The Lindner Center for

CONSERVATION AND

RESEARCH OF

ENDANGERED

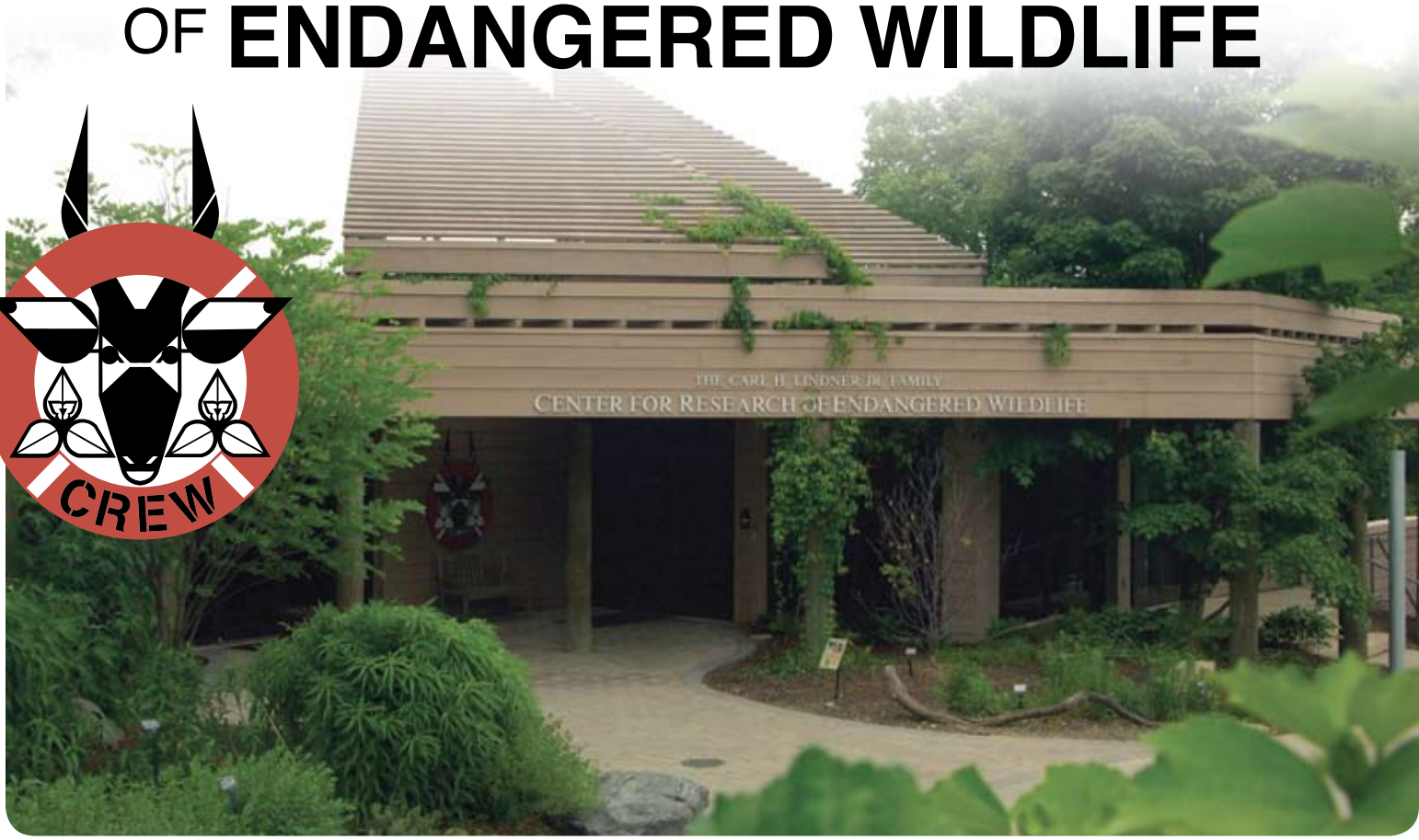
WILDLIFE

SAVING SPECIES WITH SCIENCE®

CINCINNATI ZOO & BOTANICAL GARDEN

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 now 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) where 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 was changed to the Lindner Center for Conservation and Research of Endangered Wildlife. By 2011, CREW was known worldwide for its three *Signature* Projects: Endangered Plants, Small Cats, and Rhinos.

CREW's *Signature* Projects

- CREW coined the term "*Signature* Projects" in 2001 during its strategic planning sessions
- *Signature* Projects are large-scale, comprehensive conservation efforts in which CREW plays an integral, leadership role
- *Signature* Projects comprise five components:
  1) education,
  2) research,
  3) propagation,
  4) in situ protection, and
  5) Cincinnati Zoo & Botanical Garden presence

CREW currently has three *Signature* Projects:

SMALL CATS

RHINOS

ENDANGERED PLANTS

SITUATION

Of the 37 wild cat species in the world, 28 are small in size, weighing less than 50 lbs. Many of these small cats are threatened with extinction in the wild but have received little conservation attention compared to the larger cats. The Association of Zoos & Aquariums (AZA) has established breeding management programs for several small cat species including the ocelot, fishing cat, Pallas' cat, black-footed cat, and sand cat. As a global leader in cat conservation, the Cincinnati Zoo & Botanical Garden maintains the most diverse felid population of any North American zoo, including all five of these small cat species.

GOAL

Concerted, collaborative efforts of zoos and other conservation organizations will be necessary if small cats are to survive and thrive in both the wild and captivity. CREW's goal is to ensure that Zoos become more effective at breeding small cats in captivity, educate the public about these amazing animals and support research and conservation efforts with wild populations.

PROGRESS

CREW scientists study the reproductive biology of all five small cat species to optimize captive propagation and develop assisted reproductive technologies for population management. CREW uses tools such as fecal hormone analysis and semen collection to characterize basal reproductive traits in small cats and improve breeding success. This basic reproductive knowledge also is applied in developing techniques such as sperm and embryo freezing, in vitro fertilization, embryo transfer and artificial insemination to produce viable offspring in ocelots, Pallas' cats, and sand cats.

In collaboration with field biologists, CREW also works to conserve small cat populations found in Mongolia (Pallas' cats), Thailand (fishing cats), South Africa (black-footed cats) and Brazil (ocelots). Field studies supported by CREW have used camera trapping to determine the location of cats in the wild, radiotelemetry to monitor cat movements and reforestation to restore degraded habitats. CREW scientists also work with field biologists to collect and freeze semen from wild cats which allows us to establish genetic exchange between wild and captive populations.

FUTURE

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

Pallas' Cats in Mongolia

Species: Pallas' cats (*Otocolobus manul*)

Status: Near Threatened (IUCN Redlist) in Mongolia due to poaching, vermin control programs and habitat loss.

- CREW helped to initiate the first comprehensive ecological study of wild Pallas' cats in Mongolia to assess their general health, disease exposure, habitat and prey needs, and population status.
- CREW scientists have characterized the seasonal reproductive traits of Mongolian Pallas' cats and have cryopreserved semen from wild males to improve genetic diversity of zoo populations (without removing any cats from the wild).
- Scientific capacity building in Mongolia has included training a Mongolian graduate student in reproductive sciences for research with Pallas' cats and other native species.

Brazilian Ocelots

Species: Brazilian ocelot (*Leopardus pardalis mitis*)

Status: Vulnerable to extinction (IUCN Redlist) in southern Brazil, primarily due to habitat loss and poaching.

- CREW scientists helped spearhead efforts to establish the Brazilian Ocelot Consortium, an international collaboration focused on conserving Brazilian ocelots in the wild and captivity.
- CREW's reproductive research with Brazilian ocelots has resulted in the birth of several healthy kittens from artificial insemination and embryo transfer using frozen semen and frozen embryos.
- CREW is applying these proven reproductive technologies to optimize captive management and facilitate international exchange of genetic diversity without transporting live ocelots between countries.

Trillium

SITUATION

The exact number of endangered plant species is not yet known, but it has been estimated that from 10% to 30% of flora is in danger of being lost worldwide. The causes for this include habitat loss to agriculture and development, competition from invasive species, over-collecting of medicinal and other plants of special interest, 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: ex situ conservation, or the preservation of plants, seeds, and tissues in protected collections; the production of plants for recovery of species in the wild; the development of protocols for these activities; and the use of these projects to educate students and visitors on the importance of plant conservation.

GOAL

CREW's Plant Division is contributing to the conservation of the world's flora by developing and applying protocols of nontraditional methods of propagation and preservation for the exceptional plant species that need them, and using these methods for the recovery of species in the wild.

PROGRESS

CREW's Plant Division is internationally recognized for its expertise in using in vitro methods, or plant tissue culture, to propagate endangered plants and to provide tissues for long-term cryopreservation storage in CREW's CryoBioBank. This work has focused primarily on "exceptional" species–those that produce few or no seeds in the wild, and on species with short-lived seeds, for which traditional methods of propagation and seed banking are not adequate. Protocols have been developed for the tissue culture propagation of some of the most highly endangered species of seed plants and ferns in the U.S. Methods for cryopreserving shoot tip tissues of numerous endangered seed plants and spores and gametophytes of ferns and mosses have also been developed, and these tissues, along with seeds of regionally endangered plants, have been banked in liquid nitrogen. The Plant Division also supports conservation research on *Saintpaulia* (African violets) in Africa and is conducting research on tissue cryopreservation methods for these species.

FUTURE

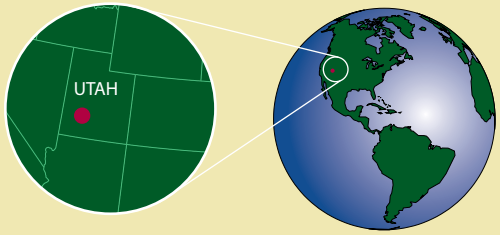
The Plant Division will continue to develop protocols for in vitro propagation and cryopreservation of endangered plants, both for those from the U.S. and elsewhere, and will work for the recovery of those species in the wild. Currently, five species are in recovery programs in Florida, Utah, Ohio, and Kentucky. This growing body of knowledge on tissue culture propagation will contribute to the science of plant growth in vitro and to our understanding of how to direct that growth. This should, in turn, help in the design of future protocols for new species and should quicken the pace of the application of in vitro methods to plant conservation.

Returning to the Wild

Species: Autumn buttercup (*Ranunculus aestivalis*)

Status: Endangered, U.S.

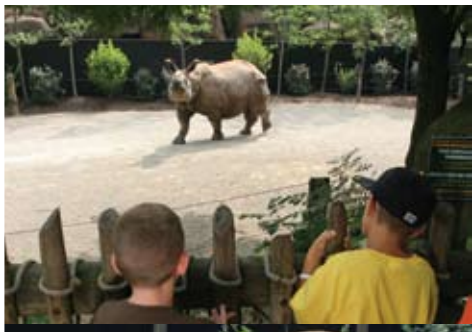
Location: Nature Conservancy, Sevier Valley Preserve, Panguitch, Utah



Project: Use tissue culture to propagate plants to support the restoration of this highly endangered species.

- Tissue culture-propagated lines have been initiated from seeds and are maintained at CREW.
- Plants in culture are sent to The Arboretum at Flagstaff for acclimatization to soil.
- Acclimitized plants are used for in situ restoration and to build an ex situ living collection of this species.

project



SITUATION

Although most people think "Africa" when they hear "rhinoceros," the three Asian rhino species are far more endangered than the two African species. A two-pronged approach involving both captive breeding and protection in the wild was established to help ensure the long-term survival of Indian and Sumatran rhinos. The Sumatran rhino captive breeding program was initiated in the mid 1980s, but breeding efforts initially failed and mortality rates were high. The Indian rhino breeding program fared better, but genetic diversity has been reduced because some males are too aggressive towards females and never sire calves. Whereas strict protection has recently improved the outlook for wild Indian rhinos, the Sumatran rhino continues to fight for survival.

GOAL

CREW scientists are using ultrasonography and hormone monitoring to better understand Sumatran and Indian rhino reproductive idiosyncrasies. After unraveling the mysteries of these species' reproductive processes, CREW scientists are now armed with the necessary information to assist natural breeding efforts and to develop artificial insemination. Ultimately, the goal is to be able to transfer sperm between wild and captive populations on a global scale to ensure the genetic diversity of both populations is maintained while maximizing the number of rhinos successfully reproducing.

PROGRESS

CREW's scientific breakthroughs led to the birth of the first Sumatran rhino calf bred in captivity in 112 years. The subsequent birth of two additional calves at the Cincinnati Zoo demonstrated the repeatability of the scientific methods employed. These same methodologies now are being used by CREW's Indonesian colleagues in Sumatra. Similarly, CREW's scientific achievements have led to the first and second pregnancy in an Indian rhino by artificial insemination. Adding to the significance of these Indian rhino pregnancies is the fact that both were produced with sperm that had been collected and stored frozen in CREW's CryoBioBank. With CREW's viable rhino sperm bank, the genetic life of founder animals can be prolonged and the genetic potential of male rhinos that may otherwise never contribute to the captive population can be preserved.

FUTURE

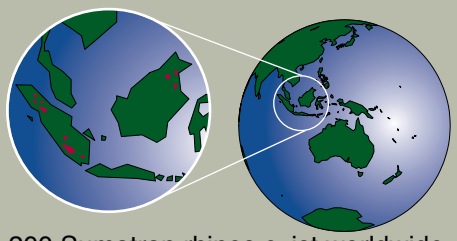
As a result of CREW's scientific breakthroughs, it is now possible to produce rhino calves from behaviorally incompatible pairs and allow new genetic material to be exchanged between wild and captive rhinos globally. CREW scientists are empowering international colleagues and organizations in range countries with the information and technologies developed at CREW in an effort to more effectively manage captive and wild populations of Indian and Sumatran rhinos worldwide. By empowering others, CREW scientists believe their work will have an even greater impact on the rhinos' struggle against extinction.

Sumatran Rhinoceros Facts

Species: Sumatran rhino (*Dicerorhinus sumatrensis*)

Status: Critically endangered (IUCN Redlist)

Location: Sumatra and Borneo



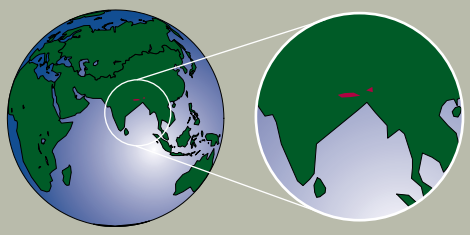
- Only ~200 Sumatran rhinos exist worldwide.
- The wild population has decreased by 50% in the last 15 years.
- In 2011, the captive population consisted of just nine rhinos (three of which were produced at the Cincinnati Zoo) in three countries.
- The Sumatran is the smallest rhino (1300-1700 lbs), and is also known as the hairy rhinoceros.
- Sumatran rhinos love to wallow in mud.

Indian Rhinoceros Facts

Species: Indian rhino (*Rhinoceros unicornis*)

Status: Threatened (IUCN Redlist)

Location: Southern Nepal and Northern India (Assam)



- Indian rhinos appear armor plated and possess a single horn.
- Indian rhinos love water.
- The largest of the Asian rhino species weighing 4000-6000 lbs.
- Worldwide population is estimated at ~2700.
- Gestation lasts 16-17 months.

CREW'S CRYOBIOBANK®

SITUATION

Genetic diversity is critical for the long-term survival and adaptation of species. Faced with years of almost certain decline, rare plant and animal populations may contain more genetic variation now than they will for decades or centuries to come. Therefore, their genetic material must be preserved today so it is available for bolstering waning populations in the future and not forever lost. Furthermore, the ability to cryopreserve samples that can then be used to infuse valuable genetic variation into populations across the globe provides a much needed alternative to translocating live, wild animals or plants.

GOAL

In the heart of the CREW building and vital to CREW's mission is the CryoBioBank. 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 plants and animals. However, the CryoBioBank's reservoir of genetic diversity 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 and seedlings so desperately needed by rare populations in decline. The CryoBioBank is essential to CREW's goal of integrating the gene pool of wild and captive populations with minimal disruption to the wild plants and animals still struggling to survive in their native habitats.

PROGRESS

It is not just the sample numbers or species represented in the CREW CryoBioBank 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. Similarly, CREW's plant scientists have used frozen shoot tips to preserve and propagate numerous endangered plants including the Cumberland sandwort and four-petal pawpaw. These achievements clearly demonstrate the power, potential and value of CREW's CryoBioBank in the broader effort of conserving plants and animals from extinction.

FUTURE

CREW's CryoBioBank will continue to serve as a resource of genetic diversity for endangered populations of plants and animals now and in the future. Through sound science, CREW researchers have demonstrated that CryoBioBank samples can be used to propagate animals and plants. Now CREW is perfectly positioned to demonstrate that CryoBioBanks can be used to integrate genetic material from captive and wild populations of endangered plants and animals around the world.

Animal Samples in CREW's CryoBioBank

- Samples represent over 75 animal species ranging from toads to elephants.
- Animal samples preserved in CREW's CryoBioBank include primarily embryos, oocytes, and sperm.
- Some samples date back as far as 1982.

CREW's Frozen Garden

- The collection of plant samples within the CryoBioBank is called the Frozen Garden.
- There are over 125 different plant species represented in the Frozen Garden.
- Samples include shoot tips, pollen, seeds and spores.