ECOLOGICAL PROFILES FOR SELECTED STREAM-DWELLING TEXAS FRESHWATER FISHES IV

A Final Report
To
The Texas Water Development Board

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Introduction

A major goal of the Water Development Board's mission are its research, monitoring, and assessment programs designed to minimize the effects of water development projects on the affected native aquatic fauna and to maintain the quality and availability of instream habitats for the use of dependent aquatic resources. The instream flows necessary for the successful survival, growth and reproduction of affected aquatic life are a major concern. Unfortunately, instream flow data with respect to the ecological requirements of Texas riverine fishes are largely unknown. While some information can be found in the published literature, a substantial but unknown quantity of information is also present in various agencies and research museums around the state. In order to minimize the disruptions to the native fauna, quantitative and qualitative information concerning life histories, survival, growth, reproduction, and habitat utilization is needed. The purpose of this study is to develop species profiles, primarily from the literature (published and unpublished), personal observations, contributions from established researchers and museum records for various obligate or mostly obligate riverine species. This final volume lists scientific publications resulting from information provided in previous volumes of this contract and contributes a new report on a recent survey of fishes in the Pinto Creek headsprings and upper watercourse which concludes that water diversions from the underlying aquifer could pose serious problems for one of the nation's endangered species, the Devils River minnow (*Dionda diaboli*).

Scientific Publications Resulting From This TWDB Contract

A number of scientific publications have been realized due to this TWDB contract. Foremost among these is the recent discovery and description of a new species of fish from Del Rio (Garrett and Edwards, in press). The species accounts in the following listing are for a number of species that are among the most imperiled species of the state. Each is commonly found in environments with a significant spring-flow component. The species accounts were compiled as a group effort with Dr. Clark Hubbs (Section of Integrative Biology, The University of Texas at Austin and Dr. Gary P. Garrett (Heart of the Hills Research Station, Texas Parks and Wildlife Department). The description of a new species of Gambusia from Del Rio was a collaboration with Dr. Garrett, and finally, the series of papers dealing with the Rio Conchos fishes were a joint effort with Dr. Garrett and Dr. Edie Marsh-Matthews (Department of Zoology, University of Oklahoma). All of these publications were with at least partially supported by this contract from the TWDB and for this I express my gratitude.

1. **Edwards, R. J. 2001. New additions and persistence of the introduced fishes of the upper San Antonio River, Bexar County, Texas. Texas Journal of Science 53(1): 3-12.**
2. **Garrett, G. P., Clark Hubbs and Robert J. Edwards. 2002. Threatened fishes of the world: *Cyprinodon bovinus* Baird & Girard, 1853 (Cyprinodontidae). Environmental Biology of Fishes 64(4): 442.**
3. **Hubbs, Clark, Robert J. Edwards and Gary P. Garrett. 2002. Threatened fishes of the world: *Gambusia nobilis* Baird & Girard, 1853 (Poeciliidae). Environmental Biology of Fishes 64(4): 428.**
4. **Edwards, Robert J., Clark Hubbs and Gary P. Garrett. 2002. Threatened fishes of the world: *Gambusia amistadensis* Peden, 1973 (Poeciliidae). Environmental Biology of Fishes 64(4): 460.**
5. **Hubbs, Clark, Robert J. Edwards and Gary P. Garrett. 2002. Threatened Fishes of the World: *Gambusia gaigei* Hubbs, 1929 (Poeciliidae). Environmental Biology of Fishes 65(1): 82.**
6. **Garrett, G. P., Clark Hubbs and Robert J. Edwards. 2002. Threatened fishes of the world: *Cyprinodon elegans* Baird & Girard, 1853 (Cyprinodontidae). Environmental Biology of Fishes 65(3): 288.**
7. **Edwards, Robert J., Clark Hubbs and Gary P. Garrett. 2002. Threatened fishes of the world: *Gambusia georgei* Hubbs & Peden, 1973 (Poeciliidae). Environmental Biology of Fishes 65(3): 358.**
8. **Garrett, G. P., Clark Hubbs and Robert J. Edwards. 2002. Threatened fishes of the world: *Cyprinodon pecosensis* Echelle & Echelle, 1978 (Cyprinodontidae). Environmental Biology of Fishes 65(3): 366.**

9. Edwards, R. J., G. P. Garrett and E. Marsh-Matthews. 2002. An ecological analysis of fish communities inhabiting the Rio Conchos basin. (Análisis ecológico de las comunidades de peces que habitan la cuenca del Río Conchos.) *In: Libro Jubilar en Honor al Dr. Salvador Contreras-Balderas (Maria de Lourdes Lozano-Vilano, ed.),* pp. 43-61.

10. Hubbs, Clark, Robert J. Edwards and Gary P. Garrett. 2002. Threatened Fishes of the World: *Gambusia heterochir* Hubbs, 1957 (Poeciliidae). Environmental Biology of Fishes 65(4): 422

11. Garrett, G. P., Clark Hubbs and Robert J. Edwards. 2002. Threatened fishes of the world: *Dionda diaboli* Hubbs and Brown, 1956 (Cyprinidae). Environmental Biology of Fishes 65(4): 478.

12. Edwards, R. J., G. P. Garrett and E. Marsh-Matthews. 2003. Pp. 81-95, Fish assemblages of the Río Conchos Basin, México, with emphasis on their conservation and status. *In*: Aquatic Fauna of the Northern Chihuahuan Desert, (G. P. Garrett and N. L. Allan, eds.). Texas Tech Press, Lubbock, Texas.

13. Garrett, G. P., Clark Hubbs and Robert J. Edwards. In Press. Threatened fishes of the world: *Cyprinodon eximius* Girard 1859 (Cyprinodontidae). Environmental Biology of Fishes.

14. Garrett, G. P. and R. J. Edwards. In Press. New species of *Gambusia* (Cyprinodontiformes: Poeciliidae) from Del Rio, Texas. Copeia.

15. Edwards, R. J., G. P. Garrett and E. Marsh-Matthews. In Press. Conservation and status of the fish communities inhabiting the Río Conchos Basin and Middle Rio Grande, México and U.S.A. Reviews in Fisheries and Fish Biology.

Discovery of a New Population of Devils River Minnow (*Dionda diaboli*), With Implications for its Conservation

The following report has been compiled as a group effort with Dr. Clark Hubbs (Section of Integrative Biology, The University of Texas at Austin and Dr. Gary P. Garrett (Heart of the Hills Research Station, Texas Parks and Wildlife Department). Partial funding for Dr. Hubbs and myself has come from our respective contracts with the Texas Water Development Board.

Summary

The Devils River minnow, *Dionda diaboli*, has a limited distribution in Texas and Mexico. It is listed as threatened in the United States and endangered in Mexico. Recent collections in previously inaccessible locations in the headwaters of Pinto Creek revealed a large population of *D. diaboli*. The fish were found in their typical habitat of moderately-flowing, spring-fed waters over gravel substrates, usually associated with aquatic vegetation, but were confined to the headwaters of the creek. Water chemistry parameters at these sites generally had lower pH, salinities, turbidities, conductivities, total dissolved solids, ammonia concentrations than other, more downstream sites. The distribution of Devils River minnows in the creek and their replacement by red shiners in the lower section may offer valuable insight into conservation needs of *D. diaboli*. Unfortunately spring flows in Pinto Creek appear to be threatened by excessive pumping from the associated aquifer.

Introduction

The Devils River minnow (*Dionda diaboli*) is a rare species with a limited distribution. Previously reported locations included the Devils River, San Felipe Creek, Sycamore Creek and Las Moras Creek in Texas and the ríos Salado and San Carlos drainages in Mexico (Fig. 1). It has been extirpated from Las Moras Creek, the upper and lower Devils River and possibly Sycamore Creek. Its current status in Mexico is poorly known. This fish was extirpated from Las Moras Creek because of reduced water quantity and quality (Garrett et al. 1992). Its range was reduced in the lower Devils River due to the construction and subsequent filling of Amistad Reservoir and in the upper Devils River (upstream of Pecan Springs) due to lack of stream flow. The status of *D. diaboli* in the Río Salado and Río San Carlos is unknown, but it is likely rare or extirpated from these locations (Garrett et al. 2002).

Concerns over reduction in habitat led to an initial proposal for listing the species as endangered in 1978. However, amendments to the Endangered Species Act in 1978 delayed completion of the final rule for more than two years and the proposal was eventually abandoned because the timeframe for making the decision had expired. The Devils River minnow remained a concern to conservationists due to its rarity in the wild and limited distribution. It was a Federal candidate species for nearly two decades before finally being listed as threatened in 1999. The Devils River minnow is also included as threatened by the Endangered Species Committee of the American Fisheries Society (Williams et al. 1989), Texas Parks and Wildlife Department and the former Texas Organization for Endangered Species (Hubbs et al. 1991). The Devils River minnow is listed by Mexico as an endangered species (CONABIO 1997).

In 1989, we found that Devils River minnows were rare throughout their remaining range compared to past collections (Garrett et al. 1992). In 25 sampling locations within the historic range, specimens were only collected in the Devils River, and San Felipe and Sycamore creeks, and our data indicated the species had decreased in both absolute numbers and relative abundance. The Devils River minnow was the fifth-most abundant species in 1953 at Bakers Crossing on the Devils River (Garrett et al. 1992); sixth-most abundant species in the river in 1974 (Harrell 1978); and one of the least abundant species in 1989 (Garrett et al. 1992). Our recent collections in the Devils River and San Felipe Creek indicate their numbers have increased substantially although the reasons for the increase and the stability of the population are unresolved.

Based on the geographic range of *D. diaboli* (Fig. 1), its presence in Pinto Creek might be expected, however this species has never been reported from there. Although there have been numerous surveys in Pinto Creek over the last 50 years, including the collections in 1989 (Garrett et al. 1992), no collections were ever made in the headwaters section, located on private property. Recent landowner concerns about aquifer levels and stream flows provided an opportunity for an aquatic resource assessment by the authors, personnel from the Texas Parks and Wildlife Department and the U.S. Fish and Wildlife Service, including access to the previously inaccessible headwaters of Pinto Creek.

Materials and Methods

Pinto Creek is a small, spring-fed tributary of the Rio Grande, approximately 55 km in length. Since a gauge was established at the State Highway 277 crossing in 1928, flows have typically ranged from 0.01 to 1.0 cms, but can vary even more dramatically over short periods due to local climatic conditions. The stream has registered no flows numerous times as well as flows in excess of 100 cms (International Boundary and Water Commission, in litt.). Most of the stream is 10 to 30 m wide, although in some locations it is as narrow as 1 m or less. Depths typically range from 0.1 to 1.5 m. Substrates in the creek are mostly cobble and bedrock, with some areas of mud, detritus, gravel, and sand. Vegetation is dominated by emergent macrophytes, usually covering 10 to 50% of the surface area. The surrounding riparian habitat ranges from relatively undisturbed to severely overgrazed.

An initial reconnaissance of the headwaters of Pinto Creek by G. P. Garrett on 17 December 2001 revealed the presence of *D. diaboli*. During 4 and 5 June 2002, a detailed sampling was conducted to determine the abundance and range of the Devils River minnow in Pinto Creek and to correlate its abundance with specific water quality and habitat parameters. Samples were taken by seining crews using 3-m to 5-m long and 5-mm to 6-mm mesh seines.

Almost 10 hours of sampling time was expended on 29 samples taken at 14 separate sites (Table 1). The average sampling time per site was 41 minutes although most individual samples ranged from 15 to 45 minutes. All habitats at each station were thoroughly sampled (typically 10 to 50-m stream stretches) in roughly the proportion in which they occurred. This method was employed to obtain a representative sample of the relative abundances of all fish species present at each site.

Most fishes collected were preserved in the field and identified and counted in the laboratory. Some of the *D. diaboli* were counted but returned alive to the creek in order to comply with the provisions of our federal collecting permit. A few of the larger fishes captured, such as the gars, were also only counted and returned to the creek. Preserved specimens were retained in the Texas Natural History Collections at the University of Texas at Austin.

Basic water chemistry data was obtained using a Hydrolab Data Sonde® at most collection sites. Measurements were taken at both the top and bottom of the water column at several locations within each site and the data reported are the averages of all measurements. GPS coordinates were also obtained at each collection site using a Trimble GeoExplorer 3®.

Results

The initial survey in December 2001 of the uppermost portion of Pinto Creek (station 1) yielded more than 50 *D. diaboli* in only two seine hauls. Many of these were males in full breeding coloration and spawning activity was noted. The Devils River minnow was the third-most abundant species at this time, behind the Mexican tetra (*Astyanax mexicanus*) and the Mexican mosquitofish (*Gambusia speciosa*), similar to our more extensive June 2002 survey.

During the June survey, a total of 6,775 fish was collected throughout Pinto Creek (Table 1). Some species were found throughout the stream course. These included: *Astyanax mexicanus, Notropis amabilis, Gambusia speciosa* (which was especially abundant in the shallow headsprings stations), *Lepomis megalotis, Micropterus salmoides,* and *Cichlasoma cyanoguttatum*. Species which were more commonly encountered in primarily the downstream stations were: *Cyprinella lutrensis, Pimephales vigilax, Ictalurus lupus, Poecilia latipinna, Lepomis gulosus, L. macrochirus,* and *L. microlophus*. The other species (*Lepisosteus oculatus, L. osseus, Notropis ludibundus, Moxostoma congestum, Pylodictis olivaris*, and the introduced *Lepomis auritus* were only rarely taken in the creek. Although species diversity in Pinto Creek is much lower than the Devils River, the relative abundance of *D. diaboli* in Pinto Creek compared favorably to that reported in the Devils River prior to its dramatic population decline (Harrell 1978; Garrett et al. 1992). Devils River minnows were found at all but one site (Station 5) upstream of State Highway 90 (Station 10) and were often one of the more abundant fishes at these locations (usually the third-most abundant species). A total of 457 Devils River minnows was obtained in the upper portion of the creek but none were found at or below the State Highway 90 crossing (our stations 10 to 14). At sites from the State Highway 90 crossing downstream, the most abundant fish were red shiners (*C. lutrensis*) and they often accounted for about two-thirds of the fishes present. At only one site (Station 9), 0.4 km upstream of State Highway 90, were both Devils River minnows and red shiners obtained in the same location (Fig. 2).

Water temperature ranged from 24 to almost 30^{o}C (Fig. 3). Temperatures were lowest at the headsprings and quickly rose in the first five kilometers downstream. Turbidity ranged from 1.7 to nearly 168 NTU with values generally lower in the upper portion of the watercourse.

Water pH and ammonia levels also followed this general pattern. The pH at the headsprings was consistently in the 7.1 to 7.3 range but rose to about 7.5 to 7.8 downstream while ammonia levels were least at the headsprings and rose to values approximately twice as high downstream. Livestock grazing near the creek's edge may have influenced ammonia levels artificially, but because livestock have access to the creek throughout the drainage, this is not the only causal factor. Dissolved oxygen levels ranged from about 4 to 8.3 mg/l and the lowest levels were at a site located approximately 9 km below the headsprings in an area with grazing activity near the creek. Salinity, conductivity and total dissolved solids, related parameters, showed very similar patterns as might be expected. For each of these parameters there was a pronounced change at stations downstream from the State Highway 90 bridge crossing (km 17; station 10) as also occurred to various degrees for turbidity, pH and ammonia (Fig.3). These water quality parameters correlate with the distinctly separate ranges of *D. diaboli* and *C. lutrensis* (Fig. 2) as well as other differences in the fish assemblages above and below the State Highway 90 crossing. Other than these water quality measures, no apparent differences in habitat were noted (i.e., flow patterns, vegetation, and substrates were all similar).

Discussion

Red shiners are known to be tolerant of degraded conditions and are typically found in high relative abundance under those circumstances (Mayden 1989). This is likely due to their tolerance to widely varying and sometime harsh ecological conditions that allow them to outcompete other fishes. Other highly tolerant species such as bullhead minnows (*P. vigilax*), sailfin mollies (*P. latipinna*), and to a lesser extent, bluegills (*L. macrochirus*) were also found only in the lower segment of the creek.

It is unusual to find such dichotomous fish distributions in such a short distance. Yet, the confined range explains why no researchers have previously noted *D. diaboli* in Pinto Creek. Public access is difficult and mostly limited to the two highway crossings. Ironically, *D. diaboli* could be found within eyesight of the State Highway 90 bridge crossing, but the lack of apparent differences in habitat would not have led one to suspect their presence. A different aquifer feeds the lower section of Pinto Creek (Bennett and Sayre 1962, Brune 1981) and this was corroborated by our water chemistry data as well as by local ranchers who noted that wells drilled south of State Highway 90 produced water of much lower quality than those immediately upstream.

Although Devils River minnows remained in abundance in the uppermost segment of Pinto Creek during both collections, the creek had visibly less flow in June 2002 than that observed in December 2001 and the headwaters of Pinto Creek had receded over one hundred meters downstream. Certainly annual fluctuations may occur in the springflows of this small creek, but the confined nature of the habitat for Devils River minnow makes protection of the aquifer that provides these springflows of utmost importance.

Devils River minnows are typically found in flowing, spring-fed waters. Reductions in springflows in Pinto Creek are of concern because it could detrimentally impact survival of this species and hamper its recovery. Detrimental impacts on spring flow from Pinto Springs by local irrigation pumping have been noted for many years (Brune 1981). If water quantity and quality of Pinto Creek were further compromised, it would likely result in a change in fish community structure in the upper segment and the extirpation of the Devils River minnow.

Knowledge of the species status and ecological requirements throughout the range of the Devils River minnow is essential to its conservation and recovery. Part of the efforts of Texas

Parks and Wildlife Department under the 1998 Devils River Minnow Conservation Agreement are designed to address these needs. This agreement is among the Department, the U.S. Fish and Wildlife Service and the city of Del Rio and many local landowners are actively engaged in its implementation. It calls for cooperative efforts to reduce the potential threats to the species and to stabilize and improve *D. diaboli* populations and the ecosystems upon which they depend. Commercial interbasin transfers of water from the aquifer supplying Pinto Creek have recently been proposed to augment the Edwards Aquifer, to the east, which supports the San Antonio region and the two largest spring systems in Texas, the Comal and San Marcos springs. A rationale for this water transfer is to maintain springflows in Comal and San Marcos springs, helping to conserve the seven endangered and threatened species inhabiting these systems which depend upon the Edwards Aquifer. Unfortunately, water taken from the aquifer supplying Pinto Creek, especially if springflows in the upper portion of the creek are diminished, would likely be detrimental to another federally listed species, the Devils River minnow. We recommend that these proposed ventures be carefully evaluated to prevent the further endangerment of the Devils River minnow population in Pinto Creek.

Due to its isolation in the headwaters of Pinto Creek, this population could represent a genetically unique population of *D. diaboli*. As such, and due to its proximity to Las Moras Creek where it has been extirpated, this population has a high potential for future reintroduction efforts. Perhaps more importantly, the distributional patterns found in Pinto Creek may provide important biological data on the habitat needs of the Devils River minnow and aid in the eventual recovery of the species throughout its range.

Acknowledgments

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Table 1--Relative abundances of fishes captured in Pinto Creek (% abundance).

	STATION													
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Lepisosteus oculatus	---	---	---	---	---	---	0.3	---	---	---	---	---	0.2	---
Lepisosteus osseus	---	---	---	---	---	---	---	---	---	---	---	---	0.2	---
Astyanax mexicanus	17.3	6.2	3.7	6.5	14.3	0.9	4.3	5.6	45.3	12.7	0.5	0.9	---	1.7
Cyprinella lutrensis	---	---	---	---	---	---	---	---	3.1	67.1	69.9	63.1	65.6	32.2
Dionda diaboli	4.7	2.1	75.7	2.6	---	9.8	18.2	22.2	27.4	---	---	---	---	---
Notropis amabilis	---	---	---	1.3	8.9	55.4	30.5	27.8	3.1	---	8.0	10.4	6.8	---
Notropis ludibundus	---	---	---	---	---	---	---	---	---	---	---	---	---	2.1
Pimephales vigilax	---	---	---	---	---	---	---	---	---	---	15.6	7.6	1.6	---
Moxostoma congestum	---	---	---	---	---	---	0.3	---	---	---	---	---	---	---
Ictalurus lupus	---	---	---	---	---	---	---	---	---	0.8	0.8	0.9	1.2	---
Pylodictis olivaris	---	---	---	---	---	---	---	---	---	---	---	---	---	0.2
Gambusia speciosa	71.5	86.8	14.3	50.6	39.3	22.3	29.5	5.6	1.3	2.5	1.2	4.1	16.6	34.3
Poecilia latipinna	---	---	---	---	---	---	---	---	---	1.7	---	0.3	1.3	3.9
Lepomis gulosus	---	---	---	---	---	---	---	---	---	---	---	---	0.3	0.6
Lepomis auritus	---	---	---	---	12.5	0.9	---	---	1.8	---	---	2.8	---	0.4
Lepomis megalotis	4.4	1.0	0.7	10.4	8.9	7.1	6.3	---	3.1	0.8	2.3	1.6	2.8	6.6
Lepomis macrochirus	---	---	---	---	---	0.9	9.9	---	5.8	0.8	0.4	2.8	1.2	5.0
Lepomis microlophus	---	---	---	---	---	---	0.3	---	1.3	---	0.2	---	---	0.2
Micropterus salmoides	---	---	5.1	26.0	10.7	1.8	---	11.1	5.8	1.7	0.2	0.9	2.3	1.7
Cichlasoma cyanoguttatum	2.1	3.8	0.4	2.6	5.4	0.9	0.3	27.8	1.8	11.8	0.8	4.4	---	11.2
Total Captured	1,885	1,351	272	77	56	112	302	18	223	237	834	317	607	484
Number of Species	5	5	6	7	7	9	10	6	11	9	11	12	12	13
Minutes/collection	100	55	30	30	15	5	45	15	15	30	40	15	50	45
Distance from headsprings (km)	0.0	0.4	3.8	4.4	6.0	6.6	9.0	12.5	16.8	17.2	29.6	30.1	32.8	48.0

Fig. 1--Map showing the range of the Devils River minnow (*Dionda diaboli*). Open circle at Brackettville indicates extirpated population.

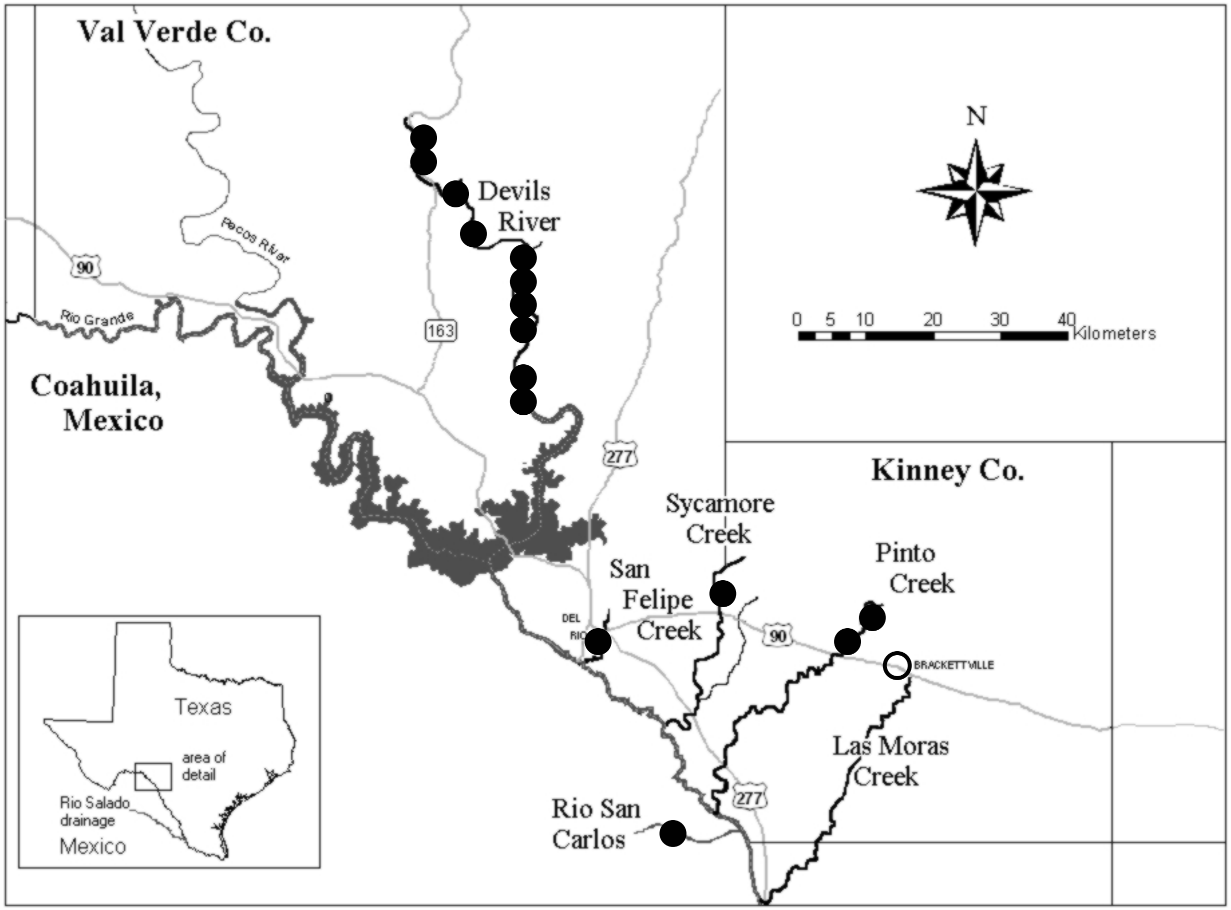

Fig. 2--Relative abundance of Devils River minnow (*Dionda diaboli*) and red shiner (*Cyprinella lutrensis*) at the Pinto Creek collection stations in June 2002. Numbers indicate captures per minute for each species.

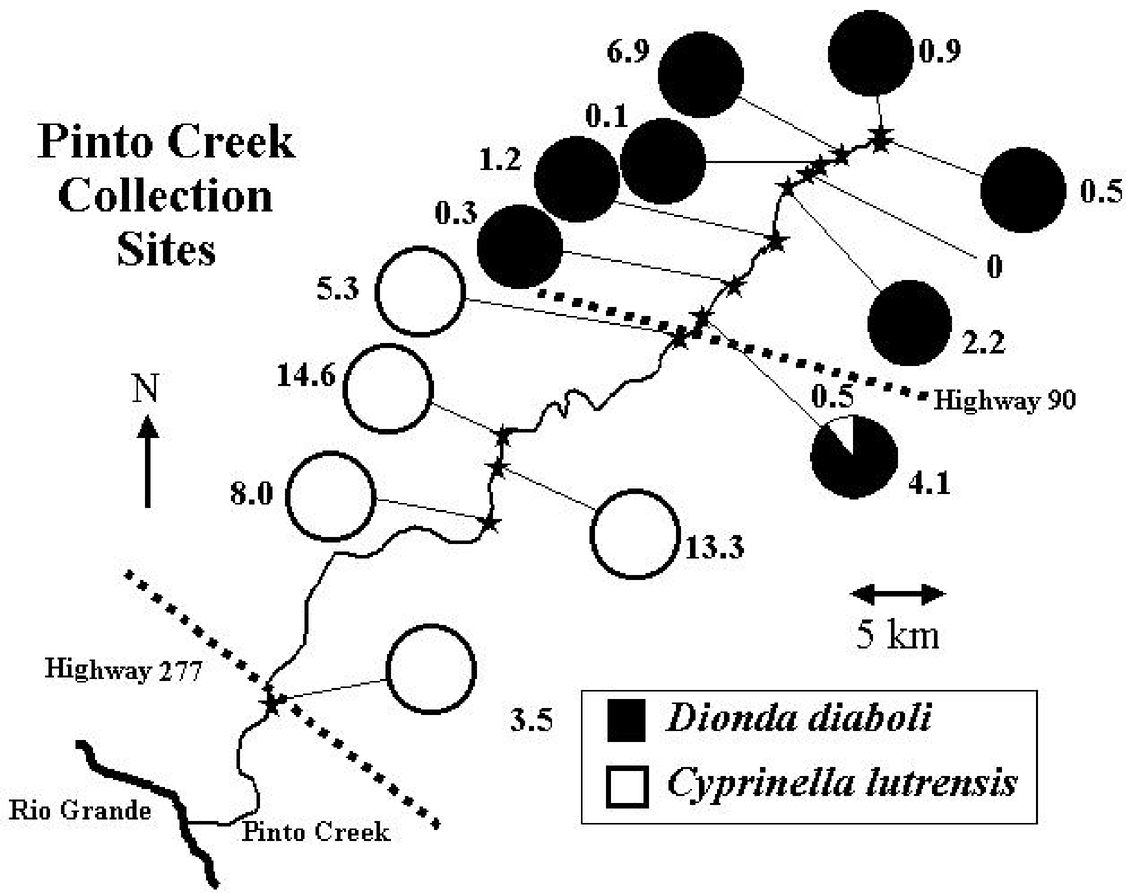

Fig. 3--Water chemistry measurements taken at various stations along Pinto Creek in June 2002.