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The Importance of Dominant Plant Genetic Structure in Riparian Restoration

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Riparian restoration often involves transplanting plant propagules, and in Arizona, cottonwood and willow species (*Populus* spp. and *Salix* spp.) are some of the most commonly transplanted species due to their fast growth in disturbed environments. However, there is very little understanding of how to choose locally adapted plant stock with an adequate level of genetic diversity for the transplant site. Though it is known that the genetics of dominant plants drive many above- and below-ground ecosystem processes, and influence the arthropod, bird, and fungal communities that will colonize a site, there are large gaps in our knowledge about the genetic structure of natural populations at the watershed scale. Without this understanding, we are limited in our ability to restore plant populations. Only through future research, experimentation, and adaptive management procedures will we learn to develop best management practices for propagule movement – and these practices are likely to differ among plant species – but there may be ways to better reach restoration goals by considering plant genetics. Here, we discuss the importance of genetic diversity and structure in dominant plant populations, and suggest some questions to ask when planning restoration projects. For each group of questions, we will discuss ongoing relevant research specific to cottonwood trees that can guide land managers dealing with these common, and genetically diverse, species.

SGS in Natural Plant Populations

Spatial genetic structure (SGS) in plants results from an interplay of the plant's breeding system, geography, and evolutionary processes such as natural selection and genetic mutation (Hedrick 2000, Conner and Hartl 2004). The complexity of SGS within and among plant populations varies by species. For example, we might hypothesize that a wind-pollinated tree with wind-dispersed seeds would have a more homogenous structure with less differentiation among populations, than an insect-pollinated, heavy-seeded tree. Highly fragmented populations, isolated by long distances and complex topography, might exchange less pollen and seed and, therefore, be more differentiated from one another than contiguous populations (Mix et al. 2006). Within a given landscape, selective pressures might cause genetic differentiation between, e.g., a north-facing and a south-facing slope, or a riparian and an upland environment (Linhart and Grant 1996); trees with genetically controlled traits that predispose them to thrive on a sunny, well-drained slope might be the first to die if the site becomes inundated.

Geneticists and geographers have only recently begun to share the tools of their trade, and those tools have only recently become adequate for exploring most hypotheses about SGS. Nevertheless, a growing body of research reveals SGS in many dominant plants, at scales from microsite to continent-wide. An awareness of these patterns can increase the effectiveness of conservation actions, from prioritizing sites needing preservation to choosing plant propagules for restoration.

Conserving SGS in Riparian Habitats

While the field of conservation genetics has been mostly concerned with saving rare and endangered species (e.g., Frankham et al. 2002), the goals of riparian and wetland conservation are often concerned with the protection of a rare or endangered habitat type and its diverse dependent species

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Inside This Issue

PRESIDENT'S MESSAGE

Greetings Council members. I have the privilege to once again take the helm as President of the Arizona Riparian Council. Diana Stuart will serve as Vice President. For the first order of business, I want to extend a big thank you to Tom Hildebrandt and Roger Joos our out-going President and Vice-President. They have done a wonderful job the last 3 years getting the Council involved in many new activities as well as organizing our established ones. Tom started the Rapid Stream and Riparian Assessment (RSRA). He will continue to lead this work along with Tim Flood on assessing the riparian ecosystem along the Agua Fria River. It is anticipated that the data collected for this system will help the Bureau of Land Management to manage this beautiful area. If you ideas on other areas where RSRA could be used or if you want to get involved in the on-going efforts at the Aqua Fria, please contact Tom or Tim. We also had an At-Large Board Member position open which was tightly contested between Collis Lovely, Alicyn Gitlin, and Ron Tiller. Collis was elected to the position but both Alicyn and Ron will be helping us out and be more involved. We'd like to thank Charles Enos for his contributions during his term.

Over the years the Council has offered (albeit intermittently) social events as a way for Council members to gather and hear a speaker talk about a topic relevant to riparian areas or natural resources in general. Diana Stuart will be leading this activity. On June 19th Tom Hulen of the Arizona League of Conservation Voters spoke at the Sonora Brewhouse to a group about the upcoming election and the candidates. Diana has some speakers in mind for future events and if you have a suggestion for a topic and/or a speaker, she would love to hear from you.

Cindy Zisner, the Chairperson for the Education Committee, attends many outdoor nature festivals for the Council. She always can use help in manning the booth and coming up with ideas on how to relay the message on the importance of riparian areas to children and adults.

Of course one of our continuing activities is organizing our fall and spring meetings. We are currently planning the fall meeting and if you have any suggestions please contact me or anyone on the Board. Speaking of meetings, we are also starting the planning for the annual meeting next spring. Our last meeting at the Hassayampa Inn in Prescott was a huge success. We had over 100 people attend the morning plenary session where issues ranging from growth and endangered species to native fish and water quantity in the Verde River were discussed. I want to thank the seven speakers who spoke at the meeting. Their presentations gave some interesting perspectives on what is happening in the Verde River watershed and the audience was actively engaged and asked thought provoking questions. Tom Hildebrandt, Bill Werner, Tim Flood, Cory Helton, Nicole Brown, and Cindy Zisner did an outstanding job organizing the speakers, location, meals, and field trip. Thank you.

If you attended the meeting you might have noticed that two of our board members were conspicuously missing. It was for a very good reason, both were busy becoming new parents, Cory Helton and his wife have a new baby boy and Nicole and her husband are the proud parents of a little girl. Congratulations to both families!

If you have never organized a meeting, I strongly encourage you to get involved with the Council. It's a skill that is learned by experience and it helps you appreciate the next meeting you attend because you realize how much behind the scenes has to happen to make the meeting a success.

I look forward to the Council's future and the various activities we are doing. I encourage you to get involved and be a part of something that is working to maintain and improve Arizona's vital riparian areas.

Kris Randall, President
Arizona Riparian Council

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(Noss 1995). Dominant riparian plants such as willows and cottonwoods define habitat types by determining the structure and function of their local environment (Ellison et al. 2005). While willows and cottonwoods might be common within riparian habitats, it is the habitat itself that is rare.

Conserving genetic diversity and structure might seem less critical when planting common species than when planting rare species, but we argue that the genetic structure of dominant trees should be considered for several reasons. The survival of dominant trees, and the communities dependent upon them, requires the preservation and restoration of evolutionary processes and climatically resilient habitats (Noss 2005). The genetics of the dominant tree influence its dependent community composition and biodiversity, and experimental research on cottonwoods has found this effect aboveground, in the soil, and in the water (e.g., Whitham et al. 2003, Wimp et al. 2004, LeRoy et al. 2006, Schweitzer et al. 2008), an effect that has been observed at multiple scales (Bangert et al. 2008). Also, dominant tree genetics affect ecosystem-level processes such as aquatic and terrestrial litter decomposition, and water and nutrient cycling (Fischer et al. 2004, Schweitzer et al. 2004, LeRoy et al. 2006). Greater genetic diversity in a plant community increases its adaptability to climate change and survival during extreme events (Reusch et al. 2005, Harris et al. 2006).

Unfortunately, for those concerned with riparian conservation, watersheds have largely been ignored in genetic analyses. Although watershed boundaries serve as practical units for a variety of analyses, the streams themselves are inherently problematic study units. Most available spatial statistics packages can only analyze distributions along one, two, or three dimensions; no commercially available software can readily perform spatial statistics along a dendritic network. As a result of this limitation, researchers have avoided the watershed scale for spatial genetic analyses of riparian plants, instead studying stands (e.g., Sato et al. 2006), individual rivers (e.g., Martinsen et al. 2001), or very large-scale inter-watershed patterns (e.g., King and Ferris 1998). Without understanding patterns of genetic and ecological variation in the wild, we cannot create genetic structure in restoration sites to mimic natural populations. However, if we ask the right questions while planning restoration projects, we can apply currently available data to reach our goals.

SGS IN RESTORATION

It is becoming evident that the goal of ecological restoration needs to be the creation of the best possible habitat, based on the current and future potential of a site, rather than simply trying to recreate previous conditions (Harris et al. 2006). The practice of improving the habitat value of a site, without strictly attempting to return it to a previous state, is often called "enhancement" rather than "restoration." To enhance or restore habitat value, propagules are either imported from offsite or collected from adjacent, less damaged areas.

It is commonly considered a best practice in riparian restoration to choose plant propagules from the nearest geographic location to the restoration site. The presence of local plant stock, especially if it grows in a similar set of microhabitats, provides an easy, inexpensive source that is likely to be genetically similar to what occupied the site prior to disturbance, and is unlikely to introduce maladapted genes (O'Brien et al. 2007, Raabová et al. 2007). However, nearby locations are not necessarily ecologically similar, and might not support plants that are well adapted to the transplant site.

Ideally, natural plant populations should be surveyed to determine how much diversity exists in the wild. Genetic surveys are rarely performed during restoration due to financial and time restraints.

Genetic surveys reveal important information concerning patterns of gene flow, population structure, and breeding systems. These surveys do not reflect adaptation to local conditions, because most current technology relies on neutral genetic markers (Rice and Emery 2003).

Although geographically close sources are likely to be similar to what once grew on a site, it is important to realize that the remnant population might be genetically depauperate. Lack of genetic variation could have negative effects on the dominant plants and their habitat value. The plant population might be at a higher risk of extirpation during future climate fluctuations or pathogen outbreaks. Whether local or not, collections should be taken from the greatest variety of microsite conditions to ensure genetic variation, prevent a founder effect, and enable evolutionary processes to occur (Lesica and Allendorf 1999, McKay et al. 2005). Although local collections will maximize the chance of capturing populations that have coevolved with local communities (Thompson 1982), genetically diverse dominant plants will attract a more diverse assemblage of organisms (Whitham et al. 2003, Wimp et al. 2004).

Recent research has indicated that ecological similarity is more important than genetic similarity or geographic closeness when selecting highly adapted propagules (O'Brien et al. 2007, Raabová et al. 2007), especially across moisture gradients (Andalo et al. 2005, O'Brien et al. 2007). Although local plant sources should be best adapted to recent environmental conditions (O'Brien et al. 2007, Raabová et al. 2007), the present and future conditions at a location may differ significantly from the past (Jones 2003, Andalo et al. 2005, Harris et al. 2006).

While introducing genetic variation can enable evolutionary processes and encourage adaptation to future conditions (Harris et al. 2006), it is possible that mixing local and nonlocal genotypes can cause decreased fitness after two or more generations as genes recombine (Hufford and Mazer 2003). This risk appears to be part of the evolutionary process. Immediate selection on seedlings can quickly eliminate poorly adapted plants, and selection over time will favor a better adapted population (see O'Brien et al. 2007, Harris et al. 2006). Since selection is stronger on seedlings than adult plants, using only juvenile or seed stock can help to eliminate maladapted genes more quickly (Bischoff et al. 2006, Raabová et al. 2007).

TREE SOURCES FOR RIPARIAN RESTORATION: QUESTIONS TO ASK

Site Ecological Potential

Questions include: What is the site like now (hydrologically and climatically)? What will it be like in the future? Might some trees be genetically predisposed to survive and reproduce at this particular location?

Cottonwoods. If a site is determined to be suitable for cottonwoods, then flow regime is probably the most important factor determining whether the stand will be able to successfully produce future generations (see Rood et al. 2005 and references therein; Stella et al. 2006). Both climate change and dams are changing the timing of flood peaks(Barnett et al. 2004). If reproductive phenology is triggered by temperature cues, then warmer temperatures might trigger earlier seed release, keeping pace with climate warming. However, there is evidence that the required temperature cues are specific to certain locations within watersheds (Stella et al. 2006). It may be desirable to move trees from rivers where upstream watershed area, climate pattern, and flood peaks are similar to the current and future hydrology, so that seed set coincides with future high flows and promotes seed establishment. Selecting a mix of trees from drought prone areas may increase survival in locations that have greater depths to groundwater, more saline soils, and higher temperatures than historical norms.

If the site is extremely unlikely to flood, then naturally occurring hybrids should be considered. First-generation hybrids between the two cottonwood species found in Arizona, Fremont (*P. fremontii*) and narrowleaf cottonwood (*P. angustifolia*), had greater survival during recent drought years (Gitlin 2007). They are capable of clonally spreading via root sprouts, enabling retention of aboveground biomass even in the absence of flooding and in the presence of fire (Gom and Rood 1999, Schweitzer et al. 2002). Hybrids are capable of supporting a large dependent community (Martinsen and Whitham 1994, Whitham et al. 1999, Wimp et al. 2004). They are unlikely to breed with low elevation broadleaf cottonwoods and unlikely to cast their own seed (Keim et al. 1989, Martinsen et al. 2001). More experimentation is needed to explore their tolerance of extremely high temperatures.

Restoration Goals

Questions include: What are the target conditions? Are there target species or communities to be conserved? Is there a local community of species that coevolved with local tree genotypes? Are there nearby source populations of undesirable plants, or rare plants nearby that shouldn't be crowded out?

Cottonwoods. If cottonwood habitat is desirable at the restoration site, then the target wildlife species should be considered when choosing what trees to plant and how to arrange them. High levels of genetic diversity in dominant plants like cottonwoods have been shown to support more diverse dependent communities than genetically similar stands (Whitham et al. 1999, Wimp et al. 2004). If beaver browsing is likely to remove cottonwoods faster than you can plant them, try to plant trees with varying levels of condensed tannins, a genetically controlled trait that affects how palatable the trees are to beavers (Bailey et al. 2004). If dense groundcover is desired, consider hybrids that can reproduce clonally; if a large local seed bank or a healthy understory is present, you may want to choose species that do not tend to clone.

Reference Conditions

Population Structure. Questions: What is the genetic structure of wild populations? What is a common level of diversity in wild populations?

Cottonwoods. Fremont cottonwoods in the southwestern states of AZ, UT, CA, and NV belong to three “genetic groups” that loosely correspond to the different rainfall regimes of the Great Basin, Mojave, and Sonoran deserts (Honchak 2007). These groupings may be indicative of broad scale adaptations to different eco-regions. There may be reason to keep these groups intact. Movement between different deserts should be justified based on projected climate changes or other environmental conditions.

At a finer scale, sampling of natural stands indicates that a sample of 30 to 50 Fremont cottonwoods will capture a level of genetic diversity representative of a natural stand (Honchak 2007). There is evidence that position within the watershed drives adaptation to flood regime and reproductive phenology (Stella et al. 2006). Size of upstream watershed, average monthly temperatures, and average timing of peak flood should be considered. To maximize genetic variation and encourage reproduction, it may be desirable to collect trees from a variety of sites with similar flood hydrology.

Summary and Future Research

Increasing genetic diversity of dominant plants in restoration sites should help land managers reach their goals of creating sustainable plant communities and increase habitat value. A genetically diverse stand of trees will be better able to deal with climatic and hydrologic changes, and will support a more diverse dependent community of organisms as well.

The Cottonwood Ecology Group at Northern Arizona University is currently testing these hypotheses by planting cottonwoods and willows in common gardens, where environmental variation is minimized and the community of organisms that colonize each site can be monitored across time. In cooperation with the Bureau of Reclamation and partially funded by the National Science Foundation, 30,000 trees have been planted on the Cibola and Palo Verde National Wildlife Refuges along the Lower Colorado River. Meanwhile, genetic surveys and ecological studies of cottonwoods and willows continue, in cooperation with collaborators across the country, so that we can increase our awareness of how genetics and ecology interact in the wild.

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SPECIES PROFILE

CANYON RAGWEED (*AMBROSIA AMBROSIOIDES*)

by Carol Birks, Arizona Department of Water Resources

Ahcoo!!! If you have allergies you probably know this plant or are affected by it because canyon ragweed or canyon bursage pollen is a known allergen and the plant is very common along desert washes (xeroriparian), canyons and draws in central and southern Arizona. It is a medium-sized rounded shrub, with a cluster of woody stems up to 4 feet tall. The deciduous leaves are 6-8 inches long and 1-2 inches wide, elongated triangles or lance shaped with coarsely toothed margins. There is a sticky pubescence on the underside of the leaf and the plant emits a pungent odor.

The plant is monoecious meaning there are separate male and female flowers on each plant. The small, green male and female flowers grow in a terminal spike. The male flowers, producing the pollen, are positioned above the female flowers on the flower stalk. This arrangement increases pollination since the pollen grains are light and float to the waiting female flowers below. This also makes the pollen easily carried in the wind and that makes seasonal allergy sufferers miserable. Seeds of canyon ragweed resemble cocklebурs and are easily transported because they stick to fur and clothes.

Canyon ragweed is important in several ways. It is an early participant in the desert food chain. Certain aphids, beetles and butterflies use this plant to lay their eggs and the emerging larvae attract insectivorous birds and lizards. Also the leaves may have small green blisters on their surface. They are produced by the plant in response to a microscopic mite that feeds on the leaves.

Canyon ragweed also has medicinal benefits. Even though the pollen of this plant causes suffering in many people, preparations from the leaves have general anti-inflammatory properties and may reduce the antibody responses that initiate the allergy process. Rhinitis, overall body itchiness and hives are reduced with leaf preparations. Even though the pollen is not used in homeopathic remedies, highly sensitive people need to be careful and all should use the leaf preparations for only a short time. Harvest the leaves when they are dark green and aromatic, usually mid-spring and after the monsoons; the more aromatic the plant the greater the medicinal value.

The roots are beneficial too. They are well known as a menstrual stimulant and reliable for relieving menstrual, stomach and intestinal cramps. Root preparations are especially effective for acute viral distress and diarrhea. Roots are collected during the winter and spring months after a rain when they are actively growing. Since the roots grow 3 to 4 feet deep, collecting them in sandy washes is easiest and less damaging to the plant. Even though the plant is regionally abundant do not remove the entire root ball; trim the side roots and replace the main root mass so it can be harvested again in a few years.

The desert is a harsh place to live and that limits the number and types of species that inhabit this environment. Just like there are no good or bad children, just bad behaviors, there are no good or bad plants only plants with unpleasant properties. Canyon ragweed is a good example of a plant with a bad rap. It is not particularly pretty and it makes MANY people miserable, but it has an important place in the desert ecosystem and reliable beneficial medicinal properties.

Canyon ragweed. Photograph by C Birks.

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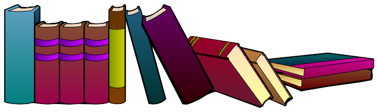

NOTEWORTHY PUBLICATIONS

by Elizabeth Ridgely, One Green World, LLC

Scott, R. L., T. E. Huxman, D. G. Williams, and D. C. Goodrich. 2006. Ecohydrological impacts of woody plant encroachment: Seasonal patterns of water and carbon dioxide exchange within a semiarid riparian environment. *Global Change Biology* 12:311-324.

Encroachment by mesquite may be the most pervasive vegetative cover change in the southwestern United States. The continuing change in vegetation will affect water and nutrient cycling, and it could be used to predict the outcomes of the changes in the ecosystem. To this end, a study was conducted of the consequences of mesquite encroachment on water and carbon exchange in a Southwestern riparian area along the San Pedro River.

Across many dryland regions, historically grass-dominated ecosystems have been encroached upon by woody plant species. A comparison of ecosystem water and carbon dioxide fluxes over a grassland, a grassland-shrubland mosaic, and fully developed woodland were used to evaluate potential consequences of woody plant encroachment on these ecosystem exchanges. All three sites were located in the riparian corridor of a perennial river in the southwest United States. Plants in these ecosystems, unlike their upland counterparts, may have access to the additional source of moisture at the capillary fringe of the near-surface water table.

Using eddy covariance fluxes measured in 2003, it was determined that ecosystem evapotranspiration and net carbon uptake increased with the amount of woody plants. Growing season evapotranspiration totals were 407 mm, 450 mm, and 639 mm in the grassland, shrubland, and woodland, respectively. While all sites had evapotranspiration in excess of precipitation, which was 227 mm, 265 mm, and 473 mm, respectively. Therefore, the sites increased in groundwater, especially during the extremely dry pre-monsoon period when plants had leafed out, but soil surface moisture was unavailable.

The greater access to groundwater for the deeper-rooted woody plants apparently caused a decoupling of ecosystem evapotranspiration from gross ecosystem production (GEP) with respect to precipitation. The woody plants were better able to use the stable groundwater source, which increased net carbon gain during the dry periods, but also potentially decreased net carbon gain during rainy periods. This was thought to be due to high microbial respiration from decomposition of accumulated leaf litter.

It was estimated that for April through December, the primary growing season, totals of carbon dioxide flux were 63 g C m^{-2}, 212 g C m^{-2}, and 233 g C m^{-2} in the grassland, shrubland, and woodland, respectively. This indicated a strengthening sink of carbon at the woodier sites that did not correlate with ecosystem water use. Despite a higher density of woody plants and a greater productivity than the shrubland, the mesquite woodland had a much higher respiration response to rainfall that largely offset its higher accumulation of carbon. The initial data suggests that the ability of the woody plants to better exploit water resources in riparian areas results in enhanced carbon sequestration at the expense of increased groundwater use under current climate conditions.

The results of the study suggest that the deep roots of mesquite will lead to an increase in ecosystem water use as the invading mesquites mature in former grasslands. The ability of mesquite to acquire stable groundwater sources, rather than precipitation, enhanced net carbon uptake in the dry periods and net carbon loss in rainy periods. The results imply that mesquite encroachment in riparian areas will increase groundwater use and lead to additional carbon sequestration. Water sources and ecosystem structure have important roles in the control of water and carbon balances in dry areas.

Legal Issues of Concern

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Legal Developments: Pinto Creek and the Carlota Copper Mine

**Editor's Note: The viewpoints expressed in this article do not represent the viewpoints of the EPA or the United States, and are the author's alone.*

In October 2007, the Ninth Circuit Court of Appeals in *Friends of Pinto Creek v. United States EPA*, 504 F.3d 1007 (9th Cir. 2007), concluded that the Environmental Protection Agency (EPA) improperly issued a National Pollution Discharge Elimination System (NPDES) permit under the federal Clean Water Act (CWA) to Carlota Copper Company (CCC) allowing mining-related discharges of copper into Pinto Creek, a waterbody already in excess of water quality standards for copper. The Ninth Circuit vacated and remanded the NPDES permit back to EPA, i.e., instructed EPA to issue the NPDES permit to CCC in a manner consistent with the Ninth Circuit's decision.

Background

Pinto Creek is located near Miami, Arizona, approximately 60 miles east of Phoenix. It has been listed by the American Rivers Organization as one of the country's most endangered rivers due to threats from proposed mining operations and excessive copper contamination from historical mining activities in the region. Pinto Creek contains riparian habitat for a variety of fish, birds, and other wildlife, including species listed under the Endangered Species Act. Pinto Creek is included on Arizona's list of impaired waters under §303(d) of the CWA as a "water quality limited stream" due to non-attainment of water quality standards for dissolved copper. As such, the Arizona Department of Environmental Quality (ADEQ) was required under the CWA to establish a Total Maximum Daily Load (TMDL) for copper in Pinto Creek, which specifies the maximum amount of copper that can be discharged or loaded into Pinto Creek from all combined sources. The intent behind the TMDL is to eventually bring Pinto Creek into compliance with Arizona's water quality standard for copper.

In the 1990's CCC proposed to construct and operate an open-pit copper mine and processing facility (the "Carlota mine") covering over 3,000 acres (1,400 acres of which are located in the Tonto National Forest), including portions of Pinto Creek and a tributary by the name of Powers Gulch. CCC's operation plans include constructing diversion channels for Pinto Creek to route the stream around the Carlota mine, as well as groundwater cutoff walls to block the flow of groundwater into the mine. The Ninth Circuit found that both channels would eventually add pollutants, including copper, into Pinto Creek especially from the groundwater that CCC will be directing into the channels for discharge into Pinto Creek.

In compliance with the National Environmental Policy Act (NEPA), the U.S. Forest Service prepared an Environmental Impact Statement (EIS), after determining the project would potentially have a significant impact on the environment. The Army Corps of Engineers also prepared an Environmental Assessment (Corps EA) covering the physical construction of the proposed diversion channels redirecting water from Pinto Creek and the Powers Gulch stream around the mine and into Pinto Creek. Because the proposed action would involve the discharge of pollutants into Pinto Creek, CCC applied to the EPA in 1996 for an NPDES discharge permit pursuant to Section 402 of the CWA. CCC proposed to offset the discharges of copper from the Carlota Mine by working to stop discharges of copper from a closed mine upstream known as the "Gibson Mine," which was still leaking copper into Pinto Creek. After EPA issued the permit, the Western Mining Action Project, Friends of Pinto Creek, and the Grand Canyon Chapter of the Sierra Club, among others (collectively referred to as the Petitioners) challenged EPA's issuance of the NPDES permit and the legality of the Gibson Mine offset to the Environmental Appeals Board (EAB), which is the internal appellate board of the EPA. The EAB denied Petitioners' claims and ruled that the EPA had indeed properly applied the CWA to allow for the "off set" as proposed in the Carlota Mine NPDES Permit. In re Carlota Copper Co., 11 E.A.D. 692, 784 (EAB 2004).

The Ninth Circuit Decision

In their appeal of the EAB decision to the Ninth Circuit, the Petitioners contended that as a "new discharger" CCC's proposed discharge of dissolved copper into a waterway that was already listed as impaired for copper in ADEQ's CWA section 303(d) List violated the intent and purpose of the CWA, which is "to restore and maintain the chemical, physical, and biological integrity of the nation's waters." EPA countered that CCC's agreement to partially remediate discharges to Pinto Creek emanating from the defunct Gibson Mine upstream would offset the copper pollution discharged from the Carlota Mine.

The Ninth Circuit concluded that it found nothing in the CWA or its regulation to provide an exception for an offset such as the one proposed by CCC (i.e., the Gibson Mine offset) when the waters in question remain impaired and the new source is discharging pollution into that impaired water (Friends of Pinto Creek, 504 F.3d at 1012). Although EPA had argued that this approach would amount to a complete ban of discharges of pollution to impaired waters, the Ninth Circuit maintained that the regulation made clear that the Gibson Mine remediation proposed by CCC would have to be completed before CCC could discharge additional pollutants to Pinto Creek. (The language of the CWA regulation in question, 40 C.F.R. §122.4(i)(2), provided that existing discharges into that segment (of the waters) are "subject to compliance schedules designed to bring the segment into compliance with applicable water quality standards.") Thus, the Ninth Circuit found that its decision did not constitute a complete ban on discharges to impaired waters but rather a recognition of a regulatory requirement that a schedule would have to be developed in order to bring the Pinto Creek segment at issue into compliance with Arizona's water quality standards. The Ninth Circuit concluded:

> The error of both the EPA and Carlota is that the objective of [40 C.F.R. § 122.4(i)(2)] is not simply to show a lessening of pollution, but to show how the water quality standard will be met if Carlota is allowed to discharge pollutants into the impaired waters. (Id. at 1014).

The Ninth Circuit then proceeded to vacate and remand the NPDES permit back to the EPA for further proceedings consistent with its opinion.

NEPA

In its decision, the Ninth Circuit also considered whether EPA had complied with the requirements of the NEPA. But because the court had already held that the NPDES permit was improperly issued it chose not to consider the NEPA violations at this time (Friends of Pinto Creek, 504 F.3d at 1017). Thus, CCC's compliance with NEPA remains an outstanding issue.

Subsequent Developments

CCC petitioned the Ninth Circuit to rehear the case but on March 7, 2008, the Ninth Circuit denied CCC's petition for a rehearing (no judge requested a vote on CCC's petition). Normally, the Ninth Circuit's decision in Friends of Pinto Creek would at this point take effect, and become legal precedent within the Ninth Circuit (i.e., the States of Alaska, Arizona, California, Hawaii, Idaho, Montana, Nevada, Oregon, and Washington), within seven days of the Ninth Circuit's denial of CCC's request for a rehearing. However, CCC petitioned the Ninth Circuit for a "stay" of its decision (i.e., asked the Ninth Circuit to prevent the decision from taking legal effect) pending CCC's filing of an appeal to the U.S. Supreme Court. On March 17, 2008, the Ninth Circuit granted the stay and decided that the stay would continue until final disposition of this case by the U.S. Supreme Court. CCC had until June 5, 2008 to file its appeal (known as a "petition for writ of certiorari") to the U.S. Supreme Court. If the U.S. Supreme Court denies CCC's petition, then Friends of Pinto Creek becomes the law in the Ninth Circuit.

Editor's note at press time: Carlota filed its appeal to the Supreme Court on June 4, 2008 (known as a "petition for writ of certiorari"). (Source: <http://www.supremecourtus.gov/docket/07-1524.htm>).

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, 2008. Please call or write with suggestions, publications for review, announcements, articles, and/or illustrations.

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CALENDAR

Arizona Riparian Council Board Meetings. The Board of Directors holds monthly meetings the third Wednesday of each month and all members are encouraged to participate. Please contact Cindy Zisner at (480) 965-2490 or Cindy.Zisner@asu.edu for time and location.

Arizona Riparian Council Dinner Meetings. Meetings with guest lecturer and dinner at the Sonora Brewhouse, Phoenix. Contact Diana Stuart (602) 506-4766 or dms@mail.maricopa.gov about upcoming events.

July 17, 2008: Ray Schweinsburg: The Wildlife Corridor Linkages Project
Sept 18, 2008: Patricia Gober: Water Supply Challenges in Urban Areas
Nov. 13, 2008: John Brock: Range Management for Riparian Health
Jan 22, 2009: (Speaker TBD - Probably in Tucson)

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