Arizona Riparian Council

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FIFTEEN YEARS OF THE ARIZONA RIPARIAN COUNCIL

Cindy D. Zisner, Center for Environmental Studies, Arizona State University, Tempe

The Arizona Riparian Council is planning its 15th Annual Meeting in Tucson this year. Time does pass quickly and it is difficult to believe that we are having the 15th Annual Meeting. Through the years I'd like to think that we played an important role in educating the public as to what riparian habitat is. The word riparian is now an everyday word for many individuals. The Council's official definition of 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." Now that is a fairly all encompassing definition but riparian areas are all encompassing. All of the parts need to be there to be a fully functional riparian system.

The Council has held an annual meeting every year except one when we switched it from fall to spring and we have held them in various locations throughout the state, in order to visit a variety of riparian areas. Our meetings consist of one day of technical paper presentations and another of field trips to the local riparian sites near the meeting location.

List of Annual Spring Meetings

1986 - Museum of Northern Arizona, Flagstaff
1987 - Wickenburg Community Center, Wickenburg
1988 - Francisco Grande Resort, Casa Grande
1989 - Sunrise Ski Resort, McNary
1990 - Tucson Hilton-East, Tucson
1991 - No meeting
1992 - Las Campañas Quality Inn, Cottonwood
1993 - Rio Rico Resort, Rio Rico
1994 - Phoenix Zoo, Phoenix
1995 - Swiss Village Lodge, Payson
1996 - Prescott Resort, Prescott
1997 - Windemere Resort and Conference Center, Sierra Vista
1998 - Shilo Inn, Yuma
1999 - Radisson Woodlands Hotel, Flagstaff
2000 - Eastern Arizona College, Thatcher
2001 - Four Points Sheraton, Tucson

We also have a fall meeting that is more relaxed and meant to be more of a social gathering. However, we do pick a different riparian site each year and then camp there and have a guest speaker or two.

The Council was started here at the Center for Environmental Studies by a graduate student studying birds, who believed strongly in preserving the habitat. His name was William "Chuck" Hunter. Chuck organized meetings to get people's interests and surveyed them to see what they felt was needed to help preserve the habitat. Duncan Patten, then Director of the Center for Environmental Studies, graciously agreed to be our founding President and was for our first five years. Since then we had other fine individuals at our helm – Andy Laurenzi of The Nature Conservancy, Marty Jakle of the U.S. Fish and Wildlife Service, Julie Stromberg of the Department of Plant Biology at Arizona State University, Kris Randall of the Arizona Department of Environmental Quality, Ruth Valencia of Arizona Game and Fish Department, and Kris is currently our President again. The Vice Presidents have been the

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above people and the current one is Janet Johnson from the Tonto National Forest, U.S. Forest Service. I have been Secretary since the 1988 meeting when Chuck completed his Masters work and moved on to work with Partners in Flight and the U.S. Fish and Wildlife Service in Atlanta, Georgia.

The Secretary position was once the Secretary/Treasurer but was separated to ease the work load. Diane Laush, Bureau of Reclamation was our first officially recognized Treasurer and together we made a great team putting meetings together. She was followed briefly by Howard Kopp who resigned to go on to school. Jeff Inwood replaced Howard and was elected for a term. Most recently, Theresa Hoff-Pinto, Flood Control District of Maricopa County, was elected as Treasurer.

We also have Members-At-Large who serve three year terms. They help out as needed with meeting preparations. Currently, they are Matt Chew, Arizona State Parks, Barbara Heslin, Arizona Game and Fish, and Susan Pierce, ReMAX Realtors.

The newsletter also has its own history. It's first real edition was created by Tanna Thornburg, Arizona State Parks. Tanna was our original editor and education promoter. She put together a table top display that we still use today for environmental education displays. Following Tanna, Ron Smith from Arizona Game and Fish was our editor and he was followed by Barbara Tellman, Water Resources Research Center, University of Arizona. I took on the desktop publishing part of the newsletter after that with a Jeff Inwood as co-editor, until he became Treasurer. When Jeff became Treasurer we needed a new co-editor. Paul Marsh, Department of Biology, Arizona State University, agreed to come on board and help. He and I are the current co-editors of the newsletter.

We also have a fledgling web site. It is pretty basic but it is there at http://aztec.asu.edu/ARC/ARC.htm. We also have a list serve for the exchange of information at riparian@asu.edu.

As mentioned previously we also have a table top display that could probably do with some new photos and verbage. The organization has been strictly volunteer from its onset and has benefitted greatly from support of the Center for Environmental Studies at Arizona State University. We've lasted 15 years – let's last another 15 and more. We need your help to do that. Please contact any of the officers listed at the back of this newsletter to offer assistance in activities. If you know of an on-the-ground project that we can help with (see article on Martinez Canyon) please let us know.

RMR Task Force

The Arizona Riparian Council for the past year has been working closely with the Arizona Floodplain Managers Association (AFMA) in the formation of a River Management and Restoration (RMR) Task Force.

The initial Task Force organization meeting was held October 27, 2000 at the Flood Control District of Maricopa County. The meeting resulted in the formation of a Steering Committee of members made up from several disciplines. We also came up with a list of 10 draft objectives with the overall goal of *Promoting river system management and restoration using nonstructural approaches appropriate to the arid Southwest*.

At the initial Steering Committee meeting, Doug Williams, Flood Control District of Maricopa County, and I were nominated as co-chairs for the Task Force. Bill Werner, Arizona Game and Fish Department, is Vice Chair, and Nasir Raza, BRW, Inc., is Secretary. Tom Loomis is the AFMA Representative on the Committee. At this initial meeting we took the list of objectives and tried to categorize them and see how they overlapped. This resulted in three major categories of (1) developing methodology, (2) influencing policy, planning, and decision making, and (3) communication. We are currently deciding on what we need to do to accomplish these objectives and how to start implementing them.

Some of the projects we would like to be able to accomplish are to be a resource for those conducting projects, have a repository for publications, workshops, etc. This is to be an interdisciplinary group and it is hoped that it will foster more cooperative solutions to various environmental issues.

Cindy D. Zisner

SPECIES PROFILE

RIVER OTTER (*LUTRA CANADENSIS*)

by Dave E. Brown

"*The transect*," we were told, "*begins at Otter Rock and continues for 200 yards downstream*."

I immediately knew that we would have no problem finding where the riparian study plot began. By just knowing its name, I could visualize the rock in my mind. Projecting out of the stream, the boulder would form a sunny hauling site for an otter, and be covered with small dog-sized scats containing fragments of crayfish exoskeletons. Such easily discernable sign is sure evidence of an otter's presence, and much more likely to be seen than the otter himself. Come to think of it, I have only seen one otter in Arizona in the last 10 years–a submerged brown-furred torpedo boiling out of the spring-head in Tavasci Marsh near Clarkdale.

How these otters came to be in the Verde River system is of some interest as this species is now much reduced throughout most of its former range and was almost certainly extirpated from Arizona sometime prior to 1960. Yet, these animals are now fairly common in the Verde and its major tributaries.

Once seen, there is usually no mistaking an otter. Wonderfully adapted to an aquatic existence, the animal's elongated body terminates in a streamlined tail that tapers from a thick base to a pointed tip. Also contributing to the otter's fusiform shape is its flattened head and small ears, the openings of which can be closed at will. The legs too are short and the hind feet are webbed to the toes. The color of the densely furred coat is a rich chocolate brown with lighter colored, even whitish underparts. Adults generally weigh between 12 and 20 pounds (5.5 and 9 kg), with occasional bruisers reportedly weighing as much as 25 pounds (11.3 kg). Lengths range from about 3 feet (90 cm) to just over 4 feet (125 cm), the males averaging larger than the females (Ceballos 1999).

When an otter is caught out on dry ground, the animal invariably heads for the nearest body of water, humping its back with each lunge forward. The otter's webbed, rhomboid-shaped tracks are easily identifiable, and differ markedly than the also webbed, but more elongated hind tracks of a beaver (Murie 1974). Once in the water, the otter shows itself to be a magnificent swimmer and diver, and can remain submerged for up to eight minutes.

Although most otter activity is a night, hunting is by sight as well as touch, and clear streams appear to be favorite haunts. As befits their aquatic existence, the otter's usual fare is fish, waterbirds, eggs, turtles, and crawfish, the latter now being the most conspicuous food item in their droppings. Adult males are generally solitary, while the females are often accompanied by their young. The breeding season in Arizona is uncertain, but otters elsewhere usually breed in late winter or early spring, mating usually occurring in the water. Pregnancy lasts about two months, but because of delayed implantation, gestation may take up to a year.

Dens are located in natural shelters under rocks, logs, flood debris, or in river banks. "Permanent dens" used for pup-rearing usually have an underwater entrance with a passage leading to a nesting chamber, which the female lines with plant material. Litter size varies considerably, but usually consists of two or three pups. The fully furred young are helpless at birth and do not open their eyes for the first month of life. Weaning requires approximately three months after which the young disperse. Sexual maturity is attained between two and three years of age, and individual animals have been known to live in captivity for more than 20 years.

Densities and home ranges have yet to be studied in Arizona but studies in other states have shown otter numbers depend largely on habitat quality and to vary considerably. Maximum reported densities of male otters are about one otter per mile (1-2 km) of stream. Finding and maintaining a suitable territory is probably the primary limiting factor for otters in Arizona as natural enemies, other than humans, are few if any.

Although otters formerly occupied most of the waterways in temperate and boreal North America, arid Arizona never ranked very high as "otter country." Museum specimens are limited to a hand-full of animals-–a male collected by E. A. Mearns on December 12, 1886 at Montezuma Well near Beaver Creek (Figure 1); another animal recorded by Mearns from the Verde River taken on January 23, 1887, and two collected along the lower Colorado River in the vicinity of Needles, California, one on December 31, 1906, and another taken in December, 1933. The only specimen of an otter from the Gila River is one taken in 1953 near Cliff, New Mexico (Findley et al. 1975). Otters were also found in the Salt River drain-

Figure 1. Courtesy of the Arizona Historical Society, Tucson, AZ.

age system as a skull was recover ed from Cherry Creek 15 miles upstream from its confluence with the Salt (Hoffmeister 1986) and Slim Ellison (1981) published a photograph of several otters trapped on Cherry and/or Canyon creeks in the 1920s. Otters were also reliably reported at various times prior to 1960 from Chevlon Creek, on Black River, and at Crescent Lake in the White Mountains.

Otters formerly inhabiting Arizona and the Southwest have been described as a supposedly paler subspecies, *L. c. sonora,* which supposedly possesses some slight anatomical differences from other otters (Hoffmeister 1986). This designation, besides being based on a very small sample size, makes little sense, however, given what we now know about gene flow. Range descriptions of the so-called *sonora* subspecies, besides including otters from the upper Rio Grande drainage, include specimens from the Canadian River in New Mexico and the Animas River in Colorado (Hall 1981). Both of the latter rivers flow into the Mississippi River, and it is improbable that an isolated subspecies of river otter would inhabit the same river system as another subspecies, in this case the widely distributed eastern river otter, *L. c. lataxina* (Hall 1981).

Whatever race of otter may once have occurred in Arizona and New Mexico is now moot as there are no good records of native otters in Arizona since the late 1950s. Those otters found in the Rio Yaqui system in Sonora are considered a different species, the southern river otter, *Lutra longicaudus*. These animals, which occur within 150 miles of the southern border of Arizona in the Rio Mulatos, reportedly possess minor but recognizable anatomical differences than their more northern brethren.

What happened to Arizona's native otters is uncertain. Never numerous, these animals were probably always subject to population fluctuations, and were periodically decimated by floods and spates of turbulent water. It is therefore possible that these animals succumbed to trapping pressures, as at various times during the 20th century, fur prices were high enough to provide an attractive incentive for rural folks chronically strapped for cash. Otters, although classified as fur-bearers, were also deemed a menace to trout fisheries, and there are second-hand accounts of fish managers and fisherman destroying these piscivores on sight. Otters are also susceptible to drowning in seines, are highly sensitive to water pollution, and prone to suffer in times of drought and low stream flows.

In an effort to restore these interesting natives, the Arizona Game and Fish Department released 20 wild-trapped otters from Louisiana along the lower Verde River in 1981. Although there was some initial mortality, prospects for success appeared favorable, and a second transplant was made a year or two later, again using wild-trapped stock. These releases were successful and otters are now present from Horseshoe Lake to above Perkinsville. Whatever the cause of their earlier demise, the introduction of crayfish and other aquatic animals to Arizona's waterways appears to have had a beneficial effect, and river otters may now be finding conditions more satisfactory than prior to settlement. To this effect, a basic life history and inventory of this species is much needed. It would also appear that additional releases are warranted in the Wild and Scenic portions of the Salt River and in Imperial National Wildlife Refuge on the lower Colorado River where otters have not been documented for nearly 50 years.

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ARC SPRING MEETING, MAY 11-12, TUCSON

ARC's fifteenth annual meeting will focus on "Urban Riparian Areas" in Arizona. The City of Phoenix/ Corps of Engineers' "Rio Salado" project is underway, and Tucson's "Rio Nuevo" is on the drawing board. Discussion in Scottsdale has generated a lot of heat regarding the Indian Bend Wash; Pima County and Phoenix are working on fundamentally different kinds of "Sonoran Desert" plans that include riparian- and wash-related aspects. Yuma is redeveloping Colorado River frontage. What's the "Agua Fria " project? What does Mesa planning to do in the Salt River?

The ARC Board has been busy just trying to make a comprehensive list, but we're also contacting representatives from Arizona counties, cities and towns to put together a morning plenary session where some of these projects can be discussed. It's not easy to convince someone to open their project to scrutiny in a technical setting, but we're giving it a shot. Come find out what's going on, and who's willing to stand up in front of you and explain the goals, objectives, and the political realities that are shaping our "Urban Riparian Areas."

The Call for Papers is out (*http://aztec.asu.edu/ARC/2001call.htm* or *http://aztec.asu.edu/ARC/2001Call.pdf*), and we particularly encourage submissions that address the theme; but there's always something going on out there that we need to hear about, but doesn't fit the theme. So send in an abstract, let us know what you've been doing, and we'll see you May 11-12 in Tucson.

MARTINEZ CANYON

Tomas and Tom Taylor, Mesa, Arizona

Martinez Canyon is a desert riparian canyon with several perennial spring fed pools of water. In February of this year we completed a field survey of these perennial pools. In the survey we described terrain, possible habitat, water depth, and general physical characteristics of the geology and stream system. The survey included field sketches of the stream channel.

Copies of this survey were sent to Arizona Game and Fish and BLM. On March 25, 2000, Rob Bettaso, a Native Fish Program Manager AGFD made a field visit. Then on October 7, 2000. Jeff Simms, Fisheries Biologist, BLM made his initial field visit. Both have expressed positive response for what they had seen. Both have expressed that the pools look favorable for longfin dace, speckled dace, Gila chub, and possibly Gila top minnow.

We would like to see these perennial pools of water, with no current use or disruptions by man, and with no heavy impact use by cattle or man in the future, used for native fishes. We have learned as we proceed with this project that native fish are in great need for available natural habitat. Martinez Canyon not only has spring-fed natural pools, but the habitat appears complete as far as shelter, aquatic insects, and vegetation. Two of the pools are so entrenched in massive boulders that they appear nearly "flood proof" even for the most violent of flows. We believe these two pools are especially suited for the precious Gila chub.

And, so at this point we would like to spread awareness of the project, via written or other forms of communication. In a sense we are soliciting any support for these efforts. These could be suggestions, field visits to the Canyon, your communication to others, etc. We are doing this solely as volunteers. Please contact us if you would like to assist in our efforts.

Tomas Taylor 480-325-1404
Tom Taylor480-964-6482
Whiptaillizard@aol.com

LEGAL ISSUES OF CONCERN

Richard Tiburcio Campbell, Law Offices of Withey, Tobin, Anderson & Morris, Phoenix

THE ARIZONA SUPREME COURT GOES WITH THE (SUB)FLOW IN 'GILA RIVER IV'

On September 22, 2000, the Arizona Supreme Court issued its long-awaited ruling regarding what constitutes the "subflow" of a surface stream in *In Re The General Adjudication of All Rights to Use Water in the Gila River System and Source,* 9 P.3d 1069; 2000 Ariz. LEXIS 94 (2000) (hereinafter referred to as *Gila River IV* to acknowledge this opinion as the fourth by the Arizona Supreme Court in the Gila River general stream adjudication). This controversial decision accepted the Arizona Superior Court's definition of appropriable subflow, a major step in the decades long Gila River adjudication. The effect of the ruling is profound because the right to water that is considered appropriable subflow under A.R.S. § 45-141(A) becomes subject to the outcome of the adjudication.

A. BACKGROUND

Gila River IV is the continuation of a consolidated general adjudication that has its genesis in 1974, when the Salt River Valley Water Users Association (SRVWUA) filed a petition with the Arizona State Land Department (ASLD) for an adjudication of water rights in the Salt River. Thereafter, various water rights claimants in Arizona filed petitions to initiate general adjudications to determine conflicting rights in the Verde, Gila, Agua Fria, Upper Santa Cruz, and San Pedro River watersheds. In 1979, the original petition by SRVWUA was transferred from ASLD to the Maricopa County Superior Court, where it was consolidated with other petitions. By 1981, approximately 58,000 known water claimants, including the United States and various Indian Tribes, were involved in the consolidated adjudication. *See Arizona v. San Carlos Apache Tribe, 463 U.S. 545, 557-559* (1983). In 1986, the Superior Court identified a number of legal issues the Arizona Supreme Court would need to resolve before the Superior Court could proceed to its adjudication of individual claims. In 1990, the Supreme Court accepted review (an "interlocutory" review) of six issues:

Issue #1

Do the procedures for filing and service of pleadings adopted by the trial court in comport with due process under the U.S. and Arizona Constitutions?

Issue #2

What underground water is subject to determination in the adjudication?

Issue #3

What is the appropriate standard to be applied in determining the amount of water reserved for federal lands?

Issue #4

Is non-appropriable groundwater subject to federal reserved rights?

Issue #5

Do federal reserved water rights holders enjoy greater protection from groundwater pumping than holders of state law rights?

Issue #6

Must claims of conflicting water use or interference with water rights be resolved as part of the general adjudication?

The Supreme Court answered Issue #1 in the affirmative in *In re Rights to Use of the Gila River,* 171 Ariz. 230, 830 P.2d 442 (1992) ("*Gila River I*"). Issues #4 and #5 were answered in *In re the General Adjudication of All Rights to Use Water in the Gila River System and Source,* 195 Ariz. 411, 415 (1999) ("*Gila River III*"). In *Gila River III*, the Court held that federal reserved rights to ground water may be established, but only in specific cases where such rights are necessary to satisfy the federal purpose for the land reservation. The U.S. Supreme Court recently denied a request filed by Phelps Dodge and SRVWUA to review this decision. *Phelps Dodge Corp. v. U.S.,* 147 L. Ed. 2d 974, 120 S. Ct. 2705 (2000); *SRVWUA v. U.S.*, 147 L. Ed. 2d 974, 120 S. Ct. 2705 (2000). The U.S. Supreme Court did not provide a reason for its denial, which is not unusual with such petitions. Issues #3 and #6 have yet to be briefed for the Arizona Supreme Court.

In *Gila River IV,* the Arizona Supreme Court addresses Issue #2 for the second time. The Court first approached Issue #2, and resolved it in part, in *In Re the General Adjudication of All Rights to Use Water in the Gila River System,* 175 Ariz. 382, 857 P.2d 1236 (1993) ("*Gila River II*").

B. GILA RIVER II

In *Gila River II*, the Arizona Supreme Court affirmed the Superior Court's holding that water constituting subflow is the only underground water subject to appropriation under Arizona law. However, the Court disapproved the Superior Court's attempt to distinguish subflow from non-appropriable "percolating groundwater" by use of a "50%/90 day test." *Id.* at 388, 392-93. This test was arrived at after five days of hearings before the Superior Court on the relationship between surface water and groundwater by hydrologists and hydrological engineers. *Id.* at 385. The test presumed that a well pumped appropriable subflow if:

> As to wells located in or close to that younger [aka "Holocene"] alluvium, the volume of stream depletion would reach 50% or more of the total volume pumped during one growing season for agricultural wells or during a typical cycle of pumpage for industrial, mining, or other uses, assuming in all instances and for all types of use that the period of withdrawal is equivalent to 90 days of continuous pumping for purposes of technical calculation.

Id. at 385. The Supreme Court, however, found that this somewhat arbitrary rule ran afoul of its 1931 decision in *Maricopa County Municipal Water Conservation District No. One v. Southwest Cotton Co.*, 39 Ariz. 65 (1931) ("*Southwest Cotton*"). In *Southwest Cotton*, the Court had defined subflow to mean:

> [T]hose waters which slowly find their way through the sand and gravel constituting the bed of the stream, or the lands under or immediately adjacent to the stream, and are themselves a part of the surface stream.

Id. at 96. The *Southwest Cotton* court also stated: "In almost all cases the so-called subflow is found within, or immediately adjacent to, the bed of the surface stream itself." *Id.* at 97. In light of this reasoning, the following test for determining whether underground water is subflow was developed by the *Southwest Cotton* court:

> The best test which can be applied to determine whether underground waters are as a matter of fact and law part of the surface stream is that there cannot be any abstraction of the water of the underflow without abstracting a corresponding amount from the surface stream, or the reason that the water from the surface stream must necessarily fill the loose, porous material of its bed to the point of complete saturation before there can be any surface flow.
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> Not only does [subflow] move along the course of the river, but it percolates from its banks from side to side, and the more abundant the surface water the further will it reach in its percolations on each side. But, considered as strictly a part of the stream, the test is always the same: **Does drawing off the subsurface water tend to diminish appreciably and directly the flow of the surface stream?** If it does, it is subflow, and subject to the same rules of appropriation as the surface stream itself; if it does not, then, although it may originally come from the waters of such stream, it is not, strictly speaking, a part thereof, but is subject to the rules applying to percolating waters. *Id.* at 96-97.

The *Gila River II* Court found the 50%/90 day test inconsistent with *Southwest Cotton* because, ultimately, it threatened to encompass too many underground waters into the adjudication. *Id.* at 391. Specifically, the 50%/90 day test could apply to all wells located in or near the younger alluvium, which in some areas stretch across entire valleys and well away from the stream bed. *Id*. This test also raised the disturbing possibility that wells pumping from "tributary aquifers", i.e., those aquifers that have not yet reached the channels of the water courses to which they are tributary, could be subject to adjudication since given enough time even pumping from a tributary aquifer could cause a corresponding depletion in stream flow volume. *Id.* at 391. In contrast, *Southwest Cotton* stated that subflow is found within or immediately adjacent to the stream bed. Further, the test in *Southwest Cotton* turned on whether a well is pumping water that is more closely associated with the stream than with the surrounding alluvium, while the 50%/90 day test turned on whether the well pumping depleted a stream by some particular amount in a given period of time. *Id.* at 392. This temporal aspect made the 50%/90 day test appear somewhat arbitrary to the Court. As a result, the Supreme Court in *Gila River II* remanded the matter back to the Superior Court to take new evidence in determining the criteria for separating appropriable subflow from percolating groundwater. *Id.* at 394. The Supreme Court also provided the Superior Court with some hypotheticals to guide the way. For example, the Court noted "if the cone of depression of a well has expanded to the point that it intercepts a stream bed, it almost certainly will be pumping subflow" and should be included in the adjudication even if only a part of its production is appropriable water (*i.e.,* subflow). *Id.* at 391.

On remand, the Superior Court held a ten-day evidentiary hearing that included a two-day "field trip" along 600 miles of the San Pedro River basin with hydrology and geologist experts, and, of course, a "large number of counsel." *See* 9 P.3d at 1075. The Superior Court then issued a detailed order on the issue of subflow, which was largely upheld in *Gila River IV.*

C. Gila River IV

In *Gila Court IV*, the Supreme Court first agreed that the Superior Court had properly found that the readily-definable saturated younger (Holocene) alluvium was the only geologic unit stable enough to provide a delineation of the subflow zone. *Id.* at 1076. The Supreme Court then proceeded to adopt the following eight conclusions of the Superior Court in regard to subflow:

1. A "subflow zone" is adjacent to and beneath a perennial or intermittent stream and not an ephemeral stream.
2. There must be a hydraulic connection to the stream from the saturated subflow zone.
3. Even though there may be a hydraulic connection between the stream and its floodplain alluvium to an adjacent tributary aquifer or basin-fill aquifer, neither of the latter two or any part of them may be part of the subflow zone.
4. That part of the floodplain alluvium which qualifies as a subflow, beneath and adjacent to the stream, must be that part of the geologic unit where the flow direction, the water level elevations, the gradations of the water level elevations and the chemical composition of the water in that particular reach of the stream are substantially the same as the water level, elevation and gradient of the stream.
5. That part of the floodplain alluvium that qualifies as a subflow zone must also be where the pressure of side recharge from adjacent tributary aquifers or basin fill is so reduced that it has no significant effect on the flow direction of the floodplain alluvium.
6. Riparian vegetation may be useful in marking the lateral limits of the subflow zone, particularly where there is observable seasonal and/or diurnal variations in stream flow caused by transpiration. However, riparian vegetation on alluvium of a tributary aquifer or basin fill cannot extend the limits of the subflow zone outside of the lateral limits of the saturated floodplain Holocene alluvium.
7. All wells located in the lateral limits of the subflow zone are subject to the jurisdiction of this adjudication no matter how deep or where these perforations are located. However, if the well owners prove that perforations are below an impervious formation, which precludes "drawdown" from the floodplain alluvium, then that well will be treated as outside the subflow zone.
8. No well located outside the lateral limits of the subflow zone will be included in the jurisdiction of the adjudication unless the "cone of depression" caused by its pumping has now extended to a point where it reaches an adjacent subflow zone, and by continual pumping will cause a loss of such subflow as to affect the quantity of the stream.*Id.* at 1077.

The Court next rejected the contention that the superior court's adoption of the saturated floodplain alluvium as the subflow zone could not be squared with *Southwest Cotton's* narrow interpretation of subflow. Recall that in *Southwest Cotton*, the Court had emphasized that "in almost all cases the so-called subflow is found within, or immediately adjacent to, the bed of the surface stream itself." The Court stated that although *Southwest Cotton's* "abstract, general statements hold true … defining subflow in any particular area is a relative endeavor, 'not an all-or-nothing proposition.'" *Id.* at 1079. Moreover, the Court emphasized that "*Southwest Cotton* should not serve as a straitjacket that restricts us from … conforming to hydrological reality." *Id.* Further, the Court found that unlike the 50%/90 day test rejected in *Gila II*, the superior court had not included tributary aquifers in its definition of subflow, or any arbitrary temporal limitations that could run afoul of *Southwest Cotton*. *Id.* at 1080.

Significantly, the Supreme Court also stated that Arizona Department of Water Resources (ADWR) could establish that a well located outside the limits of the saturated Holocene alluvium could be pumping subflow if that well's cone of depression extends into the subflow zone and is depleting the stream. *Id.* at 1082. The Court placed the burden of proof with the well owner to show that, under a 'preponderance of evidence standard' (as opposed to the more stringent 'clear and convincing standard'), ADWR's determination is wrong. *Id.* The issue of with whom the burden of proof should rest, i.e., with the pumper or the regulators, is presently the subject of an "appeal" of sorts, i.e., a Motion to Reconsider, by Phelps Dodge and APS.

D. Conclusion

The Arizona Supreme Court's ruling in *Gila River IV* means that many groundwater pumpers extracting water within the court's definition of subflow may be diverting water appropriable under A.R.S. § 45-141(A). If so, the decision renders their rights to the water dependent upon the outcome of the consolidated Gila River adjudication. As a consequence, those groundwater pumpers who cannot demonstrate to ADWR that they are not pumping from the subflow zone (e.g., by showing they are pumping from impermeable formations below these zones) face the possibility that they may be enjoined from further pumping by ADWR or other private parties (e.g, the Salt River Project) pending resolution of the Gila River adjudication.

NOTEWORTHY PUBLICATIONS

Jere Boudell, Department of Plant Biology, Arizona State University

Reinhardt, C.H. and C.A. Cole. 2000. A method for coring inland, freshwater wetland soils. *Wetlands* 20 (2): 422-426.

As one who has studied seed bank dynamics, I have used several different types of soil corers from probes, to standard 5 cm diameter corers, to split-core samplers. I've dented corer edges numerous times, and have seen a hammer broken from use due to incorrect attachment.

Reinhardt and Cole have also encountered problems with soil corers and as a result designed their own soil corer in hopes of constructing the perfect soil corer for use in freshwater ecosystems. The authors designed a corer for use in sampling larger volumes of soil. Their goal was to design a corer that would maintain the integrity of stratigraphic layers, minimize soil disturbance, and core up to a depth of 50 cm.

The corer was constructed using a 15.2 cm diameter 22-gauge black steel stovepipe. A plasma cutter was used to cut the pipe. A crumple zone of ten cm is added to the total length of the soil corer. For example, if a soil core sample depth of 20 cm is desired, the total length of pipe needed for construction of the corer is 30 cm. Two 1-cm holes were cut 2.5 cm from the top through which a 1.9 cm diameter 45 cm long steel rod is inserted as a handle. To facilitate insertion of the corer into soil, the bottom of the corer is cut to form a blocked tooth pattern.

To use the corer, the ground is first probed for large rocks. A lubricant, such as a cooking spray, is used to lubricate both the inside and outside of the corer. The corer is inserted into the soil. When the corer has ceased to be easily inserted into the soil, a steel plate placed between two wooden boards is placed on top of the corer. The corer is pounded into the ground. A hole is dug next to the corer to facilitate its removal. The ends of the corer are secured to prevent the loss of the soil sample. When one is ready to process the cores, a 10-cm wide window is cut through the pipe using the plasma cutter. This exposes the sample, by which the samples can be extracted from the various soil layers.

Reinhardt and Cole tested this device in 18 different sites and extracted 130 samples. The texture of the soil samples ranged from (percent sand/silt/clay) 29/39/32, to 60/18/22, to 53/24/23 (6% gravel). The authors claim that the device worked well in many different substrates. It worked well in soils containing gravel sized 2 cm or less.

It would be interesting to see how the Reinhardt and Cole soil corer would hold up when used in soils containing larger gravel pieces, such as those found in some of the impounded low-elevation riparian ecosystems.

Rowland, D.L., Biagini, B., and A.S. Evans. 2000. Variability among five riparian cotton-wood (*Populus fremontii* Wats.) populations: an examination of size, density, and spatial distribution. *Western North American Naturalist* 60(4): 384-393.

It is sometimes assumed that stands of *Populus fremontii* (cottonwood) trees of the same size are of the same age class. Cottonwood trees that establish during a flood event are of the same age; however, these stands may not always form in the same proximity to the channel or to themselves. Hence, variability is present in many cottonwood populations.

Rowland, Biagini, and Evans studied 1,803 trees in cottonwood populations along the Rio Grand and a major tributary in New Mexico. It has been stated that the populations of cottonwood are of the same age class. The authors investigated the size, density, and spatial distribution of these rare and endangered cottonwood populations. They wanted to know if the size and basal area density of cottonwood trees differ among populations. They also wanted to know if variability does exist, if the variability is due to distance from water sources.

Rowland, Biagini, and Evans found extensive variability in tree size among cottonwood populations. DBH varied significantly amongst the five sites. When the authors examined the relationship between tree size and distance to river, that size was not always related to distance from the channel. They noted that cottonwood trees have extensive lateral root systems that allow them to access surface water. One site had experienced overbank flooding and another site is near a diversion channel, which may account for some of the variability.

The authors point out that all five sites exhibited within site diversity of tree sizes. The authors did not measure abiotic or biotic factors that may affect size variability in cottonwood trees. However, they did suggest some of these factors such as moisture and nutrient availability, competition, and genetic differences as possibilities for causing the size variability of the cottonwood populations.

Rowland, Biagini, and Evans suggested that genetic variation might have contributed to size variability in the cottonwood populations. If this is the case, the authors point out that such genetic diversity may be exploited in future cottonwood forest restoration projects.

Middleton, B. 1999. *Wetland Restoration, Flood Pulsing and Disturbance Dynamics.* John Wiley & Sons, Inc. New York.

Middleton's *Wetland Restoration, Flood Pulsing, and Disturbance Dynamics* was recently reviewed in a popular wetland science journal. The reviewer took issue with Middleton's approach of wedding scientific theory with restoration practice. Perhaps, the reviewer really took issue with Middleton identifying the flaws that are typical in many restoration practices.

That aside, Middleton's book is a valuable book for both restoration practitioners and researchers. In part I, the author addresses the varying types of disturbance dynamics present in wetlands from flood pulsing to beaver antics to human caused disturbances. Middleton's discussion of flood pulsing was informative. Here the author discusses the interaction of flood dynamics with the biotic and abiotic components of riparian ecosystems and the consequences of disrupting these dynamics.

After discussing riparian disturbance dynamics, in part II, Middleton launches into an in-depth discussion of restoration theory. Succession, invasion, and river theories are discussed within a restoration framework. A topic of my own research, seed bank dynamics, is examined in a chapter titled, "From Seed to Adult: Missing Links in Restoration." To accompany the chapter, included in the appendices, are dispersal methodologies and germination requirements of selected wetland species.

In part III, Middleton discusses restoring disturbance dynamics in wetland ecosystems. In chapter 4, the author outlines goals that can be used in any restoration project. Middleton points out the importance of selecting project objectives before the project is initiated, developing a maintenance plan, and a post project appraisal. Passive and active restoration approaches are examined, as well as re-engineering techniques.

Middleton devotes a chapter to revegetation alternatives, such as allowing natural revegetation to occur, using direct seeding techniques, and using donor seed banks. The author concludes the book with a chapter examining various case studies. The ever popular Kissimmee River project, the Murray-Darling River and Rhine River projects are examined.

Middleton includes a comprehensive glossary in the book. Discussion boxes highlighting particular topics, such as defining the term "restoration," case studies related to the topic of discussion, and ecological theory are also included in the book. The book includes many diagrams and pictures.

Middleton tackles a large topic with her book. Of course, a small book or even a large one cannot possibly touch on all of the issues involved in restoration. However, Middleton does alert the reader to many of the issues, both controversial and non-controversial. Over 1,200 works are included in the bibliography. An appendix is included that lists many Internet addresses of interest. Middleton points to plenty of reading materials for one wishing to venture further into one of the many topics discussed in, *Wetland Restoration, Flood Pulsing, and Disturbance Dynamics*.

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

The purpose of the Council is to provide for the exchange of information on the status, protection, and management of riparian systems in Arizona. The term "riparian" is intended to include vegetation, habitats, or ecosystems that are associated with bodies of water (streams or lakes) or are dependent on the existence of perennial or ephemeral surface or subsurface water drainage. Any person or organization interested in the management, protection, or scientific study of riparian systems, or some related phase of riparian conservation is eligible for membership. Annual dues (January-December) are $15. Additional contributions are gratefully accepted.

This newsletter is published three times a year to communicate current events, issues, problems, and progress involving riparian systems, to inform members about Council business, and to provide a forum for you to express your views or news about riparian topics. The next issue will be mailed in May, the deadline for submittal of articles is April 15, 2001. Please call or write with suggestions, publications for review, announcements, articles, and/or illustrations.

Paul C. Marsh
Department of Biology
Arizona State University
PO Box 871501
Tempe, AZ 85287-1501
(480) 965-2977; FAX (480) 965-2519
fish.dr@asu.edu
or
Cindy D. Zisner
Center for Environmental Studies
Arizona State University
PO Box 873211
Tempe AZ 85287-3211
(480) 965-2490; FAX (480) 965-8087
Cindy.Zisner@asu.edu

CALENDAR

4th National Mitigation Banking Conference, 18-20 April, 2001, Ft. Lauderdale, FL, Radisson Bahia Mar. The conference will be the 2001 update on mitigation and conservation banking, and offer targeted sessions for both experienced and beginning bankers. For more information, visit http://www.terrene.org or phone 800-726-5253.

The Equity of Riparian Conservation and Restoration Projects in the Phoenix Metropolitan Area: Is a Regional Planning Framework Needed? 25-29 April 2001, Memorial Union, Arizona State University, Tempe, AZ. A workshop to be held during the 2001 International Association of Landscape Ecology Symposium of the U.S. Chapter. For more information, please see the symposium web page at http://www.west.asu.edu/LEML/iale2001/.

Urban Riparian Areas in Arizona 11-12 May 2001, Four Points Sheraton, Tucson AZ. 15th Annual Meeting of the Arizona Riparian Council. For registration information please contact Cindy Zisner at Cindy.Zisner@asu.edu or (480) 965-2490.

BT5 1005
Center for Environmental Studies
Arizona Riparian Council
Arizona State University
PO Box 873211
Tempe, AZ 85287-3211

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