Ecological Restoration

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Restoring a Colorado River Wetland

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CASE STUDY

At the End of the Line: Restoring Yuma East Wetlands, Arizona

Fred Phillips, Charles Flynn and Heidi Kloeppel

The lower Colorado River once supported more than 400,000 ha of native riparian, wetland aquatic, and intertidal habitat from what is now Hoover Dam to the Sea of Cortez. This included vast cottonwood and willow gallery forests, mesquite bosques, wetlands, intertidal salt flats, lakes, and channels that stretched as wide as 24 km across during flood stage. The Colorado River salmon, river otters, the Yuma puma, eagles, and an abundance of birds that elders say used to "darken the sky" thrived in this ecosystem. The Mojave, Chemehuevi, and Cocopah peoples' livelihoods were derived from the river, and tribal elders speak of the river creating its own climate due to the enormity of the forests and wetlands it supported.

By 1940, much of this once majestic river had been tamed. Degradation of the Colorado River began in the late 1800s with the harvest of the extensive riparian forests to feed the steamships supplying communities along the river. The non-native tamarisk (*Tamarix* spp.) was introduced in the late 1800s for windbreaks on railroad lines, to stabilize riverbanks, and also as an ornamental plant. Now this well-adapted and prolific plant dominates the entire Colorado River drainage from Utah to Mexico.

Starting in 1905, dams were constructed and forests cleared to create one of the largest and most productive farming regions in the world. Today, farming is a $3 billion industry in the Yuma area alone. Eventually, more than nine dams were constructed on the Colorado to provide electricity and to control flooding. By the time the Colorado River flows below Laguna Dam, located just above Yuma, it is a trickle, mostly leakage from inefficiencies in the water storage system or canceled water orders from the agriculture communities surrounding Yuma. What water makes it past Yuma meets Morelos Dam (the last dam on the river), and any remaining water is diverted into an irrigation canal that leaves the last 160 km of the Colorado riverbed almost always dry. Today, the Colorado River rarely completes its journey to the Sea of Cortez. Only about 109,000 hectares of wetlands, forests, and intertidal habitat remain in the stretch of the Colorado River from Hoover Dam to the Sea of Cortez, 85% of which is overrun by non-native plants, including tamarisk, phragmites (*Phragmites australis*), Russian thistle (*Salsola* spp.), and Bermudagrass (*Cynodon* spp.).

Until the 1960s, what is now known as the Yuma East Wetlands (YEW) was a haven for wildlife and a community resource for culture and recreation. By the 1990s, however, it had become a place that the Yuma community was afraid to explore. The wetlands hosted a plethora of illegal guests as well as drug trafficking and even violent crime. Most of Yuma's homeless population resided in this area. Prior to restoration, there was even a meth lab in the wetlands. During the initial reconnaissance for this restoration project, surveyors had to carry mace to protect themselves against feral dogs.

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A Partnership for Restoration

In 1999, the U.S. Congress authorized the Yuma Crossing National Heritage Area, a program funded through the National Park Service, to create a voluntary, community-wide forum to conserve natural, cultural, and historic resources through collaboration and partnerships (to learn more visit: www.yumaheritage.com). The Heritage Area board of directors represented a cross-section of the entire community and crossed jurisdictional boundaries. Of the 566 hectares in Yuma East Wetlands, about half the land is owned by the Quechan Indian Tribe, and the remainder is divided evenly among the City of Yuma, State of Arizona, private landowners, and the U.S. Bureau of Land Management. Members of the Heritage Area built a strong working relationship with the Quechan Indian Tribe early on by partnering with them to restore and reopen the historic 1915 Ocean-to-Ocean Bridge, which literally and symbolically connected the Quechan and Yuma communities. With that success, the partners were poised to take on the much larger project of restoring the Yuma East Wetlands. For several generations, the Quechan and Yuma communities had entertained visions of what the YEW area could be, ranging from a large lake and park, to golf courses, equestrian centers, and airstrips. Although many of these ideas were discussed and planned, none had ever taken the shape of a real "on-the-ground" project.

In 2001, through the efforts of the Yuma Crossing National Heritage

Area, the City of Yuma and the Quechan Indian Tribe joined forces to formulate a plan to restore the YEW to its historic state, while utilizing it for recreation and education. Congressman Ed Pastor helped secure funding through the Environmental Protection Agency's Wetlands Program to undertake the planning and consensus-building in order to bring the community together, look at the YEW landscape, and lay out a road map for the restoration of this area.

Restoration of some of the most severely degraded riparian habitat on the Colorado River would take long-term sustained and focused effort. The Yuma Crossing National Heritage Area assembled an administrative team led by Executive Director Charles Flynn, senior planner Matthew Spriggs, construction project manager Kevin Eatherly, grant writer and archeologist Tina Clark, and three key support personnel: Ali Beichler, Carol Urling, and Stephanie Caraway. The Quechan Indian Tribe's portion of this partnership included Tribal President Mike Jackson Sr., Tribal Comptroller Frank Espino, economic development administration director Brian Golding Sr., and planner Allyson Collins. The idea was to be able to plan, design, and construct using multiple sources of grant funding. Through a competitive bidding process, the YEW partnership hired Fred Phillips Consulting to guide the partnership through the planning effort for the restoration of this degraded area.

Today, the Colorado River rarely completes its journey to the Sea of Cortez. More than nine dams on the Colorado provide electricity and control flooding. By the time the Colorado River flows below Laguna Dam, located just above Yuma, it is a trickle, mostly leakage from inefficiencies in the water storage system or canceled water orders from the agriculture communities surrounding Yuma. What water makes it past Yuma meets Morelos Dam (the last dam on the river), and any remaining water is diverted into an irrigation canal that leaves the last 160 km of the Colorado riverbed almost always dry. Map by Stephen Belew and Jed Blake

Making It Happen

Imagine scrambling all day through a thicket of nearly impenetrable six-meter-high phragmites and giant reed (*Arundo donax*) cane. Picture crawling in mud on your hands and knees for hours on end through thickets of tamarisk to locate historic river channels. Think about moving at a snail's pace in 38°C heat dressed in safety goggles, hat, dust mask, and thick work pants, with cardboard duct-taped to your shins and forearms to protect you from the thicket you are crawling over.

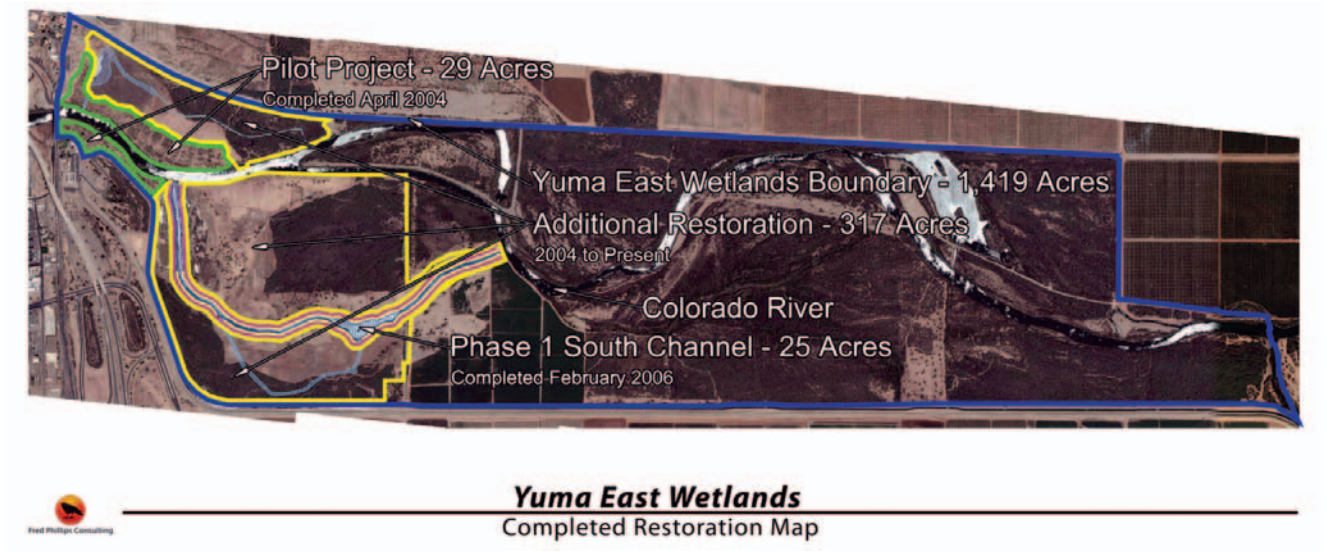
These are the conditions that the YEW research team had to brave to perform the initial biological investigations in wetlands in the spring of 2001. Our 12-person field research team traversed the dense, trash-filled thickets to complete surveys, including wetland delineation and topographical surveys to determine optimum areas to rechannel the river, endangered bird surveys to locate threatened or endangered species that might be impacted by the construction, mapping soil salinity and depth to water table to see what type of vegetation this area could potentially support, and vegetation surveys to ground truth existing vegetation maps and identify stands of native plants. These surveys yielded

Only about 109,000 hectares of wetlands, forests, and intertidal habitat remain in the stretch of the Colorado River from Hoover Dam to the Sea of Cortez, 85% of which is overrun by non-native plants, including tamarisk (*Tamarix* spp.), phragmites (*Phragmites australis*), Russian thistle (*Salsola* spp.), and Bermudagrass (*Cynodon* spp.). Dense tamarisk and phragmites dominated the Yuma East Wetlands (YEW) site prior to restoration in 2001. The Ocean-to-Ocean Bridge can be seen in the background. Photo by Fred Phillips

some sobering information about the Yuma East Wetlands area. The historic river channels had water with salinities that exceeded 28,000 ppm (beyond the thresholds of most native riparian species), and over 98% of the area was infested with dense non-native vegetation. The high salinities are due to the lack of salt-flushing flows from spring floodwaters that came every year before dam construction. Historically, floods came through Yuma at river levels of 3,000 cubic meters per second (cms), now a high ten-year flow is in the 140 cms range. The surveyors also located multiple wildcat garbage dumps and transient camps, as well as feral dogs and cats, and marginalized people wandering the wetlands.

Creating a Master Plan

The involvement of the Quechan Indian Tribe, the City of Yuma, private landowners, and public and private agencies made reaching a consensus on the plan to restore this area as difficult as scaling the dense thicket in the wetlands. In 2001 the planning team began with listening sessions. The Quechan Tribe had concerns about water rights, and farmers had concerns over the endangered species and environmental restoration potentially affecting farming practices. One individual claimed he had an organic prickly pear (*Opuntia* spp.) cactus farm (he did have an impressive set of cactus growing in abandoned tractor tires) and wrote a ten-page letter to the mayor of Yuma protesting that his "homesteading rights" were being violated. Securing water rights, environmental permits, and project start-up funds also proved to be a formidable task. Much work and many hours of listening to stakeholders' concerns had to be completed to formulate a viable design for the first phase of the project.



The YEW project area is located along the Colorado River floodplain between River Miles 29.0 and 34.0. The project area is bounded to the west by the Ocean-to-Ocean Bridge, to the east by the Gila and Colorado River confluence, and by the upper reservation levee and the south Gila levee. Ownership of most of this land is shared between the Quechan Indian tribe and the City of Yuma, as well as public agencies and private landowners. In less than one year, these stakeholders joined in an unprecedented partnership that has successfully planned and funded restorations in the Yuma East Wetlands. Map by Dave Blanchard

By 2003, however, the YEW partnership had reached an unprecedented consensus to restore 566 ha of Colorado River wetlands. The YEW team had also acquired all necessary permits and start-up money for a pilot project and created a 300-page plan that laid out the road map for restoring the wetland and riparian habitats and developing recreation and education facilities within the YEW. Based on an acceptance of water flow constraints within the Colorado River system, and with respect for the concerns of its many partners, the plan laid the foundation for redeeming the landscape and reconnecting the Quechan and Yuma communities with the river that runs through them.

The YEW Master Plan includes the creation of a 2.5 ha park; conversion of existing non-native-dominated habitat to native cottonwood (*Populus* spp.) and willow (*Salix* spp.) habitat; dredging and excavation of natural channel configuration to restore water flow in degraded wetland and aquatic habitats; conversion of 31 ha of agricultural land to native riparian trees and shrubs; and sequential replacement of the remaining 535 ha of non-native tamarisk and giant cane habitats with native riparian trees and shrubs. Over 300 species of birds, 32 species of mammals, 19 species of fish, 20 species of reptiles, and 9 amphibian species were documented along the lower Colorado River. Two endangered species in the area are the southwestern willow flycatcher (*Empidonax traillii extimus*) and the Yuma clapper rail (*Rallus longirostris yumanensis*). Many neotropical migratory birds also stand to benefit from the restoration.

Restorationist Bianca Perla crawls through the thick of it during the initial field research in the YEW. Research included wetland delineation and topographical surveys (to determine optimum areas to rechannel the river), endangered bird surveys, soil salinity and depth to water table mapping, and vegetation surveys. The field team also included landscape architect Ann Hadley, hydrologist Sam Walton, ecological coordinator Tillie Walton, Frank Protiva P.E., wildlife biologist Larry Stevens, geomorphologist Tom Moody, hydrologist R.J. Johnson, green venture capitalist Joe Hudson, insurance adjuster Eric Salkeld, and BLM employees Jeff Young and Karen Reichardt. Photo by Fred Phillips

Initial work included clearing and burning of non-native vegetation, excavation of historic channels, and the installation of water control structures. Here, I&R Contracting puts the finishing touches on irrigation ditches and laser-leveled fields, which were then planted with cottonwoods, willows, mesquites, and a variety of other native plants. Freshwater pumped from the river and used for flood irrigation provided the best scenario for establishing native riparian species. Photo by Fred Phillips

Restoration in Action

The Yuma East Wetlands Restoration plan was separated into phases. The first 10 ha revegetation project, known as the "pilot project," was cleared in the winter of 2003. The pilot project included Quechan and City of Yuma lands on both sides of the river visible from the Ocean-to-Ocean Bridge and Yuma and Quechan Mesas. This exemplified the partnership formed by the YEW project and gave the community a ringside seat to watch the transformation happen.

Revegetation efforts included clearing the dense non-native vegetation, performing intensive soil and site analyses, and revegetation of the site through various methods of planting, irrigation, and maintenance. Because of the ever-present threat of tamarisk and phragmites reinvasion, an aggressive approach was taken to reestablish the native forests of this area. Lack of river flows and high salinity levels

Left to right: Allyson Collins, Fred Phillips, Brian Golding Sr., Vernon Jose, Kenrick Escalanti, Brandon Jose, Chase Choate, Yvonne Choate, and Arno Dick gather on an area of the restoration designated for traditional food and medicinal crops. These people (except Fred), are members of the Quechan Indian Tribe and participants in the Tribal Elders Group, which assists with project designs and planning as well as spending Saturdays on planting projects like these, or building traditional structures within the YEW out of materials gathered from restored native forests. Photo by Paige Lineberry

added to the challenge of revegetating the YEW area. To remedy these conditions, freshwater flow from the Colorado River (with salinities in the 700–800 ppm range) was restored into newly created channels. In some areas of high salinity, we used salt-tolerant plants, especially inland saltgrass (*Distichlis spicata*), western seapurslane (*Sesuvium* sp.), hardstem bulrush (*Schoenoplectus acutus*), alkali sacaton (*Sporobolus airoides*), and three-square bulrush (*Schoenoplectus pungens*). Larry Sullins and a crew of JSA Landscape Company built the first 10 ha of irrigation and planting in the YEW.

The restoration of the historic river channels and wetlands within the YEW began in 2005 with the South Channel project. The objectives of this project were to clear non-native vegetation, excavate over 220,000 cubic meters of sediment-clogged channels, and construct water control structures to allow the Colorado River to flow back into the wetlands. The areas excavated included an area cherished for many generations: the historic confluence of two of the Southwest's major rivers, the Gila and the Colorado. This area had served as a seasonal camp for the Quechan Indian Tribe and was rich in wild game, beaches, and sloughs that were historically used for farming after spring floodwaters receded. This confluence was moved upstream 6 km when a 100-year-flood levee was constructed to protect communities from the devastating floods that occurred in the area. Agricultural drains that pump high groundwater from adjacent fields also augment the water flow in the wetlands. The high groundwater table in the Yuma floodplain area is artificially lowered by constant pumping to allow for proper septic tank function in residential areas as well as farm field drainage. The city of Yuma paid one million dollars to construct a pipeline to deliver one acre-foot (equivalent to 1.2 million liters) of clean water to the YEW every day. This water is recycled from the Yuma water treatment facility, and its low salt level is critical for restoring the YEW in the South Channel Project.

The next challenge was to establish native wetland and riparian vegetation along the banks and wet areas of the newly formed south channel. David Blanchard, landscape architect with Fred Phillips Consulting, formulated planting plans based on the salinity and depth to water tables in the planting areas, and what part of the floodplain was being planted. We planted supple vegetation like rushes and reeds in the wetlands adjacent to the channel to help slow the velocity of high-water events and also to help trap sediment. A team of 20 hardworking landscapers, including John Taylor of Taylorbird Enterprises, planted more than 5,000 bare-pole willow and cottonwood cuttings, 4,000 wetland plant plugs, 3,000 one-gallon plants, and 22 kg of native seed in over 5 km of channel shoreline and wetlands. About 80% of the plant material was harvested from other stands of native riparian plants, either within the YEW or within 16 km on the river. Plant material that could not be acquired locally was bought from the nearest nursery carrying the necessary plant material, usually within 150 miles. Four years later the channel boasts a robust stand of native wetland and riparian vegetation adjacent to the free flowing channel with few to no non-native plants.

Results

Revegetation and Research

More than 162 ha of native riparian revegetation is now underway in the YEW. Revegetation methods have included the following:

- Water control structures to capture the high flows of the river to flood wetland plant plugs and seeds in the channel's "bankful area"

One day during the initial field surveys, Fred Phillips and Ann Hadley fell into the camp of Verner Winston Wilkerson, who introduced himself as "Lucky" and offered Fred and Ann some instant coffee, which he served in beer cans cut in half. His camp was immaculate, with sleeping quarters, a latrine, trash cans, and an impressive stove built from gathered train track parts and metal trash. It was an instant friendship, and over the course of the next four years Lucky became a part of the field team and an employee of Fred Phillips Consulting. One summer, he helped plant more than 5,000 trees. Photo by Fred Phillips

The South Channel marsh after replanting. This effort involved excavation of more than 168,000 m³ of sediment to create a 1.5 km-long back channel. In January 2006, this "South Channel" was reconnected with the Colorado River. Agricultural drains that pump high groundwater from adjacent fields also augment the water flow in the wetlands. In the winter of 2006, a team of 20 hardworking landscapers planted more than 5,000 bare-pole willow and cottonwood cuttings and 2,000 wetland plant plugs, and spread 22 kg of native seed on over 16 ha of the channel's shoreline and wetlands. The channel now boasts a robust stand of native wetland and riparian vegetation. Photo by Fred Phillips

- Flood irrigation, the most effective method of restoring native plants, for container plants, plugs, seeds, and saplings in areas where we can laser-level fields and install irrigation canals
- Drip irrigation for plugs and container plants in higher areas with difficult terrain for a period of 1–5 years depending on the distance of the site from the water table
- Dry land revegetation in upland areas using seeds and the rainfall

We continue to experiment with propagating native plants such as cottonwood, willow, wetland plants, understory grasses, and wildflowers. Many native seeds germinate successfully in greenhouse conditions; however, our goal is to accomplish large-scale seed germination in the field. Our experiments have consisted of establishing delineated seed plots and planting a variety of species in areas with the appropriate field conditions. Seed plots were replicated three to five times for each species. Other field experiments consisted of comparing various propagation enhancement techniques, including scarring and cold flashing for a single seed species to compare propagation success. These experiments have enabled us to determine the most successful methods for seed propagation and will help inform future restoration projects.

One of the unique revegetation challenges in the YEW has been high soil and water salinities. The salt levels in the soils and agricultural drainage water in this area exceed the thresholds of most riparian species. One of the main goals of the project was to create cottonwood and willow and mesquite habitat. Unfortunately, many areas simply will not support these species because of the salinity levels in groundwater and the soils. Initially, we tried removing the soil salinity from areas through applications of sulfuric acid coupled with leaching with water but soon found that this technique is costly and that, eventually, the salts returned. We then researched extremely salt-tolerant

In 1999, the YEW had only one small remaining shallow emergent marsh; over 3,000 white faced ibis (*Plegadis chihi*) roosted there that winter. As of fall 2003, all the wetlands in the YEW had degraded into thickets of salt cedar and phragmites. Excavation in late 2005 of the 1.5-km-long "South Channel," reconnected a dead marsh once named Ibis Lake. Because Ibis Lake is lower in elevation, the area quickly became inundated when the South Channel was connected to the Colorado River. With the return of fresh flowing water, the native cattail/bulrush habitat naturally rebounded. Within one year, the recovery of the bird community was striking. Three years after restoration, the avifaunal species richness is similar to that in reference sites and is almost twice that of control sites. In the area pictured here, revegetation crews planted Goodding willows (*Salix gooddingii*) from one gallon pots, and seeded alkali sacaton grass (*Sporobolus airoides*) and evening primrose (*Oenothera* sp.). Photo by Fred Phillips

plants and settled on the native species mentioned above that are now thriving in the wet saline conditions. Joseph Grinnell (1914), an early explorer of Lower Colorado River flora and fauna, described the existence of "extensive salt and alkali flats" where these very plants once existed. In areas that once supported only tamarisk, there are now wetland marshes and large grassy meadows that are a haven for wading shorebirds, waterfowl, insects, and small mammals. We have also introduced several other plants that have been long extirpated from this stretch of river, including the invaluable homeopathic medicine plant "yerba mansa" (*Anemopsis californica*). This beautiful marsh plant thrives in the saline wetlands and is also one of the most valuable and widely used medicinal plants in the Southwest.

Some trees planted in our ten-hectare pilot project have already reached heights exceeding 12 meters. The south channel restoration now consists of dense bulrush, three-square, and inland saltgrass marsh. We now harvest more than 80% of our native plant material for other YEW projects from our completed restoration efforts, thus saving gas, plastic, and other resources expended by having to rely on nurseries to grow our material for us.

Controlling the invasive phragmites cane and tamarisk is a continuing battle, especially in moist soil areas along the south channel. Our mantra with weed control is that if you remove non-natives and replace them with nothing, you will get more non-natives. So when areas are weeded, native seed and plugs are planted to help outcompete non-native species.

In addition, biologists at Fred Phillips Consulting have integrated monitoring in all stages of the habitat restoration. Led by Heidi Kloeppel, the research and monitoring efforts at the YEW are designed to complement the Lower Colorado River Multi-Species Conservation Plan by providing a template for adaptive monitoring and research activities, increasing the available plant growth and wildlife recovery information, and addressing data gaps. The YEW Project is also helping to determine optimal planting techniques, create future restoration goals, develop restoration practices that increase the benefits to wildlife, and determine if restored areas are mimicking native habitats and maximizing ecosystem resilience along the lower Colorado River.

In seven years of restoration, the avifaunal species richness is similar to that in reference sites and is almost twice that of control sites. Riparian species such as Bell's vireo (*Vireo bellii*), blue grosbeak (*Passerina caerulea*), and black-headed grosbeak (*Pheucticus melanocephalus*) have returned to use restored riparian habitats. Also, wetland sites have recovered residents such as the white-faced ibis (*Plegadis chihi*), black-necked stilt (*Himantopus mexicanus*), Yuma clapper rail (an endangered species), snowy (*Egretta thula*) and great (*Ardea alba*) egrets,

and wintering large-billed savannah sparrow (*Passerculus sandwichensis*), snow goose (*Chen caerulescens*), cinnamon teal (*Anas cyanoptera*), mallard (*Anas platyrhynchos*), and many other species.

Economics

In the last eight years, funding for the YEW has brought in over $10 million dollars to the Yuma area. Local agencies, laborers, farmers, contractors, consultants, and suppliers have all benefited. Quechan Tribal member Reggie Antone works full-time on the project as a revegetation technician, for example. Sergio Valenzuela, a legal immigrant and foreman of the YEW revegetation crew, wakes up at 3 A.M. every work morning in order to cross the border to make it to work on time. Martha Brabec, a Wisconsin native and botanist, also works on the wetland project, assisting with field work and managing the revegetation projects in the wetlands. Mar Elise-Hill, a local resident and mother of two, started a small nursery at her home and grows native plants that are purchased by the project. The local farming community has been instrumental in providing expertise on how to grow seed and plants for resale, as well as brainstorming ideas to optimize restoration techniques. Melon Farms, a local farming outfit that has been in Yuma for generations, is now a key contractor for the project.

Revegetation technicians John Mahkewa (left) and Chris Slapintosh observe the highly saline condition of the restoration site and newly planted cottonwoods and willows. Flood control and the absence of salt-flushing spring floods had increased the salinity of some places in the YEW to four times normal levels. The "after" photo shows the same area two years later. After several planting failures due to salinity (notice the dead twigs of the trees planted earlier), we turned to hardy salt-tolerant wetland plant species, including inland saltgrass (*Distichlis spicata*) and three-square bulrush (*Schoenoplectus pungens*), now thriving in this moist saline area and bringing in many birds, mammals, and insects. Photos by Fred Phillips

Education and Recreation

The Yuma East Wetlands is now a place for the Yuma and Quechan communities to learn and to enjoy. Recreation facilities in the YEW include hiking and birding trails, a small boat launch, bird blinds, and interpretive signage. The City of Yuma has established itself as a local canoe outfitter so that visitors can explore the area by canoe. Two small nature parks are currently being built on City and Tribal lands within the YEW. Stephanie McCormick, YEW volunteer coordinator, gives tours of the wetlands every Saturday morning throughout the winter to members of the Yuma Community. On such a tour, you might hear Lorie Cachora, a Quechan elder, explain how the mesquite root was used for cradle boards and provided a staple food source for the Quechan people. Chase Choate, a Quechan tribal member and project ecological coordinator, donates time on weekends to teach tribal youth about the plants and birds of the wetlands. He is also building a traditional mud home in the "Elders' Village" next to the river. For the past six years, Yuma has hosted an annual Yuma Birding Festival and International Youth Cultural Festival in the YEW in collaboration with the Quechan Tribe and Yuma Crossing National Heritage Area.

In the last few years, a mainstay of our job at the YEW has been to teach community members, students, and even other tribes and agencies about the processes of planning, implementing, and monitoring a large-scale river restoration project. One early morning this past March, YEW staff briefed Senator Jon Kyl about the project during his annual visit to Yuma. Leaders of South Africa's "Working for Water" project and former Arizona Governor and Secretary of the Interior

Bruce Babbitt have been among those recently touring the Yuma East Wetlands. Ted Martinez, a teacher at the local Northern Arizona University campus, has made YEW a part of his environmental program and uses the "living classroom" to show local college students how to transplant native salt grass. The YEW project team continues to frequently host volunteer planting days, environmental workshops, and school education in the YEW.

Physical restoration of degraded habitat is certainly a notable accomplishment, but perhaps even more significant is the building of a strong, supportive community partnership among members of the Quechan, farmers, private landowners, the City of Yuma, and state and federal agencies. This project is serving as a living model for community restoration, in addition to developing innovative techniques and experiments designed to complement regional and natural restoration efforts.

The Road Ahead

The YEW stakeholders are proud of having restored 120 hectares. But hiking the entire 575 ha project area is still a daunting experience. We face several challenges. We must secure approximately $3 million to complete restoration over the next three years, while continuing our methodical approach to data gathering and scientific research. Our success in garnering federal and state grants, along with the steadfast support of Arizona's congressional delegation, has been the foundation of our funding strategy, and will continue to be so.

We are working to develop a funding mechanism to maintain the Yuma East Wetlands in perpetuity. Negotiations are in the works for the Lower Colorado River Multi-Species Conservation Plan, a collaboration among multiple federal agencies to manage river resources, to fund project maintenance and operations over the next 50 years, which would guarantee the long-term sustainability of the project.

Our continued success will be based on what we have done from the very beginning: living within the constraints of the Colorado River and respecting the rights and concerns of the partners who serve as the strength of the Yuma East Wetlands. Since the 1980s, more than 1,214 ha of habitat have been restored on the Colorado River. At least 4,050 ha are slated for restoration over the next 50 years and will involve the Multi-Species Conservation Plan, the Yuma Crossing National Heritage Area, Mexico's oldest conservation organization, Pro Natura Noroeste, and many other communities along the Colorado. Successful community-based restoration such as the YEW will be the key to restoring our rivers and streams. Upstream in Parker, Arizona, the 'Ahakhav Tribal Preserve has restored over 243 ha of habitat along the River (Phillips 1998). Further upstream, the National Park Service is taking on large-scale eradication of tamarisk and restoration of riparian habitat in parks and recreation areas including the Grand Canyon, Glenn Canyon, Lake Mead, and Dinosaur National Monument. Downstream in Mexico, people are being employed to eradicate tamarisk, propagate native plants, and revegetate the delta region of the Colorado. The movement of ecological restoration has rooted deep in the floodplain of the Colorado River and continues to grow.

Acknowledgments

Yuma East Wetlands sponsors and supporters include the Quechan Indian Nation, City of Yuma, Yuma Crossing National Heritage Area, Arizona Game and Fish Department, US Bureau of Reclamation, US Bureau of Land Management, US Fish and Wildlife Service, US Environmental Protection Agency, Yuma Farm Bureau, Arizona Western College, US Border Patrol, Yuma County, Arizona Water Protection Fund, Sonoran Joint Venture, North American Wetlands Conservation Council, Environmental Defense Fund, Bill Ogram, the Headstream family, and the McVey family. Special thanks go to Senators Jon Kyl and John McCain, and Congressmen Ed Pastor and Raul Grijalva. Project contractors include: Fred Phillips Consulting, Taylorbird Enterprises, Sheppard Wesnitzer Engineering, Ecosystems Management International, JSA Inc., Southwest Biomes, Revegetation and Wildlife Management Center, Southwest Recycling, PG&E Construction, Downriver Productions, Stevens Ecological Consulting, Natural Channel Design, Doug Mellon Farms, Southwest Hydro Systems, I&R Contractors, and Joe Hudson Consulting.

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Fred Phillips has been doing river restoration in the southwestern United States for the past 15 years, and he has helped raise over $15 million dollars for the restoration and protection of the Lower Colorado River and its habitats. Fred Phillips Consulting is based in Flagstaff, Arizona, fredphillipsconsulting.com, fphillips@commspeed.net.

Charles Flynn has served as the Executive Director of the Yuma Crossing Natural Heritage Area Corporation since its inception in 2000, helping to guide $100 million of public and private investment along the Lower Colorado River.

Heidi Kloeppel has been working as the principal biologist for Fred Phillips Consulting for four years. She has designed and implemented research on wildlife recovery in the restored areas of the Yuma East Wetlands, secured funding for the Project, developed monitoring protocols and designs, and conducted endangered species surveys.
