

Desert Spring Fishes

Scientific Name: Comanche Springs Pupfish – *Cyprinodon elegans*, Leon Springs Pupfish – *Cyprinodon bovinus*, Pecos Gambusia – *Gambusia nobilis*, Big Bend Gambusia – *Gambusia gaigei*

Federal Status: All Endangered; 3/11/67, 8/15/80, 10/13/70, and 3/11/67, respectively •

State Status: All Endangered

Description of Species, Habitats, and Life History

Comanche Springs pupfish

The Comanche Springs pupfish seldom exceeds 2 inches in total length. It is gray-green above and pale yellow to white below, with clear to light orange fins. The sides are silvery white with blue-black blotches forming a “stripe” along the side (often faint on the male). Males have black speckling on the side and a black edge on the caudal (tail) fin. In contrast to other *Cyprinodon* species, this pupfish has a slender body and lacks vertical bars.



Comanche Springs Pupfish
© J.E. Johnson



Leon Springs Pupfish
© TPWD

Historically, this pupfish occurred in two separate spring systems of the Pecos River drainage. One was Comanche Springs, with headwaters (now almost always dry) within the city limits of Fort Stockton, Texas, and the other was a group of springs near Balmorhea. The pupfish population at Comanche Springs were extirpated (lost) when the springs first went dry in 1955.

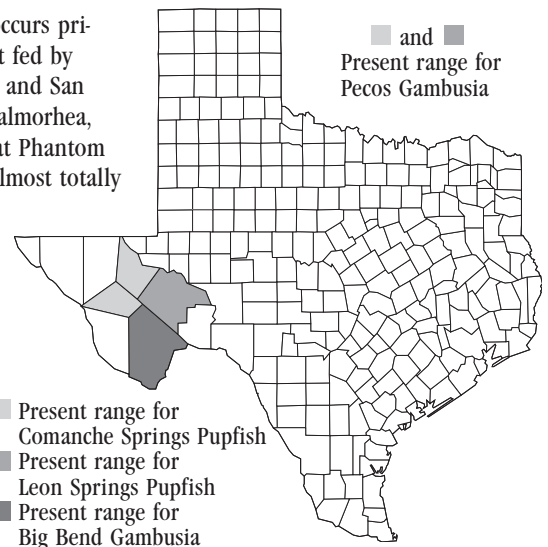
At present, the species occurs primarily in aquatic habitat fed by spring flow from Giffin, and San Solomon springs near Balmorhea, Texas. The population at Phantom Lake Springs has been almost totally lost due to loss of spring flow. The areas of greatest abundance are in Balmorhea State Park in the refugium canal (constructed in 1974) and in San Solomon Ciénega (created in 1996). Additional habitat consists mostly of

a system of concrete and earthen irrigation canals. The pupfish are often abundant in earthen ditches and concrete flumes 4 inches or more deep with bottoms covered with debris and vegetation, such as muskgrass (*Chara* spp.). They are rarely found in concrete flumes where water depth is less than 4 inches and/or the bottom is scoured of debris.

The Comanche Springs pupfish is known only from freshwater to slightly saline habitats. The springs near Balmorhea have low salinities, as did the now dry Comanche Springs. Other species of pupfish in the Pecos River system inhabit more saline waters. Breeding is thought to occur during most months of the year, and spawning (egg-laying) occurs in areas of flowing water as well as in stagnant pools. In irrigation canals, the pupfish prefer shallow areas with low current velocities. Although they feed mostly on the bottom, they also feed at the surface and at other levels in the water column.

Leon Springs pupfish

The Leon Springs pupfish is a small (about 2 inches), robust pupfish, with a wider head and body than most pupfish. Breeding males are powdery blue-gray with fins of varying shades of yellow edged with black. Females are grayish-yellow or



grayish-brown on top, and lighter below.

The Leon Springs pupfish was first discovered in 1851 by members of the U.S. and Mexican Boundary Survey. The fish was originally found at Leon Springs, a spring system that once flowed in the Leon Creek drainage about 6 miles west of Fort Stockton in Pecos County. Its historic range probably included all permanent waters within Leon Creek and the associated springs. In 1918, the area where the fish was first collected was inundated by Lake Leon, an irrigation and fishing impoundment. By 1938, the Leon Springs pupfish could no longer be found in the area where it was first discovered. Although Leon Springs once produced a flow of about 20 cfs (cubic feet per second), the springs produced no measurable flow by 1958 due to groundwater pumping in excess of aquifer recharge.

From 1958 until 1965, the Leon Springs pupfish was thought to be extinct. The fish were rediscovered in 1965, when they were collected from Diamond Y Spring, located about 10 miles north of Fort Stockton. The fish have since been found in Leon Creek, downstream from Diamond Y Spring in waters

that are quite saline. The recent localities are about 15 miles downstream from where the fish was originally found.

The Leon Springs pupfish presently occurs within two 3-mile spring-fed segments of Leon Creek and Diamond Y Spring. Diamond Y Draw is a tributary to Leon Creek. These spring-fed segments are separated by about one mile of usually dry stream bed. The fish prefer slow-flowing stretches of water, with a substrate of mud and aquatic plant roots. They are also abundant in natural spring-fed marshes (ciénegas), channels, and pools along this watercourse.

The Leon Springs pupfish feeds primarily on the bottom, ingesting large amounts of detritus (decomposed organic material) and mud. Food items include diatoms, algae, and small invertebrates. "Pit digging" has been observed, where the fish (mostly males) rest on the bottom of the pool and undulate their bodies to churn up the substrate. This behavior is thought to be associated with locating buried food items.

The Leon Springs pupfish spawns throughout the year, with females laying up to 10 eggs per day. Spawning occurs on the bottom substrate in territories aggressively defended by individual males. Shallow shelf areas with slow currents, warmer than the deeper channels, are preferred for spawning. This species is known to tolerate an unusually wide range of salinities and temperatures. However, studies suggest that the temperature range required for successful reproduction may be quite narrow. The extended breeding season, wide salinity and temperature tolerances, and broad food habits suggest that the Leon Springs pupfish is a generalist that does best in simple communities with few competing species.

Pecos gambusia

The Pecos gambusia is a small (1½ inches long), live-bearing fish with a dark lateral stripe and a metallic gray-blue color. Females have a black area on the abdomen that surrounds the anal fin and anus. The anal fin of males is modified into a gonopodium, a tube-like structure

used for internal fertilization of the female.

Historically, the Pecos gambusia was restricted to the Pecos River basin in southeastern New Mexico and western Texas. The species occurred from as far south as Fort Stockton, Texas to as far north as Fort Sumner, New Mexico. The populations of Pecos gambusia that once existed at Leon Springs and Comanche Springs were lost when these springs went dry during the mid-1950s. Presently in Texas, populations of the Pecos gambusia occur near Balmorhea in aquatic habitat supported by spring flow from Phantom Lake, Giffin, San Solomon, and East Sandia springs. The largest population is in San Solomon Ciénega at Balmorhea State Park. A substantial population also occurs in Leon Creek and in Diamond Y Spring outflow north of Fort Stockton. The species also occurs in a limited number of locations in New Mexico.

The Pecos gambusia occurs abundantly in spring-fed pools, spring runs, and downstream areas having relatively constant temperatures, abundant overhead cover, sedge-covered marshes, and in gypsum sinkholes with no surface flow. It is capable of occupying a variety of habitats if factors such as temperature and salinity are suitable.

The closest relatives of the Pecos gambusia are found in south Texas and Mexico, so the species has a long history of adaptation to warmer climates. The fish does not occur even in spring-fed waters at higher elevations, presumably because water temperatures are too cold. Maximum temperature is also important in determining suitable habitat. The Pecos gambusia seems to be less tolerant of variable temperatures than the western mosquitofish (*Gambusia affinis*), a major competitor. Studies indicate that the Pecos gambusia is more abundant in spring-fed waters, but it may also do well in less spring-like waters if there is enough cover from above to buffer temperature changes.

Predation by green sunfish (*Lepomis cyanellus*) and largemouth bass (*Micropterus salmoides*) can become a major limiting factor in areas where there is no submerged vegetation or enough shallow water to provide protection from predators. Females produce up to 40 young every 4 to 5 days.



Pecos Gambusia
© Dave Schleser



Big Bend Gambusia
© TPWD

The Pecos gambusia is an opportunistic feeder. Primarily a surface feeder, major food items include insects, other small invertebrates, and some filamentous algae.

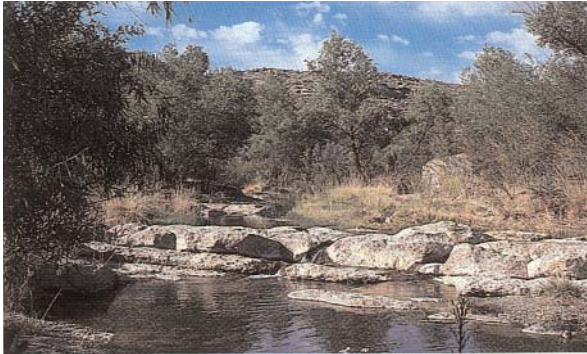
Competition with other *Gambusia* species is important in determining the relative abundance of the Pecos gambusia. Studies have shown that, over a period of years, the western mosquitofish outcompetes the Pecos gambusia in isolated pools and downstream waters well removed from spring influence. Salinity seems to be important in determining the influence of an introduced competitor, the largespring gambusia (*Gambusia geiseri*). Since the Pecos gambusia is tolerant of a wide range of salinities, it can outcompete the largespring gambusia in the saline waters of Leon Creek, while the largespring gambusia seems competitively superior in the freshwaters of the Balmorhea area. In areas where the two species are found together, the Pecos gambusia inhabits mid-water and bottom habitats and the largespring gambusia is more often found at the surface near vegetation.

Big Bend gambusia

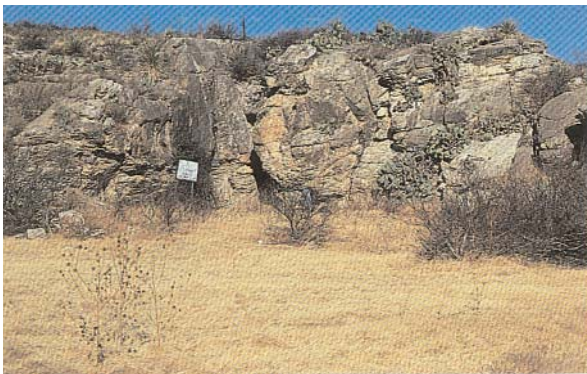
The Big Bend gambusia (*Gambusia gaigei*) is a small, live-bearing fish which reaches a maximum length of about 1½ inches. The fish is yellowish in color, with a faint lateral stripe and orange to yellow dorsal and anal fins. Other markings include a bar beneath the eye, and a faint, dark chin bar. Males



Diamond-Y Spring
© TPWD



A spring-fed creek in Big Bend Ranch State Natural Area
© Matt Wagner



Phantom Lake cienega and spring
© TPWD Andrew Price

are smaller than females, and as with other gambusia species, the male's anal fin is modified into a tube-like gonopodium for fertilizing the female.

The Big Bend gambusia is known only from spring habitats in the vicinity of Boquillas Crossing and Rio Grande Village in Big Bend National Park. Historically, the fish may have existed in other springs in the vicinity of Rio Grande Village. The population at Boquillas Spring (located about 660 ft. north of Boquillas Crossing) became extinct when spring flow ceased in 1954. The population at the spring located near Rio Grande Village drastically declined between 1954 and 1956, after the spring outflow was altered to provide a fishing pool for the park campground. The Big Bend gambusia was extirpated from this location by 1960. Two possible factors in the loss of this popu-

lation include competition with the western mosquitofish and lack of thermal stability. All present populations of Big Bend gambusia consist of descendants of three fish (two males and one female) taken from the declining Rio Grande Village population in 1956. The fish are now being maintained in a refugium pond located in Big Bend National Park. Small populations also exist at the Dexter National Fish Hatchery and Technology Center in New Mexico.

The habitats originally occupied by the Big Bend gambusia were marshes and natural pools, with clear, shallow water fed by warm springs. Dense aquatic vegetation presumably occurred in these areas. Although the present refugium has open water in excess of 3 feet, the Big Bend gambusia are most abundant among the cattails and muskgrass near the shore.

The Big Bend gambusia preys on aquatic invertebrates. Little is known concerning factors limiting reproduction in this species, but temperature, daylight hours, and food availability are known to affect reproductive success in related species. Competition with the western mosquitofish is thought to be a major factor affecting the survival of the Big Bend gambusia.

Threats and Reasons for Decline

The major threats to the survival of the desert spring fishes are habitat loss from declining springflows and reduced surface waters, competition with introduced species, and loss of genetic integrity due to hybridization with introduced species.

Introductions of fish and mollusk species from inland rivers, the Gulf Coast, and other sources pose a serious threat to these fishes. Almost any co-occurring species of fish, either indigenous or introduced, would potentially exert some competitive pressure on populations of these fishes. Competition with introduced species that are ecologically similar poses an especially serious threat.

Large artesian springs, such as those in the Balmorhea area, are diminishing in flow. Phantom Lake Spring, near Balmorhea, is particularly vulnerable because it is at a higher elevation and thus was the first of these larger springs to stop flowing. In many parts of west

Texas, more water is being withdrawn from aquifers by pumping than is being replaced by rainfall. In addition, surface waters are being diverted from aquifer recharge zones. This continued mining of aquifers could eventually cause the demise of spring systems throughout west Texas, and with them the extinction of a whole array of unique fishes and aquatic plants and animals. This would also have serious consequences for Texans of the Trans-Pecos, who would lose a valuable water supply.

Recovery Efforts

Research is ongoing to better understand the life history, habitat requirements, and limiting factors affecting the endangered fishes of west Texas. Continued monitoring of endangered fish populations and habitat is very important.

A man-made, but biologically functional desert cienega or marsh at Balmorhea State Park has been established and the endangered fishes are prospering in this new refugium. This project, sponsored by Texas Parks and Wildlife Department, the Educational Foundation of America, and the National Fish and Wildlife Foundation, not only creates habitat for the Comanche Springs pupfish and the Pecos gambusia, but also provides spring-fed habitat for a wide variety of native plants and animals. It is an excellent opportunity for school children and park visitors to learn about this unique ecosystem.

A refugium canal within the Balmorhea State Park supports several thousand Comanche Springs pupfish and Pecos gambusia. A similar refugium canal, constructed by the Bureau of Reclamation, was completed at Phantom Lake Spring. This canal supported abundant, healthy populations of these fishes. However, the refugium failed when the spring flow declined in the late 1990s.

In 1990, The Nature Conservancy of Texas purchased the land encompassing Diamond Y Spring, and the portion of Leon Creek designated as critical habitat for the Leon Springs pupfish. In the 1970s, a portion of Leon Creek was renovated, significantly reducing the problems of competition and hybridization. Future scientific man-

agement of this habitat will provide protection for the Pecos gambusia as well as the Leon Springs pupfish.

A small population of Comanche Springs pupfish is held at the National Fish Hatchery in Uvalde, Texas. Likewise, small populations of Big Bend gambusia and Leon Springs pupfish are being held at the Dexter National Fish Hatchery in New Mexico. These populations provide an opportunity for researchers to obtain specimens for study without affecting wild populations, and provide stocks for reintroductions in the event of the loss of a population.

Where To See The Desert Spring Fishes

The best places to see and learn more about these fishes are Balmorhea State Park and Big Bend National Park. At Balmorhea State Park, visitors can cool off in the world's largest spring-fed swimming pool, where the Comanche Springs pupfish and the Pecos gambusia can sometimes be seen hiding in the shallow, grassy areas of the pool. Also, the two refugia at Balmorhea State Park are excellent places to observe these fish. A refugium pond near the Rio Grande Village Campground in Big Bend National Park offers visitors a chance to see the Big Bend gambusia and its habitat.

How You Can Help

Do what you can as an individual to conserve water. Comanche Springs, Leon Springs and others have gone dry because more water is being used than is replaced by rainfall. When springs dry up, a whole host of plant and animal life disappears with them. The competition for water has taken a toll on the wetland plants and animals of west Texas. The existence of these endangered fishes, and other aquatic animals and plants which share their habitat, depends on the continued flow of the springs near Balmorhea, Leon Creek, and in Big Bend. Conservation of these spring ecosystems will result in the continued ability to use water in areas downstream from their habitats.

Since introduced species are a major threat to these endangered fishes, never release any fish into natural waters. Serious problems have

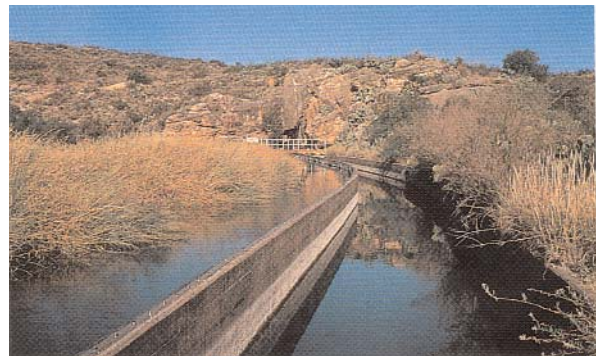
resulted from people releasing non-native fishes (especially by emptying bait buckets or releasing aquarium fish) into streams and springs, or intentionally releasing fish into state waters in an effort to improve fishing. Texas Parks and Wildlife regulations restrict these activities.

Be careful with the application of pesticides (insecticides and herbicides) and other agricultural chemicals. Improper use of chemicals can have devastating effects on aquatic systems. Always follow label precautions carefully, including instructions concerning proper disposal of rinse water and containers. Check with the Texas Department of Agriculture (TDA) for information concerning proper use of herbicides and pesticides and licensing requirements.

Due to the toxicity of some pesticides to aquatic life, special management methods are needed for certain chemicals to help prevent possible harm to protected species. Local representatives of wildlife, agriculture, and conservation groups are working with landowners to develop measures that will allow normal agricultural production to coexist with the desert fishes. Farmers, ranchers, and pesticide applicators can contact their local county extension agent, or Coordinator, Endangered Species Pesticide Protection, Texas Department of Agriculture in Austin (512-463-7476) to find out about current recommendations in your area.

A portion of the remaining habitat for the Comanche Springs pupfish and Pecos gambusia consists of the irrigation canals in the Balmorhea-Toyahvale area of Reeves and Jeff Davis counties. Conservation of these two endangered fishes can be enhanced by ensuring that water quality in the canals supports a functional aquatic community. Farmers can help by careful handling of all fuels, oils, and hydraulic fluids so that canals are not contaminated. Also, maintaining a water depth greater than 1 foot in canals occupied by these fishes is desirable.

West Texas landowners with springs and associated surface water resources can provide additional protection to various populations of rare fishes by limiting habitat disruption, preventing introduction of exotic species, and implementing conservation measures designed to maintain spring flow and water quality in



Phantom Lake canal and refugium
© USFWS Ruth Stanford



Biologists using a seine net to sample fish in Leon Creek
© Gary Garrett

spring-fed creeks and marshes. These precious water resources provide unique areas of plant and animal life. Their protection is vital to the diversity of life which they support.

Finally, you can support the Special Nongame and Endangered Species Conservation Fund by purchasing a stamp, available at the Texas Parks and Wildlife Department headquarters in Austin or at most state parks. Part of the proceeds from the sale of these items is used to provide information to park visitors concerning endangered species. Texas Parks and Wildlife also offers a wildlife conservation license plate featuring the Texas Horned Lizard, which benefits wildlife diversity efforts in Texas. The Conservation "Keep Texas Wild" (Horned Lizard) plate costs just \$25 in addition to regular vehicle registration fees, with \$20 used to support conservation of wildlife diversity and habitat in Texas.

For More Information Contact

Texas Parks and Wildlife Department
Wildlife Diversity Branch
4200 Smith School Road
Austin, Texas 78744
(512) 912-7011 or (800) 792-1112

or

U.S. Fish and Wildlife Service
Ecological Services Field Office
10711 Burnet Road, Suite 200
Austin, Texas 78758
(512) 490-0057

or

Texas Department of Agriculture
P.O. Box 12847
Austin, Texas 78711
(512) 463-7476

References

- Hubbs, C., R.J. Edwards, and G.P. Garrett. 1991. *An annotated checklist of the freshwater fishes of Texas, with keys to identification of species*. The Texas Journal of Science, suppl., Vol. 43, No. 4. 56 pp.
- Page, L.M. and B.M. Burr. 1991. *A field guide to freshwater fishes*. The Peterson Field Guide Series. Houghton Mifflin Company, Boston, MA. 432 pp.
- U.S. Fish and Wildlife Service. 1980. *Comanche Springs Pupfish* (Cyprinodon elegans) *recovery plan*. USFWS, Albuquerque, New Mexico. 25 pp.
- U.S. Fish and Wildlife Service. 1985. *Leon Springs Pupfish* (Cyprinodon bovinus) *recovery plan*. USFWS, Albuquerque, New Mexico. 26 pp.
- U.S. Fish and Wildlife Service. 1982. *Pecos Gambusia* (Gambusia nobilis) *recovery plan*. USFWS, Albuquerque, New Mexico. 41 pp.
- U.S. Fish and Wildlife Service. 1984. *Big Bend Gambusia* (Gambusia gaigei) *recovery plan*. USFWS, Albuquerque, New Mexico. 43 pp.