Research Semester Opportunities for Spring 2016

The Department of Biology is proud to offer a special research semester opportunity to work with Smithsonian research scientists during the upcoming spring 2016 semester. As part of the research semester, students can work with a scientist at either the National Zoo in Washington, DC or the Smithsonian Conservation Biology Institute in Front Royal, VA. Housing at SCBI can be provided if students choose this option. All of these opportunities involve original research that can result in publications. Work for the listings #1-5 will be at SCBI in Front Royal, VA while the work for listing #6 will be at the National Zoo in Washington, DC.

Detailed List of Potential Research Projects

1. **Non-invasive detection of protein biomarkers for early pregnancy in the feces of captive cheetahs (Acinonyx jubatus)**

Dr. Adrienne Crosier
Cheetah Biologist
Center for Species Survival
Smithsonian Conservation Biology Institute

and

Dr. Diana Koester
JoGayle Howard Post-Doctoral Fellow
Center for Species Survival
Smithsonian Conservation Biology Institute

Pregnancy diagnosis is a key element in the management of small populations of threatened and endangered species. Every offspring is critical, so knowing if a female is pregnant can aid in proper mobilization of resources and expertise to ensure a successful birth and healthy offspring. Having practical tools to diagnose pregnancy would have a tremendous impact on the management of species that do not breed well in captivity, and would contribute to the long-term sustainability of endangered wildlife populations. Additionally, such tools could advance discoveries of new mechanisms related to implantation and maternal recognition of pregnancy. This project utilizes a proteomic approach to identify potential biomarkers to diagnose pregnancy in a carnivore species of high conservation importance – the cheetah (Acinonyx jubatus). This species presents a significant breeding management challenge that would benefit from a means to routinely diagnose pregnancy. Cheetahs exhibit a frustrating mechanism referred to as 'pseudopregnancy', a condition that results after mating but in the absence of offspring produced. During a pseudopregnancy, the female experiences a non-pregnant luteal phase that cannot be reliably distinguished from pregnancy, especially during early gestation, using traditional diagnostic tests (i.e., hormone immunoassays). Due to the stress and danger of

handling wild carnivore species, we will utilize a non-invasive approach to detect pregnancy biomarkers in feces.

The student will be responsible for extracting steroid hormones and proteins from fecal material as well as quantifying total protein in samples using multiple techniques. The student will also have the opportunity to learn and practice enzyme immunoassay and immunoblotting techniques to determine specific steroid and protein concentrations respectively.

2. Research Opportunities in Field Ecology at SCBI

William McShea, Tom Akre, Tavis Forrester, Lara Lacher
Wildlife Ecologists, Smithsonian Conservation Biology Institute, Front Royal, VA

A) Assessing the distribution of loggerhead Shrikes in region. Loggerhead shrikes were a common grassland bird species in the region as recently as the 1980's. But presently fewer than 50 breeding pairs are known to exist in Virginia. Amy Johnson, GMU PhD candidate, has recently completed a habitat suitability analysis for the shrike in the southeastern US. This spring we will be engaged in using this map to locate additional breeding pairs and compare microhabitat differences between highly suitable habitat that is occupied and unoccupied. This research would involve working on habitat measures appropriate for survey; recruiting bird enthusiasts to assist with effort; and conducting roadside surveys within 100 mile radius of SCBI between mid-March and mid-May.

B) Ecology of a mature oak forest. With forests being the prime agents of carbon sequestration and simultaneously harboring and supporting important wildlife species, SCBI scientists have created a 26 ha plot of mature oak forest where all stems are measured mapped and identified to species. This plot was first established in 2008 and resurveyed in 2013. With over 56,000 stems of known history it is an important ecological laboratory. We currently have 500 trees with sensitive dendrometers to record small changes in tree girth. A student would work on the grid to measure tree growth and inventory invasive plant species across the entire grid. A special feature of the site is an embedded 4 ha grid where der were excluded in 1990. A student would quantify the impact of this grid on tree growth and invasive species expansion. Some activity would include monitoring and controlling for new invasive species and helping us understand their ecology.

C) We have created a web-based system (eMammal) for collecting and cataloging wildlife images from multiple researchers and sites. We are expanding this system to include acoustic recording of frogs, birds and bats through the work of Justin Cooper, GMU master's candidate. A student would work to refine the parameters used for species identification of acoustic recordings for frogs, and in April participate in collection, cataloging and identifying frog calls from wetland sites in the region. The student will also participate in collection of wildlife images as part of an urban-to-wild gradient in the DC metro region.

D) Mammal distribution within Asia. Smithsonian researchers have conducted several wildlife surveys across China and SE Asia over the last decade. These surveys contain vitally important information and need to be organized and imported into eMammal, the new Smithsonian camera trapping data repository. A student researcher would work to organize data from projects across the region, and assist Dr. Tavis Forrester, in preparing and analyzing the data to examine mammal diversity and occupancy across a gradient of rainfall.

E) White-tailed deer ecology. We are radiotracking white-tailed deer within the SCBI forest and working toward mapping their movements and recording their diet with respect to the distribution of invasive plants. Working with Chris Holder, GMU Master's candidate, who will catalogue their diet based on dna analysis of scat, the student will radiotrack individual deer and collect fecals from specific individuals, as well as use trip-cameras to document their behavior at specific feeding sites.

F) Landscape ecology of lands surrounding Shenandoah National Park. Dr. Iara Lacher has initiated a new project to map and model the ecosystem services of a 15 county region surrounding the Shenandoah National Park. One first step in this process is to map the specific landholdings adjacent to the park boundary and create landcover maps that highlight the intersection of resources across the park boundary. We would start with mapping Rappahannock County on the eastern side of the park and a GIS proficient student would explore the natural resources of importance to the park and the county residents.

3. Research Opportunities at the Conservation GIS Laboratory

Dr. Peter Leimgruber, Dr. Jared Stabach, Dr. Nucharin Songsasen, Stacie Castelda
Smithsonian Conservation Biology Institute, Front Royal, VA

Research at SCBI's Conservation GIS Laboratory integrates ecological field research on endangered species with satellite mapping, and geospatial modeling (GIS, remote sensing) to develop new conservation strategies. Undergraduate students will gain new skills in advanced mapping and modeling tools, such as GIS, remote sensing, and GPS tracking of animals. They will also learn how these tools are applied in conservation. Available projects include:

A) Developing Tracking Tools for the Reintroducing extinct Scimitar-horned Oryx: The scimitar-horned oryx (SHO) is one of the most endangered antelopes globally, and is now extinct in the wild. SCBI is leading a team of scientists planning and monitoring a large-scale reintroduction project for SHO in Chad's Sahelo-Sahran region. We will put GPS tracking devices, equipped with an accelerometer, on each of the released SHO to monitor their health, movement, and conservation status. Dr. Jared Stabach is currently testing these devices on SCBI's captive population of SHO. We are seeking an undergraduate student to work on analyzing the accelerometer data from these experiments to analyze activity patterns in SHO. The student will learn from experts in the field, and will gain an understanding of GPS satellite technology,

animal behavior, and activity monitoring. The student will also learn basic programming skills related to the statistical program R, an open source program commonly used by researchers in our field.

B) Evaluating Human Threats on Hoary Fox in the Brazilian Cerrado:

The Cerrado, nestled in central Brazil, is the largest savannah ecosystem in South America and is the home to one of the least studied canid species in the world, the hoary fox (Lycalopex vetulus). Intense agricultural and cattle ranching activities over the past 40 years has severely fragmented the Cerrado ecosystem. With only 2% of the Brazilian Cerrado being protected, the population trend of the hoary fox under these conditions remains unknown. Collaborating with Drs. Leimgruber and Songsasen, Stacie Castelda is using radio telemetry and fecal hormone analysis to assess how human activities impact the fitness of hoary foxes. Undergraduate students will learn how to map home ranges for hoary foxes from tracking data, make habitat maps from satellite imagery, and measure human impact on hoary fox habitat in GIS.

C) Developing Habitat Maps for Giant Armadillo from Satellite Imagery: Giant armadillo and their habitats are little studied. Dr. Leimgruber is collaborating with a team of Brazilian researchers to develop urgently needed habitat map for giant armadillos in Brazil. These maps will be used to a) assess how much giant armadillo habitat is left, b) develop species-habitat maps at the landscape and regional scale, c) map areas best suited for giant armadillo conservation, and d) identify areas that may support giant armadillos but have never been surveyed. Undergraduate students will learn how to use satellite remote sensing and GIS to develop these maps.

D) Mapping the Impact of Commercial Plantations on Myanmar's Forests: Myanmar remains one of the most forested countries in Southeast Asia, but recent political changes have opened the country for outside investment, and threatens Myanmar's forests. Plantation development, especially for palm oil, rubber, and sugar cane, is probably the main cause of major global deforestation trends in the last decade. Dr. Leimgruber is collaborating with Myanmar conservation organizations to map Myanmar's remaining forests, as well as recent changes from plantation development. This mapping requires the integration of Landsat, radar, and high-resolution satellite imagery with advanced remote sensing tools. Undergraduate students will conduct a guided project on assessing how these tools can be best integrated to accurately map plantations and measure their impact on forest ecosystem health in Myanmar.

4. Sperm banking for conserving rare and endangered ungulates

Dr. Budhan S. Pukazhenthi
Reproductive Physiologist, Center for Species Survival, Smithsonian Conservation Biology Institute

Ongoing research is focused on developing novel sperm preservation technologies for rare and endangered ungulates. Target species include the Przewalski's horse, Persian onager, addra gazelle, scimitar-horned oryx, Eld's deer and/or tufted deer. The project involves analyzing and cryopreserving

semen samples from one or more species. Frozen samples will be thawed and analyzed for both structure and function. Students will gain specialized experience in semen analysis, sperm cryopreservation and in vitro sperm function tests in endangered species.

5. Fertility Preservation in Carnivores

Dr. Nucharin Songsasen, Center for Species Survival
Dr. Jennifer Nagashima, Post –doctoral fellow

When an endangered animal passes away before breeding / contributing his or her genetics to the population, we need technologies that would allow us to 'rescue' or preserve their fertility. For females, this involves techniques such as growing ovarian tissue in vitro to produce viable oocyte or eggs. In research semester, students will conduct a study focusing on establishing in vitro culture system for ovarian follicle culture in domestic cats and dogs as models for wild felids and canids. Students will be trained in in vitro culture, molecular and cell biology techniques. The findings from the study have potential for publication in peer-reviewed scientific journal.

6. Population genetics and molecular systematics of rare or endangered mammals

Dr. Jesús E. Maldonado
Research Geneticist
Center for Conservation and Evolutionary Genetics
Smithsonian Conservation Biology Institute

The Center for Conservation and Evolutionary Genetics (CCEG) is located at the Smithsonian National Zoological Park in Washington, D.C. You can find more information about the lab here: https://nationalzoo.si.edu/scbi/cceg/. Researchers at CCEG are involved in many different projects, with a central goal of understanding and conserving biodiversity through genetic research. Dr. Maldonado is an expert in non-invasive and ancient DNA techniques, which he has used to study a diverse set of mammals including San Joaquin kit foxes, African wild dogs, maned wolves, coyotes, tigers, African elephants, and Neotropical deer.

Interested students would have the opportunity to work on a project studying the population genetics of an endangered carnivore, the southern river otter (Lontra provocax). This species has the smallest range of any of the world's 13 otter species, encompassing southern Chile and southwestern Argentina. Our study area includes two rivers within the Valdivian coastal reserve in Chile, where a population of introduced American mink has become established. This population was founded by mink that escaped from local fur farms in the 1970s, and it has since grown dramatically. The mink now share habitat, food sources, latrines, and even dens with the otters; this is a conservation concern because of the risk of disease transmission from the highly terrestrial mink to the primarily aquatic otters. Previous studies have shown that mink can transmit diseases including parvovirus and distemper through contact with local dogs. The goal of our project is to estimate the genetic diversity of the otter and mink populations in the

Valdivian reserve, identify individuals, and track their movements through genetic analysis of scat samples collected by our Chilean collaborators. Students would be trained on laboratory methods optimized for the processing of non-invasive DNA, including DNA extraction, PCR, microsatellite genotyping, and Sanger sequencing, as well as data analysis methods. In addition, students would receive training in novel noninvasive-DNA methods that are being developed by Dr. Maldonado and his graduate students, including DNA library preparation, in-solution target capture, and massively parallel sequencing on an Illumina platform. Finally, students would have the opportunity to be part of a dynamic lab group that is applying cutting edge high-throughput DNA sequencing technologies and bioinformatics pipelines to the study of evolution and conservation biology.

7. **Reassessing the role of the Great American Biotic Interchange in the evolution of the raccoon family**

Dr. Jesús E. Maldonado and Mirian Tsuchiya
Research Geneticists
Center for Conservation and Evolutionary Genetics
Smithsonian Conservation Biology Institute

The raccoon family, or Procyonidae, is one of thirteen families recognized in the mammalian order Carnivora, which also includes well-known animals such as dogs, cats, weasels and bears. The raccoon family comprises six major groups distributed throughout the Americas: Potos (kinkajous) Procyon (raccoons), Nasua and Nasuella (coatis), Bassaricyon (olingos), and Bassariscus (ringtails), 15 recognized species, and 78 subspecies. Intergeneric relationships have been assessed by several studies, with contrasting patterns recovered depending on the type of information used (morphology versus genetics). The goals of my Ph.D. dissertation project are to construct a comprehensive phylogeny utilizing high-throughput DNA sequencing techniques coupled with discrete morphological characters and geometric morphometric approaches in order to evaluate intra- and interspecific relationships as well as to determine species boundaries. Interested students would have the opportunity to work on a project adopting an integrative approach based on genetic analyses of modern specimens, morphometrics and biogeographic modeling. Students will learn DNA extraction techniques, PCR, Sanger DNA sequencing and data analysis. This research has potential to revise our understanding of mammal evolution in the Neotropics, while contributing to the advancement in the fields of genomics, systematics, taxonomy and biogeography.

Summary List of Potential Research Projects

Principal Investigator	Title of Project	Location
Dr. Adrienne Crosier and Dr. Diana Koester	Non-invasive detection of protein biomarkers for early pregnancy in the feces of captive cheetahs	Smithsonian Conservation Biology Institute Front Royal, Virginia
Dr. William McShea Dr. Tom Akre	Assessing the distribution of loggerhead shrikes	Smithsonian Conservation Biology Institute Front Royal, Virginia
Dr. William McShea Dr. Tom Akre	Ecology of a mature oak forest	Smithsonian Conservation Biology Institute Front Royal, Virginia
Dr. William McShea Dr. Tom Akre	Expansion of web-based (e-Mammal) system for cataloging wildlife	Smithsonian Conservation Biology Institute Front Royal, Virginia
Dr. Tavis Forrester	Distribution of Mammals in Asia	Smithsonian Conservation Biology Institute Front Royal, Virginia
Dr. William McShea Dr. Tom Akre	White-tailed deer ecology	Smithsonian Conservation Biology Institute Front Royal, Virginia
Dr. Lara Lacher	Landscape Ecology of areas around Shenandoah National Park	Smithsonian Conservation Biology Institute Front Royal, Virginia
Dr. Peter Leimgruber Dr. Jared Stabach Dr. Nurharin Songsasen Stacie Castelda	Developing tracking tools for the reintroduction of the Scimitar-horned Orys	Smithsonian Conservation Biology Institute Front Royal, Virginia
Dr. Peter Leimgruber Dr. Jared Stabach Dr. Nurharin Songsasen Stacie Castelda	Evaluating human threats on Hoary Fox in the Brazilian Cerrado	Smithsonian Conservation Biology Institute Front Royal, Virginia
Dr. Peter Leimgruber Dr. Jared Stabach Dr. Nurharin Songsasen Stacie Castelda	Developing habitat maps for Giant Armadillo from Satellite Imagery	Smithsonian Conservation Biology Institute Front Royal, Virginia
Dr. Peter Leimgruber Dr. Jared Stabach Dr. Nurharin Songsasen	Mapping the impact of commercial plantations in Myanmar's forests	Smithsonian Conservation Biology Institute Front Royal, Virginia

Dr. Budhan S. Pukazhenthi	Sperm banking for conserving rare and endangered ungulates	Smithsonian Conservation Biology Institute Front Royal, Virginia
Dr. Nucharin Songasen Dr. Jennifer Nagashima	Fertility preservation in carnivores	Smithsonian Conservation Biology Institute Front Royal, Virginia
Dr. Jesus Maldonado	Population genetics and molecular systematics of rare or endangered mammals	Center for Conservation and Evolutionary Genetics National Zoological Park Washington, DC
Dr. Jesus Maldonado Mirian Tsuchiya	Reassessing the role of the Great American Biotic Interchange in the evolution of the raccoon family.	Center for Conservation and Evolutionary Genetics National Zoological Park Washington, DC