Research Networks and Large-Landscape Conservation and Restoration: The Case of the Colorado River Delta

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Abstract

In arid regions, water transforms the land. Water diverted from riparian zones, wetlands and estuaries decreased diversity and ecosystem services on the Colorado River delta. But in the case of the delta's Ciénega de Santa Clara, agricultural wastewater from the U.S. accidentally created and now sustains a 6,000 hectare wetland in Mexico. Diversion of this water to a U.S. desalting plant threatened conflict between U.S. water agencies and environmental groups, and between the U.S. and Mexico. Thanks to bi-national negotiations and far-sighted individuals, both conflict and environmental damage was averted. A pre-existing bi-national research coordination network of academic and NGO scientists was able to monitor the wetland environment during a trial run of the desalting plant. University scientists, working with NGO and agency partners, can provide objective counsel to lessen the chances for conflict and universities can provide neutral ground, financial accountability and flexibility in complex environmental decision-making. Academic scientists can be effective advocates for large landscape conservation.

About the Author

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Water Transforms the Land

In southwestern North America, water transforms landscapes. In the Colorado delta region of the southwestern U.S. and northwestern Mexico, diversion of Colorado River water in the early 1900s transformed a dry lake bed and delta plain into agricultural fields. Downstream, wetlands and channels—along with their cottonwood trees, willows and mesquites—dried up, creating a bleak landscape of bare dirt and salt flats.

A Conservation Story with a Happy Ending

In 1977 another transformation took place when the U.S. sent brackish water down a concrete-lined ditch to a patch of bare dirt and salt flats along the lower delta's eastern margin in Sonora, Mexico. The water, from beneath farm fields in Arizona's Gila Valley, was too salty to send back into the Colorado River. Doing so would violate the terms of the treaty between the U.S. and Mexico. A new addition to the treaty had limited the salinity of the water that the U.S. was obliged to deliver to Mexico. By terms of the treaty, the U.S. was permitted to dump this salty water south of the border. Too salty for crops and too salty to drink, it wasn't too salty for cattails, bulrush and common reed. The open water and vegetation of this new wetland provided habitat for migratory birds, resident marsh birds, carp, desert pupfish, and other wildlife.

Residents of the local ejidos, or community farms first noticed this unintentional wetland and it was given its name "Ciénega de Santa Clara" (figure 1) by a University of Arizona environmental scientist in 1992 (Glenn et al., 1992): "Ciénega" meaning either spring or wetland, and "Santa Clara" from the trace of a former drainage channel, Estero Santa Clara (Sykes, 1937) near the wetland.

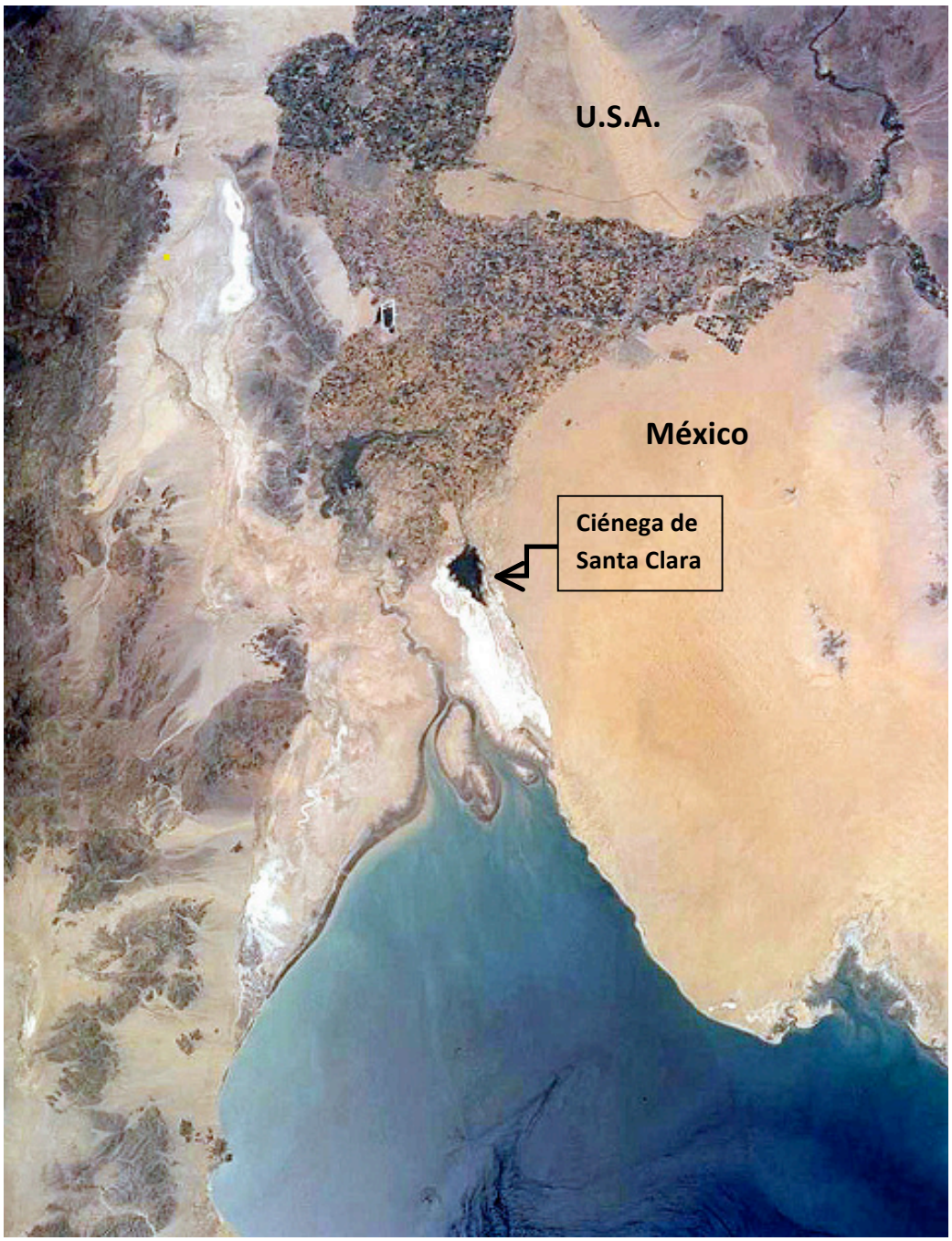
While completely dependent on the delivery of brackish groundwater from the U.S., the Ciénega de Santa Clara became, at 6,000 hectares (15,000 acres) the largest wetland on the Mexican part of the Colorado River delta. A rest stop along the Pacific Flyway for migratory birds, the Ciénega is habitat for species listed as endangered or threatened in both countries, including the Yuma Clapper Rail, a marsh bird, and desert pupfish. A small ecotourism enterprise, catering to birdwatchers is based in an adjacent farming community and guides have been trained by U.S. and Mexican environmental organizations.

Extensive research efforts, most based at the University of Arizona, established the characteristics and ecological value of the Ciénega (e.g., Glenn et al., 1992, 1995, 1996, 2001; Hinojosa-Huerta, et al., 2001, 2006; Zengel et al., 1995)

The Ciénega de Santa Clara is also an accidental homage to the "green lagoons" visited by Aldo Leopold in 1922. Leopold's green lagoons were somewhere nearby. "All this was far away and

long ago," he wrote in 1949. "I am told the green lagoons now raise cantaloupes. If so, they should not lack flavor." (Leopold, 1949) The green lagoons are back, now constructs of human activity, not nature. But they are no less valuable for it.

Figure 1. Colorado River Delta and upper Gulf of California.



In 1993, a presidential decree established Mexico's "Reserva de la Biosfera Alto Golfo de California y Delta del Río Colorado" (Upper Gulf of California and Colorado River Delta Biosphere Reserve, or Biosphere Reserve hereafter) a federally protected natural area that encompasses the Colorado River's estuary, delta tidal flats, lowermost channel, and wetlands—including the Ciénega de Santa Clara. The northern part of the Ciénega de Santa Clara lies with a zone—commonly called the "buffer zone"—that permits the sustainable use of natural resources, including fishing, tourism and ecotourism. The southern portion lies with the "Zona Núcleo" or core region of the Biosphere Reserve, where only activities such as research, monitoring, control of introduced species, ecotourism, restoration, and environmental education are allowed (SEMARNAT, 2007).

In 1997, the wetlands of the Colorado Delta, including the Ciénega de Santa Clara, were added to the List of Wetlands of International Importance under the Ramsar Convention. In 2005, the Ciénega de Santa Clara was identified as a "conservation priority" area by an international group of environmental NGOs (Zamora-Arroyo et al. 2005).

Meanwhile, back in the U.S., the Bureau of Reclamation, the federal agency responsible for the storage, management and delivery of Colorado River water to U.S. states and to Mexico, completed construction of a desalting plant near Yuma, Arizona. The Yuma Desalting Plant (YDP) was built to help meet the treaty requirement to deliver water to Mexico that was equal in quality to that used on U.S. farms. After a brief trial run, the YDP was mothballed and water quality standards were met by other, less expensive means, including the release of additional water from Lake Mead, an upstream reservoir.

By 2004, the Colorado River Basin was in a drought. Water levels in the two principal reservoirs, Lake Mead and Lake Powell, had fallen to worrisome levels. As the southwestern cities continued to grow, demand for water continued to increase. In addition, the Metropolitan Water District of Southern California (MWD) was facing limits on the importation of water from northern California because its pumps were affecting an endangered fish.

MWD, together with the Southern Nevada Water Authority (SNWA), provider of Colorado River water to Las Vegas, and the Central Arizona Project (CAP), provider of Colorado River water to Phoenix and Tucson, proposed a trial run, at one-third capacity, of the Yuma Desalting Plant, principally at their expense. These agencies wanted to know if the YDP was an economical way to augment existing supplies.

The water for the plant would come from the water in the canal that fed the Ciénega de Santa Clara. One-third of the salty ground water would be diverted to the YDP before it crossed the border into Mexico. All that water belongs to the U.S. and the U.S. is entitled, by treaty, to use it as it sees fit. The desalted water would then be delivered to Mexico via the river's main channel, helping the U.S. meet its treaty obligation and a similar volume could then be held in storage in an upstream reservoir for future use. The brine from the desalting process would be directed to the canal that supplies the Ciénega de Santa Clara.

Saltier water, and less of it, would likely harm the Ciénega de Santa Clara; it would become smaller as its wet footprint was reduced and as saltier water killed or changed the vegetation. A

smaller Ciénega would provide less habitat for migratory and resident birds—including endangered species.

NGOs were upset. Legal remedies were not apparent. Courts had earlier held that the U.S. Endangered Species Act did not apply to the consequences of U.S. activities beyond the borders of the U.S.

Seeing protracted conflict ahead, Sid Wilson, then director of the Central Arizona Project, sought a solution that did not involve expensive litigation, public feuds with environmental groups, and the enmity of the Mexican government. He convened an ad hoc working group that included individuals from the major water agencies, from the Bureau of Reclamation, and from key environmental NGOs. The resulting report (Yuma Desalting Plant/Cienega de Santa Clara Workgroup, 2005) provided the guidelines for what happened next. The group supported operation of the YDP on the condition that no harm would come to the Ciénega de Santa Clara.

Preparations to operate the YDP for a one year period continued, but now with Mexican representation, through the International Boundary and Water Commission and its sister agency in Mexico, the Comision Internacional de Limites y Aguas—the agencies responsible for administering the water treaty. Mexican water agencies and Mexican environmental NGOs were also invited to the negotiating table.

Conflict was avoided in two ways:

1. An agreement to replace the water that would be directed to the YDP. One third of the so-called "arranged" water would come from the U.S., one-third from Mexico, and one-third from a bi-national collaboration of NGOs. Flow to the Ciénega would not be reduced and its quality would be unchanged.

2. The Ciénega de Santa Clara's hydrology, water quality, vegetation and bird populations would be monitored before, during and after the trial operation of the YDP. The water agencies would fund the monitoring effort.

The replacement water and the monitoring program required an addition to the treaty: Minute 316, signed in 2010, marks the first time that water allocated for environmental purposes was allowed to cross the border. Because it was a temporary arrangement, many emphasized that this transboundary flow for environmental purposes was not a precedent for such flows in the future. Of course, whenever people go to great lengths to say that something is not a precedent, it is clearly a precedent.

And finally, the happy ending—for now: The Yuma Desalting Plant ran successfully, the replacement water was delivered, and the monitoring program completed, without detecting any lasting harm to the Ciénega de Santa Clara. Plant engineers are happy, water agencies are happy, environmental NGOs are relieved, and Mexican interests have been respected. This is a good news story about western water and a good news story about transboundary water.

The Role of Research Networks

Academic institutions and research networks don't play a large role in this story—and that may be as it should be. Far-sighted individuals from NGOs and agencies deserve the greatest credit.

A research network based at the University of Arizona made its contribution by organizing the team of scientists that monitored the Ciénega de Santa Clara during the trial run of the YDP. The fact that that bi-national team could be assembled and deployed on very short notice is the result of a formal Research Coordination Network funded by the U.S. National Science Foundation in 2004, with the author as the Principal Investigator. Research Coordination Networks (RCNs) are intended to stimulate and facilitate interdisciplinary research.

The goal of the Research Coordination Network: Colorado River Delta was to investigate the coupled human-natural system of the Colorado River Delta. In less than 100 years, the water that supported its natural and human-modified ecosystems had passed from the short-term control by weather and natural geomorphic processes into the control by human activity. How did that happen and what are the consequences for the future? This RCN sought to facilitate interdisciplinary, inter-institutional and international research on those questions. The RCN did so by hosting bi-national workshops and field trips that included scientists and other scholars from academic institutions, NGOs, and agencies It also supported travel of students to professional meetings, hosted a website, distributed a newsletter, and provided support for pilot projects and workshops that would enhance the chances for additional funding of research on the Colorado River Delta. As a result of these activities, participants came to know each other better, came to trust each other, and developed collaborative projects.

When the CAP, acting on behalf of the three major southwestern water agencies, approached me to find out if I could administer a monitoring program for the Ciénega de Santa Clara during its trial operation, I was able to say yes, thanks to the collaborations and mutual trust that had been established by the formal RCN. Frankly, we were not just the best group to do the job, we were the only group who could do the job. We were the group of scientists who knew the area best and already knew how to work together. Hiring a U.S. consulting firm to do the job was out of the question—not only would they lack knowledge of the area, they could not have gotten the necessary permits from Mexican agencies.

We are proud to have developed trust among individuals from academic institutions, NGOs and agencies on both sides—and across the border. And we are proud to have facilitated—in any small way—a new, and we hope lasting effort at bi-national collaboration on environmental protection and restoration.

Lessons Learned from the Colorado River Delta: Large Landscape Conservation

Water transforms landscapes in arid parts of the world. The habitats that support the greatest biodiversity and produce the most ecosystem services are wet or damp ones. Allocating water can be just as important as protecting land.

In southwestern North America, water is regulated by a complex and often inflexible legal and physical infrastructure. High value landscapes in such regions can't depend on water that falls from the sky. Water needs to be delivered and actively managed.

The Colorado River Delta is a bi-national landscape. Challenges for large landscape conservation increase greatly when the size of the two countries' economies differ, when there is no common language, and when legal systems and policies regarding water and environmental protection differ. These differences can also work in favor of conservation efforts. For example, research funding and student support can move across the border more easily than water. Mexican water law is more flexible with regard to allocations of water for nature than the Colorado Basin states' "Law of the River". Water in Mexico is regulated be national policy, whereas the states play a larger role in the U.S. If an approach doesn't work in one country, it might work in the other.

As in many delta settings (Sacramento–San Joaquin Rivers, Yellow River, Rhine–Meuse–Scheldt rivers), most of the Colorado River's Delta has already been transformed for human use. Few, if any, natural areas remain. Under these circumstances, large-landscape *restoration* is the challenge that we face.

Lessons Learned from the Role of the University of Arizona

The University of Arizona is a large, public, land grant, research university. Its mission statement makes no mention of the importance of large-landscape conservation.

In 2011, the University of Arizona budget exceeded $1.8 billion dollars, with $618 million (33%) coming from state appropriated funds, including tuition. The remaining funds came from grants, contracts, donations and proceeds from a relatively small endowment. Most of those grants and contracts resulted from the efforts of individual faculty and research scientists. Indeed, faculty—especially those in the sciences, engineering and health-related fields, are encouraged to think of themselves as entrepreneurs—bringing in, from external sources, the funds needed to support their research, their students, their scholarly publications, and to bring their cutting-edge knowledge into the classroom. That way, everyone benefits.

To the extent that an individual faculty member—or a team of them—dedicates efforts toward large-landscape conservation, then the university can be said to be dedicating such effort. In such a way, universities provide the business services and financial accountability needed for such efforts, some flexibility in how funds are spent, the students who work on such projects, and the office space and research facilities. While this is a substantial contribution, the principle is that the research should pay for itself. The institutional subsidy, if any, is modest.

That said, the role of students in academically-based research in large-landscape conservation is vital. Students often end up doing the hard work in the field and lab for relatively little monetary reward. Their long-term contribution can be enormous when they go on to careers in relevant NGOs, agencies, or other academic institutions. The Colorado River Delta has served as a natural laboratory and training ground for dozens of people who are now conservation practitioners and leaders. Indeed, individual faculty advisors and mentors—and the University of

Arizona—takes great pride in the many graduates of its environmental programs who are now in Mexican universities, agencies and NGOs. In many cases, their education was supported by grants from the Mexican government, as well as grant support from their advisors or as teaching assistants supported by the university. Certainly one important mission of a research university is increasing the scientific capacity of institutions that serve society in some way.

One of the ways in which universities serve society is through research that serves state, national, and international needs. While such efforts as seeking a cure for cancer or increasing fuel efficiency are not controversial, not all research is so universally valued by the public. While large-landscape conservation seems benign, it is not without the potential for conflict. The sagebrush rebellion and its descendant movements asserted the primacy of local control over public lands and their exploitation. One person's protected area is another person's productive land that has been "locked away" from wise use.

The Colorado River is already over-allocated—dedicating water for nature in the Colorado River Delta can mean that some existing water user will get less without adequate compensation. The aphorism attributed to Mark Twain is apt here: In the West, whiskey is for drinking; water is for fighting. For example, the University of Arizona's alumni magazine published an article about my work on the value of ecosystem services lost due to large-scale diversions of Colorado River water. This does indicate that the university values my efforts. The article prompted a letter to the editor in the next issue that stated "Flessa should go jump in the Colorado River and stay there."

I don't mean to sell the roles of universities short, I seek only to be realistic about their roles. In the case of the Colorado River Delta, The University of Arizona provided neutral ground and funding flexibility. The oft-used metaphor is that of a Switzerland for such efforts. In addition to chocolate and clocks, Switzerland is known for its neutrality. Precisely because large-landscape conservation is not in the mission statement of the University of Arizona, there is no conflict of interest. The university's success does not depend on the success of a particular effort at large-landscape conservation. Both agencies and NGOs can depend on university scientists to provide objective, or at least independent, analyses of facts. University scientists are, unlike politicians and attorneys, still held in high regard by the general public. When inclined to do so, academic scientists can work with all stakeholders precisely because they are not stakeholders themselves.

The university as a Swiss bank, the other allusion to Switzerland, is less appealing, though it can be just as important. While this can imply financial deals that are hidden from view, such is decidedly not the case with the transparent and highly regulated practices of university business offices. In the case at hand, the University of Arizona could subcontract with NGOs and disburse funds to Mexican institutions. Such activities can be difficult or impossible for water agencies. But no one is hiding anything.

Lessons Learned on the Role of Academic Scientists

It is hard to imagine academic scientists being effective at large-landscape conservation by acting only within their institutions. One major lesson learned from the case of the Colorado

River Delta is that partnerships with NGOs and agencies are vital. As universities and funding agencies seek to speed up the transition from basic research to beneficial application, there is likely no better pathway than that provided by working in collaboration with mission agencies and NGOs.

Scientists and engineers are less expensive than lawyers. Agencies and businesses don't like litigation. It can be expensive and it can delay or, if the outcome is not favorable, stop projects. With some exceptions, NGOs would also prefer to stay out of court. If scientists and engineers can be deployed to find answers, provide options or devise solutions that can avoid or lessen conflict, then the lawyers lose, but money and time are saved.

Not all academic scientists are comfortable dealing with matters of public policy and the attendant risks of conflict. Some consider working with environmental NGOs as violating some unstated principle of academic neutrality. Never mind that large corporations that award contracts to university scientists are just as much advocates for their own cause—economic well-being—as NGOs can be for their particular goal.

Roger Pielke (2007) provides a useful classification for academic scientists. The "Pure Scientist" likes the isolation of the ivory tower and wishes to be left alone. If his or her work is useful in the public arena, that is for someone else to decide and apply. The "Science Arbiter" responds to the needs of decision makers by providing expert judgment on scientific issues arising in policy debates. The Science Arbiter seeks to stay above the fray. In contrast, the "Issue Advocate" aligns himself or herself with a particular position, marshaling or generating scientific data in its support. Some Issue Advocates make their stands know, while others act in stealth mode. Finally, there is Pielke's ideal, the "Honest Broker of Policy Alternatives". The Honest Broker works directly with decision makers and often with other such scientists. Honest Brokers explore both the consequences of policy alternatives and actively try to devise new ones or new compromises among the existing choices. Pielke contrasts Issue Advocates and Honest Brokers by noting that Honest Brokers seek to expand policy alternatives while Issue Advocates seek to narrow them.

The four categories are, of course, caricatures and they do not even lie along a single spectrum. And, to the extent that they exist, there is a place in the academic scientific community for all of them. Pielke's categories are a useful reminder that many, if not most, policy issues involving scientists are controversial to some degree. Issues surrounding conservation and restoration can often qualify in that regard.

Note however, that in Pielke's taxonomy, it is only the Issue Advocate who has—or is allowed to have—an opinion or who is allowed to act on a considered judgment. In this way, Pielke comes close to subscribing to the fallacy that scientists lack human emotions, biases or even points of view. And that scientists should simply let the "facts speak for themselves." The facts never speak for themselves. As succinctly sung by Talking Heads (1980): "Facts all come with points of view. Facts don't do what I want them to. Facts just twist the truth around."

I may be too hard on Pielke. His is a handbook of cautionary lessons about the dangers of politicizing science. But there is a danger to not politicizing science as well. If scientists don't

put their considered judgments or scientifically-informed opinions to work, we then run the risk of not addressing significant problems. As Howard Zinn (2004) put it, “You can’t be neutral on a moving train.” As society converts more and more land—and water—to direct human use, not advocating for an alternative (so-called neutrality) is the same thing as acquiescence.

Most conservation biologists—even those in academic institutions—are Issue Advocates. So be it. We subscribe to Ed Abbey’s dictum “It is not enough to understand the natural world. The point is to defend and preserve it.”

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