Saving Species With Science®

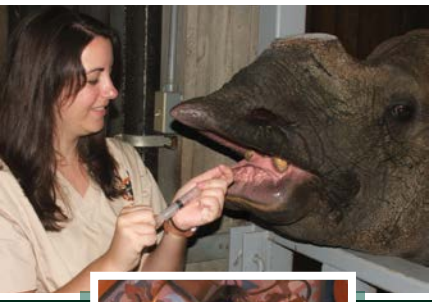
CREW ReView

Lindner Center for Conservation and Research of Endangered Wildlife

Cincinnati Zoo & Botanical Garden • Fall 2019








Roth's Remarks

Dr. Terri L. Roth
VP of Conservation & Science and Director of CREW

CREW Interns Move Up as They Move on

Although CREW has long touted the success of its post-doctoral training program, in recent years, more emphasis has been placed on developing professional internships for aspiring wildlife scientists still in the early formative years of their careers. These internships range in focus from wildlife lab management to a particular CREW *Signature* project (rhinos, cats, exceptional plants or polar bears) to a specific grant or study within a *Signature* project. In all cases, the interns have a chance to immerse themselves in the CREW culture, interact with scientists at all levels of the organization as well as volunteers and other interns, and observe many unique procedures at the Cincinnati Zoo and Botanical Garden, or beyond. All of these experiences are value added to learning, first-hand, many techniques that are employed at CREW to help save imperiled plants and animals from extinction. But, how do we know if the intern program is truly successful? Since internships are supposed to prepare individuals for the next step in their careers, we reviewed where our interns have landed after leaving CREW. We found several interns have moved on to jobs in similar fields at locations ranging from Disney's Animal Kingdom in Florida to SeaWorld San Diego in California and many locales in between (eg. Memphis Zoo, TN, Longwood Gardens, PA, Lincoln Park Zoo, IL). Others chose to further their formal education as graduate students at various colleges including the University of Alaska Fairbanks, University of Tennessee, University of Cincinnati, Colorado State University and University of Alberta, whereas, still others completed veterinary school and are now engaged in clinical practice. We are pleased to report that the results of our review far exceeded our expectations. CREW interns certainly are moving upward as they move onward!

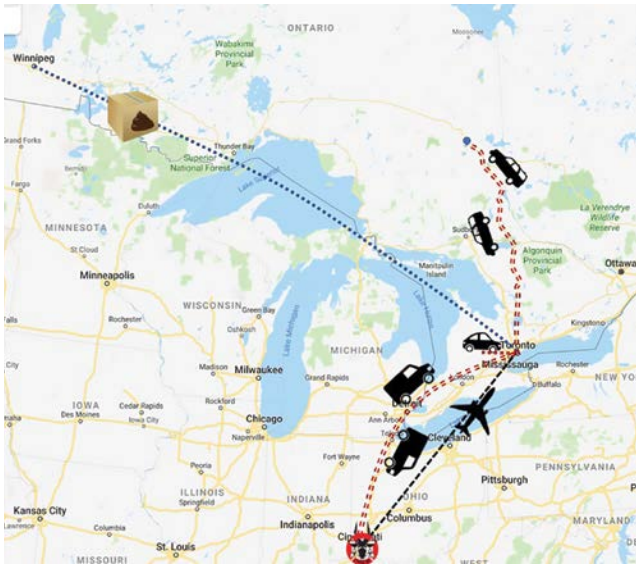
Where recent CREW interns have landed (n=34):

53% Advancing their university-based education
17.6% Conducting research in zoos or gardens
17.6% Practicing as veterinarians
8.8% Pursuing unknown adventures
3% Working in academia

POLAR BEAR *SIGNATURE* PROJECT UPDATES

A Great Brown Pick Up from the Great White North

How do you import valuable fecal samples from Canada if [not-to-be-named] shipping companies are notorious for losing samples shipped from Canada? This was a concern of CREW scientists who needed to receive ~3000 samples collected from polar bears at Canadian zoos as part of a 10-year project to better understand sexual maturation in this species. Fecal collections ended in December 2018, and frozen samples were stored at four different institutions throughout Canada, but the logistics of transporting them to CREW for analysis were challenging. Driving the entire route through Canadian backcountry would take approximately a week, but samples needed to remain frozen (so they couldn't be transported over multiple days). No single institution had adequate freezer space to store all samples temporarily. So, circuitous plans were made to orchestrate shipment dates within Canada - with pickups by CREW scientists to prevent samples from thawing while trying to minimize driving time. Details of the venture included: shipping 300 lbs of feces from Winnipeg to Toronto by air (~930 miles); transporting samples from the University of Guelph to the Toronto zoo by personal car (60 miles; one flat tire); a one-way flight to Toronto (490 miles); a round-trip drive from Toronto to Cochrane to retrieve samples (~950 miles); two rental cars (one per country); a brief detainment by U.S. customs (45 minutes); and driving back to Cincinnati (~260 miles) before the samples thawed. Clearly, CREW scientists are fortunate to work with committed collaborators at zoos around the world; without them, large-scale research projects such as this would not be possible.



A Foray with Feces from a Fur Farm

Reproductive monitoring of many wildlife species is hindered by the lack of an accurate, non-invasive test for diagnosing pregnancy. For example, polar bear pregnancy cannot be confirmed until cubs are born (or not). Consequently, there is growing interest in the exploration of fecal biomarkers which may be useful as diagnostic indicators of pregnancy; however, performing scientific studies on zoo-housed animals outside of a controlled laboratory setting can be challenging. Whereas those studying endangered cat species sometimes can utilize domestic cats, no suitable model species is known to exist for polar bears. Remarkably, mink (*Neovison vison*) appear to exhibit the same unique reproductive medley as polar bears: they are seasonal breeders, induced ovulators, experience embryonic diapause, and can exhibit pseudopregnancies. Therefore, the aim of a recent study by CREW scientists was to utilize farm-raised mink to evaluate changes in the fecal proteome associated with embryonic diapause and placental pregnancy in hopes that proteins would be different between pregnant and non-pregnant individuals. A total of 1500 fecal samples were collected from 50 mink maintained on a commercial fur farm and, using advanced proteomic technologies, 10 proteins were identified that differed in abundance between pregnant and non-pregnant mink at one or both stages of pregnancy. Moreover, one of these proteins previously had been identified as being higher in polar bear pregnancies as well, making it an exciting candidate to pursue as a diagnostic indicator of pregnancy. To our knowledge, this is the first study to investigate differentially excreted fecal proteins during embryonic diapause in any species.

2019 Charlotte R. Schmidlapp Scholar Investigates Fertility Test for Polar Bears

Ms. Adrianna (Adri) Tompros was selected from a competitive pool of candidates as the 2019 Animal Division Charlotte Schmidlapp Scholar - a unique opportunity granted by the Charlotte Schmidlapp Fund which sponsors the advancement of promising young women in STEM fields. Adri first joined CREW in 2018 as a Wildlife Laboratory Management intern in the endocrinology laboratory, where she excelled in her responsibilities. Originally from the Baltimore area, Adi earned her Bachelor's degree in Wildlife Biology from Colorado State University. As part of her undergraduate work, she spent time in Tasmania researching the burrow sharing behaviors of wombats, which resulted in her first scientific publication.

In her Scholar role, Adri evaluated an assay to measure anti-Mullerian hormone (AMH) in polar bear serum. In other species, AMH can be used to assess fertility, but it has never been characterized in any bear species. Adri successfully validated the assay and quantified AMH in dozens of samples banked over the past 20 years, generating baseline information on AMH in polar bears and how the circulating concentrations of this hormone differ by age, season, and sex. Results of her work may be useful in understanding the effects of contraception on the fertility of this species and may guide breeding recommendations, ensuring that fertile individuals are paired to increase chances of reproductive success. Additionally, a better understanding of AMH may be beneficial in monitoring wild bears whose fertility may be impacted by environmental pollutants. Adri plans to pursue a career in wildlife conservation and, this fall, she started working on her M.S. degree at the University of Tennessee.

CREW Scientists Moonlight as a Mobile Sperm Delivery Service

Artificial insemination (AI) in polar bears has yet to yield cubs, but with every attempt, our understanding of the procedure increases, and with it, our chances for future success. This spring, CREW scientists embarked on a trip to further our chances of a successful AI, by using fresh semen, within 24 hours of sample collection, for two females residing 150 miles apart. The first ever 'inter-state fresh polar bear semen delivery' adventure began at the Brookfield Zoo in Chicago, IL where CREW successfully collected high quality (~90% motile) semen from their male bear via urethral catheterization. The sample was packed in a cooler and we hit the road in our trusty sperm transporter (also known as the Cincinnati Zoo van). Following one quick pit stop at the Road Ranger gas station for sample processing and snacks, the CREW team arrived at the Henry Vilas Zoo in Madison, WI in the late afternoon of the same day and immediately jumped into an AI procedure for female bear, Berit, who moved from CZBG a couple years ago. The next morning, we drove back to Brookfield for a second AI procedure on their female bear. All three procedures went swimmingly: the collected semen maintained its high-quality for the first AI and though motility dropped a bit by the next day, we were able to supplement the sample with frozen semen from our CryoBioBank. It is far too soon to know if the procedures were successful, but here in Cincinnati we'll be keeping our fingers and our paws crossed for a pregnancy.

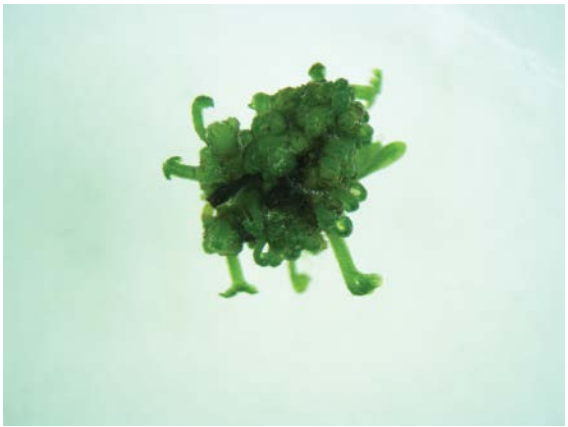
CREW's Front Door Face Lift

CREW's original garden August 1991; photo credit: Steve Foltz

CREW's Plant Division has been involved in many outplantings around the US, but this year we are working on repopulating our own front yard. CREW's Endangered Species Garden is undergoing a total make-over! First planted in 1991, upon completion of the CREW building, it was originally conceived to display four local habitats: wetlands, prairie, woodland, and rocky outcroppings. To illustrate the habitats, native species were included such as royal catchfly, lakeside daisy, prickly pear cactus, Short's goldenrod, and Tennessee coneflower. However, through the years, changes slowly occurred. The pond was removed, some species, like the Franklinia tree, did not survive, and some species overgrew their boundaries. Finally, in the fall of 2018, the Plant Division, including CREW's Greenhouse Manager, Alexia Callihan, and the Horticulture Department developed plans to revamp the garden from top to bottom. Several trees that had gotten too large had to go. Old soil was removed, and a liner for plants requiring wetter conditions was added. A base layer of new soil was added, and then specialized soil mixes were layered on top. The land was given some contour and graced with large rocks, some of which will create a grotto. As conditions cool, plants will be added, focusing on species that CREW has propagated and grown *in vitro* and many of which have been sent back to collaborators for growth and restoration projects. By spring of 2020, the new plantings and interpretive signage will help bring the story of these fascinating species closer to our visitors, illustrating CREW's work and the importance of conservation for their future survival.

From Lava Tubes to the Frozen Garden

One of the Hawaiian species the Plant Division is working on is the endangered *Asplenium peruvianum* var. *insulare*, a fern with a very interesting habitat. This fern is found on the islands of Maui and Hawai'i and lives almost exclusively in a very Hawaiian habitat – lava tubes and lava tree molds. Lava tubes are formed by molten lava flowing through previously hardened lava flows which form underground passageways. Lava tree molds form when molten lava encases trees and completely incinerates them – leaving a mold of the tree made completely from lava. To propagate this species *in vitro*, we took a page from our American hart's-tongue fern (*Asplenium scolopendrium*) protocol and induced tissues to form green globular bodies, which are 1-5mm clumps of tissue with multiple zones capable of producing a whole new plant. While these little clumps may look odd, GGBs from our Hawaiian fern have a 90% survival rate after cryopreservation and are much easier for us to isolate than shoot tips, which allows us to quickly bank more genotypes of this species. While this species may be losing habitat and population numbers in its natural environment, we're able to preserve it for future reintroductions in our Frozen Garden. It's just one of the many cool stories coming out of our IMLS collaboration with the Lyon Arboretum in Hawai'i!

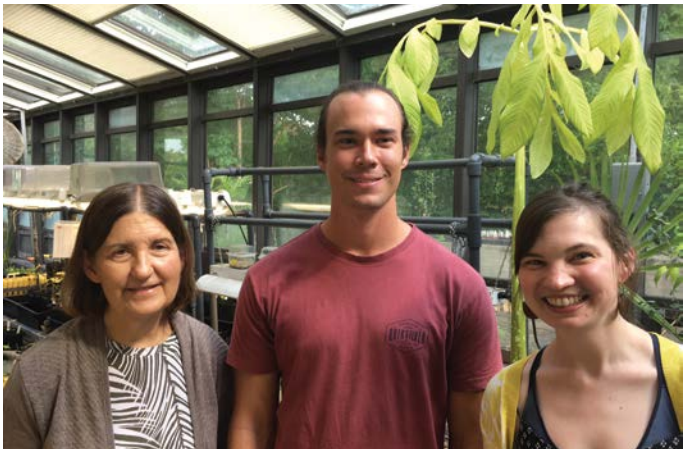


Plant Schmidlapp Scholar Tackles Oak Conservation

Some research projects are more difficult than others, and working on oaks is definitely one of the challenging ones. However, CREW's 2019 Plant Division Charlotte Schmidlapp Scholar Mandi Miller jumped in with enthusiasm to look at two aspects of conserving these exceptional species. Oaks have seeds (acorns) that cannot be stored in conventional seed banks, so CREW has been striving to develop tissue cryopreservation protocols for these species. Success will include developing protocols for propagating the plants *in vitro*, including establishing shoot cultures, the source of tiny shoot tips needed for liquid nitrogen (LN) storage. In addition, methods must be available for 1) assuring the survival of those tips in LN, and 2) recovering them as plants by propagating, rooting, and acclimatizing those shoots. Mandi chose to study rooting and the effects of the culture medium and STS, an inhibitor of the plant stress hormone, ethylene. She found that in some species of oaks, STS did indeed improve the percent of shoots that formed roots, and she also worked with staff to successfully acclimatize some of those rooted shoots back to soil. Mandi also explored the effects of cold pretreatment on tips before cryopreservation and obtained preliminary data suggesting that cold can improve survival after LN exposure. After helping to move the oak project forward at CREW, Mandi left to pursue a M.S. degree at the University of Colorado in Denver, working on plant conservation. Our thanks to the Charlotte R. Schmidlapp Fund for helping foster young women scientists who also contribute to the mission and research at CREW!

Training the Next Generation of Plant Conservationists

The Plant Research Division had a full house of interns this summer! For our Hawaiian IMLS project, intern Monroe Conner was able to bank nearly all of our collection of *Melicope mucronulata* and *Cyrtandra gracilis*. Natalia Ungashick undertook a population genetics study on *M. mucronulata* and found that a significant amount of genetic diversity was remaining in the ex situ collection of the species – while only four plants remain in the wild! Lauren Lautermilch helped us make headway in our efforts to develop protocols for preserving our oak species. She looked at the effects of several plant hormones on the growth of shoot tips *in vitro*. Sarah Fening, who was with us for 6 months, cryopreserved much of our collection of *Hedeoma todsenii* and finished our population genetic analysis of the species. Maribeth Stafford identified genetic markers for us to use in our new *Crotalaria avonensis* study in collaboration with Archbold Biological Station as we try to understand the extent of clonality in the species. Finally, we hosted an undergraduate student from the University of Hawai'i and Lyon Arboretum, Devon Gordon, for two weeks to teach him cryopreservation protocols as the Lyon Arboretum plans to set up their own cryobank. Devon was even able to bank three species for us during his short time here. It's clear from our recent batch of summer interns that the future is bright for plant conservation!



IMPERILED CAT *SIGNATURE* PROJECT UPDATES

Ocelots on Ice – Now Twice as Nice

Arizona Sonora Desert Museum

Back in 1995, a young post-doc at the Smithsonian's National Zoo experienced the thrill of his relatively brief tenure there by producing the first ocelot kitten ever born from artificial insemination (AI) – using frozen semen for the procedure. Fast forward 24 years and history finally repeated itself – twice over two days. That young post-doc, CREW's Dr. Bill Swanson, isn't quite so young anymore but, as Coordinator of the Ocelot Species Survival Plan (SSP), ocelots are still one of his conservation priorities. During the past two decades, CREW has improved its AI strategies for felids by modifying its protocols for semen cryopreservation, ovarian synchronization and laparoscopic insemination. Using a fixed-time laparoscopic oviductal AI approach, CREW has produced multiple pregnancies in domestic cats and several wild felid species in just the past few years. These efforts paid off for ocelots over two consecutive days in March with the birth of two litters and three healthy kittens following AI with frozen semen at the Arizona Sonora Desert Museum and the El Paso Zoo. The kittens' father had been imported from Brazil in 2006 by the Cleveland Metroparks Zoo where his semen was collected and frozen nine years ago by CREW. This male, now 16 years of age and currently housed at the Houston Zoo, has no other offspring and is the most genetically-valuable male ocelot within the SSP. Thanks to the birth of his three kittens from AI, his genetic legacy is now secured and will help to maintain the sustainability of the SSP population for years to come. (*Supported by a Collection Stewardship grant from the federal Institute of Museum and Library Services*).

El Paso Zoo

Conservation of Wild Texas Ocelots – Taking It to the Bank

Many Americans are surprised to learn that ocelots are native to the United States, once ranging across the breadth of Texas, but now surviving as a mere 80 cats in fragmented thorn-scrub habitat at the southern-most tip of the state. Genetic exchange no longer occurs among Texas subpopulations or with ocelots living in Mexico, leading to inbreeding and possible regional extinction. To help conserve the Texas ocelot, CREW has initiated a collaborative project involving the U.S. Fish and Wildlife Service (USFWS), Texas A&M University-Kingsville, East Foundation and University of Tennessee. Working with wildlife biologists and veterinarians at these institutions, the primary goal is to bank semen from as many wild ocelots as possible on both public and private lands, while concurrently characterizing their basal reproductive parameters. To achieve this goal, collaborators are learning CREW's field-friendly method of semen banking, using urethral catheterization to recover semen from anesthetized males followed by ultra-rapid freezing (URF) directly in liquid nitrogen. In April, this approach was used for the first time with a wild Texas ocelot by Dr. Hilary Swarts, a USFWS field biologist working in the Laguna Atascosa National Wildlife Refuge. Dr. Swarts collected a semen sample opportunistically from a young male ocelot and froze 48 semen pellets, containing almost 200 million sperm, that were shipped to CREW for storage in the CryoBioBank. Sperm motility after thawing of a sample pellet proved adequate to fertilize domestic cat oocytes in vitro, indicating that the frozen semen is potentially robust enough to use for artificial insemination. Collection and freezing of semen from additional males ultimately may help us to conserve these last few American ocelots – and you can take that to the bank!

Pregnancy Diagnosis in Cats: It's Not What You're Expecting

Diagnosis of pregnancy is an important aspect of assisted reproductive technology (ART) procedures at CREW. While ultrasonography remains the gold standard in felids, application of this technique requires extensive animal training—which may not be feasible for many institutions—or chemical restraint—which is not ideal for potentially pregnant individuals. CREW scientists routinely measure fecal progesterone concentrations in cats as a non-invasive alternative to ultrasound, but this hormone can remain elevated following ovulation in non-pregnant individuals for up to two-thirds the duration of gestation. This delay in pregnancy diagnosis creates uncertainty in planning for parturition and neonatal care. Moreover, fecal progesterone monitoring cannot distinguish between conception failure and post-implantation pregnancy loss, which is relevant for assessing both natural breeding and ART success. Because of these challenges, our recent research has focused on investigating alternative pregnancy markers, including a promising placental molecule with a convoluted name: 13,14-dihydro-15-keto-prostaglandin F2alpha metabolite (PGFM). CREW scientists have characterized fecal PGFM concentrations in two of our signature cat species: the Pallas' cat and sand cat. In the pregnant Pallas' cat, PGFM begins to increase 29-35 days before giving birth (or 9-15 days sooner than would be detected with progesterone). In the sand cat, the PGFM rise is much more variable, occurring 2-27 days before birth. In both species, these PGFM increases appear to be highly specific to pregnancy since similar elevations do not occur in non-pregnant cats. This diagnostic tool can allow earlier confirmation of pregnancy following natural breeding or AI, as well as identification of females that possibly conceive but fail to carry their offspring to term.

Progesterone – It's not Just for Artificial Insemination Anymore

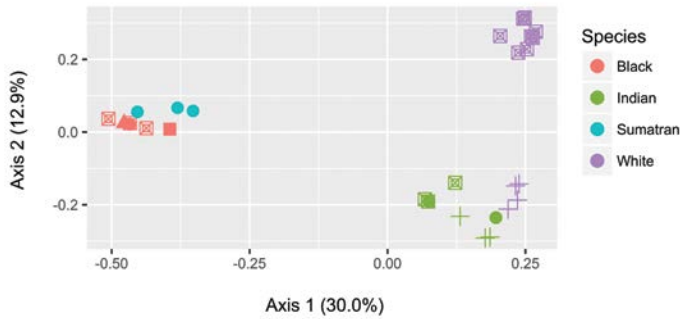
Progesterone is the hormone of pregnancy – produced by the female's ovaries and placenta to support embryo implantation and fetal development while concurrently inhibiting ovarian follicular growth. The latter attribute represents an essential component of our fixed-time artificial insemination (AI) protocol in cats. Using a synthetic progesterone or progestin (altrenogest), we suppress ovarian activity prior to hormone treatment. However, our use of progestins for addressing reproductive challenges in felids goes well beyond AI. For example, in ocelots, our extensive experience in using oral progestins for AI provided insight into developing a treatment option for cystic ovaries in a genetically valuable Brazilian ocelot at the Oklahoma City Zoo. With this female, a low dosage of daily oral progestin for 30 consecutive days was able to suppress cystic follicle growth and essentially "reset" her ovaries to resume natural cyclicity. Breeding by the male two weeks after treatment resulted in a pregnancy and the birth of a healthy kitten. Similarly, our ongoing studies investigating fixed-time AI in Amur leopards suggested a physiologically-suitable progestin dosage for providing hormonal support during pregnancy. A female Amur leopard at the Pittsburgh Zoo, with a history of repeated breeding and suspected pregnancy loss, was treated with daily oral progestin for the last 40 days of a confirmed pregnancy. She carried her offspring to term and, a few days after progestin withdrawal, gave birth to her first viable cub. Although the prescribed progestin treatment was based on knowledge gained from CREW's AI studies, in both cases, progestin played a crucial role in the birth of healthy offspring produced by natural mating and not AI.

A World's First Rhino Immersion Experience – Only at CREW!

Researchers involved in cutting edge reproductive science often proudly tout that they have produced the "world's first" this or that. Although such achievements are noteworthy, in conservation it is not the "first" but the "many" that are necessary for saving a species. Something accomplished once never to be repeated generally has little conservation impact. However, if a "world's first" significantly impacts many, there could be great value in that one particular creation. Charlotte, CREW's new interactive black rhino, is just such an invention. Charlotte offers kids and adults alike the opportunity to experience being a CREW rhino scientist…safely. Sheltered in CREW's Public Exhibit, Charlotte stands calmly while volunteers and educators teach program participants how rhinos are being trained by animal care staff at zoos across North America to stand voluntarily for rectal ultrasound exams, how ultrasound technology works, and why the information from these exams is so critical to CREW's rhino reproductive research. And then the moment comes when one or two lucky participants are chosen to actually perform a rectal ultrasound exam on Charlotte. Yes – complete with plastic sleeve! The ultimate goal of this "immersion" experience is to locate the rhino fetus with beating heart, and our program leaders make sure that no participant leaves disappointed. Our hope is that the Charlotte experience inspires many budding young scientists to pursue a career in conservation research. If Charlotte does that, the impact of this one unique creation could indeed help to save endangered species. *(This one-of-a-kind interactive exhibit was made possible by a generous donation from the Hilton Family in honor of Elisabeth and Reagan Hilton. Charlotte was created by American Visionary.)*

De-bugging Iron Overload Disease Susceptibility by Studying the Bugs

The gut microbiome (the hundred trillion friends you never knew you had) has received a lot of scientific attention in recent years because it plays a significant role in the overall health of organisms. Because two of the four rhino species are susceptible to iron overload disease (IOD), and iron gets absorbed from the diet in the intestine, the gut microbiome also is of interest to CREW scientists as a potential differential between IOD-resistant and IOD-susceptible rhino species. Furthermore, we know that interactions between an organism, iron availability and gut microbial populations can impact host health and susceptibility to disease. In a 5-yr collaborative research effort between CREW, Stanford University and Cincinnati Children's Hospital Medical Center, the rhino gut microbiome was characterized and compared among four rhino species, and the results were profound. We found a striking similarity in microbial community composition within IOD-susceptible black rhinos and Sumatran rhinos that differed significantly from that of the IOD-resistant rhino species (white and Indian) despite the fact that the IOD susceptible species live on two different continents with substantially different diets. Furthermore, the microbiota of black rhinos and Sumatran rhinos are much less diverse than those of the white and Indian rhinos, despite the fact that as browsers their diets are more complex and variable. It is well documented that diverse gut microbial composition is associated with better health. These initial, intriguing results support the hypothesis that gut microbiome may be involved with IOD-susceptibility in the rhinoceros taxon.



Data point locations demonstrate the similarities/ differences in gut microbiota between individual rhinos of four different species.

SCIENTIFIC HIGHLIGHTS

BOOK CHAPTERS

Ballesteros D and **VC Pence**. 2018. Fern conservation: spore, gametophyte, and sporophyte ex situ storage, *in vitro* culture, and cryopreservation. In: Fernandez H (ed), Current Advances in Fern Research. New York: Springer International Publishing AG, pp. 227-249.

PEER-REVIEWED PUBLICATIONS

Pence VC. 2018. Growth of fern gametophytes after 20 years of storage in liquid nitrogen. Fern Gazette 20:337-346.

Swanson WF. 2018. Practical application of laparoscopic oviductal artificial insemination for propagation of domestic cats and wild felids. Reproduction, Fertility and Development 31:27-39.

Wojtusik J, MA Stoops and **TL Roth**. 2019. Animal protein-free OptiXcell and shortened equilibration periods can replace egg yolk-based extender and slow cooling for rhinoceros semen cryopreservation. Cryobiology 89:21-25.

SCIENTIFIC PRESENTATIONS

Bateman HL and **WF Swanson**. 2019. Characterization of diapause and ovarian reactivation by non-invasive fecal progestin analysis in the fisher (*Pekania pennant*) and wolverine (*Gulo gulo*). Proceedings of the 3rd International Symposium on Embryonic Diapause, p. 30. Oral presentation, Ascona, Switzerland.

Bolton D, M Philpott and **VC Pence**. 2018. Genetic diversity of the federally endangered Avon Park harebells in *ex situ* and natural populations. 2018 Natural Areas Conference. Poster presentation, Bloomington, IN.

Brandhuber M, S Atkinson, **E Curry** and **TL Roth**. 2019. Excretion of dehydroepiandrosterone sulfate (DHEAS) in wild and zoo female polar bears. Alaska Marine Science Symposium. Poster presentation, Anchorage, AK.

Butler H, **T Roth** and D Agnew. 2019. Hepatic iron overload disorder in captive rhinoceros. National Veterinary Scholars Symposium. Oral presentation, Worcester, MA.

Butler H, T **Roth T** and D Agnew. 2019. Hepatic iron overload disorder in captive rhinoceros. Michigan State University's 28th Annual Phi Zeta Research Day. Poster presentation, East Lansing, MI.

Conner ME and **ME Philpott**. 2019. Genetic effects of small founding population size in an experimental outplanting of the endangered perennial *Minuartia cumberlandensis*. Botany 2019 meeting. Poster presentation, Tucson, AZ.

Counsell KR, JA Landero, **TL Roth** and **E Curry**. 2019. Identification and quantification of steroid hormones in polar bear (*Ursus maritimus*) feces by HPLC. International Society of Wildlife Endocrinology 7th International Meeting. Poster presentation, Kruger National Park, South Africa.

Curry E, JS Easley, **J Wojtusik** and **TL Roth**. 2019. Evaluating mink fecal proteins during embryonic diapause and placental pregnancy for non-invasive pregnancy diagnosis. 3rd International Symposium on Embryonic Diapause. Oral presentation, Ascona, Switzerland.

Curry E, MA Stoops and **TL Roth**. 2019. Fecal metabolite monitoring as a tool to assess sexual maturation in polar bears. Proceedings of the International Embryo Technology Society 45th Annual Conference. Reproduction, Fertility and Development 31:180. Poster presentation, New Orleans, LA.

Donelan EM, S Shuler, M Miller, A Moresco, E Ehmke, R Evans and **TL Roth**. 2019. Assessment of fecal progestogen and estrogen metabolites for reproductive monitoring in female aye-ayes (*Daubentonia madagascariensis*). International Society of Wildlife Endocrinology 7th International Meeting. Poster presentation, Kruger National Park, South Africa.

Gonzalez R, A Moresco, **A Miller**, **H Bateman**, **L Vansandt**, D Dembiec, A Ista and **W Swanson**. 2018. Assessment of reproductive traits and semen cryopreservation in servals (*Leptailurus serval*) and Canada lynx (*Lynx canadensis*). International Embryo Technology Society 45th Annual Conference. Reproduction, Fertility and Development 31:176. Poster presentation, New Orleans, LA.

Hall LM, **A Miller**, **SL Fritz**, **WF Swanson** and **LM Vansandt** 2019. Characterization of 13,14-dihydro-15-keto-prostaglandin F2-alpha metabolite (PGFM) in the Pallas' cat (*Otocolobus manul*) and sand cat (*Felis margarita*) as a non-invasive marker for pregnancy. Proceedings of the Annual Meeting of the American Association of Zoo Veterinarians. Poster presentation, St. Louis, MO.

Merritt BJ, **ME Philpott**, R Tunison, J Barreiro Sanchez, E Tepe, M Torres and T Culley. 2019. Receiving proper credit for research in developing countries: A study of co-authorship in plant conservation genetics. Botany 2019 meeting. Oral presentation, Tucson, AZ.

Pence VC. 2019. The need for cryopreservation in conserving seeds and vegetative plant tissues. 4th Xishuangbanna International Symposium. Saving All Plants in a Changing World. Invited speaker. Xishuangbanna Tropical Botanic Garden, Xishuangbanna, China.

Pence VC, RP Niedz, **LR Finke**, **JM Wedig**, AR Pinhas and RT Voorhees. 2019. A multi-species evaluation of factors affecting growth and phenotype in vitro. In Vitro Cellular and Developmental Biology 55:522. Invited speaker, Tampa, FL.

Philpott ME. 2019. Cryobiotechnology for the Conservation of Endangered Hawaiian Plants. International Plant Propagators Society Eastern Region meeting. Oral presentation, Cincinnati, OH.

Philpott ME and **VC Pence**. 2019. Cryobiotechnology for conservation and storage of endangered exceptional Hawaiian plant species. CRYO2019. The 56th Annual Meeting of the Society for Cryobiology. Oral presentation, San Diego, CA.

Philpott ME and **VC Pence**. 2019. Cryobiotechnology for conservation and storage of endangered exceptional Hawaiian plant species. Botany 2019 meeting. Oral presentation, Tucson, AZ.

Philpott ME and **VC Pence**. 2019. Cryobiotechnology for preserving exceptional plants for the future: A case study of endangered Hawaiian species. Society for Economic Botany meeting. Poster presentation, Cincinnati, OH.

Roth TL. 2019. Saving Species on the Brink: Sumatran Rhino Rescue. 29th International Congress for Conservation Biology. Invited participant in National Geographic plenary discussion panel. Kuala Lumpur, Malaysia.

Roth TL. 2019. The quest for a reliable biomarker of iron overload disorder in the rhinoceros. Proceedings of the Annual Meeting of the American Association of Zoo Veterinarians. Poster presentation, St. Louis, MO.

Shellabarger W and **E Curry**. 2018. North American polar bear (*Ursus maritimus*) SSP veterinary advisor report. Proceedings of the 2nd Joint EAZWV/AAZV/Leibniz-IZW Conference. Poster presentation, Prague, Czech Republic.

Stoops MA, A Moresco and RS Larsen. 2019. Clinical assessment and treatment of infertility in a greater one-horned rhinoceros (*Rhinoceros unicornis*). Proceedings Society for Theriogenology Conference. Poster presentation, Savannah, GA.

Swanson WF, **RG Herrero**, **A Miller**, G Sturgeon, A Hahn, J D'Agostino, GA

SCIENTIFIC HIGHLIGHTS

Cole and **LM Vansandt**. 2019. Oral progesterone treatment facilitates improved reproductive management of wild felids. Proceedings of the Annual Meeting of the American Association of Zoo Veterinarians. Poster presentation, St. Louis, MO.

Vansandt LM, CH Adania, PR Yanai, JS Paulino, RCR Paz, **HL Bateman** and **WF Swanson.** 2019. Ovarian synchronization, ovulation induction, and successful artificial insemination in the jaguar (P*anthera onca*). 2019. Proceedings of the Annual Meeting of the American Association of Zoo Veterinarians. Poster presentation, St. Louis, MO.

Vansandt LM, **A Moresco**, **R Gonzalez**, **A Miller**, **J Newsom**, ME Iwaniuk, JR Herrick and **WF Swanson**. 2019. Sperm cryopreservation with a soy lecithin-based medium in black-footed cats (*Felis nigripes*) and sand cats (*Felis margarita*): it's no yolk! International Embryo Technology Society 45th Annual Conference. Reproduction, Fertility and Development 31:177. Poster presentation, New Orleans, LA.

Winkeljohn M and **V Pence**. 2019. The effects of silver thiosulfate on in vitro survival of oak shoots. Botany 2019 meeting. Poster presentation, Tucson, AZ.

Wojtusik J, IMC Brandicourt, W Rice and **TL Roth**. 2019. Reproductive cycle and pregnancy monitoring in the common hippopotamus (*Hippopotamus amphibius*) through salivary analyses and trans-abdominal ultrasonography. Proceedings of the International Embryo Technology Society 45th Annual Conference. Reproduction, Fertility and Development 31:176. Oral presentation, New Orleans, LA.

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CREW WISH LIST

Vortex
We could use several of these so that each work station in the endocrine lab has one within reach. **Cost: $300 each.**

Repeat Pipettors
These are absolutely essential for accuracy when running enzyme immunoassays, but they don't last forever. **Cost: $352 each.** (could use up to three)

Gamete Lab Pump
Needed for filtering our culture medium and assay buffers to ensure sterility. **Cost: $619.**

Precision Balance
CREW volunteers can tell you just how much we use balances to precisely weigh out fecal material for assays! We just need one right now. **Cost: $1,300.**

Orbital Shaker
These help shimmy and shake our assay plates. One more would help alleviate a space crunch when the lab is really rockin'. **Cost: $2,500.**

Thermal Cycler
Needed to help expand our genetics research. This will allow us to do PCR for genetic analysis in-house and increase the number of species we're able to analyze. A gift of any amount will help us reach our goal. **Cost: $4,721.**

Feline Great: Reducing Stress in Cat Shelters

There are many aspects of an animal shelter that can be stressful for cats. Chronic stress can suppress cats' immune systems and lead to behaviors that make them appear less desirable for adoption. In CREW's ongoing efforts to improve the health and well-being of domestic cats, two recent studies have focused on defining housing principles to minimize physiologic stress and maximize immune function in cats housed at shelters. In the first study, CREW scientists explored the ability of double-compartment housing (i.e., housing with two separate areas connected by a pass-through) to reduce stress by allowing an animal to urinate and defecate away from its eating and sleeping area and providing more space to express natural behaviors. Our study demonstrated that cats in double-compartment cages tended to do better in the study metrics (faster rate of weight gain, quicker return to baseline adrenocortical hormone levels) versus cats in single-compartment housing. Another way to positively impact the welfare of shelter cats is by offering them a comfortable place to rest. In the second study, we explored the preference of individual cats for one of four offered textiles (blanket, towel, absorbent pad, and cardboard). Our study found that 56% of cats demonstrated a textile preference. Surprisingly, most of the cats preferred interacting with the cardboard or absorbent pad much more than the blanket or towel. There is a close relationship between housing, stress, and illness, so providing guidance to shelters by informing housing principles should improve the health and welfare of the cats under their care. (*Supported by a grant from the Joanie Bernard Foundation.*)

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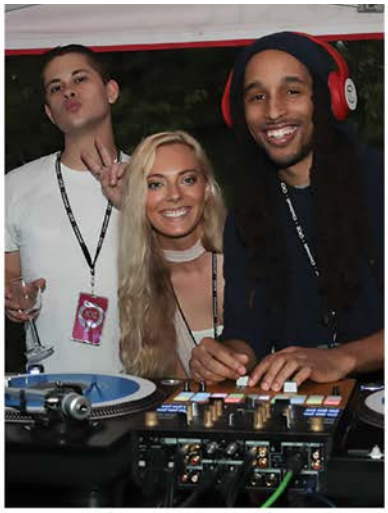


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