Arizona Riparian Council

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# SAN PEDRO RIVER RIPARIAN VEGETATION ACROSS WATER AVAILABILITY AND FLOOD DISTURBANCE GRADIENTS

*by Sharon Joy Lite, Ph.D., School of Life Sciences, Arizona State University*

Along arid-region rivers, fluvial disturbance and water stress are two of the primary factors that influence vegetation patterns. Flood intensity and water availability gradients can exist along the length of and across the river due to regional and local geomorphic and hydrologic variations. The establishment and survival of riparian plant species is, in part, limited by the species tolerance to flood disturbance and water availability levels. The likelihood that a given species will occur on a particular landform is a function of suitability of the site for germination, establishment, and survivorship, as influenced by abiotic conditions, and by biotic interactions such as interspecific competition, all of which depend on flood disturbance and water availability. Similarly, flood disturbances influence the structure of the riparian vegetation community.

Hydrologic changes along many Southwestern rivers have led to a decline in pioneer tree communities of Fremont cottonwood-Goodding willow (*Populus fremontii-Salix gooddingii*). In many areas, including the San Pedro River, these forests have been replaced by shrublands of saltcedar (*Tamarix ramosissima*). Consequences of declines in riparian forests include loss of habitat for animal species and loss of scenic areas for recreation. Riparian vegetation loss also can contribute to increased flood peaks, erosion, and channel widening. Many people value these forests and their functions, and thus there is considerable interest in restoring cottonwood-willow forests along degraded river reaches and conserving those forests that remain. These restoration and management activities require knowledge of species requirements for abiotic factors including hydrologic regimes. They also require identifying hydrologic threshold values for desired attributes such as community structural traits and species abundances.

Under the guidance of Dr. Julie Stromberg (School of Life Sciences, Arizona State University), the objective of my dissertation research was to examine how woody vegetation population abundances, age class structure, biomass structure, and diversity varied across gradients of water availability and flood intensity along the semi-arid San Pedro River. In addition to summarizing these vegetation-hydrology relationships, I developed a model for riparian forest management. The Hydrologic Threshold Model, as I refer to it, identifies surface flow and groundwater depth and fluctuation thresholds for maintaining cottonwood-willow forests.

As riparian conservation and restoration projects have increased in recent years, there has been a heightened need for techniques that assess riparian ecosystems.Assessment protocols can be used to monitor

***(Cont. pg. 3 . . . . . San Pedro)***

## Inside This Issue

# PRESIDENT'S MESSAGE

The Arizona Riparian Council (the Council) recently held a one-day visioning and planning session to discuss the future direction of the Council. Over the past 18 years the Council has accomplished a great deal through the help of many volunteers. To maintain a successful organization, it is necessary to evaluate from time to time where you have been as an organization and where you want to go. This session was part of the Council's ongoing evaluation efforts. For those of you who could not attend, I have summarized some of the highlights from the planning session below.

The first step in the process was to look back on the past history of the Council. The Council exists to provide for the exchange and transmittal of information on the status, protection, and management of riparian systems in Arizona. For the purpose of the Council the term "riparian" is intended to include vegetation, habitats, or ecosystems that are associated with bodies of water (streams or lakes) or are dependent on the existence of perennial or ephemeral surface or subsurface water drainage. These riparian systems are to be located in Arizona but are not so limited as to exclude extensions of systems into adjacent Southwestern states and Mexico.

The strengths of the Council that were identified included a membership that is multi-disciplinary and multi-agency. Also, the Council tends to appeal to wide range of people and the Council links technical expertise across many subjects and disciplines.

An exercise was conducted to rank the importance of the objectives listed in the Constitution of the Arizona Riparian Council. The most selected objective by the participants was "To function in an advisory capacity on questions involving management, conservation and protection of riparian systems and adopt such measures as shall tend to ensure the continued survival and maintenance of healthy riparian systems." This led to more discussion as to the meaning of "advisory" and the role of advocacy within the Council.

At the session, the question was asked "What is the most important factor to keep you active in the Council?" As expected, there was a wide range of responses to this question. Here are a few of the responses.

- Affiliation with a credible group that uses credible science;
- Opportunity to exchange the newest information while it is being developed;
- Educational outreach;
- Ability to attend technical meetings and present information;
- Opportunity to have students present meaningful information to membership; and
- Evidence that the Council is improving and saving riparian habitat.

Finally, I wanted to share some of the responses from participants regarding what should the Council be doing more of? Some of the responses include conducting workshops, partnering with other organizations, hosting more gatherings or regular events to promote organizational fellowship, and interfacing with governmental officials.

It was evident from those in attendance that there is enthusiasm for reinvigorating the organization and building upon past efforts and accomplishments. Although the planning/visioning session is over, the Board of Directors understands that determining future direction is an ongoing effort. To this end, I encourage everyone who could not attend the recent planning session to communicate your comments and suggestions regarding the Council's future to the Board. We are interested in what is important to our membership and what will keep you active in the Council. What should the Council be doing more of that is meaningful to you? Your input is crucial in shaping the future of our organization. Please feel free to forward items to me at *jinwood03@aol.com* or by telephone at (602) 274-6725.

*Jeff Inwood, President*

***(San Pedro . Cont. from pg. 1)***

changes in ecological condition, determine the need and type of restorative actions, assess restoration success, select high-quality sites during conservation planning, and facilitate determination of habitat acreages needed for compensatory mitigation. Another component of my dissertation focused on developing an overall assessment model for southwestern riparian vegetation. The Riparian Condition Index Model identifies plant-based indicators that change in response to the stressors of stream and aquifer dewatering and uses these indicators as a basis for placing sites into condition classes.

## STUDY SITES AND METHODS

I collected data at 18 sites along the San Pedro River in southeastern Arizona from Palominas to Winkelman (Fig. 1). At each site, I sampled woody vegetation along one transect that was perpendicular to the river on both sides, and extended from the thalweg (channel low point) to the mesquite-sacaton (*Prosopis velutina-Sporobolus wrightii*) terraces. Vegetation patch types were identified and characterized along the transect, based on dominant woody species, tree canopy cover, tree size class, and fluvial surface. Woody vegetation was recorded within 100-$m^2$ study plots within each vegetation patch. Vegetation data were collected for the stands as a whole and by tree and shrub species, and included vegetation volume, canopy cover, canopy height, stem density, basal area, and shrub cover. Plants were divided into four functional groups (hydromesic pioneer, hydromesic competitor, xeric pioneer, xeric competitor) based on life history and drought tolerance traits described in the *USDA PLANTS National Database*.

Each transect was surveyed to obtain a flood-plain topographic cross-section. To quantify water availability at each site, surface flow presence/absence, depth to groundwater, and river stage (depth at thalweg) were monitored monthly during water years 2001 and 2002. WinXSPRO channel cross section analyzer was used to calculate values for total stream power for floods of various recurrence intervals, and inundation frequencies for each plot (measures of flood disturbance). I used Pearson product-moment correlation and single and multiple regression analyses to determine which environmental factors individually and collectively

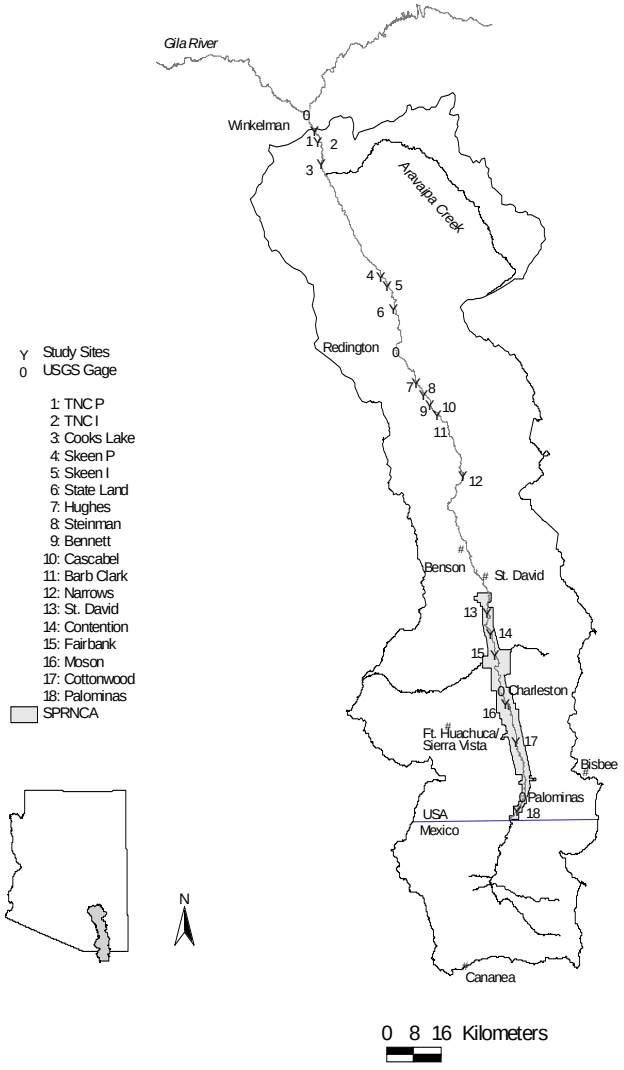



***Figure 1.*** *San Pedro River basin and location of study sites.*

influenced site values for vegetation abundance and structure.

## RESULTS

The primary findings of my research were:

- Plant communities became dominated by mesophytic species including salt cedar at drier sites, whereas hydrophytic species including cottonwood and willow dominated at wetter sites.
- Dry sites had increased areal coverage of shrublands and decreased woodland coverage as well as a decrease in maximum canopy height, total vegetation volume, and upper canopy (>8 m) vegetation volume.
- Sites with intense flood disturbance had more open patches and shorter vegetation.
- There was a downstream increase in stem densities of young pioneer trees that was due to the interaction between flood size and power and pioneer species recruitment patterns.
- Woody plant diversity increased as a function of increased site landscape heterogeneity and water availability, but not flood disturbance.
- The number of vegetation patch types increased with increasing flood disturbance and site water availability.
- Species richness within cottonwood and willow patches increased with increasing flood disturbance and site water availability.
- Biomass across the flood plain tended to be higher on low elevation, wet surfaces.
- Total woody species richness did not vary greatly across floodplain stress or disturbance gradients, but some differences were apparent among functional groups.

With respect to the Hydrologic Threshold Model, I identified threshold values for hydrologic variables at which cottonwood-willow forests are more abundant than saltcedar. Overall, cottonwood and willow maintained tall dense stands with diverse age classes and were more abundant than saltcedar at sites where average maximum depth to groundwater was shallower than 2.9 m, annual groundwater fluctuation was less than 0.6 m, and surface flow duration was greater than 73% (surface flow present in the channel for 73% of the months over the two-year study period). Saltcedar was the dominant pioneer species at sites where depth to ground was deeper than 3.2 m, flow frequencies were less than 60%, and annual groundwater fluctuation was less than 0.7 m. The species were codominant at intermediate hydrologic conditions (Fig. 2 and Table 1).

The Riparian Condition Index is based on nine vegetation traits (indicators) that were sensitive to changes in surface flow presence and groundwater levels on the San Pedro River. The indicators include measures of woody and herbaceous species composition, and population and community structure. Focusing on plant functional groups and structural traits emphasizes restoring ecosystem functions rather than particular species. Riparian condition classes are based on surface flow duration and groundwater depth and fluctuation; each condition class is associated

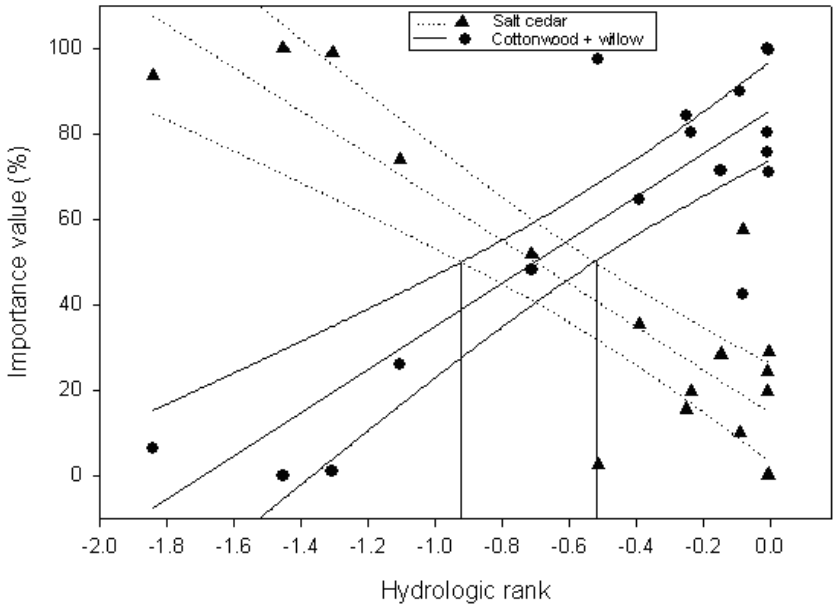



***Figure 2.*** *Regression lines (with 95% confidence intervals) showing hydrologic thresholds for the maintenance of cottonwood - willow stands along the San Pedro River. Importance value is a measure of the relative abundance of each species. Hydrologic rank integrates flow duration and ground-water depth and fluctuation, and ranks the sites from wet (high values) to dry (low values).*

*Table 1. Hydrologic threshold ranges (corresponding to thresholds in Figure 2) for the dominance of pioneer tree and shrub species along the San Pedro River. Ranges span the values derived from relationships between individual abundance (basal area, vegetation volume, canopy cover) and hydrologic variables.*

| | Hydrologic rank (from Fig. 2) | Flow duration (%) | Depth to groundwater (m) | Groundwater fluctuation (m/yr) |
|---|---|---|---|---|
| Cottonwood-willow | -0.52 | 73 - 76 | 2.9- 2.6 | 0.46 - 0.56 |
| Co-dominant | | 42 - 76 | 3.2 - 2.6 | 0.69 - 0.56 |

with ranges for each indicator variable as well as levels of functional capacity (Table 2).

## MANAGEMENT APPLICATIONS

Decades of groundwater pumping and surface diversions for municipal, industrial, and agricultural uses have contributed to lowered water tables and decreased base flows along the San Pedro River. This stream and aquifer dewatering have reduced riparian zone water availability, but conditions are changing. Groundwater pumping at a copper mine near San Manuel has slowed as mining operations wind down. At the same time, The Nature Conservancy recently purchased approximately 1,000 hectares and associated water rights within the Lower Basin with the intention of dramatically reducing groundwater pumping and allowing cottonwood and willow to reestablish. As hydrologic conditions change along the San Pedro River, there is great interest by local land managers, including the Bureau of Land Management and The Nature Conservancy, to conserve and restore the cottonwood-willow forest community and to track ecological changes subsequent to decreases and increases in groundwater extraction. The vegetation-hydrology relationships and thresholds identified though my research can help define management goals and be used to predict shifts in vegetation community composition and structure. The San Pedro River Riparian Condition Index, in combination with groundwater/surface water models being developed for the San Pedro River, will provide valuable tools to land managers for predicting and monitoring ecosystem condition changes resulting from groundwater depletion and hydrologic restoration. As well, the Hydrologic Threshold Model can be used as a basis for designing restoration projects to restore cottonwood-willow forests to rivers that have become dominated by saltcedar and other drought-tolerant plant species.

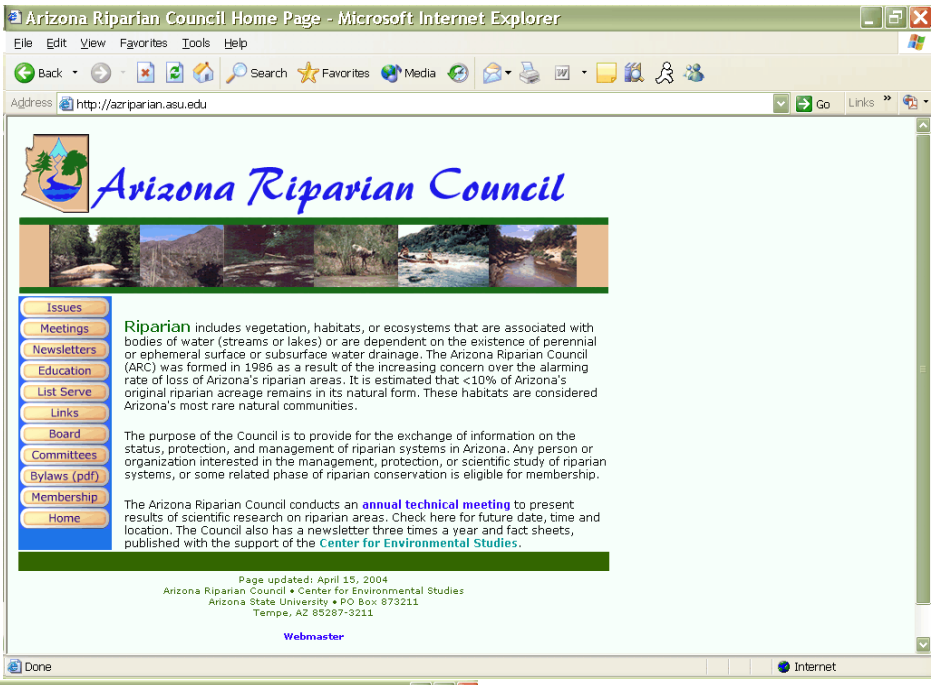
*Table 2. Summary of riparian condition classes in Riparian Condition Index Model*

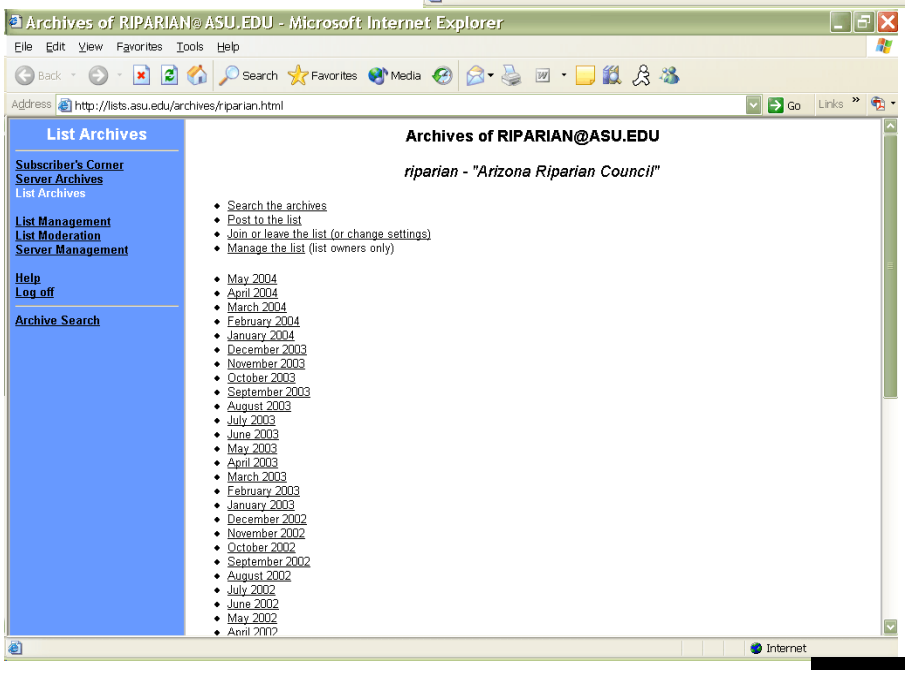
| Condition Class | Hydrology | Vegetation |
|---|---|---|
| 1 (intermittent-dry) | • Intermittent stream flow<br>• Deep and highly fluctuating groundwater | • Saltcedar dominant<br>• Short shrublands with limited canopy cover<br>• Sparse streamside herbaceous cover<br>• Herbaceous cover dominated by mesic species |
| 2 (intermittent-wet) | • Intermittent stream flows<br>• Moderately deep and fluctuating groundwater | • Saltcedar has increased, although cottonwood-willow dominant.<br>• Streamside herbaceous cover is reduced, and hydric herb species replaced by mesic species |
| 3 (perennial) | • Perennial or near-perennial stream flow<br>• Depth to groundwater averages <2.5m, with little seasonal fluctuation | • Tall, dense, multi-aged cottonwood-willow forests<br>• Saltcedar subdominant or absent<br>• Channel lined by dense herbaceous cover. |

# ARIZONA RIPARIAN COUNCIL ACTIVITIES – HELP!!

Are you missing one of our meetings or gatherings? As mentioned in the last issue we now have a new website hosted at Arizona State University. The address is http://azriparian.asu.edu

We will try to keep things updated there and would also appreciate any comments for additions or subtracts. One of the links that is currently on the website is to the Council's list serve. If you click on the link you can see the archives of discussions and you can also self subscribe to the list. All members are initially put on the list when they pay their dues.




**Are you missing meetings and other announcments? Please don't forget our list serve!**

# ARIZONA RIPARIAN COUNCIL ANNUAL MEETING

This year's annual meeting was held at Estrella Mountain Community College in Avondale, Arizona, on March 12-13. Attendance was lower than expected but all in all it was still a very good meeting at a great facility. Papers were presented on Friday and on Saturday many of us took part in the Tres Rios Nature Festival held at Estrella Mountain Park. Council member either assisted as volunteers or attended on their own to this first-year event.

The plenary session of the Friday talks were all around the theme of the meeting, *The Lower Gila River: Then and Now*. We started out with a presentation by Wendy Bigler, Arizona State University, on the history and cultural use of the Gila River system. Tom Hildebrandt, Arizona Game and Fish Department spoke to us about riparian habitats and wildlife on the lower Gila River Region west of Phoenix. From Flood Control of Maricopa County, Doug Williams shared with us watercourse master plans in Maricopa County. Finally, Bill Werner, Arizona Game and Fish Department, presented the impacts of growth on sustainability of riparian areas. A panel discussion of the invited speakers followed their talks.

After lunch, the technical papers were presented and included a team presentation by Joseph Feller and Joy Herr-Cardillo on the application of the Public Trust Doctrine to the lower Gila River. Matt Chew presented some fascinating information about saltcedar – 5000 years of tamarisk in 15 minutes. Gary Gin presented information on the Rio Salado Habitat Restoration Project, Phoenix, Arizona and a water supply development summary. A preliminary investigation of microclimate on the Rio Salado Project was presented by Anthony Brazel. Our farthest traveler, Roy Marler came from Oregon to present his work on riparian vegetation community development along the effluent-receiving Salt River near Phoenix, Arizona. Another distant presenter, Liz Payson, from Colorado, presented a quantitative study of riparian vegetation changes on the Verde River, 1934 to present. Vanessa Beauchamp's talk was about cottonwood-willow stand structure on regulated and unregulated reaches of the Verde River, Arizona. Julie Stromberg presented her student's work (Sharon Lite) on riparian vegetation water needs: stressor-response model for assessing riparian ecosystem condition, case study of the San Pedro River, Arizona. Brad Vandermark told us about the water desalinization plant: Is it for Arizona, the western United States, the world – or is it a mirage dancing in the desert? Revegetating abandoned farmland in the Cienega Creek Natural Preserve, Pima County, Arizona was presented by David Scalero. Tim Flood provided a slide show of a boater's view of the Gila River. A Water Resources Committee Report was given by Julia Fonseca.

At this meeting we also elected Members at Large. The three New Members at Large are: Diane Laush, Jim Lombard, and Diana Stuart. Their contact information can be found at the back of the newsletter. Welcome aboard to all of you.

# NOTEWORTHY PUBLICATIONS

*Elizabeth Ridgely*
*Gila River Indian Community, Pima-Maricopa Irrigation Project*

**Cartron, J-L. E., M. C. Molles Jr., J. F. Schuetz, C. S. Crawford, and C. N. Dahm. 2003. Ground arthropods as potential indicators of flooding regime in the riparian forest of the Middle Rio Grande, New Mexico. *Environmental Entomology* 32(5):1075-1084.**

This study is part of an effort to examine the influences of periodic flooding on populations. One of the goals of this research was to fill in knowledge gaps about the impact of flow regulation on other taxa besides birds. Another goal is to identify biotic and abiotic indicators of successful habitat restoration using managed flooding. As periodic flooding strongly influences soil surface processes such as litter dynamics, ground arthropods may be particularly good candidates for indicators of restoration status. Recent research along the middle Rio Grande suggested that with flooding, arthropod community structure may tend toward higher representation of carabid beetles and *Gryllus alogus* crickets, and toward lower representation of a common exotic isopod, *Armadillidium vulgare*.

The authors pit trapped arthropods at eight riparian forest sites next to the middle Rio Grande. Four sites were characterized by flooding (flood sites), and four sites were characterized where flooding no longer occurs (nonflood sites). All of the flood sites flooded in 2001 but not in 2002. Arthropod counts and hierarchical cluster analyses of the sites indicated (1) a significantly greater abundance of carabid beetles and the isopod *Porcellio laevis* in 2001 than in 2002; (2) a significantly greater carabid beetle abundance at flood sites during each year of the study; (3) a marginally significantly higher (2001) or significantly higher (2002) carabid species richness at flood sites; (4) no obvious response of the other taxa examined (isopods, tenebrionid beetles, and the cricket *Gryllus alogus*) to flooding regime; (5) successful classification of all nonflood sites and three flood sites using the Bray-Curtis Similarity Index and carabid abundance. The hierarchical cluster analysis based on abundance data for all four main taxa indicated no obvious segregation of flood and nonflood sites. The results suggest that carabid beetles are fairly sensitive indicators of a hydrologic connectivity between the Rio Grande and its riparian forest, while the other taxa examined are not. With the number of ongoing or planned restoration efforts increasing along the middle Rio Grande, carabids may represent an important tool for monitoring the response of riparian areas to managed flooding.

Carabid beetle abundance and species richness showed both significant inter-annual variation and differences between flood and nonflood sites. The patterns suggest that carabid beetles may be an important tool for monitoring restoration efforts that involve managed overbank flooding. As a result of the study, the following ecological indicators of successful riparian habitat restoration along the middle Rio Grande were proposed: (1) a local increase in the abundance of carabid beetles; (2) a local increase in carabid species richness; and (3) an increase in the relative abundance of *G. janus, P. chalcites*, and/or *P. lucublandus*, accompanied by a decrease in the relative abundance of *C. opaculus*.

**Molina-Freaner, Francisco, and Eguiarte, Luis E. 2003. The pollination biology of two paniculate agaves (Agavaceae) from northwestern Mexico: contrasting roles of bats as pollinators. *American Journal of Botany* 90(7):1016-1024.**

Plant pollination systems form a continuum between plants pollinated by hundreds of pollinator species including honey bees, native bees, wasps, hummingbirds, woodpeckers, orioles, sphingids and moths, nectar-feeding bats, and those pollinated by just one species . Assuming asymmetric fitness tradeoffs, simple models predict that specialized pollination systems will evolve whenever effective pollinators are predictably available in space and time and that a generalized pollination system will evolve when the abundance of effective pollinators varies in space

and time. As angiosperms are thought to occupy virtually every point on the continuum of pollination systems, it is important to understand the ecological forces that have favored generalization or specialization in particular lineages and regions. The concept of the pollination syndrome contains the implicit notion that pollination systems tend toward specialization. However, empirical evidence indicates that moderate to substantial generalization is the rule rather than the exception.

Others have suggested that the geographic pattern shown by the pollination systems of columnar cacti and paniculate agaves reflects year-to-year variation in the abundance and reliability of this nectar-feeding bat at the northern range of its distribution. Bat unpredictability has been suggested as the major ecological factor behind the evolution of the generalized pollination system of columnar cacti from the Sonoran Desert . Pollination experiments in tropical deserts showed that bats are the major pollinators . In contrast, pollination-exclusion experiments in extratropical deserts near the northern limit of nectar-feeding bats have shown that both bats and diurnal visitors (several species of birds and bees) are effective pollinators. These studies reveal a general geographic pattern: the relative importance of nocturnal vs. diurnal pollinators varies geographically, with paniculate agaves having a relatively specialized pollination within the tropics, where they are dependent on nectar-feeding bats, and moderate generalization outside the tropics, where they are pollinated by a variety of diurnal and nocturnal pollinators.

Phenological data from paniculate agaves and columnar cacti suggest that both groups form a nectar corridor for *L. curasoae* during its migration. *Agave angustifolia* Haw. (group Rigidae) and *A. subsimplex* Trel. (group Deserticolae) are two paniculate agaves with contrasting ranges of distribution. Arita detected a close geographic association between the distribution range of *A. angustifolia* and *L. curasoae* and suggested that this bat could be its major pollinator. Based on current knowledge about the geographic distribution of roosting sites of *L. curasoae* in Sonora, two populations were selected of *A. angustifolia* at different distances from a known roost to explore the influence of contrasting rates of bat visitation on fruit and seed set. An investigation is conducted of whether *L. curasoae* is the major pollinator of *A. angustifolia*, an assessment is made of the relative importance of nocturnal vs. diurnal pollinators, and a hypothesis is made of whether the pollination system of these two species resembles those of paniculate agaves from extratropical regions. Pollinator-exclusion experiments, floral visitor observations, and temporal variation in fruit set values at different distances from a roosting site were observed. Floral visitors were observed for a brief period. The results seem to support the trend from specialization to generalization along the continuum of tropical to extratropical deserts. The trend from relative specialization to generalization in the pollination system of paniculate agaves breaks down in the central Sonoran Desert. Several attributes and some observations on *A. subsimplex* suggest that this species is not dependent on nectar-feeding bats. Furthermore, nocturnal nectar secretion was probably low as compared to other paniculate agaves. Nocturnal nectar secretion was greater than diurnal nectar secretion, and anther dehiscence was nocturnal, indicating adaptation to nocturnal visitors.

The data suggests that the distance to the nearest *Leptonycteris* roosting site has important reproductive consequences for populations of *A. angustifolia*. Populations within the foraging range of this bat may be sexually successful, whereas populations at the limits of the foraging range may vary significantly in reproductive output and change from sexual to asexual reproduction (i.e., formation of bulbils), depending on bat abundance. If the probability of establishment of bulbils is greater than sexually derived seedlings, vegetative propagation could be more important than sexual reproduction in the maintenance and regeneration of populations near the limits of the foraging range of nectar-feeding bats. The genotypic diversity of populations of *A. angustifolia* could vary spatially with bat abundance. Future studies should explore the relative importance of sexual reproduction vs. vegetative propagation in the maintenance and structure of populations of *A. angustifolia*.

## LEGAL ISSUES OF CONCERN

*Richard Tiburcio Campbell, U.S. Environmental Protection Agency**

# GILA RIVER INDIAN COMMUNITY WATER RIGHTS SETTLEMENT STATUS OF THE "ARIZONA WATER RIGHTS SETTLEMENT ACT OF 2003"

*(*After six years practicing environmental and water rights law in Arizona, Richard is now an Associate Regional Counsel with EPA Region 9, which includes Arizona within its jurisdiction. The viewpoints expressed in this article do not necessarily represent the viewpoints of the EPA.)*

Momentum is building in Congress once again to enact legislation to provide for adjustments to Central Arizona Project (CAP) water allocations in Arizona and authorize the Gila River Indian Community water rights settlement. Arizona Senator Jon Kyl introduced this legislation, S. 437 (the "Arizona Water Settlements Act"), in the 108th Congress on February 25, 2003 (the text of S. 437 may be viewed at *http://thomas.loc.gov /cgi-bin/query/z?c108:S.437:*). An identical bill, H.R. 885, was introduced in the House that same day by Arizona Representative J. D. Hayworth (The text of H.R. 885 may be viewed at *http://frwebgate.access.gpo.gov*).

## Allocation of CAP Water to Indian Tribes in Arizona

Section 104 of the proposed Settlement allocates to the Indian tribes located in Arizona a total of 667,724 acre-feet (ac-ft) of CAP water. (One ac-ft is approximately 325,851 gallons of water. One ac-ft of water is generally considered enough to meet the water demands of a family of 4-5 for one year.) This amount comes out of the 1,415,000 ac-ft that Arizona is entitled to under the long-term contracts for the delivery of CAP water held by all users (Indian and non-Indian alike) in the State. In other words, the remaining 747,276 ac-ft of CAP water is shared by non-Indian municipal and industrial entities, the Arizona Department of Water Resources; and non-Indian agricultural entities in Arizona. For example, under the proposed Settlement, Phoenix and Tucson are each reallocated 8,206 ac-ft of CAP water [(Section 104(b)(1)(Q) & (S)].

## CAP Water for Wildlife

The proposed Settlement also provides that Central Arizona Project may be used to transport nonproject water for domestic, municipal, fish and wildlife, and industrial purposes (Section 103). For instance, Section 110 of the proposed Settlement authorizes appropriations for compliance with specified biological opinions relating to impacts of CAP water delivery and storage, including:

- The April 15, 1994 biological opinion (2-21-90-F-119) relating to the transportation and delivery of CAP water to the Gila River basin.
- The July 23, 1996 biological opinion (2-21-95-F-462) relating to the impacts of modifying Roosevelt Dam on the Southwestern Willow Flycatcher.
- The May 1999 draft biological opinion (2-21-91-F-706) relating to the impacts of the CAP on Gila Topminnow in the Santa Cruz River basin through the introduction and spread of nonnative aquatic species.

In addition, Section 213(a)(6)(B) authorizes the appropriation of not more than $10,000,000 to carry out the mitigation measures in the Roosevelt Habitat Conservation Plan.

Section 205(f) of the proposed Settlement prohibits the use of CAP outside the state. Thus, it may be the case that no water under this proposed Settlement could be used for delivery to the Cienega de Santa Clara or Colorado River Delta in Mexico.

## Approval of the Gila River Indian Community (GRIC) Water Rights Settlement Agreement

Section 203 of the proposed Settlement approves the GRIC Water Rights Settlement Agreement, and thereby reallocates GRIC water rights, revises GRIC water delivery requirements, and provides for waiver and release of GRIC water rights claims against Arizona.

Section 205(c) of the proposed Settlement also explicitly provides for the lease of GRIC CAP water to Phelps Dodge.

The ongoing drought in the western States will no doubt increase the pressure to enact this legislation. It would be better for Arizona stakeholders if the water rights situation in Arizona is clear as can be once the Upper and Lower Basin States begin negotiating how to divvy up the decreasing supply of Colorado River water.

The Arizona Riparian Council (ARC) was formed in 1986 as a result of the increasing concern over the alarming rate of loss of Arizona's riparian areas. It is estimated that <10% of Arizona's original riparian acreage remains in its natural form. These habitats are considered Arizona's most rare natural communities.

The purpose of the Council is to provide for the exchange of information on the status, protection, and management of riparian systems in Arizona. The term "riparian" is intended to include vegetation, habitats, or ecosystems that are associated with bodies of water (streams or lakes) or are dependent on the existence of perennial or ephemeral surface or subsurface water drainage. Any person or organization interested in the management, protection, or scientific study of riparian systems, or some related phase of riparian conservation is eligible for membership. Annual dues (January-December) are $20. Additional contributions are gratefully accepted.

This newsletter is published three times a year to communicate current events, issues, problems, and progress involving riparian systems, to inform members about Council business, and to provide a forum for you to express your views or news about riparian topics. The next issue will be mailed in May, the deadline for submittal of articles is April 15, 2004. Please call or write with suggestions, publications for review, announcements, articles, and/or illustrations.

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## CALENDAR

**Arizona Riparian Council Board Meeting.** June 8, 2004 at 4:30 pm at Fluid Solutions, 1121 E Missouri, Ste 100, Phoenix, AZ. Board meetings are held monthly, contact Cindy Zisner, Cindy.Zisner@asu.edu or (480) 965-2490.

**Arizona Riparian Council Fall Meeting**, October 16-17, 2004. Tentatively planned for San Pedro River. More information will be available on the website http://azriparian.asu.edu and list serve http://lists.asu.edu/archives/riparian.html as it becomes available. Please put the dates on your calendar they are definite!

**Arid Regions 10th Biennial Conference: Restoration and Management of Arid Watercourses**, November 16-19, 2004, Hilton Phoenix East/Mesa, Mesa, Arizona. For more information on the conference, including the Call for Abstracts, please see web site at www.azfma.org.

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APOLOGIES FOR THE LATENESS OF THE NEWSLETTER!!