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# Saving Species

SAN DIEGO ZOO GLOBAL®
INSTITUTE FOR CONSERVATION RESEARCH

## San Diego County:
## An Endangered Biodiversity Hotspot

**Hundreds of rare native species found only in Southern California live in San Diego's microhabitats. Our challenge today is to protect as many plants and animals as we can.**

*It seems to be a well-known fact that San Diego County is a biodiversity hotspot, but it seems less obvious that this means we have rare species in our own backyards—and I am lucky enough to work with one of them.*

–Colleen Wisinski

## Paying Attention to Biodiversity Hotspots

San Diego County has been named a biodiversity hotspot in the United States, with good reason. Just travel a few miles in most directions and you will find native amphibians, reptiles, insects, birds, mammals, and plants found nowhere else. Diverse ecosystems and a favorable climate are benefits, but tremendous habitat loss has led to large numbers of imperiled species. A diminutive burrowing owl endangered right here in San Diego—a Species of Special Concern and one of the smallest owls in North America—has sent our research team into action.

Technologies and strategies have helped, including a project to save another local endangered species, mountain yellow-legged frogs. Our efforts to breed them at the Institute for Conservation Research and release them into mountain streams have led to thousands of tadpoles and froglets being introduced to wild habitat.

Threatened plants also caught our attention: San Diego has 1,500+ native plant species, including 368 rare species and 140 endangered species. Our Native Plant Seed Bank is a valuable repository for many of these and provides assurance against extinction. We take the term biodiversity hotspot seriously and work hard to protect species in many ecosystems.

## How You Can Help

Our field research teams all over the world rely on the generosity of donors like you to help achieve San Diego Zoo Global's vision to lead the fight against extinction. To learn ways you can help, please call Maggie Aleksic at 760-747-8702, option 2, ext. 5762, or email **maleksic@sandiegozoo.org**.

ON THE COVER: Although the burrowing owl is disappearing from parts of its widespread range across the U.S., our research team is trying new approaches so these owl families stay in San Diego. We are creating more grassland habitat for them by encouraging ground squirrels to live nearby and dig the burrows these small owls need to raise chicks.

***Picture this:*** *Trail cameras placed in burrowing owl habitat help our team learn how families raise their young, protect them against predators, and hunt for food. Habitat conservation and burrows are essential for their survival.*

# Conservation: It's Closer Than You Think

By Colleen Wisinski, Conservation Program Specialist, Recovery Ecology

**I'm sitting in the dark in a field truck, a stone's throw from the San Diego-Tijuana border with Mexico, waiting for a burrowing owl to take the bait—literally. Then I can put a GPS transmitter on it and follow its movements to its new home, if the site it currently occupies is developed and becomes a shopping mall or housing tract.**

I've spent countless nights over the past year on stakeouts like this all over Southern California. It's easy to imagine biologists traipsing around in the jungle in some far-flung place, in search of an exotic species that is threatened with extinction. And while the Institute for Conservation Research is home base to such biologists, it is also home to biologists working in places that are much closer to home, although much less romantic.

It seems to be a well-known fact that San Diego County is a biodiversity hotspot, but it seems less obvious that this means we have rare species in our own backyards—and I am lucky enough to work with one of them. Since 2011, our team has been keeping track of the population of western burrowing owls in San Diego County, which is centered in Otay Mesa, near the Mexican border. This grassland stretch is home to the county's last breeding population of this feisty predator.

*Continued on page 3*

*This trail camera photo revealed three curious juveniles outside their burrow. Weighing only 7 ounces and standing no more than 10 inches tall, it's easy to miss a burrowing owl in the wild as it blends in so well with its surroundings.*

We have taken on burrowing owl conservation from every angle imaginable. Using tools like colored leg bands, remote cameras, and GPS mini-backpacks with data loggers, we have learned about the owl's reproduction patterns, movements, feeding habits, and survival. For example, it was thought that if the owls couldn't find enough food to feed their young near their nests, they would fly to more fruitful areas in search of prey. But we found that these birds stay pretty close to home when providing for their chicks. This highlights the importance of habitat conservation that includes productive hunting grounds along with good burrow sites for nesting.

Armed with our years of experience working with burrowing owls, we have embarked on a collaborative study with the U.S. Fish and Wildlife Service to examine different mitigation methods for burrowing owls throughout Southern California. Using the newest GPS/satellite technology, we are trying to assess the effects of habitat loss and fragmentation from development by following owls that have been impacted, as well as a control group that has not, and examining their nesting success, habitat, and survival. This study will help us understand when it's best to move owls into conservation areas, where ground squirrels create burrows for their owl neighbors, and when it's best to let the owls move out and find new homes on their own.

Although we are still in the early stages of this study, we are already obtaining valuable information and a better understanding of burrowing owls that can be used to help protect them. What we learn from this work will help shape conservation solutions for this pint-sized raptor that will keep them from disappearing from our local fauna.

*Saving burrowing owls includes ground squirrels, which dig up the ground and create nesting burrows favored by the owls. We release squirrels into protected areas where their foraging style keeps the vegetation low and their burrowing activity creates a refuge for other wildlife.*



# SOUTHERN CALIFORNIA CONSERVATION MAP

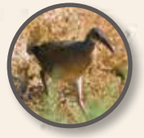
## BIRDS

BURROWING OWL
Employing ground squirrels as ecosystem engineers to dig burrows that encourage owl settlement and bolster the last breeding population in San Diego County.

CALIFORNIA CONDOR
Reintroducing these majestic scavengers to a key part of their historic range in Baja California, Mexico.

COASTAL CACTUS WREN
Recovering a local cactus wren population includes restoring nest sites, so prickly pear cactus destroyed by wildfires is being planted.

CALIFORNIA LEAST TERN
Monitoring nesting colonies of this endangered migratory bird along the Pacific coast.



RIDGEWAY'S CLAPPER RAIL
Collaborating on a breeding and release program to boost local populations of this reclusive saltwater marsh dweller.

SAN CLEMENTE LOGGERHEAD SHRIKE
Ensuring a successful comeback for these feisty songbirds through decades of breeding and release.

WESTERN SNOWY PLOVER
Protecting and enhancing critical nesting areas at Naval Air Station North Island.
*Photo courtesy of Naval Base Coronado.*

## MAMMALS

PACIFIC POCKET MOUSE
Managing a conservation breeding and reintroduction program for the world's smallest mouse.

PENINSULAR BIGHORN SHEEP
Understanding migration patterns and challenges across the U.S.-Mexico border for these legendary climbers.

STEPHENS' KANGAROO RAT
Rescuing these important seed dispersers from development and creating new populations in protected areas.

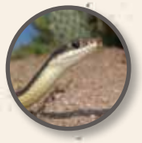
## PLANTS

NATIVE PLANT SEED BANK
Banking 700 seed collections from nearly 400 taxa for restoration and recovery, such as salt marsh bird's-beak.

TECATE CYPRESS
Creating a field gene bank supporting 1,000 seedlings and providing habitat for the rare Thorne's hairstreak butterfly.

TORREY PINE
Understanding the genetic variation essential for defense against invasive bark beetles for this local rare species.

## AMPHIBIANS & REPTILES



COASTAL PATCH-NOSED SNAKE
Elucidating the biology of this little-known Species of Conservation Concern.

DESERT TORTOISE
Headstarting juvenile tortoises to increase their chances of survival following release to the wild.

FLAT-TAILED HORNED LIZARD
Establishing a conservation assurance colony of this rare lizard at the San Diego Zoo.

MOUNTAIN YELLOW-LEGGED FROG
Breeding and reintroducing thousands of tadpoles and froglets to their native mountain stream habitats.

WESTERN POND TURTLE
Assisting with releases of turtles to the wild and educating the public about the plight of California's only native aquatic turtle species.

## INSECTS

QUINO CHECKERSPOT BUTTERFLY
Rearing more than 5,000 butterfly larvae for release into the San Diego National Wildlife Refuge to help restore this once abundant pollinator species.

**Southern California is home to amphibians, reptiles, insects, birds, mammals, and plants found nowhere else, thanks to diverse ecosystems and a favorable climate. But tremendous habitat loss has led to large numbers of imperiled species. This page shows a few we're working hard to protect.**

# BRINGING BACK THE FROGS

Debra Shier, Ph.D., Brown Endowed Associate Director, Recovery Ecology

Not long ago, it was difficult to walk around in Southern California's mountain lakes and creeks without tripping over mountain yellow-legged frogs. But after decades of human impacts—introducing nonnative trout to mountain lakes, pollution, mining, dumping, and off-road vehicle traffic, combined with drought and a deadly chytrid fungus epidemic—our most abundant local amphibian species now faces extinction.

So why save mountain yellow-legged frogs? As an amphibian vulnerable to environmental changes, they're an indicator of ecosystem health: if the frogs are thriving, the mountain streams and lakes are healthy. They also play a critical role in ecosystem balance by controlling insect populations and as prey for snakes, birds, and mammals. Losing them from our mountain ecosystems has a cascading effect.

*"Since 2015 we have reintroduced thousands of tadpole and juvenile mountain yellow-legged frogs back to the wild—a huge step toward recovery."*

– Debra Shier, Ph.D.



*We learned that mimicking the frigid winter breeding conditions found in the wild was essential for this species. Since these frogs live in cold mountain streams, they need to hibernate for several weeks at 40° Fahrenheit for successful mating to occur and for females to lay fertile eggs.*

When we initiated a mountain yellow-legged frog conservation breeding and release program at the Institute in 2005, treating chytrid infections in the wild founders and maintaining water quality were a challenge. Along the way we learned that providing frogs with a winter hibernation period was key to reproduction: today we have over 1,000 tadpoles each year. Since 2015 we have reintroduced thousands of tadpole and juvenile mountain yellow-legged frogs back to the wild—a huge step toward recovery.

But we can't stop there. Our challenge is to establish a new thriving population in the wild. Animals need to settle near the release site, survive, and breed in order for the population to grow. Now we release the frogs as older juveniles to improve their survival and reproduction. Conserving this frog species relies on knowing how many are in the wild, how many survive release, and whether they are reproducing. But these frogs are very hard to see in the water. To solve this, we relied on a little help from man's best friend: Luna, the family dog of one of our researchers. Luna worked with canine scent detection trainers to develop a keen sense of smell for the frogs and is doing a good job of finding them in streams so we can count them. The amphibian K-9 unit is a new approach for us but one that just may help save this species.


*Luna*

We have heard of canine units (K-9) with law enforcement teams that help track missing persons, sniff out drugs and bombs, and chase down criminals. Now our Recovery Ecology team has Luna, the first dog with our amphibian K-9 unit that is trained to detect the frogs' scents, even if they are several weeks old. Recently, Flynn and three more dogs also joined the team.

Our team regularly surveys local creeks and captures released frogs, some of which are tagged, so we can assess their health and see how far they are dispersing from the release site. What began as an emergency rescue mission to save the species 12 years ago is now a comprehensive effort that is helping to turn the tide for this critically endangered frog.

*Flynn*

# San Diego's Torrey Pine: Rare and Charismatic

Stephanie Steele, Ph.D., Postdoctoral Associate, Plant Conservation

The rarest pine in North America, the Torrey pine, can be found in our own San Diego County backyard at the Torrey Pines State Natural Reserve in La Jolla and Crest Canyon Park in Del Mar. This iconic pine occurs naturally in only one other location—on Santa Rosa Island, one of the Channel Islands off the coast of Santa Barbara County. In addition to its rarity, the species is threatened by habitat loss, low genetic diversity, drought stress, and bark beetle pests.

This fall, Plant Conservation researchers and volunteers collected tissue from various trees, which will allow the team to assess gene-coding diversity across the genome and the potential for the trees to respond to bark beetles and other stresses. This work will help guide future seed banking and reintroduction efforts to aid the conservation of this rare, charismatic pine.

*This work will help guide future seed banking and reintroduction efforts to aid the conservation of this rare, charismatic pine.*

**– Stephanie Steele, Ph.D.**



*Similar to animal conservation efforts, we have our eyes on the next generation.*

**– Joyce Maschinski, Ph.D.**

# Collecting Seeds, Saving Plants

Joyce Maschinski, Ph.D., Senior Scientist, Plant Conservation, and Chief of Science, Center for Plant Conservation

Abundant and glorious blooms followed the good winter rains of 2016-2017. This allowed the Plant Conservation team to collect seeds of nine San Diego County rare plant species from four habitat types, including increasingly threatened vernal pools. San Diego thornmint and Orcutt's bird's-beak grow in coastal sage scrub, while salt marsh bird's-beak, not surprisingly, thrives in coastal salt marshes.

Our team hiked canyons to collect seeds of Mexican flannelbush—with fewer than 100 living plants in the wild from just three small populations—and willowy monardella. As vernal pool waters subsided, Otay Mesa mint, spreading navarretia, little mousetail, and California orcutt grass set seed, each in its own timing. Similar to animal conservation efforts, we have our eyes on the next generation. With funding from the San Diego Association of Governments (SANDAG), we will germinate the seeds, grow them to maturity, and collect the next generation seeds for vernal pool restorations.

Kimberly Kutina, Senior Research Coordinator, collecting seed from San Diego thornmint, ***Acanthomintha ilicifolia.***

Salt marsh bird's-beak
***Chloropyron maritimus maritimus***

Humboldt's lily
***Lilium humboldtii***

Mexican flannelbush
***Fremontodendron mexicanum***

# Conservation Achievements

## HONORS AND AWARDS

Trustee emeritus and Institute founder **Dr. Kurt Benirschke** was honored with the Duane Ullrey Award at the 49th Annual Conference of the American Association of Zoo Veterinarians. This is the highest award given by the AAZV to wildlife health researchers.

**Dr. Chris Tubbs,** Reproductive Sciences, was elected to the Board of Directors of the International Rhino Keepers Association.

## HIGHLIGHTED PUBLICATIONS

**The fight to end extinction happens on a variety of fronts. Our San Diego Zoo Global conservationists, scientists, and researchers are constantly working behind the scenes to lead this fight in every capacity, whether studying the smallest cells or working with the biggest animals. From the genes of plants that store their seeds in unusual ways to the role of personality in tortoises, to respiratory viruses in cheetahs and the most effective education methods for humans, here's what we've published lately:**

In this article, we discuss the unique challenges of conserving geophytes, perennial plants with underground storage structures such as bulbs, corms, and rhizomes. To capture the breadth of a species' genetic diversity for seed banking, it must be assessed across its entire range. The ability of geophytes to remain dormant underground for prolonged periods of time makes this difficult. The problem is further exacerbated by drought and the inherent unpredictability of future weather as a result of climate change. Because of this, we must make seed collections across many different years and under different climatic conditions.

**Davitt, J. M.** 2017. Conserving San Diego's endemic geophytes. *Samara* 31:12.

We examined the effect that personality has in tortoises about to be released into the wild. We showed that personality in tortoises can be used to predict both survival and ability to engage in beneficial behaviors after release. For instance, we found that curious tortoises were more likely to find and use burrow refuges, giving them a survival advantage. Personality and behavior may provide meaningful guidance to conservation practitioners, allowing suitable candidates to be selected for release that minimize welfare problems and maximize conservation impact.

**Germano, J. M., M. G. Nafus,** J. A. Perry, D. B. Hall, and **R. R. Swaisgood.** 2017. Predicting translocation outcomes with personality for desert tortoises. *Behavioral Ecology* 28: 1075-1084.

We reviewed outcomes from a symposium about building conservation capacity in Southeast Asia. We found that delivering successful conservation education requires understanding conservation's place in society, developing a feeling of community among students, providing students with financial support, using practical teaching methods, and crafting culturally appropriate messages.

Souter, N. J., A. C. Hughes, T. Savini, M. Rao, E. Goodale, A. Van Nice, N. Huang, J-X. Liu, M. P. Hunt, **D. A. O'Connor**, A. L. Heung-Lam, G. Gnuen, Y. Sun, and I. Silva. 2017. Building conservation capacity in Southeast Asia: Outcomes of the ATBC 2015 Asia-Pacific Chapter meeting conservation education symposium. *Applied Environmental Education & Communication* 16: 149-156.

A collaborative study of nearly 150 cheetah cubs housed across six breeding institutions helped us better understand Feline Herpesvirus (FHV), a respiratory disease that can cause illness in zoo-housed cheetahs. Our findings showed that, contrary to popular belief, manifestation of FHV in the mother was not a significant predictor of disease in her cubs. Other important factors that may guide future management of cheetahs and research on this disease were also identified.

**Witte, C. L, N. Lamberski, B. A. Rideout**, F. Vaida, S. B. Citino, M. T. Barrie, H. J. Haefele, R. E. Junge, S. Murray, and L. L.Hungerford. 2017. Epidemiology of clinical feline herpesvirus infection in zoo-housed cheetahs *(Acinonyx jubatus). Journal of the American Veterinary Medical Association* 251: 946-956.



# Conservation Partnerships

## BUD HELLER CONSERVATION FELLOWSHIPS:

## *Benefiting Rare Species*

**Bud Heller was devoted to the San Diego Zoo Safari Park and quietly supported it for many years through generous personal and foundation gifts. In his memory, his descendants at the Heller Foundation of San Diego established Bud Heller Conservation Fellowships for research to benefit the health, well-being, and sustainability of wildlife species at the Safari Park. This is a tribute to a modest man who always declined the recognition he so deserved yet who made an important difference to conservation.**

For more than two decades, San Diego Zoo Global has honored the memory of Elwyn "Bud" Heller through Bud Heller Conservation Fellowships. Since 1997, Bud Heller Fellows have advanced research that benefits rare and endangered animal and plant species, many of them native to San Diego County. Made possible by the Heller Foundation of San Diego, these highly valued fellowships give young scientists a unique opportunity to increase their knowledge, skills, and abilities as they build their careers in the life sciences.

Bud Heller Conservation Fellows have worked alongside mentors in the fields of Conservation Genetics, Recovery Ecology, Plant Conservation, Reproductive Sciences, Disease Investigations, and Population Sustainability. We are grateful to the Heller Foundation of San Diego for making possible highly sought-after fellowships that have made a tremendous difference in the lives of wildlife and young scientists.

In addition to the many projects for endangered African species generously supported by the Heller Foundation, those benefiting local native species have included:

- California condor parenting and disease management
- Monitoring released condors
- Activity patterns of native snake species
- Germplasm cryopreservation
- Cactus wren nesting and habitat restoration
- Genetic studies of Peninsular bighorn sheep
- Genetic studies and reintroduction of Pacific pocket mice
- Recovery and release of mountain yellow-legged frogs.

### RECOVERY ECOLOGY

Eleven alala—classified as Extinct in the Wild—released by our Hawaii field team last fall are doing well and have been observed foraging and spending time near the release aviary.

### PLANT CONSERVATION

Our ongoing native plant restoration project at Lake Hodges was featured in a Wildlife Conservation Society report promoting a message of hope for conservation in the face of climate change.

### POPULATION SUSTAINABILITY

Only one of four zoos to have ever bred the critically endangered Jamaican iguana, we successfully produced four hatchlings that will become part of a crucial assurance population.

### CONSERVATION GENETICS

We held a training session for members of the Vaquita CPR field team that led to the successful preservation of living genetic cell lines from this rarely seen, critically endangered porpoise.

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# WHAT'S News

### REPRODUCTIVE SCIENCES

Our avian group successfully cryopreserved testicular tissue from quail with the ultimate goal of saving exotic bird species like the kiwi by using tissue transfer into living domestic chicken hosts.

### DISEASE INVESTIGATIONS

Almost 2,000 desert tortoises were screened for two species of respiratory disease in support of tortoise translocation efforts.

### COMMUNITY ENGAGEMENT

This summer we surpassed a milestone for our Teacher Workshops in Conservation Science program with our 1,000th educator trained to date for a grand total of 1,057 program alumni thus far.

### GLOBAL PARTNERSHIPS

Together with the University of Oxford and TRAFFIC, we co-hosted the first-ever Wildlife Trade Symposium, focused on reducing the demand for illegal wildlife products.

Saving Species

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SAN DIEGO ZOO INSTITUTE FOR CONSERVATION RESEARCH