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Endangered Species and the Arizona-Sonora Desert Museum



Mexican gray wolf
Photo by Jim Clark/USFWS

*T*he Arizona-Sonora Desert Museum, a nonprofit research and education institution located in the city of Tucson, is a combination zoological park, botanical garden, nature center, and museum. Our multiple functions are reflected in our memberships in the American Zoo Association (AZA), American Association of Botanical Gardens and Arboreta, American Association of Museums, and Center for Plant Conservation, among others. Our primary mission is to understand and interpret the natural history and ecology of the Sonoran Desert and its surrounding habitats, and to promote conservation in the region.

Nursery Horticulturist John Wiens marks developing fruits on hand-pollinated, cultivated specimens of Nichol's Turk's head cactus. The fruit and seed counts will determine the maximum fecundity for this endangered cactus, known from only three populations in Arizona and Sonora. ASDM Research Associate Bob Schmalzel is two decades into a multifaceted ecological study of this plant. The plants shown here are second generation cacti in the Desert Museum's collection.

Photo: Mark Dimmitt.



The Sonoran Desert covers about 100,000 square miles (260,000 square kilometers) in the United States and Mexico. In contrast to the other three North American deserts, the Sonoran is tropical in origin and most of its area is frost-free. Half of its flora and a similar proportion of the fauna are descended from tropical ancestors. This fact is visually evident in two plant life forms that are characteristic of both the Sonoran Desert and dry tropical forests: legume trees and columnar cacti. The other three North American deserts have few trees and no columnar cacti.

Numerous biological communities occur adjacent to and within the Sonoran Desert proper. Representatives of all of the biomes can be found within this region, from alpine tundra near Flagstaff, Arizona, to tropical forests in southern Sonora, Mexico.

The wide variety of habitats and the biseasonal rainfall pattern in the Sonoran Desert support great biological diversity. Its flora contains about 2,000 species of vascular plants, and the whole region interpreted by the Desert Museum has at least 5,000. The desert proper supports approximately 600 species of vertebrates. The invertebrates have not been enumerated, but there are estimates for some taxa. Arizona alone boasts 40 species each of scorpions and velvet ants, and 250 butterflies; the Sonoran Desert has 40 species of termites. The area around Tucson has 1,000 species of native bees, and an equal number of moth species occurs in a single canyon in the Huachuca Mountains of southern Arizona.

Most of our exhibits at the Arizona-Sonora Desert Museum are outdoors and integrate native, live animals and plants in natural settings. Our interpretive focus is as much on ecological processes as it is on individual species. For example, our Pollination Gardens interpret the interaction of animals and plants and the reciprocal benefits of pollination ecology rather than simply talking about, say, hummingbirds or flowering ocotillos.

We mainly promote *in situ* conservation (that is, conservation of nature in



place as opposed to in botanical gardens or zoos), and we focus on the protection of natural communities more than on preservation of individual species. For example, research on the ecology and population dynamics of desert ironwood trees (*Olneya tesota*) revealed just how important this plant is to the ecological health of the Sonoran Desert and its wildlife. These findings attracted the attention of the Department of the Interior and provided the scientific underpinnings for the creation of the Ironwood Forest National Monument in 2000. The ironwood studies and other research results have also been used by Pima County in developing its Sonoran Desert Conservation Plan (see the following article).

The Desert Museum also maintains *ex situ* or museum-based populations of several endangered species. The animals bred as part of our participation in AZA's Species Survival Plan program include the Mexican gray wolf (*Canis lupus baileyi*), thick-billed parrot (*Rhynchopsitta pachyrhyncha*), and ocelot (*Leopardus pardalis*). Our Botany Department maintains populations of several endangered plants, including the Nichol's Turk's head cactus (*Echinocactus horizontbalonius* var. *nicholii*), Pima pineapple cactus (*Cory-*

A field-netted lesser long-nosed bat is about to surrender a small tissue sample for DNA analysis before being released. Studies of this endangered nectar-feeding bat species are part of the Desert Museum's Migratory Pollinators Program.

Photo by Karen Krebs



This San Esteban chuckwalla (*Sauromalus varius*) provides in situ blood samples for analysis as part of a long-term study (photo shows Curator of Herpetology Craig Ivanyi in 1997). The Desert Museum has also maintained a captive breeding population of this species for more than 20 years. This chuckwalla is abundant on tiny San Esteban Island in the Gulf of California, but occurs naturally nowhere else.

Photo by Gary P. Nabhan

phantha scheeri var. *robustispina*), and Kearney blue-star (*Amsonia kearneyana*).

We have numerous other rare plant and animal species in our collections. Our list of Species of Conservation Concern for the Sonoran Desert region totals 195 rare or vulnerable plant taxa, of which 125 are in our collections. Some of these are plants that our field botanists have located within the Sonoran Desert region for the first time, and some were previously unknown to

science. Of 90 vertebrate species of concern, specimens of 44 species are on exhibit or in breeding programs at the Desert Museum.

Members of our Conservation and Science Department staff are involved in several field research projects that involve endangered and threatened species. The largest is the Migratory Pollinators Program, which is being funded by the Turner Foundation, Turner Endangered Species Fund, and National Fish and Wildlife Foundation. One of the species under investigation is the endangered lesser long-nosed bat (*Leptonycteris curasoae*). Among the non-listed species we're studying are the rufous hummingbird (*Selasphorus rufus*), white-winged dove (*Zenaida asiatica*), and monarch butterfly (*Danaus plexippus*). There is evidence that the latter three species are declining due to habitat destruction. Our Migratory Pollinators Program seeks to map the migration corridors of these species from the southwestern United States to the state of Jalisco, Mexico. We are also identifying the major plant resources that fuel the migrations, recommending the preservation of important habitat that we identify in Mexico and the southwestern U.S., and providing information to the public about the loss of pollination services in nature and agriculture due to habitat destruction and excessive pesticide use.

Working beyond species boundaries, the Desert Museum has been a leader in research and public education about endangered ecological processes. Gary Nabhan, the Museum's former Director of Conservation and Science, worked on the ecology of the desert ironwood tree (see sidebar) and revealed its status as a keystone species upon which numerous other plants and animals depend. Through a grant from the National Fish and Wildlife Foundation, we are conducting exhaustive studies on the ecology and population dynamics of the Pima pineapple cactus, including its pollination biology, fecundity, growth rates, seed dispersal, and predators. Rick

Brusca, our new Director of Conservation and Science, conducted research in the Gulf of California and its coastal habitats. His findings have played a key role in developing conservation strategies for critical coastal and island habitats in the Gulf and the Colorado River Delta region, including protection of coastal wetlands and of the endangered Gulf miniature porpoise or vaquita (*Phocoena sinus*), a fish known as the totoaba (*Totoaba macdonaldi*), and others. Brusca was co-Principal Investigator on the construction of an All-Animal Database for the Gulf of California (accounting for more than 6,000 species) that is currently being used to identify the most important conservation priorities in the region.

There is an urgency to conservation in the Sonoran Desert region because southern Arizona and Sonora, Mexico, are among the fastest developing areas in North America. Conducting all of these projects puts tremendous demands on our small staff of 110 employees, even with the help of several hundred docents and volunteers. We maintain the grueling pace because we love this land and want to keep the best parts of it healthy and beautiful for the benefit of future generations.

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The Arizona Sonora Desert Museum has had a long-standing interest in the wellbeing of the desert ironwood tree. This legume, the only species in its genus, has no close relatives. It is a dominant tree in much of the Sonoran Desert and is nearly endemic to this region. Desert ironwood trees are slow growing and live up to 800 years. The wood is so dense that it sinks in water, and it contains toxins that render it nearly non-biodegradable. Because dead wood is immune to termites and wood-rotting fungi, large trees can take a millennium to weather away after dying.

Gary Nabhan discovered ironwood's role as a keystone species in the Sonoran Desert ecosystem. Most desert plants cannot become established in the harsh, open desert environment; they must germinate beneath a "nurse plant." In some regions of the Sonoran Desert, ironwoods are the most important nurse trees, sheltering more species within their canopies than any other plants. The diversity of associates is greatest in the Silverbell Mountains and adjacent ranges west of Tucson, Arizona.

Although it is not classified as endangered, desert ironwood is greatly threatened by human activities. For example, the trees have been locally depleted by the ironwood carving industry. Begun by the Seri Indians of Sonora, Mexico, in the 1960s, the carving of ironwood



Illustration by Bill Singleton

into animal figures created a growing demand for these items that many other Mexicans carvers now seek to fill. A greater threat is the demand for firewood and charcoal. The main tree cut for these uses is mesquite (*Prosopis* spp.), but ironwoods are often indiscriminately cut as well. The damage is increased by changes in cutting techniques. When felled by axe, ironwood trees resprout from the stump. But today they are most often cut to ground level with chain saws, causing them to die. Major components of the desert community die with the nurse trees. This information was gathered and publicized by the Ironwood Alliance, a conservation organization in which Desert Museum staff members are actively involved.

The above studies led to creation of the Ironwood Forest National Monument in 2000. This monument encompasses the Silverbell Mountains and four other desert ranges and intervening valleys. The Desert Museum will continue to be involved in this new monument, which is practically in our back yard, and the Bureau of Land Management has contracted us to conduct the vegetation analysis and baseline faunal studies needed to develop the monument's management plan. The monument is expected to be an important part of the proposed Sonoran Desert Conservation Plan's system of habitat reserves.