The Arizona Riparian Council Newsletter

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STATEWIDE RIPARIAN MAPPING UPDATE

Jen Wennerlund, Arizona Game and Fish Department

President's Note: It has been almost five years since the Arizona Legislature passed the Waters-Riparian protection bill (Arizona Revised Statues 45-101). For those of you whose memories need refreshing, this bill directed three state agencies to conduct investigations relating to Arizona's riparian areas, including the evaluation of hydrologic effects of groundwater pumping and surface water appropriations on riparian areas (Arizona Department of Water Resources [ADWR]), identifying activities, operations and land use that involve removing or depositing material, removing vegetation or otherwise obstructing, altering or destroying riparian areas (Arizona Department of Environmental Quality [ADEQ]) and finally in part, to identify and map land ownership, current land uses and riparian vegetation, and to develop a hierarchical designation system according to relative functions and values (Arizona Game and Fish Department [AGFD]). It also created the Riparian Area Advisory Committee (RAAC). At the time it was passed, I think many of us hoped these studies would show definitively the precarious nature of riparian areas and wetlands in Arizona. Unfortunately, the overly ambitious scope of this directive may have been the cause of its demise, or at least the lack of any positive ancillary actions. A lesson to be learned for future legislative efforts? Possibly. But sometimes we have to take what we can get.

On the positive side, this bill resulted in the production of several reports and databases that provide a wealth of information about riparian areas in the state (ADEQ 1993; ADWR 1994a, 1994b, 1994c, 1994d; Valencia et al. 1993; RAAC 1994a, 1994b). It also enabled researchers to experiment with the use of new technologies. In fact, the Arizona Game and Fish Department has just completed their evaluation of the use of Landsat TM satellite imagery to map riparian vegetation along perennial and intermittent waterways. The following article summarizes this evaluation.

One aspect of the Waters-Riparian protection program called for Arizona Game and Fish Department (AGFD) to identify riparian areas in the state, giving priority to perennial waters and then continuing to intermittent systems. The project utilized a Geographic Information System (GIS) and remote sensing approach to facilitate identification and to create statewide maps of riparian vegetation. The project covered >10,000 miles of streams, approximately 5,000 of which were considered perennial.

The inventory associated with perennial waters was conducted first. Field investigations of this phase were completed in early 1996. This phase used a combination of Landsat TM satellite imagery and a multiple resolution aerial

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Inside This Issue

LETTER TO THE EDITORS

[Editors' Note: Letters to the editors are not necessarily the views or opinions of the Council and may be edited.]

My perspective on the filling of Roosevelt Lake and the southwestern willow flycatcher is neither that of an environmental activist nor a federal employee. It is the perspective of a professional biologist who has spent the past three spring and summer seasons surveying the largest population of these birds known to inhabit the American Southwest.

In the pastoral setting of southwestern New Mexico that was home to 138 pairs of willow flycatchers in 1996, as many as 400 head of cattle grazed permanent pastures nourished by irrigation ditches lined with large cottonwoods, willows, and box elders. Protected to some degree from destructive flooding by earthen levees, dense riparian forest patches thrive along the returns of these irrigation ditches to the Gila River.

Within this agrarian setting accentuated by mature, riparian forest patches and stringers, resides the largest known breeding concentration of southwestern willow flycatchers, we verified the presence of 64 pairs of these birds on territories. In 1995, our surveys revealed the presence of 107 pairs, and, in 1996, 138 pairs of willow flycatchers were found to be in occupancy of territories within this same area.

So it is with an awareness of this background that I trust you will pardon me when I raise an eyebrow in utter disbelief at the claim made by David Hogan of the Southwestern Center for Biological Diversity in his letter to the editor of the *Arizona Riparian Council Newsletter*, that the extinction of the willow flycatcher is somehow imminent if Roosevelt Lake were to be filled. Just as is the case on the Gila, nothing could be further from the truth.

According to the Southwest Center, filling of Roosevelt Lake will destroy habitat that is essential to the existence of the willow flycatcher. But if this were in fact so, then perhaps Mr. Hogan might tell us what the flycatchers did for habitat in this area before the saltcedars of current concern grew up there? Indeed, and in point of fact, aerial photographs taken in 1980 reveal that there were no trees then existent at either the Salt River or Tonto Creek inflow areas to Roosevelt Lake. In short, the habitat now described as "essential" to the willow flycatcher's existence did not even exist at either of these inflow areas in the late 1970s or early 1980s.

Another false myth is that consensus exists among biologists and conservationists that the filling of the new conservation space at Roosevelt Lake will cause the extinction of the willow flycatcher in the Southwest. But who are the biologists and conservationists being referred to? Apparently they are not to be found among the biologists and conservationists employed by the U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, and private consulting firms that have thoroughly and professionally addressed this very issue. In fact, none of the above have concluded that the filling of the lake coupled with the undertaking of mitigation measures, threatens the willow flycatcher with extinction.

Mr. Hogan also claims that the water supply to be provided by the filling of the new conservation space at Roosevelt is not necessary to the metropolitan area. Information provided by Arizona Department of Resources on this matter shows that the water is indeed necessary to the metropolitan community.

So what is the truth about the filling of Roosevelt Lake and the southwestern willow flycatcher? The truth is, the habitat at the Tonto Creek and Salt River inflow areas is ephemeral. In 1978, when Roosevelt Lake was low, a huge flood scoured both of these inflow areas. The trees that are today seasonally inhabited by willow flycatchers came in at this flood's high-water mark and became established as a result of the lower lake levels necessary to accommodate reconstruction of the dam. In actuality, then, the risks posed to this habitat by scouring flooding are much greater if such flooding occurs again while the lake is at a lower, rather than higher, water level. Moreover, the new conservation space will not fill every year.

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videography system, developed by Dr. Lee Graham at the University of Arizona, to identify and label riparian vegetation. The procedure used was previously reported in Valencia et al. (1993). In brief, perennial waterways were identified and entered into a GIS. These buffered streams were extracted from satellite imagery and were classified based on reflective values of land cover recorded by the Landsat satellite. Aerial videography was then used to identify vegetation types and to correlate the vegetation types to a specific reflective value or group of values. Values that were determined to represent certain vegetation types were clustered during the image analysis to create distinct polygons of vegetation types.

Initially, attempts were made to classify these vegetation polygons to the association level of the Brown et al. (1979) classification system, which identifies vegetation communities by the dominant species present. However, image analysis was not successful in making species level determinations. Thus, classification of vegetation types was driven by the limitations of the technology resulting in a much less refined system (Valencia et al. 1993).

On December 1, 1993, when Valencia et al. (1993) was published the results of the remote sensing and aerial videography were just concluded and field efforts to assess the vegetation inventory were underway. At that time, less than 3% of vegetation had been field checked. It was apparent, however, that extensive ground data would be necessary to increase the accuracy of the remotely sensed map products. That effort was concluded in January 1996 and a report documenting the method and application of the field inventory and providing metadata of the field sample database was recently completed by AGFD staff (Winstead in press).

The intent of field sampling of riparian polygons was to provide data to support the classification of satellite imagery. However, its greatest value proved to be its use in assessing the accuracy of the vegetation classification and to modify vegetation boundaries. Initial evaluations of the satellite/videography products, conducted in 1993, revealed that accuracy fell below the desired project goal of 80%. Field data were then used to modify the database, updating both vegetation types and polygonal extent.

Because field data were continually incorporated into the mapping classifications, a final accuracy check of the riparian vegetation maps is quantitatively unknown. However, Winstead (in press) reports a field check of the San Pedro and Santa Cruz rivers showing close agreement between the vegetation inventory and existing plant communities. Of 1,866 polygons randomly selected from the perennial vegetation GIS database, 1,671 were field checked. Eighty-seven percent were correctly identified as riparian vegetation. However, only 35% of these were correctly identified when comparing dominant vegetation types. Classification errors were due to important understory plants not being visible to aerial sensors, and similarity in appearance of different plants from videography. Final vegetation maps show 165,263 acres of riparian area in 10 vegetation classes. Total acreage was found to be 38% less than was shown by maps before field sampling.

Arizona Game and Fish Department researchers concluded that the use of extensive ground data to supplement and modify Landsat TM data and aerial videography methods was essential to achieving the desired accuracy. Using these data, the project exceeded accuracy standards for delineating the boundary between riparian and upland zones. However, more extensive analysis of the field data needs to occur before it can be of use in correcting the vegetation classifications on these maps.

In January 1995, AGFD proceeded to devise a method to inventory riparian vegetation associated with intermittent waterways. Since the initial satellite classification of perennial riparian areas resulted in a low accuracy rate, the AGFD decided to evaluate other remote sensing methods to inventory and map intermittent stream riparian areas. Both time and cost were critical factors in the evaluation. Because of this, Landsat TM satellite data was deemed the most efficacious choice.

Investigations took place on a portion of the Tonto Creek Basin. Tests revealed that the most effective differentiation of riparian and upland vegetation was obtained from a ratio of two levels of collected information on the Landsat TM satellite, band 3 and band 4. Testing also revealed that the use of Landsat TM data alone was not sufficient for distinguishing all riparian and upland vegetation communities along intermittent streams throughout the state. In higher elevations the separation of upland from riparian zones could not be delineated. The upland vegetation displayed reflectance values similar to vegetation in the riparian zone. However in lower desert regions of Arizona a band ratio (band 4/band 3) appeared to separate riparian zones from upland zones.

The intermittent inventory proceeded using the Landsat TM imagery in lower elevation zones and the aerial videography system in the higher elevations. Separation of these two areas correlated to biotic communities identified by Brown and Lowe (1980). Early attempts to separate vegetation into community types using the satellite imagery failed. Therefore, in the intermittent inventory, AGFD only attempted to differentiate riparian vegetation from upland vegetation.

Results of the intermittent inventory at lower elevations were disappointing. Overall accuracy for this area was only 58.8%. Several contributing factors to the accuracy problem are discussed in a report produced by AGFD (Wahl et al. in press). An overall conclusion is that Landsat TM satellite imagery is not the best tool to identify riparian areas along intermittent and ephemeral corridors in Arizona. Regardless, satellite technology should not be dismissed from future riparian inventories. The next generation of satellites will record information with greater spectral detail as well as at smaller ground resolutions.

Technical reports and databases developed under this project will soon be available through the Nongame and Endangered Wildlife Program at the AGFD.

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This means that water may not even enter the area occupied by saltcedar and willow flycatchers but once or twice per decade. Furthermore, it is unlikely that such temporary and infrequent inundation of their roots would have anything more than a negligible affect on these trees.

Ironically, before the discovery of breeding willow flycatchers in seasonal residence of saltcedar at the Tonto Creek and Salt River inflow areas to Roosevelt, saltcedars, per se, were viewed as a scourge to this bird's very existence. In point of fact, eradication projects were then proposed which included the destruction of these same and allegedly now "essential" saltcedar habitats currently found at the Salt River and Tonto Creek inflow areas.

Dennis Parker, Biologist employed by Applied Ecosystem Management, Inc. He is also a member of the Arizona Water Protection Fund Commission.

Saltcedar and Biological Controls — A Response to C. J. DeLoach

The article by Dr. C. J. DeLoach (*Arizona Riparian Council Newsletter* 10[1]:1-3) requires comment in my judgement because of several grossly inaccurate statements in his article. In the lead sentence DeLoach states that "The invasion since the 1920s by exotic saltcedar (*Tamarix ramosissima*) has caused enormous damage to native plant and animals communities in riparian ecosystems of the western United States." This is just simply not true. Any serious student of Southwestern riparian ecology knows that it is not the saltcedar that has caused damage, but rather it is the damage done by man to riparian ecosystems that has created an exotic habitat in which saltcedar thrives and in which native riparian species do poorly. The saltcedar did not build the dams that stopped the regularity of annual flooding, which in turn flushed salts and debris from the system.

Saltcedar does not create salt and dump it into the ecosystem. Rather it takes salt already in the soil and copes with it effectively, a capacity less developed in native riparian tree species. DeLoach also claims that saltcedar has a "lack of insects." This is grossly untrue. Dr. R. D. Ohmart and I directed insect collecting in saltcedar and other riparian habitats on the lower Colorado River over a 24-month period. In terms of biomass saltcedar ranked first. Insect diversity in saltcedar ranked substantially lower than in cottonwood (*Populus fremontii*)/willow (*Salix gooddingii*) habitats, but the diversity in saltcedar was nonetheless substantial (Anderson and Ohmart in prep.). Furthermore, the major food items in the diets of insectivorous birds corresponds to the major food items available in saltcedar (Anderson and Ohmart unpubl. data).

In the second paragraph it is pointed out that saltcedar is highly susceptible to fire. This claim too, misleads the reader. The truth is that without annual floods to remove debris that inevitably collects on forest floors, forests in hot, dry areas will all have relatively higher susceptibility to fire. I cite the rather frequent occurrence of fires on the Bill Williams Delta as an example of a largely native habitat in which debris has collected and fires have done significant damage over the past decade or so.

Dr. DeLoach asserts that the saltcedar causes sedimentation and narrowing of channels, and increases flooding. He fails to point out that one of the advantages of having an area vegetated is that it collects sediment and holds water. It's a natural event. That is why the rich alluvial soil within floodplains is such an appealing place for agriculture. He is appealing to the mentality that calls for clearing ALL vegetation, native or otherwise. With extensive clearing or extensive grazing, floods flush out not only salts, but all nutrients, as well as fine soil; water retention capacity of the soil diminishes. A prime example is the Santa Clara River watershed in the vicinity of Valencia, California. Much of this system is unsuitable for almost all native riparian species or even saltcedar (Anderson and Vasquez, reports to Valencia County, 1992-1996, Valencia, California).

Dr. DeLoach's comments create a picture in my mind of a horde of saltcedar that came marching across the deserts, sabers drawn, swooped into riparian systems, and killed all individuals of native species, young and old alike, wherever the invaders decided that they wanted to settle. They (i.e., the saltcedar) forbade insects from occupying their new domain and began to immediately synthesize salt by means unknown to science. They also pulled the plug on local water tables, draining them so that natives could not use this water. (The billions of acre feet of water used for flood irrigation in agriculture, and the dredging and channeling of the rivers, we should believe, are quite unrelated to water table depletion.)

In his third paragraph, DeLoach suggests that white-winged doves (*Zenaida asiatica*) would use native habitats more extensively than saltcedar, if only these habitats were available. This again, suggests his unfamiliarity with the literature. White-winged doves on the Colorado River reached maximum nesting densities in saltcedar in spite of hundreds of acres of very nearly pure stands of honey mesquite, supporting smaller densities of white-wings, in the same area (Rosenberg, K. V., R. D. Ohmart, W. C. Hunter, and B. W. Anderson. 1991. *Birds of the lower Colorado River Valley.* University of Arizona Press, Tucson.) Furthermore, as pointed out by Howe (*Arizona Riparian Council Newsletter* 10[1]:9), bird use of saltcedar increased from west to east.

If successful, DeLoach's saltcedar control project can only reduce the already damaged bird populations in arid land riparian situations. Native tree species will not, on average, replace the saltcedar. This, as stated above, is due to the impacts of a variety of man's projects, not because of actions taken by saltcedar. Saltcedar is an indicator species, not a culprit species. On the Colorado River, arrowweed (*Tessaria sericea*) will probably replace any saltcedar that the insects may destroy. This species is native, but as a wildlife value less than that of saltcedar (Rosenberg et al. 1991).

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ELEVENTH ANNUAL MEETING OF THE ARIZONA RIPARIAN COUNCIL

This year's meeting was held in Sierra Vista, Arizona, at the Windemere Hotel and Conference Center on April 11-12, 1997. The theme was *Saltcedar: Friend or Foe?* and the morning session was filled with information about saltcedar. Topics included Marty Jakle presenting issues in saltcedar management, C. Jack DeLoach informed us about using insect biological control for saltcedar, Julie Stromberg told us some causes and consequences of saltcedar spread, wildlife use of saltcedar was expressed by Larry Stevens, and Rob Marshall enlightened us of the status of the southwestern willow flycatcher with respect to saltcedar. Presentations were followed by a roundtable discussion with audience participation.

The afternoon session also contained papers about saltcedar and other topics as well. They included two papers by Curt Deuser concerning saltcedar water use and its removal from national park units; Larry Stevens also presented a second paper on dam impacts on saltcedar in the Grand Canyon; the extent of the spread of saltcedar along the lower Colorado River was presented by John Swett; Jonathon Horton presented a proposed method for determining groundwater requirements of low-elevation riparian trees; and John Rinne told us about grazing and fish populations in the Southwest. For the third time, high school students (pictured above) from Cactus Shadows and North Canyon high schools presented data they have been collecting on water quality sampling of Cave Creek, working with Patti Fenner of the Cave Creek Ranger District, Tonto National Forest. They were very professional in presenting their information and answering questions from the audience. These young people are to be commended for their work. Saturday fields trips were to the San Pedro Riparian National Conservation Area and the Patagonia-Sonoita Creek Preserve.

CURRENT RIPARIAN RESEARCH

THE RELATIONSHIP OF SPRING FLOW TO RIPARIAN VEGETATION AND AVIAN ABUNDANCE AT DESERT SPRINGS

by Leigh Rouse, Department of Botany, Arizona State University

As urban areas continue to grow in desert regions, demands on water become greater and greater. This is especially true in the Mojave Desert of southern Nevada which receives an average of 3 inches of rain per year compared to the Sonoran Desert's 7 inches. In some areas, desert springs, capable of supporting riparian woodlands, provide the only perennial water source. These desert springs are common throughout the basins of southern Nevada and contribute significantly to regional biodiversity.

Because springs are a source of water for humans as well as animals, they have been threatened with diversions and pumping. The most recent threat comes from the City of Las Vegas and its growing population. In an effort to secure an adequate municipal water supply, the Las Vegas Valley Water District recently proposed to increase groundwater pumping from various basins across the state. In response to the proposal, various federal agencies including the U.S. Fish and Wildlife Service, National Park Service, Bureau of Land Management, and Bureau of Indian Affairs commissioned several studies to determine the effects of increased pumping on ecological components of Nevada's springs.

Localized groundwater pumping has had significant impacts on spring discharge in many areas of Nevada, leading to a decline of water level and in some cases, the eventual elimination of spring flow (Fiero et al. 1970, Dudley and Larson 1976, Hendrickson and Minckley 1985, Schaeffer et al. 1995). Many studies have documented detrimental effects of lowered water tables on riparian vegetation in arid regions (Perkins et al. 1984, Sorenson et al. 1991, Stromberg et al. 1992, 1996); thus, we would predict a shift in distribution of riparian plants if groundwater pumping leads to declines in spring flow, lowered water tables, and diminished moisture gradients. These potential changes in vegetation could affect other trophic levels including bird populations. As groundwater pumping reduces spring discharge, shifts in vegetation type and cover could lessen structural complexity leading to an eventual decline in bird densities and species richness at desert springs. Therefore, this two-part study attempts to look at not only the response of spring vegetation to hydrological and environmental variables but also differences in avian distribution, abundance, and species richness due to vegetation and spatial variables.

Several representative springs in southern and central Nevada that may be affected by the proposed pumping were used in this study. For my master's thesis, however, I limited my research to Ash Meadows National Wildlife Refuge. Ash Meadows was established as a refuge by the Fish and Wildlife Service in 1984. It is located in southwestern Nevada, near the California border, just east of Death Valley. This area is unique in that it has over 30 springs and seeps that provide a constant supply of water. As a result, there is a rich array of habitats that support many endemic species of plants and animals. The springs have been moderately disturbed in the past but are now protected from diversions, surface pumping, clearing, and wild horse grazing. The surrounding desert is dominated by quailbush (*Atriplex confertifolia*) and creosote bush (*Larrea tridentata*).

GROUNDWATER/ VEGETATION STUDY

This study examines the relationship of spring flow to other components of the hydrology such as groundwater levels and soil moisture, and how these factors influence the distribution and abundance of vegetation. Making comparisons of small and large springs enables us to develop models of vegetation responses to spring flow alterations.

For this portion of the study, I selected two springs: Fairbanks, considered a high flow spring; and Collins Ranch spring, considered a low flow spring. At each spring, I placed five transects perpendicular to the flow and established sampling plots within vegetation zones. Herbaceous vegetation was sampled spring and summer for two consecutive years. I did a one-time sampling on woody vegetation and soil characteristics including pH, electrical conductivity, and texture. I also monitored flow rates, groundwater levels, and soil moisture for one full year at each spring. Groundwater levels were monitored with wells placed at various locations along vegetation transects. I sampled vegetation and soil at two additional springs to make comparisons across a greater range of spring flow.

My objective is first to characterize the herbaceous and woody communities of the springs, followed by determination of relationships among spring flow, groundwater levels, soil moisture, soil characteristics and riparian communities. Although analyses have just begun, some trends are apparent in regard to vegetation and groundwater depth. Species that require shallow groundwater such as *Eleocharis rostellata* and *Carex praegracilis* are sensitive to slight changes, while *Distichlis spicata* and *Prosopis pubescens* have a greater range of tolerance for water depth levels and are found across a greater range of groundwater depths. *Distichlis spicata* is found at many of the sampling locations but shows a decrease in cover with distance from the spring and outflow channel. The high alkalinity of the soils seems to strongly influence the distribution of some of the herbaceous species. Statistical analyses should help determine what factors are important in explaining plant distribution.

AVIAN STUDY

According to studies done in Arizona, riparian areas in arid regions have some of the highest breeding bird densities (Carothers et al. 1974) and provide important resting and foraging areas for migrants. Riparian areas associated with springs can be small and isolated but still provide important habitat for many bird species. These habitats are often neglected in avian population studies. To gain insight into what factors influence both breeding and non-breeding birds at these spring sites, I measured avian abundance and species richness at several springs. Nonbreeding birds include migrants, birds with widespread habitat requirements and winter residents. From March to October, I conducted two to three bird surveys per month for two years at nine springs with varying flow rates and riparian vegetation. For each spring, I also obtained measurements of total vegetation volume, foliage height diversity, volume by species, riparian patch size, and distance to closest spring area.

Each spring is unique in its vegetation composition and structure. However, springs could be classified as either screwbean mesquite (*Prosopis pubescens*) or mixed broad-leafed dominated. Broad-leafed species include velvet ash (*Fraxinus velutina*), Fremont's cottonwood (*Populus fremontii*), willows (*Salix* sp.), and other planted cultivates. All springs support at least some mesquite but not all springs support broad-leafed species. The birds most commonly detected at the springs include Ash-throated flycatcher (*Myiarchus cineracens*), Bewick's wren (*Thryomanes bewickii*), blue grosbeak (*Guiraca caerulea*), verdin (*Auriparus flavipes*), and blue-gray gnatcatcher (*Polioptila caerulea*). Across the nine springs, 30 species of breeding birds were detected. Of these, 21 are known breeders while the remaining 9 species are probable breeders. Many of the species known to breed were found at all nine springs (33%), while over half (62%) were found at six or more of the sites. Bell's vireo (*Vireo bellii*) and Say's phoebe (*Sayornis saya*) were the only known breeders detected at one site only.

In many regions, breeding bird diversity has shown a strong correlation with structural complexity of habitats (MacArthur and MacArthur 1961). However, studies from desert regions do not strongly support this relationship (Austin 1970, Stamp 1978). This suggests that many other factors influence species richness and abundance in arid regions. Riparian patch size, isolation, and habitat type most likely exhibit strong influences on the distribution of desert riparian birds. Multiple regression will help explain the relationship among the different environmental and spatial variables.

Desert springs are ecologically unique systems that warrant protection from potential threats. Understanding the structure and function of spring ecosystems is important for their future preservation and management as well as for predicting the effects of possible disturbances. This study will demonstrate the relationship between the hydrological components of springs and riparian vegetation, and the avian communities they support. It will provide insight into the consequences of changes in spring hydrology as a result of groundwater pumping. The results of this study will be part of my master's thesis. If you have any comments or would like more information, contact me at the Center for Environmental Studies at ASU, (e-mail: lrouse@asu.edu).

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Arizona Cardinal Fans!

Are there any of you out there? The Arizona Cardinals organization kindly donated an official winter Cardinals jacket to the Council for our annual silent auction. Unfortunately, there were no Cardinals fans at our meeting and the jacket remains without a home. If you are interested in purchasing this jack, please contact Ruth Valencia at (602) 345-9558. The jacket is an extra large, maroon with official logos on the back with a retail value of $80-100. We will sell it for $40 and all proceeds will benefit the Arizona Riparian Council.

SPECIES PROFILE

NORTH AMERICAN BEAVER (*Castor canadensis*)

by Richard Yarde, University of Arizona

Beaver don't get the attention that they used to. Depending on how you look at it, this could be a good thing or a bad thing. After all, too much attention on hats created all sorts of problems for the beaver — anyone who was *anyone* in the world of fashion around 1800 was wearing a hat made of beaver fur. On the other hand, if the beaver got the credit it deserves (for being among the most important inhabitants of healthy riparian areas), the favorable attention could be a boost to public relations for the otherwise underrated rodent.

A HISTORICAL BACKGROUND

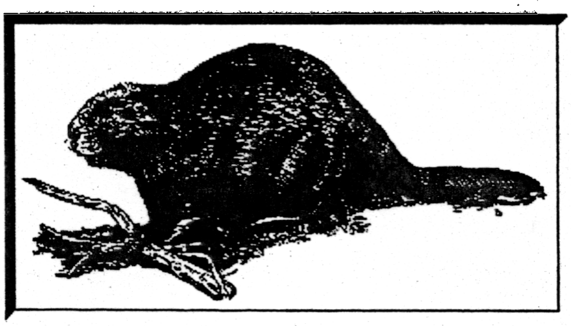
The beaver has been credited as being the inspiration for the exploration of North America. Trappers traveled down waterways in search of the dense, soft, and profitable fur of beaver after European populations had become scarce. The story of French trappers in the Northeast and Canada is well known; the story of western trappers is not.

In fact, parties of beaver trappers were the first English-speaking people known to have entered portions of the Southwest, including Arizona. James Ohio Pattie's journals from the early 1820s are a record of the penetration of what is now known as Arizona. Pattie and about a dozen other men followed the Gila River all the way to its confluence with the Colorado, and collected hundreds or possibly thousands of pelts on the way.

In the next decade, many groups or individual trappers wandered down the rivers of Arizona for beaver pelts. Although the number of animals taken was high, the fashion of beaver-felt hats was ending in the 1830s, and the population recovered without any documented long-term impacts.

FUN FACTS ABOUT BEAVER (BIOLOGISTS READ IT AS: LIFE HISTORY)

The reason beaver pelts were so desirable is related to the function of the pelt while it is still integrated with the animal beneath. The dense, sleek, water-repellent coat helps keep the animal warm and dry. Here in Arizona, and in other hot climates, the fur is shorter, cooler, and of a lighter color than that of beaver from the Northeast and Canada.



In fact, there is a spectrum of fur length and color which is related to the beaver's distribution. *Castor canadensis* is found throughout North America, including all 48 contiguous states and Alaska. The riparian areas across this extensive range are inhabited by no less than 24 subspecies of the North American beaver. These 24 subspecies differ in fur length, fur color, and other less visual characteristics, like cranial morphology. Here in Arizona we have a subspecies called *Castor canadensis frondator,* whose range includes a lot of the lower Colorado River basin.

SIZE, REPRODUCTION, ETC.

The beaver is the largest rodent in North America, and among the largest rodents in the world. Adults generally are around 3 feet long and weigh between 40 and 60 pounds, females being slightly smaller. There are specimens on record, though, that weigh as much as 85 pounds — according to the American Kennel Club, that's about as much as the average Alaskan Malamute.

Castor is generally a social animal, living in colonies of 4 to 8 related individuals. After a gestation period of roughly 3 months, the female gives birth to about 2-4 young. The kits are fully furred, eyes slightly open, and ready to swim immediately after they are born in early spring.

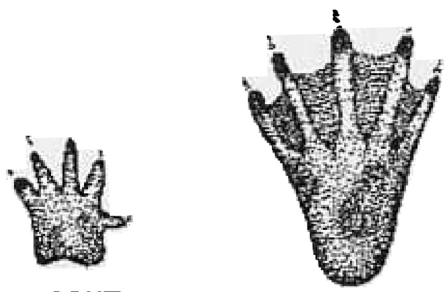
SWIMMING ADAPTATIONS

The adaptations that the beaver has for life in the water are fascinating. Thick fur and a layer of blubber keep the animal warm and dry. The tail, 12 inches long and 4 or 5 inches wide, can be used for locomotion in the water, but is more often used for communication. The hind feet are completely webbed and used for propulsion. There is a transparent eyelid for underwater viewing, and respiratory and circulatory mechanisms that allow the beaver to stay underwater for up to 20 minutes. Valves keep water from getting in ears and nose, and a valve in the mouth allows the animal to gnaw while underwater without drowning.

CHEWING DOWN TREES

Not only is the beaver an excellent swimmer, it has also been known as the "engineer of the animal kingdom." The four large incisors that *Castor* chews down trees with grow continuously. They must be used constantly and worn down — the busy beaver really doesn't have the option of relaxing very long.

Anyone who has observed a beaver while it was gnawing on a tree knows how efficient the rodent is. It takes only about 5 minutes for a beaver to chew down a substantial sapling 8 feet tall. Beaver are opportunistic regarding which trees they will chew. It is known that they prefer small trees, and in Arizona *C. c. frondator* seems to favor cottonwood. The trees may be gleaned for their edible green parts, and then used in lodges or dams.



BEAVER IN ARIZONA: PAST AND PRESENT

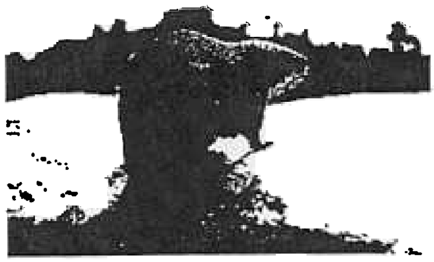
The current distribution of the beaver in Arizona is less than it had been prior to settlement. Although it was beaver trapping that brought some of the first settlers to the Southwest, any detrimental effects of trapping were probably not long-term.

The reason that the distribution of *Castor* is limited now is habitat loss. Many of the riparian areas that had populations of beaver historically are now not suitable habitat. All of the adaptations that allow the beaver to have such a great relationship with its water resources, lead to narrow and specific habitat requirements. Whereas beaver could have been found anywhere with perennial water and proper vegetation, today the animal is absent from most of the Gila and Little Colorado rivers, all of the Santa Cruz and San Pedro rivers, and some of the Little Colorado.

Castor is associated with relatively little controversy — clogging an occasional irrigation canal is its most offensive behavior — and is even considered cute by some. Those who study the animal's behavior know that the incidental benefits of the beaver's presence are significant. Slowing down sediment and runoff, enhancing riparian vegetation, and providing habitat for many other species are among the benefits of a humble beaver's dam. For these and other reasons, the beaver has been a candidate for reintroduction into Arizona riparian areas.

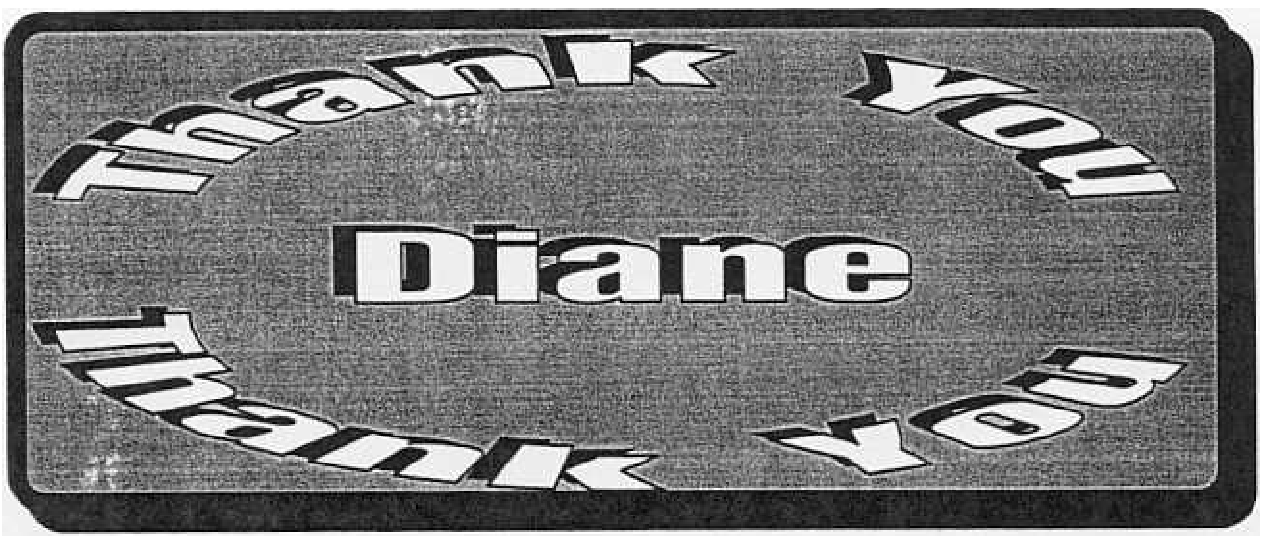
The effort to reintroduce beaver into the San Pedro Riparian National Conservation Area has been well publicized. What is not well known is that several attempts have been made to reintroduce beaver in Arizona streams over the last 50 years. Some of these efforts have been more successful than others, and the success is primarily dependent on the habitat.

Beaver are an essential component of a truly healthy riparian area, but they need perennial water and adequate vegetation in order to survive. To try to restore beaver populations on the San Pedro and other riparian areas is a great idea. Unfortunately, the rivers and streams in Arizona that still have perennial flow are all in a precarious condition, threatened by human encroachment, dewatering by groundwater pumping or surface water diversion, and vulnerable to pollution. Successful reintroduction programs, and healthy beaver populations in the future, depend on protected riparian resources.



***Rick Yarde** has recently earned an M.S. in Renewable Natural Resource Studies from the University of Arizona. He can be reached at 520-722-3584, or ryarde@u.arizona.edu.*

For further information on Castor canadensis, see Hoffmeister's "Mammals of Arizona," (University of Arizona Press, Tucson, 1986), or Jenkins and Busher, Mammalian Species No. 120, 8 June 1979. Historical information can be found in Davis, "Man and Wildlife in Arizona," Arizona Game and Fish Department, 1982 (edited by Carmony and Brown), and in the recent publication by Tellman, Yarde, and Wallace — "Arizona's Changing Rivers," Water Resources Research Center, The University of Arizona, Tucson, 1997.



Special thanks to Diane Laush for her many years of service to the Council as Treasurer. For the past seven years, Diane has been responsible for locating facilities and co-ordinating with the facilities' management for our spring meetings. She has done an excellent job in this capacity and as Treasurer. She will be missed. Thanks, Diane!

1997 Arizona Riparian Council Election Results

President	Ruth Valencia	Term: One year
Vice President:	Janet Johnson	Term: One year
Secretary	Cindy Zisner	Term: Three years
Treasurer:	Howard Kopp	Term: Three years
Member-at-large:	Barbara Heslin	Term: One year (fulfilling Russ Haughey's position)

Congratulations to all!

LEGAL ISSUES OF CONCERN

Chris Vamos and Alexandra Arboleda, Law Offices of Kane Jorden von Oppenfeld Bischoff & Biskind, P.L.C.

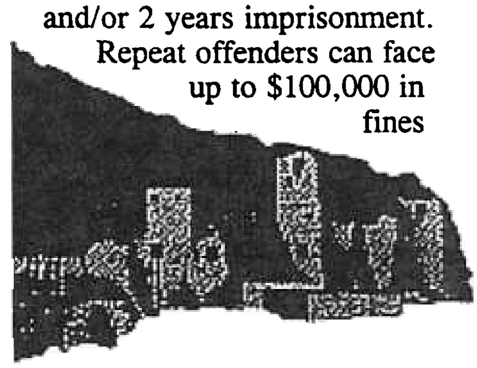
PRESERVATION OF ARIZONA'S CULTURAL RESOURCES

As a child growing up near the Chesapeake Bay, summer days were spent combing the beaches for fossils and artifacts. We all had jars full of prehistoric shark teeth, bones from unidentified sea monsters, polished see glass, and other junk that our mothers would throw away as soon as we went to college, but occasionally one of us would make a real find: an Indian artifact! Mostly we would uncover arrowheads scattered amongst the smooth beach rocks, but I can remember one particularly lucky hunter who stumbled upon a genuine piece of Indian pottery. We proudly displayed these trophies on our bookshelves next to our Cal Ripken, Jr. rookie year cards. What we didn't realize at the time was that we were likely in violation of archaeological preservation law.

The public has begun to realize that the record of the past is part of our national heritage and must be protected for future generations. This is especially true in Arizona where a large portion of the State's land was once or continues to be inhabited by Native Americans. Because of the recent increased development of Indian lands and resources, familiarity with archaeological and historic preservation laws is becoming increasingly important.

The Antiquities Act of 1906 represented the first major federal commitment to archaeological preservation. The Act was passed, in large part, in response to wanton vandalism at the Casa Grande ruins in Arizona. The Act committed the federal government to protect "any object of antiquity" on federal lands by prohibiting any person from excavating, injuring, or destroying any historic or prehistoric ruin or monument, or any object of antiquity without permission of the United States government. Moreover, the Act empowered the President of the United States to declare historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest situated on public lands, as national monuments. The Act imposed criminal penalties for looting and damaging protected objects, but given the extensive territory under government control and the limited number of federal officials with enforcement authority, the Act was for the most part unenforceable. The Act was further limited after a federal appellate court ruling in 1974 overturned a criminal conviction based on the Act's "vague definition of ruin, monument or object of antiquity."

The Archaeological Resources Protection Act (ARPA) was enacted in 1979 to fill the void left by the shortcomings of the Antiquities Act. The ARPA is directed particularly towards protection of archaeological resources and sites located on public and Indian lands. Under the ARPA, no person may excavate, remove, damage, or otherwise alter or deface any archaeological resource located on public or Indian lands unless a permit is obtained from the federal land manager and, if the site is on tribal land, approval from the Indian tribe. Congress was sure to define archaeological resource in the ARPA to ensure the Act's enforceability, and specifically listed over 50 resources falling within this definition, some of which include: human remains, pottery, basketry, tools, containers, weapons and weapon projectiles, clothing, rock carvings and paintings, and shipwrecks. Violators of the ARPA face fines up to $10,000 or 1 year imprisonment or both. If the artifacts are valued at over $500, the ARPA provides for a maximum fine of $20,000 and/or 2 years imprisonment. Repeat offenders can face up to $100,000 in fines



and/or 5 years imprisonment. Congress excluded paleontological remains, coins, bullets, and unworked minerals and rocks from the jurisdiction of ARPA.

Archaeological resources are also protected under State law. The Archaeological Discoveries Act (ADA) prohibits excavation of archaeological sites or collection of any archaeological specimen on State land without a permit from the State Museum Director. The language of the Archaeological Discoveries Act, however, appears only to regulate those sites that are already determined to be historically or archaeologically significant. Where excavations or construction unexpectedly unearths an archaeological, paleontological, or historical site or object, the discovery must be reported promptly to the State Museum Director so that reasonable steps can be taken to secure and maintain the artifact. Violation of the ADA may result in 4 months imprisonment and a $750 fine. Interestingly, arrowheads are specifically excluded from State regulations.

In reality, very few individuals have been prosecuted for taking home a prized arrowhead found on a family vacation. Archaeological preservation laws are typically enforced against only the most egregious violators — grave robbers and illegal artifact traders. Consequently, ARPA and ADA ensure that "hunting for artifacts" is done responsibly in a way that recognizes the importance of preserving relics of history. For further information, contact Rolf von Oppenfeld or the authors at (602) 955-9200.

ARIZONA WATER PROTECTION FUND 1997-98 FUNDING CYCLE

The Arizona Water Protection Fund (AWPF) Commission released its Grant Application Manual in April for the 1997-98 funding cycle. The manual provides an updated application form with general program information and detailed instructions for completing an application. Any applications for the 1997-98 funding cycle must be submitted to the Arizona Department of Water Resources no later than 5:00 PM on August 1, 1997.

This funding cycling is the third for the AWPF program. The AWPF Commission has received 152 application-with-funding requests of nearly $42 million in the first two funding cycles (1995-96 and 1996-97). Approximately $5 million is available for potential funding in the 1997 funding cycle.

To assist applicants with their applications, a total of 11 grant application workshops will be conducted by AWPF staff throughout the state from May 12 through June 30. Workshops will be held in Phoenix, Lake Havasu City, Tucson, Flagstaff, Safford, and Prescott. In addition, AWPF staff will conduct project proposal development meetings with individual applicants. Grant application manuals or information on application workshops can be obtained by called the Arizona Department of Water Resources at (602) 417-2400 X7016.

Lastly, Tricia McCraw, AWPF Program Manager, resigned from her position earlier this year. Sue Miller is the new AWPF Program Manager. Ms. Miller was formerly with Arizona State Parks.

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 $15. 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 September with the deadline for submittal of articles August 15, 1997. Please call or write with suggestions, publications for review, announcements, articles, and/ or illustrations.

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CALENDAR

Symposium on Environmental, Economic, and Legal Issues Related to Rangeland Water Developments, November 13-15, 1997, Phoenix, Arizona. Questions regarding the symposium should be directed to Daniel Strouse, Director, Center for the Study of Law, Science, and Technology, Arizona State University, PO Box 877906, Tempe, AZ 85287-7906; phone (602) 965-2554; email Daniel.Strouse@asu.edu.

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