Saguaro National Park

Saguaro National Park is well known for its iconic Saguaro cactus, but what makes the park so special is its astounding biodiversity. This handbook was put together to help guide you through the expansive biodiversity of not only Saguaro National Park, but of the many plants and animals found in your own backyard.

Background

Saguaro National Park is composed of two distinct districts: The Rincon Mountain District and the Tucson Mountain District. The Tucson Mountain District lies on the west side of Tucson, Arizona, while the Rincon Mountain District lies on the east side of Tucson. Both districts were formed to protect and exhibit forests of their namesake plant: the Saguaro Cactus.

Most people think of Saguaro National Park as being a desert park. True, the lower elevations of the park encompass Sonoran Desert Vegetation, but there is much more to Saguaro National Park than just cacti.

The Tucson Mountain District of Saguaro National Park ranges from an elevation of 2,180 ft to 4,687 ft and contains 2 biotic communities, desert scrub, and desert grassland. Average annual precipitation is approximately 10.27 in. Common wildlife include the coyote, Gambel’s quail, and desert tortoise.

The Rincon Mountain District of Saguaro National Park ranges from an elevation of 2,670 ft to 8,666 ft and contains 6 biotic communities. The biotic communities (starting from the lowest elevation) include desert scrub, desert grassland, oak woodland, pine-oak woodland, pine forest and mixed conifer forest. Average annual precipitation is approximately 12.30 in. The Rincon Mountains peak at a considerably higher elevation than the Tucson Mountains, therefore there are more biotic communities and increased plant and wildlife diversity. Because of the higher elevation in the Rincons, animals like the black bear, Mexican spotted owl, Arizona mountain king snake, and white-tailed deer live in this district.

Plants

Saguaro National Park is located within a desert, but contrary to what you might expect, there is an abundance of life. Plants here are adapted to drought, so during long dry periods they are able to go dormant, conserving their water. At these times, many plants appear lifeless, but shortly after a rainfall these plants are able to come to life sprouting new green leaves. If you like green, you will especially enjoy Saguaro National Park during the rainy seasons. Within just 48 hours after a rainfall, the ocotillo plant is able to change from what appeared to be a handful of dead sticks into a cheerful shrub with tall green branches, covered in new leaves.
The varied elevation within the park allows for a great variety of different species. Current research indicates there are approximately 1200 species in the Rincon Mountain District and approximately 400 species in the Tucson Mountain District. A precise number is difficult to ascertain given the complexity of the topography for sampling uniformly and changes in taxonomy, and the voucher specimens housed in unknown locations.

**Buffelgrass**

Buffelgrass (*Pennisetum ciliare, Cenchrus ciliaris*), is the archenemy of the Sonoran Desert, the invasive grass most likely to cause significant damage to the native ecosystem. Buffelgrass is native to Africa, Asia, and the Middle East. This grass was intentionally brought to arid portions of the U.S. in the 1930s and was planted for cattle forage because of its drought tolerance.

Buffelgrass is a dense grass that was introduced for cattle forage in the 1930's. Buffelgrass grows densely between the sparse desert plants and can fuel large, hot fires that the desert plants are not adapted for. These fires can lead to increased runoff and erosion, which in turn cause larger floods and damage the landscape. The park has a well-developed program to remove buffelgrass from within the park boundaries but buffelgrass re-sprouts because it spreads from the neighborhoods in Tucson into the park. Beating buffelgrass is a community effort to eradicate it from yards, parks, roadsides and the park.

*Check out these websites for more information pertaining to plants of Saguaro National Park:*

https://www.nps.gov/sagu/learn/nature/upload/Common-Plants-of-Saguaro-NP.pdf


https://www.nps.gov/sagu/learn/nature/buffelgrass.htm#CP_JUMP_2667227

**Animals**

Although the Sonoran Desert can seem forbidding, it is home to many animal species. These animals have adapted to the desert’s high temperatures and scarce water supply. Many species simply avoid the hot daytime temperatures by being active only at night or by seeking shelter in shaded nests or burrows. Others have features that allow them to stay cool - the jackrabbit’s large ears allow heat to radiate away from its body, and vultures actually urinate on themselves to dissipate heat!
Saguaro National Park contains a great variety of unusual animals, some of which can only be found in southern Arizona. Roadrunners, horned lizards, Gila monsters, kangaroo rats, and collared peccaries are all seen regularly by visitors. Although Saguaro NP lies on the edge of the Sonoran Desert, Mica Mountain in the Rincon Mountain District reaches more than 8600’ in height. This altitude allows for cooler temperatures and pine trees, as well as mammals such as black bears and white-tailed deer. The park is also home to species more commonly associated with the tropics, such as coati. Precious, often hidden desert waters contain aquatic leopard frogs and mud turtles.

Mammals

Mammalian species are found throughout Saguaro National Park. Mammals are characterized by their fur and the ability to nurse their young with milk from modified sweat glands called mammary glands. Mammals are warm-blooded, or endothermic. Bats, the only flying mammal, are numerous throughout the park, as are bobcats and javelina.

Biologists from Saguaro National Park are interested in the health of the carnivore populations in the Tucson Mountains, which is becoming more surrounded by development. Across the world, biologists have seen species decline in natural areas as they become isolated from other areas. Could this be happening in the Tucson Mountains? We do not know, but we have seen fewer photos of certain carnivores when we use our infrared-triggered cameras.

Check out these websites for more information pertaining to mammals of Saguaro National Park:


http://www.lostcarnivores.org

To see a species inventory list of mammals, birds, and amphibians:

https://www.nps.gov/sagu/learn/nature/animals.htm

Birds

Birds are flying vertebrates. They’re built to fly with feathers and a strong but lightweight skeleton. All birds have beaks, whose shapes are specialized to the food they eat. For example, predatory birds (raptors) like hawks have hooked beaks to kill and dismember prey. Hummingbirds and other nectar feeders have bills designed to fit into flowers. Although bird songs can sound melodic and simple, they are very specific calls used to attract a mate or warn other birds.
Arizona is a bird-watcher’s paradise. Saguaro National Park contains many species seen in few other places in the United States, such as vermillion flycatchers and whiskered screech owls. The diversity of habitats in the park ranges from lowland desert up to pine forests. These diverse ecosystems support a surprising array of bird life. Common desert birds include greater roadrunners, Gila woodpeckers, and Gambel’s quail. Northern goshawks, yellow-eyed juncos, and Mexican jays can be found in the park’s higher elevations.

Amphibians

Throughout their life cycle, amphibians live on both land and water. Young are usually born in water and spend the early part of their life cycle there. As they grow, their bodies change through a process called metamorphosis. Gills necessary for breathing in water transform into air-breathing lungs, and young amphibians lose their aquatic tail in favor of strong legs for swimming and jumping. Now these juveniles are ready to live on the land!

The Sonoran Desert is dry and very hot – not a place where one might expect wet-skinned amphibians! Torrents of summer monsoon rain summon toads from their underground burrows where they spend most of the year. On July nights, hundreds of toads can be found breeding in temporary pools. Saguaro National Park amphibians include Couch’s spadefoot, leopard frogs, and the canyon treefrogs which live year-round in small water sources such as rock pools and springs.

Reptiles

Although all reptiles have dry and scaly skin, they are an extremely diverse class of animals. Some are venomous, such as the western diamond-backed rattlesnake and the Gila monster, both found in Saguaro National Park. Other reptiles, like the tortoises and turtles of the desert, have developed hard shells for protection. Saguaro National Park is home to some of America’s most charismatic reptiles, including Gila monsters, desert tortoises, Western coral snakes, and six species of rattlesnakes. Desert tortoises are most active either in early morning or at dusk (crepuscular); many snakes are either crepuscular or active at night (nocturnal). The “high season” for seeing reptiles is during and after the summer monsoon rains which come in July and August. Reptiles and amphibians are rarely seen from November through March, although they are occasionally active in these months. Visitors are advised that collecting or molesting any wildlife in the park is not allowed.
Water

"Water, water, water... There is no shortage of water in the desert but exactly the right amount, a perfect ratio of water to rock, water to sand, insuring that wide free open, generous spacing among plants and animals, homes and towns and cities, which makes the arid West so different from any other part of the nation." - Edward Abbey, Desert Solitaire: A Season in the Wilderness

Many visitors to Saguaro National Park think that because the park is in the desert it has very little water...yet Saguaro is filled with unique water features that sustain a wide variety of wildlife and plants. Saguaro National Park is a two district park on the east and west side of Tucson. Although they are part of the same park the two districts are vastly different. The low elevation west district has primarily Sonoran desert vegetation and receives only 12 inches of rain per year. The east district rises from the valley floor to over 8,000 feet elevation at Mica Mountain with vegetation communities ranging from desert scrub to temperate pine forests. Mica Mountain receives over 30 inches of precipitation per year providing water to springs and streams farther down the mountain front.

Check out this website for more information pertaining to water in Saguaro National Park:

http://www.arcgis.com/apps/MapSeries/index.html?appid=6a8ae9bd94de47179b66bb8d4fddc861

Dragonflies

Citizen scientists in Saguaro National Park are joining citizen scientists across the nation in the Dragonfly Mercury Project to assess mercury levels in the park.

Mercury is a pollutant that can have serve impacts on human and wildlife health. The main human source of mercury in remote parks is coal burning power plants. The plants release mercury into the air which is eventually deposited on the landscape. Dragonfly larvae are good indicators of mercury in the food web because they live for a long time in the water as larvae and they are predatory, accumulating mercury from the other insects they eat. They are also an important source of food for birds and fish and so can indicate larger trends in the food chain. Citizen scientists at Saguaro National Park use dip nets to collect dragonfly larvae from tinajas, springs and creeks. The samples are analyzed and the data becomes part of a larger data set from parks across the country so scientists can understand larger trends in the landscape.

Check out this website for more information pertaining to dragonflies and the presence of mercury in Saguaro National Park:

http://www.nature.nps.gov/air/studies/air_toxics/dragonfly/index.cfm
Past Schoolyard BioBlitzes:


https://www.inaturalist.org/projects/manzo-elementary-school-schoolyard-bioblitz

https://www.inaturalist.org/projects/john-b-wright-elementary-school-schoolyard-bioblitz

https://www.inaturalist.org/projects/davis-elementary-school-schoolyard-bioblitz
BioBlitz Count Update from the Saguaro NP BioBlitz 2011

Introduction

On October 21-22, 2011, Saguaro National Park became the fifth park to host the annual BioBlitz. Starting in 2006 and continuing until the 100th Anniversary of the National Park Service in 2016, the National Geographic Society and the National Park Service are sponsoring ten annual BioBlitzes, each a 24-hour scientific inventory and celebration of the diversity of life in a selected premier national park. These events are designed to make connections between parks, science, and young people; stimulate scientific research in national parks; and publicly celebrate the amazing biodiversity that parks protect.

The 2011 BioBlitz was a huge event and great success! More than 5,000 participants, including over 200 scientists and 2,100 school children, searched for species and learned about the amazing diversity in the Sonoran Desert and Sky Island region of Arizona. Students helped collect and identify lichens and insects in the desert environs of the Tucson Mountains, and studied tracks and set up remote wildlife cameras in the Rincon Valley. A few climbed up over 8,000 feet on Mica Mountain, where they camped and explored the pine forests to find and learn about butterflies, bryophytes, and migratory birds. In the Science Tent at the BioBlitz Base Camp, public participants used microscopes to examine lifeforms - endophytes and tardigrades - that many of them had never heard of, as well as to view photos and live specimens of larger animals.

Primary sponsors included the Friends of Saguaro National Park and the Arizona Sonora Desert Museum, but many other groups contributed funding, volunteers, expertise, and many other creative forms of support. Tucson really rose to the occasion as the entire community supported and participated in the 2011 BioBlitz.

Trends and Status

When the original count of 859 identified species was revealed at the Base Camp on the afternoon of October 22, 2011 we knew the number would continue to increase. Since the event, scientists and technicians have spent hundreds of hours indentifying unknowns, confirming previous identifications, and calling in experts to review specimens. However, it may be years before some of the specimens collected during the BioBlitz can be identified beyond the family or genus level to species. This is because many small insects, in particular,

Students dissect the decaying material of a saguaro cactus to find the insects that live on dying saguaros and help with decomposition

are so difficult to identify that only a few experts (some of whom do not even live in the US) know enough about their important characteristics to key them out. The current list of 1106 (updated in October 2013) includes only individuals that have been identified to the species level so far.

Saguaro BioBlitz 2011 Species Count
Updated October 1, 2013

<table>
<thead>
<tr>
<th>Species Groups</th>
<th>Actual Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphibians</td>
<td>3</td>
</tr>
<tr>
<td>Birds</td>
<td>107</td>
</tr>
<tr>
<td>Fungi</td>
<td>197</td>
</tr>
<tr>
<td>Invertebrates</td>
<td>324</td>
</tr>
<tr>
<td>Mammals</td>
<td>25</td>
</tr>
<tr>
<td>Non-Vascular Plants</td>
<td>25</td>
</tr>
<tr>
<td>Reptiles</td>
<td>36</td>
</tr>
<tr>
<td>Vascular Plants</td>
<td>389</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1106</strong></td>
</tr>
</tbody>
</table>

Continued >>
Biodiversity Highlights

Saguaro's BioBlitz has already provided many exciting finds!

- John Spence, a biologist from Glen Canyon National Recreation Area, found several species of bryophytes (mosses and liverworts) that are new to the park, including Rosulabryum leptotormesens, new to North America, and Bryum sp. nov. "chiricahuenesis" which is new to science, meaning it has never been described before.

- Entomologists (insect scientists) from around the country worked from the desert to the mountaintops collecting literally thousands of insects during the BioBlitz. Because Saguaro's current species list contains less than 50 insect species, most of the ones collected during the BioBlitz will be newly documented for the park.

- Dr. Betsy Arnold’s lab at the University of Arizona discovered 191 species of endophytic fungi that live inside plants in the park, such as desert broom and creosote bush; all species found are new to the park and many of these species have never been previously described.

Citizen Science

In addition to helping scientists gather data in over 120 public inventory programs, "citizen scientists" participated in the BioBlitz by taking their own photos and uploading them to Saguaro’s Flickr site.

For specimen photos, check out: http://www.flickr.com/groups/1725510@N21/

For more photos check out: http://www.flickr.com/search?q=Saguaro%20BioBlitz

BioBlitz photos of species can also be found at the Project Noah website: http://www.projectnoah.org/missions/6986014

What's Next?

Further information on the 2011 BioBlitz and the count updates are available on the Saguaro National Park’s website at www.nps.gov/sagu. Here you can also find links to the list of species found during the event, to NGS’s FieldScope, an online mapping program with observations, photos, and metadata collected during BioBlitzes to date; the National Park Foundation’s Electronic Field Trip, a live broadcast for schoolchildren that reached tens of thousands of kids throughout the US; and many blogs about the event. You will find links to media coverage following the BioBlitz and any resources scientists want to share about their work.

If you would like to be involved in Saguaro National Park’s ongoing efforts to document and learn more about the incredible diversity of the Sonoran desert and the Sky Island region, please contact Don Swann at Don_Swann@nps.gov

Students from the Ironwood Tree Experience hike to a remote backcountry site to help inventory species with scientists

Scientists on the BioBlitz working diligently sorting and identifying bees in the science tent

More Information

<table>
<thead>
<tr>
<th>Name</th>
<th>Phone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don Swann</td>
<td>(520) 573-5177</td>
<td><a href="mailto:Don_Swann@nps.gov">Don_Swann@nps.gov</a></td>
</tr>
<tr>
<td>Biologist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saguaro National Park</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3693 S. Old Spanish Trail</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tucson, AZ 85730</td>
<td></td>
<td></td>
</tr>
<tr>
<td>National Geographic</td>
<td></td>
<td></td>
</tr>
<tr>
<td><a href="http://www.nps.gov/sagu">www.nps.gov/sagu</a></td>
<td></td>
<td></td>
</tr>
<tr>
<td><a href="http://www.nationalgeographic.org/bio">www.nationalgeographic.org/bio</a> blitz</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Inventory of medium and large mammals at Saguaro National Park

Don E. Swann and Brian Powell

Introduction

Many visitors to national parks eagerly anticipate the chance to see large mammals such as bears, elk, and bighorn sheep. Yet surprisingly little is known about mammals in most parks. Many species are elusive, nocturnal, or rare, and studying them often requires intrusive methods and significant funds. Biologists usually rely on sightings and other evidence to determine which species occur in parks, but these data may be subject to interpretation and are not ideal. Increasingly, wildlife cameras that use infrared light beams and are triggered by the animals themselves are providing new ways to learn about mammals.

We used wildlife cameras at Saguaro National Park for 10 years (1999-2008) to document the park’s medium and large mammals and where they occur. Cameras were located at random locations as well as near springs and other water sources in the park’s two districts — the Rincon Mountain District, located east of Tucson, and the Tucson Mountain District, located west of the city.

Methods

We photographed mammals using both film and digital infrared-triggered wildlife cameras. We set cameras at more than 88 non-random points throughout both districts during 2000-2003. In addition, during 1999-2008, we set cameras at more than 88 non-random points that represented the full geographic and vegetative diversity of Saguaro National Park. We checked cameras approximately once every two weeks (less frequently for digital units) to change film and trouble-shoot problems. We moved most cameras every few weeks, but a few cameras were left in the same location for extended periods to determine how many species may occur in these locations over long periods of time.

Photographs of wildlife were examined to identify the species present in each photo. Data associated with each photo, including the date, time, location, species, and number of individuals, were entered into a database for further analysis, and photos were archived at the Western Archeological Conservation Center in Tucson. For analysis, we focused only on larger mammals: opossums, squirrels, rabbits and hares, carnivores, and hoofed animals. We used a variety of statistical procedures to summarize the data and estimate the number of species present in the park (species richness) at different periods of time.

Results

During 1999-2008 we obtained more than 7500 photographs of medium and large mammals, approximately 4500 in the Rincon Mountain District and 3000 in the Tucson Mountain District. We confirmed 30 species in Saguaro National Park: six squirrels, three rabbits and hares, one opossum, 16 carnivores, and four hoofed animals. We documented 21 species in the Tucson Mountain District and 29 species in the Rincon Mountain District. We did not photograph two species in the Tucson Mountains (bighorn and porcupine) and four species (bighorn, porcupine, jaguar, and Mexican gray wolf) in the Rincon Mountains that have been reliably documented at the park and may now be locally extinct. However, we did photograph two species (opossum and coati) that do not appear on early species lists and may have colonized Saguaro National Park after it was established. We photographed four non-native mammals: domestic dogs and cats, feral cattle, and the Abert’s squirrel. Estimates of species richness were similar to species counts, suggesting we photographed most species present.
Carnivores and hoofed animals

Among the largest mammals in Saguaro National Park are black bears, which we photographed only in the Rincon Mountains, and mountain lions. We obtained many more photos of mountain lions in the Rincons than in the Tucson Mountains, suggesting that lions are relatively uncommon in the latter. In contrast, we obtained more photographs of bobcats in the Tucson Mountains, which are smaller, more arid, and closer to large human population centers than the Rincons. Gray foxes and javalina were among the most frequently photographed mammals; other common species include coyotes, hooded skunks, and striped skunks. Two species (kit fox and badger) were rarely photographed. White-tailed deer were not photographed in the Tucson Mountains but appeared to be far more common than mule deer in the Rincons.

![Javalina photographed during the study](image)

Squirrels, rabbits, and opossums

Photographs of opossums in the Rincons were the first known observations of this species in Saguaro National Park. We photographed two jackrabbits and the desert cottontail, as well as one species at high elevations in the Rincon Mountains that may be the eastern cottontail. We photographed six squirrels, including the Arizona gray squirrel, an uncommon native species that may be threatened by the introduced Abert’s squirrel in the high elevation forests of the Rincons.

Changes in mammals in Saguaro National Park over time

Saguaro National Park (originally Saguaro National Monument) was established in 1933, but included only the Rincon Mountain District until 1961, when the Tucson Mountain District was established. There is evidence that the mammal community in both districts has changed over time, but precise knowledge of these changes is limited due to poor historic information. Based on specimens, photographs, and reliable historic records we believe that several species once present in the Rincons no longer occur. A grizzly bear, perhaps the last one in southern Arizona, was killed in or around 1921, and records suggest that four jaguars were killed in the Rincons between 1900 and 1933. Gray wolves were sometimes observed prior to 1950, but there have been no credible reports in decades. Bighorn sheep were certainly present in both districts historically, but now appear to be locally extinct. In contrast, coats and Abert’s squirrel are both now relatively common in the Rincons but were not reported in the early years of the park. Abert’s squirrels were introduced from northern Arizona to nearby Mount Lemmon in the 1940s, and may have impacted populations of the native Arizona gray squirrel.

We found evidence that several mammals are declining in the park. We photographed badgers only occasionally in the Tucson Mountain District, and only one individual was photographed (by a park ranger) in the Rincons during our study. We did not photograph any porcupines, which were frequently sighted in the early years of the park. And we photographed only white-tailed deer in many areas that were historically known to be occupied by mule deer, suggesting that mule deer may also be declining.

An important goal of our study was to establish a photographic baseline of medium and large mammals at Saguaro to improve our ability to track changes in species presence and distribution at the park. We hope that this effort can be repeated at the park in future years.

Project Contact

Don Swann
Saguaro National Park
3693 South Old Spanish Trail, Tucson, Arizona. 85730
Don_Swann@nps.gov
“Pulse study” of the Madrona Pools, Saguaro National Park

Don E. Swann, Margaret W. Weesner, Sarah Craighead, and Larry L. Norris

Introduction
In May 2003, Saguaro National Park sponsored a “pulse study” of the Madrona Ranger Station area in the park’s Rincon Mountain (east) District. While the definitions of pulse studies vary, their main goal is to bring together scientists and land managers to quickly assess the ecological health of an area. Pulse studies have been successful in many forests and parks, including Olympic and Sequoia/King’s Canyon National Parks.

The Madrona Ranger Station area (hereafter called “Madrona”) is a lush desert oasis far from the park’s popular cactus forest and includes a series of perennial pools in Chimenea Creek. For many years it was a base camp for the park’s backcountry operation, but the deteriorating facility was abandoned around 1999. Public access is limited, but potential changes in management and visitor use, and rapid development outside park boundaries, had raised concerns about the site’s future.

The Madrona pulse study—2003
Saguaro National Park’s Madrona pulse study took place during a warm week in May 2003. Scientists from many disciplines and organizations participated, including biologists, ecologists, geologists, social resource specialists and NPS resource managers. The Western National Parks Association and Friends of Saguaro National Park provided funding, with additional support from the Community Foundation of Southern Arizona and Earth Friends Wildlife Fund.

As in all pulse studies, scientists and managers at Madrona worked side-by-side all week in the field. Days began at dawn with bird surveys, and mornings were spent on animal and plant surveys, water quality measurements, sampling for aquatic invertebrates, and studying buildings and trails. At night, participants searched for frogs and checked mist nets for bats. Participants camped, studied, and learned together throughout the cool evenings and unseasonably hot days. The last two days included an outdoor workshop with additional park staff, friend’s group members, and others that summa-

ized results and included opportunities to work in the field with scientists and share information about Madrona’s history and resources.

Scientists concluded that Madrona was rich in ecological and cultural resources. More than 50 species of birds and 153 plants were observed during the short study. The pools, fed by bedrock springs in a unique geological setting, appear to be one the least impacted aquatic resources of their kind in the Tucson area due to low levels of historic diversions and recreation, and contain a stable population of the protected lowland leopard frog (Rana yavapaiensis). The results were written up in a technical report (Edwards and Swann 2003), with an illustrated Executive Summary for lay readers.

Follow up to the pulse study, 2003-2008
Participants in the Madrona pulse study left the park with many unanswered questions, including: What were the dynamics of water volume and water quality in the pools? How many visitors used the site? How was wildlife activity changing over time? How large was the threat from exotic species? The Technical Report identified a series of data gaps and recommended further research and monitoring. In the six years since, the park has followed up with studies and monitoring which address some of these gaps, including regular monitoring of water levels in Chimenea Creek by volunteers; tracking of sediment levels in the Madrona pools and throughout the park; and studies of water quality. A graduate-student project examined the relationship between recreational use and wa-
ter quality, and the USGS has begun baseline monitoring of heavy metals and other water-quality parameters.

![Diagram of High Water, Maximum Depth, Datum 4, and Downstream]

Example of results from pool surveys conducted as follow up to the pulse study.

Researchers also studied Sonora mud turtles (*Kinosternon sonoriense*) and amphibians, confirming the importance of the Madrona pools for aquatic species. During a drought in 2005–2006, leopard frogs and canyon treefrogs (*Hyla arenicolor*) disappeared, and many turtles died in a nearby stream when it went completely dry for nearly a year; however, most frogs and turtles survived at Madrona. We also used infrared-triggered “camera trape” to monitor mammals. During six years of surveillance, 20 species of medium and large mammal species were detected, including species of management interest such as mountain lion (*Puma concolor*) and white-nosed coati (*Nasua narica*).

![Photo of Coati "captured" in an infrared-triggered "camera trap"]

In 2004 and 2005 Saguaro National Park received two grants from the Department of the Interior’s Cooperative Conservation Initiative. Working with the non-profit Rincon Institute, neighbors, and volunteers, we monitored visitor activity and restored several social trails and the abandoned stable area by seeding and planting native flowers, shrubs, and trees. We also removed non-natives plants such as tamarisk (*Tamarix ramosissima*), and African buffelgrass (*Pennisetum ciliare*).

### Management implications

A major driver of the pulse study was the need for information for the park’s general management plan. The problem was how to appropriately manage and plan for a sensitive resource site that also included management activities. Alternatives in the plan recognize the educational and scientific value of Madrona. The approved plan calls for visitor use to be regulated, and facilities placed carefully, to protect sensitive resources. The study also noted that Madrona would become a primary destination if new trails ran through the area as proposed, and that heavy recreational use would adversely affect natural and cultural values. As a result, the trails plan calls for the Arizona Trail to connect to the Manning Camp Trail through a scenic area west of the site rather than through Madrona itself.

The Madrona pulse study benefited Saguaro National Park in unexpected ways. For example, more detailed information from this one site supported a partnership to create refugia for leopard frogs in backyard ponds outside the park. The study also renewed appreciation for the park’s history and the cultural values of wilderness. It was a factor in reinvigorating Saguaro National Park’s packing program and the 2005 celebration of Manning Cabin’s 100th anniversary, which brought back many old-timers who had lived, worked, and packed in the park’s wilderness areas.

Saguaro National Park’s Madrona pulse study provides evidence that pulse studies are a very useful, though underutilized, tool for connecting science and park management. The National Park Service Omnibus Management Act of 1998 directed the Service to integrate scientific knowledge into management decisions. Pulse studies seem to be ideally suited for site-specific resource issues that demand information in a short time frame but are complex enough to require a range of expertise. For Saguaro National Park, the Madrona pulse study also led to further monitoring and unexpected benefits.

### Literature cited


### Project Contact

Don Swann  
Saguaro National Park  
3693 South Old Spanish Trail, Tucson, Arizona. 85730  
Don_Swann@nps.gov
Lowland leopard frogs in Saguaro National Park

Don E. Swann and J. Eric Wallace

Introduction
Saguaro National Park was established to protect the saguaro cactus, but the park also provides habitat for many unique animals. The lowland leopard frog (*Rana yavapaiensis*) is a native frog that depends on unique desert waters. It has declined in the desert Southwest and is considered a species of special conservation concern.

The purpose of this study was to evaluate habitat, summarize long-term monitoring data, and make recommendations for conserving lowland leopard frogs and other aquatic wildlife. We received funds from the National Park Service, Western National Parks Association, T&E, Inc., and Friends of Saguaro National Park, with support from the Desert Southwest Cooperative Ecosystem Studies Unit and U.S. Geological Survey Sonoran Desert Field Station at the University of Arizona.

Methods
We reviewed the natural history and conservation status of the lowland leopard frog throughout its range, including past records in Saguaro National Park. For long-term monitoring, we surveyed eight major canyons at least once annually during 1996-2007, and nine smaller canyons less frequently. In each survey we visually searched stream pools for all stages of leopard frogs and other aquatic species. For habitat analysis, we studied 24 canyons in the Santa Catalina and Rincon mountains (for details, see Wallace et al. 2008). We compared habitat characteristics among canyons and pools that were either occupied or not occupied by leopard frogs. We also evaluated the effects of fire on leopard frogs in the Rincon and Santa Catalina Mountains following the large Helen’s II and Aspen Fires of 2003 (for details, see Wallace et al. 2006) by comparing frogs in canyons that had burned with those that did not burn.

Results

Monitoring
During 1996-2007, lowland leopard frogs were observed in approximately 15 canyons in the park’s three major watersheds (Tanque Verde, Rincon-Pantano, and Paige). However, distribution varied greatly among years; for example, during a severe drought in 2004-2006, we found frogs in only 5 canyons. Frog abundance also varied over time, with the maximum number of adults observed annually ranging from approximately 20 during 1996-97 and 2005-06 to more than 140 during 1999-2000 and 2007. In general, the number of frogs observed decreased during drought years and increased following wet years.

Habitat
Canyon watershed size and amount of water available were the most important factors in whether canyons were occupied by leopard frogs or not. The average watershed areas of occupied canyons were more than twice as large as those without frogs, and occupied canyons were located closer to other streams. We found little differences among bedrock-bound pools (tinajas) occupied by frogs. However, plunge pools, the large pools that form below waterfalls and have greater soil development, were more likely to be used by frogs when they had more vegetation, more tree cover, and more hiding places such as rock cracks, holes, and root cavities.

Very large fires had a significant effect on water available in pools and presence of frogs. Several years after the fires, pools in unburned canyons showed essentially no change in volume, but more than 50% of pools in burned canyons were filled with sediment. Frogs persisted in burned canyons, although counts of frogs and evidence of breeding declined compared to unburned canyons.
Threats

The reasons for the declines of amphibians in Arizona and world-wide are not known, but probably include a combination of global and local factors. Lowland leopard frogs in Saguaro National Park may be vulnerable for many reasons, including the fact that their habitat in the park (i.e., perennial surface water) is naturally rare; their populations are relatively isolated from each other; and the species undergoes natural population cycles in response to rainfall and drought.

Potential threats at Saguaro include introduced non-native fish, bullfrogs, and crayfish, which can eat the native frogs, as well as pollution and the loss of rare desert water sources. Fortunately, bullfrogs and crayfish do not now occur in the park, and impacts due to recreation and water development appear to be minimal. However, leopard frogs in the park have died from a fungal disease called *Batrachochytrium dendrobatidis* (also called Bd, or chytrid). Bd is considered a major global threat to amphibians, and Saguaro National Park is supporting research to better understand this disease and strategies to contain it.

Our study indicates that frog habitat in the park is damaged by very large wildfires when pools are inundated by sediments that are no longer contained by vegetation in the burned areas upstream. Although the habitat eventually recovers, this process may take decades (Parker 2006). However, the park has strived to reduce excessive fuel loads resulting from decades of fire suppression. These activities probably benefit frogs by reducing the size and severity of fires.

Recommendations

Lowland leopard frogs are an important component of Saguaro National Park’s unique aquatic biodiversity. In addition, lowland leopard frogs are an indicator species of ecosystem health, and measures to protect them will inevitably benefit other the many other animals that rely on desert water sources for drinking. In our report (Swann and Wallace 2008) we recommend cost-effective steps that will support healthy frog populations, including working closely with other organizations in the lands surrounding the park. One such program, to restore frog habitat and work with park neighbors to raise lowland leopard frogs in backyard ponds, was initiated in 2005 and is continuing to expand.

Literature Cited


Project Contact

Don Swann
Saguaro National Park
3693 South Old Spanish Trail, Tucson, Arizona. 85730
Don_Swann@nps.gov
Lesser Long-nosed Bats

Importance
The lesser long-nosed bat (Leptonycteris curasoae yerbabuena) is an endangered nectar feeding bat that inhabits the Rincon Mountain District (RMD) of Saguaro National Park in late summer and early fall. These bats are migratory, and spend winters in Mexico. When in the U.S., lesser long-nosed bats feed primarily on saguaro flowers, nectar, and fruit, agave, and even at hummingbird feeders in urban areas. These mammals are important to the Sonoran desert ecosystem because they help pollinate the saguaro cactus and other plants.

Quick Facts
Small numbers of lesser long-nosed bats have been known to share a bat roost in the park during the summer. Recently, however, biologists discovered many more of these bats using the roost later in the year, before they head back to Mexico for the winter. Park managers believe the bats that have learned to forage at hummingbird feeders in Tucson are now using this roost, which is relatively close to town. This site is monitored regularly now to better understand lesser long-nosed bat population dynamics and movements at both local and regional scales.

Quick Facts
- Lesser long-nosed bats feed on and pollinate saguaro and agave flowers at night. Saguaro flowers are white so they are more visible at night, and the flowers produce a strong fragrance that lures the bats.
- This species was listed as endangered in 1998, in part due to the loss of a large “maternity colony” in nearby Colossal Cave. When this privately owned cave was opened for public tours, a ventilation system was installed to get rid of the bat smell. This changed environmental conditions in the cave so it was no longer suitable for the bats.

Discussion
Because they prefer to roost in large colonies, especially when raising their young, lesser long-nosed bats are particularly vulnerable to (roosting) habitat loss. Park biologists will continue to monitor and study this species so they may be effectively protected and hopefully, someday removed from the endangered species list.

More Information
Natasha Kline  
Bioligist  
Saguaro National Park  
3693 S. Old Spanish Trail  
Tucson, AZ 85730  
ph: (520) 733-5171  
e-mail: natha_kline@nps.gov

Saguaro National Park Website:  
http://www.nps.gov/sagu
Southwest Learning Center:  
http://www.southwestlearning.org

I&M Sonoran Desert Network:  
http://science.nature.nps.gov/i/m/inventory