CREW

The Lindner Center for
Conservation and Research
of Endangered Wildlife

Saving
Species
with
Science®

The Lindner **Center** for **Conservation** and **Research** of **Endangered Wildlife**

SITUATION

Conservation is critical to the Cincinnati Zoo & Botanical Garden's mission and the sustainability of the world's valuable natural resources. The world's plants and animals are facing difficult times ahead because of both climate change and the competition for natural resources that is unavoidable on a planet that is occupied by over 7 billion people. However, some of those same people offer hope for the animals and plants struggling to survive against all odds. At CREW, researchers work hard every day using science to learn, and applying knowledge to save a future for wildlife.

GOAL

CREW's mission is: Saving Species with Science®. We achieve our mission using the latest in cutting edge technology guided by a heavy dose of common sense and driven by heartfelt passion. Channeling the strengths and expertise of the scientific staff, CREW takes a focused approach to wildlife conservation by identifying a few programs (*Signature* Projects) in which we believe our impact can be significant.

History of CREW:

A snapshot across the decades

CREW was first established in 1981 as the Cincinnati Wildlife Research Federation. A decade later, the state-of-the-art Lindner Center for Reproduction of Endangered Wildlife (CREW) opened on the grounds of the Cincinnati Zoo & Botanical Garden, becoming the first facility of its kind dedicated to both animal and plant conservation. As it grew and became more established, CREW's impact became broader than just reproduction and to reflect this growth, its name had changed by 2001 to the Lindner Center for Conservation and Research of Endangered Wildlife. Today, CREW is known worldwide for its valuable role in conserving the species within its four *Signature* Projects: Rhinos, Exceptional Plants, Imperiled Cats, and Polar Bears.

CREW's *Signature* Projects

CREW coined the term "*Signature* Conservation Projects" in 2001, during its strategic planning sessions where it was decided that CREW's strategy would be to commit significant resources to a few focused programs for substantial impact. These *Signature* Projects are large-scale, comprehensive conservation efforts in which CREW plays an integral, leadership role. Although research is the foundation upon which CREW scientists base their activities, *Signature* Projects comprise four additional components: education, *ex situ* conservation, *in situ* action, and visitor involvement.


Pg. 4


Pg. 6


Pg. 8


Pg. 10

Meet the Scientist

Terri L. Roth
CREW Director and Cincinnati Zoo Vice President of Conservation and Science
BS and MS in Animal Science, UC Davis
PhD in Animal Science, Louisiana State University

"At CREW, we remain optimistic that science will withstand the test of our current societal shifts and will prevail to guide decisions on conservation, health, and environmental policies vital to the long-term existence of Earth's amazing diversity of life."

Having served as CREW's Director for over two decades, I have witnessed amazing scientific accomplishments by a remarkable team of researchers committed to our mission: Saving Species with Science. The CREW staff believe in it, embrace it, and live it every day as we conduct research that contributes to saving a few of the world's imperiled plants and animals. With so many species in need of assistance, we work in a constant state of urgency, and victories sometimes seem too few and far between. However, that is the way good science progresses: incrementally, patiently but ultimately spectacularly.

POLAR BEAR *Signature* Project

SITUATION

Polar bears (*Ursus maritimus*) are under threat due to climate change. They depend on sea ice to hunt seals and to find mates, but the decline in annual ice coverage is having deleterious impacts on polar bear survival and reproduction. Despite the worldwide popularity of this iconic species, little is known about how they will adapt to a changing environment. In response, zoos are striving to maintain a self-sustaining population that would provide opportunities to study the unique physiology of this species and serve as some buffer against extinction; however, despite concerted efforts to pair individuals for breeding, reproductive rates are poor overall.

GOAL

To better understand polar bear physiology and to pinpoint the cause of reproductive failure, CREW scientists are studying polar bears in zoos to characterize the reproductive physiology of this species. Additionally, they are pioneering assisted reproductive technologies, such as artificial insemination (AI) and semen collection, to preserve valuable genetic material and to complement natural breeding efforts.

Meet the Scientist

> *"I'm fortunate to have the unique opportunity to help increase our understanding of species threatened with extinction."*

Erin Curry
Reproductive Physiologist
BS, Animal Science, University of Delaware
MS and PhD, Animal and Veterinary Sciences, Clemson University

When I began working on CREW's Polar Bear project in 2011, I was surprised at the deficit in knowledge surrounding the basic physiology of this species. I quickly realized that polar bear research is remarkably challenging, both in the wild and in zoos, and many techniques that we rely on to monitor other species simply aren't feasible with polar bears. From the stance of a reproductive physiologist, polar bears are a fascinating (and sometimes frustrating) species to study; they exhibit an unusual medley of reproductive phenomena, including seasonal breeding, induced ovulation, embryonic diapause, and pseudopregnancy. It's my goal to improve and develop methods to better characterize polar bear physiology and reproductive processes at the molecular, whole animal, and population levels.

PROGRESS

Scientists at CREW have analyzed samples from over 60 individual bears at 31 different institutions and, in doing so, have established the largest polar bear endocrine database in the world. The samples are used to monitor reproductive cycles, identify seasonal fluctuations in reproductive hormones and characterize sexual maturation; however, the ability to distinguish true pregnancy from pseudopregnancy continues to elude scientists. It is evident that a novel avenue must be pursued in developing a pregnancy test for polar bears and, by utilizing cutting edge scientific methods, CREW scientists are narrowing down candidate biomarkers that may be indicative of pregnancy. This non-traditional research path may finally yield an accurate, reliable, non-invasive pregnancy test. Furthermore, CREW scientists were among the first to collect and cryopreserve polar bear sperm and to perform an AI in this species. Although no cubs were produced following initial AI attempts, protocol refinement continues, and more is learned during every procedure.

FUTURE

The ability to non-invasively monitor reproduction in polar bears will illuminate the cause of reproductive failure and provide an invaluable tool for assessing the reproductive health of wild bears, which will be especially important as they face imminent environmental stressors. The reproductive research performed at CREW is contributing to the effort of saving polar bears with science. Moreover, the techniques being developed are likely to have broad application to other critically endangered populations.

IMPERILED CAT *Signature* Project

SITUATION

Most of the world's 40 wild cat species are threatened to some degree with extinction in nature. Thirty-two of these felid species are small in size (weighing less than 50 lbs) and have received relatively little conservation attention compared to the larger cats. The Association of Zoos & Aquariums has established Species Survival Plans (SSPs) for 17 cat species, including the ocelot, fishing cat, Pallas' cat, black-footed cat, sand cat, serval, and caracal. These seven small cats have been the primary focus of CREW's research efforts for the past 20 years, and substantial progress has been made with each species. Most recently, conservation challenges facing big cats have necessitated CREW's research involvement with larger felids, notably the jaguar, Amur leopard and snow leopard.

GOAL

One of CREW's goals is to help zoos become more effective at propagating cats under human care, improving natural breeding and incorporating assisted reproduction when necessary. In collaboration with field biologists, CREW also is striving to apply reproductive sciences to the conservation of free-ranging, wild felids, and develop vital linkages to zoo-based cat populations.

Meet the Scientist

"The birth of this jaguar cub represents a major scientific advancement and enhances the potential of using assisted reproduction as a management tool to conserve this iconic cat."

Lindsey Vansandt
Theriogenologist
DVM, University of Missouri-Columbia
PhD, Animal Sciences, University of Maryland

The jaguar is the largest cat native to the Americas and a focal species for conservation efforts, so I was thrilled to take the lead on a collaborative research project with colleagues in Brazil to develop assisted reproductive technologies in this amazing felid. By using a systematic research strategy, we were able to improve our understanding of the jaguar's unique reproductive biology, making species-specific modifications to our assisted reproduction protocols, and ultimately, produce the first jaguar cub ever born from artificial insemination (AI). Our research progress in Brazil has allowed us to begin applying this new knowledge to help propagate jaguars housed in US zoos.

PROGRESS

CREW has investigated the reproductive biology of ten wild cat species. These studies have helped us to improve their propagation and develop assisted reproductive technologies for population management. Working with ~50 U.S. zoos, CREW has collected and frozen semen from over 100 cats, enough for more than 700 AI procedures! Using our innovative laparoscopic oviductal AI approach, multiple pregnancies have been produced in ocelots, fishing cats, Pallas' cats, sand cats, tigers, and jaguars in just the past few years.

CREW also has supported efforts to conserve wild cat populations found in Central Asia (Pallas' cats, snow leopards, Amur leopards), Southeast Asia (fishing cats), Middle East/North Africa (sand cats), South Africa (black-footed cats) and South America (ocelots, jaguars). These field studies have included camera trapping, radiotelemetry, and reforestation. CREW scientists have also worked directly with field biologists to collect and freeze semen from wild cats in several countries which allows us to establish genetic exchange between wild and zoo-based populations.

FUTURE

Conservation efforts for imperiled cats must be collaborative and international in scope for long-term success. One key for the future will be developing global management programs for each species, connecting the various regional zoo populations to form one larger meta-population to maximize genetic viability. CREW's ongoing research to improve both natural and assisted reproduction of wild cats and its international network of dedicated collaborators are invaluable assets in linking zoo-managed populations with one another and with felids surviving in the wild.

EXCEPTIONAL PLANT *Signature* Project

SITUATION

It is estimated that about 25% of plant biodiversity is in danger of being lost worldwide due to habitat loss, competition from invasive species, over-collecting, and climate change. The Global Strategy for Plant Conservation is a worldwide effort to document and conserve the world's plant diversity. The Plant Division at CREW contributes to several of the strategy's goals, including *ex situ* conservation (banking tissues and seeds); the production of plants for recovery of species in the wild; and educating students and visitors on the importance of plant conservation. CREW focuses on plants that cannot be conserved in traditional seed banks due to lack of seeds or to having seeds that are sensitive to drying or long-term freezing. These species are named "exceptional."

GOAL

CREW's Plant Division contributes to the conservation of global plant biodiversity by developing and applying *in vitro* and cryopreservation protocols to propagate and preserve endangered exceptional plants and to support their recovery in the wild. CREW is also working to increase awareness of exceptional species and promote their conservation globally.

Meet the Scientist

Valerie Pence
Director of Plant Research
BS, Biology, Mount Holyoke College
MS and PhD, Biology, Northwestern University

"It is exciting when we can see tissues grow after they have been taken to -196°C in liquid nitrogen, and especially after they have been stored for 20 years!"

During my time at CREW, I have had the opportunity to work with a wide array of rare species from across the U.S. I've been fascinated by the differences in their adaptations and the diversity of factors involved in their growth in tissue culture and survival through liquid nitrogen storage. It's especially rewarding when we can overcome a roadblock, such as when we tried an unconventional treatment and finally achieved rooting in the four-petal pawpaw or saw the first oak tissues survive cryopreservation. It's exciting to know that the biological questions we're trying to answer can help secure threatened species for the future.

PROGRESS

CREW's Plant Division is internationally recognized for its expertise in using *in vitro* methods (plant tissue culture) and cryopreservation (storage in liquid nitrogen) to address the needs of threatened exceptional plants (TEPs). Protocols have been developed for conserving some of the most endangered species in the U.S., including Florida pawpaws, the American chestnut, several endangered oaks, and critically endangered species from Hawaii. The viability of cryopreserved tissues from multiple species after up to 20 years in liquid nitrogen has been confirmed. Plants have been produced for restoration projects in Florida, Utah, Ohio, and Kentucky. Genetic analysis of the diversity of our collection has begun. Working with global partners, the Exceptional Plant Conservation Network (EPCN) has been established to promote research and collaboration on the conservation of TEPs.

FUTURE

The Plant Division will continue to develop protocols for tissue culture propagation and cryopreservation of threatened exceptional plants and will work for the recovery of those species in the wild. Specific areas of focus include the oaks and critically endangered species from Hawaii. Genetics will be used to inform the future development of the Frozen Garden collection, and contributions to the growth of the EPCN will continue. The goal of conserving threatened exceptional plants for future generations goes beyond CREW and will require multi-institutional capacity. CREW will continue to facilitate and promote this work in other institutions, work with multiple collaborators and train young scientists, all with the goal of providing more effective and efficient conservation tools for the future.

RHINO *Signature* Project

SITUATION

The three Asian rhino species are more endangered than the two African species, but the latter are targets of a deadly poaching epidemic. Therefore, a two-pronged approach that embraces both managed breeding and protection in the wild is paramount for ensuring the survival of all the world's rhinos. In fact, many believe that the only way to save the critically endangered Sumatran rhino is to capture what few exist and breed them in sanctuaries. However, rhino breeding is fraught with challenges. The Asian rhinos often exhibit excessive aggression towards their mates when paired for breeding, and many female white rhinos experience aberrant reproductive physiology that impedes breeding efforts. In contrast, the prolific black rhino is plagued by a plethora of diseases that reduce longevity.

GOAL

CREW scientists are tackling the primary challenges facing rhino propagation. Through reproductive and disease research, CREW strives to enhance the success of managed populations by improving rhino health and longevity, breeding success and genetic diversity.

Meet the Scientist

Jessye Wojtusik
Post-doctoral Researcher
BS and MS, Animal Science, Cornell University
PhD, Environmental Science and Policy, George Mason University

"The hardest part about working with endangered species is knowing that every individual we encounter could be one of the last of its kind. The weight of this understanding adds urgency and stress to every project undertaken."

While conducting an ultrasound exam on a pregnant rhino, I felt the baby kicking. It seems like such a small event, but the significance lies in the hope created by the act more so than the event itself. My hope for the future of rhino species lies in the advances we've made in understanding rhino biology and developing methods to promote survival, and in that feisty baby rhino letting us know it's ready to join the battle to save its species.

PROGRESS

CREW's scientific breakthroughs led to the birth of the first zoo-bred Sumatran rhino calf in 112 years. The subsequent birth of two additional calves at the Cincinnati Zoo demonstrated the repeatability of the scientific strategy employed. These same methodologies-and offspring that resulted from them-were transferred to CREW's Indonesian colleagues in Sumatra and were pivotal in their subsequent success producing calves of this critically endangered species at the Sumatran Rhino Sanctuary.

Several Indian rhino calves have been produced by artificial insemination procedures developed by CREW scientists. Many of these pregnancies were established using semen that had been cryopreserved in CREW's CryoBioBank for many years. Because of CREW's good work, these preserved samples are serving as a reservoir of genetic diversity for today's rhino populations.

Iron overload disorder (IOD) is a health concern in Sumatran and African black rhinos. However, the etiology of this disease and its significance in each species is complicated and obscure. CREW scientists recently discovered that a biomarker routinely used for tracking IOD progression in rhinos is unreliable and have shared this critical information with the veterinary community. A search for better biomarkers and a clearer understanding of this condition is underway.

FUTURE

Armed with the expertise that comes from decades of focused rhino research and development, CREW scientists are now empowering and assisting others with rhino propagation skills to enhance breeding programs in North America and around the globe. These efforts, together with new insight into rhino health issues, will help ensure managed rhino populations thrive in the years ahead, providing a robust back-up population to those clinging to survival in the wild.

1981 – 1990

CREW begins as a founding member of the Cincinnati Wildlife Research Federation.

CryoBioBank® is created to store sperm and embryos from endangered animals.

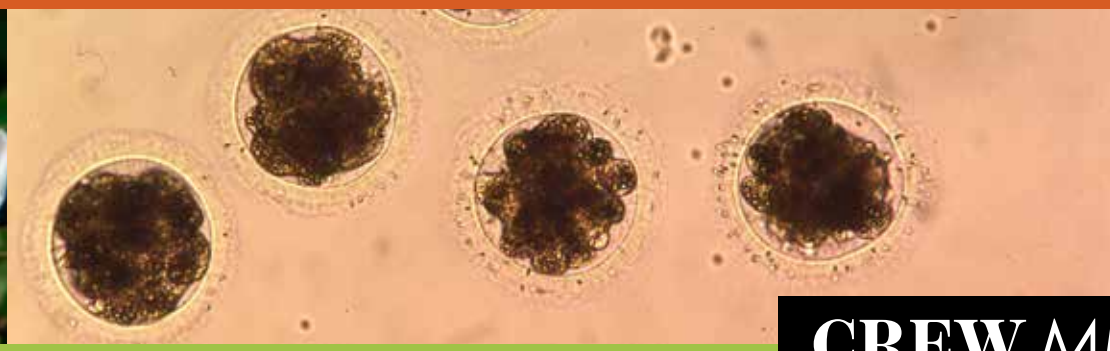
Antelope embryo transfer in eland and bongo results in many "world's firsts."

Kittens produced from cryopreserved domestic cat embryos demonstrate the feasibility of using cryopreservation to help conserve endangered cats.

Dr. Valerie Pence establishes the Plant Research Division at CREW in 1986 and initiates the Endangered Plant Propagation Program.

CREW's first endangered plant species, *Trillium persistens*, is successfully propagated *in vitro*.

In vitro fertilization and embryo transfer results in the birth of an Indian desert cat kitten to a domestic cat mother.



CREW M

2001 – 2010

Strategic planning in 2001 leads to the creation of "*Signature* Conservation Projects."

Successful 2001 birth of first Sumatran rhino produced by managed breeding since 1889 followed by a second and third calf in 2004 and 2007.

Tree embryos shown to be viable after 10 years in CREW's CryoBioBank.

Ocelots in Brazil and sand cats in the United Arab Emirates produced by embryo transfer.

CREW becomes the nation's headquarters for reproductive monitoring of zoo-maintained polar bears.

First ever term pregnancies produced in the greater-one-horned rhino after artificial insemination (AI) with cryopreserved sperm.

Successful establishment in southern Kentucky of an experimental population of the Cumberland sandwort with plants propagated through tissue culture at CREW.

1991 – 2000

The Carl H. Lindner, Jr. Family Center for Conservation and Research of Endangered Wildlife (CREW) opens its doors in 1991– the first facility at a zoo or botanical garden dedicated to both animal and plant conservation research.

Working with the government of Trinidad and Tobago, CREW spear-heads the reintroduction of extirpated blue and gold macaws to Trinidad.

"Test-tube" gorilla born after *in vitro* fertilization and embryo transfer.

Dr. Terri Roth becomes the new Director of CREW in 1996 and initiates the Rhino Conservation Program.

CREW pioneers "*in vitro* collecting" technique for plants in Trinidad, Costa Rica, and several habitats in the United States.

CREW initiates a post-doctoral training program to produce future leaders of conservation research programs worldwide.

Dr. Bill Swanson joins CREW in 1997 as Director of Animal Research and expands CREW's global small cat conservation program to Mongolia, Brazil, Thailand, and South Africa.

First endangered cat, an ocelot, born following the transfer of frozen embryos.

ILESTONES

2011 – 2019

The reintroduction of blue and gold macaws to Trinidad declared a success.

Two Sumatran rhino calves born in Sumatra sired by Cincinnati Zoo's first calf.

Polar bears are added as CREW's fourth *Signature* Project in 2014 in addition to rhinos, exceptional plants, and small cats.

Vectored contraception, a form of gene therapy, shows promise for non-surgical sterilization of domestic cats.

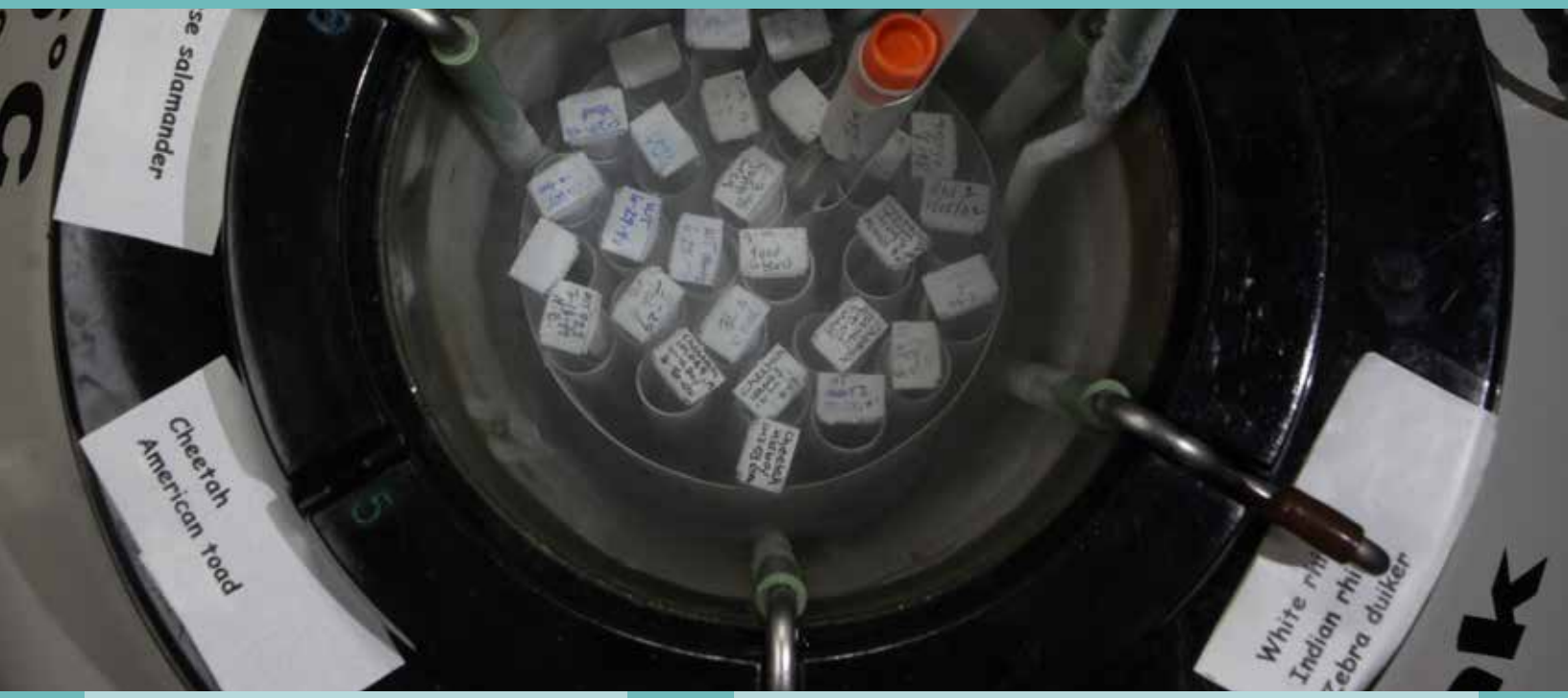
Shoot tips, spores, seeds, pollen, and other plant tissues in CREW's CryoBioBank prove viable after 10-20 years in storage.

Five wild cat species (ocelot, Pallas' cat, fishing cat, sand cat, tiger) propagated using CREW's new oviductal AI technique.

Two outplantings reintroduce hundreds of Autumn buttercup plants, propagated at CREW, to reinforce the declining population in the wild.

Jaguar cub produced by AI in Brazil as CREW expands its reproductive research into larger cat species.

CREW's *CryoBioBank®*



SITUATION

Genetic diversity is critical for the long-term survival and adaptation of species and, sadly, many species are experiencing genetic loss at alarming rates. With almost certain impending decline, the genetic material of rare animal and plant populations must be preserved today so it is not forever lost.

GOAL

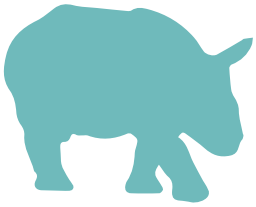
In the heart of the CREW building and vital to CREW's mission is the CryoBioBank. Established in 1982, CREW's CryoBioBank was created to provide a safe haven for some of the world's most valuable and irreplaceable biological samples from rare and endangered animals and plants.

Fauna: The CryoBioBank's reservoir of animal samples is not a static collection. Instead, samples are added to and removed from these tanks year-round as CREW scientists use them to further their research and to produce genetically valuable offspring so desperately needed by rare populations in decline.

Flora: The Frozen Garden® of the CryoBioBank is dedicated to the secure, long-term storage of plant biodiversity, as a back-up to species that might be lost in the wild, and as a resource for future restoration of those species.

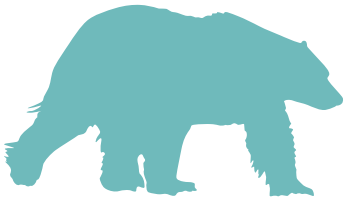
The CryoBioBank is essential to CREW's goal of preserving the gene pool of *in situ* and *ex situ* populations with minimal disruption to wild populations of animals and plants struggling to survive in their native habitats.

Impressive Feats



An Indian rhino calf was conceived 10 years after her father's death from sperm collected and stored in the CryoBioBank.

A Pallas' cat kitten was born from sperm that had been frozen for over 20 years.



The CryoBioBank contains the world's largest collection of polar bear sperm.

Over 16,000 shoot tips are stored in the Frozen Garden, as well as numerous samples of seeds, fern spores, fern and moss gametophytes, pollen, embryos, and other plant tissues.

PROGRESS

Samples from over 85 animal species and 200 plant species are stored in the CREW CryoBioBank. They are maintained at -196°C in 15 cryogenic tanks.

Fauna: It is not just the sample numbers or species represented that are important to CREW scientists. Rather, the products of those samples are what really matter. Using valuable biological samples (embryos and sperm) from the CryoBioBank, CREW's animal scientists have been able to produce ocelot kittens and Indian rhino calves.

Flora: In a project testing over 1,000 samples, the viability of most of the samples after up to 20 years of storage in liquid nitrogen was confirmed.

These achievements clearly demonstrate the power, potential, and value of CREW's CryoBioBank in the broader effort of providing a safeguard for animals and plants against extinction.

FUTURE

CREW's CryoBioBank is insurance against loss of genetic diversity in future generations of hundreds of endangered plant and animal species. Through sound science, CREW researchers have demonstrated that CryoBioBank samples can be stored long-term while retaining viability. Samples of new species will continue to be added to the bank in coming years, providing an invaluable resource for restoring species that may face the threat of extinction in the future.

TRAINING *The Next Generation*

SITUATION

Many wildlife populations are becoming increasingly threatened by a host of environmental factors ranging from habitat loss to pollution to poaching to climate change. Skilled scientists are greatly needed to address these conservation challenges, but few training opportunities exist to provide these individuals with the specialized skills and knowledge required to work effectively with endangered wildlife.

GOAL

The primary goal of CREW's fellowship and training programs is to build scientific and conservation interest and capacity through a network of specially trained researchers across the globe.

Dr. Justine O'Brien

Manager of Conservation Science, Taronga Conservation Society Australia
(CREW Animal Division Post-Doctoral Scientist 1998)

"On finishing my PhD I was thrilled to move to the USA from Australia to undertake my post-doc at CREW. It was a wildlife learning curve that exceeded anything I had imagined, and laid the foundation for my career in conservation biology. One focus of my post-doc was rhino reproductive biology. This research continues today with CREW as a long-term partner in applying science to rhino conservation and management."

Dr. Daniel Ballesteros

Early Career Research Fellow, Kew Gardens
(CREW Plant Division Post-Doctoral Scientist 2014)

"CREW and Valerie Pence were some of the places and names I dreamed to work with when I was a Ph.D. student far away, in Spain. I was lucky and got the chance to develop a great research project as Valerie's postdoc, reviving the amazing Frozen Garden's collection and validating the use of cryopreservation for long-term plant conservation. Thanks so much, CREW."

Dr. Zulfi Arsan

Head Veterinarian, Sumatran Rhino Sanctuary
(CREW international colleague since 2014)

"The Cincinnati Zoo CREW scientists are always welcome at the Sumatran Rhino Sanctuary. We enjoy working with them and learning new techniques. Their assistance and advice are very valuable to us as we work hard to produce more Sumatran rhino calves."

OPPORTUNITIES

Internships

CREW's internship opportunities are broad-reaching and diverse. They are offered to individuals at many education levels typically ranging from undergraduates to veterinary students. The program focus can be learning how to manage a wildlife research laboratory, assisting with a specific plant or animal research project, or conducting an independent study that complements ongoing CREW programs.

Graduate Students

Working in collaboration with faculty in the Department of Biological Sciences at the University of Cincinnati, CREW has been involved in mentoring several graduate students at both the M.S. and Ph.D. levels. Grants awarded to CREW from the Institute of Museum and Library Services have provided the funding necessary to make several of these training opportunities possible and have allowed the students to conduct conservation-oriented research as a part of their thesis or dissertation.

CREW Charlotte R. Schmiddlap Scholars

With generous support from the Charlotte R. Schmiddlap Foundation, CREW has been able to offer a special opportunity to emerging women scientists with a passion for plant or animal conservation. The Scholar positions are for pre-doctoral students on a scientific career path. Scholars work full-time for five-months at CREW during which they conduct all steps of an independent research project from study design to professional conference presentation. Upon completing the Scholar program, many accept positions in the field of conservation research or return to graduate school to earn an advanced degree.

International Outreach and Empowerment

Scientific advancements are only effective when embraced and employed by others. Therefore, training and technology transfer across borders are essential components of CREW's activities. CREW scientists have worked internationally with conservationists, veterinarians, graduate students, and government officials in many countries including Brazil, Indonesia, Malaysia, Namibia, Mexico, Thailand, and Mongolia to provide resident scientists with the expertise needed to conserve their native wildlife species.

Post-doctoral Fellowships

CREW is one of the few zoo-based research programs in the world that provides in-depth scientific training to individuals holding PhD and/or DVM degrees. Initiated in 1997, the post-doctoral program has supported 20 scientists from 5 different countries for 1 to 3 year periods. Most of CREW's post-docs subsequently find research positions at other zoological parks, botanical gardens or universities.

Ashley Clayton
Longwood Gardens Research Specialist
(CREW Plant Division Intern 2016)

"The internship at CREW was one of the most transformative experiences in my life. It provided me with opportunities to gain applicable research skills and to develop professionally. I assisted with new research projects, attended my first conference, and presented a scientific poster, all of which have helped me progress on my career path."

Tori Kennedy
Colorado State University PhD Student
(CREW Animal Division Schmidlapp Scholar 2017)

"My favorite part of my internship with CREW was getting to travel and assist with polar bear artificial insemination procedures! It was my first time getting to be a part of such an exciting procedure and seeing just how many people from different areas of the zoo come together to make it work. It was really an inspiration."

CREW *Helping the* ZOO

The Cincinnati Zoo has one of just eight accredited cheetah breeding centers in the United States. CREW helps support the program by performing non-invasive fecal hormone metabolite monitoring as a pregnancy diagnostic tool.

Fiona has been a star since before she was born. CREW scientists were the first to ever use ultrasonography to see a Nile hippo fetus *in utero*.

CREW was one of the first institutions to investigate fecal glucocorticoid metabolites (FGMs) in kea. We established that FGMs are not associated with outbreaks of illness in our flock but can increase in the breeding season.

Sex determination in sloths can be very difficult, as reproductive organs are housed internally. Using ultrasonography, CREW helped to determine that our suspected-to-be-pregnant female, Moe, was actually a male!

CREW helps visitors to the Botanical Garden better understand endangered plants by displaying the endangered species propagated through tissue culture.

CREW has provided plants of African violet species to Jungle Trails to show visitors that even this well-known plant is endangered in the wild.

Red pandas at the Cincinnati Zoo & Botanical Garden are trained to voluntarily participate in ultrasound examinations which allows CREW scientists to diagnose and monitor pregnancy.

CREW monitors the Zoo's snow leopard breeding pair through behavioral observations, non-invasive fecal hormones, and voluntary abdominal ultrasounds.

At CREW, Zoo Academy students learn what it takes to make a lab functional and how science is conducted in a working lab. They experience techniques from poop-pounding to pipetting.

THE DOMESTIC CAT CONNECTION
to Conservation and Welfare

For three decades, domestic cats have been helping CREW scientists to unravel the mysteries of felid reproduction. Domestic cats have a shared genetic lineage with all wild felids, and their physiology has been well-conserved across cat species.

All assisted reproductive technologies (semen collection and cryopreservation, artificial insemination, *in vitro* fertilization, embryo transfer) now used with wild cats were first developed in the domestic cat. As a model species, the domestic cat has been essential for the application of assisted reproduction for the management and conservation of wild felids.

Our research efforts also have been focused on improving the general health and well-being of domestic cats. There are ~80 million free-roaming (stray) domestic cats in the United States. Many of these animals have short lives, dying from trauma, disease, or euthanasia in animal shelters. These cats also prey upon wild birds and small mammals, causing significant declines in these species. To control stray cat populations and improve the welfare of free-roaming and sheltered cats, CREW scientists have focused on two main areas:

Reducing stress and disease transmission in animal shelters

These studies have identified several key aspects of husbandry, such as social hierarchy, pheromone use, textile choice, and caging type, which potentially impact a cat's wellness while housed in a shelter.

Evaluating new contraceptive alternatives to surgical sterilization

The development of a single-dose, nonsurgical sterilant for domestic cats would have global impact, allowing worldwide reductions in feral cat populations and improving welfare of both cats and wildlife.

Meet the Scientist

"I'm most excited by the potential conservation impact of one of our collaborative projects – to develop a non-surgical approach to feral cat sterilization."

Dr. William Swanson
Director of Animal Research
BS, Zoology, University of Texas
DVM, Texas A&M University
PhD, Animal Science, Louisiana State University

Findings from our conservation research with cats over the past 20 years have improved the sustainability and health of wild felid populations within zoos, and that progress has been gratifying both professionally and personally. However, our collaborative studies developing non-surgical sterilization for domestic cats may be the most significant globally. If our efforts prove successful, the broad application of this science could provide us with a nonlethal means to control feral cat overpopulation and substantially reduce the adverse impact of predation on wild birds and small mammals.

CREW *by the* Numbers*

150 CREW Volunteers

Donate

12K Hours Anually

CREW Processed

30K Polar Bear Poo Samples

CREW's Work Produced

10 Rhino Calves

CREW's Assisted Reproductive Technology Produced

30 Wild Cats

in

8 Different Species

CREW's Collaborators

125 Zoos

&

17 Botanical Gardens

CREW staff worked in

15 Countries

CREW's CryoBioBank® Holds

85 Animal Species

200 Plant Species

Wild Outplantings Provided By CREW

8 Different Plant Species

1,200 Individual Buttercups

*As of 2019

FINANCIAL *Overview*

SITUATION

The Lindner Center for Conservation and Research of Endangered Wildlife relies on the generosity of individual, corporate and foundation philanthropic support to fulfill its mission: Saving Species with Science®.

GOAL

As one of the leading wildlife conservation research facilities in the world, CREW requires increased support to continue its leadership role in saving species from extinction.

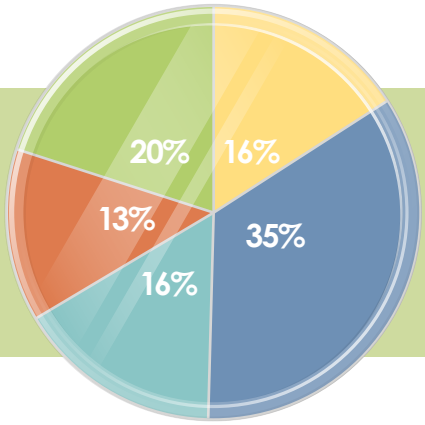
PROGRESS

The Cincinnati Zoo & Botanical Garden's commitment to CREW's success is realized through annual growth from individual supporters as well as through participation in the Toast to the Wild event series. Over the past decade, substantial increases in investment have been accomplished.

FUTURE

In order to continue this groundbreaking work and continue to raise the bar, the Zoo plans to intentionally grow philanthropic funding sources by identifying new individual, corporate, and foundation donors as well as work to creatively maximize revenue from the Toast to the Wild event series.

CREW ACTUAL REVENUE

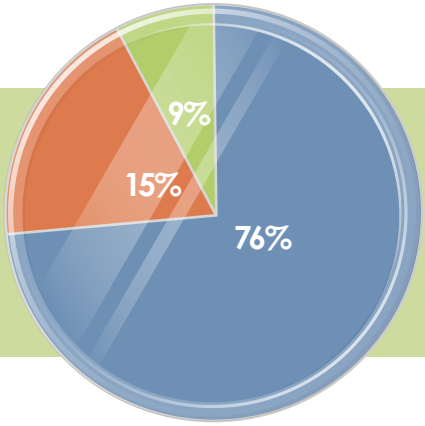


Research grants	$272K
CREW restricted donations	$592K
Fundraising events (Toast to the Wild)	$276K
Endowment allocations	$227K
Zoo operating budget	$346K
CREW revenue	$1,713K

2018/2019 BUDGET

12 months ending 03/31/19

CREW ACTUAL EXPENSES



Animal research/conservation	$1,259K
Plant research/conservation	$321K
Administration/maintenance	$133K
CREW expenses	$1,713K

HOW TO GET INVOLVED...

Donate

Visit cincinnatizoo.org/conservation/crew or call 513-487-3327 to support CREW's vital work.

CREW Endowment

You can support CREW's conservation and research in perpetuity through a bequest, trust, or other planned giving vehicle specifically restricted to CREW.

Toast to the Wild

This event series of spirit tasting events works to raise funds and spread awareness for CREW while providing a night of grown-up fun at the Zoo.

For more information on these events and how you can purchase tickets, please visit cincinnatizoo.org/events.

Volunteer

CREW has over 150 dedicated volunteers who help move our mission forward. There are many ways to volunteer with CREW. Visit cincinnatizoo.org/volunteer for more information.

Want to know more?

For more information about these opportunities and how you can become involved, please visit cincinnatizoo.org/conservation/CREW or call 513-487-3327.

Photos by: Buffalo Zoo, Shannon Calvert, C. Crawford, Association Mata Ciliar, DJJAM, Mark Dumont, Steve Folz, Lisa Hubbard, David Jenike, Brian Jorg, NaCL, Kathy Newton, Tom Uhlman

Designer: Nicolle Masucci-Webb

Printed Winter 2020

Meet some of CREW's supporters

"I am most grateful for having the opportunity to use my resources, talents and passions to work toward making our world a better place for all living things and for the opportunity to work with like-minded people including the good folks at CREW and the Cincinnati Zoo!"

As a member of our Board of Trustees and chair of our Conservation Committee, Craig Young has been leading the way to share a global conservation stance and a commitment to inspiring future generations to take action. In fact, the entire Young family is in on the act. As loyal CREW supporters, especially of our polar bear work, they don't just talk the talk!

"What started out as a small donation relating to cats, has blossomed into a wonderful partnership with the Zoo. We were introduced to Bill Swanson and his work at CREW. We did not realize all of the behind the scenes work that goes on and most of which is accomplished through donations. We have often said this was the best investment we've ever made."

Through their annual gift to CREW, Roger and Kathy Gross support CREW's Imperiled Cat *Signature* Project which has enabled the program to expand its work to larger cat species and hire more staff. They are also Toast to the Wild volunteers and have generously agreed to leave a gift in perpetuity for CREW.

Beth and Rowe Hoffman began providing an annual gift to CREW to support a post-doctoral fellow in 1996 and Beth has continued this support in Rowe's memory after his passing in 2010. Rowe and Beth's generosity gives these young scientists the opportunity to pursue their dreams, by ensuring CREW's additional training of these conservation scientists. Beth and her current husband Frazier have expanded their combined family to include triplet grandsons, all of whom are fans of the Zoo and Fiona.

cincinnatizoo.org

FSC LOGO HERE