Arizona Riparian Council

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ARIZONA DEPARTMENT OF WATER RESOURCES

by William E. Werner, Environmental Program Manager, Phoenix, Arizona

The role of the Arizona Department of Water Resources (ADWR) is multi-faceted. Some roles are statewide, others are limited to defined geographic areas.

ADWR MISSION - SECURING ARIZONA'S WATER FUTURE

The Department:

- ❖ administers and enforces Arizona's groundwater code, and surface water rights laws (except those related to water quality);
- ❖ negotiates with external political entities to protect Arizona's Colorado River water supply;
- ❖ oversees the use of surface and groundwater resources under state jurisdiction; and
- ❖ represents Arizona in discussions of water rights with the federal government.

In addition, the Department explores methods of augmenting water supplies to meet future demands, and develops policies that promote conservation and equitable distribution of water. The Department also inspects dams and participates in flood-control planning to prevent property damage, personal injury, and loss of life. In support of these activities, ADWR collects and analyzes data on water levels and on water-quality characteristics.

As defined in statute: "The director has general control and supervision of surface water, its appropriation and distribution, and of groundwater to the extent provided by this title, except distribution of water reserved to special officers appointed by courts under existing judgments or decrees." ARS 45§103(B)

Figure 1 shows the source and amount of water used in Arizona on an annual basis and Figure 2 shows how that water is used.

(Cont. pg. 3 . . . . ADWR)

Arizona Water Supply
Annual Water Budget

Water Source	Million Acre-Feet	% of Total
SURFACE WATER		
Colorado River	2.8	35.6 %
CAP 1.6		*21%*
On-River 1.2		*16%*
In-State Rivers	1.4	17.8%
Salt-Verde 1.0		*13%*
Gila & others 0.4		*5%*
GROUNDWATER	2.9	36.8%
RECLAIMED WATER	0.77	9.8%
TOTAL	*7.87 maf*	

Figure 1.

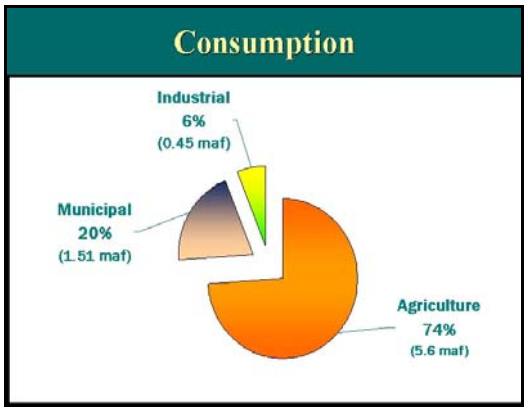


Figure 2.

Inside This Issue

PRESIDENT'S MESSAGE

Despite the summer heat, the distraction of vacations, and the pervasive loss of focus that seems a reliable summer phenomenon, I'm pleased to report that your Board of the Arizona Riparian Council remains hard at work. The Board has been grappling with our standard areas of effort – note the information contained herein regarding our Fall Campout; also, planning is well underway for next year's spring meeting; our budget is as healthy as it has been in many years; and our newsletter remains an excellent offering of information to our members and others. The Board is also deeply involved in applying their best thoughts for ways to broaden the involvement of the membership in Council activities and areas of interest.

A primary focus of recent "visioning" meetings is energizing the membership. The Board has directly confronted the question of whether there still remained a mission for the Arizona Riparian Council, and determined that yes indeed, there are many issues where ARC can contribute to the discussion. That there are many activities on the ground where ARC members can participate and contribute if they know about them. And that there still is a hunger out there for scientifically based information sharing on riparian issues and research.

The Board needs your involvement and participation to continue to move forward in a brisk and effective manner. In order to provide you all with greater access to the workings of the Council we have resolved to more clearly invite your attendance at Board meetings, to try to hold the Board meetings occasionally in social settings, and to both conduct more frequent field trips and activities and to publicize these more effectively.

So… Please mark your calendars! We intend to hold our board meetings each month on the 3rd Tuesday of the month (next meeting Sept. 20, 2005). Unless otherwise announced, they will be at 4:30 pm at the Flood Control District of Maricopa County building, 2801 W. Durango St. in Phoenix. All members are invited to attend any of the Board meetings. I will ensure that a draft agenda and an invitation to the membership appears on the Council web site and on the listserve about 10 days prior to each meeting.

We also resolve to communicate more effectively with you, the members, on activities and opportunities. To do this most effectively, we need your help. If you have not signed up for our list serve, please do! Just go to *<http://lists.asu.edu/archives/riparian.html>* and click on "Join or leave the list (or change settings)" and follow the instructions. We are all busy with our "real" lives and sometimes deadlines for communicating via mail, etc. come up on us too fast. The list allows us to communicate with you all in just a few keystrokes and make sure you get the information you need to stay in touch with our issues and activities. It seems about only one half of the official membership is receiving the list serve messages. You don't have to be a member to join the list! However, if you do receive the list serve messages it would be great if you join us! There is a membership form on the website at *<http://azriparian.asu.edu/MEMBER.pdf>* We use the list to notify you of opportunities for field trips, volunteer work projects, riparian conservation issues and news, etc. Please give us feedback on the selection of items you see on the list (too many, too few, inappropriate material, etc.). Anyone can post to the list, although the list is moderated and each note is checked by the list owner before being allowed to go to everyone. That eliminates everyone receiving "out of office" replies, spam, etc.

Finally, let me know if you would like to be more involved in Council activities (tomarc@cox.net). We need an ongoing supply of new blood in our working leadership to help us identify potential ways for ARC to remain effective and to implement them. We need assistance in planning field trip, work projects, and developing workshops to benefit the membership. We need assistance at our booth at events (Verde River Days coming up on Sept. 24th) and in preparing and disseminating educational materials. It's all about you, the members in the final analysis. Your participation defines our effectiveness.

Tom Hildebrandt, President

ADWR . . . . Cont. from pg. 1

ENVIRONMENTAL PROGRAMS
Adaptive Management Workgroup

ADWR is involved in the Glen Canyon Dam Adaptive Management Workgroup established as a result of provisions of the Grand Canyon Protection Act following an environmental impact statement on operation of Glen Canyon Dam (Fig. 3). The Grand Canyon Protection Act provides that the Secretary of the Interior operate Glen Canyon Dam

> "…in such a manner as to protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park and Glen Canyon National Recreation Area were established, including, but not limited to natural and cultural resources and visitor use."

The Adaptive Management Workgroup makes recommendations to the Secretary on such operation.

Figure 3. Glen Canyon Dam.

LOWER COLORADO RIVER MULTI-SPECIES CONSERVATION PROGRAM

ADWR has been involved, in cooperation with water, power, and wildlife agencies and others in Arizona, California, Nevada, and the Federal government, in development of the Lower Colorado River Multi-Species Conservation Program(LCR MSCP). This program addresses needs of endangered species affected by operation and maintenance of the lower Colorado River system including Hoover Dam, Davis Dam, Parker Dam, Headgate Rock Dam, Palo Verde Diversion Dam, Imperial Dam, and Laguna Dam, and stabilized channel and appurtenant works. The LCR MSCP will implement a conservation plan including creation of an additional 5,940 acres of cottonwood/willow habitat, 1,320 acres of mesquite habitat, 512 acres of marsh, and 360 acres of backwater habitat in the first 30 years of the 50-year program term. The benefit of the program from a water supply perspective is that it provides regulatory certainty regarding use of the Colorado River water supply.

ARIZONA WATER PROTECTION FUND

ADWR provides staff support to the Arizona Water Protection Fund Commission. The purpose of the Arizona Water Protection Fund, admin-

Figure 4. Hoover Dam.

istered by the Commission,

> "…is to provide an annual source of funds for the development and implementation of measures to protect water of sufficient quality and quantity to maintain, enhance and

restore rivers and streams and associated riparian habitats, including fish and wildlife resources that are dependent on these important habitats consistent with existing water law and water rights." (ARS 45§2101)

For more information about the Water Protection fund see *Arizona Riparian Council Newsletter* 16(3).

Statewide Conservation and Strategic Planning

Statewide Conservation and Strategic Planning is a newly defined initiative to develop a statewide strategy to collaborate with local communities in the development of regional water resources. As envisioned, this effort will entail identification of water resources, demands, constraints, and identification of community/ regional desired future conditions during an inventory phase. An evaluation phase will include formulation of alternative strategies that address supply needs, demand management, and environmental needs. Environmental needs may include increasing available supplies/instream flows through augmentation or management strategies, addressing environmental compliance issues, and maintaining, improving, or restoring habitat/ riparian resources to meet local/regional desires. The evaluation phase will also assess alternatives for cost, supply availability, water quality issues, legal/political issues, and environmental impacts. The next phase will entail working to identify consensus regional solutions. Legislative efforts to secure authorization and appropriations for consensus regional solutions would follow.

Arizona Rural Water Initiative

ADWR works with organized watershed partnership groups across Arizona to facilitate water-planning efforts, working toward locally driven solutions. Groups include the Arizona Strip Watershed Partnership, Coconino Plateau Water Advisory Council, Gila Watershed Partnership, Little Colorado River Water Coordinating Council, Middle and Lower San Pedro Watershed Partnerships, Mogollon Highlands Watershed Partnership, Northwest Arizona Watershed Council, Show Low Creek Watershed Partnership, Silver Creek Watershed Partnership, Upper Agua Fria Watershed Partnership, Upper Bill Williams River Watershed Partnership, Upper Little Colorado River Watershed Partnership, Upper San Pedro Partnership, Verde Watershed Association, and Yavapai County Water Advisory Committee.

Primary issues confronting most watershed partnerships include: limited knowledge and available technical data pertaining to surface and groundwater supplies; limited resources to complete planning and technical studies; Indian water rights settlements and adjudication; concern over potential impacts to groundwater system from current and proposed large industrial groundwater users; increasing water demands from growth, and legal establishment of what is surface and groundwater. Environmental issues must be considered in finding lasting solutions in much of Arizona. Through cooperative efforts of stakeholders and cooperating agencies watershed groups have been able to secure funds to improve the knowledge base in several areas. A good technical understanding is important to evaluation of potential alternatives for managing our water supplies. In the Upper Verde, as an example, stakeholders focused over the last decade on securing funding for studies identified by hydrologists to fill in the gaps. The result has included highly technical geologic and gravity investigations, isotopic analysis of water sources, and complex modeling.

SPECIES PROFILE

VERMILLION FLYCATCHER (*PYROCEPHALUS RUBNIUS*)

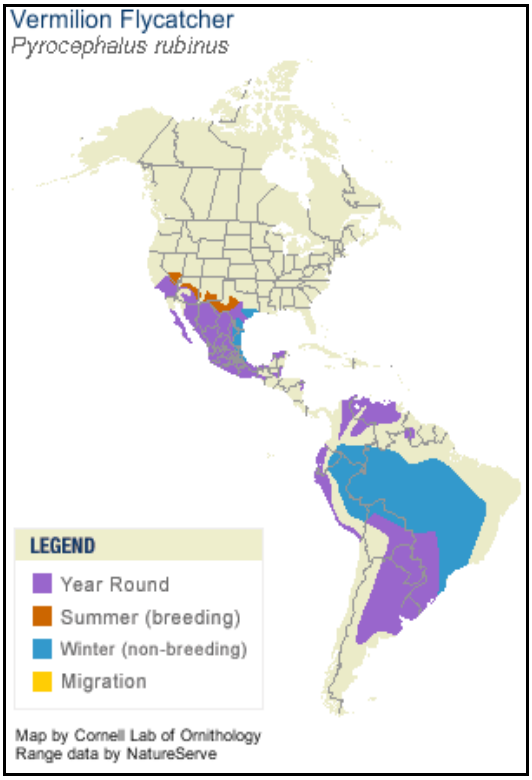
By Kathleen Tucker, AZTEC Engineering

Editor's note: I'd like to thank Kathleen Tucker who has volunteered to be our new Species Profile Editor. This feature has been missing from the last few issues. Hopefully, Kathleen will be able to rejuvenate it. Welcome aboard Kathleen!

My first experience viewing this brilliantly colored creature was down south near Tubac at a Tucson Audubon Society workshop. Many of the trees had little to no leaves so this bright little red bird flitting around caught my eye. In trying to decide what to do my first *Species Profile* on, this little red bird came to my mind. Because of its color it is one of the more distinct flycatchers. This flycatcher is from the family of Tyrant Flycatchers with characteristics and behaviors similar to flycatcher species.

This neotropical migrant inhabits riparian areas, scrub, cultivated land, and riparian woodlands in the southwestern United State that includes California, Nevada, Arizona, New Mexico and Texas. It also occurs throughout Mexico, Central America and South America to include the Galapagos Islands.

The Vermillion Flycatcher is considered small, with a size of 13 to14 cm and a weight of 11 to 14 gm. The male's crown, lower face and underparts are a bright red or orange-red. The upperparts, nape and mask through the eye area are a blackish brown. Wings and tail area are a dark blackish brown with a narrow white tip on the tail. The female's upperparts are a dull gray brown. The underparts are white near the throat changing to a pale salmon or orangish under the tail. Most of the body is streaked with grayish brown and the wings and tail are colored a darker grayish brown. The immatures are more nondescript like the females but with the streaking on the breast and pink tinge on the undertail the immatures as well as the females can be distinguished from other flycatchers.



Distribution map and photos are from the Cornell Lab of Ornithology web site, <http://www.birds.cornell.edu/programs/AllAboutBirds/BirdGuide/Vermilion_Flycatcher_dtl.html>

FEMALE FLYCATCHER

Both the male and female's bill is a brownish black in color and the shape is short and broad. They have dark brown eyes. Their legs and feet are blackish. Their song is a series of chirps followed by a trill and often repeated approximately 10 times.

Their winter range is predominately Mexico and South America. They can also reside year round through most of their breeding range. Populations in the United States tend to migrate or wander in the winter. The summer range, which is the breeding season, includes southern Arizona, New Mexico, Texas and most of Mexico down into South America and the Galapagos Islands.

Female Vermillion Flycatcher.

Male Vermillion Flycatcher.

MALE FLYCATCHER

Flycatchers forage for food by sitting and waiting on an open perch. Once they locate their prey, which consists of insects and other arthropods, they pursue it. They often take their prey on the wing anywhere from ground level to approximately 10 m above.

The breeding male will spend about 90% of the day perched. During breeding season the male will perform a spectacular display by fluttering 10 to 30 m above the canopy singing. During courtship the male seeks to initiate copulation by presenting the female with a colorful butterfly or other showy insect.

The nest that is built consists of a loose cup of twigs, grasses and fibers lined with down, feathers and hair. Usually located in the fork of a horizontal tree branch approximately 2.5 to 6 m above ground. There are 2 to 4 eggs per clutch and the eggs are a white to creamy color with bold dark blotches and smaller lighter spots.

These flycatchers are common within most of their range. However human impacts have caused drastic declines in populations, especially in the lower Colorado River Valley. Water use and development have reduced riparian habitat and other habitats for these creatures. As with many species, habitat destruction poses a threat to the flycatchers, and preservation of these habitats especially riparian are crucial.

REFERENCES

<http://www.birds.cornell.edu/programs/AllAboutBirds/BirdGuide/Vermilion_Flycatcher_dtl.html>. Accessed August 11, 2005.

<http://www.mbr-pwrc.usgs.gov/id/framlst/i4710id.html>. Accessed August 13, 2005.

EC BAR RANCH ON NUTRIOSO CREEK, ARIZONA

by Jim Crosswhite, Owner

For those interested in attending the ARC Fall Campout at the EC Bar Ranch, in the Nutrioso Valley and part of the White Mountains near Springerville, you may be interested in some background on the area and EC Bar Ranch conservation projects.

Nutrioso Creek is located in the Little Colorado River Basin in southern Apache County, along the eastern border in the White Mountains of Arizona. It is a 27-mile (mi)-long tributary to the Little Colorado River. Over the last 100 years, streambanks have become incised on a 7-mi section leading to water-quality concerns. Erosion of the exposed streambanks have been aggravated by historical overuse by large ungulates, such as livestock and elk.

In 1993, the Arizona Department of Environmental Quality (ADEQ) listed Nutrioso Creek as an impaired water for violating the turbidity standard for aquatic and wildlife cold water streams. The entire 27-mi reach of Nutrioso Creek was listed on the state's 303(d) list, requiring the development of a Total Maximum Daily Load (TMDL) for the watershed. The "Nutrioso Creek TMDL for Turbidity" report, issued in July 2000, focused recommendations on 3 mi of private property and 4 mi of property owned by the U.S. Forest Service.

Primary goals of TMDL implementation include:

- Decreased erosion from streambanks by lower stream velocities using willows and streambed vegetation, stream grade stabilization structures, and increased floodplains.
- Decreased sheet flow and wind erosion contributions to the creek with removal of rabbitbrush and increased density of grasses as land cover.

- Increased education and public awareness.

In 2000, I began applying for Water Quality Improvement Grants to provide financial assistance to help implement TMDL recommendations focused on: (1) fencing to control large ungulate activities, (2) riparian and upland pasture revegetation, and (3) improved irrigation to help establish and maintain vegetative practices. As I acquired neighboring properties along Nutrioso Creek, additional practices were installed. For those attending the Fall Campout, I will describe water quality and habitat improvement practices during a walking tour along 2 mi of Nutrioso Creek on Saturday, October 1st.

After five years and eight Section 319 grants, I have treated about 3 mi of Nutrioso Creek and hundreds of acres of riparian and upland pastures on the EC Bar Ranch, plus helped revegetate about 3 mi of streambanks downstream on the Apache Sitgreaves National Forest . In doing so, some people believe I have effectively created a new "paradigm" by demonstrating how the integration of conservation and sustainable agricultural practices can improve water quality, wildlife habitat, and ranching economics while meeting public policy objectives. A paradigm is a set of rules and regulations (written and unwritten) that tells people how to behave to be successful.

I have tried to merge accepted ranching and environmental paradigms into a new model that has included financial and technical support from state and federal agencies, including ADEQ, Arizona Game and Fish Department (AGFD), Arizona State Land Department, Arizona Department of Water Resources Water Protection Fund, Natural Resources Conservation Service, US Fish and Wildlife Service (FWS), and US Forest Service. The approximate value of conservation projects installed on the EC Bar Ranch is $1.6 million, with a 50% match from myself.

So far, I believe the EC Bar Ranch "model" is a successful new approach that has helped me become the first private landowner in Arizona who has completed all the recommendations in a TMDL report, species recovery plan, watershed-based plan, and a Safe Harbor Agreement, specifically, the *Nutrioso Creek TMDL for Turbidity; Little Colorado River Spinedace Recovery Plan; Nutrioso Creek Fish Management Report; Upper Little Colorado River Watershed-based Plan*; and *Safe Harbor Agreement With James W. Crosswhite for Voluntary Enhancement and Restoration Activities Benefitting the Southwestern Willow Flycatcher and Little Colorado Spinedace in Nutrioso Creek, Arizona.*

The new paradigm not only includes practice implementation, but maintenance and protection of successful practices. With the implementation phase completed, maintenance is expected through the Conservation Security Program (CSP) when the Upper Little Colorado River Watershed (ID15020001) is opened by the NRCS. The CSP is only available to producers who have completed soil quality, water quality, and habitat improvement practices after their watershed is opened. In the meantime, I have received support from a state agency to apply sprinkler irrigation along 2 mi of riparian corridor to help establish and maintain vegetative practices previously installed by the ADEQ and other agencies.

Since early 2004, I have been working to protect practices through negotiations with a state agency to hold a conservation easement to protect 2.5 mi of riparian channel located inside riparian fencing on the EC Bar Ranch. When completed, the conservation easement will prohibit future real estate development and management practices that would adversely impact water quality and habitat conservation values on the easement property.

The unique feature of the EC Bar Ranch paradigm is that water quality, soil quality, and habitat improvements are compatible and sustainable with increased ranching economics. This feature is critically important to preserve open spaces and conservation values over the long term.

Some of the ranching economic benefits include:

- EC Bar Ranch's forage production in upland pastures has soared from 300 lbs an acre in 1996 to 3,000 lbs in irrigated upland pastures and 5,000 lbs in riparian pastures. I adopted a NRCS-recommended livestock management plan with rotational grazing of all pastures and dormant season-only use of riparian pastures.
- By following an NRCS-recommended irrigation and nutrient management plan, I save millions of gallons of water each year,

much of which remains in the creek.

- ❖ Rapidly growing willow pole cuttings can be sustainably harvested and sold to federal and state agencies for replanting in other riparian areas, the restoration of which is inevitable to ensure water quality for humans and protect wildlife.
- ❖ Healthier wildlife populations offer other potential income sources, such as ecotourism aimed at the growing numbers of birdwatchers.

In addition to the implementation, maintenance, and protection of complimentary and sustainable conservation practices, the EC Bar Ranch paradigm also includes monitoring and outreach components. In 1998, I began an extensive annual monitoring program that included photo points and expert observations. The program was expanded in 2000 through support from the ADEQ Water Quality Improvement Grant Program and periodic site monitoring by the ADEQ, AGFD, and FWS, including a 50-year Safe Harbor Agreement monitoring commitment. In 1999, the *ECBarRanch.com* website was created. To date, information about conservation projects has been provided to more than 17,000 visitors. In addition, over 30 groups and 400 people have toured the projects, including the ADEQ *Year of Clean Water Celebration* in 2002. The website includes over 15 newspaper, magazine, and newsletter articles, including a recent article by Environmental Defense, a leading environmental organization. Over the years, I have made numerous presentations to groups interested in ecosystem restoration, often as the only private landowner in the State of Arizona sharing information about completed projects. In their 2004 Water Quality Improvement Grant Workshops, the ADEQ used a DVD describing conservation projects on the EC Bar Ranch to help illustrate the benefits of water quality practices.

In summary, I have tried to create a new and successful approach, or paradigm, that bridges the gap between traditional ranching practices based on a profit motive and the environmentally based water quality and habitat improvement programs available through state and federal agencies. Viewed independently, the ranching and environmental paradigms are having limited success at achieving desirable social goals, whereas the EC Bar Ranch paradigm has demonstrated short and potential long term success at meeting public policy objectives.

For further information about conservation projects on the EC Bar Ranch contact Jim Crosswhite, EC Bar Ranch, Email: jim@ecbarranch.com, visit the website at *http://www.ecbarranch.com*, and/or read recent articles about projects on the ranch at link *http://ecbarranch.com/articles/articles.htm*.

2005 FALL CAMPOUT AND GET TOGETHER

For registration information please go to the Arizona Riparian Council website at *http://azriparian.asu.edu/Meetings.htm* and scroll down to Fall Meetings 2005.

There is a draft agenda, links to directions on how to get to EC Bar Ranch, and a registration form there that may be printed and mailed prior to September 23rd to: Theresa Pinto, Arizona Riparian Council, Flood Control District of Maricopa County, 2801 W Durango St, Phoenix AZ 85009

Remember that it could be chilly at night and that it is a campout so be prepared to do so. Hope to see you there!

NOTEWORTHY PUBLICATIONS

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

Fagan, W. F., C. Aumann, C. M. Kennedy, and P. J. Unmack. 2005. Rarity, fragmentation, and the scale dependence of extinction risk in desert fishes. *Ecology* 86(1):34-41.

This study is about the value of multiscale analyses to investigations of extinction in species assemblages. Extinction risk is scale dependent, but it is unclear how scale dependency affects linkages between species' distributions and extinction risk. The relationships are evaluated between number of occurrences, distributional fragmentation, and extinction risk for a diverse assemblage of desert fishes across multiple spatial scales.

The SONFISHES biodiversity database was used, which details occurrence patterns of 25 native fishes to contrast the species' historical distributions with their much-reduced modern distributions. SONFISHES includes 150 years of ichthyological research.There are many factors that can influence a species' vulnerability to extinction (e.g., life history traits, population size). Among these the factors of spatial distribution are considered some of the most important. A species' spatial distribution includes range size, the number of occurrences, and the arrangement of those occurrences being the most frequently considered. Spatial arrangement of occurrences has been extensively studied by linking habitat fragmentation or the fragmented distribution of species to declines in population size and/or increases in extinction risk. These studies found that the degree to which a species' historical range was fragmented was a stronger predictor of local extinction risk than was the number of historical occurrences.

There is a major need when investigating spatial dynamics to understand how the linkages between species' spatial distributions and their risks of extinction vary as a function of spatial scale. An aid in understanding is the SONFISHES database, which documents the historical and modern occurrence patterns for native freshwater fishes of the Sonoran Desert. These fish historically exhibited large interspecific differences in spatial distribution due to factors such as hydrologic (e.g., flow connectivity), water temperature tolerances, habitat preferences, as well as differing life-history attributes (e.g., dispersal abilities, parental care strategies). They all contributed to interspecific variation in spatial connectivity. No single process was responsible for the historical distributional fragmentation. However, recent anthropogenic modifications of stream networks and their surrounding landscapes, largely via dam building, water diversion, and species introductions, have disrupted the ecology of the region, have driven populations and/or species extinct, and continue to threaten species' persistence.

In a system like the Sonoran ecoregion, where connectivity may be determined largely by in-stream proximity of individual populations, it is probable that the extent of fragmentation in populations is a strong predictor of extinction risk. This analysis revealed that species whose distributions were more fragmented historically had greater risks of extinction, whether losses were measured at the local scale, intermediate scales, or on the scale of river basins. In contrast, species whose historical distributions were more compact (less fragmented) were apparently at an advantage as to subsequent extinction losses, presumably due to increased opportunities for local recolonization on decadal time scales. Proximity must play a key role in long-term persistence of these species because increases in only the number of occurrences did not carry the same benefits. Furthermore, the 25 species in this diverse assemblage are not equally susceptible to an assortment of anthropogenic modifications. Interspecific variation in fish life history traits will contribute to variation in extinction risk.

Knowledge of which species are more likely to go extinct, on what scale such extinctions are likely, and what occurrences are most at risk would greatly aid in the prioritization of management actions to protect extant occurrences or to design translocation activities to restore lost populations. An additional general contribu-

tion of this study is to demonstrate that even seemingly simple information such as presence/absence data can play an important role in conservation planning.

Sabo, J. L., R. Sponseller, M. Dixon, K. Gade, T. Harms, J. Heffernan, A. Jani, G. Katz, C. Soykan, J. Watts, and J. Welter. 2005. Riparian zones increase regional species richness by harboring different, not more, species. *Ecology* 86(1): 56-62.

Riparian zones are habitats of critical conservation concern worldwide because they filter agricultural contaminants, buffer landscapes against erosion, and provide habitat for greater numbers of species. This paper tests the idea that riparian habitats harbor more species than adjacent upland habitats. Using previously published data collected from seven continents, the authors show that riparian habitats do not harbor higher numbers of species, but rather support significantly different species pools. In this way, riparian habitats increase regional richness by greater than 50%. Conservation planners can increase the number of species protected in a region by including a river within terrestrial biodiversity reserves.

The hypothesis that riparian habitats have higher richness has not been evaluated across large geographic scales or major taxonomic groups. This paper asks four questions about riparian-upland gradients in species richness. They are: (1) Does average richness (reflecting a-diversity) differ between riparian and upland habitats across all replicated studies examining this question? (2) Does cumulative richness differ between riparian and upland habitats (reflecting differences in the relative turnover of species among plots, or b-diversity, within each habitat)? (3) Is turnover in species richness (b-diversity) significant between riparian and upland habitats, reflecting greater regional richness (y-diversity) of larger landscape elements that include riparian zones? (4) Do observed patterns of relative species richness (reflecting a-, b-, or y-diversity) in riparian and upland habitats depend on regional climate or the taxonomic group of interest?

A literature search of 150 articles was conducted. These papers contained three types of data. They were estimates of mean richness in riparian and upland habitats (with associated sample sizes and variance estimates), estimates of richness pooled across replicate sites in riparian and upland habitats, and estimates of turnover in richness between riparian and upland sites. Within a particular taxonomic group native and non-native species were consistently pooled in an attempt to make richness estimates more consistent between studies that reported separate estimates of natives and nonnatives and studies that did not differentiate between these two groups.

Average richness was not significantly higher in riparian vs. upland habitats across the 37 data sets examined in this study. However, the range in weighted effect sizes was large, suggesting that richness gradients were strong (in either direction) for some records but not others. Categorical analyses revealed no relationship between annual rainfall patterns or taxonomic grouping and mean effect size. Mean effect size was not significantly different between wet and dry climates. Finally, mean effect size was not significantly greater than zero (e.g., higher riparian diversity) for any individual rainfall or taxonomic category.

High species richness is a frequently cited property of riparian zones. High species richness in riparian habitats could relate to a variety of factors including disturbance, flow-facilitated dispersal of propagules, and the diversity of physical conditions present at the interface between aquatic and terrestrial ecosystems. This paper shows that high species richness in riparian relative to upland habitats is not a general pattern across the globe. It was observed that there was significant heterogeneity in changes in mean richness between riparian and upland habitats, and rainfall patterns or taxonomic grouping could not explain this heterogeneity. These results suggest that future studies of species diversity in riparian settings should focus on understanding the causes of variation in species richness gradients across the riparian-upland transition. Generality is only achieved through consistent findings across systems, study subjects, and methodologies.

The results have two important consequences for river and riparian conservation. First, the results suggest that although a-measures of diversity may not consistently differ between riparian and upland habitats, turnover in species pools (b-diversity) between these two

habitat types are consistently high and significant. Second, turnover patterns are stronger for plants than animals and are stronger in dry than wet climates. These patterns probably reflect (1) higher mobility in animals and (2) extreme physical gradients (i.e., water, temperature) in dry climates. Mobile animals may take advantage of seasonally favorable microclimates, surface water, or other riparian conditions and resources, despite significant dependence on upland habitats. Regional climate may further dictate the degree of facultative use of riparian habitats and resources by these more mobile taxa, and upland-riparian transitions in dry regions are often characterized by major shifts in plant associations (e.g., xeric to mesic assemblages). These observations suggest that reserves designed to protect upland habitats, may fail to protect mobile taxa dependent on multiple habitats, unless some combination of riparian and upland habitats is considered together in a comprehensive plan.

Baker, M. A., C. S. Crawford, C. N. Dahm, L. M. Ellis, M. C. Molles, Jr., J. A. Morrice, D. L. Moyer, J. R. Thibault, and H. M. Vallet. 2005. Biogeochemical and metabolic responses to the flood pulse in a semiarid floodplain. *Ecology* 86(1): 220-234.

In their natural state, riparian zones are intimately linked to the rivers they border, and flooding facilitates the exchange of materials and energy between rivers and their floodplains. For the 139 largest river ecosystems of the northern one-third of the Earth, 77% of the total water discharge is strongly or moderately affected by fragmentation of river channels by dams, interbasin diversions, and irrigation. Therefore, disconnection of river channels from their historical floodplains is a common ecological alteration worldwide.

The flood pulse concept emphasizes that inundation of the floodplain creates and maintains riparian forests as some of the most productive and diverse ecosystems in the biosphere. In the flood pulse model, flooding is predicted to trigger an increase in the magnitude of biological processes that occur during both the rising and falling of the pulse.

Flood pulse inundation of riparian forests alters rates of nutrient retention and organic matter processing in the aquatic ecosystems formed in the forest interior. Along the middle Rio Grande, impoundment and levee construction have created riparian forests that differ in their inter-flood intervals (IFIs) because the flood pulse still regularly inundates some floodplains, and they are connected. Other floodplains remain isolated from flooding, and they are disconnected.

This research paper quantifies nutrient and organic matter dynamics during three years of experimental flooding of the disconnected floodplain and during a single year of natural flooding of the connected floodplain. Water used for flooding the disconnected flood site was diverted from the Rio Grande and conveyed via irrigation canals to the refuge. Surface and subsurface conditions were monitored to address metabolic and biogeochemical responses.

Compared to dry controls, rates of respiration in the flooded sites increased by up to three orders of magnitude during the flood pulse. In the disconnected forest, month-long experimental floods produced widespread anoxia of four-week duration during each of the three years of flooding. In contrast, water in the connected floodplain remained well oxygenated. Experimental floods showed the disconnected floodplain to be a sink for inorganic nitrogen and suspended solids, and a potential source of dissolved organic carbon (DOC). Floodwater on the connected floodplain contained fewer nitrates, but comparable concentrations of DOC, phosphate-phosphorus, and ammonium-nitrogen.

Results suggest that floodplain IFI drives metabolic and biogeochemical responses during the flood pulse. Impoundment and fragmentation have altered floodplains from a mosaic of patches with variable IFI to a bimodal distribution. Relatively predictable flooding occurs in the connected forest, while inundation of the disconnected forest occurs only as the result of managed application of water.

Riparian forest sites that represent extreme values for the IFI (i.e., approximately annual vs. 50-year intervals) were used to see how very different hydrologic histories organize a response to the flood pulse. For any river system, variable duration and intensity of river discharge, differences in floodplain manipulation, and geomorphic complexity of the fluvial landscape will interact to dictate the IFI distribution among patches of riparian forests. Manipulated flooding

may be employed during the process of riparian and floodplain restoration, and knowledge of the IFI distribution might provide critical guidance. Finally, it provides a conceptual basis for understanding floodplain responses to aquatic-terrestrial interaction.

FOSSIL CREEK UPDATES

On June 18, 2005, Arizona Public Service returned the flows to Fossil Creek. Tim Flood, Land Use Committee Chair, and Marty Jakle, former chair and instrumental in ARC's participation, attended the event. On our website you may find information regarding the event at <*http://azriparian.asu.edu/issues*>.

Recently, during the August Water Summit held at Northern Arizona University participants visited Fossil Creek on a field trip. Northern Arizona University Assistant Professor Jane Marks led the trip. She, her students, and others in the Stream Ecology and Restoration Group of the Fossil Creek Watershed Group have been studying Fossil Creek. More information about their studies may be found at the Fossil Creek Watershed Project website (*http://www.verde.nau.edu/fossilcreekproject/research.htm*).

The project collected data to set baseline information before the flows were restored. Now, they can begin to compare that information with what will be collected since flows were returned, by continuing to collect data. The Council supports them in their efforts.

LEGAL ISSUES OF CONCERN

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

FOSSIL CREEK RESTORATION

*Editor's Note: *The viewpoints expressed in this article do not necessarily represent the viewpoints of the EPA.*

For the first time in nearly a century, enough water is flowing in the Tu Do Tliz River[1] (hereinafter referred to as "Fossil Creek") to support native fish. Fossil Creek is a 14-mi perennial stream in the Mogollon Rim country of central Arizona. The historic year-round flow is 43 cubic feet per second. Fossil Creek is notable for its travertine deposits and waterfalls – similar to Havasu Falls but on a much lesser scale. The river is a tributary to the Tu Cho[2] (more commonly referred to as the "Verde River"). The confluence of the two watercourses is between the growing town of Camp Verde and the Strawberry-Pine area.

Arizona Public Service (APS) dammed the river in 1908 to create hydroelectric energy. The dam is located a mile downstream of Fossil Springs. Water was diverted into a concrete-and-steel flume supported by a vintage, roller-coaster type wooden trestle. Fossil Creek water flowed in the flume roughly adjacent to the creek bed for several miles until it reached two of the oldest hydroelectric power plants in Arizona – the Irving Plant and then the Childs Plant. The Childs Plant is located near Fossil Creek's confluence with the Verde River. Childs was the oldest hydroelectric power plant in Arizona.

The power plants are located on US Forest Service (USFS) land within the Tonto National Forest. When the time came for APS to re-license dam with the Federal Energy Regulatory Commission (FERC), pursuant to the Federal Power Act, the environmental community recognized a unique opportunity to put water back in the creek. The Childs/Irving facility generated approximately 7 megawatts of electricity, or <1% of the total electric load that APS produces. Its generation capacity would not be missed. On the other hand, allowing water to flow in Fossil Creek would have significant benefits to the environment and the reintroduction of native fish. In 1997, environmental organizations including the Nature Conservancy, American Rivers, and the Arizona Riparian Council presented a shut-down proposal to APS that would involve placing the water that was flowing in the flumes back into the creekbed. Around the same time, the Center for Biological Diversity issued notices of intent to sue to USFS and FERC for violations of various environmental statutes, including the National Forest Management Act and Endangered Species Act, for failing to protect native and threatened species. On November 3, 1999, the Yavapai-Apache Tribe also requested that FERC grant the tribe official intervenor status in the re-licensing proceedings.

On September 11, 2000, APS entered into an agreement with several environmental groups to decommission the Childs/Irving plant. One goal of the agreement was to ensure that when APS decommissioned the dam, the water would be put back into the Fossil Creek streambed and left there pursuant to an instream flow right. Because Arizona's Water Code prevents the transfer of APS's Fossil Creek surface water directly to the USFS, the agreement anticipated taking advantage of an instream flow right application filed by USFS with the Arizona Department of Water Resources (ADWR) in December 1999. USFS had applied for instream flow maintenance rights to the full annual flow (approximately 57,000 acre-feet) of Fossil Creek for the purpose of protecting recreational and wildlife uses, including fish. Fortuitously, USFS's application date placed it in a senior position to use Fossil Creek water.

On October 8, 2004, FERC agreed to decommission the dam. In preparation for returning water to the creek, state and federal biologists salvaged 1,200 speckled dace, roundtail chubs, Sonora suckers, and desert suckers from the upper reach of Fossil Creek located upstream of the Irving Plant.

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1 Yavapai-Apache word for Fossil Creek.

2 Yavapai-Apache word for Verde River

On October 29, 2004, biologists dramatically used helicopters to transport bucketfuls of these salvaged fish from holding tanks located near Irving back into Fossil Creek3[3]. Prior to this reintroduction, the section of stream just below Fossil Springs was treated to remove exotic fish, such as green sunfish. [*Editor's note:* See *Arizona Riparian Council Newsletter* 18(2) for article about the fish removal.]

On June 18, 2005, APS opened the gates on the dam, and water is now free-flowing in Fossil Creek. APS is spending $13 million to restore the creek's habitat. Restoration is scheduled for completion in 2009. [*Editor's note:* See *http://azriparian.asu.edu/issues* for more information.]

Senator John McCain recently pledged to introduce legislation in 2005 to federally designate Fossil Creek as a Wild and Scenic River within the National Wild & Scenic Rivers System, pursuant to the Wild and Scenic Rivers Act. The Act affords some protections to rivers that display "outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values." Wild and Scenic Rivers are "preserved in free-flowing conditions, and protected for the benefit and enjoyment of present and future generations." The Act requires that the managing agency, which in this case would be the USFS, administer the area "to protect and enhance" the Wild and Scenic River's values and limit inconsistent uses if they are found to substantially interfere with public use and enjoyment[4].

CHERRY CREEK: COURT OF APPEALS FINDS PHELPS DODGE'S CHALLENGE TO VALIDITY OF INSTREAM FLOW RIGHTS IN ARIZONA IS THE PITS

Phelps Dodge's challenge to the validity of USFS' instream flow rights in Cherry Creek, a tributary of the Salt River, poses a threat to win-win situations such as Fossil Creek. Key to the success of the Fossil Creek restoration effort was the ability of USFS to secure an instream flow permit from ADWR to the historical flows of Fossil Creek. Phelps Dodge continues to challenge the State of Arizona's legal authority to issue instream flow permits for the benefit of recreation, and fish and wildlife. As discussed in previous issues of the *Arizona Riparian Council Newsletter* (16[1]:13, 16[2]:7], and 17[3]:12) Phelps Dodge is steadily moving its legal claim through Arizona's administrative and lower courts to a resolution by the Arizona Supreme Court. Phelps Dodge lost its case in administrative court and in Maricopa County Superior Court, but appealed the Superior Court decision to the Arizona Court of Appeals on June 25, 2004. Civ. No. 1 CA-CV 04-0491.

On June 28, 2005, the Court of Appeals held against Phelps Dodge. The Court of Appeals found that its prior decision in *McClellan v. Jantzen*, 26 Ariz. App. 223 (1976), wherein the court had already recognized the validity of instream flows, remained valid. "[W]e interpret the inclusion of wildlife and recreational uses in the list of beneficial uses in [the Arizona Water Code] as allowing appropriation for beneficial uses in situ."[5] On July 28, 2005, Phelps Dodge filed a petition for review to the Arizona Supreme Court.

ADEQ TAKES A VACATION

On August 22, 2005, the Ninth Circuit overturned and vacated EPA's decision to grant NPDES authorization to the Arizona Department of Environmental Quality (ADEQ) in December, 2002.[6] In response to a challenge by environmental groups, the Ninth Circuit held that EPA had violated the Endangered Species Act and the Administrative Procedures Act by failing to assure protection of endangered species, including the southwestern willow flycatcher, Pima pineapple cactus, Huachuca water umbel, and cactus ferruginous pygmy owl. While recognizing that vacating EPA's program approval decision would cause considerable administrative problems for both the State of Arizona and EPA, the Court concluded that protection of endangered species was of paramount importance.

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3 Mary Jo Pitzl, "Returning Waterway to Nature," *Arizona Republic* (Nov. 2, 2004).

4 16 U.S.C. §§ 1271-1287.

5 As of this writing, the Court of Appeals' decision is unpublished. ADWR has petitioned the court to publish its decision.

6 *Defenders of Wildlife v. United States EPA*, 2005 U.S. App. LEXIS 17983 (9th Cir. 2005).

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 January, the deadline for submittal of articles is December 15, 2005. Please call or write with suggestions, publications for review, announcements, articles, and/or illustrations.

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CALENDAR

Conservation & Innovation in Water Management, Arizona Hydrological Society Symposium, September 21-24, 2005 at Radisson Woodlands Hotel, Flagstaff. For more information, contact Margot Truini at mtruini@usgs.gov

Fall Campout and Get Together, EC Bar Ranch, October 1-2, 2005, Nutrioso Valley. For more information contact Theresa Pinto at tmp@mail.maricopa.gov or Cindy Zisner at Cindy.Zisner@asu.edu or check the website Meetings page at http://azriparian.asu.edu

Tamarisk Symposium, Tamarisk Coalition and the Colorado State University (CSU) Cooperative Extension, October 12-14, 2005, Grand Junction, CO. To learn more about the agenda and to register f please use either of the links: *http://www.tamariskcoalition.org/* or *http://www.colostate.edu/Depts/CoopExt/TRA/Tamarisk2005.html*

Watchable Wildlife 2005 Conference, Watchable Wildlife Inc., Virginia Beach, VA, October 12-14, 2005. For more information contact Watchable Wildlife at (631) 433-4100 or go to their website at http://www.watchablewildlife.org

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