

✓ 2007



**SAGUARO NATIONAL PARK
RINCON MOUNTAIN DISTRICT
SCIENCE SYMPOSIUM**

**MAY 11, 2007
1:00 – 4:30 PM**

**Presented in Cooperation with
The Rincon Institute &
Friends of Saguaro National Park**



Friday, May 11		
Introduction	1:00-1:10	Science in the Park
Kevin E. Bonine	1:10-1:30	Canyon Treefrog (<i>Hyla arenicolor</i>) Population Structure in the Rincon Mountains, Arizona
Chris Kirkpatrick	1:30-1:50	Effects of Surface Water Depletion on Arizona's Riparian Bird Communities
Brian Powell	1:50-2:10	Vascular Plant and Vertebrate Inventory of the Rincon Mountain District, Saguaro National Park
Nathan English	2:10-2:30	Physical and Chemical Indicators of Age and Growth in Saguaro Cacti
James W. Cornett	2:30-2:50	Do Roadrunners Hibernate?
	2:50-3:10	break
John L. Koprowski	3:10-3:30	Native and introduced tree squirrels as indicators of forest condition in sister parks, Saguaro and Sierra de San Pedro Martir
John T.C. Parker	3:30-3:50	Post-wildfire sedimentation in Saguaro National Park, Rincon Mountain District, and effects on lowland leopard frog habitat
Donald B. Miles	3:50-4:10	Climate Change perturbs Activity Patterns, Social Structure and Population Dynamics of the Lizard <i>Urosaurus ornatus</i> .
Olav T. Oftedal	4:10-4:30	Nutritional Ecology of the Desert Tortoise at Saguaro National Park East

Kevin E. Bonine
University of Arizona
Department of Ecology and
Evolutionary Biology and
School of Natural Resources
kebonine@u.arizona.edu

Taylor Edwards
Christine Schirmer
Kristina Ratzlaff
Jamia Fillinger
University of Arizona
Genomic Analysis and
Technology Core

Don Swann
Saguaro National Park

Canyon Treefrog (*Hyla arenicolor*) Population Structure in the Rincon Mountains, Arizona

We are interested in how the Canyon Treefrog (*Hyla arenicolor*) moves around the landscape at several spatial and temporal scales. Using molecular techniques we hope to elucidate the metapopulation structure and dynamics of this small, cryptic frog.

Since May 2006, we have collected mouth swabs from 140 Canyon Treefrogs from 12 sites, most of which are in the Rincon Mountain District of Saguaro National Park. In addition to photographs of individual dorsal coloration patterns, we have marked 80% of these frogs with individual identification tags for assessment of recapture rates, population sizes, and other life-history traits.

Using published primers, we sequenced 886 base pairs of mitochondrial DNA for each frog. Preliminary analyses of about half (67 specimens) of the samples identified nine unique haplotypes (i.e., variations in nucleotide sequence of this 886 bp region). Based on these nine haplotypes and the geographic location of each sampled individual, we tested for an association between genetic distance and geographic distance.

Statistical analyses of haplotype distributions indicate that there is population structure when all individuals and all sampling locations are included. However, finer scale resolution and mechanisms are not yet apparent. At this point, we are uncertain if the findings indicate the results of a panmictic population, inadequate geographic sampling, or small sample size.

Goldberg and colleagues (2004) collected data on population structure of Lowland Leopard Frogs (*Rana yavapaiensis*) in the Rincon Mountains. It will be interesting to compare the results for that species with those for the Canyon Treefrog. Although currently abundant in canyon drainages in the Southwest U.S., this riparian species may suffer from loss of habitat through surface-water depletion and urban development in areas like Rincon Valley. Our findings will also be helpful in establishing a baseline for future studies of responses to changing climate patterns.

Chris Kirkpatrick
University of Arizona
kirkpatr@email.arizona.edu

Courtney J. Conway
University of Arizona

Effects of Surface Water Depletion on Arizona's Riparian Bird Communities

Arizona's riparian woodlands are an extremely important resource because they constitute <1% of the landscape, yet typically support >50% of the breeding birds. Increasing demand for limited water resources in the region has the potential to degrade or eliminate these riparian woodlands, including riparian woodlands along Rincon Creek in Saguaro National Park. The goal of this research project is to quantify the extent to which the presence of surface water and the health of riparian vegetation affect the abundance, diversity, and reproductive success of riparian birds. During the first year of our study (2006), we surveyed birds, sampled vegetation, measured surface water flows, and monitored bird nests at Rincon Creek and at 16 other study sites located in riparian woodlands throughout southeastern Arizona. Preliminary results from the first year of our study indicate that breeding populations of several riparian bird species (e.g., Bell's vireo and yellow warbler) appear to have declined at Rincon Creek, perhaps in response to recent drought conditions. We plan to continue this research by monitoring bird populations along Rincon Creek in 2007 and 2008. Results from this research project will provide important information that will allow Park managers to better predict how riparian birds will be affected by future reductions in ground and surface water levels in the region.

Brian Powell
University of Arizona
USGS Southwest Biological
Science Center
Sonoran Desert Research
Station
bpowell@ag.arizona.edu

Vascular Plant and Vertebrate Inventory of the Rincon Mountain District, Saguaro National Park

Biological inventories provide an important first step in documenting the resources of an area, but few areas in southern Arizona have complete inventories for plants and animals. I summarize the results of the first comprehensive inventory of plants and vertebrates at the Rincon Mountain District (RMD) of Saguaro National Park. From 2001 to 2003 my colleagues and I surveyed for vascular plants and vertebrates (amphibians, reptiles, birds, and mammals) at the district to document the presence of species within its boundaries. Our spatial sampling design was ambitious and was one of the first of its kind in the region to co-locate study sites for vegetation and vertebrates using a stratified random design. Because we used repeatable study designs and standardized field methods, these inventories can serve as the first step in a biological monitoring program for the district.

We recorded a total of 801 plant and vertebrate species, including 50 species not previously found in the district of which five (all plants) are non-native species. Based on a review of our inventory and past research at the district, there have been a total of 1,479 species of plants and vertebrates found there. The inventories for all taxonomic groups are nearly complete, but the status of some species need to be clarified. Despite these deficiencies, the plant, amphibian and reptile, and mammal species lists are the most complete of any comparably large natural area of the "sky island" region of southern Arizona and adjacent Mexico. Data from this inventory effort provide important insights into patterns of species richness and environmental determinants of these patterns. I discuss recent species loss (particularly plants and mammals) for the district and the potential for future species loss as development pressures increase along the park's boundary.

Nathan English
University of Arizona
Department of Geosciences
nenglish@email.arizona.edu

Physical and Chemical Indicators of Age and Growth in Saguaro Cacti

Saguaro cacti do not have annual rings like some trees, but saguaro do have other physical and chemical characteristics that reveal their age and growth. Over the last century, researchers have used photographs or statistical models of height gathered over decades to infer saguaro age and growth rate. Today, the chemical analysis (radiocarbon, oxygen and carbon isotopes) of rows of spines along the length of a saguaro reveal seasonal, annual and decadal patterns of growth and a good estimate of an individual saguaro's age. Chemical analyses allow growth rates of cacti to be determined relatively quickly without decades of research, and are plant specific and are accurate enough to allow for comparison with climate records.

David L. Dettman
University of Arizona
Department of Geosciences

Other physical characteristics of the saguaro cactus may reveal patterns of growth. Distinctive, inverted, waxy bands on the epidermis of ribs have an annual character to them but are not understood well enough to be used as an accurate chronometer of growth. Unlike the waxy bands, there is excellent evidence that small (0.7 mm) bands within saguaro spines, perpendicular to the spine axis, are associated with daily growth. Each band represents one day of spine growth during the growing season and is the result of changes in cell wall density as the spine starts and stops growth each day.

David G. Williams
University of Wyoming
Department of Renewable
Resources and Botany

These new tools for accurately dating the age of saguaro and measuring their growth rates over time, in minute detail, may help to assess the effect of past, present and future climate changes on saguaro health. Additionally, these techniques are not limited to saguaros and may be useful for other species of columnar cacti as well.

James W. Cornett
JWC Ecological Consultants
JWCornett@aol.com

Do Roadrunners Hibernate?

Field records indicate the greater roadrunner (*Geococcyx californianus*) is observed less frequently during winter than at other seasons. The abundance of information on this species' winter rarity has prompted an investigation into its seasonal habits. Two methods of analysis are used to explain the apparent disappearance of the roadrunner during winter: systematic seasonal fieldwork and the radio tracking of individual roadrunners.

Seasonal observations have been compiled in Saguaro National Park (Rincon Mountains) and other areas in the Southwest to determine if the anecdotal information is accurate. An evaluation of preliminary data reinforces that roadrunners are less frequently observed during winter. This could be explained by declining populations due to fall mortality of very old and young individuals. Local migrations to lower elevations by some individuals may be another explanation.

Another hypothesis for the scarcity of winter observations is the possibility that some roadrunners enter hibernation. This species regularly enters torpor at night and conserves energy by doing so. Individual birds studied by Ohmart and Lasiewski (1971) maintained a body temperature of approximately of 94 degrees F. when resting in the dark as compared with 101 degrees when active during daylight hours.

Hibernation is known to be practiced by at least one bird species. The late Edmund Jaeger (1948) discovered that the common poor-will (*Phalaenoptilus nuttallii*) has the ability to survive a radically lowered body temperature for more than three months in winter.

In order to obtain definitive information on winter activity, radio telemetry devices will be affixed to three roadrunners in the fall of 2007. The data obtained from these birds will provide information on winter movement patterns and whether the roadrunner, like the poor-will, can enter hibernation.

John L. Koprowski
University of Arizona
Wildlife Conservation and
Management
School of Natural Resources
squirrel@ag.arizona.edu

Nicolas Ramos
David Wood
Bret Pasch
Margaret Rheude
University of Arizona
Wildlife Conservation and
Management
School of Natural Resources

Native and introduced tree squirrels as indicators of forest condition in sister parks, Saguaro and Sierra de San Pedro Martir

Forest condition in the National Parks of the southwestern United States and northwestern Mexico is challenged by historical fire suppression, recent droughts, global climate change, wildfire, and insect damage. Tree squirrels (genera *Sciurus* and *Tamiasciurus*) are obligates of mature forests due to their dependence on trees for food and nests. As a result, tree squirrels can serve as excellent indicators of forest condition and health. Saguaro National Park in Arizona and Parque Nacional Sierra de San Pedro Martir in Baja California have entered into a sister park relationship. Each park represents a 'sky island' of montane forest surrounded by low elevation deserts. In addition, an endemic tree squirrel resides in each park and a non-native species has been introduced. We have studied the status and habitat associations of each species in the sister parks using radiotelemetry and nest/sign surveys. Arizona gray squirrels (*Sciurus arizonensis*) in Saguaro appear on the decline and have been replaced by non-native Abert's squirrels (*S. aberti*) in much of the park. Conversely, native Mearns's squirrels (*Tamiasciurus mearnsi*) have not been displaced by introduced eastern gray squirrels (*S. carolinensis*). Tree squirrels in each park are associated with mature, dense forests despite significant differences in the structure of forests between the sister parks due to historical differences in fire suppression.

John T.C. Parker
U.S. Geological Survey
Arizona Water Science Center
jtparker@usgs.gov

Post-wildfire sedimentation in Saguaro National Park, Rincon Mountain District, and effects on lowland leopard frog habitat

The Rincon Mountain District of Saguaro National Park contains some of the last remaining habitat in the Tucson basin of the lowland leopard frog that lives in the bedrock pools called tinajas in canyons at elevations between 850 and 1,800 meters. Tinajas that contain water year-round are critical winter habitat for tadpoles, and the breeding success of the leopard frogs depends on these pools. In recent years, many tinajas that previously had provided habitat for the leopard frogs have been buried beneath large volumes of coarse sandy gravel that resulted from hot, stand-replacing wildfires in the watersheds above them.

The USGS in cooperation with the National Park Service conducted a study in 2004-2006 of post-wildfire sedimentation in the Rincon Mountains and its effect on leopard frog habitat. Spatial data of watershed characteristics and historical data—photographs, monitoring surveys, precipitation and stream discharge records—were used in conjunction with field observations conducted between spring 2004 and fall 2005. The Helens II fire in 2003, the fifth largest wildfire to burn in the Rincon Mountains since 1989, offered an opportunity to observe mechanisms of sediment erosion, transport and deposition in the immediate post-fire environment. As of fall 2005, sediment had traveled at least 3.3 km downstream from the burn area and had buried several tinajas under as much as a meter of sediment. Sediment continued to overwhelm the transport capacity of the channel even as burned hillslopes were showing evidence of recovery.

The sedimentation history and effects on leopard frog habitat in other channels in the Rincon Mountains were evaluated by analyzing surveys of lowland leopard frog populations made by Saguaro National Park staff. The residence time of sediment in tinajas was found to be highly variable. Some tinajas in Wildhorse Canyon that had been filled after the 1989 Chiva fire were still filled with sediment 17 years after the fire, but others had recovered sufficiently to support some leopard frog adults at least as early as 1998.

Donald B. Miles
Department of Biological
Sciences
Ohio University
dmiles2@ohio.edu

Climate Change perturbs Activity Patterns, Social Structure and Population Dynamics of the Lizard *Urosaurus ornatus*.

Climatic patterns in the arid desert southwest are characterized by cycles of normal or wet years interspersed by episodes of drought. These climatic patterns, driven by El Niño-Southern Oscillation Events, have the potential to dramatically influence species population dynamics by altering key life history traits, such as clutch size, growth rates, social structure and survival. The ornate tree lizard is among the most common vertebrate species in Saguaro National Park. The species is unique in that males and females are polymorphic for throat coloration: six male morphs and two female morphs inhabit mesquite trees in the bosques of upper bajada habitats in the Rincon Mountain Unit. Territories of each individual are linked to the distribution of live mesquite trees. Male morphs are characterized by three mating strategies, Dominant male (Orange/Blue, Yellow/Blue or Blue throat), satellite males, and sneaker male (Orange/Yellow throat). Orange females pair with males having a blue throat, but yellow females prefer yellow males. Each male morph varies in dominance status, activity patterns and attractiveness to females. The response to climatic variation is contingent on the throat morph. Dominant, active males, with multiple females have fitness advantages during wet years by virtue of attracting multiple females. However, survival in drought years is lower for these males relative to survival in wet years. Climatic conditions affect the thermal environment as well as resource availability which restrict opportunities for growth and reproduction. During drought years, individuals have reduced activity times, which affect social interaction, foraging success, energy budget and survival probability. ENSO cycles drive temporal variation in natural selection that differentially favors throat morphs, individual body size and physiological characteristics (e.g., sprint speed and endurance). Differential patterns of natural selection are manifested as changes in adult body size, which in turn results in variation in population density.

Olav T. Oftedal
Smithsonian National
Zoological Park
OftedalO@si.edu

Roy Averill-Murray
U.S. Fish and Wildlife Service
Arizona Game and Fish
Department

J. Daren Riedle
West Texas A&M University
Dept. of Life, Earth and
Environmental Sciences
Arizona Game and Fish
Department

Nutritional Ecology of the Desert Tortoise at Saguaro National Park East

A nutritional study was conducted on desert tortoises at the Mother's Day Burn Site in Saguaro National Park East [SNPE] in August 2003 and April 2004. Eleven tortoises were observed to take more than 61,000 bites. In spring tortoises consumed predominantly annual legumes, including deervetch (*Lotus humistratus*), lupines (*Lupinus sparsiflorus*, *L. concinnus*), and milkvetch (*Astragalus nuttallianus*). Substantial amounts of slender grama (*Bouteloua repens*) and desert vine (*Janusia gracilis*) were also eaten. At this time tortoises were highly selective in foraging, consuming legumes of high nutritional quality, i.e. high water, high protein, low potassium and high Potassium Excretion Potential (PEP) concentrations. The diets of tortoises were high in PEP (15.9 ± 1.1 g/kg dry matter). In summer tortoises were less selective, feeding on various annual and perennial grasses, summer annuals and some perennial plants. Annuals were consumed roughly in proportion to availability, but some perennials [e.g., desert vine, milkweed vine (*Cynanchum arizonicum*) and fruit of Engelmann prickly pear (*Opuntia engelmannii*)] were favored, as indicated by the large number of bites per plant. Summer diets were significantly lower in water, higher in potassium, and lower in PEP index (7.9 ± 0.8 g/kg), as compared to spring diets. Sonoran tortoises face very different nutritional challenges in spring and summer. In spring the absence of drinking water may require tortoises to be highly selective for high PEP plants, as in the Mojave Desert. However, in summer regular monsoon showers allow tortoises to drink and to dispose of excess potassium by urination, precluding the need to consume high PEP plants. Our data indicate that annual legumes (52% of spring bites) and annual grasses (63% of summer bites) are most important to nutrient balance in SNPE tortoises. These forage plants may be particularly valuable in supporting nutrient demanding processes such as early growth and egg production.

