

An underwater photograph of a kelp forest. The water is a deep blue-green. In the foreground, there is a dense school of small, silvery fish swimming towards the right. Above them, several larger, dark-colored fish are visible. The background is filled with tall, yellowish-brown kelp stalks and their broad, leafy blades. The lighting is natural, coming from above, creating a sense of depth and tranquility.

REVIVE & RESTORE'S 2022

ANNUAL REPORT

Reflecting on Growth – Planning for Progress

revive & restore

GENETIC RESCUE OF ENDANGERED
AND EXTINCT SPECIES

When we started this organization 10 years ago, we gave it a name that we would need to live up to: "Revive & Restore". Our goal— to use insight from genomic technologies to “revive” endangered species and to one day even bring back extinct species, and to help “restore” them to the wild. We have always aimed to move beyond individual species to work at the ecosystem level of restoration.

We're pleased to say now, 10 years later, that we have over 50 different projects using genomics to better manage endangered species along with two programs focused at the ecosystem level, working with coral reefs and with the kelp ecosystem.

And we're just getting started.

The urgency of the extinction crisis demands transformative solutions. Revive & Restore is the leading conservation organization using biotechnology to save species and their ecosystems. [We hope you'll continue on this journey with us in 2023 by making your gift today.](#)

Together, we can build the tools we need to solve conservation's most difficult challenges. Thank you for all that you do to help move conservation forward.



Ryan Phelan and Stewart Brand
Co-Founders, Revive & Restore

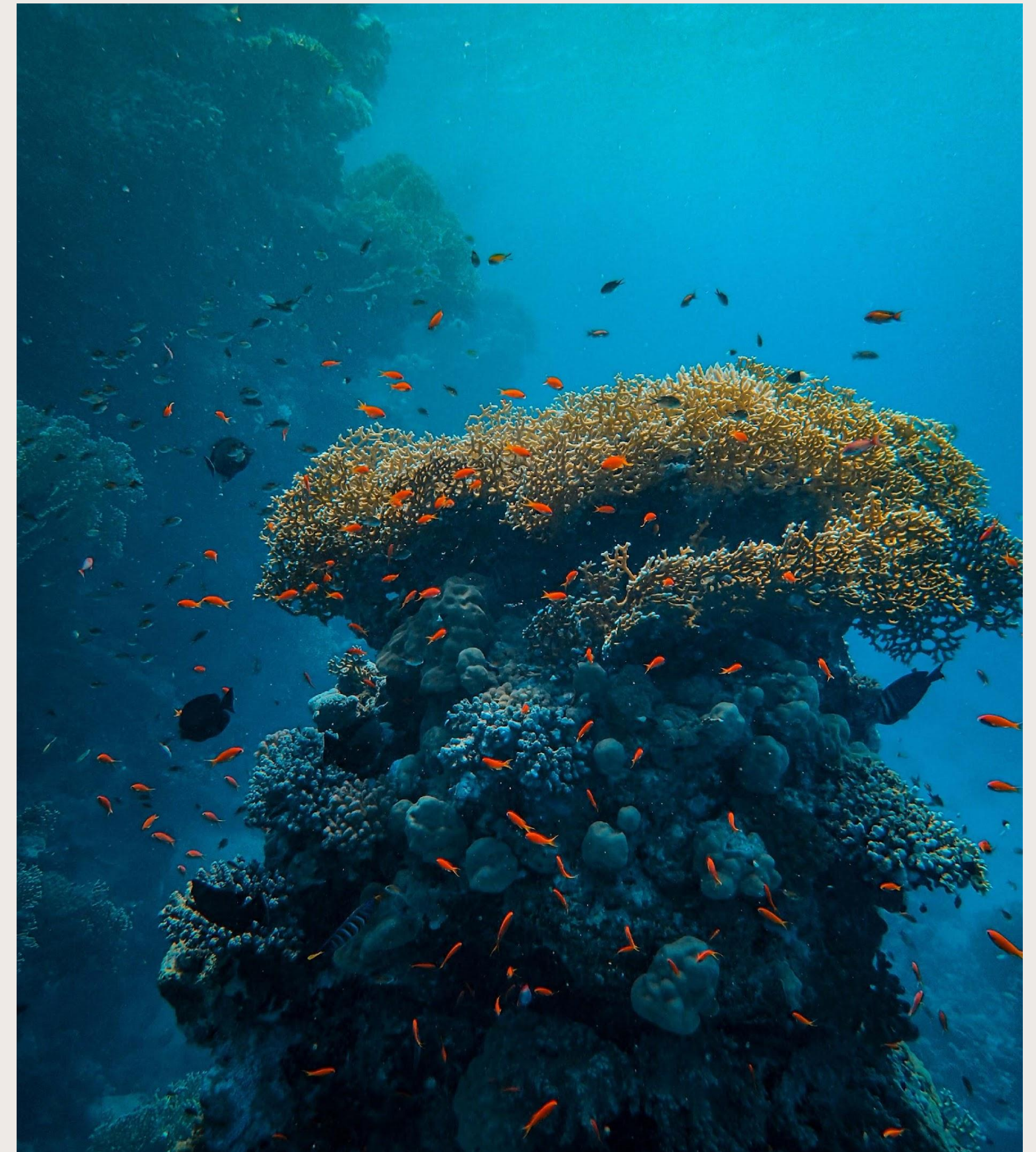


Ryan Phelan and Stewart Brand
Petaluma, CA
Photo: Christopher Michel

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A coral reef in the Red Sea. In 2022, we greatly expanded our Advanced Coral Toolkit, which enables genetic technologies for reef recovery. Photo: Unsplash



An endangered black-footed ferret (*Mustela nigripes*). In 2022, we were awarded a grant from the USFWS for research on genetic interventions for sylvatic plague. This is the first USFWS grant to leverage synthetic biology techniques for potential use in an endangered species. Photo: Stewart Brand

WHAT WE'VE ACHIEVED SO FAR

OUR IMPACT BY THE NUMBERS

50+ SPECIES ARE THE FOCUS OF OUR GENETIC RESCUE TOOLKIT

40+ HIGH-IMPACT RESEARCH PROJECTS FUNDED

15+ REFERENCE GENOMES CREATED FOR SPECIES

5+ MAJOR RESEARCH PROGRAMS LAUNCHED

\$8+ MILLION DOLLARS AWARDED TO CONSERVATION PROJECTS

WHY THIS WORK MATTERS

Genetic rescue has the power to improve conservation outcomes, both now and in the future.

The Revive & Restore mission is to enhance biodiversity through the genetic rescue of endangered and extinct species.

To do this, we take on three distinct roles:

- **CONNECT** - We connect a global network of science, conservation, and genetic technology experts. Together, we establish priorities and opportunities for biotechnology to make a difference in wildlife conservation.
- **ADVANCE** - We identify conservation challenges where biotechnology can bring innovative solutions. By working with research partners, we co-create new tools for conservation.
- **FUND** - We fund transformative, early-stage bioscience research and proof-of-concept projects that can be applied to high-value, high-impact wildlife conservation challenges.

WHAT WE DO

CONNECT | ADVANCE | FUND



Partnerships are the key to our success. Photo features working group participants at the Genomics Solutions Workshop (pre-COVID days).

THOUGHTS FROM A NEW DONOR

“In a world filled with challenges,
I’m inspired by organizations that bring hope,
optimism and solutions.
And that’s you — Revive & Restore.

Learning how to leverage biotechnology for
conservation is a crucial capability for
humanity to survive and thrive. I’m grateful
that you’re helping lead the way.”

CHRISTOPHER MICHEL

Recent Donor to Revive & Restore

(Artist-in-residence, National Academy of Sciences)



BIOTECHNOLOGY FOR BIRD CONSERVATION

ADVANCING REPRODUCTIVE TECHNOLOGIES



In 2022, we launched the Biotechnology for Bird Conservation program, to advance genetic technologies for bird conservation, starting with model species like the zebra finch (*Taeniopygia guttata*). Photo: Shutterstock

The reproductive biology of birds makes it difficult to apply key technologies used for genetic rescue in mammals such as *in vitro* fertilization and cloning. To overcome this challenge, we launched the Biotechnology for Bird Conservation Program.

Impact Highlights this Year:

- We raised over **\$5 million** for the Biotechnology for Bird Conservation program.
- We launched this program with a call for proposals to develop reproductive and gene-editing methods tailored to enable new tools suited for the unique biology and conservation demands of birds.
- As a result, we selected **8 proposals** led by scientists in the U.S., Germany, Korea, and Japan, building new tools for diverse birds ranging from cockatiels to peacocks. Research is now underway.

BIOTECHNOLOGY FOR BIRD CONSERVATION

2022 AWARDED PROJECTS

Program Track 1: Culturing Avian Germ Cells for Reproduction

Erich Jarvis

*Rockefeller University
USA*

Michael Liers

*Universität Giessen
Germany*

Yoshiaki Nakamura

*Hiroshima University
Japan*

Program Track 2: Avian Stem Cells for Reproduction

Guojun Sheng

*Kumamoto University
Japan*

Qilong Ying

*University of Southern California
USA*

Program Track 3: In Vivo Gene Editing

Jae Yong Han

*Seoul National University
Korea*

Program Track 4: Sterile Surrogates for Reproduction of Donor Cell Lines

Kichoon Lee

*Ohio State University
USA*

Rusty Lansford

*University of Southern California
USA*



Japanese Quail
(Coturnix Japonica)

“HUMANITY’S LOVE OF BIRDS INSPIRED THE MODERN CONSERVATION MOVEMENT. OVER A CENTURY LATER, MANY BIRDS FACE THREATS ONLY BIOTECH CAN SOLVE – WE’RE DEVELOPING TOOLS THAT CAN CHANGE THE FUTURE FOR BIRDS.”

BEN NOVAK

*Lead Scientist and and Program Manager for
Biotechnology for Bird Conservation, Revive & Restore*



WILD GENOMES PROGRAM

EXPANDING ACCESS TO BIOTECH



A species of harlequin toad. In 2022, we launched a new Wild Genomes initiative, targeting amphibian species. Photo: Shutterstock

Wild Genomes accelerates the adoption of genomic sequencing for applied wildlife conservation. Through our portfolio of projects, we provide state-of-the-art genomic tools to the people who need them most: field scientists, wildlife managers, and citizens working to protect their local biodiversity.

Impact Highlights this Year:

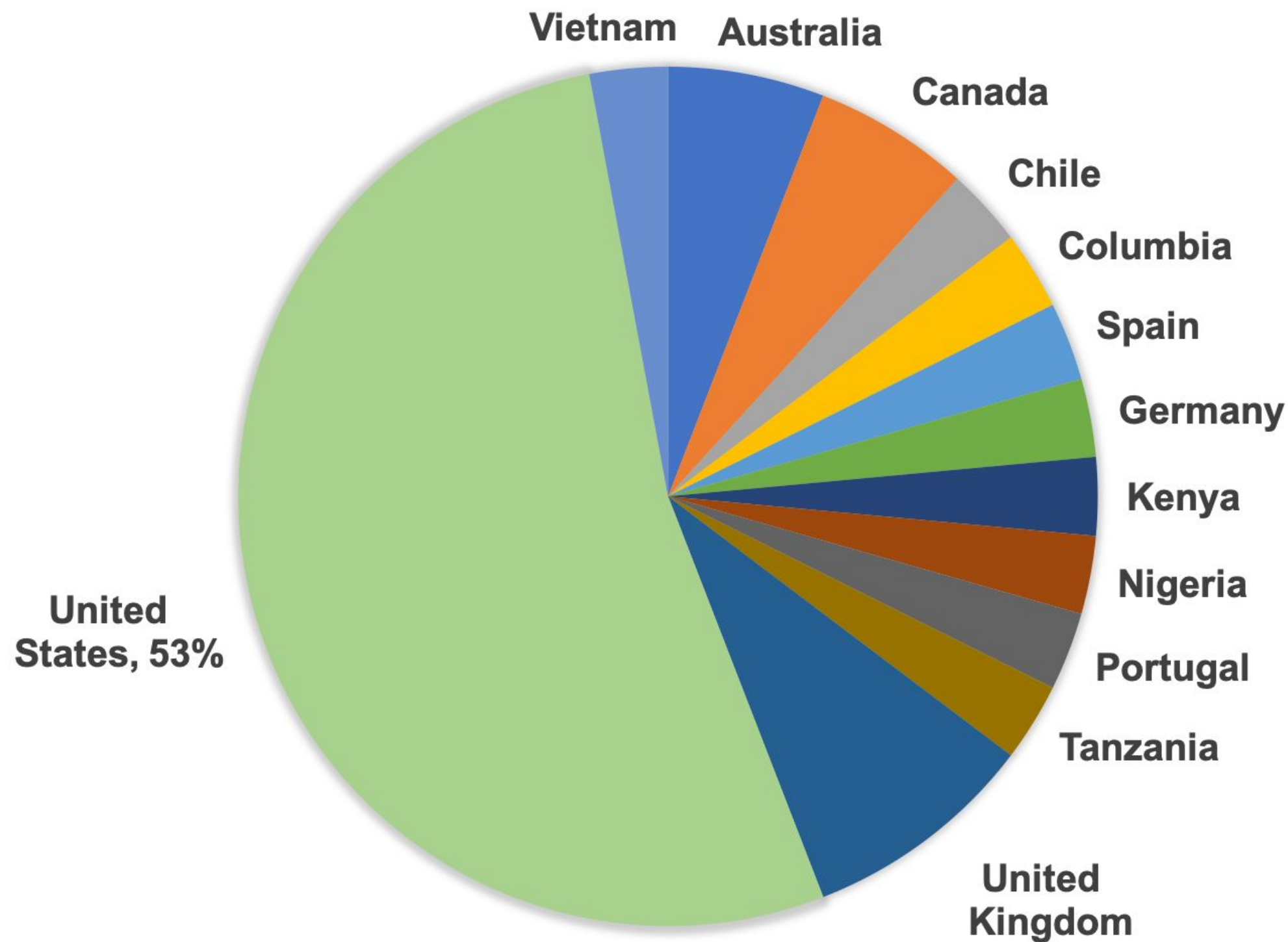
- We developed a new partnership with the Morris Animal Foundation. This led to **two new Wild Genomes initiatives**: one for kelp ecosystems and one for amphibians.
- We received **38 applications** to our Wild Genomes Amphibians program, from applicants spanning **13 countries**.
- We opened our call for proposals for the Kelp Ecosystems topic in **October 2022**. We will begin selecting applicants in 2023.

WILD GENOMES AMPHIBIANS 2022

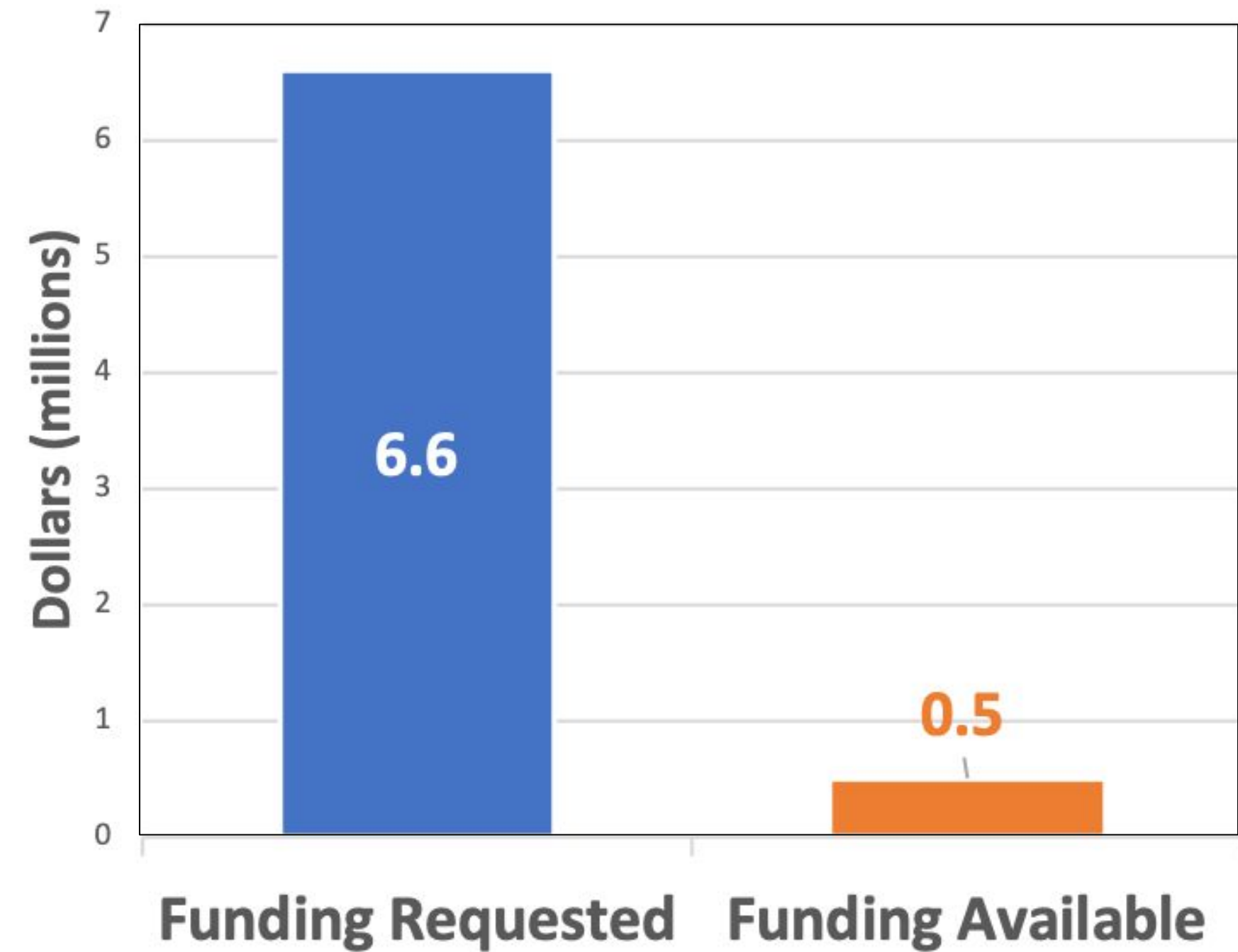
DEMAND OUTPACES OUR FUNDING ABILITY

We received proposals from a wide range of countries, achieving broad international reach. However, we are limited by our ability to fund only a fraction of these amphibian genomics projects. **More funding is needed to support these important projects for critically endangered amphibian species.**

WILD GENOMES AMPHIBIANS PROPOSAL ORIGINS



Wild Genomes Amphibian Funding Gap



[Donate online today!](#)

“GENOMICS OFFER INSIGHT THAT CAN HELP WILDLIFE MANAGERS MAKE MORE INFORMED DECISIONS. THE WILD GENOMES PROGRAM PROVIDES GENOMIC TOOLS FOR PEOPLE WORKING TO PROTECT THEIR LOCAL BIODIVERSITY.”

BRIDGET BAUMGARTNER

Director of Research & Development and Program Manager for Wild Genomes, Revive & Restore



INFORMED BIOBANKING

PROTECTING GENETIC DIVERSITY



Our goal is to lower the barriers to biobanking at every step of the process, from sample collection, to cell line processing, genomic sequencing, and cryopreservation. Photo: Male Pronghorn, USFWS

In partnership with the US Fish & Wildlife Service (USFWS), Revive & Restore is forging a path to enable the genetic rescue of US endangered species. Our goal with Informed Biobanking is to cryopreserve samples from all US endangered species, making biobanking standard practice in conservation.

Impact Highlights this Year:

- We laid the groundwork for a **biobanking pilot program** with the USFWS. The pilot will biobank and sequence genomes from 10 endangered species in the US Southwest.
- We developed a **biobanking pipeline** for cell culturing with the San Diego Zoo Wildlife Alliance and ViaGen.
- We compiled **standard protocols** for tissue collection, starting with mammal species.

**“INFORMED BIOBANKING
REPRESENTS THE FUTURE IN
EFFECTIVE MANAGEMENT AND
RESTORATION OF SPECIES FACING
THE THREAT OF EXTINCTION.”**

PETE MIRAGLIA

Deputy Director, Revive & Restore





“BIOBANKING GIVES US THE CHANCE TO SAVE IRREPLACEABLE GENETIC DIVERSITY. IF DONE RIGHT, IT CREATES A MARKER-IN-TIME AND GIVES FUTURE RECOVERY BIOLOGISTS OPTIONS, LIKE GENETIC RESCUE, THAT ARE ONLY POSSIBLE IF WE ACT NOW!”

SETH WILLEY

*Deputy Assistant Regional Director, Ecological Services
US Fish & Wildlife Service*

BLACK-FOOTED FERRET RESCUE

GENETIC INTERVENTION IN DISEASE



An endangered black-footed ferret (*Mustela nigripes*). In 2022, we were awarded a Recovery Challenge grant from the USFWS for foundational research on genetic interventions for sylvatic plague. Photo: USFWS

Since 2013, Revive & Restore has been working to develop solutions to the threats challenging the future of the endangered black-footed ferret: low genetic diversity and sylvatic plague. In 2022, with funding from the US Fish & Wildlife Service and Morris Animal Foundation, we've launched two cutting-edge projects to address both threats.

Impact Highlights this Year:

- We were awarded a Recovery Challenge grant from the USFWS, for foundational research on genetic interventions for sylvatic plague. **This is the first USFWS grant to leverage synthetic biology techniques for potential use in an endangered species.**
- Our collaborator, Dr. Kamila Mustafina at Massachusetts Institute of Technology, is pursuing a synthetic biology approach to creating **genetic vaccines** against sylvatic plague that can be inherited through the germline.
- We've scoped a project to develop a **gene editing technique** that would enable lost genetic diversity to be added back to the black-footed ferret gene pool, in collaboration with Dr. Jef Boeke at New York University.

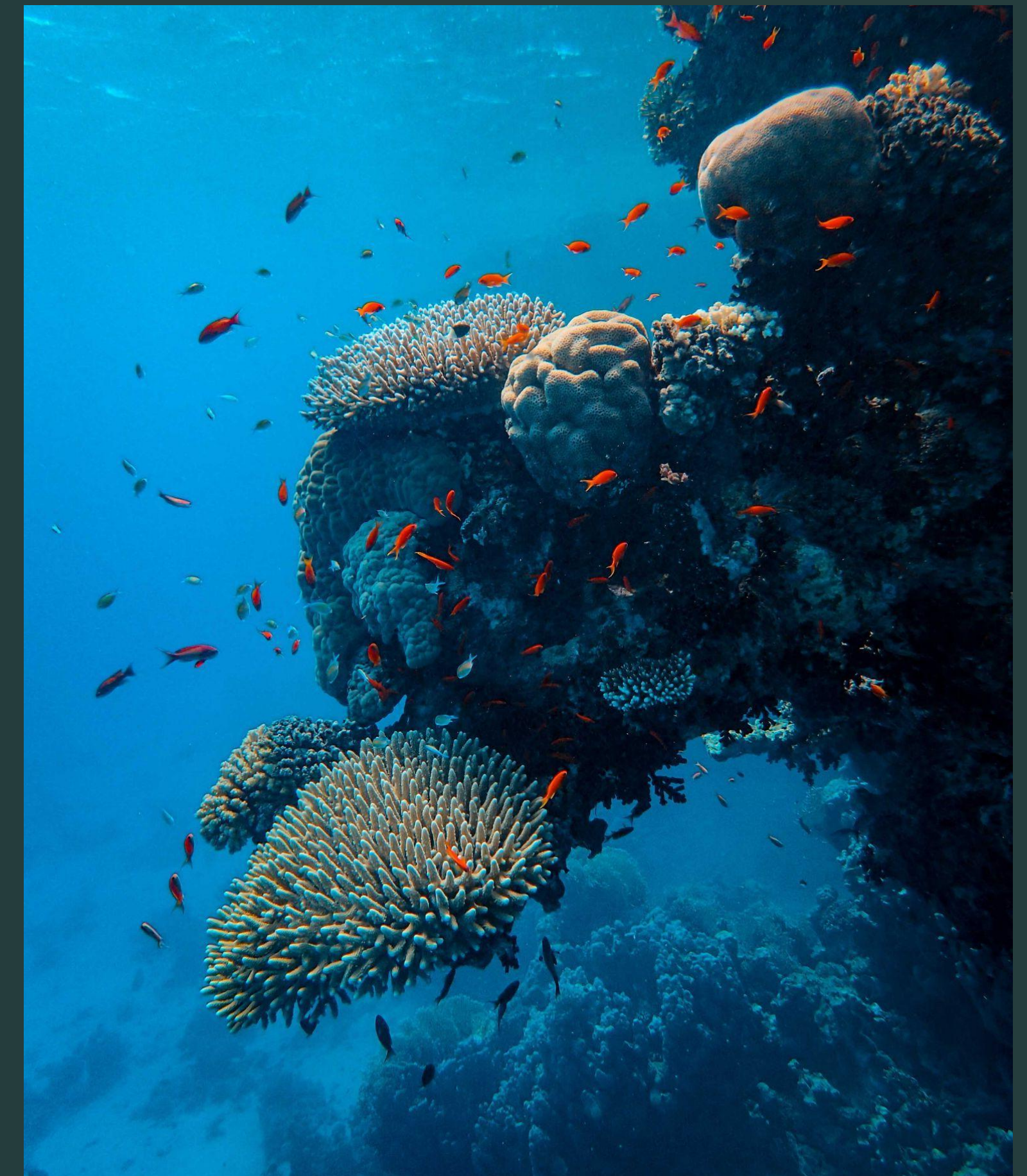
Coral reefs are some of the most diverse ecosystems on our planet, but over 50% of the world's corals have already been lost with as much as 90% loss projected by 2050. The Advanced Coral Toolkit supports the development and fielding of new biotechnologies that benefit coral resilience and restoration efforts.

Impact Highlights this Year:

- Thanks to a generous grant from Oceankind in 2022, we've extended the Advanced Coral Toolkit another 3 years.
- In partnership with scientists at the Smithsonian Conservation Biology Institute and University of California - Berkeley, we've demonstrated that coral fragments can be frozen and thawed by isochoric freezing techniques, opening up the potential for large scale coral biobanks.
- We've shown that coral stem cells can be isolated from a donor coral and transplanted to a recipient coral, in partnership with scientists at the University of Miami and Ben Gurion University.
- In partnership with scientists at Rutgers University, we've developed a method for detecting metabolic signatures of coral stress for use in field surveys.

ADVANCED CORAL TOOLKIT

TECHNOLOGIES FOR REEF RESTORATION



A coral reef in the Red Sea. In 2022, thanks to a generous grant from Oceankind, we've extended the Advanced Coral Toolkit another 3 years.

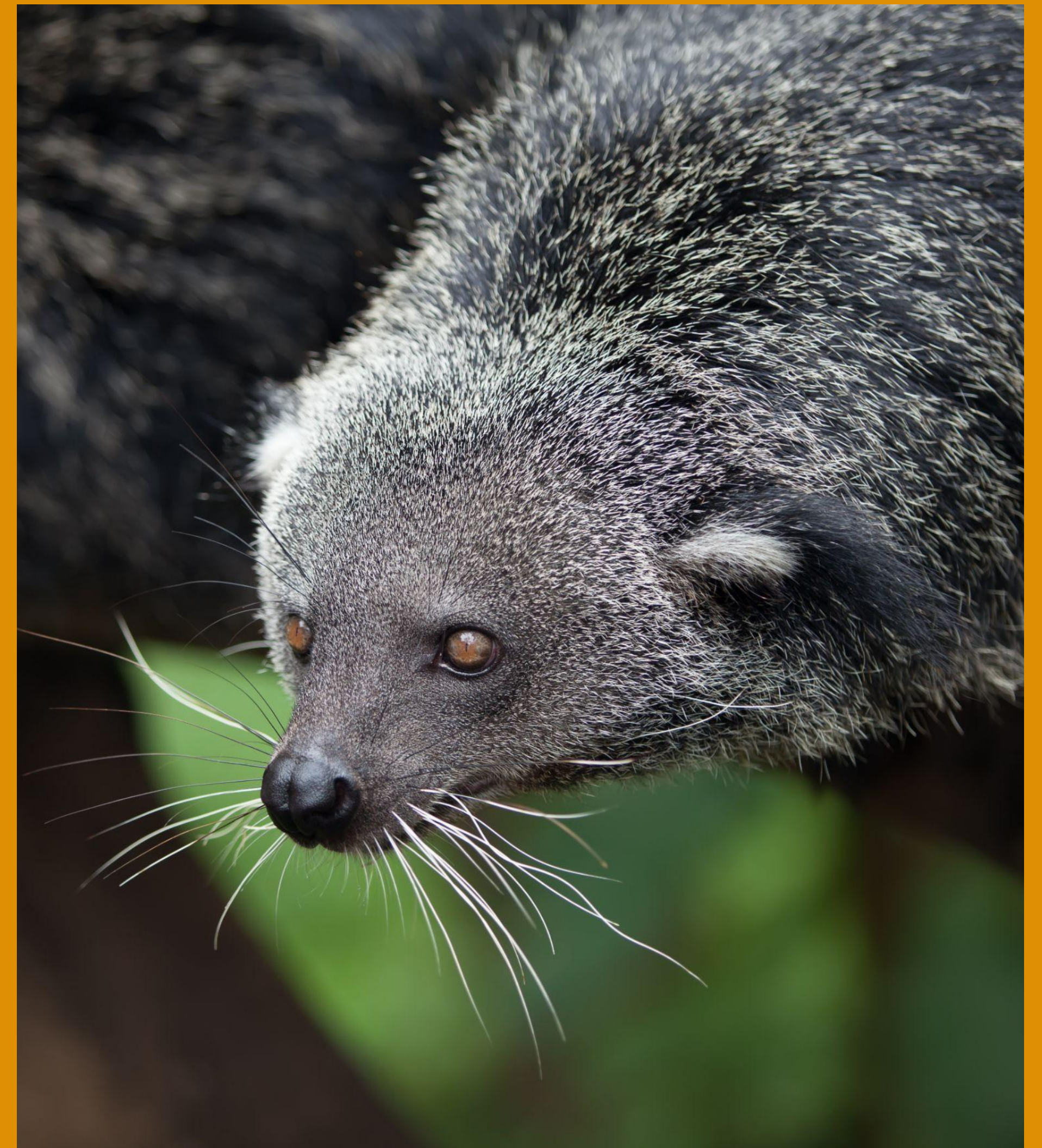
REVIVE & RESTORE RELIES ON THE GENEROSITY OF INDIVIDUALS LIKE YOU

Please consider making a tax-deductible donation today.

Donate online today!

Donate via check
Revive & Restore
1505 Bridgeway, Suite 203
Sausalito, CA 94965

**Revive & Restore is a 501(c)3 non-profit
Charity Navigator Score 100**



**Despite protected status, binturongs are routinely involved in the illegal wildlife trade. Through Wild Genomes, we funded the creation of genetic markers to help return rescued binturongs to their original home.
Photo: Freepik**

THANK YOU

for helping us
turn the tide on species loss

