



Conservation and Science

2023



SMITHSONIAN'S NATIONAL ZOO
& CONSERVATION BIOLOGY INSTITUTE



“The Smithsonian’s National Zoo and Conservation Biology Institute is on the cutting edge of conservation rooted in research and innovation. Our focus is to foster life on a sustainable planet for the conservation of species and ecosystems.”

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Cover photo and inside front cover photos by Kate Person

— Dr. Peter Leimgruber,
Director of Conservation and Science



Conservation lives and breathes *here.*

As a global leader in animal care and conservation of wildlife, the world looks to us—for knowledge, for partnership, for inspiration and hope.

We're not just a zoo. We're the Nation's Zoo, propelled by the Conservation Biology Institute, headquartered at our 3,200-acre campus in Front Royal, Virginia. And as part of the Smithsonian, we're a trusted resource for the world. Communities and partners in more than 47 countries work with us to help wildlife on the brink, and protect and rebuild habitats and landscapes on a changing planet. The scientists of the future come to us to learn and grow, preparing to carry on the tough work of conservation—work that spans generations. The visiting public and students in classrooms across the country are inspired to curiosity and stewardship for the natural world around them by in-person and virtual experiences that last a lifetime.

The heart of our mission is to help build a more sustainable future for people, for wildlife and for nature.

This report offers a snapshot of that mission in action over the last year. Our work includes continuing to help restore species like the scimitar-horned oryx in Chad; pioneering techniques to help corals adapt to warming seas; collaborating with Indigenous communities in Montana to preserve grasslands and their rich biodiversity; and working with more than a dozen South American cocoa farms to promote bird-friendly practices.

I am grateful for our staff's dedication and expertise, and their ability to bring our mission to life. I hope you, too, are inspired to learn more about our work and its incredible impact.

Thank you for your support.

Dr. Brandie Smith
John & Adrienne Mars Director
Smithsonian's National Zoo and
Conservation Biology Institute



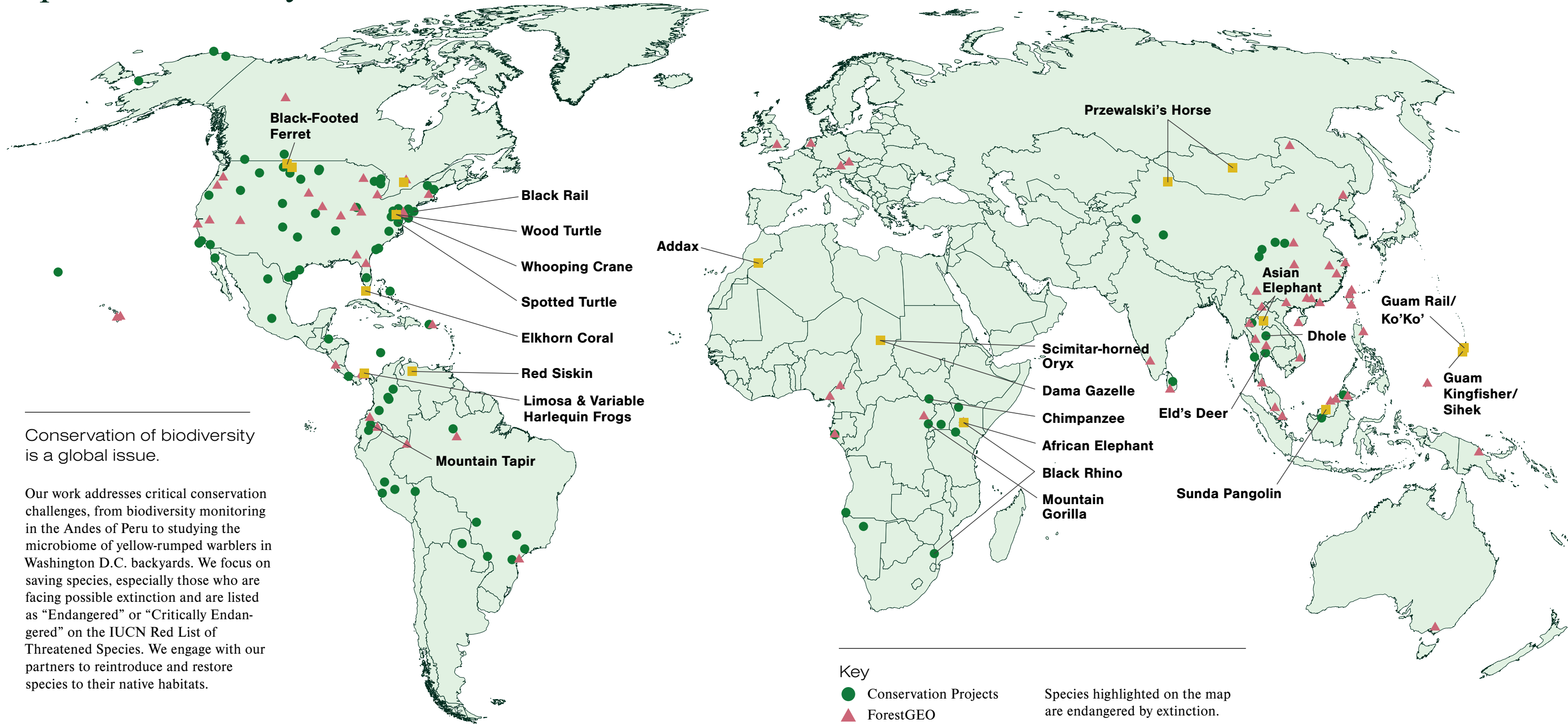


Mission

At the Smithsonian's National Zoo and Conservation Biology Institute, we save species. We provide engaging experiences with animals and create and share knowledge to save wildlife and habitats.

Around the world, our scientists are working with local partners to save species and ecosystems.

47 Countries
200+ Study Sites
131+ Vertebrate Species



Conservation of biodiversity is a global issue.

Our work addresses critical conservation challenges, from biodiversity monitoring in the Andes of Peru to studying the microbiome of yellow-rumped warblers in Washington D.C. backyards. We focus on saving species, especially those who are facing possible extinction and are listed as “Endangered” or “Critically Endangered” on the IUCN Red List of Threatened Species. We engage with our partners to reintroduce and restore species to their native habitats.

Key

- Conservation Projects
- ▲ ForestGEO
- Species Reintroduction

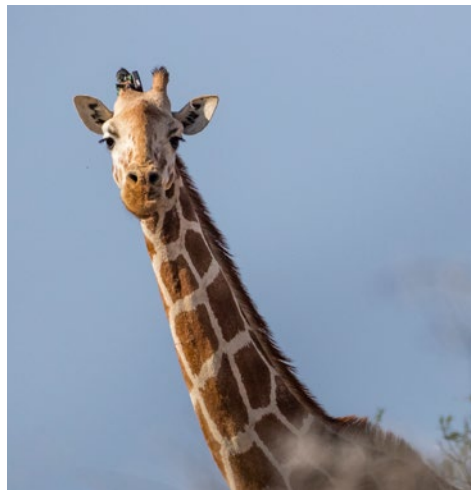
Species highlighted on the map are endangered by extinction.

Conserving Wildlife and Habitats

188

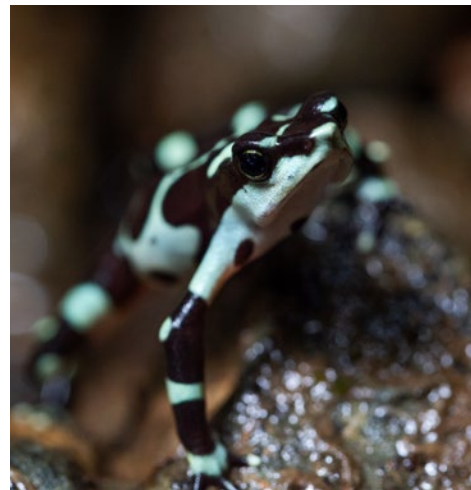
Peer-reviewed publications in 2023

Around the World:



Tracking Giraffes Across Africa

Giraffe populations have been in sharp decline across Africa, and baseline data about giraffe movements can help to inform conservation and restoration activities. We partner with the Giraffe Conservation Foundation and have launched the largest study of giraffe movements to date, with over 300 giraffes tagged across 12 African countries. Since satellite collars do not work on their long necks, we use solar-powered horn or tail units that record locations and transmit the data via satellite.



Panama Amphibian Rescue and Conservation Project

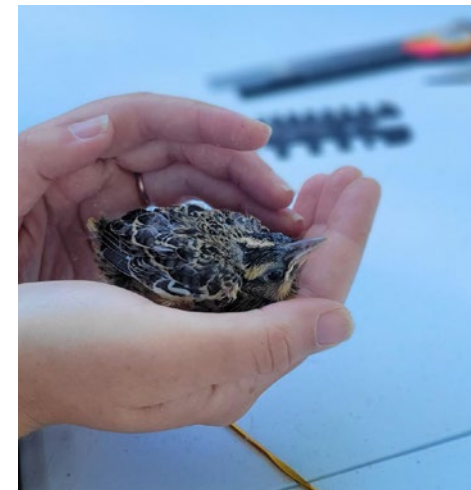
Amphibians are at risk of extinction from the chytrid fungus that has caused the disappearance of over 90 species worldwide. In 2009, the Smithsonian established an amphibian conservation and research facility in Panama, which is now home to one of the largest captive breeding colonies of endangered amphibians. We are developing tools such as probiotics, selective breeding, genetic rescue and vaccines to mitigate the fungus, to reestablish populations of these frogs in the wild.



Giant Panda Conservation

Giant pandas are a great example of how National Zoo and Conservation Biology Institute (NVCBI) scientists integrate our animal care and conservation efforts. Over the course of the 52-year program, having pandas at the Zoo has allowed us to greatly improve assisted reproductive techniques that enhance breeding success. In the wild, our ecologists have been working closely with partners in China to establish large-scale mammal, vegetation and climate surveys to inform strategies for restoring habitat and connecting protected areas.

In Our Backyard:



Project Fledgling

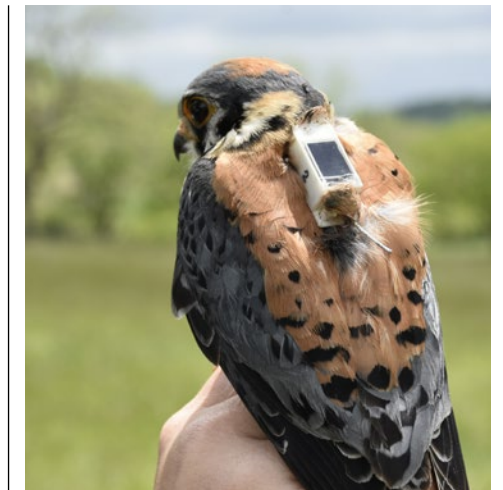
Our Virginia Working Landscapes program promotes conservation of native biodiversity and sustainable land management through research, education and community engagement. Project Fledgling is an innovative study using tracking technology to identify crucial habitats for vulnerable fledgling birds. This study will provide essential data to develop management practices for reversing grassland bird decline.

Learn more about Virginia Working Landscapes:



Wood Turtle Conservation

Wood turtle distribution in Virginia decreased by 30 to 40% over the last 50 years, and little is known about the location of their last strongholds. NVCBI scientists are using novel technology to detect DNA shed by turtles in streams and ponds, allowing us to identify turtle presence that cannot be recorded by other techniques. This efficient and economical survey technology will significantly advance the conservation of wood turtles and other species.



Piedmont Kestrel Project

Hands-on conservation training provides inspiration and knowledge to future conservation leaders from around the world. At the Smithsonian-Mason School of Conservation (SMSC) we facilitate research opportunities such as the Piedmont Kestrel Project, focused on behavioral and movement ecology of American Kestrels. The project uses small solar GPS tracking backpacks and video monitoring inside nest boxes to explore their habitat and inform management to stop the long-term decline of this grassland raptor.

Gateway to Conservation

Being a zoo is a huge asset to our work in conservation and science. With over 2,100 animals representing nearly 400 species, we connect our visitors to nature. Our world-renowned science and conservation work, highlighted at the Zoo and in our education programs, provides exciting stories that inspire people to care about conservation and take action. Our staff are experts at working with our animals to advance critical science for the conservation of species and their ecosystems.



Understanding Mammal Milk

The Milk Repository at the Zoo is the largest collection of exotic animal milk in the world and is a world-class scientific resource for learning about the nutritional and evolutionary aspects of milk. For example, recent data collected on the nutrient composition of milk from rhinos and related species are critical for developing new formulas and for improving hand-rearing of young animals at risk.



Black-Footed Ferret Conservation

NZCBI has been a leader in black-footed ferret conservation since helping to bring this species back from the brink of extinction in the 1980s. In 2023, 57 black-footed ferrets were born at our breeding facility to support ongoing recovery efforts, including the reintroduction of ferrets across their native range. Partnering with the U.S. Fish and Wildlife Service and other organizations, we achieved a major landmark this year when a cloned black-footed ferret kit was born at NZCBI. The application of this technology to endangered species addresses specific genetic diversity and disease concerns associated black-footed ferrets.



Inspiring Conservation Careers

Our Learning and Visitor Education team engages students and public audiences with exciting NZCBI science stories to convey important concepts in biological, environmental and life sciences. These stimulating on-site and virtual programs for Pre-K-12 students include videos featuring scientists in STEM careers and encourage hands-on exploration of scientific concepts for young learners, students and general visitors.



Watch a recent video

Our Zoo is a gateway to conservation, allowing our scientists and animal care experts to address critical conservation challenges while inspiring our visitors to care about nature.

New Bird House Celebrates Birds' Annual Migrations

In March 2023, we unveiled our new Bird House, inviting visitors to explore the fascinating world of migratory songbirds, waterfowl and shorebirds. Bilingual panels – in English and Spanish – tell the story of how migratory birds connect communities and contribute to healthy ecosystems across the Americas. The Bird House also provides a new platform for education programs that feature conservation research on coastal food webs.



Learning and Visitor Education at the Bird House

The new Bird House provides a platform for our Learning and Visitor Education team to create migratory bird-themed STEM activities for students in grades K-5. We also train science staff and interns in techniques for engaging the public in conservation and science. STEM activities include science career videos, virtual bird banding programs for schools and hands-on activities in the Bird Observatory.



Coastal Food Webs: Healthy Food for Migrating Shorebirds

In a new walk-through aviary featuring shorebirds from Delaware Bay, visitors learn about migration and critical food species for shorebirds, including horseshoe crabs, fish and native invertebrates. The exhibit is closely linked to ongoing field research in Cape May, New Jersey, focused on developing new and innovative techniques for assessing the health of horseshoe crabs in the wild.

From the smallest details of elephant DNA to multi-country habitat assessments, elephant conservation requires dedication, cutting-edge technology and strong partnerships.

Asian elephants demonstrate our capacity to take a more holistic approach to saving species. While elephants living at our Zoo provide an up-close experience and inspire visitors to care about this endangered species, our reproductive biologists work to advance their reproduction under human care, and our ecologists strive to ensure the species' survival in the wild.

Elephant Genome

We are mapping the elephant genome to understand the distinct genetic makeup of individual animals. By learning more about how much of elephant health can be attributed to genetics versus the environment, we are better able to inform decisions to manage elephant populations in the future.

Conservation Physiology

We have pioneered non-invasive techniques for monitoring stress, reproductive and nutritional hormones in elephants both at the Zoo and in the wild. In Thailand and Laos, our Endocrinology Research Laboratory has used these techniques to monitor how tourist activities affect captive elephant health and welfare.

Studying Diseases

Elephant Endotheliotropic Herpesvirus (EEHV) can cause significant illness in both captive and wild populations. Our National Elephant Herpesvirus Laboratory is a resource of herpesvirus information, testing and research for the global elephant community.

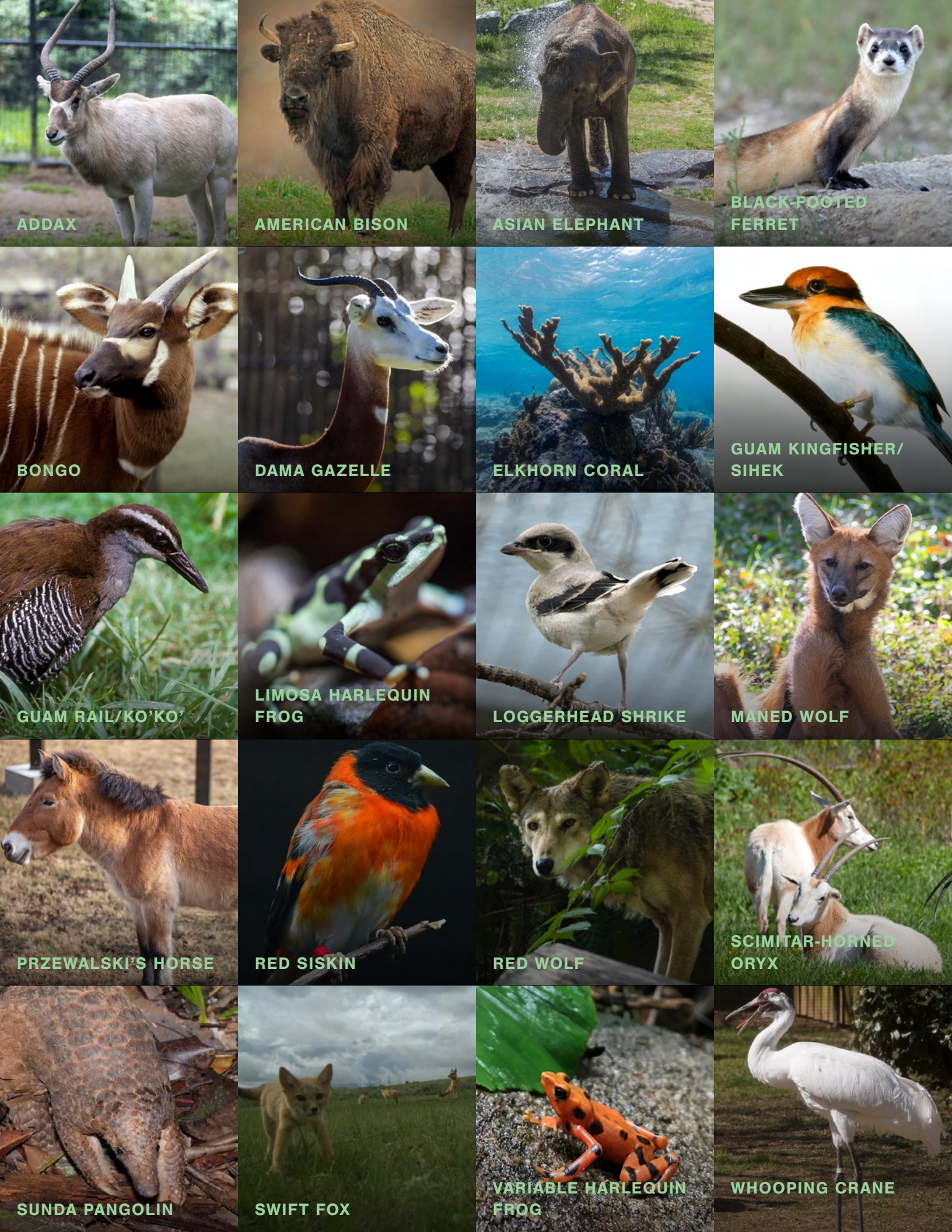
Tracking Wild Elephants

We integrate field surveys with satellite mapping to assess what type of habitat is still available to elephants across their range. By combining these habitat suitability analyses with elephant movement data, we can inform future conservation planning and reduce human-elephant conflict.

Rewilding Captive Elephants

Elephants that previously worked alongside humans in timber or tourism industries have the potential to help reverse extinction in the wild and restore native populations. In Laos, we work with the Elephant Conservation Center to monitor former work elephants via satellite GPS collars as they are reintroduced to the wild.





WILDLIFE REINTRODUCTIONS

Watch a video on the Limosus Harlequin Frog Release



Bringing species back to their historic ranges is a vital step towards restoring healthy ecosystems.

In many parts of the world, species have been lost from their original habitats. Through our holistic conservation approach, we work closely with partners to ensure reintroductions of wildlife will be safe, effective and successful.



Whooping Crane

We breed whooping cranes to support their population recovery from extinction and advance ongoing conservation efforts with the Whooping Crane Eastern Partnership. In May 2022, our animal program staff successfully hatched the first chick at our Conservation Biology Institute, where our scientists study factors impacting egg laying success in female cranes. Successful production of fertile eggs and live chicks is critical to the success of the reintroduction program.



Scimitar-horned Oryx

In December 2023 the scimitar-horned oryx was downlisted from “Extinct in the Wild” to “Endangered” by the IUCN Red List. This conservation success was made possible by the large-scale reintroduction of oryx into their historic range, led by the Environment Agency - Abu Dhabi, the government of Chad, Sahara Conservation, the Smithsonian and other partners. Our scientists provided crucial science and monitoring via satellite tracking to inform adaptive management and help build a self-sustaining population in the wild.

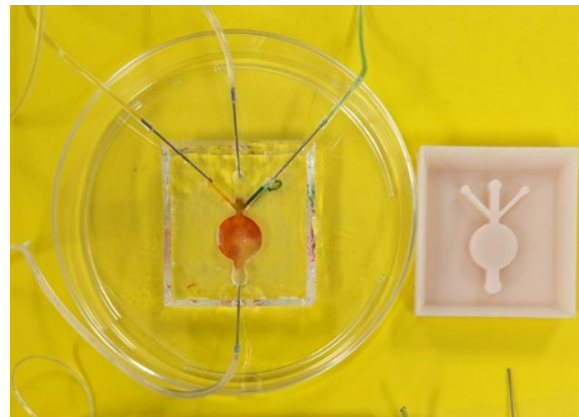


Maned Wolf

In collaboration with government agencies and NGOs in Brazil, we have been rehabilitating and reintroducing maned wolves into their native habitat. Between 2017 and 2024, eight juvenile maned wolves were rescued, rehabilitated and released back to the wild. Seven of these wolves received an implantable bilogger to monitor heart rate before and post-reintroduction. To date, live pups have been born from one of the released females. The collaboration is led by Brazil’s ICMBio/Centro Nacional de Pesquisa e Conservação de Mamíferos Carnívoros.

Conservation Innovation

Our scientists work on the cutting edge of technology to save species.



Organ on a Chip

Together with partners, our researchers have developed a prototype 'ovary-on-a-chip' device that mimics the flow of blood through the ovarian tissue. With this device we can grow eggs from cryo-preserved ovarian tissue from genetically valuable females. This technology will allow us to "rescue" the genetic potential of animals that may have died decades ago. The technique may prove critical for the recovery of very small animal populations near extinction such as rhinos and black-footed ferrets.



A Nation-Wide Survey of Mammals

Snapshot USA brings together scientists across the United States to use camera traps to conduct an annual survey of the nation's wild mammals. Since beginning this collaboration in 2019 with North Carolina's Museum of Natural Sciences, we have recorded over 660,000 detections of 131 mammal species and collaborated with over 150 institutions across all states. All data are managed and identified within the Wildlife Insights platform, a global repository of camera trap images providing world-wide metrics on mammal diversity and distributions.



Tracking Animal Movement

For more than 100 years, Smithsonian scientists and partners have tracked animals across changing land and seascapes to reveal the role that movement plays in sustaining life on Earth. This work has led to the discovery of unknown migrations, produced technological breakthroughs, and defined conservation priorities for threatened species around the world. Today, the Movement of Life Initiative is drawing upon this institutional legacy to inform and inspire conservation action through the science of animal tracking.

(Photo courtesy of Nicole Gorman, Virginia Tech University.)

Artificial Intelligence for Large Ungulate Surveys

In collaboration with UC Santa Barbara's Vision Research Lab and Microsoft AI for Good, we are advancing automated methods to find and count livestock (like cows) and large mammals (like wildebeest) from video footage collected by satellite, aircraft and drones. This will allow conservation managers to more efficiently monitor wildlife populations and tailor conservation solutions in places where domestic livestock and wild ungulates compete for grazing and food.



Genomics to Guide Conservation

We are using genomics to guide conservation planning that addresses sharp declines in native Hawaiian bird populations. By better understanding the evolutionary lineage of an invasive avian malaria strain and introduced mosquitoes, we can unravel the genetic basis of why some honeycreeper species are resistant to the disease while it is deadly for others.

(Photo courtesy of Jack Jeffrey Photography.)



Rhythm of Life

Applying human medical technology to wildlife studies is helping conservationists better understand how animals respond to stress. We are using heart rate monitors to learn about internal physiological responses to stress, which can be used along with hormone measurements and genetic analyses to improve care for animals under human care and in the wild.



Pan-Smithsonian Cryo-Initiative

NZCBI leads the Pan-Smithsonian Cryo-Initiative to preserve biological collections in a frozen state. These repositories preserve a wide range of samples from DNA and reproductive cells to tissues and blood, and allow future scientists to access biodiversity information from the past. Ultimately, many of these collections may provide blueprints for restoring biodiversity and species in the future.



Snapshot USA has recorded over **660,000 detections** of **131 mammal species** since 2019.

One Health

The health of humans, domestic and wild animals, plants and the wider environment are closely linked.



Microbiomes and Conservation

Our scientists are leading research projects on how microbiomes can inform management and conservation strategies for species in the wild and under human care. Microbiomes can influence animal or ecosystem health, as can be seen in our key projects that involve uncovering the role of the microbiome in (1) mitigating diseases such as amphibian chytrid and avian malaria, (2) nutritional health in wild and zoo populations and (3) ecosystem function, especially in modified systems such as coffee farms.



Monitoring Emerging Infectious Diseases

Emerging infectious diseases pose an increasing threat to wildlife, biodiversity, livestock and public health. We have developed “EarthRanger Health,” an online platform which connects people working in rural, biodiverse landscapes and their observations of animal health, to inform decision-making in conservation, veterinary medicine and public health. The new module is part of the existing global “EarthRanger” platform that uses real-time data to inform conservation decision-making.



Pathogen Surveillance in Northern Kenya

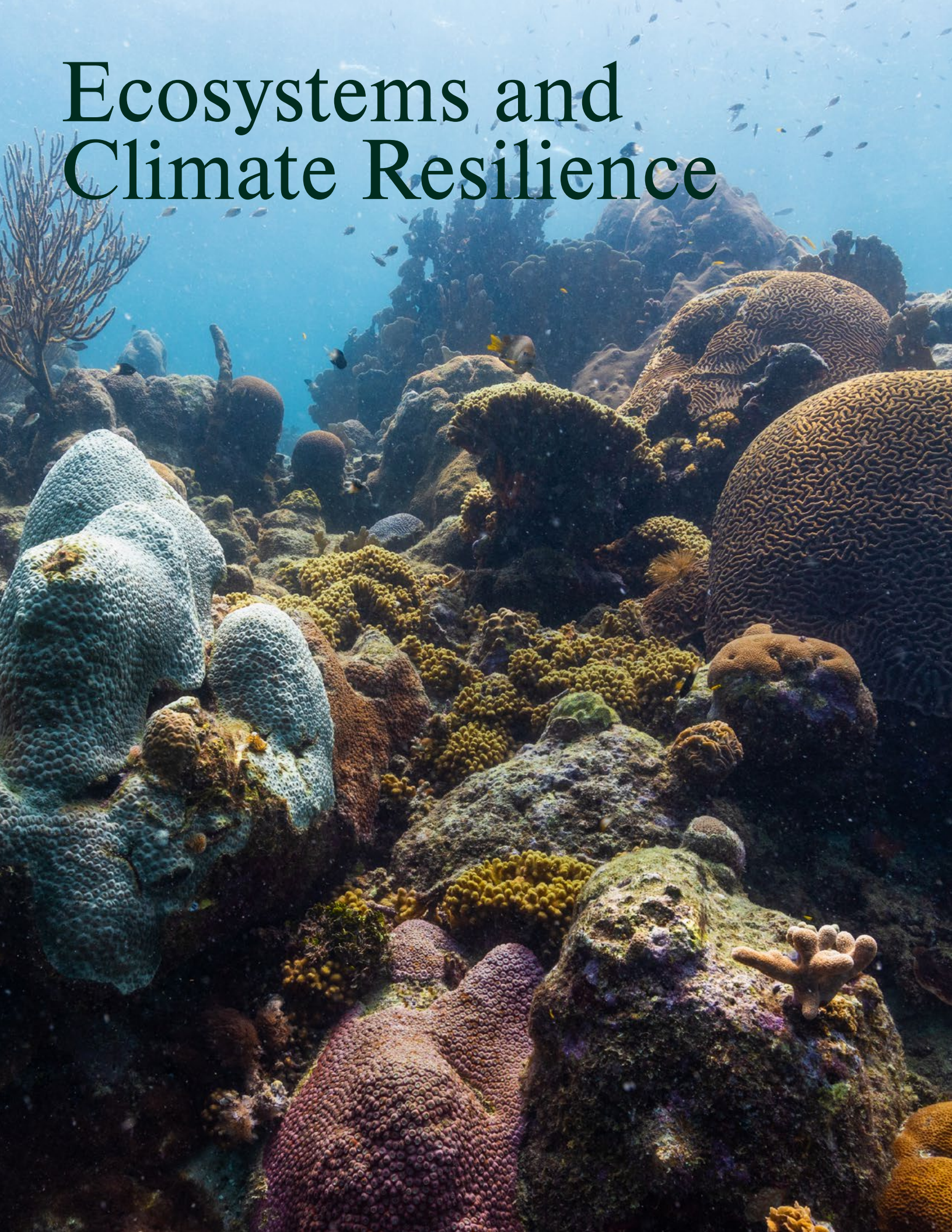
Pastoralists in Kenya live on the frontlines of emerging infectious diseases, in part because their livestock come into repeated contact with wildlife. We are leading an interdisciplinary research team that will embed within pastoralist communities in northern Kenya to study the social and ecological drivers of emerging vector-borne diseases across the region. Information gathered during the project will be used to increase the resilience of pastoralist communities to these threats and advance the Kenyan government’s capacity to prevent and respond to emerging diseases.



Ecosystems and Climate Resilience

Our conservation research helps understand and support species, ecosystem, and climate resilience.

Watch our award-winning video "Spawning Hope"



A New Understanding of Carbon Sequestration

Global climate models previously assumed that as the climate gets warmer, more carbon will be stored in forests. Using data from the Smithsonian and Harvard ForestGEO plots, we found that temperate deciduous forests are not sequestering as much carbon as expected. This highlights the importance of emissions reduction for climate change mitigation.



Helping Coral Evolve in the Face of Climate Change

NZCBI scientists are pioneering techniques that help coral species adapt to changing oceans. New technology that allows corals to be reproduced from frozen genetic material in cryo-preservation banks opens up avenues for conservationists to assist corals in adapting to ocean acidification and warming. Cryo-preserved genetic material can be used to generate new corals and to strengthen small populations by adding genetic diversity.



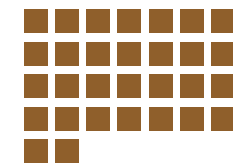
Annual Cycle Bird Ecology

Over the past two decades, NZCBI has conducted extensive research on bird populations during all periods of the annual cycle to better understand how linked populations are affected by changes throughout the year in different locations. Our complex, often multi-national studies have provided key insights about how events in one season, such as winter drought in the Caribbean, affect timing of migration, survival and reproductive success in temperate breeding areas. These discoveries empower wildlife managers to address population declines observed in many migratory bird species.



Great Plains Science Program

In the five years since starting the Great Plains Science Program:



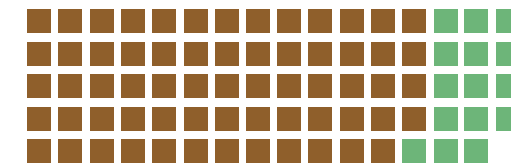
30+

Research projects initiated



17

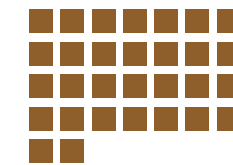
Articles published in peer-reviewed journals



65

Interns and fellows trained

Representing 15 universities and Tribal colleges and a variety of partner organizations including academic institutions, NGOs, rancher groups, federal agencies and public community groups.



30+

Collaborating organizations

Each year, over a million acres of intact prairie are converted to other land uses, resulting in significant habitat and biodiversity loss. Our Great Plains Science Program works with partners to build a sustainable future for this vulnerable grassland ecosystem.



Bison and Food Sovereignty

Our research collaborations in the Northern Great Plains region have found that widespread restoration of bison to Tribal lands can help restore the prairie ecosystem while improving the long-running issue of food insecurity and food sovereignty for Native nations. Bison restoration can also help to mitigate adverse impacts to traditional agricultural systems due to climate change.



Monitoring Impacts of Climate Change on Grasslands

We are collaborating with four Montana Tribal communities (Blackfeet, Fort Belknap, Fort Peck and Rocky Boy's Indian Reservation) to establish North America's first Inter-Tribal Grassland Network to monitor changes at an ecosystem level. The goals are to strengthen people's ties to their environment, wellbeing, heritage and identity while ensuring the long-term resilience of grassland ecosystem services and biodiversity on Tribal lands.



Restoring Swift Foxes Back to Tribal Lands

The Nakoda (Assiniboine) and Aaniiih (Gros Ventre) Tribes of Fort Belknap have successfully reintroduced swift foxes back to their historic range with the support of NZCBI scientists and other conservation partners. Swift fox populations declined dramatically starting in the late 1800s, Populations are separated geographically, preventing the exchange of genes for healthy populations. NZCBI scientists are using GPS collars, DNA analyses and camera traps to help monitor the progress of the reintroduction, and work toward breeding for more resilient swift fox populations.



Watch "The Return of Nōuhâh-Toka'na, (Swift Fox)"

Sustainable Living with Wildlife



Photo by Kate Person

Science is the backbone for nature-based solutions to transform how we live.

See Bird Friendly in action



Bird Friendly

The Smithsonian Bird Friendly program develops scientific standards for market-based conservation of birds in coffee- and cocoa-growing landscapes. Over 5,000 farms are certified in 13 countries, and Bird Friendly products are sold by 82 coffee roasters and chocolatiers in five countries. Bird Friendly® Cocoa launched in 2023 with 17 Dominican Republic farms and three craft chocolatiers selling certified cocoa and chocolate that conserves high-quality bird habitat.



Biodiversity Monitoring and Assessment for Sustainable Development in Peru

Our Biodiversity Monitoring and Assessment Program (BMAP) monitors biodiversity vital signs across Peru's tropical Andean landscapes. As part of the Smithsonian MarineGEO network, the BMAP monitors coastal marine fisheries, ocean floor organisms, plankton and breeding seabird colonies. Across 14 Andean landscapes, critical habitats such as Andean wetlands and cloud forests are monitored. In the biologically rich Madre de Dios, the BMAP supports best practices for conservation corridor functionality and sustainable development.



Supporting Birds & Farmers

The Virginia Grassland Bird Initiative draws on the expertise of partners at The Piedmont Environmental Council, American Farmland Trust and Quail Forever to assist farmers and landowners in the adoption of science-based best management practices. These approaches can help stem the decline of grassland birds while also benefiting production goals. Since its inception in 2021, we have expanded beyond the Virginia Piedmont. A robust farmer incentive program provides financial assistance to farmers that adopt bird-friendly farming practices, preserving thousands of acres of habitat during the critical grassland bird nesting periods.

Growing the Future of Conservation



Building capacity for the conservation and science needs of the future is fundamental to our mission. We collaborate with students and colleagues around the world to further the body of knowledge in the conservation community.

In 2023, our staff worked with:

112

interns who received hands-on learning experience.

73

fellows who conducted independent research with us.

52

research associates whose long-term collaborations enhance our shared work.



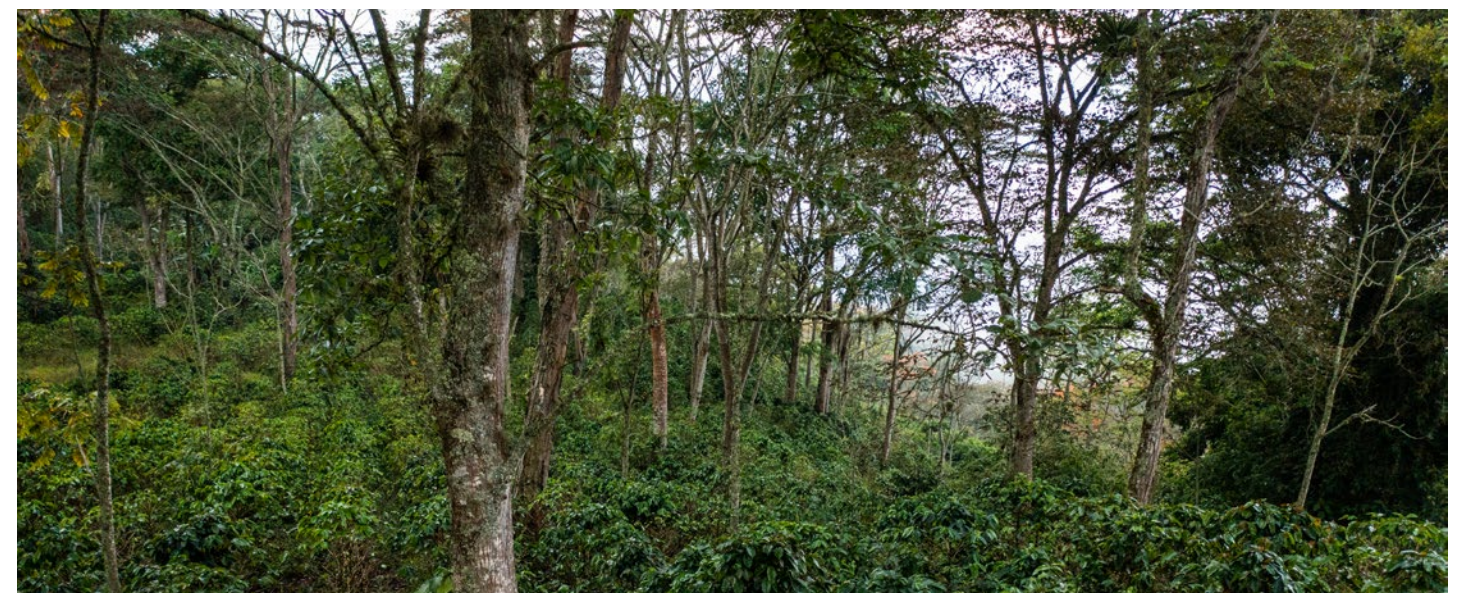
Building Capacity for Animal Care

One way we collaborate on conservation with partners in the Association of Zoos & Aquariums (AZA) is through the Saving Animals from Extinction (SAFE) program. In 2023, we led a capacity building trip to Wildlife SOS in India to work with 55 former “dancing bears” and their keepers and veterinarians on animal training techniques. The goal is for the bears to voluntarily participate in their own medical care, such as ultrasounds, oral exams, voluntary injections and body scoring. One of our education specialists worked with Wildlife SOS educators to update their programming and incorporate information about their work into AZA SAFE programming.



Supporting Local Partners in Wildlife Rescues

In Madagascar, we worked with the Turtle Survival Alliance to provide herpetological expertise after wildlife trafficking authorities confiscated over 10,000 radiated and spider tortoises. We assisted with health screenings and tagging to prepare tortoises for release back into the wild. We worked with staff at the tortoise facility to help solve husbandry and breeding issues on-site.





This collaboration between the Smithsonian and George Mason University is a unique resource at our campus in Front Royal, Virginia where undergraduates, graduates, professionals and high school students get hands-on training in conservation biology.



2023 Course Offerings: Bioinformatics Analysis for Conservation • Conservation in Practice • Conservation Management Planning • Conservation Seminar • Conservation Theory • Field Skills in Ecology • Generalized Linear and Mixed Models in Ecology and Conservation Biology • Genomics Practical Zoo Nutrition Management • GIS in R: Fundamentals and Applications for Ecologists • Human Dimensions in Conservation • Insect Biology • Integrated Conservation Strategies • Introduction to Animal Behavior • Landscape and Macrosystems Ecology • Managing Ecological Data in R • Monitoring and Assessment for Biodiversity • Primate Behavior, Ecology, and Conservation • Research in Conservation • Small Population Management • Statistics and Study Design in Ecology and Conservation

Smithsonian-Mason School of Conservation 2023 Snapshot

89

high school students and 11 undergrads in the summer program.

41

undergraduate students in the semester programs.

155

participants in Graduate and Professional Courses: 15 graduate students, 140 professionals (29 of whom came from outside North America and Europe, representing 28 countries).



Financial Report

Conservation and Science received \$8.43 million in funding from the Smithsonian to cover salaries and operational expenses. We leveraged this support to raise \$24.09 million from other sources. This funding supported the development of critical research and conservation projects. It also allowed us to share our data and tools, and to train the next generation of conservation scientists and leaders. Our research programs are highly competitive which is reflected in our success rate in securing federal grants (45%) from

the National Science Foundation (NSF), the National Institute of Health (NIH), NASA, and other government agencies and our success rate in securing non-government funding (83%).



2023 Financials

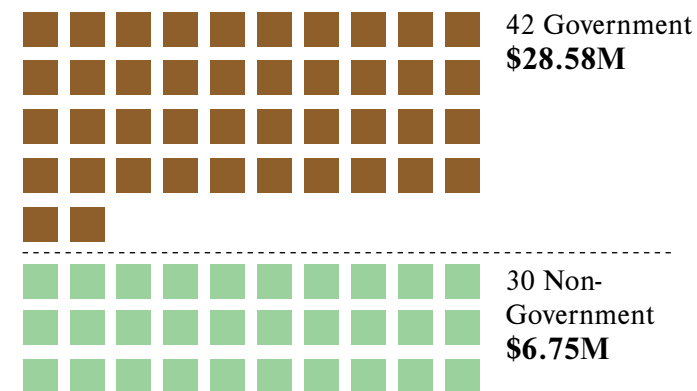
INCOME

Smithsonian Institution	\$ 8,534,799
Internal Grants	\$ 1,291,242
External Grants & Contracts	\$ 15,532,208
Giving	\$ 6,636,399
Other Income (e.g., royalties, honoraria, revenue)	\$ 624,322

Total:	\$ 32,618,970
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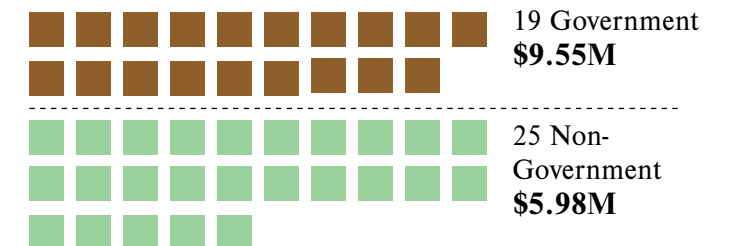
2023 Proposals Submitted

72 Proposals for
\$35.33M



Awards Received

44 Awards for
\$15.53M



*Excludes the Smithsonian Astrophysical Observatory, which is tracked separately for grant funding through the SI Office of Sponsored Projects

A photograph of a sunset over a wetland. The sky is filled with colorful clouds in shades of orange, yellow, and purple. A single tree stands in the middle ground, its reflection clearly visible in the calm water in the foreground. The overall scene is peaceful and scenic.

THANK YOU

We are grateful for the support of our generous donors, funders, partners and communities—you are essential to our work.



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