



The Arizona  
Native Plant  
Society

# The Plant Press

## THE ARIZONA NATIVE PLANT SOCIETY

VOLUME 34, NUMBER 2

WINTER 2010/11

### In this Issue: Riparian & Wetland Ecology

1-4 **Arizona Springs: Hotspots at Risk**

5 **Volunteer Opportunities to Learn  
About Arizona's Springs on the  
Colorado Plateau**

6-7 **Ephemeral Drainages: The Quiet  
Riparian Plant Community**

### Plus

5 **A Life Well-Lived: Nancy Zierenberg**

8 **Join the USA National Phenology  
Network in Tracking the Plants and  
Animals in Your Own Backyard!**

12 **Six New Plants on the Arizona Strip,  
and an Old Plant, Now of Interest**

14 **A Champion for Arizona Native  
Plants: H. David Hammond**

### & Our Regular Features:

2 **President's Note**

5 **Conservation Education &  
Outreach Committee Report**

9-11 **Book Reviews: Eat Mesquite! A  
Cookbook and Plants at the Margin**

13 **Ethnobotany: People Using Native  
Plants**

14 **Who's Who at AZNPS**

15 **AZNPS Merchandise**

16 **Membership**



**above** Vasey's Paradise, a gushet springs complex in the Grand Canyon about 32 miles downstream from Lee's Ferry, was named by John Wesley Powell for his friend, botanist George W. Vasey, who accompanied Powell on his expeditions north of the Grand Canyon.

## Arizona Springs: Hotspots at Risk

by Lawrence E. Stevens<sup>1</sup>. Photos courtesy the author.

Springs are places where groundwater is exposed, and usually flows from the earth. In arid regions like Arizona, springs seem like rare miracles, often surrounded by lush vegetation and containing strange and often unique creatures. But springs are ubiquitous across the globe and harbor biological rarities wherever they occur, even though springs are more difficult to detect beneath forest canopies or underwater. Springs ecosystems are among the most ecologically complex, biologically diverse, culturally valued, and threatened ecosystems on Earth. Although Eugene Odum's studies of Silver Springs in Florida launched the study of ecosystem ecology in 1957, there has been little integrated study of springs distribution, ecological complexity, or status since that time. Working with several colleagues over the past decade, we have begun to take a closer look at springs, and learn more about just how important these hotspot ecosystems are to our natural and cultural heritage. Our recent book, *Aridland Springs in North America* (L.E. Stevens and V.J. Meretsky, editors, University of Arizona Press, Tucson, 2008), summarizes and illustrates many of the ecological and sociological questions about springs in Arizona and throughout the world. A website we created at

*continued next page*



Printed on recycled paper.

Copyright © 2011. Arizona Native Plant Society. All rights reserved.

Special thanks from the editors to all who contributed time and efforts to this issue.

<sup>1</sup> Lawrence E. Stevens, Curator, Biology Department, Museum of Northern Arizona, 3101 N. Ft. Valley Rd., Flagstaff, AZ 86001

# President's Note

by Barbara G. Phillips [bgphillips@fs.fed.us](mailto:bgphillips@fs.fed.us)

Coconino, Kaibab and Prescott National Forests, Flagstaff

We wish to express our sadness at the passing of two stalwart members of the Arizona Native Plant Society, Nancy Zierenberg (“Z”) and David Hammond. Both are greatly missed by those who had the pleasure to know them and we are very grateful for each person’s contributions to AZNPS and the conservation of Arizona native plants.

Winter is a season of transition for plants: a time when some plants die, and others go dormant. However, in the warmer parts of the state new plants germinate in winter and begin to grow in anticipation of the coming spring. Our Arizona Native Plant Society is experiencing a period of transition now but it will emerge with increased diversity and be stronger and more resilient.

In this issue of *The Plant Press*, Larry Stevens, our 2010 Arizona Botany meeting keynote speaker, describes spring features in depth and tells us that Arizona has the highest density of any state — and that the over 10,000 known springs may be a very low estimate! I had no clue this occurred in Arizona, the nation’s second driest state. AZNPS is already integrally involved in assessing springs as Wendy Hodgson details in her Conservation Education and Outreach column. AZNPS members can volunteer to work with the Grand Canyon Trust Spring Stewards and our Plant Atlas Project of Arizona (PAPAZ) programs. Theresa Crimmins and Erin Possumus also tell members how they can join the USA National Phenology Network to track plant phenology in their own backyards.

I have always enjoyed observing the diverse plant and animal species of ephemeral drainages so am pleased to read Matt Haberkorn’s article on “...the Quiet Riparian Plant Community.” Book reviews are our opportunity to learn about exciting new literature to read and the two reviews in this issue — Greta Anderson’s on climate change and Kevin Dahl’s, a cookbook on mesquite — are no exceptions. The first is a meaty review of a complex topic, and the second encourages us to sample (literally) a familiar plant. As Lee Hughes retires from the Bureau of Land Management where he has amassed much information on the flora for us, we wish him well in retirement and thank him for his many contributions in behalf of the native plants of the Arizona Strip over many years.

Jessa Fisher again contributes a splendid article of ethnobotanical insights about our theme. Hopefully, this will not be the last time we hear from her in *The Plant Press*, although she has left Arizona to pursue new dreams in New York. Speaking of more changes, many thanks to Karen Reichhardt, former Yuma Chapter President, and State Board member. We really appreciate her insight, enthusiasm, and guidance over the years and know she will continue to provide the same enthusiasm to the Yuma Chapter without a title. Welcome to our new Phoenix Chapter Co-Chairs — Cass Blodgett and Michael Plagens. We look forward to their input in their local chapter and at the AZNPS Board meetings. A great welcome also to Anna Van Devender, our new Administrative Assistant. We especially thank her for stepping up to help during this time of regrouping and transition.



**above** Grand Canyon Wildlands Council staff and volunteers inventorying Middle Tovar Springs near Flagstaff.

## Arizona Springs *continued*

[www.azheritagewaters.nau.edu](http://www.azheritagewaters.nau.edu) celebrates a number of Arizona’s most prominent springs and water bodies.

Arizona is the nation’s second driest state, although the Lower Colorado Desert in Arizona and California may be driest region in the U.S. It comes as a surprise to learn that Arizona has the highest density of springs of any state: Geographer Jeri Ledbetter of Pennsylvania State University has identified more than 10,000 springs in Arizona thus far, and estimates that this may only be one tenth the total number. The high density of springs in Arizona is due the state’s many, long escarpments, such as the Mogollon Rim, the rims of Grand Canyon, and the Grand Wash Cliffs. Aquifer edges are exposed along such escarpments and springs emerge.

However, there are many challenges with the basic chore of counting springs. Most springs are not mapped, many are mis-mapped, many are ephemeral (only flowing after wet periods), and some like Vaseys Paradise in Grand Canyon are not even called springs. In addition, many springs have been excavated to create watering holes for livestock, so some cattle tanks should be considered as springs. Also adding to the challenge, springs often have multiple orifices. For example, Montezuma Well is fed by four sources, and several separate springs contribute flow to Quitobaquito Spring. Consequently, we usually refer to springs in the plural form. With so many uncertainties, and with springs being dewatered by groundwater pumping, the question of exactly how many springs exist in Arizona may never be known.

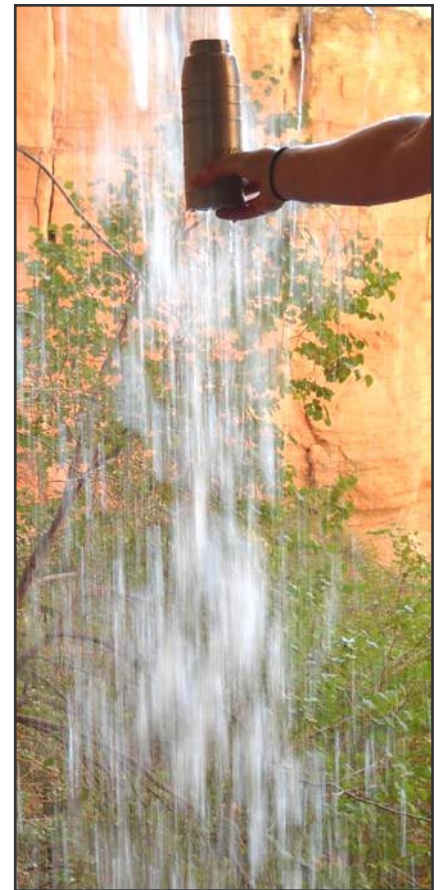


**left** Grassy Spring on the Arizona Strip, one of thousands of springs used for livestock watering in Arizona. **above** MacDougal's flaveria (*Flaveria macdougalii*), an endemic shrub that grows only at Matkatamiba Alcove Spring and a few dozen other hanging gardens and hillslope springs in central Grand Canyon. **below** Deer Creek Spring provides cool, clear water for desert hikers.

Physical processes dominate springs ecosystem structure and function. Groundwater is almost entirely derived from precipitation, which infiltrates into fractures and faults and acquires dissolved ions as it moves. Generally, the longer the groundwater flow path, the more likely it is to become chemically enriched. Also, groundwater warms with depth, and the deeper the aquifer the warmer the spring. Although most high elevation springs emerge from shallow aquifers with short, brief groundwater flowpaths, the water in some springs in northern Arizona is 3,000 years old, and some groundwater flowpaths in Nevada take more than 10,000 years to daylight. Groundwater pumping that depletes such aquifers has lasting impacts on the springs they feed and the life those springs support.

Springs emerge in different geomorphological settings, generating an array of emergence environments and springs types. Abe Springer (Northern Arizona University) and our colleagues have identified 12 different types of springs in the Southwest, including: marsh-forming cienegas or fens, hanging gardens, hillslope springs, pool- or lake-forming limnocrene springs, gushets where water flows out of cliff faces, rheocrene springs that emerge in existing stream channels, and other types. Each springs has its own location-specific disturbance regime, microclimate, and productivity. In addition, each springs contains various microhabitats, which vary by springs type. We have identified as many as 13 different kinds of microhabitats, and sometimes many can be found within a single springs ecosystem. Each microhabitat may support a suite of species, and those species may or may not interact with each other. Consequently, each springs ecosystem with its mosaic of microhabitats is highly individualistic, and no two springs are precisely alike. From this, it is obvious that geologic structure, rock type, climate, and other physical factors play a large role in where springs emerge, the quality of their waters, their productivity, and the life forms they support.

Endemism is the evolutionary process through which unique species arise, and ecologically stable and undisturbed springs are often hotspots of endemic species. Hanging gardens, where water drips out from between geologic strata, and limnocrene (pool-forming) springs are places at which rare and unique plant and animal species are found in Arizona. These settings typically are relatively protected from natural disturbances like flooding, rockfall, or wildlife grazing. Such settings also are rather harsh. Hanging gardens, such as Cliff Spring on the North Rim of Grand Canyon, are often light-limited habitats, making it difficult for many plant species to exist there. Pool-forming springs, such as Montezuma Well, may have constant water temperature, but have a challengingly low concentration of dissolved oxygen and high concentrations of calcium carbonate and arsenic. Such characteristics largely preclude colonization by aquatic insects from the surrounding landscape. However, if a gravid female aquatic bug survives colonization in Montezuma



*continued next page*

## Arizona Springs *continued*

Well, her offspring may be adapted to a highly productive habitat with few predators or competitors. Because the Well has been a stable but harsh habitat for tens of thousands of years, several such events have taken place there. Montezuma Well supports the highest concentration of unique species of any point that we know of in North America, with endemic shrimp-like amphipods, a water scorpion, a springsnail, a leech, and several very rare invertebrate species.

The degree of specialization and endemism of plant and animal species at springs varies within several groups. Some plant species, like crimson or yellow monkeyflower (*Mimulus cardinalis* and *M. guttatus*, respectively), and many aquatic beetle species are widespread but commonly occur at springs. Helleborine orchids (*Epipactis gigantea*) and a few of the nearly 100 species of springsnails (genus *Pyrgulopsis*) are relatively widespread, but are found almost exclusively at springs. Microendemic species, like MacDougall's flaveria (*Flaveria macdougallii*), most of the other springsnail species in Arizona and Nevada, several aquatic waterbug taxa (Hemiptera), and many pupfish (*Cyprinodon*) and other springs pool fish are exclusively found at one or in just a few locally clustered springs. Such species are tightly adapted to the microclimate and geochemistry of those sites, and are often most at risk from groundwater pumping and pollution.

Springs have been, and continue to be, intensively used by humans. Early Native Americans used springs to ambush prey, and mammoth and other Pleistocene megafauna kills have been excavated at paleosprings in the Southwest. Agricultural cultures, such as the Sinagua culture in central Arizona, used springs for irrigation. In historic times, the Anglo-American culture has extensively used springs for livestock and potable water supplies. Groundwater pumping jeopardizes springs that form the headwaters and baseflow of many western rivers, such as the Verde River. As a consequence of limited attention, poor resource stewardship practices, hyperactive groundwater pumping, and global climate change, springs ecosystems are everywhere gravely threatened by human activities. A recent inventory in northern Arizona by the Grand Canyon Wildlands Council, Inc. reports that more than 90 percent of the springs there have been compromised or devastated by human manipulations. Who knows what springs and wetland species we have already lost to such activities?

Springs are generally small ecosystems that are disproportionately important in the landscape, and often support unique, non-renewable species and resources. If a springs' aquifer is healthy, springs are remarkably resilient, and can readily be restored. Depending on the steward's desires, many springs can be managed sustainably for both natural characteristics and human goods and services, such as



**above** Helleborine orchids (*Epipactis gigantea*) are commonly found at low and middle-elevation springs in the Southwest, but are rarely found in other habitats.

water supplies. However, improving springs stewardship at regional, state, national, and global societal scales will require increased scientific, managerial, and public attention. We suggest the need for development and application use of consistent scientific inventory and assessment methods that are applicable across landscapes and ownerships. Such information should help guide springs' managers through the maze of activities necessary for inventory, assessment, strategic planning, protection and restoration of springs. But such efforts are well worth the effort, as springs provide a wide array of resources, goods, services, and habitats for us all.



### Acknowledgements

*My thanks to the Museum of Northern Arizona, Grand Canyon Wildlands Council, Inc., and to Dr. Barbara Phillips and the Arizona Native Plant Society for their support of this work and their interest in this topic. I warmly thank my colleagues Abe Springer and Jeri Ledbetter for their many contributions to this effort.*



## A life well-lived

Nancy Zierenberg died peacefully on Thursday, December 2 on a warm, sunny afternoon with her husband Rod by her side and family nearby.

We miss her tremendously already.

There are memorials being planned to honor Z and her spirit. No dates are set yet, but information will be posted at [www.friendsofnancyz.wordpress.com](http://www.friendsofnancyz.wordpress.com) when it becomes available.

Look for a tribute to Z in the Spring issue of *The Plant Press*.

### CONSERVATION EDUCATION AND OUTREACH COMMITTEE REPORT

## Volunteer Opportunities to Learn About Arizona's Springs on the Colorado Plateau

by Wendy Hodgson, Conservation Education and Outreach Committee Chair

Springs — and the riparian ecosystems they support — are unique harbors of biodiversity in the typically dry landscapes of the Southwest. They provide critical water and food resources for wildlife and humans and are also rare and subject to threats by human activities and global warming. Grand Canyon Trust, Grand Canyon National Park, the National Park Service Southern Colorado Plateau Inventory and Monitoring Program, and the Kaibab and Coconino National Forests have joined together to inventory these important ecosystems in the Grand Canyon region.

The **Springs Stewards** program of The Trust continues to develop opportunities for volunteers to help scientists and resource managers from the partner agencies to assess baseline spring conditions, learning basic spring ecology and how to identify spring types, while working with regional hydrologists. In addition, **Budding Botanists**, under the umbrella of AZNPS's **Plant Atlas Project of Arizona (PAPAZ)**, learn to document the unique flora of the springs from expert botanists. Volunteers have assisted in spring and botanical inventories in Vermilion Cliffs, House Rock Valley, Kanab Canyon watershed, Grand Canyon, and Paria Canyon

to name a few. Two trips I have been involved in took us to the remote areas of Jump Up Point, Horse Spring Point, and Sowats Point where Budding Botanists, under the supervision of Barb Phillips and me, documented nearly 300 plants including many cacti. Last September Budding Botanist and hydrologist volunteers assisted greatly in documenting hydrological and botanical information and specimens at fourteen spring sites in the Inner Canyon along the Bright Angel Creek corridor.

Among the noteworthy botanical collections of the year were at least five new additions to the Paria Canyon flora, a new site for an extremely rare *Sclerocactus*, the discovery of the largest population of a new species of *Mentzelia* (stick-leaf) known (being described as we speak) and hundreds of specimens from areas previously not well documented. To learn more about these programs, contact Grand Canyon Trust at [www.gcvolunteers.org](http://www.gcvolunteers.org), or contact Barb Phillips at [bgphillips@fs.fed.us](mailto:bgphillips@fs.fed.us). These field trips involve hard work but the reward is great, knowing one is contributing towards the understanding and protection of these special areas in a special place — the Colorado Plateau.



above Deeply incised channel.

# Ephemeral Drainages: The Quiet Riparian Plant Community

by Matt Haberkorn, Phoenix College. Photos courtesy the author.

For much of the year, Sonoran Desert dry washes appear quiet. Even during those precious few hours a year when water violently cascades through a wash the event largely goes unnoticed to the human world. Charismatic, ever-flowing perennial waterways get all the attention. You would never guess rummaging through Southwestern botanical, ecological, and recreational literature that ever-popular perennial waterways only compose approximately six percent of all Arizona riparian areas. The remaining 94 percent are common quiet dry washes (ephemeral drainages) or intermittent drainages. But who is to say that ephemeral drainages are not charismatic? We just might have to look a little closer and at just the right times to find their charisma.

Though often taken for granted by the human world, ephemeral drainages are not, however, unnoticed by the natural world they dissect. Even from the air thin ribbons of greener, thicker vegetation clearly mark washes across the landscape. On the ground vegetation is taller, thicker, more diverse, and occasionally almost “jungle” like compared to surrounding upland desert. Examining the wash channel we

will most likely notice the sand dotted with prints of many animal and bird species that utilize washes for corridors, cover, and food. However, much of what goes on in these washes cannot easily be seen. Though water only flows after heavy rainstorms, these flows carry significant amounts of sediments and nutrients across the landscape, building new soils and supplying nutrients for plant life. After the few hours of flow, water does not simply disappear but rather is stored in channel sediments where it can water plants for many months.

The infrequent and violent flows of ephemeral drainages are both destroyer and builder. Bajadas, the gently sloping landforms flanking mountainsides, are both built by ephemeral drainage sediment deposits and destroyed by their erosion. Late in the 1800’s ephemeral drainages displayed this destructive and building power rather dramatically. During this time, changes in rainfall patterns led to the rapid incision of once shallow drainages into the deep drainages which we see today. Eroded sediments were subsequently deposited down slope, building new soils and landforms.

**right Shallow braided channel.**

From this history we find the present context for Sonoran Desert ephemeral drainage plant communities. Compared to uplands, drainage plant species richness is considerably higher, likely due to greater moisture and diversity of soils. Similar to uplands, drainage species richness decreases down slope, possibly due to decreased soil diversity and increased erosional disturbance. Also similar to uplands, drainage plant communities are determined by landscape position. For example, high on bajada slopes, drainage channels are often deeply incised



and characterized by Foothills Palo Verde (*Parkinsonia microphylla*), Triangle Leaf Bursage (*Ambrosia deltoidea*), Brittlebush (*Encelia farinosa*), and various cacti species. Downslope, channels are generally much shallower and colonized by Creosote (*Larrea tridentata*), *Acacia* spp., Wolfberry (*Lycium* spp.), Mesquite (*Prosopis* spp.), Ironwood (*Olneya tesota*), and Blue Palo Verde (*Parkinsonia florida*).

Distribution of drainage plant species is primarily determined by landscape position controls on channel shape, associated soils, and hydrology. This complex association of physical environmental factors means plant associations are often very plastic. So as channel shape, soils, and hydrology change so will plant communities. For example, if flow frequency is higher in deeply incised upper bajada channels Wolfberry, *Acacia*, and Mesquite can occupy the channel. Lower bajada drainage communities with higher moisture are often characterized by Mesquite and Blue Palo Verde while drier channels are dominated by Creosote. Other species appear to capitalize on flash flood disturbance such as Canyon Ragweed (*Ambrosia ambrosioides*), Sweetbush (*Bebbia juncea*), and Burrobush (*Hymenoclea salsola*).

Many species common to ephemeral drainages are also common to surrounding uplands such as Foothills Palo Verde, Triangle leaf Bursage, Brittlebush, Creosote, and Ironwood. Other species only found in drainages across a particular landscape may be found in upland areas where annual rainfall is higher. For example, *Acacia* sp and Mesquite species are obligate riparian species where rainfall is not sufficient but may be found in uplands where rainfall is sufficient. A few species are near complete obligate ephemeral drainage species with only occasional upland occurrences such as Blue Palo Verde, Canyon Ragweed, Sweetbush, and Burrobush.

The question of whether these drainage communities are upland or riparian is likely the reason they have been ignored in much ecological research. Best I can tell they transition between upland and riparian communities, a type of xeric-riparian community that no one quite knows how to categorize. Fortunately, this is becoming an area of important research and policy in the desert southwest and people take note of the tremendous hydrological, floral, faunal, and recreational value these riparian habitats contain.



## Workplace Giving to Support Arizona Native Plant Society

If you work for a government entity, you can make contributions through your workplace to support Arizona Native Plant Society as part of the Combined Federal Campaign (AZNPS #38438), and the State Employees Charitable Campaign. We are also a member group of the ever-growing Environmental Fund for Arizona ([www.efaz.org](http://www.efaz.org)) which supports many of our state's conservation and environmental organizations (29 member groups). Employees of the federal government, Arizona state government, some counties, city programs, and other workplaces can contribute through their workplace giving programs. If you don't have a workplace giving program, see the EFAZ website to find out how we can help get one started. The EFAZ website lists businesses with campaigns supporting EFAZ organizations, but that list needs to be expanded in communities throughout the state. Feel free to contact Laine Seaton, EFAZ Executive Director ([laine@efaz.org](mailto:laine@efaz.org)) with ideas or suggestions!



# Join the USA National Phenology Network in Tracking Plants and Animals in Your Own Backyard!

by Theresa Crimmins and Erin Posthumus

What do a robin building a nest, a butterfly emerging from a cocoon, and a cherry tree in bloom all have in common? All are examples of **phenology**, or seasonal life cycle events in plants and animals. Throughout history, people have used phenology to make decisions about when to plant crops and when and where to hunt for particular animals. More recently, phenological observations such as the timing of bird migrations, insect molts, and flowering have proven to be very valuable in documenting species' and ecosystems' responses to changing climate conditions.

Changes in phenology are among the most sensitive biological responses to climate change. For example, some butterflies are becoming mismatched with their host plants, the life cycles of some pests are becoming better matched with their hosts, and, in some cases, species with phenologies that are adapting to changes in climate are increasing in abundance while those that are not adapting are declining in abundance.

In general, readily accessible long-term phenology data are rare, which limits our ability to understand the changes taking place and forecast their likely impacts. Recognizing this limitation, the USA National Phenology Network (USA-NPN)—a collaborative network of government agencies, nongovernmental organizations, citizen science and education programs, and individuals—was created. A key activity of the USA-NPN has been the creation of **Nature's Notebook**, a national plant and animal phenology observation program.

Using Nature's Notebook, you can track the phenology of plants and animals in your yard. By doing so you will join thousands of other individuals who are providing valuable observations that scientists, educators, policy makers, and resource managers are using to understand how plants and animals are responding to climate change and other environmental changes. Your observations make a difference! Want to help? Here's how it works:

1. Go to [www.usanpn.org](http://www.usanpn.org).
2. **Learn about the plants and animals you can observe.** Find out which species in your area are on the list — learn more about them and the phenophases to look for.
3. **Learn how to observe.** Learn how to select a site, select your plants and animals, and record your observations.
4. **Sign up to be an observer.** Become an official participant and set your username and password. All you need is an email address and Internet access.
5. **Start reporting!** Now you are ready to register your site and the plants and animals you will observe, and start reporting! As you collect data during the season, log in to your account at "Nature's Notebook" and enter your observations.
6. Have fun being a "citizen scientist"!

from top

***Aquilegia desertorum* begins blooming from exposed and sunny limestone outcrops during the stressful period of mid-May.**

***Iris missouriensis* begins blooming in late May/early June. According to eFloras.org: "Homer Metcalf (pers. comm.) made a detailed study of this species. The basic requirement for its success seems to be an extremely wet area before flowering and then almost desertlike conditions for the rest of the summer."**

***Cleome serrulata* begins blooming in late July and varies in abundance according to rainfall.**

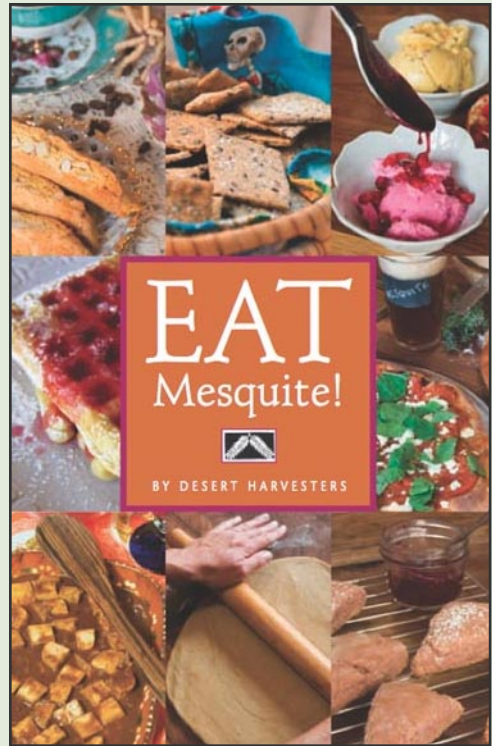
Photos courtesy Susan Lamb Bean.







**above** Garth Mackzum feasts on mesquite pancakes with prickly pear syrup at the The Dunbar/Spring Organic Community Garden Mesquite Milling and Pancake Breakfast in Tucson. *Courtesy Brad Lancaster.*



## BOOK REVIEW

# Eat Mesquite! A Cookbook *Reviewed by Kevin Dahl*

You will not regret buying this book. It's a labor of love by a community of Tucson food activists known as Desert Harvesters, people with a lot of talent who have promoted the use of mesquite with community events and helping people mill collected pods into sweet, nutritious flour. The recipes are varied and well-tested. They will surprise you with their variety and usefulness. Right now I wish I had a Mesquite Milkshake, or a bowl of Mesquite Ice Cream. Sometime I would like to compare Sonoran Baklava to Jacqueline Soule's Mesquite Baklava. For dinner tonight, a pizza with a mesquite crust or Mesquite Tamales followed by Mesquite Coffee with an Almond Mesquite Biscotti — sounds pretty darn good, doesn't it?

Nancy Zierenberg saw the book when it was first published, and is quoted on the group's website:

*"We are so fortunate to have Desert Harvesters promoting our bountiful native foods. They've teamed up with food adventurers, lovers, and researchers to uncover myriad ways of, and advantages to, using what grows naturally in the Sonoran Desert. These tasty explorations invite readers into healthy, diabetes-resistant eating habits, but the education doesn't stop there. Desert Harvesters is so committed to*

*empowering people to eat the goodness from our ubiquitous native Velvet Mesquite, that they long ago purchased a mobile hammermill to transform sweet and healthy mesquite pods into delectable flour. This quick and easy service is available to anyone willing to collect and store the pods until annual milling events every fall. This wonderful cookbook, along with their website, will teach you how to collect, store, and use this harvest. Don't miss out!"*

The book's front matter has instructions on how to harvest, store and mill mesquite pods, tips for cooking, an essay on mesquite's great potential as a world food crop by Richard Felger and Neil Logan, and information on its medicinal values by John Slattery.

The cookbook was printed on 100% recycled paper, which is not surprising from a group that spends a lot of effort to get people to build rainwater harvesting basins and plant native trees.

The 88-page, 52-recipe hardbound book sells for \$20 — purchase it by mail or see a list of retailers at [www.desertharvesters.org](http://www.desertharvesters.org).

## BOOK REVIEW

# Plants at the Margin: *Ecological Limits and Climate Change*

*Reviewed by Greta Anderson, Department of Geography and Regional Development, University of Arizona*

Much attention in contemporary biogeography is given to the issue of climate change, for which global redress seems more and more imperative with each new discovery about the disequilibrium of current warming trends. With predictions from the International Panel on Climate Change envisioning grim futures for coastal lowlands, arctic ice sheets, and human communities worldwide, concern for plants hasn't been at the top of most people's list of worries. However, for botanists, biogeographers and others who are concerned with such things, *Plants at the Margin: Ecological Limits and Climate Change* by R.M.M. Crawford provides an important overview of how plants in different regions can be expected to respond to this new global paradigm. Crawford surveys the past and the present adaptive responses of vegetation in order to support his hypotheses for the future and provides the reader with a solid understanding of diverse plant physiology along the way.

Organized in three parts, this book explores what constitutes a margin, how plants function with marginal areas through adaptation, and the challenges posed to various marginal environments by the changing climate. In the first part, "The Nature of Marginal Areas," Crawford highlights the myriad types of spatial and temporal margins that occur in nature, from the edges of biomes to the persistence of relict species in places where related species have long since disappeared or where climatic conditions have changed since their establishment. He defines "margin" to mean an isolated area, but clarifies that isolation isn't only a spatial consideration. In some cases, peripheral habitats for plants are defined as biologically limiting factors to distribution, be they demographic, physiological, or genetic.

The reason that Crawford focuses on ecological margins to discern the likely impacts of climate change is because these areas are already highly susceptible to variability (given that they contain the intersections of habitats) and because they contain species assemblages that differ genetically and physiologically from core populations. The first part of the book identifies ways in which plants in marginal areas have evolved resistance to extreme conditions, including the climatic extremes of the polar regions and to the intense grazing pressure of native and introduced herbivores. Crawford highlights the high degree of endemism in marginal populations which indicates both a long history of speciation and specialized responses to disturbance, but also their vulnerability to climate change. Thus, while these marginal plants may have inherent resilience and plasticity to

change, they are also subject to greater variation in their habitat due to climate flux.

This first section focuses on the role of disturbance in ecosystems and the various types of disturbance that occur in peripheral areas. Plants have evolved in dynamic relationship to many types of disturbance- fire, grazing, flooding- but not to the disastrous destabilization of overgrazing, deforestation, and invasive species. Crawford makes the point that some of the ecosystems we're most familiar evolved with intensive human influence, and some of these areas are consequently floristic diversity "hotspots."

The second part of the book looks at the various survival strategies that plants employ in order to thrive in marginal areas, including how plants acquire resources and reproduce in various habitats. The author demonstrates that plants have profound flexibility in acquiring necessary resources. When water is scarce, plants condense dew and fog. When soil nutrition is scarce, plants exploit animal carcasses and detritus from human settlements. Some species have evolved to obtain higher levels of carbon dioxide by growing in the relatively short window of soil thawing, which releases carbon produced by aerobic soil processes of cyanobacteria.

### Merely surviving is not enough; plants must also be able to reproduce.

The timing of flowering depends on climatic conditions like the onset of spring and the first thaw, and the book delves briefly into the significance of synchronous phenology for long-term reproductive success. Crawford focuses on the promise of seeds as a reproductive strategy. Seed banks represent the latent capacity of an ecosystem, and sexual reproduction is a survival strategy that has provided endurance and diversity in the plant kingdom. Not all plants reproduce this way, but the ones that do have the ability to make a comeback when their forebears are long gone and have a better chance at dispersing into suitable habitat as climate changes. Unfortunately, seed distribution often depends upon climate-related disturbance such as flooding and fire regimes, and on relationships with animals for pollination, cross-fertilization and distribution, which may not occur within the same temporal scale in a climate-altered world.

It is in this section of the book that Crawford highlights the problem of invasive species as they pertain to climate change. He is circumspect about the degree to which this is a

problem, noting that the very term, “invasive” carries a negative connotation and that any differences between invasion and “migration” are highly qualitative. Still, he provides examples of some of the commonly described invaders and describes their deleterious contributions to ecosystems, and correlates (where scientifically supported) their advances and climate warming.

The third and final part of the book considers marginal habitats, and Crawford posits vegetation responses in each of these regions based on the species currently found there. The section has whole chapters on the tundra-taiga interface, the arctic, coastal margins, effects to woody plants, high elevation areas, and a chapter called, “Man at the margins” which considers the long history of peripheral human habitats. Each of these sections predicts the responsiveness of the vegetation communities based on genotypic plasticity and evolutionary tenacity. Instead of limiting the discussion to that of straightforward adaptation to warming temperatures, he considers the myriad impacts of warming in each of these habitats. Crawford discusses the significance of sea rise for coastal plants, the increase solar radiation on high altitude species due to ozone depletion, and the increasing bog communities as an impediment to forest advance in the tundra-taiga. Though the sheer volume of such threats is overwhelming, Crawford seems to weigh his esteem for plant adaptation and historic responses with a recognition that some communities are in dire straights.

Indeed, a key point of Crawford’s is, “Adaptation is the first step on the road to extinction,” because adaptation increases habitat specialization which in turn makes species more vulnerable to environmental change. As such, he predicts that highly-adapted species and endemic species may not be able to cope with the rapid climatic changes already underway. Nevertheless, he does try to end the case study chapters optimistically, concluding more than once that the high degree of variability and plasticity among plants reflects positively on their potential to withstand and adapt to future fluctuations. He even offers this optimistic (though hopefully tongue-in-cheek) gem about the bright side of global warming in the arctic: “Botanists in the future may look forward confidently to relaxed exploration of a diverse and plentiful flora as far north as land exists without the inconveniences and risks of ursine disturbance.” Only a true plant geek could be this sanguine about polar bear extinction.

Crawford tempers his optimism about the persistence of plants in other marginal habitats by expressing concern for ongoing human degradation including grazing, development, and agriculture. In many examples throughout the book, Crawford discusses the roles disturbance has played in shaping marginal ecosystems and directing elegant evolutionary responses in the plant kingdom. And while he recognizes the role of native herbivores in shaping vegetation communities through controlling aggressive and dominant

species, he also acknowledges that different habitats have different responses to domestic livestock pressure. He strongly contends that desertification in many regions is directly attributed to livestock, not climate change. “Well managed lands can recover from drought when the rains return. It is land abuse during drought that causes the degradation and desertification.” This seems a timely reminder for conservation management in arid and aridifying lands.

Aside from the content, the general structure of the book includes some convenient details. Throughout the chapters, the reader is provided with mini-glossaries of terms relevant to the text, which serve as a helpful reminder of some basic ecological and conceptual terminology. This supplements the accessible writing and removes some of the pedantry of similar texts. The tables and charts in the text are useful depictions of the material, and often these figures are as engaging as the paragraphs below them.

Furthermore, the book is rife with specific examples of all ecological concepts, emphasis on *specific*; Crawford highlights the individual taxon with the adaptations or habitats that demonstrate his conclusions. The text is peppered with basic plant physiology as well, including discussions about nutrient uptake and storage, tissue damage and resilience, and limits to anoxia. The book includes many original illustrative color photographs of subjects on nearly every page. The photographs of marginal ecosystems illustrate how drastic some delineations of vegetation zones can be, which supplements the reader’s understanding the cause of these limits (e.g. resource availability, temperature, or water availability).

If there is a drawback to his reliance on his own knowledge and photographic archive, it is one of limited geographic scope. Crawford brings in occasional examples from around the globe, but mostly, he seems to understand plants in northern Europe the best, and many of the photos are from places in this bioregion as well. This book relies heavily on his earlier studies and papers on *Saxifraga* spp. and the Orkney Islands. The text and the examples are certainly still useful, but less interesting to botanists of other regions than it might be if more varied explanations were included and greater diversity represented. While the predicted effects of climate change can be extrapolated to other floras, the book contains too few examples and photographs of these other regions to really be considered a global compendium. It does serve as a useful and pertinent overview of vegetative adaptation and possibilism. Crawford has done a fine job of compiling relevant conceptual examples which should assure the reader that s/he will never live in a world without a great diversity of interesting plants.

R.M.M. Crawford. Cambridge University Press. 2008. xv and 478 pages. \$80.00 (ISBN: 978-0-521-62309-4).



# Six New Plants on the Arizona Strip, and an Old Plant, Now of Interest

by Lee Hughes, Ecologist, Arizona Strip District, Bureau of Land Management. Photos courtesy the author.

From 1999 to 2005, the Arizona Strip received grants from the National Fish and Wildlife Foundation and the U.S. Park Service to do inventories for the rare plants, listed plants, and for plants not previously found on the Arizona Strip. During this process the cooperators in the grant were Duane Atwood, Larry Higgins and Blaine Furness who carried out the inventories and the processing plant vouchers. In addition to those found by the above three botanists, Noel and Pat Holmgren found one plant on the Arizona Strip that they have described.

In the inventories six new taxa were found and described. They are: *Phacelia higginsii*, *P. hughesii*, *furnissii*, *Sphaeralcea gierischii*, *Mentzelia memorabilis*, *Camissonia dominquez-escalantorum*, and *Tetradymia canescens* var. *thorneae*. Another species of interest from The Strip is *Crypthantha semiglabra*.

Most the new plants are endemic or closely associated with the Harrisberg member of the Kaibab Formation. *Phacelia higginsii* looks most like *P. palmeri*; however, *P. palmeri* blooms in spring whereas *P. higginsii* blooms and goes to seed in the late summer and fall. *P. furnissii* has large blue- violet flowers and wand-like stems and grows in talus. *P. hughesii* has much longer cymes than its closest relatives. *Sphaeralcea gierischii* is glabrous and grows only on the Harrisberg member. *Mentzelia memorabilis* has entire linear leaves compared to the serrate leaves of its relatives. It is also endemic to the Harrisberg member. *Camissonia dominquez-escalantorum* has longer seed capsules than the common *C. parryi* that grows in the area. *Tetradymia canescens* var. *thorneae* is very close to the other member in its species, and I have not found a striking character to distinguish the new variety. *Cyphantha semiglabra* is easy to distinguish from its nearby relatives because of its leaves. The leaves are glossy and glabrous on top, with a unique strigose design in the pubescence on the bottom the leaf.



from top

Gierisch Mallow (*Sphaeralcea gierischii*).

Stickleaf (*Mentzelia memorabilis*).





**above** A view of Montezuma Well overlooking rimrock country.  
**right** The sacred spring at Montezuma Well.



## ETHNOBOTANY: PEOPLE USING NATIVE PLANTS

# Montezuma Well

by Jessa Fisher, Flagstaff Chapter member, nightbloomingcactus@yahoo.com. Photos courtesy the author.

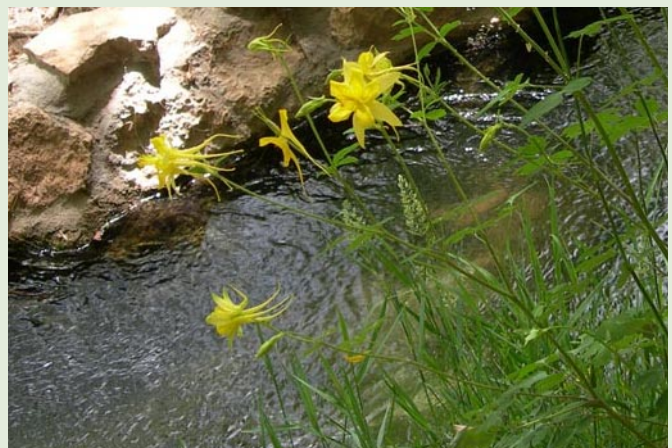
Montezuma Well is a National Park Service unit area near Rimrock, Arizona, and is a sacred site to the Hopi and Yavapai tribes. It is a circular sinkhole formed by the collapse of a limestone cavern. It has a beautiful representation of plants in the mixed chaparral zone. At the 2008 ethnobotany-themed Arizona Botany Meeting, Phyllis Hogan of the Arizona Ethnobotanical Research Association (AERA) and Theodora Homewytewa of the Hopi Tribe led a field trip to the area, explaining the significance of the well to the Hopi and highlighting some of the uses of plants which grow there.

Montezuma Well is 90 feet deep with a centrifugal force that constantly swirls around the sludge and sand at the bottom. The levels of CO<sub>2</sub> are so high in the well and the levels of O<sub>2</sub> so low that no fish can live in the water. You can often see ducks floating on the water, though, and there are several endemic species of animals found only at the well, including a leech, a snail, and a scorpion. The water in the well comes from four flowing underground springs.

According to Theodora Homewytewa, who is a medicine woman, the rooms you can still see on the rim of the well were used for storage and housing by ancient members of certain Hopi clans. Eventually people living here became corrupt and weren't living a good path anymore. One year, the residents at the well were dancing and creator decided to punish the people for being corrupt. A serpent came up through the well and took all the villagers down into the well with him. Because of this story, Montezuma Well is still a sacred site, and was part of the Hopi migration route. Theodora suggests only being in a positive mood when you are at the well, and leave an offering—if you don't, they say the serpent will take your soul forever until someone comes and releases you.

Many of the plants at the well are still important to different tribes living in the area of the well. *Acourtia wrightii*, or buffalo fur, is a purple-flowered shrubby aster family plant used by the Yavapai and Hualapai as an internal medicine. *Nicotiana trigonophylla*, or "piva" in Hopi, is tobacco used as a sacred smoke. *Ephedra viridis*, also known as Mormon Tea, grows at the well and is a mild bronchial dilator. *Juniperus coahuilensis* or red berry juniper is the beautiful species of this tree found at the well, and used by the Hopi as a veritable medicine chest for colds, thirst, and spiritual purposes.

When you visit Montezuma Well, make sure to walk down the flowing spring at the bottom after you pause at the overlook. Feel the sacred energy of the site and dip your feet in the water and give thanks for all the gifts in your life. Then the serpent should stay underwater in the well for he can see that you are balanced and happy to be alive.



**above** *Aquilegia chrysantha* (golden columbine) at the spring.

# Who's Who at AZNPS

## BOARD OF DIRECTORS

Cass Blodgett, *Director, Phoenix Chapter Co-Chair*, [cblodgett2@cox.net](mailto:cblodgett2@cox.net)

Suzanne Cash, *Director, Secretary*, [roxiep@msn.com](mailto:roxiep@msn.com)

Wendy Hodgson, *Director, Conservation Education & Outreach Committee Chair*, [whodgson@dbg.org](mailto:whodgson@dbg.org)

Kendall Kroesen, *Director, Membership and Chapter Development Chair*, [kkroesen@cox.net](mailto:kkroesen@cox.net)

Andy Laurenzi, *Director, Vice President*, [alaurenz33@gmail.com](mailto:alaurenz33@gmail.com)

Linda Marschner, *Director, Treasurer, Finance Committee Chair*, [ldmarschner@msn.com](mailto:ldmarschner@msn.com)

Barbara G. Phillips, *Director, President, Editorial Committee Chair*, [bagphillips@yahoo.com](mailto:bagphillips@yahoo.com)

Michael Plagens, *Director, Phoenix Chapter Co-Chair*, [mjplagens@arizonensis.org](mailto:mjplagens@arizonensis.org)

Ana Lilia Reina-Guerrero, *Director at Large*, [analilia.reina@yahoo.com](mailto:analilia.reina@yahoo.com)

Douglas Ripley, *Director, Tucson Chapter President*, [ripley@powerc.net](mailto:ripley@powerc.net)

Andrew Salywon, *Director at Large*, [asalywon@dbg.org](mailto:asalywon@dbg.org)

Carl Tomoff, *Director, Prescott Chapter President*, [tomoff@northlink.com](mailto:tomoff@northlink.com)

Tom Van Devender, *Director at Large*, [yecora4@comcast.net](mailto:yecora4@comcast.net)

## AZNPS COLLABORATORS

Marilyn Hanson, *Website Editor*, [mfhanson@comcast.net](mailto:mfhanson@comcast.net)

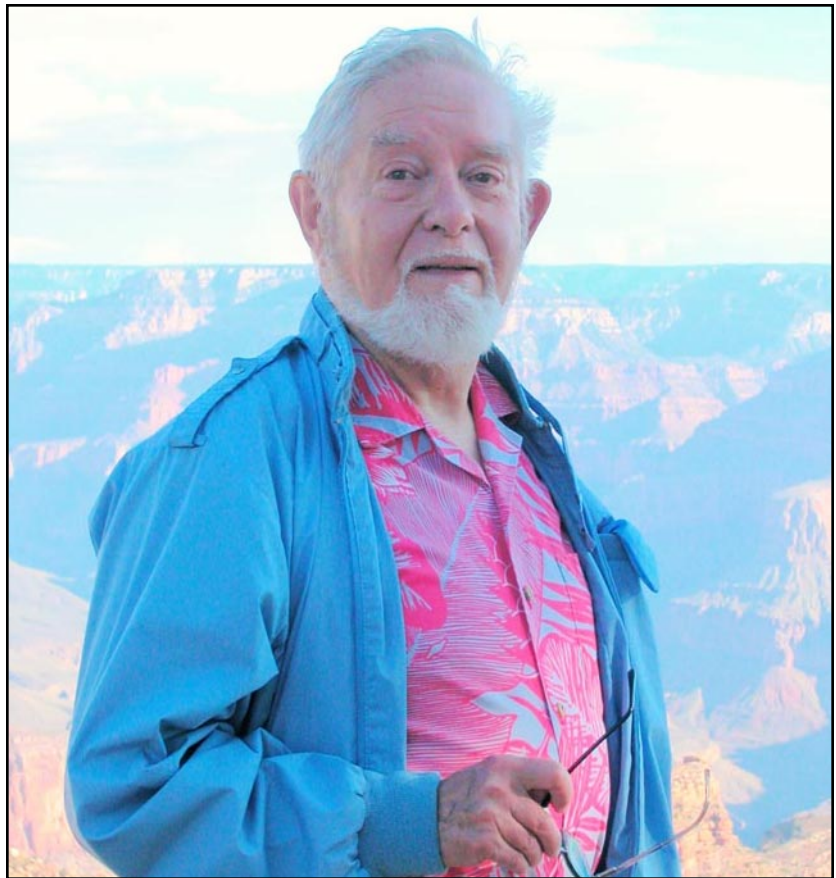
Julie St. John, *The Plant Press Layout Editor*, [julieDesign@cox.net](mailto:julieDesign@cox.net)

Troy Wood, *Happenings Editor*, [trowood@indiana.edu](mailto:trowood@indiana.edu)



**Would you like to take a more active role in protecting Arizona's native plants?**

Please contact your local chapter (see back cover) for local volunteer opportunities.



## A Champion for Arizona Native Plants H. David Hammond

The Arizona Native Plant Society lost a wonderful friend, H. David Hammond, Ph.D., an active member of the Flagstaff Chapter and its treasurer for many years. David died of a severe stroke on November 26, 2010 at the age of 86. David was a steadfast volunteer curator at Northern Arizona University's Deaver Herbarium for the past seventeen years where he influenced and mentored many students. He also helped our new Budding Botanists learn the ways of mounting plants from a real expert during the Plant Atlas Project of Arizona (PAPAZ) training sessions. David had relocated back to Rochester, New York where he spent his last few months with his daughter and family. We miss his cheerful presence.



## New Women's Violet tee shirts in the datura design!



These 100% cotton (not pre-shrunk) tees are more fitted for women, have a scoop neck and shorter sleeves than the standard datura tees. They are a lovely violet color, between a light lavender and the deep purple.

Please contact your local chapter to order this tee shirt or one of the older designs.

### We are officially part of Basha's "Shop & Give" program!

When you shop at any Basha's, AJ's or Food City, a percentage of your purchase will come back to support your favorite Native Plant Society! **It's simple:** At the cash register, tell them to attribute your purchase to **AZNPS #25053**. This is a super easy and effective way to help AZNPS bring in extra cash for our important efforts!

Thank you... and thank you Basha's!

### Clearance Sale on our landscaping booklets!

Originally created by the AZNPS Urban Education Committee, these booklets flew off the shelves due to the excitement over new xeric plant offerings (though some were not native to this country... the text in the booklets notes that), and due to the very low price we set to appeal to newcomers in our region. The booklets have done a great service to AZNPS over the years, keeping us flush with money to fund our educational projects through the years. We are grateful to the professional growers, landscapers and other committee members who developed these useful tools. There is good growing information in these booklets and we are urging you to utilize that for formulating your own landscape plans and adding to them. We also urge that you consider growing our Arizona Natives instead of some of the suggestions in these booklets to use non-natives. Our plan is to keep plugging on production of several good native plant lists that we will eventually put onto our website to help people with landscape planning. The Cochise, Phoenix, Tucson and Yuma chapters are now stocking and selling these booklets locally to educate their locals and raise funds for the individual chapters. The following booklets are still in print: *Sonoran Desert Trees*, *Desert Shrubs*, *Desert Grasses*, *Butterfly Gardening*, and *Bird Gardening*.

AZNPS booklets and posters are also available in Phoenix at the Desert Botanical Garden; in Tucson at Saguaro National Park (East and West), Tohono Chul Park, Tucson Botanical Gardens, Audubon Society Nature Store, Arizona-Sonora Desert Museum; in Superior at Boyce Thompson Arboretum; and at Organ Pipe National Monument.



The Plant Press is a benefit of membership in the Arizona Native Plant Society.

### UPCOMING ISSUE: Plant-Animal Interactions



The Arizona  
Native Plant  
Society

For information on contributing articles, illustrations, photos, or book reviews on this topic — as well as to suggest themes you'd like to see us cover pertaining to the protection, conservation, and habitats of Arizona native plants — contact *The Plant Press* Technical Editor, Barbara Phillips, at [bagphillips@yahoo.com](mailto:bagphillips@yahoo.com)



**Arizona Native Plant Society**  
**PO Box 41206**  
**Tucson AZ 85717**  
**[www.aznativeplantsociety.org](http://www.aznativeplantsociety.org)**

**Nonprofit Org**  
**US Postage**  
**PAID**  
**Tucson, AZ**  
**Permit #690**

*Address Service Requested*

## New Members Welcome!

People interested in native plants are encouraged to become members. People may join chapters in Flagstaff, Phoenix, Prescott, Sierra Vista, Tucson, or Yuma, or may choose not to be active at a chapter level and simply support the statewide organization. For more information, please write to AZNPS at the address below, visit **[www.aznativeplantsociety.org](http://www.aznativeplantsociety.org)**, or contact one of the people below:

Cochise: Jerome Ward, [wardjer@gmail.com](mailto:wardjer@gmail.com)

Flagstaff: Dorothy Lamm, 928.779.7296,  
and Keri Stiverson, 928.699.6809

Phoenix: Cass Blodgett, 480.460.0725, and  
Michael Plagens, 602.459.5224

Prescott: Carl Tomoff, 928.778.2626

Tucson: Doug Ripley, 520.212.6077

Yuma: Karen Reichhardt, 928.317.3245

### Membership Form

Name:

---

Address:

---

City/State/Zip:

---

Phone/Email:

---

Chapter preferred:  State only  Cochise County  Flagstaff  
 Phoenix  Prescott  Tucson  Yuma

Enclosed:  \$15 Student  \$75 Commercial  
 \$30 Individual  \$100 Plant Lover  
 \$35 Family  \$500 Patron  
 \$50 Organization  \$1,000 Lifetime

**Mail to:**  
**Arizona Native Plant Society**  
**PO Box 41206, Tucson AZ 85717**