

Creating a road map to a balanced planet

By mapping the biodiversity of our Earth, ASU is helping identify how to stem the dual crises of biodiversity loss and climate change

By Lisa Robbins, ASU News
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When Greg Asner looks out at the world from one of the countless locales he's visited through his work mapping the planet's coral reefs and coastal forests — he's been all over, from the Brazilian Amazon to the Andes Mountains, Borneo to Madagascar, and beyond — he doesn't just see the species of a region.

"My brain works on evolutionary time," says Asner, director of ASU's [Center for Global Discovery and Conservation Science](#). Even looking onto the bay outside his laboratory's window in Hawai'i, he sees past its current form beyond the reefs right under the water's surface to the history of Hawai'i's isolation and formation that helped bring about the thousands of species that live only in those reefs.

"I can kind of see it back in time and why it was unique, and I can do that anywhere on the planet," he says.

Asner combines that worldview with Earth-mapping technology. Satellite imaging and geospatial data can reveal ecosystems' details as they exist today — all the animals and plants that live in a certain place. Through Asner's on-the-ground research and engagement with local residents and the integration of Indigenous knowledge and experiences, he can explain why it's so crucial to save that land.

"That's how I, and the (Global Safety Net) team, view the planet's surface," he says.

The Global Safety Net is a blueprint for saving areas of Earth essential for biodiversity and climate resilience, and the first estimate of the total amount of land area requiring protection to address the dual crises of biodiversity loss and climate change.

Teams at the ASU [Julie Ann Wrigley Global Futures Laboratory](#) identify where, exactly, should we put our efforts to save the most species and mitigate the worst of climate change?

Why biodiversity matters

In 50 years, from 1970 to 2020, we've lost an estimated 73% of the world's wildlife populations on average, according to the 2024 World Wildlife Report. A United Nations report, co-authored by Leah Gerber, director of ASU's Center for Biodiversity Outcomes, found that Earth's biodiversity is declining at a rate unprecedented in human history.

According to the 2024 IUCN Red List of Threatened Species, there currently are more than 166,000 species on the list, with more than 46,300 of those species threatened with extinction. That biodiversity loss has huge impacts on humans.

"The more (healthy and thriving) species that naturally occur in an area, the better that ecosystem is able to absorb shocks, threats and disturbances," says Beth Polidoro, an associate professor of environmental chemistry at ASU, involved in the Center for Biodiversity Outcomes and a participant on the IUCN Red List. "We need these healthy ecosystems because they provide ecosystem services for us."

Healthy forests provide clean air; healthy soil is needed for us to grow food; healthy rivers maintain water quality.

ASU works around the globe to help protect biodiversity. Paola Sangolqui, '24 MS in biology, is dedicated to updating zoning around the Galapagos Islands — home to many species not found anywhere else on Earth.

Sangolqui is a third-year PhD candidate who works with Gerber in the Center for Biodiversity Outcomes and grew up on the islands. The Galapagos are especially vulnerable to invasive species, Sangolqui says, and protecting the area's biodiversity is important for the study of evolution and ecology and crucial to the livelihoods of the local population, 80% of which depends on nature-based tourism.

The Arizona connection

Although biodiversity may conjure images of far-off places, it is vital to Arizona and the Southwest. The Sonoran Desert, covering 100,000 square miles across Arizona, California and Mexico, is the most biodiverse desert on the planet, home to more than 2,000 plant species, over 350 bird species, 60 mammal species and up to 1,000 species of native bees.

Losing the plants whose roots protect the Colorado River could destabilize a freshwater system that supplies drinking water to 40 million people and nearly 5.5 million acres of farmland. The loss of bees means losing their pollination services for countless other species. Bulldozing wild land as urban sprawl expands can mean losing wildlife forever.

In Arizona alone, researchers from the Global Futures Laboratory have identified 66,000 square miles, or about 59% of the state's land, as critical for preserving biodiversity and ecosystems. Crucial areas also extend out west: In Utah, nearly 59,000 square miles, or 69% of the land; in Nevada, more than 95,000 square miles, or 86% of the state's land; and in California, 82,000 square miles, half of the state's land. The mountains, deserts and canyons that span these states are unique ecosystems and crucial habitats for thousands of species.

Working across departments

Even though Asner is based in Hawai'i, he was inspired to come to ASU and start the Center for Global Discovery and Conservation Science, he says, because of how the sustainability mandate through ASU President Michael Crow isn't hyperbole — it's real.

"The university is trying to play a role beyond standard academia, forging and influencing communities up to U.N.-level decision-making," he says.

ASU's conservation efforts stretch beyond that center. Its work to protect critical biodiversity areas reaches across departments, like to the School of Mathematical and Statistical Sciences, where Steffen Eikenberry is a clinical assistant professor. Eikenberry uses math to quantify environmental problems like consumption and land use.

"The climate crisis and biodiversity crisis are twin crises fundamentally driven by consumption throughout the world, primarily the rich world," he says.

But how do you quantify that, and how do you find out the most important things to change in order to solve those crises?

"If you want to say anything, you have to do the math," he says.

Cross-departmental work for an issue as big as biodiversity is important because of the unique expertise everyone brings to the table.

The importance of Indigenous knowledge

More than one-third of the lands identified as biodiversity hot spots by ASU are communally held by Indigenous peoples, and ASU's campuses across Maricopa County sit on ancestral territories, including the Akimel O'odham (Pima) and Pee Posh (Maricopa) Indian communities.

While historically institutions and researchers have gone onto Indigenous lands and dictated what to do, at ASU, Indigenous peoples are an active part of exploration of the challenge and development of the solutions from the outset.

That's especially true when it comes to biodiversity work. Indigenous peoples account for 6% of the global population, yet manage 80% of the world's remaining biodiversity.

"Indigenous peoples know they come from ancestral lands and waters, even if some migrated to different territories. They have a deep kinship and responsibility for the health of their diverse landscapes," says Melissa Nelson, professor of Indigenous sustainability in ASU's [School of Sustainability](#).

"What's Indigenous in Africa is going to be completely different from what's Indigenous in North America, Mesoamerica, Pacific Islands, the Arctic, etc. We are place-based peoples, and so our very concepts of Indigeneity are going to completely differ, and no one person can speak for any others.

“There’s finally now an interest by Western science and others about Indigenous knowledge systems, because there are memories and histories in the sciences and stories that go back thousands of years about climate change, about cataclysmic events, about how to live sustainably and self-sufficiently within your home ecosystem.”

In protecting oceans, Cliff Kapon, an analytical chemist and an assistant professor and member at the Center for Global Discovery and Conservation Science, isn’t the kind of researcher who spends all his time in the lab. He is also a professional surfer and a Hilo native of Hawai’i. Those experiences, combined with his scientific education, give him and in turn, ASU, a unique perspective on the places he’s trying to protect.

Understanding the ocean depths

Mapping coral reefs has become easier and more comprehensive, thanks to researchers like Asner and fellow Global Futures Senior Scientist Robin Martin, a biochemist and remote-sensing expert, both of whom are also faculty with ASU’s School of Ocean Futures, one of five schools within the [College of Global Futures](#).

The pair are working with a global collaborative that includes the Anthropocene Institute, Planet Labs and Vulcan, Inc. to create and maintain the Allen Coral Atlas, among the most detailed maps of coral reefs ever devised. It uses a unique suite of advanced technologies including new ultrahigh-resolution satellites calibrated using ASU’s custom-mounted lab on board a Dornier 228 turboprop aircraft, dubbed the [Global Airborne Observatory](#), and artificial intelligence on the ground. But the research is not academic.

Nancy Knowlton, former Sant Chair for Marine Science at the Smithsonian Institution, describes the Allen Coral Atlas’ mapping techniques as able to “really transform our ability to understand what’s happening (to coral reefs) essentially in real time over the entire globe, and nothing like that’s been possible before.”

The Center for Global Discovery and Conservation Science is able to use the data from the atlas to work with local groups to operate coral “nurseries” in the ocean such as the ‘?ko’ako’a Reef Restoration Program on Hawai’i Island and anticipates leveraging the observatory to see if corals grown in the nurseries and seeded on damaged reefs are growing successfully. The Global Futures Laboratory also has a coral nursery operated by Liza Roger that is set up within the Walton Center for Planetary Health on the ASU Tempe campus.

It’s a direction Crow is happy to see. He describes the traditional academic approach as “rigid, siloed thinking” while ASU has created instead a culture that’s “about the understanding and the solution, not about the protection of the discipline.”

It is this exact approach that has been central to the establishment of the [School of Ocean Futures](#), founded under its current Director Susanne Neuer, with active laboratories in the Pacific and Atlantic oceans. ASU faculty and researchers in the Atlantic Ocean are also applying decades of discovery practice and conservation efforts at the ASU [Bermuda Institute of Ocean Sciences](#), originally founded in 1903 and merged with ASU in 2021. ASU BIOS is the home of the Research Vessel Atlantic Explorer, a U.S. flagged ocean class vessel in the U.S. Academic Research Fleet, as well as long-term research projects like the Bermuda Atlantic Time-series Study that has

conducted monthly collections of physical, biological and chemical properties of the Atlantic since 1988.

Having a research station with the legacy and robust facilities that ASU BIOS provides at the point of one of the world's northernmost coral reefs and at the western mouth of the Sargasso Sea, one of the world's most diverse open-ocean ecosystems, allows researchers and students from ASU, as well as other institutions from around the world, access to singular insights and perspectives.

"Interdisciplinary science has long been the spirit and centerpiece of the research programs at ASU BIOS," says Craig Carlson, ASU BIOS' newly named president and CEO.

"Analogous to the dynamic interactive environment of being at sea on a research vessel, ASU's School of Ocean Futures and BIOS's collaborative teams embrace real-time adaptive strategies to tackle critical challenges in marine science. An approach that leads to discoveries and solutions."

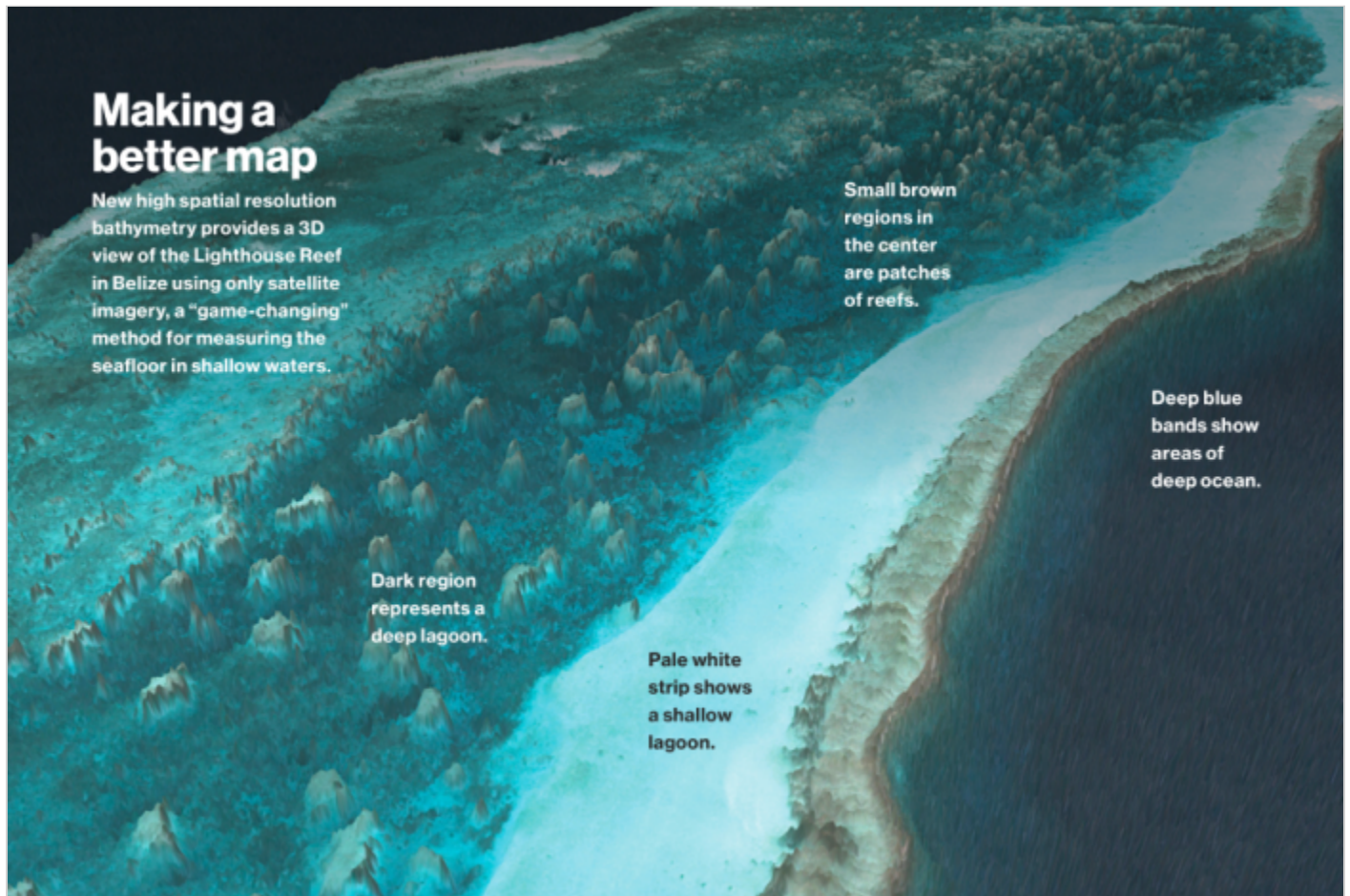
This story originally appeared on [ASU News](#).

Main image



The country of Micronesia comprises more than 600 islands spread across the western Pacific Ocean. Upper left inset: The Allen Coral Atlas maps can show changes among the world's massive reefs at a level of detail of just a few square meters. Photo credits: Greg Asner and Allen Coral Atlas

Text image(s)



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Oceans by the numbers

1 billion

People report sea life as an
important source of protein

\$375 billion

Contributed by reefs annually to the
global economy in the form of food,
coastal protection and tourism

\$1 million

The annual economic value of
some reefs per square kilometer

SOURCES:
THE NATIONAL INSTITUTES OF
HEALTH, UN ENVIRONMENT
PROGRAMME, THE NATURE
CONSERVANCY

No caption



Global Futures scientists and scholars collect a diverse array of data from an African savanna in Botswana. Photo by Dave White/ASU



The 'ʻŌkoʻakoʻa coral reef nursery is the largest of its kind. Photo by Maiana Villegas