Arizona Riparian Council

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EFFECTS OF FLOW REGULATION ON A SONORAN RIPARIAN ECOSYSTEM, VERDE RIVER, ARIZONA

by Vanessa B. Beauchamp, Ph.D., Fort Collins Science Center, Fort Collins, CO

Maintenance of the ecological functioning of riparian systems depends on the natural flow regime, which is influenced largely by watershed size, topography and rainfall patterns. One of the main consequences of flow regulation in the western United States is a reduction in the regeneration of cottonwood (*Populus* spp.) and willow (*Salix* spp.), which are major overstory components of arid region riparian zones. Regeneration of these trees is closely linked to the local flood cycle. Seed dispersal follows winter and spring flood events that clear streambanks of vegetation and create nursery sites composed of moist, bare mineral soil where these pioneer species can germination. Alteration of the timing, frequency and intensity of floods by reservoir operation often has a detrimental effect on cottonwood and willow recruitment and survival. Another consequence of flow regulation has been the wide-scale colonization of riparian habitats by saltcedar (*Tamarix ramosissima*) a small tree from the Mediterranean and Asia, which may be better adapted to survive in environments with regulated flows.

While the effects of flow regulation on cottonwood and willow recruitment have been well studied, few studies have addressed the impacts of flow regulation on other aspects of cottonwood-willow-dominated riparian ecosystems, including the composition and structure of herbaceous plant communities. Decreases in overbank flooding and sediment and nutrient trapping within reservoirs could decrease fine soil particles, soil moisture and soil nutrient concentrations in below dam reaches, creating a more stressful environment for vegetation. These changes may result in lower herbaceous cover and richness and could favor upland, flood intolerant species or annual species that can avoid the most stressful times of year.

My dissertation research (supervised by Dr. Julie Stromberg, Arizona State University, School of Life Sciences) compared the woody and herbaceous communities of above- and below-dam reaches on the Verde River, Arizona, to determine the impacts of flow regulation on multiple aspects of a riparian ecosystem dominated by Fremont cottonwood (*P. fremontii*) and Goodding's willow (*S. gooddingii*). Although unreplicated, these investigations provide a comprehensive look at the impact of flow regulation on a Sonoran riparian ecosystem. This research is also important because the bulk of the studies investigating the effect of dams on riparian areas have been undertaken in the midwestern United States in areas dominated by Plains cottonwood (*P. deltoides*). Less is known about

(Cont. pg. 3 . . . . . Flow)

Inside This Issue

PRESIDENT'S MESSAGE

Hi everyone. Well, there is a new byline for this column. I was elected President at the spring meeting on April 1st (I'm not sure who the joke is on – you all or me!). More on this below.

The spring meeting was a rousing success. As you recall, we structured our meeting this year around a workshop on restoring native riparian habitats. We held a classroom session on the day prior to the spring meeting, and had a field exercise in restoration on the Saturday after the meeting. This worked extremely well for us, with enthusiastic feedback from those who attended. Our goal was to provide our membership with a reason to turn out for the spring meeting, and we nearly doubled our attendance from the last two spring meetings. We recruited some new members from those who attention was on the workshop, and gave the existing members a nice rewarding learning experience.

The meeting's theme was the Colorado River Multi-Species Conservation Plan (MSCP). You've probably read about this program recently. We were fortunate enough to have scheduled our meeting just three days prior to the big signing ceremony for the Plan. Our plenary speakers were excellent and informative and several stayed around to chat with us into the evening. The afternoon speakers largely continued the theme of riparian issues of the Colorado River vicinity and were very worthwhile as well. The field trip on Saturday for those not in the workshop exercise was to the Bill Williams River, and was also very interesting, especially after the recent flooding. Our host facility, the Blue Water Resort and Casino in Parker was comfortable and attended to our needs in a truly hospitable manner. All in all it was a great meeting.

We did do some Council business while there, perhaps most significantly, electing a new President and Vice President. We went into the Business Meeting with no candidate for President, and myself as candidate for re-election to Vice President. When it became obvious that we would be entering an awkward year without an elected President, I took it upon myself to do some recruiting. I asked a friend of many years to consider working with me, and with her agreement, I withdrew as the nominee for Vice President and nominated her instead. She, in turn, nominated me for President. With no other nominations, we were elected in a tight race. Margie Latta is thus the Council's new Vice President. Margie has been associated with the Council in a casual manner for several years, and brings a rich background of knowledge and abilities that will be valuable to us all. She describes herself as follows:

I have a Bachelor's Degree in Physical Anthropology from SUNY Albany and a Masters of Science in Natural Resources with an emphasis on Wetlands and Ornithology from the University of Rhode Island. I have been with the AZ Game and Fish Dept. since 1994. I worked 6 years in the Nongame Birds Program, first on the Breeding Bird Atlas project and then as the State Partners in Flight Coordinator where I coordinated the writing of the State Bird Conservation Plan. Most recently I have been working in the Lands program where I worked on land acquisitions for the Department. I am currently in a liaison position between the Dept. and NRCS where I promote and market the Farm Bill Conservation Programs and work with our Wildlife Area Managers, and private landowners to design and implement conservation projects on our property and private property statewide.

Please join me in welcoming Margie to our Council leadership.

Margie Latta

With the election of Margie and me, it is also time to say a fond farewell to our outgoing president, Jeff Inwood. You don't need me to describe the hard work and dedication Jeff has brought to the office over the last three years. What you may not know is the steady hand that Jeff brought in leadership of your Council Board. Always there, always with just the right thing to say and manner of getting the Board to reach a consensus. Jeff brought a style of leadership that any one of us should be proud to emulate.

Thanks for a job well done Jeff!

Finally, it is probably traditional that as incoming President, I should try to send an inspirational message to our members. It is a new term of office for Margie and me, and we see many opportunities for ARC. We would like to provide service to our membership, to make a contribution to riparian conservation and restoration, and to be an organization that we are proud to belong to and in which we find some measure of personal satisfaction. If asked what I hope to achieve as president during my 3-year term, you may be able to find at least a partial answer in the previous sentence. I know Margie will be a source of great enthusiasm and dedication. She is bubbling with ideas. Our Board has met only briefly since the election, but I have challenged them to come to our May Board meeting with one or two goals or objectives for the Council for the upcoming year, beyond our normal two meetings and the newsletter. Without goals, it is hard to achieve new things and improve on the current situation. With small, but meaningful objectives in front of us, my hope is that we can energize you, our membership to participate with us in achieving something of value to us all.

Thank you all for your support and continued interest in making ARC a successful enterprise, both now and into the future.

Tom Hildebrandt, President

Flow . . . . . Cont. from pg. 1

the response of *P. fremontii* and *S. gooddingii*-dominated riparian ecosystems to flow regulation. Results from this study can be applied to the management and restoration efforts in riparian corridors dominated by *P. fremontii* and *S. gooddingii*.

STUDY SITES AND METHODS

To investigate the effects of reservoir operation on Verde River flows I compared annual peak discharge and average daily flow data between the U.S. Geological Survey stream gage immediately above Horseshoe Reservoir (Tangle; USGS 9508500), which records unregulated flow, and the gage directly below Bartlett Dam (Bartlett; USGS 9510000), which records regulated flow. To compare the woody and herbaceous communities of the above and below-dam reaches I established study sites at seven locations along the Verde River; three in the unregulated upper Verde and four in the regulated lower Verde (Fig. 1). Within each site I selected nine

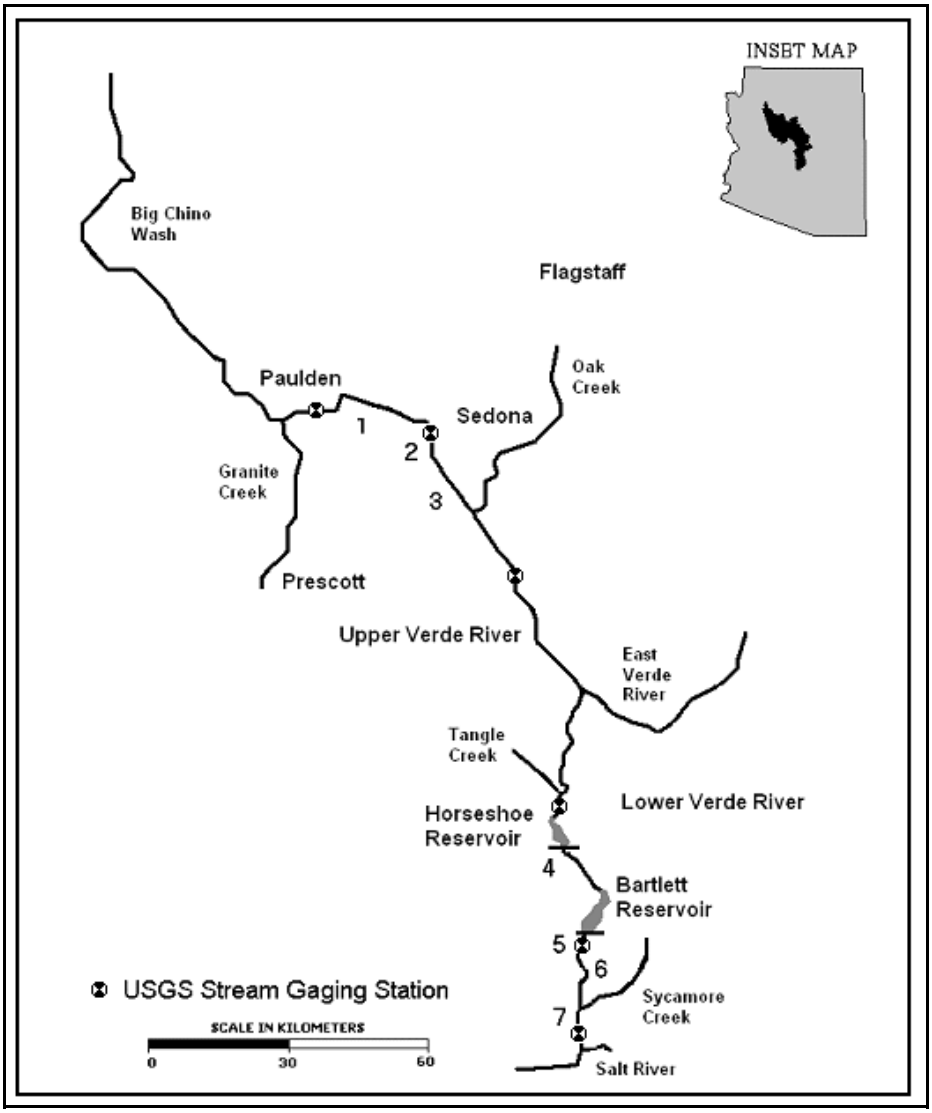

Figure. 1. Map of the Verde River showing study sites, and stream gage and dam locations. Study sites: 1 = Perkinsville, 2 = Tapco, 3 = Dead Horse Ranch, 4 = Horseshoe Dam, 5 = Bartlett Dam, 6 = Rio Verde, 7 = Fort McDowell.

cottonwood-willow stands that spanned the age range of stands present. I estimated the ages of these stands by coring the largest trees in each stand and counting the annual growth rings. These stands were placed into sapling (1-10 years), mature (11-55 years) and old (>55 years) age classes. Within each stand I established a 100 m^2 plot to sample vegetation. Woody vegetation was censused once in each plot. Herbaceous cover, by species, was sampled in summer 2000, spring and summer of 2001 and spring of 2002 in five, 1-m^2 plots within each larger 100-m^2 plot. Species found in the larger plot but not encountered in subplots were included in species richness counts. Woody and herbaceous plants were divided into functional groups based on life history (annual or biennial and perennial), origin (native or exotic) and drought tolerance (hydric, mesic and xeric) traits described in the *USDA PLANTS National Database*. Species richness and diversity, cottonwood, willow and saltcedar stem density and basal area, total herbaceous cover, herbaceous cover and richness by functional group, soil nutrients and soil texture were compared between reach types within age classes with Mann-Whitney U tests.

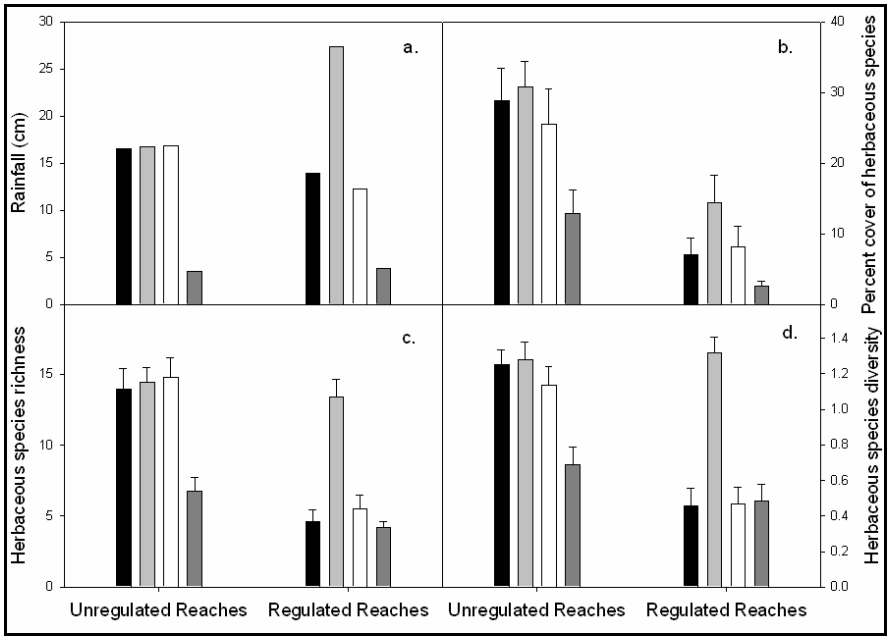

Figure 2. Temporal changes in rainfall and herbaceous species cover, richness and diversity. (a) Rainfall received by each reach in the six months prior to vegetation sampling and (b) average percent cover (per m^2), (c) species richness (per 100m^2) and (d) diversity (per m^2) of herbaceous vegetation in study plots along unregulated and regulated reaches of the Verde River. Fall 2000 (■), Spring 2001 (■), Fall 2001 (□), Spring 2001 (■).

RESULTS

- During potential recruitment years and nonrecruitment years alike, the seasonal pattern of water flows differs below the dam, given that flow patterns are dictated by seasonal irrigation demands. In general, the magnitude of late-winter/early-spring flows has decreased and the magnitude of summer base flows has increased in the below-dam reach.
- The water storage capacity on the Verde is relatively small and in wet years water must be released from the reservoirs. The lower Verde still experiences large floods with similar magnitude and frequency as the unregulated upper Verde. These large winter/spring floods often create the conditions that allow for large-scale cottonwood-willow establishment.
- Smaller floods are captured in the reservoirs and the frequency of these floods below the dam has decreased. Overall, sapling and mature stands of cottonwood-willow in the regulated reach are inundated less often than they would be if the river was free flowing.
- Cottonwood and willow stand density, basal area and species richness are similar between reach types.
- Within sapling stands, saltcedar density was 200 times greater in the regulated reach than the unregulated reach. Saltcedar density was similar between reaches in mature stands and no saltcedar was encountered in old growth stands on either reach.
- Nutrient levels (nitrate, phosphorus and potassium) were lower in regulated reach plots when compared to the unregulated reach. In plots with sapling and mature trees, the regulated reach had a higher percentage of sand and a lower percentage of silt and clay than the unregulated reach.
- Herbaceous cover was consistently higher in the unregulated reach when

compared to the regulated reach, with values ranging from double that of the regulated reach in spring 2001 (30.8% vs.14.5%) to six times greater (12.8% vs. 2.6%) in spring 2002. Species richness was greater in the unregulated reach in three of the four sampling seasons. These values were one to three times greater in the unregulated reach than regulated reach during these three seasons (Fig. 2).

- There was no difference in the proportion of exotic species or xeric species between reach types; however, the proportional richness of annual species was greater in the regulated reach then in the unregulated reach.

Patterns of woody and herbaceous vegetation abundance on the upper and lower Verde River indicate that the floodplain ecosystem responds to flood disturbance at two scales. The regeneration of woody vegetation is regulated primarily by the geomorphic work performed by large flows, while herbaceous vegetation is more responsive to the direct and indirect effects of smaller floods. Large flood events are needed to re-work the channel and provide suitable sites for cottonwood and willow recruitment, and these events have not been substantially altered by flow regulation. Cottonwood-willow stand density is similar between reach types suggesting that opportunities for cottonwood recruitment have not been significantly affected by flow regulation. While large floods still occur on the lower Verde, smaller floods are trapped efficiently in the reservoir system, decreasing the amount of sediment and nutrients deposited on the floodplain. The lowered soil-moisture holding capacity and nutrient levels in the regulated reach have created a stressful environment for herbaceous species. The elevational difference between the regulated and unregulated reaches may contribute to some of these observed differences in herbaceous vegetation, although studies on another regional river show such elevational effects to be minor.

Another striking difference between the two reach types was the large difference in saltcedar density within the sapling-age plots. Saltcedar density was similar between reaches in the older age classes, suggesting that something happened between 1991 and 2000 to encourage saltcedar recruitment within the below dam reach. In 1995, the Verde experienced large winter floods which were followed by elevated early spring flows due to releases for water delivery. Cessation of water delivery in June lowered water levels and likely created a recruitment opportunity for saltcedar that only occurred below Bartlett and Horseshoe Dams (Fig. 3). In other wet years with large spring floods suitable for cottonwood and willow recruitment (1979, 1980, 1993), summer flow releases have extended into September or October and likely prevented saltcedar establishment.

MANAGEMENT APPLICATIONS

In many areas instream flow management has been offered as a low-cost method of riparian restoration. Patterns of cottonwood-willow stand structure on the Verde River provide more evidence that when large flood events remain relatively unaltered, riparian pioneer species can still recruit in the below-dam reach. Large floods on the Verde River are not planned or managed for cottonwood recruitment, yet

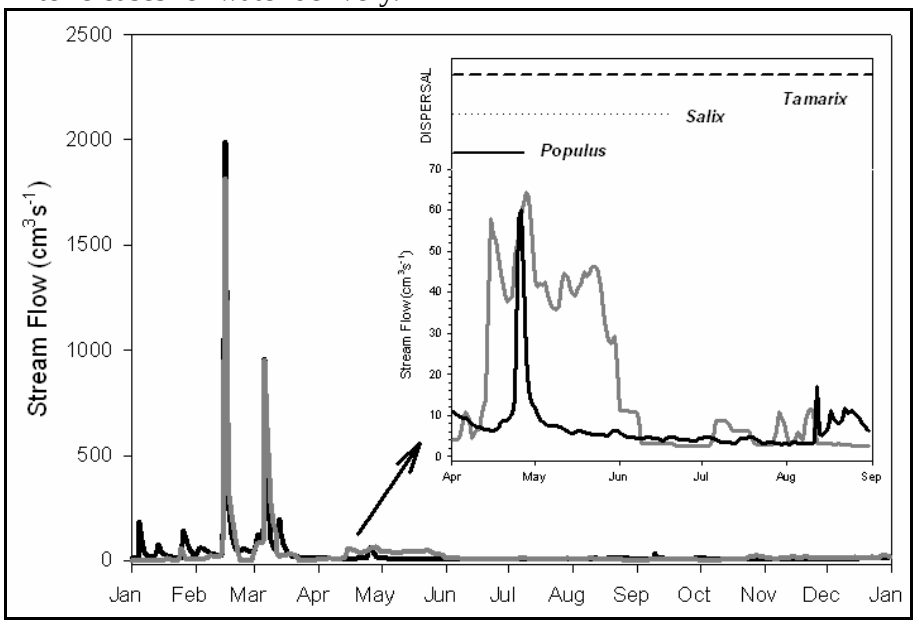

Figure 3. Hydrograph of the 1995 flood on the Verde River. Black line = unregulated flow. Gray line = regulated flow. Inset panel shows flow from April to September. The seed dispersal periods of cottonwood, willow and saltcedar are shown at the top of the inset graph. Cottonwood seed dispersal typically begins in late February and willow and saltcedar seed dispersal begins by early April.

cottonwood and willow regeneration still occurs on the regulated reach. In the future, careful attention to hydrograph decline rates after high release events could increase the success of cottonwood and willow establishment on the lower Verde. Summer irrigation release flows can also be managed to reduce the chances of saltcedar recruitment. High flow events appear sufficient to drive riparian tree recruitment; however managed flooding is not a panacea for riparian restoration. The physical barrier of the dam-reservoir system, and the loss of small floods that deliver sediment and nutrients to the floodplain, appears to have a substantial impact on the herbaceous community through reductions in moisture and nutrient availability in the below dam reach.

Editor's Note: For those of you wanting more information, you may contact the author by email at: Vanessa_Beauchamp@usgs.gov

WATER AND THE ENVIRONMENT: THE ROLE OF ECOSYSTEM RESTORATION

Many of the Council Board members attended the April 6, 2005, conference sponsored by the Arizona Water Resources Research Center at the University of Arizona. The conference was about water and the environment and brought together experts to provide us with information on ecosystem restoration. We, as a Council, endorsed the conference.

The national perspective on ecosystem restoration was provided by the Army Corps of Engineers and then overview presentations were made on ecosystem restoration efforts. Actual restoration efforts in Arizona were then presented by several individuals who were actively engaged in restoration efforts. The projects were from all over the state.

At lunch, Alan Stephens, Chief of Staff for Operations, Office of the Governor presented Governor Napolitano's water policy priorities for 2005. Following lunch, presentations were given on the legal system as a tool for effecting environmental policy. Specific projects within the Verde watershed were then presented.

The Lower Colorado River Multi-Species Conservation Plan was the next topic of discussion and was timely as we had just had our annual meeting concerning it and on Monday April 4, 2005, the Plan was signed.

The meeting concluded with an outlook for funding and closed by the Honorable Tom O'Halleran, Arizona House of Representatives.

The Council Board members who in attendance then held a very brief Board meeting which Tom has described here in the newsletter in his President's Message on page 2. Some of the presentations may be viewed online at *http://cals.arizona.edu/AZWATER/conf2005/*

Cindy D. Zisner

Water Resources Research Center

FOSSIL CREEK NATIVE FISH RESTORATION

From the journal of Dave Weedman, Fish Biologist, Arizona Game and Fish Department

For nearly 100 years, Arizona Public Service diverted water from Fossil Creek to operate turbines at the Childs and Irving power plants. The turbines generated electricity for central Arizona's rural communities. During those 100 years, non-native fish became established in Fossil Creek, making it hard for native fish, which are becoming rare in Arizona, to reproduce and maintain their populations. Then, in 2004, things changed.

Jun 17, Thu. I got word today that the US Forest Service has signed the decision notice authorizing us to implement the Native Fish Restoration Project. After a mandatory 45-day appeal period, we can finally begin on the ground research for renovating Fossil Creek. All of the stream flow (43 cubic feet per second, nearly 20,000 gallons per minute) will be returned to the creek following our renovation, creating a lot more habitat diversity for aquatic and riparian species. Game and Fish will be working with Tonto and Coconino national forests, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, Northern Arizona University, and of course APS. First we'll have to finalize the project plan, then we can get started.

August 2, Mon. The appeal period has expired and none were filed, meaning on the ground implementation can begin. A bioassay will be done tomorrow to determine chemical application rates, but the project will begin in earnest in September. There's a lot to do in the meantime. If successful, this project will eliminate non-native predatory fish from 10 miles of Fossil Creek, increasing the area available for native fish, mainly Sonoran and desert suckers, roundtail and headwater chub, and longfin and speckled dace. The restoration may also provide habitat to introduce threatened and endangered native fish – spikedace, loach minnow, Gila topminnow, desert pupfish or razorback sucker – and aid in their recovery.

My home base will be the department's Mesa regional office, but I'll be making a lot of trips to the creek as we get underway.

Sep. 20, Mon. Got to my office at 6 a.m. and checked messages before leaving for Fossil Creek. I had one from Bob Calamusso, a fisheries biologist with the Tonto, who had worked at the creek over the weekend helping anglers with hook-and-line capture of roundtail chub. He reported that heavy rains had caused part of a hillside to slide off, collapsing a section of the flume, which allowed all the water from the diversion dam to flow into Fossil Creek. Not good.

Arrived at the creek at 10:30. Looks like the flume will take about two weeks to repair. The spring flow combined with the muddy storm run-off will make it near impossible to capture native fish for salvaging, so we're postponing the start date. The fish holding facility we built at Irving gets its water supply from the flume, now dry, so we had to put the roundtail chub captured over the weekend back in the creek. We didn't want to risk losing them.

We had to postpone everything for three weeks. Time to come up with Plan B.

Oct. 11, Mon. The project is finally underway. Arrived at Fossil Creek early to assist in dispersing equipment to 12 drop zones upstream. A helicopter carried hoop nets, seines, trammel nets, 55-gallon fish transport drums, application drip buckets, and other miscellaneous equipment in a cargo net slung 100 ft. below it. What an experience to stand under a hovering helicopter hooking the line to the slings! Crews organized by Pam Sponholtz and Shaula Hedwall of the Fish and Wildlife Service will spend the week capturing native fish and holding them in the stream until Friday.

Oct. 13, Wed. Back to Fossil Creek to fill and place sandbags at the Irving diversion. Blocking

Drip bucket.

this diversion will force about 1 cfs of stream flow to stay in the creek and flow over the waterfall, improving the mixing of the fish toxicant and allowing us to treat the diversion canal later on.

Oct. 15, Fri. Arrived at the creek early to aid in the helicopter transport of captured native fish from their holding pens upstream to the holding tanks at Irving. The helicopter carried nine 55-gallon drums of fish and water to a cleared parking lot, where the fish were removed from the drums, placed in a tank in the back of a truck, and driven to the tanks at Irving. They'll spend the next couple of weeks there. Game and Fish hatchery staff will be on hand to ensure the health of these lucky survivors. Weather reports predicting rain next week – I don't need this…

Oct. 17, Sun. Made preparations to begin. Thirty-seven modified 5-gallon buckets evenly spread over 2.9 miles of stream were assembled, filled with stream water, and placed where they could drip their toxicant into the stream over a four-hour period. It took us all day to accomplish this. Weather cloudy, sprinkles off and on, threatening to rain us out again.

Oct. 18, Mon. Mixed and packaged toxicant for treatment crews to apply. Some will charge and monitor drip rates from 5-gallon buckets, others will hike the stream course applying toxicant with backpack sprayers, and others will apply toxicant-coated sand to large pools. We're maintaining a neutralization station at the downstream end of the treatment reach so that no toxicant gets past–we want to salvage natives from this area later on. The crew got a safety briefing and last minute details this evening. Calling for rain Tuesday and Wednesday, rain still threatens, but holds off.

Oct. 19, Tue. The big day finally arrived. Crews began hiking to their assigned areas around 6:30 a.m., and treatment started at 8. Everything ran smoothly. Fish began succumbing to the toxicant effects after about four hours, although many were still active even late in the day. Cloudy but no rain yet.

Spraying the toxicant.

Oct. 20, Wed. Crews repeated the procedure, and by late afternoon we could see no movement or appearance of fish. We decided to conduct a complete visual survey of the stream as confirmation, and also to treat several questionable pools a third time. Looking stormy all around, but holding off.

Oct. 21, Thu. No live fish observed anywhere. While conducting today's visual surveys, crews began dismantling and consolidating equipment for flying out next week. As we hiked out about 2 p.m., comfortable in the successful completion of the first phase, the rain began to fall, slowly at first, then increasing to a downpour.

Nightfall back at camp and we are engulfed in a torrent of rain.

Oct. 22, Fri. Mud everywhere. APS shut down the Irving turbine this a.m., put all the water back in the creek, and drained the canal and tailrace so we could treat it. By 1 p.m. they started directing the water back to the turbine. The group camp and kitchen facilities were packed up – wet of course. We did a final clean up and headed for home. I guess Mother Nature held off the storm as long as she could, which was just barely long enough.

Oct. 29, Fri. Returned to Fossil Creek to assist in restocking the native fish held in captivity since Oct. 15. News reporters, a National Geographic documentary crew, and agency public information officers were on hand to document the historic occasion. The helicopter arrived about 11:30 and took the fish to three locations upstream from the holding facility. What a relief to see Fossil Creek's native residents returned to their newly remodeled home where they'll be able to reproduce and repopulate unmolested by non-native predators.

Nov. 3, Wed. Helped with helicopter transport of equipment to Fossil Creek's Reach 4 in the Mazatzal Wilderness Area. The final phase has begun. Salvage crews will work through next Monday capturing native fish and transporting them to the Irving holding facility.

Nov. 7, Sun. Made preparations to treat two more reaches, 5.8 miles of stream. Drip buckets were assembled and disbursed throughout Reach 3.

Rain sprinkles off and on all day, rain is predicted for next week. This constant threat of rain/flooding is getting old!

Nov. 8, Mon. Drip buckets were assembled and placed along Reach 4 to a fish barrier being constructed downstream. The helicopter transported captured native fish to the holding facility, and took camping gear and neutralization chemical and equipment to the barrier construction site. AGFD water quality specialists Marc Dahlberg and Kevin Bright will camp down there from Wed. through Sat. applying liquid sodium permanganate to the stream. This chemical will oxidize the fish toxicant, eliminating its downstream effects on non-targeted areas.

After the helicopter left, I realized we forgot to send the two 30-gallon barrels that will hold and dispense the neutralization chemical. Late in the afternoon, the department's Kirk Young and Matt Rinker strapped

Helicopter with gear.

them to backpacks and hiked them downhill to the neutralization site. Problem solved.

Finally, late in the evening, we measured the creek's discharge to calculate the amount of chemical to apply. We discovered – to our dismay – that due to run-off the flows were nearly double what we'd expected. We were feeling anxious until our calculations showed there was enough chemical to meet the current conditions. Due to the seven layers of packaging we had to open and the large amount of toxicant to mix, we worked until 1:30 am getting the doses ready for the crews to apply tomorrow.

Nov. 9, Tue. Got the crews organized and off to apply the first treatment in Reach 3: four 4-person crews to spray slack water areas with backpack sprayers, six 2-person crews to charge and monitor bucket drip rates, and two 2-person crews to apply toxicant-coated sand to pools. The creek's early morning discharge measurement, nearly 17 cfs, was even higher than last night's! Fortunately, still within acceptable parameters. When crews returned in the afternoon they reported that effects were already being observed. Tonight we were only up until about 10 pm mixing and packaging chemical for tomorrow's application.

Nov. 10, Wed. Started first treatment of Reach 4. Discharge measurements were made again this morning and flows have dropped back down to a manageable 11 cfs. Returning crews reported treatment effectiveness very high. Construction crews poured concrete for the final phase of barrier construction as the treatment crew worked its way down to the site. In fact, several treatment crews walked below the helicopter as it was dumping its last several loads of cement! Timing is everything. We got the toxicant mixed and packaged by 8 tonight. Efficiency is improving. Storm that was predicted still not materialized.

Nov. 11, Thu. Retreated Reach 3. Discharge flows continued to hover around 11-12 cfs. Bucket monitoring crews returned in early afternoon with equipment in tow. All crews reported that no live fish were observed anywhere in Reach 3. The treatment appears to be a resounding success. It only took us until dinnertime to get the toxicant packaged up and ready for tomorrow.

Nov. 12, Fri. Retreated Reach 4. Same observations and results as for Reach 3. The crews transported renovation equipment to helicopter pick-up sites before hiking out of the wilderness area. We're all beginning to relax a bit and feel confident about the project's success. Once again, as if Mother Nature approved, the rain returned within hours of this weeks work, and fell off and on most of the night.

Nov. 13, Sat. Kirk and I hiked down to the barrier/neutralization site to assist Marc and Kevin with final neutralization and to pack up their camping gear for flying out. Back at base camp, the crews packed up tents, canopies, kitchen gear, etc. – all wet of course – and headed for home.

Nov. 15, Mon. Returned to Fossil Creek this morning to hike down to the barrier site and connect the helicopter long-line to the remaining equipment. It took four trips for the chopper to carry camping gear, leftover

chemical, and application barrels to Irving where everything was loaded in a truck for the drive home.

Nov. 17, Wed. Back one last time for, probably, the most rewarding experience of my 13-year career-returning the many salvaged native suckers and chubs to Fossil Creek. The fish were transported in small tanks in the back of a pickup to two areas where we could move them to buckets and hike them down to the creek. The *National Geographic* documentary crew was on hand again to record the momentous occasion. We placed the fish carefully into large, deep pools. Through the crystal clear water, we watched them swim away, nearly assured that they and their offspring will inhabit 10 miles of the restored Fossil Creek.

Postscript: Observations indicate that the Fossil Creek Native Fish Restoration was a complete success. At press time, follow-up monitoring has failed to detect any smallmouth bass or green sunfish. We hope that in the months and years ahead, no non-native fish reappear in Fossil Creek. If they do, scientific methods will be used to determine their origin, either missed during the treatment or illegally reintroduced by the public. Anyone caught transporting or releasing live sport fish in Arizona is subject to criminal prosecution and civil penalties that may include restitution for the cost of reversing the effects of their illegal act. Stream renovations may cost several hundreds of thousands of dollars or more.

Editor's Note: This article is reprinted from the Arizona Game and Fish Department's 2005 *Wildlife Views* 48(2):18-22.

The Fossil Creek Native Fish Restoration was a model cooperative effort between the Arizona Game and Fish Department, Tonto and Coconino national forests, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, Northern Arizona University, and Arizona Public Service. A team of biologists put many uncounted hours of effort into planning the project, discussing, arguing, and e-mailing their way to an implementation plan that all agreed had the best chance for successful removal of the non-native fish while protecting the native species that existed in the stream at the time. This article is published in recognition of their dedication, and in memory of David Mark Whitney. Mark Whitney was the Fisheries Biologist for the Coconino National Forest and lost his life in a car accident enroute to work at Fossil Creek on April 26, 2004. His years of dedication to Fossil Creek helped make the decommissioning possible. He is well remembered and sorely missed.

THE ARIZONA RIPARIAN COUNCIL AND FOSSIL CREEK

by Tim Flood, Land Use Committee Chair

An historic event is about to occur on Fossil Creek. The Arizona Public Service (APS) power company is prepared to take the definitive step toward restoring a major creek in central Arizona. This is scheduled to happen on June 18, 2005, when APS shuts down the hydropower generators at its Irving and Childs power plants on Fossil Creek. On that day, the water from Fossil Springs, which has been diverted into flumes, pipes, and turbines since 1909, will once again flow freely in the creek bed for 14 miles to the Verde River.

The Arizona Riparian Council (ARC) began advocating for restored flows to Fossil Creek when we held our first fall meeting there in 1992. The Council decided that the Federal Energy Regulatory Commission (FERC) relicensing of the hydropower plants offered a rare opportunity to restore a major Southwest stream that had few of the impacts noted on other, more developed streams in our state. The Council believes that restoring base flow to Fossil Creek is truly a win-win situation for all of those involved with this project. The agencies and corporate decision makers have found a way to restore the stream, yet resolve their individual concerns. We believe that people working together to find solutions to complex problems have found a way to make restoring the stream a reality. The Council has worked with agencies, business interested, and other interested groups to make it happen. In 1997 the Council submitted comments on the Draft Environmental Assessment. In October 1999 the Council once again held a fall meeting at Fossil Creek, and in November, APS announced that it would close the two hydroelectric plants and restore flows.

The Council's main role in this effort has been to highlight the outstanding natural resources of Fossil Creek and the opportunities that restoring the riparian ecosystem offer. A partnership of environmental groups was formed to advocate restoring the flows and to negotiate with APS. These partners included American Rivers; Northern Arizona Audubon Society; Sierra Club-Grand Canyon Chapter; The Nature Conservancy-Arizona Chapter; and the Center for Biological Diversity. The agreement for decommissioning and restoring Fossil Creek was reached through discussion rather than litigation. The ARC's efforts were led by Marty Jakle, Andy Laurenzi, and Kris Randall.

FUTURE DIRECTIONS

The ARC's goal is to restore and maintain Fossil Creek as a functioning ecosystem. Now with the achievement of one major objective of returning full flows to the creek, we will be addressing other objectives. The federal Bureau of Reclamation, Arizona Game and Fish Department, and the US Forest Service conducted a native fish restoration project in late 2004 when they cooperatively built a fish barrier on the lower creek that prevents upstream migration of fish from the Verde River, and they poisoned exotic fish and returned three species of native fish to the creek (see Dave Weedman's article, this issue).

However, significant challenges remain, especially the writing by the Forest Service of a comprehensive management plan for the creek and the associated watershed. Specific issues that must be addressed include recreational use, monitoring of impacts, response to emergencies, exotic species

such as crayfish, and solidifying the in-stream water right.

For decades, APS has been a calming presence in keeping down the numbers of visitors who otherwise would have overrun the canyon. Following deconstruction of its project facilities, APS will leave the canyon around 2009. This will create a vacuum in area management. It will be crucial to have a well-designed management plan in order to prevent the area from being "loved to death."

A number of other interested parties have been active participants in restoring the creek. For example, Northern Arizona University is conducting research and monitoring projects addressing biological, geological and recreational values; the Yavapai-Apache Nation continues to advocate for restoring this revered creek; and the Friends of Arizona Rivers take serial photos.

The ARC remains committed to monitor progress in restoring the creek. The Land Use Committee, chaired by Tim Flood, will be tracking the proceedings.

We have also been invited to have three members attend the flow releases on June 18. We will be represented by Marty Jakle, Tim Flood, and Margie Latta.

REFLECTIONS ON RIVER CONNECTIONS

Julie Stromberg, Associate Professor, School of Life Sciences, Arizona State University

I went on a field trip the other day to look at the vegetation that has developed in Phoenix around the storm drains and effluent outflows that feed into the Salt River – including those at 35th and 51st Avenues. Although many of these urban tributaries were scoured by the recent floods, some still support lush pockets of wild (unplanted) vegetation–Goodding's willow, Colorado River hemp, burro-brush, and cocklebur, as well as Red River gum, chaste tree, and assorted legume trees. Some of these plant species have a long history in the Sonoran Desert region, pre-dating European settlement; others are of more recent introduction.

We stopped for a moment to consider how rivers are related to their watersheds. Although the urbanized Salt River has been disconnected to some degree from its upstream reaches by concrete dams, and from its lateral reaches by urban development that has obliterated historical tributary connections, this urban river still reflects its watershed. Despite our attempts to tame and control it, riverine processes still occur: vegetation is scoured, sediment is transported, and water, seeds, and other propagules arrive at the river from the many urban storm drains.

After a bit we came across a small tree, which we identified as *Ricinus communis*, or castor bean. A brief discussion ensued about the history of cultivation of this species in Arizona and about its ethnobotanical uses, from castor oil to the poison ricin. It dawned on me that interpreting the urban riparian landscape from this ethnobotanical perspective could be interesting and valuable, and could serve to connect people with their natural areas and with their history. Some subset of the species we plant for food or for landscape aesthetics will be washed downstream, or transported by birds, and make their way into the river bottom- and some subset of these that are adapted to riverine settings will thrive. The world might be a nicer place if we could accept these plants, and appreciate them. In trying to remove them, we are trying to remove the imprint of human actions on the landscape. If people, by definition, are part of the urban ecosystem, shouldn't our "umbrella plants" be allowed to become part of the urban riparian landscape?

Environmental education is planned for the Salt River in conjunction with the urban river restoration projects that are occurring. If the present dominant paradigm is followed, the students will be taught that non-native species are "bad" and should be removed. I worry about the message we are sending about the human-nature connection, and about riverine processes, by teaching that we control which plants belong in the urban riparian landscape. I hope that an alternative viewpoint – that an urban river can run wild and reflect its watershed – can be on the educational table, too.

NOTEWORTHY PUBLICATIONS

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

Figuerola, J., L. Santamaria, A. J. Green, I. Luque, R. Alvarez, and I. Charalambidou. 2005. Endozoochorous dispersal of aquatic plants: Does seed gut passage affect plant performance? *American Journal of Botany* 92:696-699.

The ingestion of seeds by vertebrates can affect the germinability, which is the capacity of a seed, bud or spore to germinate under some set of conditions such as a period of cold temperature, and/or the germination rate of seeds. It was unclear if an earlier germination, as a result of ingestion, affects later plant performance. For sago pondweed (*Potamogeton pectinatus*) the effects of seed ingestion by ducks on both germinability and germination rate have been previously reported from laboratory experiments. A new experiment was performed to determine the effects of seed ingestion by ducks on germination, seedling survival, plant growth and asexual multiplication. Both at the start and end of the winter, seeds were fed to three captive shovelers (*Anas clypeata*) and subsequently planted outdoors in water-filled containers. Plant biomass and its allocation to vegetative parts including shoots and roots, tubers, and seeds were determined in autumn. More duck-ingested seeds than the control group of uningested seeds germinated in early winter, but this difference disappeared for seeds planted in late winter. None of the variables for measuring seedling survival and plant performance varied between treatments. Under experimental conditions (no consumption of herbaceous vegetation or competition), ingestion by ducks in early winter resulted in increased performance for seeds surviving gut passage due to enhanced seed germinability, without other costs or benefits for the seedlings.

Korman, J., S. M. Wiele, and M. Torizzo. 2004. Modeling effects of discharge on habitat quality and dispersal of juvenile humpback chub (*Gila cypha*) in the Colorado River, Grand Canyon. *River Research and Applications* 20: 379–400.

A two-dimensional hydrodynamic model was applied to seven study reaches in the Colorado River that were within the Grand Canyon to examine how the operation of the Glen Canyon Dam has affected the availability of suitable shoreline habitat and the dispersal of juvenile humpback chub (*Gila cypha*). Suitable shoreline habitat typically declined with increasing discharges above 226–425 m^3/s (cubic meters per second), although the response varied among modeled reaches and was strongly dependent on local morphology (landforms and landscapes). The area of suitable shoreline habitat over cover types that are preferred by juvenile humpback chub, however, stayed constant, and in some reaches, actually increased with the discharge. In general, changes in discharge caused by impoundment tended to decrease the availability of suitable shoreline habitat from September to February. However, there was increased habitat availability in spring (May-June). Hourly variations in discharge from Glen Canyon Dam substantially reduced the amount of persistent shoreline habitat at all reaches. Changes in suitable shoreline habitats with a discharge were shown to potentially bias historical catch per unit effort indices of native fish abundance up to fourfold. Physical retention of randomly placed particles simulating the movement of juvenile humpback chub in the study reaches tended to decline with an increasing discharge, but the pattern varied considerably due to differences in the local morphology among reaches and the type of swimming behavior modeled. The implications of these results to current hypotheses about the effects of Glen Canyon Dam on juvenile humpback chub survival in the mainstem Colorado River are discussed.

Glenn, E. P., and P. L. Nagler. 2005. Comparative ecophysiology of *Tamarix ramosissima* and native trees in western U.S. riparian zones. *Journal of Arid Environments* 61: 419-446.

Over the past century, the natural flow regimes of the major western U.S. rivers have been altered by dams, flow regulation and diversion of

water for human use. As a result, the floodplains of many rivers have become drier and more saline than in the pre-dam era. Water tables associated with riparian areas have also declined. These drier conditions have favored the replacement of native mesic trees, or those that require moderate amounts of moisture, such as cottonwood (*Populus* spp.) and willow (*Salix* spp.) by saltcedar, (*Tamarix ramosissima*). Saltcedar is an introduced, nonnative, stress-tolerant shrub originally from Eurasia. It is now the dominant woody species on many perennial rivers systems in the arid southwestern U.S. and northwest Mexico. A review of the research literature shows that saltcedar has greater salt tolerance, drought tolerance, resistance to water stress, and fire tolerance than mesic native trees. In one study, saltcedar grew more slowly than native trees, as determined by comparison of annual tree ring widths. Eventually, it came to dominate the floodplain, mainly because, according to tree ring evidence, recurring droughts diminished the population of native trees while saltcedar was able to survive and to form dense stands. There was a gradual replacement of native vegetation by saltcedar due to its great stress tolerance. Saltcedar is also better able to withstand highly concentrated saline water and soils. However, under a natural flow regime, native trees are competitive with saltcedar in germination and establishment during a flood year and they have equal or faster growth rates. On rivers that still experience a normal spring-summer pulse-flood regime or where floods have been reestablished, cottonwood and willow have shown the ability to reestablish themselves despite the presence of saltcedar. Contrary to previous reviews, the current evidence does not support the conclusion that saltcedar has unusually high evapotranspiration rates or leaf area index that would allow it to desicate watercourses. According to most researchers, an effective management strategy for saltcedar must include the return of a more dynamic hydrological regime (alternating flooding and dry periods) to regulated rivers, allowing saltcedar and native trees to coexist to maximize the habitat value of the riparian zone. Finally, a beetle from the plant's native habitat is being tested as a possible biocontrol agent. This could potentially allow saltcedar to be controlled along much larger areas of a river.

LEGAL ISSUES OF CONCERN

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

ARIZONA DECLINES RESPONSIBILITY FOR ACTIVE MANAGEMENT OF UPPER SAN PEDRO BASIN GROUNDWATER

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

On March 9, 2005, the Arizona Department of Water Resources (ADWR) determined the Upper San Pedro Basin would not be declared an Active Management Area (AMA) pursuant to Arizona's 1980 Groundwater Code. ADWR found after its review of groundwater resources and water demand in the Basin that this hydrogeographic area did not yet require active management of groundwater by the State.[1] This determination raises a number of legal issues, as well as environmental issues associated with the continuing viability of the San Pedro River.

BACKGROUND

ADWR already administers five AMAs in the state: Phoenix, Pinal, Prescott, Tucson, and Santa Cruz. Over 10 years has passed since the establishment of the last AMA, the Santa Cruz AMA, which was carved out of the Tucson AMA and established by the Legislature in 1994. The concern over rapid population growth in Cochise County municipalities such as Sierra Vista, Benson, and Tombstone convinced ADWR in 2001 to study whether water demand issues warranted designating the Upper San Pedro Basin as the next AMA. To make this determination, ADWR analyzed municipal, agricultural, and industrial water demand in the Basin, and available water supply data. After analyzing this data, ADWR found that although water tables in the area were declining, and that cones of depression were increasing in size, there remained enough water in the Basin to satisfy foreseeable demand.

There remains some question, however, with regard to the adequacy of the data ADWR examined. To determine water demand in the Basin, ADWR looked at, among other things, the demographics of the Basin. In doing so, ADWR was obliged to use data from the year 2000 census and the State's Department of Economic Security (DES) official population projections from 1997 and its 2002 population estimates. The notorious inaccuracy of this data, which year after year fails to adequately forecast the explosive growth that Arizona is experiencing, is well known to those engaged in residential and commercial development in Arizona. DES data for the Basin provided no exception. For instance, the official DES projections predicted a meager 1.1% linear future growth rate per year, for an increase in population from 79,944 people in 2000 to a total of 110,000 people by 2030. ADWR recognized that DES projections did not account for some recent residential developments coming to the Basin, and adjusted the DES projections to account for "The Canyons" at Whetstone Ranch (a 1,150 unit subdivision in Benson),[2] and the Bachmann Springs development (a 1,135 unit subdivision, resort hotel, 18-hole golf course located northeast of Tombstone). However, ADWR did not include in its calculations Smith Ranch, a 2,000-acre, 5,300 home residential development located approximately four miles northwest of Benson, with a projected water demand by some accounts of 2,723 acre-feet per year.[3] It is also unclear whether ADWR took into account the full-build out population of the 8,000-acre Whetstone Ranch development.

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1 A.R.S. § 45-402(2).

2 *City of Benson Application for Modification of Designation of Adequate Water Supply No. 21-400179* (June 19, 2000).

3 "City Creates Water Plan," *San Pedro Valley News-Sun* (March 9, 2005); *see also* "Diamond Ventures: Facts to Prevail", *San Pedro Valley News-Sun* (September 29, 2004); *see also* "City's Study Disputes Developers' Claim," *San Pedro Valley News-Sun* (June 23, 2004).

Environmental Considerations

ADWR was under no mandate to consider environmental issues, however, such as the effect of pumping on the riparian health of the San Pedro River. The San Pedro is the last undammed river in Arizona. The river flows from Mexico to the Gila River, and is home to several endangered species, such as the Southwestern Willow Flycatcher (*Empidonax traillii extimus*) and Huachuca Water Umbel (*Lilaeopsis schaffneriana* var. *recurva*). Groundwater in the Basin and surface water in the San Pedro form an interconnected hydrologic system in which quantities of water are exchanged between the aquifer and the river, based on changing hydrological conditions. And hydrological conditions are changing. Because the hydrological system is interconnected, extensive groundwater pumping in the Basin is suspected of resulting in the depletion of river streamflow by inducing infiltration of surface water through the streambed or interception of groundwater that would have discharged to the stream. U.S. Army Corps of Engineers' data from monitoring wells in the Basin indicate water levels are dropping by approximately a half-foot per year in the Basin. If groundwater withdrawals continue to exceed inputs, over time baseflow in the River is expected to diminish or be lost in some reaches.[4]

Consequences of the No-AMA Determination

The Adequate Water Supply Program addresses groundwater demand outside of the AMAs and was established in 1973 as a consumer protection program. The Assured Water Supply Program addresses groundwater demand within AMAs and was established as part of the 1980 Groundwater Code. There are significant differences between the two Programs. Under the Adequate Water Supply Program, a residential developer cannot record its final subdivision plat until it receives from ADWR a report on the subdivision's water supply indicating the developer has satisfied ADWR's water supply requirements.[5] The primary requirement is "adequacy," i.e., that the water supply is physically, continuously and legally available to satisfy the applicant's 100-year projected water demand, and that the water supply is of suitable water quality.[6] ADWR then submits its water adequacy report to the Arizona Department of Real Estate, so that promotional material and contracts for sale of lots in the subdivision include language putting potential homebuyers on notice that the legal availability of water withdrawn from wells in the area may be the subject of court action in the future as part of a determination of surface water rights.[7]

The Assured Water Supply Program, on the other hand, also requires that the proposed water use be consistent with the "management plan" and "management goal" of the respective AMA. An assured water supply in an AMA can be demonstrated in one of two ways: The owner of the subdivision can prove access to a renewable and sufficient water supply and receive a Certificate of Assured Water Supply from ADWR, or, the owner of a subdivision can receive service from a city, town or private water company which has been designated by ADWR as having an assured water supply, i.e., the water supplier has obtained a Designation of Assured Water Supply from ADWR.

Some of those in Arizona with a stake in the management of groundwater believe that having a management plan and goal in place for the Basin makes sense in light of the reasonably foreseeable develop-

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[4] San Pedro Expert Study Team, 1999; *See also* Tony Davis, "Death of the San Pedro: Not If, But When," *High Country News* (Aug. 30, 2004) at 11.

[5] A.R.S. § 45-108.

[6] A.A.C. R12-15-715 *et seq*.

[7] It is the consumer protection aspects of this statute that convinced Center for Biological Diversity to file suit against ADWR in 2004 alleging that it is falsely representing the adequacy of the Sierra Vista area's water supply to consumers and lenders in violation of Arizona's consumer fraud stautes. *The Center for Biological Diversity v. ADWR*, CV2003-011945, Sup. Court of Arizona, Maricopa County, *filed* September 9, 2004.

ment to occur in that portion of Cochise County.

No Management Plan

In AMAs, the Assured Water Supply Program requires that the proposed water use be consistent with a "management plan" for the area developed by ADWR with stakeholder input. These plans generally include conservation requirements that municipal, industrial, and agricultural users must satisfy, such as turf limits for golf courses and residential open space areas, and water metering. Although riparian considerations are not directly addressed by establishment of an AMA, the hydrologic relationship between groundwater and surface water in the Basin suggests the conservation measures that accompany an AMA would make it more likely that flows in the San Pedro could be maintained.

No Management Goal

Each AMA has its own particular goal. In the Phoenix and Tucson AMAs, the management goal is "safe yield" by 2025 (while in the Santa Cruz AMA it is to *maintain* safe-yield).[8] Safe yield requires that the applicant for either a designation or Certificate of Assured Water Supply in the AMA establish the physical availability of "sufficient groundwater" upon showing that the proposed withdrawals over a period of 100 years will not cause the depth to water to exceed 1,000 feet or the bottom of the aquifer, regardless of the level of recharge in the area.[9] This requirement encourages the prudent use of groundwater resources by the users themselves, and also requires them to put some thought into the location of wells. Also, in safe-yield AMA's, groundwater users must also show that their water demand will be met primarily with nongroundwater supplies (i.e., surface water, effluent, CAP water) or groundwater withdrawn pursuant to credits acquired through the extinguishment of agricultural grandfathered groundwater rights.

In addition, this year the Arizona Legislature moved a bill onto Governor Napolitano's desk that prohibits the drilling of new exempt wells (wells with a pump capacity of 35 gallons per minute or less) on property within 100 feet of the drinking water distribution system of a municipal provider with a designated assured water supply in AMAs. If enacted into law, this would be a significant development for groundwater management in AMAs[10]. Currently, exempt wells owners need not comply with any water management or water quality requirements, and are under no obligation to report how much water they withdraw annually to ADWR, thus making groundwater management difficult.

No Right to Appeal

The Arizona Water Code does not afford a right to appeal an ADWR determination of water adequacy. On the other hand, A.R.S. §45-578 provides interested parties with the opportunity in certain circumstances to appeal ADWR's issuance of a Certificate of Assured Water Supply.

CONCLUSION

In sum, without the AMA in place, new developments coming to the Basin, such as the 8,000-acre Whetstone Ranch, and The Canyons at Whetstone Ranch, Cottonwood Bluffs, Bachmann Springs, and Smith Ranch, will not have to meet the same water use and pumping restrictions found in the other five AMAs, and will not be restrained by a safe yield requirement. Neither can determinations of adequacy be challenged by interested parties. As groundwater pumping increases, so does the threat that cones of depression and lowering water tables will adversely affect surface flows in the San Pedro. Since ADWR has chosen not to act, a possible solution would be for registered voters in the Basin

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[8] Contrast this to the goal of the Pinal AMA, which is to "allow development of non-irrigation uses and to preserve existing agricultural economies in the AMA for as long as feasible, consistent with the necessity to preserve future water supplies for non-irrigation uses." In other words, rather than a goal of safe yield by the year 2025, the goal is a planned phase-out of crop irrigation in favor of which comprises part of the equation explaining the sprawl occurring in Pinal County.

[9] *See* A.A.C. R12-15-703(B).

[10] Senate Bill 1190; transmitted to the Governor on April 28, 2005.

to vote for the establishment of a Upper San Pedro Basin AMA. The Water Code provides that if 10% of registered voters residing within the boundaries of the proposed AMA petition for vote, an election is held. In fact, the Water Code even provides the wording of the ballot: "'Should the _____ (insert name of basin) groundwater basin be designated an active management area?' followed by the words 'yes' and 'no'. Opposite each such word there shall be a square in which the voter may make a cross indicating his preference."[11] A recent poll suggests there may be sufficient voter interest to get this issue on a ballot.[12]

TREASURER'S REPORT

	May 1, 2004 to May 2, 2005				
Date	**Item**		**Expenditures**	**Deposits**	**Balance**
05/10/04	Deposit for Spring Meeting			$ 1,141.00	$8,314.48
08/17/04	Office Depot - Fall brochure supplies		-$71.10		$8,243.38
09/29/04	CES - copying/mailing		-$1,029.27		$7,214.11
10/22/04	Fall Meeting - Grayhawk		-$380.00		$6,834.11
11/08/04	Fall Meeting Reg.			$ 425.00	$7,259.11
11/08/04	Dues			$ 85.00	$7,344.11
11/16/04	Returned $15 check + $7 fee		-$22.00		$7,322.11
12/16/04	Institute for Sustainability - Admin costs July 04-Nov 04		-$516.46		$6,805.65
	Spring mtg planning mileage to Blue Water		-$112.50		$6,693.15
03/11/05	Deposit - dues			$ 1,465.00	$8,158.15
03/11/05	Fall Registration			$ 15.00	$8,173.15
04/01/05	Check 451 - spring meeting costs		-$47.48		$8,125.67
04/01/05	Check 452 - spring meeting costs		-$155.10		$7,970.57
04/01/05	Check 453 - Meeting Costs		-$3,811.73		$4,158.84
		dues		$ 925.00	$5,083.84
	Deposit ($7115 total) - Spring Meeting, Dues,	meeting reg.		$ 6,090.00	$11,173.84
04/25/05	workshop;donation	donation		$ 100.00	$11,273.84
		dues		$ 60.00	$11,333.84
	Deposit - Spring Meeting,	meeting reg.		$ 2,766.73	$14,100.57
04/29/05	Dues, workshop	T-shirts		$ 24.00	**$14,124.57**
		Totals	-$6,145.64	$13,096.73	

[11] A.R.S. § 45-415.F

[12] Rocky Mountain Poll (2004) indicating *six out of ten Arizonans favor laws to prevent developers from building subdivisions in rural areas where there is no proven water supply to support such developments. Support transcends political party lines and regions of the state, and is unabated even if such laws were to have the effect of slowing down growth in those rural areas*. Quoted in State Legislative Water Policy Resolutions of the Board of Directors of the Arizona Municipal Water Users Associations (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 September, the deadline for submittal of articles is August 15, 2005. Please call or write with suggestions, publications for review, announcements, articles, and/or illustrations.

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CALENDAR

No Adverse Impact: Partnering for Sustainable Floodplain Management, Association of States Floodplain Managers Annual Conference June 12-17, 2005, at the Monona Terrace Convention Center in Madison, Wisconsin. The full brochure and registration forms are on the their website at http://www.floods.org. Direct any questions and concerns to ASFPM staff at 608-274-0123 or memberhelp@floods.org.

Tri-University Water Conference, August 3-5, 2005, The University Union, Northern Arizona University, Flagstaff, Arizona. Later this spring, more information on the conference will be available on the CLIMAS web site (http://www.ispe.arizona.edu/climas), as well as the NAU CSE web site (http://environment.nau.edu/).

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.

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