Smithsonian | GEORGE MASON UNIVERSITY

Smithsonian-Mason School of Conservation

SMSC REU Site: Saving Critically Endangered Species and Habitats: Next-generation Education, Research, and Training for Conservation Biologists

Project Descriptions and Mentors

Summer 2026

1) Lowland tapir movement in response to anthropogenic disturbance (Mentor: Dr. Cody W. Edwards): Students will use existing tracking datasets to understand the movement ecology of the lowland tapir (*Tapirus terrestris*), a globally threatened species, in two different regions in Brazil: the Cerrado, with human encroachment, and the relatively pristine Pantanal. Students will learn and apply state-of-the-art statistical methods and software tools for analyzing animal tracking data. These statistical methods will provide information about animal movement that can be applied to other threatened species.

(Note: Mentor is based off-site; interactions with mentor will be mostly online and occasional in-person).

2) Movement and population ecology of the eastern box turtle (Mentor: Dr. Thomas Akre and Dr. Joe Kolowski): Students will become engaged in all aspects of an ongoing study of the Eastern Box Turtle (*Terrapene carolina*) which aims to investigate the movement behavior and population status of this vulnerable species in the mixed farmland landscape of northern Virginia. Students will learn about and practice various monitoring techniques (visual encounter, mark-recapture, radio & GPS telemetry) as they develop their own research questions within this larger project framework. The project is one of the first to employ GPS tracking and spatial mark-recapture approaches to study this species, and students will have access to this large and novel dataset to explore research questions that can directly inform management decisions and future monitoring approaches.

3) Understanding forest responses to climate change through long-term monitoring (Mentor: Dr. Kristina Anderson-Teixeira): Students will learn forest monitoring methods employed by the Forest Global Earth Observatory (ForestGEO) to inform scientific understanding of forest dynamics under climate change, with a focus on how climate change and other pressures are changing tree growth, mortality, and consequent forest carbon sequestration. Students will use automated data quality assurance and control and analysis of field data to ensure accuracy and produce near real-time results relevant to forest-based climate change mitigation efforts. These techniques allow for a rich analysis of forest dynamics under climate change and can further support forest-based climate change mitigation efforts.

4) Tracking the movements and breeding behavior of a declining raptor (Mentor: Dr. Joe Kolowski): Students will utilize a large database of GPS tracking data and nest box videos to study how American kestrels (*Falco sparverius*) survive in, and interact with, a working agricultural landscape. Students will learn: 1) the latest coding approaches in R to clean, visualize and explore animal movement data, and 2) video-based methods of animal behavior analysis. Students will also monitor kestrel nest boxes, assist in field capture and tagging of birds, and remotely download GPS tracking data. Both datasets are unique for the species, so students will not only gain modern analytical skills, but will also help fill critical gaps in ecological knowledge needed for management and conservation recommendations.

5) Do reintroduced oryx share information or track current resources? (Mentor: Dr. Katherine Mertes): Recent analyses found that inexperienced oryx observed in social groups with experienced oryx visited sites closer to their peak vegetation productivity than inexperienced oryx traveling with other naïve animals. Students will analyze nine years of GPS tracking data and field observations for more than 300 scimitar-horned oryx (*Oryx dammah*) reintroduced into a large, protected area in central Chad. Students will learn and apply quantitative movement analysis methods to investigate oryx tracking of vegetation productivity, assess potential social transmission of information, and evaluate whether oryx movements are driven by site revisitation or resource tracking. Students will have access to a large, unique set of tracking data from a highly Endangered species; learn cutting-edge quantitative skills in movement and conservation ecology; and have the opportunity to directly inform the management of the only free-roaming population of scimitar-horned oryx in the world.

6) How and where to save the world's most vulnerable species from extinction (Mentor: Dr. David Luther): The Alliance for Zero Extinction (AZE) focuses on the effective conservation of key sites that are the last remaining refuges of Endangered (EN) or Critically Endangered (CR) species, the most vulnerable species threatened with extinction. Students will help identify the conservation action needs of these species, learn about the implementation of conservation actions to prevent extinction, and which actions are needed in which circumstances. Students will assess, organize, and manage global data on habitat restoration, captive breeding, law enforcement, and habitat protection needs for AZE species management. Students will work with the mentor and international NGOs to analyze data and disseminate results for effective conservation needs of these threatened species.

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7) Ecosystem services of cavity-nesting birds in working landscapes (Mentor: Dr. Amy Johnson and Allison Huysman): Landowners install nest boxes on their properties to attract cavity-nesting birds that may consume pest arthropods and rodents. Students will examine if birds consume enough pests to have a meaningful impact on pest control and if this impact varies with land use and nest box density. Students will learn methodology for arthropod sampling and identification, avian nest monitoring, bird capture and banding, collection and laboratory preparation of biological samples for genomics analysis, and vegetation surveys. These findings will help advise landowners on best management practices for nest boxes, which has the potential to reduce need for pesticides and provide habitat for birds that are nest-site limited.

8) Exploring nutritional forage quality and tradeoffs in bird-friendly haying (Mentor: Dr. Bernadette Rigley): Students will examine how temporal variation in haying schedules affects forage nutritional composition and the reproductive success of grassland bird species. Students will learn forage sampling techniques, gain proficiency in R for data management, visualization, and statistical modeling, and acquire avian field research skills, including nest searching and mist-netting/ deploying tracking technologies on grassland birds. In addition, students will learn how to effectively communicate scientific findings and translate research outcomes into actionable messages that support conservation and sustainable agricultural practices. The project's outcomes will inform haying strategies that balance forage quality with the conservation of declining grassland bird populations.

9) Reproductive technologies in endangered species conservation (Mentor: Dr. Nucharin Songsasen): Reproductive technologies play an important role in the *ex situ* management of threatened species, including the black-footed ferret, whooping crane, and giant panda. Students will conduct lab-based research to better understand reproductive mechanisms of a variety of species and apply the knowledge gained from this research to establish assisted breeding tools for captive populations of threatened species. Research techniques will include improved understanding of reproductive endocrinology, sperm biology and cryopreservation, ovarian folliculogenesis, fertilization, and embryo development as well as physiological responses to environmental changes or management strategies.

10) Conservation genomics for management of insurance populations of endangered species (Mentor: Dr. Klaus-Peter Koepfli): Genomic data and analyses are increasingly being used to inform genetic management and breeding programs of *ex situ* insurance populations. Using existing and planned whole-genome sequence datasets for *ex situ* populations of the threatened black-footed ferret (*Mustela nigripes*), black rhinoceros (*Diceros bicornis*), cheetah (*Acinonyx jubatus*), clouded leopard (*Neofelis nebulosa*), or Eld's deer (*Rucervus eldii*), students will gain conceptual knowledge in population genetics and learn skills in using computational tools for analyses of genome-wide heterozygosity, genetic structure, inbreeding levels, and mutational load. Students will learn fundamental concepts and methods behind generating and analyzing next-generation sequencing datasets from endangered species and how results can be applied to support the management of genetically diverse insurance populations.

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11) Museomics and phylogenomics provide essential guidance for conservation efforts (Mentor: Dr. Susette Castañeda-Rico): Students will contribute to an ongoing project exploring the evolutionary history of the subfamily Neotominae, one of the most diverse and ecologically significant groups of rodents in North America, which includes several poorly known and range-restricted species. By harnessing genomic-scale data and DNA from museum specimens, students will advance our understanding of Neotominae evolution and strengthen the phylogenetic framework for the group. These findings will provide valuable insights for assessing species' conservation status and identifying vulnerable lineages. Through hands-on training in genomic data generation and bioinformatics, students will gain experience at the intersection of evolutionary biology and conservation.

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12) Understanding *ex situ* African rhino well-being (Mentor: Dr. Elizabeth Freeman): Students will use existing datasets to understand the well-being of black (*Diceros bicornis*) and/or white (*Ceratotherium simum)* rhinoceros managed in North American zoos. Data has been gathered about the 'five domains' of well-being, including: nutrition and feeding, physical health, environment/management, behavior and mental state. Students will use statistical methods to explore question(s) related to physical, physiological, behavioral, and environmental factors that contribute to positive and negative indicators of well-being. Results will allow for aligning management decisions to individual variation, as well as the natural history and evolution of these threatened species, to help further support overall health, well-being, and reproductive success of the zoo populations.

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13) Evaluation of hormone regimes on domestic cat cells, for application to endangered felid assisted reproduction (Mentor: Dr. Jennifer Nagashima): Students will learn cell isolation and gamete rescue techniques, sterile cell culture methods, and microfluidic chip fabrication, using the domestic cat model. They will also develop skills in immunocytochemistry and fluorescence microscopy for analyses of the cells following culture under natural vs. ovarian hormone regimes. This research advances the development of biomimetic culture systems, toward the goal of producing and maintaining healthy, developmentally competent gametes and embryos *in vitro*, with application to threatened species.

14) Reproductive technologies for threatened ungulate conservation (Mentor: Dr. Budhan Pukazhenthi): Understanding the fundamental reproductive biology of species is paramount for developing assisted reproductive technologies such as artificial insemination, semen cryopreservation, and embryo transfer. Students will have the opportunity to learn about various research efforts employed by reproductive physiologists to support ungulate species conservation, including the Przewalski's horse (*Equus ferus przewalskii*), Persian onager (*Equus hemionus onager*), Hartmann's mountain zebra (*Equus zebra hartmannae*), scimitar-horned oryx (*Oryx dammah*), addra gazelle (*Nanger dama*), and Eld's deer (*Rucervus eldii*). Specifically, the student will assist with on-going studies focused on sperm cryopreservation, *in vitro* culture of reproductive tissues, and/or genomics.

15) Applying microbiome science to conservation and animal care (Mentor: Dr. Sally Bornbusch): Students will contribute to projects investigating (a) the role of microbiomes in maintaining animal health and (b) how beneficial manipulation of microbiomes may improve animal care and conservation efforts. Students will learn the process for generating and analyzing microbiome analyses, including bioinformatic analysis and statistical interpretation of high-throughput DNA sequencing data. Potential projects include working with microbiome data from cheetahs, giant pandas, red pandas, siamangs, and/or elephants. Microbiomes are a critical component of animal and environmental health and by incorporating microbial ecology into conservation research, we can improve conservation outcomes.

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