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Community Involvement – A More Comprehensive Approach to Recovering Endangered Species

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Abstract

Springs, along with their associated wetlands and streams, constitute some of the most dramatically impacted habitats in the desert southwest. Texas Parks and Wildlife Department has embarked upon an aggressive approach to restoring these habitats and resolving attendant endangered species problems through cooperative programs with local governments and especially private landowners. To date, 1) a "natural" ciénega for two endangered fishes has been recreated, 2) a Conservation Agreement has been enacted to enable private landowners to create wetlands for the Pecos pupfish and preclude the need to list it as endangered, and 3) restoration has begun on restoring an urban stream that emanates from the third largest spring in the state and is home to a federally threatened minnow. Involving individuals and local governments in conservation of endangered species and their habitats increases the likelihood of achieving long-term benefits for natural resources as well as protection of these resources for the public.

Introduction

Texas Parks and Wildlife Department (TPWD) is working with federal, state, and local agencies and especially private landowners to conserve natural resources and resolve endangered species issues. With 97 percent of the land in Texas privately owned, involvement with the private sector is often the only way to achieve long-term conservation goals.

Approximately 25 percent of the 170 native freshwater Texas fishes are of conservation concern (Hubbs *et al*. 1991). In the Chihuahuan Desert region of Texas, 50 percent of the native fishes are of conservation concern or already lost to extirpation or extinction (Hubbs *et al*. 1991). Spring-fed wetlands, or ciénegas, are an important biological resource in this region. They have been important not only to wildlife as a source of water and habitat, but also to man throughout his history. Unfortunately, these ecosystems are probably some of the most abused and damaged. It has seldom been intentional. Simply, water is rare in the desert and people want it for a variety of uses. The ways in which ciénegas have been destroyed include: 1) grazing and watering livestock, 2) draining to move water more efficiently to agricultural fields, and 3) overpumping aquifers.

This paper presents three case histories of innovative approaches to resolve specific issues. Although each situation has unique elements, these case histories serve to provide examples that have worked and to generate new ideas on how to approach such issues.

Comanche Springs Pupfish and San Solomon Ciénega

In 1996, a cooperative effort among private, state, and federal entities allowed the creation of a desert-wetland (ciénega) habitat for two federally endangered fish species, Comanche Springs pupfish (*Cyprinodon elegans*) and Pecos gambusia (*Gambusia nobilis*). The primary benefit to the fishes is a "natural" habitat critical to their survival, but which had been eliminated through human modifications for recreation and agriculture. Benefits to area residents included: 1) relaxation of some pesticide regulations for farmers, 2) protection of the water supply, and 3) increased tourism.

Prior to human alterations, Comanche Springs pupfish and Pecos gambusia inhabited two large ciénega systems separated by approximately 100 km, one fed by the Balmorhea springs complex (Phantom Lake, San Solomon, Giffin, and East Sandia springs; Figure 1), and one by Comanche Springs. San

Solomon Springs is the largest spring in the Balmorhea springs complex**,** producing about 750 liters per second (lps); it is presently the largest spring in the Trans-Pecos and the seventh largest in Texas. Comanche Springs, in Fort Stockton, once flowed at approximately 1,200 lps, but ceased its perennial flows in 1961 due to groundwater pumping (Brune 1981**;** Scudday 2003).

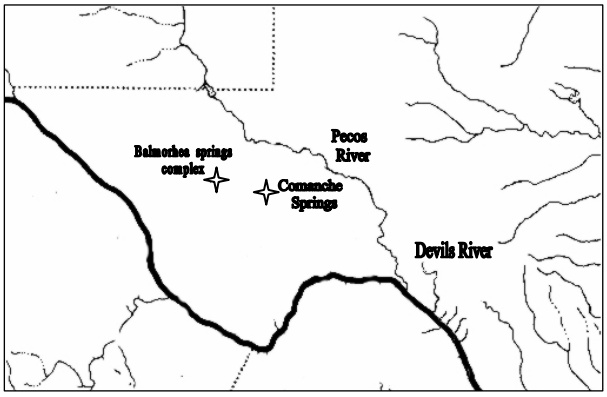

Figure 1. Project locations in West Texas.

More than 100 farmers depended on surface irrigation waters flowing out of Comanche Springs and the ciénega. Groundwater pumping by 18 landowners in an area west of Fort Stockton severely diminished the flows from the spring. The local water district sued these pumpers in 1952 in an attempt to establish its water rights. The pumpers prevailed in the lawsuit by basing their defense on a 1904 case from which had emerged the concept of “rule of capture.” This concept established that a well owner could pump as much water as desired, regardless of the impact on the aquifer. This was also the case in which the Texas Supreme Court had determined that the intricacies of aquifers were so “secret, occult, and concealed” that it would be impossible to administer a set of protective rules. Ultimately, the flows of Comanche Springs ceased, the ciénega dried up**,** the native flora and fauna disappeared, the surface irrigators lost their farms, and their land reverted to desert.

Similarly, farmers also diverted water for agriculture from the Balmorhea springs complex and have been doing so since the mid-1870s (Brune 1981). In 1915, the Reeves County Water Improvement District No. 1 (RCWID) was established and, with water from San Solomon and other associated springs, administered irrigation water for 4,900 ha of farmland. Ciénegas presumed to have supported large numbers of *C. elegans* and *G. nobilis* were drained and spring flows were diverted into an irrigation network of concrete-lined canals with swiftly flowing water and dredged, earthen laterals. This habitat is highly unnatural, ephemeral and wholly dependent upon local irrigation practices and other water-use patterns. In the 1930s, the Civilian Conservation Corps modified San Solomon Springs into a large swimming pool at Balmorhea State Park. The work of this New Deal program enhanced the park's visitor services, but further disrupted the natural ciénega.

Ciénegas, and their associated springs, provide habitat for a wide variety of plants and animals, some of which are endemic to these systems (Hendrickson and Minckley 1984). Not only can ciénegas harbor unique species, but an entire community of interacting organisms also depends on these fragile habitats for survival. This is especially true for the increasingly rare desert fishes. Few ciénegas have survived intact to this day. When the original San Solomon ciénega was modified, and for the most part destroyed, the only "aquatic habitat" remaining was in the concrete irrigation canals. Although better than no habitat at all, the irrigation canals, at best, provided a tenuous existence for some life forms. Some indigenous species, such as the Pecos River muskrat (*Ondatra zibethicus ripensis*), did not adapt and were extirpated. The Comanche Springs pupfish and Pecos gambusia managed to survive in the irrigation canals, but their numbers were greatly reduced. Because of the loss of most of their natural habitat, both fishes are rare and on the federal and state Endangered Species lists.

Previous efforts to improve habitat have occurred in the Balmorhea area. A small refuge canal (120 m) was constructed in 1974 at Balmorhea State Park (Echelle and Hubbs 1978). During a two-year sampling study (Garrett and Price 1993), Comanche Springs pupfish population size in the park refugium canal was estimated to be as low as 968 (May 1990) and as high as 6,480 (September 1990).

In 1993, a modified canal was constructed at Phantom Lake Springs by the Bureau of Reclamation (Young *et al*. 1994). Instead of the original concrete walls, the 110-m canal has sloped, earthen, sinuous sides and was designed to resemble a portion of a ciénega. The Phantom Lake Springs Refugium Canal resulted in an increase in local abundance of Comanche Springs pupfish, resulting in an average of 14.7 pupfish/m^2 (Winemiller and Anderson 1997). Unfortunately, the springs have now failed (Hubbs 2001) and a pump is needed just to maintain water in a small pool at the spring source (N. Allan, U.S. Fish and Wildlife Service, pers. com.).

People also suffer when their water sources vanish. Farmers who depended on surface irrigation water from Comanche Springs lost their livelihood when the springs went dry. Farmers in the Balmorhea area also rely on surface irrigation from springs, and if the aquifer was further diminished, local agriculture would certainly suffer. The effects on the rest of the community of Balmorhea would be devastating since they depend on the aquifer and the spring flows for everything from domestic water to tourism.

Although current state law would allow unrestricted pumping from the aquifer that supports the Balmorhea springs complex, one thing that can prevent overpumping is the Federal Endangered Species Act. The Endangered Species Act protects the fish, the fish need the water, and as long as the water is flowing from the springs it also is available to humans. Through a pragmatic understanding of the basic relationship between the natural and human communities, biologists and Balmorhea community leaders chose to work together on a solution that would benefit all concerned rather than adopt adversarial roles. While the farmers had previously viewed the fishes as something that hampered and perhaps threatened their livelihood, they realized the fishes could be their best insurance for sustained spring flows.

A plan was formulated to create a ciénega to look and function like a natural ecosystem. The RCWID and agricultural community it represents agreed to provide the essential water needed to create a secure environment for the endangered fishes. Water is a rare and precious commodity in West Texas, particularly for farmers, but by each of the users giving up a small amount, they would provide insurance for future water supplies.

An additional benefit for the farmers was that, because of their help in creating preferred habitat for the endangered fishes, the Texas Department of Agriculture (TDA), U.S. Fish and Wildlife Service (USFWS), and U.S. Environmental Protection Agency (EPA) proposed a plan to allow benefits of the ciénega to offset any potential effects from pesticide use on farms that could impact endangered species in the irrigation canals. The fishes would have a better place to live and the farmers could continue to apply pesticides necessary to raise their crops.

Biologists, engineers and resource managers from universities and government agencies joined forces to make the project work. The U.S.D.A. Natural Resource Conservation Service provided soil analysis and, along with staff from the Texas Agricultural Extension Service, TDA, the University of Texas at Austin, and the University of Texas-Pan American, gave expert advice on some of the intricacies of the project. The expertise of the Texas Department of Transportation also was crucial. Their surveyors, design engineers and equipment operators transformed biological concepts into reality. The Texas Department of Criminal Justice provided inmates to build the Observation Deck and retaining walls as well as install plant materials selected for initial ciénega vegetation restoration. Botanists at Sul Ross State University provided container-grown native plants for the project. The one-of-a-kind window wall was designed, built, transported and installed by a beneficent concrete fabrication company located 500 km away.

Funding for San Solomon Ciénega was provided by grants from the Educational Foundation of America and National Fish and Wildlife Foundation. Additionally, fabrication costs for the window wall were provided by a TDA grant from the EPA and with contributions from the Texas Organization for Endangered Species.

In 1996, construction of the 1-ha San Solomon Ciénega was completed. This wetland

is situated on Balmorhea State Park land within the boundaries of the original, natural ciénega. As a result, the native fish fauna, including Comanche Springs pupfish and Pecos gambusia, have flourished. This location now provides a natural habitat and contains the largest known concentration of Comanche Springs pupfish. The most recent monitoring efforts yielded average estimates of the summer population of pupfish in the ciénega at 270,000 individuals.

Aquatic plants indigenous to ciénegas, as well as grasses and shrubs characteristic of the drier aspects of these desert wetland communities, were planted at the ciénega and now are well established. Some of the more common species are common cattail (*Typha latifolia*), common reed (*Phragmites australis*), alkali bulrush (*Scirpus maritimus*), hardstem bulrush (*S. acutus*), Olney bulrush (*S. olneyi*), sand spikerush (*Eleocharis montevidensis*), buttonbush (*Cephalanthus occidentalis*), Goodding willow (*Salix gooddingii*), Rio Grande cottonwood (*Populus deltoides* var. *wislizenii*), four-winged saltbush (*Atriplex canescens*), alkalai sacaton (*Sporobolos airoides*), big sacaton (*S. wrightii*), tobosa (*Hilaria mutica*), granjeno (*Celtis pallida*), and western soapberry (*Sapindus saponaria* var. *drummondii*). Beyond the immediate wetted perimeter of the ciénega, the habitat grades into a desert plains grassland that was once common to the region.

Many species of birds, reptiles and mammals began to use the new wetland almost immediately. These include belted kingfisher (*Megaceryle alcyon*), black phoebe (*Sayornis nigricans*), swallows (*Petrochelidon* spp.), white-throated swift (*Aeronautes saxatalis*), green heron (*Butorides virescens*), swamp sparrow (*Melospiza georgiana*), yellow-headed blackbird (*Xanthocephalus xanthocephalus*), sora (*Porzana carolina*), yellowthroat (*Geothlypis trichas*), blotched watersnake (*Nerodia erythrogaster transversa*), spiny softshell turtle (*Trionyx spiniferus*), slider (*Trachemys scripta*), javelina (*Pecari angulatus*), and desert cottontail (*Sylvilagus auduboni*).

People of the local and regional community and state park visitors benefit from a living exhibit that shows the importance of the springs and their wetlands for fishes and other wildlife of West Texas. Because the primary purpose of the ciénega is to provide desert wetland habitat, visitor access is limited to only a small portion of the total restoration. However, TPWD has tried to maximize the aesthetic and educational experiences available at locations accessible to the public. The observation deck provides an unobstructed view of most of the above-water portion of the ciénega, and the clear water allows viewing of much of its underwater life. The window wall was custom designed for San Solomon Ciénega so that visitors would have a view that few have seen -- life in the ciénega as its aquatic residents see it.

Another attempt to further protect Comanche Springs pupfish was not so successful. Lake Balmorhea is a downstream, 200-ha storage reservoir for irrigation water from the Balmorhea springs complex and contained an introduced population of sheepshead minnow (*Cyprinodon variegatus*). This species is known to compete and hybridize with Comanche Springs pupfish (Stevenson and Buchanan 1973; Echelle and Echelle 1994). In 1998, the RCWID allowed TPWD to partially drain the reservoir and attempt to remove all fish by application of rotenone, a fish toxin. The objective of the project was to eliminate sheepshead minnow from the reservoir to remove the threat of hybridization with Comanche Springs pupfish. A large population of sheepshead minnow inhabited the lake; post-rotenone extrapolation of subsamples put the estimate at 5,000,000. Unfortunately, and for undetermined reasons, some sheepshead minnow survived the rotenone treatment. They have since begun repopulating the reservoir. Part of the agreement with RCWID was to restock the reservoir with sport fishes to improve tourism in the area. These piscivores should help keep the numbers of sheepshead minnow in check.

Creation of the San Solomon Ciénega was accomplished through willing participation of diverse entities with a common goal of mutual benefit. During the last decade, USFWS developed a formal method of participation in such projects (for non-listed species) through Conservation Agreements. Although Conservation Agreements were not available

when the San Solomon Ciénega project was initiated, successful cooperation among private and government entities served as a precursor to future conservation efforts by TPWD. Conservation Agreements are relatively new and some have not worked. Therefore, they are closely scrutinized by not only the USFWS, but also by others from across the political spectrum. To be effective, a Conservation Agreement must provide some immediate reduction in threat to the species and provide long-term security against extinction. When well designed, they provide a format and incentives for affected entities to work together to resolve issues and conserve natural resources.

Devils River Minnow Conservation Agreement

A Conservation Agreement among the city of Del Rio, TPWD, and USFWS was implemented in 1998. Due to the cooperative efforts outlined in the Agreement, Devils River minnow (*Dionda diaboli*) was listed as threatened rather than endangered (USFWS 1999). The Agreement details a five-year plan of research and conservation actions designed to resolve the threats to the Devils River minnow and lead to its ultimate de-listing. Benefits include protection of water quality and quantity in the Devils River and adjacent streams for both fish and people, and creation of a greenbelt/stream corridor along San Felipe Creek in the city of Del Rio that not only provides quality habitat for fishes, but will also provide a nature-friendly, city park and potential for increased tourism.

The Devils River (Figure 2) is one of the most pristine rivers in southwestern North America. Due to its geographic location and historic stability, the Devils River sustains many indigenous organisms. It remains relatively unpolluted and undammed and although spring flows have diminished, they are still substantial. Limited access has kept the river from being thoroughly studied by the scientific community; however, collections in the past decade by Garrett *et al.* (1992) and others indicate a diminution in abundance of most flowing-water species, particularly Devils River minnow. A survey in 1953 showed Devils River minnow was the fifth-most abundant fish species at Baker's Crossing and the sixth-most abundant fish in the upper Devils River (Hubbs and Brown 1956). In the mid-1970s, Harrell (1978) found it remained the sixth-most abundant fish (in 72 collections, Harrell averaged 24 to 25 *D. diaboli* per collection). In 1988 to 1989, collections from 25 locations throughout the historic range in the United States yielded a total of only seven individuals: Devils River = 2; San Felipe Creek = 3; Sycamore Creek = 2 (Garrett *et al.* 1992). Numbers had declined such that it was rare where it occurred at all and was probably the least abundant of the approximately 30 species that occur in these streams. In 1979, Devils River minnow made up 6 to 18 percent of the *Dionda* population at the Head Spring area of San Felipe Creek. In 1989, none was present there (Garrett *et al.* 1992).

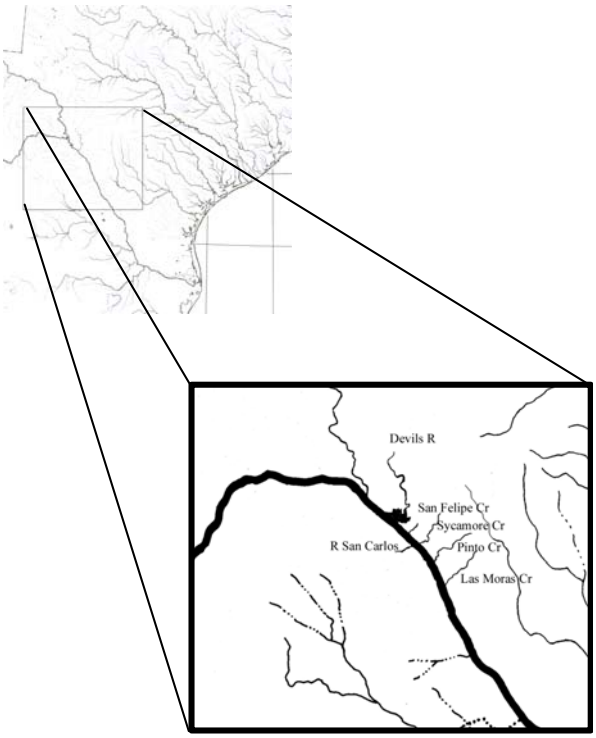

Figure 2. Range map for Devils River minnow.

Members of the genus *Dionda* are specialized for living in spring-fed, flowing waters and are found primarily in Texas and Mexico (Garrett *et al.* 1992). Devils River minnow is distinguished from other species of the genus by a variety of characters, including distinctive color pattern, narrow head, and number of lateral line scales (Hubbs and Brown

1956). Biochemical work in the past decade has further distinguished unique characteristics of this species (Gold *et al*. 1992; Mayden *et al*. 1992).

The Devils River minnow is known to occur in the Devils River, San Felipe Creek, and Sycamore Creek in Val Verde County, and Pinto Creek in Kinney County (Garrett *et al*. in press). It historically occurred in nearby Las Moras Creek, Kinney County, but was eliminated from that locality sometime before 1980 (Smith and Miller 1986; Garrett *et al*. 1992). Extirpation was likely due to periodic failure of the springs from drought and groundwater pumping as well as from modifications to the spring for construction and maintenance of a swimming pool. There are also historic records of occurrence in two small streams in Coahuila, Mexico, the Río San Carlos and Río Sabinas (Contreras-B. and Lozano-V. 1994). Their current status there is unknown; no collection attempts have been made since the early 1970s.

Although very little is known of the ecology of the Devils River minnow, some threats are apparent. Range reduction has occurred by extirpation of the Las Moras Creek population, minimal flows in Sycamore Creek, and inundation of the lower Devils River first by Walk and Devils lakes earlier in the 20th century and ultimately Amistad Reservoir in 1968. Many springs in the area have diminished flows and some have totally stopped (e.g., Beaver Springs, Juno Springs, and Dead Man's Hole), thus reducing the overall length of the Devils River as well as the quantity of water flowing in it (Brune 1981). Many of the area's perennial streams, listed by Gray (1919), no longer flow. In the Devils River, U.S. Geological Survey data from the Pafford's Crossing gauging station reveals a general decrease in daily mean discharge for the period between the study by Harrell (1978) and that of Garrett *et al*. (1992).

The Devils River minnow may be suffering from biological threats as well. Numerous exotics have become established in the area, including common carp (*Cyprinus carpio*), Gulf killifish (*Fundulus grandis*), redbreast sunfish (*Lepomis auritus*), small mouth bass (*Micropterus dolomieu*), and blue tilapia (*Oreochromis aureus*). Although fishes throughout the Chihuahuan Desert have been negatively impacted by predation and competition from introduced species (Hubbs 1990), specific effects on Devils River minnow are not known. Experiments designed to elucidate these interactions are ongoing.

Much of the water for San Felipe Creek comes from two large springs (San Felipe Springs) within the city of Del Rio. The city also gets its municipal water supply from San Felipe Springs. Conserving the quantity and quality of water from the springs is critical for both the Devils River minnow and citizens of Del Rio.

The USFWS proposed the Devils River minnow for listing as threatened in 1978 with critical habitat proposed for portions of San Felipe Creek and the Devils River. The USFWS withdrew the proposal in 1980 and retained its designation as a candidate species. The USFWS published a new proposal to list the Devils River minnow as endangered in March 1998.

During the period 1997 to 1998, TPWD worked with USFWS, Del Rio, and private landowners to develop ways to protect the minnow. Landowners and city officials feared repercussions of listing the fish as endangered and came to understand that a cooperative approach to restoring and protecting the ecosystem would be the best for all concerned. The Devils River Minnow Conservation Agreement was signed by the USFWS, TPWD, and the city of Del Rio in September 1998. The TPWD worked closely with city officials and local landowners to develop conservation actions that were beneficial to the species. Those actions in the Agreement include determining the current status of the species throughout its range, maintaining captive populations for reintroductions into nature, protection of the San Felipe Creek watershed, providing technical assistance to landowners on riparian protection and management, revising live bait harvest and selling practices in the Devils River area to prevent the further establishment of exotic, aquatic species, and additional ecological research, including interactions between Devils River minnow and smallmouth bass.

The Conservation Agreement provides a positive incentive for cooperative actions by all parties and yields scientific access to previously unavailable locations. The primary motivation

for the Conservation Agreement was to remove threats to the Devils River minnow sufficiently so that protection under federal law was not necessary. The USFWS carefully considered the Agreement and to what extent it had been implemented at the time the listing decision was due. The USFWS concluded that with an accelerated implementation schedule, a listing determination of threatened rather than endangered would be appropriate. If successful, the Devils River minnow and other aquatic fauna will be protected and the quantity and quality of streams throughout the range will also be ensured.

Pecos Pupfish Conservation Agreement

The Pecos Pupfish Conservation Agreement was initiated in 1999. Parties involved are TPWD, New Mexico Department of Game and Fish, New Mexico Department of Agriculture, New Mexico Division of State Parks, U.S. Bureau of Land Management (BLM), and USFWS. The Agreement provides conservation measures, new bait fish regulations, and creation of additional habitat. It is designed to preclude the need to list the Pecos pupfish (*Cyprinodon pecosensis*) as a federally endangered species by reducing threats to the species and establishing populations in newly created habitats adjacent to the Pecos River in Texas. This effort incorporates the help of private landowners through the federally funded, state administered, Landowner Incentive Program. With financial assistance and biological guidance provided by TPWD, landowners have modified private ponds to mimic natural desert wetland habitat while still allowing the landowner's original intentions for the water body. Due to the ability of the Agreement to remove immediate threats to the fish, a proposal to list it as endangered was withdrawn by USFWS in 2000.

The Pecos pupfish is endemic to the Pecos River system (Figure 1) from the vicinity of Roswell, New Mexico, to the mouth of Independence Creek, Terrell County, Texas (Echelle and Echelle 1978). It now only occurs in Salt Creek, a small Pecos River tributary in Texas, and at Bitter Lake National Wildlife Refuge and Bottomless Lakes State Park in New Mexico (Hoagstrom and Brooks 1999). It also occurs sporadically in the Pecos River upstream of Artesia, New Mexico (Propst 1999).

Pecos pupfish can occur in a variety of habitats and water qualities. It can flourish in locations that fluctuate in water quantity and chemistry, ranging from highly saline sinkholes to typical desert streams. It has been found in locations with dissolved chlorides ranging from 185 mg/l to 8,940 mg/l (Davis 1981). Age at reproductive maturity, ovary size, egg size, and egg number vary among populations, and are apparently associated with population density (Garrett 1982). The distribution is mostly limited by interspecific interactions and thus, it is typically found in habitats that are low in species diversity (Echelle and Echelle 1978).

During 1954, Pecos pupfish were the most abundant fish in the Pecos River between New Mexico and Sheffield, Texas (Echelle *et al*. 1997). Abundance has declined dramatically since the early 1980s, when non-native sheepshead minnow was introduced into the Pecos River in Texas. The original introduction appears to have been a baitfish release in Red Bluff Reservoir (Childs *et al*. 1996). As a result, Pecos pupfish was eliminated from the lower Pecos River upstream to Loving, New Mexico, and replaced with a hybrid swarm (Echelle and Conner 1989; Wilde and Echelle 1992; Echelle *et al*. 1997). Pecos pupfish is listed as "threatened" by Texas and New Mexico and is considered a "species of concern" by the American Fisheries Society (Williams *et al*. 1989). Its status is due to habitat loss and especially to hybridization with sheepshead minnow.

The Texas portion of the Conservation Agreement consists of establishing off-channel populations near the Pecos River through a cooperative program with private landowners, developing more restrictive bait-fish regulations, attempting to remove sources of sheepshead minnows from West Texas, and monitoring the status of Pecos pupfish in Texas. Progress has been made in all categories.

New Mexico's commitment is similar to Texas, with the addition of ensuring the security of populations on state park lands. The USFWS and BLM are also protecting populations on federal lands as well as providing some funding.

This Conservation Agreement is the most feasible approach to addressing the biological problems of this fish. Although restrictive rules inherent in endangered species status are often necessary to prevent extinction, in the case of the Pecos pupfish, the opposite is true. Creation of new habitat on private lands would likely not be possible if there was a potential for negative impacts on private enterprise. With the Conservation Agreement, landowners are willing to have Pecos pupfish stocked in their ponds and federal grants can be used to help develop suitable habitat in the ponds. To date, two shrimp farmers, using naturally saline groundwater in West Texas, have joined the program. At each location, a ciénega was constructed (1.7 ha and 7 ha) to provide secure habitat, and Pecos pupfish from Salt Creek were stocked in 2000 and 2001. The program allows and encourages individuals to participate in the conservation of rare, natural resources without personal risk or liability.

Summary

In each of the above projects, many of the critical conservation actions would not have been possible without the cooperation of public and private entities. These are examples of a positive approach to problem resolution that provides benefits to each of the cooperators. These "win-win" situations are not always available, but are certainly the most desirable.

Acknowledgments

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