

Smithsonian National Zoological Park Conservation Biology Institute

CONSERVATION ECOLOGY CENTER ANNUAL REPORT 2018-2019

GAZELLE GRAZING IN LAIKIPIA COUNTY, KENYA.

Photo by Ramiro Crego

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A LEOPARD GAZES OVER THE MASAI MARA, KENYA.

Photo by Jared Stabach

MESSAGE FROM THE CENTER HEAD

Peter Leimgruber

Nature is declining at unprecedented rates with at least 1 million species threatened with extinction. The major causes for these declines are increased land use conversion, wildlife trade, and climate change. Transformative solutions are needed to stop and reverse this biodiversity loss.

At the Conservation Ecology Center (CEC) we build the science for transformative change. Our scientists study endangered species and ecosystems, and develop tools and strategies for their conservation and restoration. We analyze the drivers behind these declines, study how species and ecosystems interact, and assess how global changes affect species survival. We develop new tools for monitoring species abundance and distribution, and for measuring ecosystem services. Using our tools and data, we create conservation scenarios so that decision-makers can identify the best actions to implement.

I am proud to report that the last 2 years were highly successful. Our staff expanded from 8 to 25 full-time scientists. We added new programs focusing on landscape-level conservation. Our movement ecologists have successfully collared and tracked wildlife species across the world to better conserve them (e.g., giraffe, oryx, elephant, wolves, turtles). Our quantitative ecologists released a new software for analyzing tracking data that, for the first time ever, allows wildlife managers to accurately calculate a species home range or the area needed to ensure its survival. Our oryx reintroduction program now includes 169 free-roaming animals, returned to the wild after being extinct for over 30 years. And finally, we trained over 60 interns from 10 countries. These are just a few examples of the tremendous work my colleagues at CEC have achieved.

This report provides an overview and presents some highlights of our work during 2018 and 2019; a glimpse of the advanced technology and conservation initiatives that we bring to bear to solve the current global crisis. Our work is only possible through the contributions made by our colleagues, partners, students and interns, and by our generous supporters, specially the Smithsonian Institution. We are profoundly grateful for your support and look forward to expanding our reach and impact in 2020.

MITIGATING HUMAN-ELEPHANT CONFLICT

CEC researchers work closely with Myanmar locals to mitigate human-elephant conflict.

Photo by Christie Sampson





OUR MISSION

We use basic and applied science to conserve species and ecosystems worldwide.

Scientists at the Smithsonian Conservation Biology Institute's (SCBI) Conservation Ecology Center (CEC) develop new and advanced analytical tools to study and model how ecosystems and species interact with their environment and how these systems respond to global changes. Using these new tools and models, CEC scientists create conservation scenarios so that practitioners and decision makers can identify the best possible strategies for preserving ecosystem health and biodiversity. American Prairie Reserve Wildlife Restoration Mammals in Urban to Wild Landscapes

Blue Ridge Forest Studies

DC Wildlife

Deer Impacts in Suburban Developments

Wood Turtle Conservation

Spotted Turtle Conservation

Changing Landscape Initiative

Scimitar-horned Oryx Reintroduction

> Chimpanzee Nutritional Ecology

Mountain Gorilla Nutritional Ecology

Yucatán Box Turtle Conservation

Pantanal Conservation Network 🎺

Capybara & Brazilian Spotted Fever Project

Jaguar Tracking and Ecology

Mapping Araucaria Forests

CEC Projects ForestGEO Research Plots

CONSERVATION IN ACTION WORKING GLOBALLY TO SAVE SPECIES & ECOSYSTEMS

CEC partners with global, regional, and local research networks to address critical conservation challenges such as maintaining ecosystem function, conserving biodiversity, and mitigating climate change. We achieve this by partnering with over 130 conservation leaders around the world. Though SCBI is stationed in the Blue Ridge Mountains of Virginia, CEC scientists are leading wildlife and conservation research projects spanning 38 countries.

Przewalski's Horse Reintroduction Mapping Giant Panda Corridors

Restoring Giant Panda Landscapes

Wildlife Interactions Around Giant Panda Reserves

Climate Change Impacts on Giant Pandas

Returning Giant
Pandas to the Wild

Asian Elephant Behavior in Logging Camps

Smithsonian Myanmar Biodiversity Initiative 🄶

> Mammals in Urban to Wild Landscapes

Tanintharyi Working Landscapes

Arabian Oryx Reintroduction

Smithsonian Primate Research Station

Human-Elephant Conflict & Asian Elephant Ecology

> Rewilding Working Elephants in Myanmar

> > Tracking Elephants to Manage

Human-Elephant

Conflict

Giraffe Conservation Program Saving the Greater

Mara Ecosystem

African Elephant Orphan Behavior

WHERE WE WORK



SPECIES CONSERVATION HOW OUR SCIENTISTS SAVE SPECIES







147 SCIMITAR-

HORNED ORYX RELEASED

TURTLES

Turtles are an ancient lineage dating back more than 200 million years. They also are among the most endangered group of vertebrates in the world—more than half of species are threatened with extinction. Yet, we know very little about most endangered turtles and even less about how to protect them from habitat loss and unsustainable use for food and the pet trade. CEC scientists work with local NGOs and national agencies to understand the fundamental ecology of poorly known species and develop conservation strategies at local and global scales.

PRZEWALSKI'S HORSE

For over a decade, CEC scientists have supported ongoing Przewalski's horse reintroduction and restoration efforts in China and Mongolia. We are monitoring horses using satellite tracking collars, mapping habitat and environmental data via remote sensing, and monitoring wildlife through camera trapping. Our goal is to improve understanding of their ecology and habitat requirements, and to analyze dynamics and drivers of their movements. We assess interactions of horses and other wildlife species around shared resources in order to improve management strategies for the conservation of wild horses and other wildlife sharing the ecosystem.







SCIMITAR-Horned Oryx

Once abundant across most of North Africa, scimitar-horned oryx are currently considered extinct in the wild due to a combination of widespread overhunting, habitat loss, excessive livestock grazing, and persistent drought. CEC scientists and collaborators are working with the government of Chad and the international zoo community to return oryx to the Ouadi Rimé-Ouadi Achim Game Reserve, a former stronghold of this species and one of the largest terrestrial protected areas in the world. Released oryx are equipped with tracking collars that provide data on their movements, habitat requirements, and survival. Since 2016, this reintroduction effort has established a population of 169 surviving oryx, after over 30 years of being extinct in the wild.

GIANT PANDA

The giant panda is an icon of global conservation and while many studies have projected that future and imminent climate change will pose a large threat for their long-term survival, high uncertainty still exists due to methodological limitations. To address these limitations, CEC scientists launched a new project to evaluate the impacts of climate change on giant panda habitat by conducting novel in-situ experiments. Data from this initiative is providing critical information needed to plan for their conservation under a rapidly changing climate.

GIRAFFE

Giraffe, one of the most charismatic species on earth, have declined dramatically over the past few decades. Now considered 'vulnerable' to extinction. their wild population is estimated to be less than 100,000 individuals. Working with world experts on giraffe ecology and conservation, CEC is leading efforts to track the movements and habitat use of giraffe across Africa. The Twiga-tracker project (Twiga is Swahili for giraffe) focuses on utilizing current technology to better understand and protect giraffe habitat.

Location of Known Elephant Death or Disappearence

Inset Map:

- ★ Collared Elephant Death
- 👚 Collared Elephant Disappearence

100 150 200 km

50

- Reported Kill Site of Uncollared Elephant
- ▲ Uncollared Elephant Death

AN EMERGING CRISIS IN MYANMAR.

Myanmar is one of the last countries in Asia with substantial wildlands suitable for supporting elephants. In the southern Bago Yoma Mountains of Myanmar, Asian elephants are being killed at a disturbing rate. CEC scientists discovered and helped to stop this emerging crisis through a movement tracking study in which 7 of 19 collared elephants were poached within a year of being fitted with a satellite-GPS collar.

Pictured above are known elephant deaths/disappearances from this study site (Sampson et al 2018).

TRACKING COLLARED ELEPHANTS WITH LOCAL MAHOUTS IN MYANMAR.

Photo by Christie Sampson

THEME HIGHLIGHT: ASIAN ELEPHANT

Managing humanelephant conflicts.

Understanding the behavior of threatened and endangered species on humandominated landscapes can help to structure the management of wild populations. One of the major threats to endangered Asian elephants is human-elephant conflict, which is often manifested as elephants cropraiding in places where human and elephant populations overlap. Through a collaboration with Hunter College-City University of New York, we are combining GPS tracking data with behavioral experiments in Myanmar to understand variation in how individual elephants differ in crop-raiding tendencies. This research will provide us with a deeper understanding of crop-raiding behavior to help mitigate conflict in Asian elephant countries.

ECOSYSTEMS & LANDSCAPES CONSERVING ECOSYSTEM FUNCTIONS





ANDSCAPES

1,000,000+ km² AREA COVERED



AMERICAN PRAIRIES

In 2017 the Smithsonian partnered with the American Prairie Reserve on their initiative to protect and restore Montana's Great Plains. From this partnership, CEC scientists have built an ecology program for grassland restoration, with a focus on understanding prairie dog colonies and American bison reintroduction. In 2018 we used infrared camera traps to survey mammal and bird species across varying grassland systems, including some with bison, some with cattle, and some with no large grazers. Our scientists are also assisting in mitigating the impacts of plague on prairie dog colonies.

LAIKIPIA PLATEAU

Over the past year, CEC scientists have strengthened long-standing connections with the Mpala Research Centre in Laikipia County, Kenya, by conducting two workshops building technical capacity of African researchers. This renewed engagement is leading to new opportunities for collaboration, with an emphasis on understanding how vegetation and dramatic changes in the abundance of livestock affect wildlife. Through partnerships with Mpala, we are building new tools to help local conservancy managers make informed decisions, such as optimizing placement of wildlife corridors.







PANTANAL

The Pantanal, located in Brazil, is the largest remaining wetland in the world (180.000-210.000 km²) and threats to this ecosystem have grown for decades—including deforestation, agricultural conversion, overfishing, overgrazing, and upstream development. CEC scientists are working with stakeholders in the Pantanal region, including land owners, NGOs, and academia to develop a conservation network for knowledge exchange and to define conservation priorities. CEC scientists are also providing technical expertise for the conservation of a range of species in the Pantanal, including jaguar, hyacinth macaw, tapir, and capybaras.

TANINTHARYI

The Tanintharyi Landscape in Myanmar is a global biodiversity hotspot, home to a wide array of locallyendemic and globallythreatened species, yet it lacks research and conservation involvement due to decades of political conflict. CEC scientists are working with in-country partners to collect biodiversity data, build environmental and infrastructure maps, analyze species distribution across the landscape, and build tools for mitigating impacts of development on biodiversity. Outputs will be used to predict landscape changes under future scenarios and inform policy-makers. We also work with local universities to build capacity for monitoring and conserving the vast biodiversity of the region.

FORESTGEO

Forests play critical roles in climate regulation, and the future of Earth's forests will influence the course of climate change. Understanding and predicting how forests are changing provides critical support for biodiversity conservation and climate change mitigation. The Smithsonian-led Forest Global Earth **Observatory** (ForestGEO) is strategically poised for monitoring, understanding, and predicting forest responses to global change across all forest biomes. CEC scientists seek to understand how global change is altering forests around the world and how changes to forest ecosystems will either mitigate or exacerbate climate change.

CONSERVATION TOOLS HOW TECHNOLOGY HELPS



22,000

CAMERA TRAP

DEPLOYMENTS

 \bigcirc

CONSERVATION DRONES

INDIVIDUALS

450

Repeated and accurate surveys of species occurrence are cornerstones of modern conservation biology. Working with scientists across the Smithsonian, the Conservation Drone Program aims to use emerging technologies, like Unmanned Aerial Systems and high resolution sensors, to test and improve methods to monitor species and their habitats. An example is the collaboration between the Movement of Life Initiative and Virginia Working Landscapes which are developing methods using small drones equipped with thermal cameras to accurately detect active bird nests in grassland ecosystems.

eMAMMAL/CAMERA TRAPPING

CEC manages **eMammal**, one of the world's largest repository of wildlife images and data. Researchers and citizen scientists have input images from camera traps from over 24 countries around the world. We currently have over 1.2 million detections of wildlife species. We have recently joined our work with that of other conservation organizations into *Wildlife Insights* to provide global metrics on mammal diversity and distributions. Locally, we are monitoring mammals along an urban to wild gradient from Washington DC to West Virginia.

600,000+

WILDLIFE

DETECTIONS ON eMAMMAL





QUANTITATIVE ECOLOGY

The worldwide accumulation of animal tracking data promises to revolutionize ecological understanding. However, advanced statistical methods necessary to interpret these complex datasets are often lacking. The Quantitative Ecology group at CEC works to build a modern statistical foundation for movement ecology. Their user-friendly movement analysis software is now freely available as a web service. CEC quantitative ecologists have leveraged an unprecedented dataset of 369 individuals from 27 species distributed across 5 continents to demonstrate the superior performance of their flagship home range estimator.

MAPPING DEFORESTATION

Recent political transition and economic reforms have led to rapidly increasing rates of deforestation in Myanmar, one of last remaining forest frontiers in Asia. The absence of knowledge on the national distribution of forest cover and forest type is a primary challenge for their monitoring and conservation. To address this need. CEC scientists are leading the development of a national-scale forest cover and forest type map. They are using machine learning algorithms to mine big data from remote sensing archives, including imagery from radar and optical satellite sensors, drones, and field surveys.

FOREST CARBON DATABASE

Forest conservation and reforestation are essential to avoiding warming beyond 1.5-2°C. Yet, forests responses and feedbacks to climate change are some of the largest uncertainties in future climate projections. To address needs for global data on forest carbon, CEC's Ecosystems & Climate program published an open-access Forest Carbon database (ForC) containing 29,000+ published records of ecosystemlevel C stocks and annual fluxes across 3,000+ plots worldwide. Notably, our data recently contributed to the Intergovernmental Panel on Climate Change (IPCC) standards for forest carbon accounting and to a globalscale analysis of the potential for carbon sequestration through forest regrowth.





THEME HIGHLIGHT: TRACKING WILDLIFE

INNOVATIVE MOVEMENT TRACKING: In 2018, Smithsonian scientists began testing new prototype GPS tags on Przewalski's horse and scimitar-horned oryx. These devices, which are designed to fit on the tail and/or horn of the animal are aimed to reduce the possible adverse effects of fitting an animal with a traditional GPS collar, while potentially increasing the life of the device. While still in development stage, these devices show promise as an alternative method for increasing our understanding of animal movement.







CONSERVATION INITIATIVES INCREASING SMITHSONIAN IMPACT







CHANGING LANDSCAPES INITIATIVE

The Changing Landscapes Initiative (CLI) aims to conserve biodiversity, protect human livelihood, and promote sustainable living in Northern Virginia by providing objective information on the impact of land use change on the local landscape. Working with regional planners, NGO's, and local farmers, the CLI supports strategic decision-making and planning for landscape change and natural resources over the next fifty years. The vision of the CLI is to serve as a precedent for boundary-spanning scientific initiatives focused on preserving natural resources and heritage in growing metropolitan areas.

MOVEMENT OF LIFE

With a mission to advance the understanding of how all living things move across changing land and seascapes, CEC **Movement of Life** scientists are currently tracking over 14 species (135 individuals) across 4 continents. By fitting animals with GPS tracking units, our scientists aim to unravel some of the earth's greatest mysteries, providing the ecological foundation for conserving species worldwide.





WORKING LAND AND SEASCAPES

Working Land and Seascapes harnesses the expertise of the Smithsonian and its partners to develop integrated conservation strategies, grounded in strong science, that balance the needs of people and nature to foster a sustainable future for the ecosystems upon which we depend. With a portfolio of fifteen projects across four continents, we work to untangle the complex web of ecological and social systems to identify conservation solutions that can scale across geographies.

SMITHSONIAN MYANMAR BIODIVERSITY INITIATIVE

The **Smithsonian Myanmar Biodiversity Initiative** is a pan-science effort to leverage Smithsonian resources to support Myanmar's efforts to study and sustain their biodiversity. We partner with government agencies and NGOs to build biodiversity and environmental databases, monitor endangered species (elephants and Eld's deer), assess and mitigate impacts of human-wildlife conflict and wildlife trade, and to evaluate wildlife disease risks.

CAPACITY BUILDING

Training future conservationists.

The Smithsonian has always facilitated the training and knowledge-building of young professionals. CEC interns are typically undergraduates, learning conservation skills between semesters, or young professionals just outside of a formal education setting. Our internship program provides hands-on training in conservation skills, applied ecology, data analysis, and facilitates the interaction with conservation practitioners from all branches of conservation biology.

BY THE NUMBERS



91 INTERNS, GRADUATE STUDENTS AND POSTDOCTORAL FELLOWS TRAINED IN THE LAST 2 YEARS



40 TRAINING WORKSHOPS, SEMINARS AND COURSES



10,000+ ATTENDEES AT OUTREACH EVENTS



CEC researchers training on the use of camera traps to a group of paraecologist in Myanmar.

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Photo by Grant Connette

"My internship at SCBI provided an incredible foundation for my career in data sciences and taught me the importance of collaboration in taking on global challenges. Just out of college I was able to learn from and work with top scientists, and others like me who were just getting started, from around the world in a stimulating and immersive environment that would be difficult to reproduce in another setting. I look back fondly at my time with SCBI and credit the experience for helping me to establish my early career while also providing the opportunity to contribute to work that helped improve our understanding of the world."

—Kevin Koy (CEC Intern 2001), Managing Director of Data Science and Al Affiliates Programs, Stanford University

2018-2019 INTERNSHIP



62+ INTERNS FROM 10 COUNTRIES



30+ ACADEMIC/ PROFESSIONAL INSTITUTIONS REPRESENTED



15 MASTERS OR DOCTORATE DEGREES EARNED



~35% WILL PURSUE GRADUATE SCHOOL

FINANCIAL REPORT

2018 AND 2019 FISCAL YEARS FUNDING

Category	FY2018	FY2019	Both years
A. Individual	\$1,332,800	\$765,048	\$2,097,848
B. Non-government Organization	\$557,546	\$1,516,176	\$2,073,722
C. Federal Agency	\$261,439	\$365,019	\$626,458
D. Other Government Agency	\$288,733	\$268,506	\$557,239
E. Smithsonian Institution	\$734,238	\$715,781	\$1,450,019
F. Other	\$12,773	\$49,245	\$62,018
Total Revenue	\$3,187,530	\$3,679,777	\$6,867,307



CONTRIBUTORS

DONORS

- Andrea Ball
- Linda Bettinger
- Cedar Hill Foundation
- Clara Weiss Fund
- Suzanne Engels
- Ford Motor Company Fund
- Friends of the Dickerson Park Zoo
- L.R. Fisher
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FUNDERS

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- Humane Rescue Alliance
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- National Geographic
- North Carolina Museum of Natural Science
- North Carolina State University
- San Diego Zoo
- Shared Earth Foundation
- Shenandoah National Park Trust
- North Carolina Museum of Natural Science

- North Carolina State University
- Shenandoah National Park Trust
- Smithsonian Women's Committee
- Texas Biomedical Research Institute
- University of Washington
- Virginia Native Plant Society
- Willowsford Conservancy
- Yale University
- Youth Access Grant

GOVERNMENT GRANTS

- National Aeronautics and Space Administration
- National Institutes of Health
- National Science Foundation
- United States Department of Defense
- United States Department of State
- United States Fish & Wildlife Service

INTERNAL

- Smithsonian National Zoological Park
- Smithsonian Scholarly Studies Program

As part of our commitment to disseminate our scientific findings, CEC scientists continuously publish results in peer-reviewed scientific journals. During 2018 and 2019, our staff authored or co-authored the publications listed below. These and more than 1250 other publications by current and former CEC staff and partners are available at https://research.si.edu/

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