Saving Species with Science®

CREW ReView

Lindner Center for Conservation and Research of Endangered Wildlife

Cincinnati Zoo & Botanical Garden • Fall 2023

Dr. Terri L. Roth

VP of Conservation & Science and Director of CREW

ROTH'S REMARKS

CREW Provides National Leadership

Over two decades ago, CREW's strategic planning efforts landed on the concept of "*Signature* Conservation Projects", a term coined through the process and still used today. The philosophy behind it is the desire to focus our time and resources on playing a leading role and making a significant impact in the conservation of a narrowly defined group of species rather than spreading ourselves thin trying to do a little for each of the many species in need. The strategy requires discipline; two decades later, CREW has only four *Signature* Projects, but our achievements with our targeted species have been rewarding. Measuring success is always part of the strategic plan discussion, and there is no better way to demonstrate it than in the form of third-party validations. The Institute of Museum and Library Services (IMLS) offers highly competitive National Leadership Grant awards. Proposals are reviewed and scored by several esteemed colleagues working in zoos, aquariums, and/or botanical gardens. These reviewers understand the needs of our living collections and the challenges facing their long-term sustainability. In 2008, CREW was awarded its first National Leadership Grant for work on rhinos and small cats. Fifteen years later, CREW has received nine such grants spread across all four *Signature* Conservation Projects. Not only do these awards confirm our national leadership with our targeted species, but they also enable program expansion so that we can answer more questions, develop more technology, have more impact, and train more next-generation conservation scientists. Thanks to the CREW-IMLS partnership over the years, the future for rhinos, imperiled cats, exceptional plants, and bears is a little brighter.

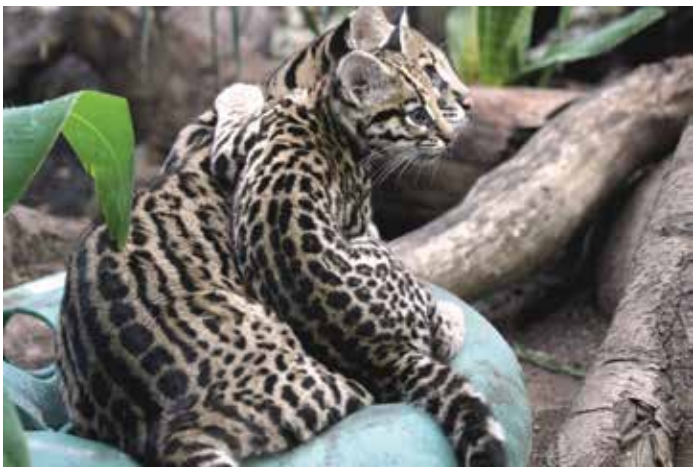
Keeping the MEOWmentum Going

In collaboration with Massachusetts General Hospital and the Michelson Found Animals Foundation, CREW scientists recently published a groundbreaking study on a new method for sterilizing domestic cats that doesn't require surgery. Instead, gene therapy is delivered with a single injection that results in long-term (perhaps even lifetime) contraception. While this technology has tremendous potential to win the fight against pet overpopulation, our work has only just begun. Before we can make this technology widely available, a robust manufacturing platform needs to be developed. The hope is that this therapy can be provided as affordably as possible to animal shelters and people with limited income for veterinary care; hence the relative ease (and resulting cost) of manufacturing needs to be carefully considered. To that end, CREW will be investigating three additional variations of the original treatment for safety, efficacy, and cost of production. Just like any drug developed for humans, this treatment must go through regulatory approval for use in cats. Michelson Found Animals recently met with the Center for Veterinary Medicine at the U.S. Food and Drug Administration to begin the regulatory approval process. Between the manufacturing needs and regulatory process, we anticipate a commercially-available product is years down the road. Nonetheless, this breakthrough represents a major milestone toward humanely reducing free-roaming cat populations and eliminating the shelter euthanasia of healthy cats. (*This work was funded by the Joanie Bernard Foundation and the Found Animals Michelson Prize & Grants in Reproductive Biology.)*

CaraCALLING all Males!

Caracals are small savannah cats with populations in Africa, the Arabian Peninsula, and Northern India. Understanding their reproductive biology is crucial to maintaining populations in the wild and in our zoos, but virtually no caracal reproductive data exist. In 2019, CREW committed to characterizing the male side of caracal reproduction in collaboration with the Oregon Zoo, who was investigating the female side. Although COVID temporarily put a halt on assisted reproduction across our cat species, we were able to reinitiate this important study in November 2022. In just six short months, scientists from CREW's Team Cat traveled to nine zoos in eight states to collect semen from every single male in the Association of Zoos and Aquariums (AZA) caracal population. Our study demonstrated that high-quality spermatozoa could be collected consistently from caracals using standard electroejaculation procedures previously established in felids. The semen samples were used to characterize the basic seminal traits of caracals and investigate the effects of three sperm cryomedia utilizing heterologous in vitro fertilization to test sperm function post-thaw. Additionally, a caracal genome resource bank was established within CREW's CryoBioBank, which can provide frozen sperm for future artificial insemination procedures while serving as a safeguard against the loss of genetic diversity. CREW has championed the advancement of assisted reproductive technologies in many small cat species. The caracal represents the last small cat in AZA zoos to be investigated. This study has laid the foundation for further progress in caracal reproduction and population management and helps secure a future for this charismatic species.

Making America SAFE for Ocelots



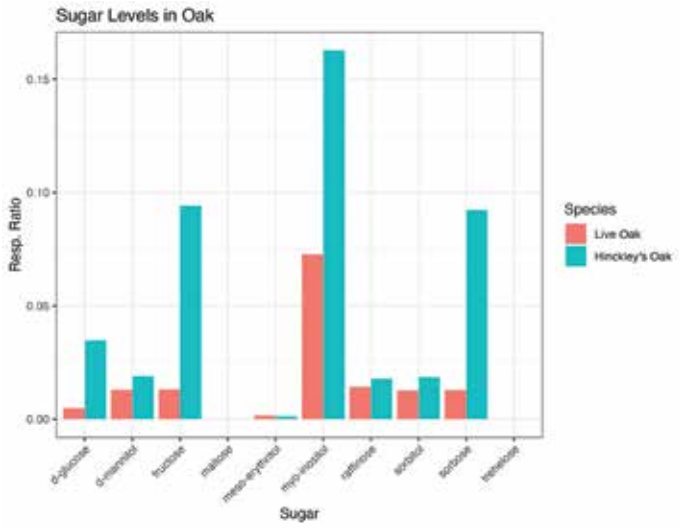
Of the four wild cat species currently found in the United States, ocelots are the closest to extinction on a regional basis, with just 60-80 cats surviving in fragmented habitats in southern Texas. Recovery efforts over the past 40 years have done little to stem their decline with growing threats from habitat loss, inbreeding and climate change. Until recently, breeding ocelots in zoos had no defined role in preventing the extinction of America's last ocelots. Now, however, through the dedicated efforts of a host of conservation-minded government agencies, universities and private institutions in Texas, zoo-managed ocelots are gaining greater importance for recovery efforts. Zoo involvement in Texas ocelot recovery is multifactorial, including serving as a source population for a new breeding facility in Texas, assisting with ocelot breeding and husbandry, advising on genetic management and assisted reproduction, raising funds to support recovery efforts, and educating the public about ocelot conservation. One essential component is the creation of an Ocelot Saving Animals From Extinction (SAFE) program within the Association of Zoos & Aquariums. Led by CREW's Dr. Bill Swanson, Ocelot SAFE will coordinate zoo activities in cooperation with other SAFE program partners. One goal of Ocelot SAFE is to use both assisted and natural reproduction to interbreed zoo-sourced ocelots with their wild counterparts, with five years of funding support provided by a federal grant. Eventually, the ocelots produced from this breeding program will be habituated to the wild and released onto expansive ranchlands in South Texas, helping to make America safe for wild ocelots well into the future.

The World's Most Endangered Cat: It's No Yolk!

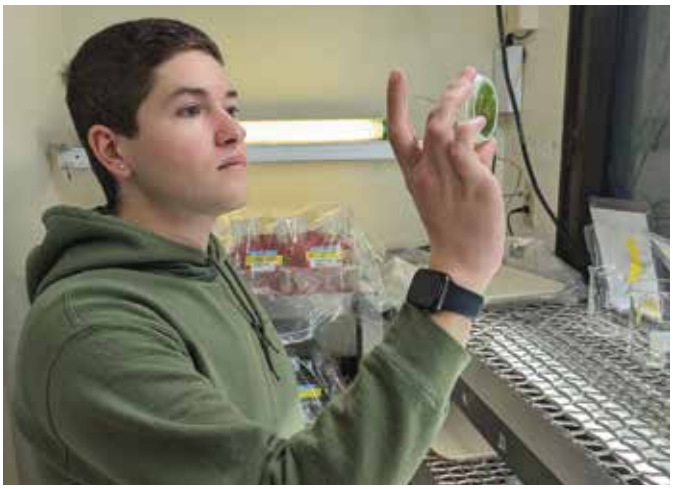
The Amur leopard is a critically endangered leopard subspecies that is only found in a small patch of mountainous forest habitat in the Russian Far East. With fewer than 40 individuals left in the wild, in situ conservation efforts are pivotal for the survival of this species. Semen cryopreservation is a critical component of the conservation management strategy, but current methods to collect and freeze sperm have yet to be assessed in this species. Our objectives were to (1) assess the feasibility of a new method of semen collection (urethral catheterization) and sperm cryopreservation (ultra-rapid freezing) with Amur leopards housed in zoos (both of the aforementioned techniques represent field-friendly alternatives to methods currently in use), and (2) compare a soy lecithin-based cryomedium to the standard egg yolk-based cryomedium for sperm cryopreservation (the use of egg yolk presents several problems such as variability in composition and microbial contamination). Our results demonstrated that urethral catheterization allowed recovery of a substantial number of sperm (on average 120 million motile sperm per collection), providing a more field-friendly semen collection option. Post-thaw sperm viability in both the soy lecithin-based cryomedium and ultra-rapid freezing medium was comparable to that in the egg yolk-based medium, providing two new animal protein-free sperm cryomedia alternatives. Ultra-rapid freezing has the additional benefit of providing a more rapid, simplified cryopreservation option to standard straw freezing methods. Collectively, these findings represent advances in simplicity, quality control, and biosecurity for Amur leopard semen banking and should enhance its application for in situ population management of this imperiled felid. *(This project was made possible, in part, by the Institute of Museum and Library Services National Leadership Grant #MG-245393-OMS-20.)*

Plants Turn to Sugar During Stress

Plants convert the sun's energy into sugar, sustaining all life. But plants contain many types of sugars: mono-, di-, tri-, oligo-saccharides, sugar alcohols, and sugars bonded to hormones, and each plays a unique role in the life of the plant. For example, certain sugars, primarily di- and tri-saccharides, are a key component of stress tolerance. They help seeds survive extreme drying (important in seed banking) and accumulate in buds as they prepare for the cold of winter. Similarly, cryopreservation protocols include high levels of the disaccharide sucrose in the cryoprotectant solutions to protect plant tissues during freezing in liquid nitrogen. But what about the actual sugars inside the shoot tips we try to cryopreserve? Do they factor into tissue survival? To answer that question, multiple samples of 13 tissue types from 9 species in CREW's in vitro collection were sent to the Center for Agricultural and Life Sciences Metabolomics (CALM) lab at the University of Kentucky to measure 11 different sugar concentrations. Samples included tissues that grew abnormally in culture, came from diverse habitats, and/or exhibited varied survival following cryopreservation. Among the results, Hinckley's oak, which does not survive cryopreservation well, had much higher levels of sorbose, fructose, glucose (all mono-saccharides), and myo-inositol (a sugar alcohol) than live oak cultures, which do survive. Thus, the proportion of di- and tri-saccharides may be key to survival. These interesting results form the basis of future plant sugar studies CREW's Plant Division has planned. By looking inside the tissues, we hope to get a clearer picture as to why some species survive cryopreservation, whereas others do not. *(This work was funded by a grant from the Basis Foundation.)*



Learning to De-Stress: Improving Oak Survival by Inhibiting a Stress Hormone



Every spring for the past three years, Max Winkeljohn, CREW graduate researcher, ventured out onto zoo grounds, to Spring Grove Cemetery & Arboretum, and as far as The Morton Arboretum in Chicago, to collect fresh growth from mature oak trees. As part of his dissertation work, Max was interested in using these cuttings to start oak tissue culture lines, which could be used to test whether a compound called silver thiosulfate (STS) could make culture initiation, which has a low success rate with many oak species, more successful. STS inhibits the action of the plant hormone ethylene, which is produced in response to stress and can inhibit tissue growth. Once shoots were brought back to the lab, they were sterilized in a bleach solution and the tips were placed into tubes of culture medium, some of which included STS. Survival and growth of the shoots were measured over the course of several months and results were mixed. For example, the Pin Oak *(Quercus palustris)* had a nearly 100% survival rate without the STS, so there wasn't much room for improvement, but for others, such as the 400-year-old White Oak *(Q. alba)*, the oldest tree at Spring Grove, the survival rate increased by 40%! Based on Max's work, CREW now is testing the effects of STS on culture initiation of several threatened oak species as part of its IMLS-funded project. The results from the first year's collections confirm that STS does increase survival in some species and helps establish oak shoots in culture. Those cultures are important as they will provide tissues for cryobanking in the Frozen Garden of CREW's CryoBioBank.

Oaks From Around the U.S. Settle in at CREW

CREW's Plant Division has been busy since last spring with its IMLS-funded oak research. Since March 2023, we've received 91 genotypes of eight oak species, and we've used these to initiate over 1,200 tubes of oak cultures! We've acquired these samples through collaborations with 18 partner organizations across the United States, from Texas to Minnesota. Partner organizations have ranged from major botanic gardens and arboreta, like the Atlanta Botanic Garden, Missouri Botanical Garden, and Dawes Arboretum, to smaller entities, including an individual in Illinois who sent us samples from her 250-year-old Burr oak. We'll receive samples of these same trees each year for a total of three years to determine how genetic, landscape, and climate differences may affect oak culture initiation. After comparing four new sterilization techniques with our standard method, we were able to reduce contamination and browning in our new cultures by nearly 20%. We also compared two commonly used antimicrobial media additives and found that one combination, the fungicide Benlate in conjunction with an antibiotic, controls fungal contamination much better than the broad-spectrum biocide/fungicide Plant Preservative Mixture (PPM) – although PPM appears to control bacterial growth fairly well. Building on our graduate researcher Max's work, we have also found that STS improved oak culture initiation in about half the species studied, although data from additional years of the study should clarify whether these species' responses are consistently significant or not. *(This project was made possible, in part, by the Institute of Museum and Library Services National Leadership Grant #MG-252118-OMS-22.)*

Cycad Embryos: Slow but Sure

Last year, CREW's Plant Division initiated tissue culture lines from multiple species of cycads which are considered the most endangered plant group in the world. The goal of the project was to produce somatic embryos, which are embryos that can be produced clonally by hormone stimulation of plant tissues such as leaves or stems. Over the course of several months, many of the cultures formed spherical structures that appeared to be proembryos, but then, the proembryos just sat. . . and sat. Some of them produced more proembryos, but they showed no signs of progressing in development. Finally, this summer, the first embryos emerged! The embryos are *Ceratozamia robusta*, an endangered cycad from Mexico and Guatemala. This exciting development proved that the structures we were seeing were truly proembryos and should be capable of eventually growing into full cycad plants. However, like the proembryos, the embryos are developing at a very slow pace growing perhaps a few millimeters per week. However, this sluggishness mirrors that of cycad seed embryos which can take anywhere from 6-18 months to develop fully. Meanwhile, this study has already proven that proembryo structures can be produced in multiple cycad species which will be significant if the embryos or proembryos can be cryopreserved. Cycad seeds cannot be seed banked, so cryopreservation may be the best way to conserve the biodiversity of threatened cycads into the future. *(This project has been funded by BGCI's Global Botanic Garden Conservation Fund and the Basis Foundation.)*

American Institute of Rhinoceros Science (AIRS):
A Model for Saving Species With Science *Ex Situ*

AIRS – by the Numbers

As the team completes its second year working on AIRS, we continue to be inspired by the outpouring of support from the rhino community. The numbers paint the story better than words. Below is a glimpse of our progress as we march towards our goal of producing science-based, affordable, and feasible management recommendations for monitoring and controlling physical condition, iron overload, and reproduction while ensuring optimal rhino wellbeing. *(AIRS is made possible, in part, by the Institute of Museum and Library Services National Leadership Grant #MG-249011-OMS-21.)*

70 PARTNERS

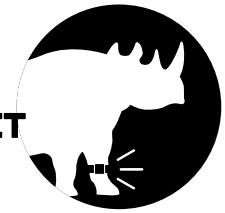
167 WHITE RHINOS

54 BLACK RHINOS

42 FACILITIES VISITED

>1500 FECAL SAMPLES

>75 RHINOS HAVE WORN AN ANKLET



>70 RHINOS TESTED WITH NOVEL OBJECT

>60 HORNS SAMPLED

AmeriCorps in Service to Rhinos – by the Numbers

CZBG recently expanded their AmeriCorps vision of service to encompass not only service to humans, but also service to the greater environment. Under that broader umbrella, CREW has been fortunate to have AmeriCorps service member Caitlin Consago working in service to conservation focusing on the AIRS project. Coming to CREW from Mississippi State University with a degree in Wildlife, Fisheries, and Aquaculture Science, Caitlin has provided much-needed support to not only the AIRS project but also the Polar Bear and Cat *Signature* Projects. In her service of **1700** hours at CREW this past year she has accrued some impressive numbers. She has processed over **2300** fecal samples(!), evaluated over **170** slides for sperm viability, acrosome integrity, and motility, and run close to **100** fecal hormone assays independently, generating valuable data for the AIRS project. In addition, Caitlin has been extremely helpful in managing our endocrine lab volunteers and Zoo Academy students for **950** hours of time. Although Caitlin's service has been very instrumental to CREW and AIRS, it has also been rewarding enough to her that she has agreed to join us for another year giving her **2** full AmeriCorps service years before heading to graduate school. We are very grateful to be a part of the AmeriCorps program, and the numbers speak for themselves about the impact the program has had through Caitlin.

Taking to the Air for AIRS

Greetings from Canada, eh! As I write this, I (Parker) am currently on the road for AIRS. Essential to the AIRS project is in-person data collection at almost every participating zoo during both winter and summer seasons. The three AIRS graduate students have certainly done their share of site visits, but with so many partners and rhinos participating in AIRS, more help was needed. Therefore, I stepped up to the task of covering zoos in California and Canada. In addition to being crucial to the project, these trips provide additional benefits beyond the data alone. They give us the chance to build relationships with the zoos and people that care for rhinos. Trip activities include morphometric measurements, bioimpedance readings, resting heart rate, activity tracking devices, behavior observations, nocturnal video recording, and a novel object test. Completing all of these tasks is challenging given the keepers' already busy daily schedules, but it is amazing to work alongside such committed caretakers who go above and beyond to help with this project. Behavior observations (ten 30-minute sessions on each rhino) are the most time-consuming, especially when a lot of rhinos are involved, and limit how quickly I can move from one zoo to the next. To reduce costs, I string as many zoos together regionally as possible which means long periods of time away from home at the Wilds. However, these AIRS trips have been an incredible experience. I have met some of the most dedicated keepers and wonderful rhinos in our care, and it helps to know that all of this effort is for them. *(AIRS is made possible, in part, by the Institute of Museum and Library Services National Leadership Grant #MG-249011-OMS-21.)*

What's Good for the Cat and Bear is Good for the Rhino, or is it?

CREW scientists have typically used electroejaculation (EEJ) to collect semen from rhinos, but urethral catheterization (UC) is often used in cats and always used in polar bears since EEJ is ineffective in the species. In recent years, UC has been gaining popularity in rhinos too. CREW scientists have begun to compare data on these two methodologies as part of their effort to determine the pros and cons of each. EEJ involves using specialized equipment and multiple trained personnel, whereas UC requires simple catheters and fewer people. Both procedures tend to be performed opportunistically when a rhino has been sedated for another procedure (e.g., physical exam, dental work, etc.). However, EEJ often stimulates body movements so it typically is performed after other procedures which can prolong the immobilization period. No body movement has been observed during UC, and the procedure takes no more than 10-15 minutes. Sperm collected via UC share a lot of the same characteristics as EEJ samples; total motility, concentration, pH, and osmolality are comparable, but the amount recovered via UC tends to be lower than that via EEJ which means fewer total sperm collected. Regardless, on several occasions, UC samples have contained enough sperm for cryopreservation and possibly even for artificial insemination. However, unlike most EEJ samples, almost all UC samples have been contaminated with urine, which is concerning as urine will affect the quality of sperm and survivability after freezing. Therefore, CREW scientists are now testing media supplements and processing techniques that may buffer the sperm from the deleterious effects of urine in UC samples in hopes of providing researchers and rhino caretakers an adequate alternative to EEJ for rhino semen collection. *(This project is made possible, in part, by the Institute of Museum and Library Services National Leadership Grant #MG-249011-OMS-21.)*

Bearing Great News!

Scientists at CREW hit the honey pot by receiving a prestigious National Leadership Grant from the Institute of Museum and Library Services in the amount of $649,060. By building on over a decade of polar bear research, they'll soon be expanding the Polar Bear *Signature* Project to include other threatened and endangered bear species, including Andean and sloth bears. But that's bearly scratching the surface! Activities will include reproductive monitoring via fecal and serum hormone analyses, developing assisted reproductive technologies such as semen collection and cryopreservation, and establishing a gold-standard protocol for fertility assessments including progressive diagnostic approaches like endometrial biopsies. An innovative facet of the project involves the characterization of extracellular vesicles (EVs), which are circulating nanoparticles recently identified as one of the most promising reservoirs of disease biomarkers. Bear with me. By characterizing EVs throughout pregnancy and comparing them in pregnant versus pseudopregnant individuals, the elusive pregnancy test conundrum might finally be resolved. The suspense is unbearable! The initiative also incorporates educational components, creating a Post-Doctoral Scientist and three consecutive IMLS Scholar positions who will get their bearings in the laboratory. Trainee stipends will be provided to mitigate financial beariers and promote broader participation in zoological research. Additionally, funds will strengthen collaborations between CREW and scientists at the Memphis Zoo studying giant panda reproduction, providing invaluable cross-training opportunities. Through dedication to advancing scientific research and the utilization of innovative methods, CREW scientists will bear down on contributing to the conservation of bear species around the world. *(This project was made possible, in part, by the Institute of Museum and Library Services grant #MG-253001-OMS-23.)*

Polar Bears Can Catch Colds, Too

Studying the immune systems of endangered species can provide crucial information on the health and persistence of wild populations. Cytokines, which are hormones produced by immune cells, regulate inflammatory responses to infection and can increase in the blood during sickness as much as 1000 times normal concentrations. However, measuring a single cytokine provides limited information on how an animal's immune system is functioning. Seeking to better understand polar bear immune function and health, CREW scientists are utilizing Luminex© multiplexing technology to measure cytokine levels in polar bear serum. Multiplexing revolutionizes this process by allowing the measurement of multiple cytokines from a single sample, conserving valuable banked serum resources while providing a more comprehensive understanding of polar bear health. Through funding from IMLS, CREW scientists have tested and successfully measured eight cytokines in 450 polar bear blood samples (totaling 3600 data points!) to examine how environmental factors (such as latitude or season) and individual traits (such as age, sex, or health status) affect polar bear immune function. Preliminary data indicate that polar bears with a history of health issues, such as liver disease or cancer, exhibit substantially elevated cytokine levels which may similarly serve as useful indicators of illness in wild populations. Measuring immune function across the lifetime of individual polar bears will help scientists identify patterns or trends and may eventually help inform decisions regarding population management and veterinary care while contributing to the broader understanding of their wild counterparts. *(This project was made possible, in part, by the Institute of Museum and Library Services grant #MA-249327-OMS-21.)*

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Ms. Diane R. Vogelsang
Mr. Thomas C. Vogelsang
Jerry and Katherine Warner
Ken Weaver
Reid and Karen Wells
Robert Werdman
Ms. Joyanna Wesche-Blake
Drs. Jeffrey T. and Kyra R. Whitmer
Dr. and Mrs. Jeffrey A. Whitsett
Mr. Steven Zusman

** Deceased*

SCIENTIFIC HIGHLIGHTS

PEER-REVIEWED PUBLICATIONS

Brandhuber M, S Atkinson, C Cunningham, **T Roth** and **E Curry.** 2023. Assessing dehydroepiandrosterone sulfate (DHEAS) as a novel biomarker for monitoring reproduction in polar bears. General and Comparative Endocrinology 338:114276, doi: 10.1016/j.ygcen.2023.114276.

Carroll RA, ES Rice, WJ Murphy, LA Lyons, L Coghill, **WF Swanson,** KA Terio, T Boyd and WC Warren. 2022. A novel fishing cat reference genome for the evaluation of potential germline risk variants. bioRxiv 2022.11.17.516921, https://doi.org/10.1101/2022.11.17.516921.

Curry E, ME Philpott, J Wojtusik, WD Haffey, MA Wyder, KD Greis and **TL Roth**. 2022. Label-free quantification (LFQ) of fecal proteins for potential pregnancy detection in polar bears. Life 12:796, doi: 10.3390/life12060796.

Gonzalez R, A Miller, LM Vansandt and **WF Swanson.** 2023. Characterization of basal seminal traits and semen cryopreservation in Canada lynx *(Lynx canadensis)*. Theriogenology Wild 2 100026, https://doi.org/10.1016/j.therwi.2023.100026.

Maynard L, B Cadena, T Thompson, **V Pence, M Philpott,** M O'Neil, M Pritchard, J Glenn, B Reilly, J Hubrich, and D Jenike. 2023. Local plant and insect conservation evaluated with organizational identity theory. Journal of Zoological and Botanical Gardens 4(1):214-230, https://doi.org/10.3390/jzbg4010019.

Philpott M, VC Pence, B Bassüner, AS Clayton, EED Coffey, JL Downing, CE Edwards, R Folgado, JJ Ligon, C Powell, JF Ree, AE Seglias, N Sugii, PJ Zale and J Zeldin. 2022. Harnessing the power of botanical gardens: Evaluating costs and resources needed for exceptional plant conservation. Applications in Plant Sciences 10(5), https://doi.org/10.1002/aps3.11495.

Philpott M, VC Pence and EED Coffey. 2022. Building capacity in the conservation of exceptional plant species. Applications in Plant Sciences 10(5), https://doi.org/10.1002/aps3.11498.

Rispoli LA and **TL Roth**. 2023. Validation of the iSperm for assessing rhinoceros sperm. Theriogenology Wild 3:100048, https://doi.org/10.1016/j.therwi.2023.100048.

Ross GM and **VC Pence**. 2023. Shoot-tip cryopreservation for oak conservation. The Journal of the International Oak Society 34:149-158.

Roth TL, EM Donelan, LA Rispoli and T Reilly. 2023. Prolactin enzyme-linked immunosorbent assay for rhinoceroses–another tool for assessing reproductive function and dysfunction in this taxon. Theriogenology Wild 2:10035, doi: 10.1016/j.therwi.2023.100035.

Rzucidlo C, **E Curry** and M Shero. 2023. Non-invasive measurements of respiration and heart rate across wildlife species using Eulerian video magnification of infrared thermal imagery. BMC Biology 21:61, doi: 10.1186/s12915-023-01555-9.

Vansandt LM, M Meinsohn, P Godin, N Nagykery, N Sicher, M Kano, A Kashiwagi, M Chauvin, HD Saatcioglu, **JL Barnes, AG Miller, AK Thompson, HL Bateman, EM Donelan, R González, J Newsom,** G Gao, PK Donahoe, D Wang, **WF Swanson** and D Pépin. 2023. Durable contraception in the female domestic cat using AAV9 delivery of a feline AMH transgene. Nature Communications 14:3140, https://doi.org/10.1038/s41467-023-38721-0.

Winkeljohn M. 2023. Improving shoot survival in vitro through ethylene inhibition. The Journal of the International Oak Society 34:159-164.

Winkeljohn M, VC Pence, and TM Culley. 2022. Improving culture initiation of mature oak shoots through use of silver thiosulfate. Applications in Plant Sciences 10:11497, https://doi.org/10.1002/aps3.11497.

SCIENTIFIC PRESENTATIONS

Barnes JL and **LM Vansandt.** 2023. Improving the art of semen banking in the Amur Leopard *(Panthera pardus orientalis)*. Society for Theriogenology Annual Conference, Birmingham, AL. Platform presentation.

Curry E, E Donelan, D Sabo, N Smith and **T Roth.** 2023. Timing of physiological and behavioral estrous following gonadotropin treatment in polar bears. Reproduction, Fertility and Development 35(2):139. International Embryo Transfer Society 49th Annual Conference, Lima, Peru. Poster presentation (virtual).

Pence VC and **M Philpott.** 2023. Adventitious bud clusters can increase tissue cryopreservation efficiency: A case study of Gesneriads. The IV International Symposium on Plant Cryopreservation, Oslo, Norway. Oral presentation.

Philpott M. 2023. Trees in test tubes: Using biotechnology to save species. Sustainable Urban Landscapes Symposium, Cincinnati, OH. Oral presentation.

Philpott M and **VC Pence.** 2023. Cryopreservation of the endangered Hawaiian fern *Asplenium peruvianum* var. *insulare* using green globular bodies. IV International Symposium on Plant Cryopreservation, Oslo, Norway. Oral presentation.

Reeves AM, **WF Swanson**, L Schofield, T Campbell, CD Hilton, ME Tewes, N Szafranski, R Gerhold and DL Miller. 2023. Assessment of health status and pathogen prevalence in free-ranging ocelot *(Leopardus pardalis)* and bobcat *(Lynx rufus)* populations of southern Texas. Wildlife Disease Association Conference, Athens, GA. Poster presentation.

Rodrigo ML, J Wojtusik and **E Curry.** 2022. The analysis of fecal PGFM concentrations as a pregnancy marker for polar bears *(Ursus maritimus)*. Association of Zoos and Aquariums Annual Conference, Baltimore, MD. Poster presentation.

Rzucidlo CL, **E Curry** and MR Shero. 2022. Validation of infrared thermography for non-invasive assessment of animal vital rates across wildlife species. International Council for the Exploration of the Sea North / Pacific Marine Science Organization Early Career Scientist Conference, St. John's, Newfoundland, Canada. Poster presentation.

Swanson WF. 2023. Integration of reproductive sciences into conservation of imperiled felid species. Special Species Symposium, College of Veterinary Medicine, Cornell University, Ithaca, NY. Invited oral presentation.

Vansandt LM. 2023. Vectored Contraception: Utilizing AAV-MIS as a single injection sterilant. Alliance for Contraception in Cats & Dogs Council of Stakeholder's Briefing, Crystal Beach, FL. Invited oral presentation.

Vansandt LM. 2023. A tale of two kitties: what ART in wild felids can teach us about the domestic cat. Society for Theriogenology Annual Conference, Birmingham, AL. Invited oral presentation.

Wojtusik J and **E Curry.** 2023. Validation of a multiplex immunoassay for characterization of follicle stimulating hormone, luteinizing hormone, prolactin, and growth hormone in polar bear *(Ursus maritimus)* serum. Society for the Study of Reproduction 56th Annual Meeting, Ottawa, Canada. Poster presentation.

GRANTS AWARDED

Funding Source: The Institute of Museum and Library Services. Project: Innovative reproductive assistance for overcoming sustainability challenges with bear populations in zoos. Role: Principal Investigator. Duration: 9/1/23 - 8/31/26. Amount: **$649,060.**

Funding Source: U.S. Fish and Wildlife Service. Project: Impacts of the US Customs and Border Wall on Wildlife, Wildlife Habitats, and Endangered Species Recovery. Role: Subrecipient Principal Investigator. Duration: 9/22 – 10/27. Amount: **$533,000.**

Funding Source: Botanic Gardens Conservation International and US Forest Service. Project: Evaluation of the genetic diversity of a micropropagated outplanting of the rare plant Minuartia cumberlandensis in Daniel Boone National Forest. Role: Principal Investigator. Duration: 7/1/23-8/1/24. Amount: **$8,307.**

Funding Source: Basis Foundation. Project: Doing more with less. Role: Principal Investigator. Duration: 1/1/23 – 12/31/23. Amount: **$6,100.**

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Help us in our mission of Saving Species with Science!

CREW WISH LIST

SHED – The plastic shelves in the current shed are subject to fall at random. A shed upgrade is much needed to (safely) store the Plant Division's pots and tools without having to worry about everything crashing down! **Cost: $2,500.**

MULTICHANNEL, ADJUSTABLE PIPETTE – Given the thousands of samples analyzed each year by the Animal Division, we are always looking for ways to gain efficiency, and this pipette will do just that. **Cost: $2,224.**

CAT COLONY FACE LIFT – Our animal holding area is long overdue for a fresh coat of paint and general spruce up. Help us give our kitties (and animal care staff) a little extra cheer in their day. **Cost: $1,500.**

TRAVEL CENTRIFUGE – A much lighter and more versatile centrifuge than the current one that Team Rhino uses when on the road. **Cost: $1,200**

TRAVEL WARMER – To lighten the load when traveling for semen collections, this device would replace the much heavier version currently in use. **Cost: $900**

IPAD – This tablet will be used by the Plant Division for fast data entry when initiating new plants, mobile data entry, tracking inventories, and preparing outreach materials. **Cost: $600.**

HOSE CART – This item will eradicate the risk of trampling plants while trying to wield a large hose from the back faucet to the front beds. **Cost: $220.**

TRAVEL VORTEX MIXER – A lightweight device for mixing solutions when traveling to other facilities. **Cost: $200**

SPADE – This spade will make digging a breeze and will save us from back pain in the long run! **Cost: $160.**

AZA Research Award Top Honors Bestowed Upon the Cincinnati Zoo & Botanical Garden

At the 2023 AZA Annual Conference, the Cincinnati Zoo & Botanical Garden received the AZA Research Award for its decades-long work using science to overcome the challenges associated with breeding Sumatran rhinos. The research was led by CREW scientists with essential support and assistance provided by the Zoo's dedicated rhino keepers. Ultimately, an international team effort resulted in the successful births of six calves, three in Cincinnati and three in Indonesia, with more on the way. CREW Director Terri Roth and Senior Keeper Paul Reinhart were present in Columbus, OH to receive the award on behalf of the Zoo.

About the award: *The Association of Zoos and Aquariums recognizes exceptional efforts to advance the body of scientific knowledge that contributes to our collective mission. Top Honors are awarded to a project that has garnered significant results/application, is still ongoing, demonstrates the use of novel methods or technologies to address significant research questions, and has already had clear implications for science or applied purposes.*

Cincinnati Zoo & Botanical Garden
Center for Conservation and Research of Endangered Wildlife
3400 Vine Street
Cincinnati, Ohio 45220

A TOAST TO THE WILD

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CREW would like to thank our generous sponsors, the best volunteers and the Cincinnati community for their support of another WILDLY successful Toast to the Wild event series. Each event in the series helps CREW to further its mission of Saving Species with Science®.

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