental disaster. Right now, species are being lost to extinction faster than at any other time in human history. **More than 1 million species**, including mammals, birds, fish, amphibians, reptiles, and plants, will likely face extinction during your lifetime (Figure 1B).

What can we do to prevent this unprecedented extinction crisis and protect Earth's **biodiversity**? Urgent steps are needed to conserve **rare and threatened species**. While there are a number of things we can do to save species, the most important action is preserving their homes, especially by protecting the habitats where rare and threatened species live (to learn about ongoing efforts to protect a species of bird from extinction, read [this Frontiers for Young Minds article](#)).

SAVING HOMES CAN SAVE LIVES

You might be thinking, "But efforts to protect habitats are already happening! What about large wildlife reserves, national parks, and other nature sanctuaries?". You are right, lots of steps have already been taken to safeguard the homes of Earth's animals and plants. Today, 17% of the planet's land surface is already in **global protected areas**, and many countries are trying to do even more. A recent worldwide goal called **30x30** aims to protect 30% of Earth's land and water areas by 2030.

MASS EXTINCTION

A widespread and rapid decrease in Earth's biodiversity, where many species across different groups suddenly die out due to catastrophic environmental changes or human activities.

BIODIVERSITY

The variety and variability of life on Earth, including the diversity within species, between species, and of ecosystems.

RARE AND THREATENED SPECIES

Species with small or declining populations at risk of extinction due to habitat loss, environmental changes, or other factors that threaten their survival.

GLOBAL PROTECTED AREAS

Specific regions designated to conserve nature, preserve biodiversity, and protect ecosystems from harmful human activities, ensuring the survival of wildlife and natural habitats.

Figure 1

(A) Hundreds of millions of species have become extinct since life began on Earth. Dinosaurs became extinct 66 million years ago. Woolly mammoths ceased to exist about 10,000 years ago, at the end of the last Ice Age. Dodos became extinct relatively recently—in the late 1600s (this comic does not imply that these animals actually communicated with each other).

(B) Here, you can see just a few examples of the more than one million species that are likely to face extinction in your lifetime, if we do not act quickly to protect them (image credits: Polynesia imperial pigeon—RyanStudies Birds, CC BY-SA 4.0; Roti Island snake-necked turtle—H. Nell, CC BY-SA 3.0; Jamaican ground iguana—Rob Bulmahn, CC BY-SA 2.0; Marvelous spatuletail—Thibaud Aronson, CC BY-SA 4.0; Marquesan kingfisher, eBird).



Although it might look like we are saving a lot of critical habitats, there is a problem—some of our efforts so far might not be protecting the “right” areas. Between 2018 and 2023, about 1.2 million km² were added as global protected areas, but research indicates that only 9.1% of these additions contain land where rare and threatened species actually live [2]! Instead, some protected areas might contain species that are less threatened, or the areas might be chosen because they are easier to manage or because there is strong support from the local government, for example. But it does not matter how much land we protect if the homes of the rarest, most threatened species are not *in* those areas.

What is going wrong? How do we know which areas really need protection and which of those crucial areas to focus on first, so that we can save as many rare and threatened species as quickly as possible? These are some of the questions we wanted to answer in our research.

PROTECTING THE MOST AT-RISK AREAS

To figure out the most critical areas to protect first, we used powerful computers and mathematical techniques to combine detailed maps showing where rare and threatened species live with other maps showing the current global protected areas. Many of these species are **endemic**—a very important word to have in your biological vocabulary! It means species are limited to a small area; that is, they are found nowhere else on Earth (sometimes endemic species have always been rare, like some frog species that have lived all their lives on a mountaintop in Haiti; other endemic species once lived in wider areas but were made rare by human activities such as the clearing of their habitats. This happened to the spectacular kagu—a near-flightless bird inhabiting the rainforests of New Caledonia). By creating these maps and placing them on top of each other using a computer program, we could see the areas where rare, threatened endemic species live that are still not protected [3]. We call these areas **Conservation Imperatives sites** because it is imperative (extremely necessary) that we conserve (protect) them. Although we found a lot of these sites (16,825, to be specific), protecting them might not be as big a job as you might imagine. That is because the total area of the Conservation Imperatives sites we identified only adds up to 1.2% of Earth's land surface—that is a tiny number! Remember, the 30x30 goal aims to conserve 30% of the Earth's surface by 2030, so in comparison, our number is much less and therefore much more achievable.

Our study also uncovered some more good news. Most of the Conservation Imperatives sites are found in the same region of the world, which makes protecting them much easier. 89% of the unprotected sites occur in the tropical belt—warm regions near the equator (Figure 2). Although species in other areas also need our protection, warm, tropical places with high biodiversity often contain species that are rarer and more easily threatened by extinction. The top 5 countries with the highest number of Conservation Imperatives sites are the Philippines, Brazil, Indonesia, Madagascar, and Colombia. The even better news is that we do not always have to build new protected sites from scratch. In about 40% of currently protected sites, we could save the homes (and lives) of many endangered species just by expanding their boundaries outwards by only 2.5 km (Figure 3).

Overall, our research shows that many of the species that most need to be preserved are concentrated into a really small region of the

ENDEMIC

Describes a species that is found naturally in only one geographic area, such as a mountain range, single mountain, lake, island, or river, and nowhere else in the world, often due to geographical isolation or specific habitat conditions.

CONSERVATION IMPERATIVES SITES

Currently unprotected areas that require urgent conservation efforts to preserve rare or threatened species.

Figure 2

While Conservation Imperatives sites are found all over the world, most (89%) are found in the warm, tropical areas near the equator.

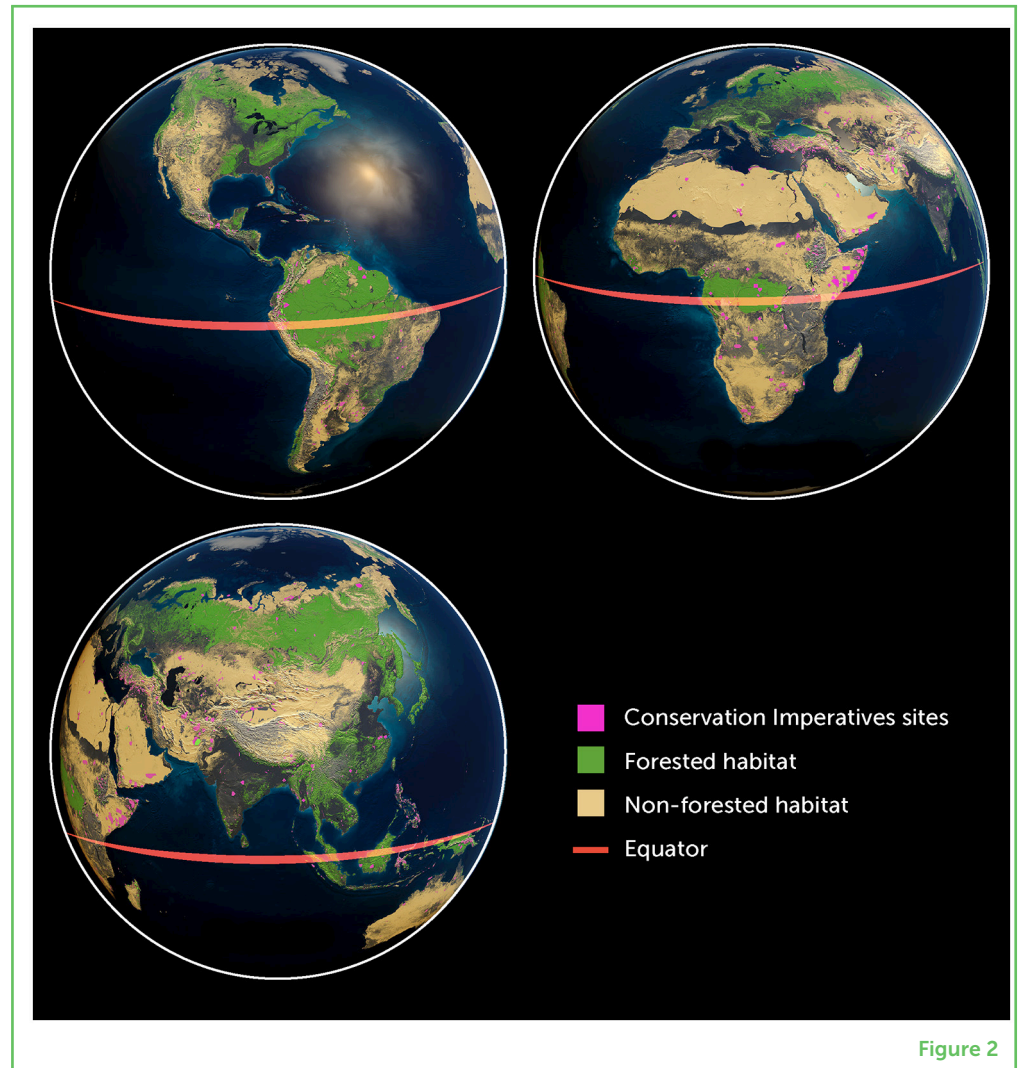


Figure 2

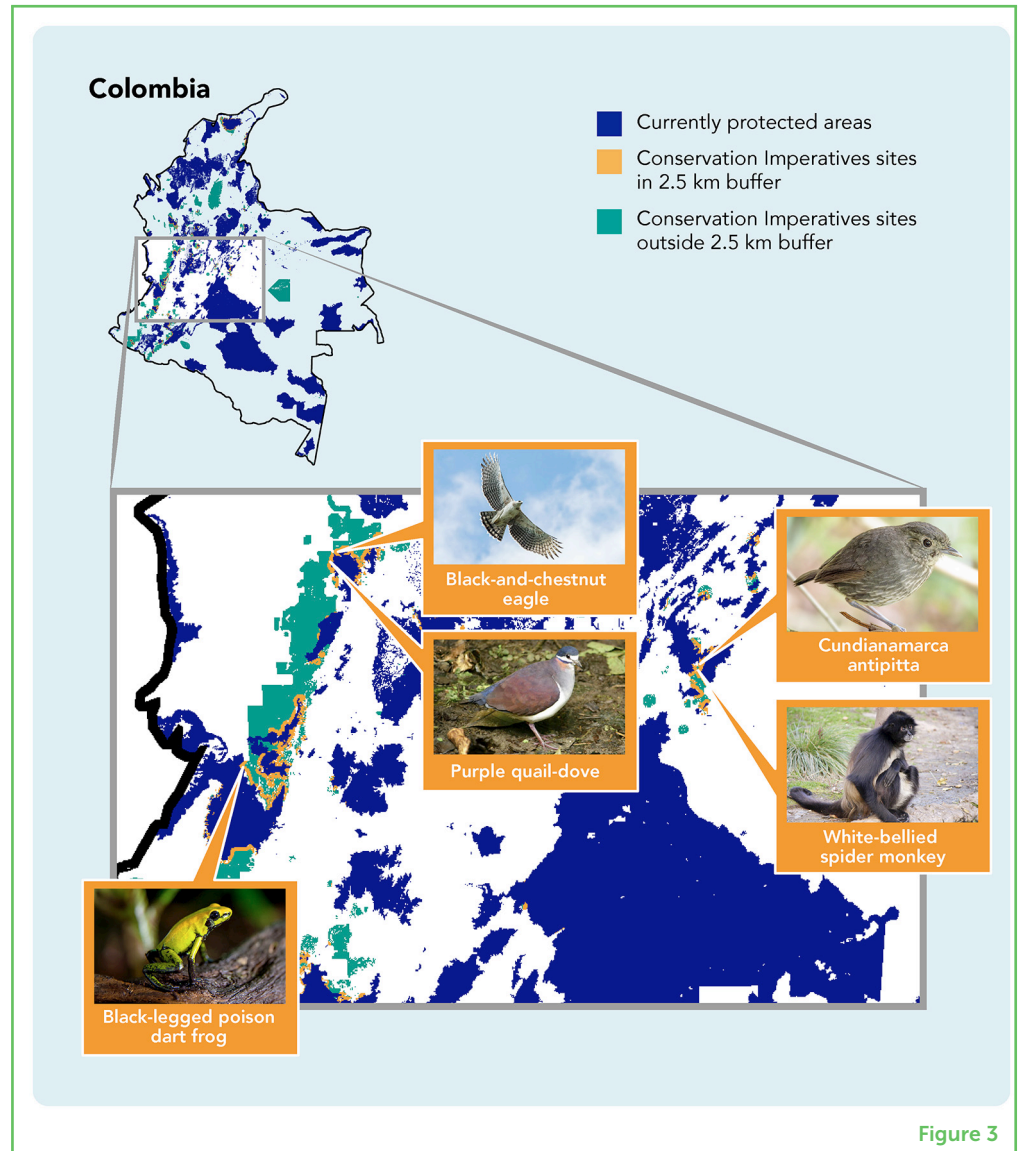
Earth, making the job of protecting them much more do-able than most people might think! This means that, if we start by focusing our habitat-protection efforts in these areas, we could save a lot of species in a fairly short span of time. This would be a huge step toward protecting the world from the worst impacts of the current extinction crisis.

THE COST OF SAVING SPECIES: MORE GOOD NEWS!

Conserving habitats is not as easy as putting up signs saying, “Protected Area—Important Species Live Here!”. Creating or expanding global protected areas costs money. Usually, the land must be bought or leased (kind of like renting) from the people, corporations, or governments that own it. People also need to be paid to look after these areas, and there might be costs involved in keeping the habitats healthy and safe for the animals who make their homes there. Obviously, the more land we need to protect, the more it will cost.

Figure 3

It is possible to protect a number of endangered or critically endangered species just by expanding some currently protected areas (blue) slightly—specifically, by adding a 2.5 km “buffer” (orange) all around those areas. While only five species are specifically pictured in this example from Colombia, this expansion strategy could save more than 350 species in these areas [image credits: Monkey: Wikipedia CC BY 2.0; Eagle: Flickr CC BY NC SA 2.0 DEED; Quail dove: flickr CC BU SA 2.0 DEED; Antipitta: ebird; Frog: iStock].



Several studies have suggested that it could cost up to US \$224 billion per year for 10 years to protect nature globally [4].

If we were to focus on protecting just the 10 most critical tropical regions identified in our study, we could safeguard 63% of the total number of Conservation Imperatives sites, and the cost of this smaller amount of land would be much lower—somewhere around US \$59.4 billion. While this might still seem like a lot of money, **people in the U.S. spend about \$136 billion per year on their pets...** do you think it is reasonable to spend less than half of that amount to save our pets' wild relatives from extinction? We certainly think so!

NOW IS THE TIME TO ACT

In summary, our research suggests that a targeted, worldwide strategy aimed at preventing extinctions is within our reach. If we focus the

conservation efforts of the 30x30 goal on protecting Conservation Imperatives sites over the next 3–5 years, we could avoid a worst-case scenario situation in which much of Earth's biodiversity is lost. But we must act quickly! If we take action right away, the costs of protecting these areas are reasonable and many species will be saved from extinction. However, if we wait 10 or 15 years, not only will land prices go up, but many plants and animals will die between now and then. When species' population numbers are lower, it takes more time, effort, and money to save them... and we may even be too late.

We hope this article has helped you to realize how urgent it is to take action *now*. Even as kids, you should not underestimate the power you have to create big changes. While kids everywhere can help, it is especially important to teach kids who live near Conservation Imperatives sites about the value of preserving nearby species. Although many human actions might not show it, most adults want to leave kids with a healthy, thriving planet—they just need to be reminded... sometimes more than once. So, take what you have learned here and speak up for your generation! Spread the word on social media, start conversations at school, and urge the adults in your life to help create a world where you—kids of the future—will also be able to enjoy Earth's amazing biodiversity.

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YOUNG REVIEWERS

ANAGHA, AGE: 9

I am Anagha. I love to read, draw, and dance. My favorite subjects ELA, Math, and Science. I would like to be a Teacher in the future.





ANVITHA, AGE: 12

My name is Anvitha and I think polar bears are awesome! I also love music; dancing to it, making it or just listening to it. I enjoy learning about what is going on in the world, so I am really happy to be a young reviewer for the journal *Frontiers in Young Minds*.



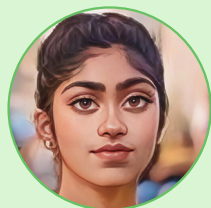
HUGO, AGE: 12

Hi! My name is Hugo, I am 12 years old, I am interested in science and for this reason I wanted to participate like a young reviewer, however, my passion is soccer and my favorite teams are America Soccer Club and Real Madrid Soccer Club, I like play football soccer and my greatest dream is to be a professional goalkeeper and architect since I enjoy to build in Minecraft.



ITZAMNÁ, AGE: 11

Hello everyone! I am Itzamná, I am an enthusiast of science because of my mom. I really love dinosaurs, medicine, and space and I want to be a space medical doctor in the future. I love video games also of all kinds but my favorite is Minecraft and Hollow night. I like soccer and my favorite team is Real Madrid, and my favorite player is Cristiano Ronaldo. I enjoy a lot to watch anime.



SRINIKA, AGE: 12

My name is Srinika, and I love trying new things. I love playing chess, drawing, and biking. I also love the outdoors. My favorite subjects are math and science. I hope, that someday in the future, I become a doctor.

AUTHORS

ERIC DINERSTEIN

Dr. Eric Dinerstein is the senior science advisor at RESOLVE, a Washington DC-based environmental non-profit organization. Since 1975, he has been deeply involved in studying rhinos and tigers, initially in Nepal's Bardia National Park and later with the Smithsonian. As chief scientist at the World Wildlife Fund for 25 years, he contributed extensively to global conservation efforts. Notably, in 1990, he pioneered the use of trail cameras in Indonesia to monitor Javan rhinos. Eric's expertise extends to designing conservation plans for iconic landscapes such as Nepal's Terai Arc and China's panda mountains. With numerous publications on biodiversity and large mammal biology, Eric is a leading voice in the field. Eric's involvement in initiatives like the Nature Needs Half Network underscores his commitment to protecting our planet's natural heritage. At RESOLVE, he leads research such as the Global Deal for Nature and Global Safety Net, to accelerate conservation and prevent extinctions. Eric is also the CEO of Nightjar, a social enterprise dedicated to developing AI conservation technology to protect wildlife and communities. *edinerstein@resolve.ngo



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Andy Lee is a senior researcher at RESOLVE. Originally from Hong Kong, he has researched coastal dolphin conservation there, large carnivore reintroductions in South Africa and snow leopards in Tibet, and he has worked on stopping illegal wildlife trade. At RESOLVE, Andy focuses on global biodiversity conservation and uses AI technology to protect endangered wildlife and habitats. In his spare time, Andy enjoys playing music, reading, and exploring natural areas.



ANUP R. JOSHI

Anup Joshi is a researcher in the department of Fisheries, Wildlife, and Conservation Biology at the University of Minnesota. He studied natural history of sloth bears in Chitwan National Park, Nepal for his Ph. D. degree. While working for National Trust for Nature Conservation in Nepal, he led a field team to capture and move one-horned rhinoceros from Chitwan National Park to Bardia National Park, which is 215 miles away, to establish a second population. His current research focuses on using satellite images on computers, to find remaining habitats where wild animals can live and reproduce safely. He likes to spend his free time reading books, watching wild animals, and hiking in natural areas.