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The ecology and life history of the Mexican tetra, Astyanax mexicanus, (Teleostei: Characidae) in the lower Rio Grande Valley, Texas

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THE ECOLOGY AND LIFE HISTORY OF THE MEXICAN TETRA, *ASTYANAX MEXICANUS*, (TELEOSTEI: CHARACIDAE) IN THE LOWER RIO GRANDE VALLEY, TEXAS

by

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The University of Texas-Pan American
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A study was conducted from April 1997 to April 1998 to study the life history of the Mexican tetra, *Astyanax mexicanus* (Filippi), and its place in the ichthyofauna of the Lower Rio Grande Valley of Texas. The Mexican tetra is the only member of the family Characidae native to the United States. It was originally found in the Lower Rio Grande, Pecos, and Nueces rivers. There are two forms of the Mexican tetra, the river form and the cave form. The cave form, formerly known as *Anoptichthys jordani*, is found primarily in the caves of northeastern Mexico, and was not studied in this research project.

The Mexican tetra has been found to migrate from shallow waters in the spring and summer months into deeper waters during the winter months when temperatures are too cold for their survival. This fish is omnivorous with insect material being the major

source of food. Its food types include green algae, nematoceran larvae, hemipterans, coleopterans, hymenopterans, dipterans, ostracods, fish eggs and amphipods. Furthermore, size classes showed that the Mexican tetras reached their largest size at the River site and smaller sizes at the Bridge and Gate sites and apparently breed year round. They are capable of producing from 300 to just over 7000 eggs per female. The diameter of Mexican tetra eggs range in size from 0.5mm to 1.0mm, and the mean egg size was found to be 0.7mm $\pm$ 0.11mm. In addition, analysis of the relative abundances at the tree sites showed the Mexican tetra to have an overall ranking of six at the Gate site, two at the Bridge site and eight at the River site.

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INTRODUCTION

The Mexican tetra, *Astyanax mexicanus* (Filippi), is the only tetra native to the United States. In the U.S., it is found only in Texas originally, from the Nueces River and Pecos drainage system to the Lower Rio Grande Valley of Southernmost Texas (Birkhead, 1978; Bechler and Harrel, 1994; Edwards, 1976, 1977; Tomelleri and Eberle, 1990). However, its range has expanded into many other parts of the U.S. due to anglers' use of the species as bait and then released into non-native waters (Bechler and Harrel, 1994; Birkhead, 1978; Brown, 1953; Edwards, 1976, 1977; Hubbs *et al.*, 1978).

Isolated populations of the tetra have been found in areas such as the Edwards Plateau in central Texas, in the Pecos River in central New Mexico, the lower Colorado River in southwestern Arizona, the Red River in and adjacent to Lake Texoma, Cross Lake in the Red River drainage near Shreveport, Louisiana, and the Neosho River drainage at Lake Spavinaw in northeastern Oklahoma (Birkhead, 1978). Edwards (1976, 1977) reported it in Waller Creek in Austin, Texas. Bechler and Harrel (1994) reported it in Hildebrandt Bayou drainage system in Jefferson County, Texas, as well as in and around Beaumont, Texas. Brown (1953) reported the species in the San Marcos River, San Antonio River, and the Guadalupe River basin between 1908 and 1930. Hubbs et al. (1991) considered the distribution of the tetra to be statewide. However, there are no records of the tetra in the Sabine Lake drainage basin in southeast Texas (Bechler and Harrel, 1994). Cold winter temperatures are thought to limit any distribution northward from the above areas (Edwards, pers. comm.)

The Mexican tetra has two forms. One is the blind cave form, which was known as *Anoptichthys jordani* (Kirby et *al.*, 1977) and has now been synonomized by many scientists as *Astyanax mexicanus*. The other is what most people know, the eyed surface form, found in many streams.

Studies to determine genetic differences between these forms have failed to show any significant differences between them, which led to the determination that both forms are conspecific (Kirby *et al.* 1977; Avise and Selander, 1972). The most obvious visible difference between the forms is that the cave form is eyeless and unpigmented (Avise and Selander, 1972; Sadoglu, 1965). Both forms readily interbreed in aquaria, producing fertile offspring (Jordan, 1946; Sadoglu, 1965, 1957; and others; *In* Avise and Selander, 1972). Furthermore, Avise and Selander (1972) reported in their study that at Chica Cave in Nuevo Leon, Mexico, fish showed the full range of variation from fully eyed and darkly pigmented to eyeless and unpigmented. This was due to periodic flooding after heavy rains, allowing surface forms to inhabit the caves and therefore producing intermediate offspring. A chromosomal study by Kirby *et al.* (1977) showed no significant differences between male or female of either blind or eyed forms. A modal chromosome number of 50 was reported for each sex of each form of tetra.

Few studies have been conducted on the life history of the species in its native range in the U.S. Winemiller and Anderson (1998) briefly reported on their food habits in a newly created habitat in west Texas; however this was not the main focus of their study. Nevertheless, they reported food material such as coleopterans, dipterans, ephemeropterans, hymenopterans and amphipods. Only a few studies have been conducted on introduced tetra populations. Two of those studies showed that the Mexican tetra migrates to deeper waters during the winter months (Edwards, 1977; Bechler and Harrel, 1994). Furthermore, Edwards (1976) found that in Waller Creek, breeding activities begin in May and continue through August. He also found that the young of the year were present in shallow waters along dense vegetation from May to September. Food habits were also reported. Individuals captured in April were found to have consumed adult dipterans; whereas, specimens collected in the summer had eaten both larval and emerging adult dipterans and beetles. A correlation between the standard length and body weight (wet) showed a positive correlation ($r=0.98$). No significantly skewed sex ratios were found. Bechler and Harrel (1994) also found that the Mexican tetra migrated to deeper waters during the winter months.

Due to the lack of knowledge on the life history of the tetra in the U.S., and due to the fact that the Mexican tetra is the furthest northward ranging characin in North America, and the only native tetra in the United States, I sampled three localities in the Lower Rio Grande Valley (Figure 1). This study allowed me to determine the community structure, growth, fecundity, and food habits of the Mexican tetra within a portion of its native range.

MATERIALS AND METHODS

Three sites were sampled for a thirteen month period, from April 1997 to April 1998 in Hidalgo County, Texas. The first two sites, called Bridge and Gate, are drainage canals located about 8km north of the University of Texas-Pan American in

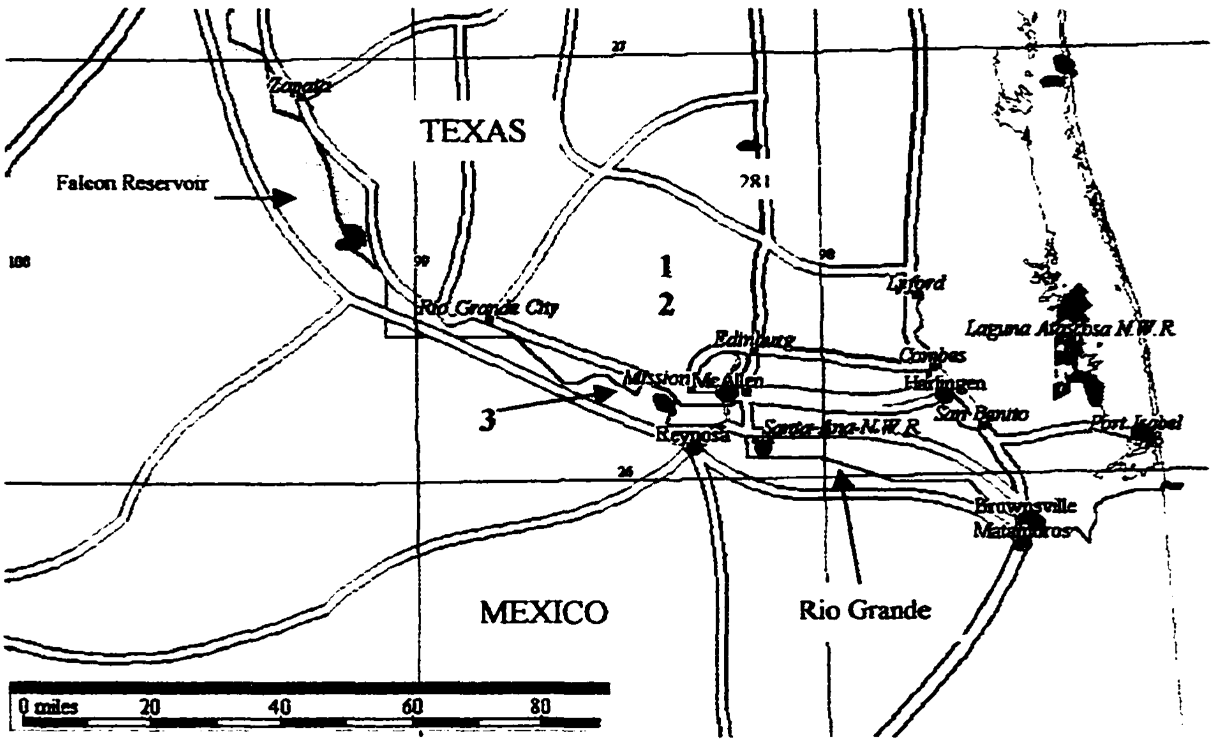

Figure 1. Map of the three sites sampled in Hidalgo Co., Texas during the thirteen-month period. Number 1 represents the Gate, 2 represents the Bridge, and 3 represents the River. Site locations are approximate.

Edinburg, Texas. The third site, River, is located on the Rio Grande at Anzalduas Park south of Mission, Texas. Each site was sampled once a month. Two seines were used. A small seine (5m with a 5mm mesh) was used primarily at the shallow, drainage canals. For the much larger river site, a 10m-bag seine with 10mm mesh was used. The drainage canal sites were sampled at the beginning of each month, and the river site was sampled toward the end of each month. In addition, the temperature was measured at each site in order to determine any water temperature differences between the sites. This data allowed me to determine any seasonal variation on the abundance of the species found at the three sites. A great effort was made to collect for the same amount of time (one-half hour) in each monthly collection at each site. Specimens were preserved in a 10% formalin solution and taken to the laboratory at the University of Texas-Pan American, where samples were separated into species counted and weighed.

DESCRIPTION OF SITES

The Gate site is located at the east end of the Edinburg Lake and is part of the North Floodway drainage system. This site starts out at a depth of about 1.2m and a width of 8m. The west side of the ditch is made out of cement and continues for about 5m. The east side starts out with cement, which ends after about 2m. The bottom consists of clay and mud with some rocks and vegetation. The depth quickly decreases from 1.2m to about 0.15m at 5m from the gate. The width of the site also decreases as the distance from the gate increases. It begins with 8m in width and narrows to about 2m at 10m from the gate. There is an abundance of vegetation on both sides of the ditch. These include grasses, sedges, and cane.

The Bridge site is located about 1km southwest of the Gate site and is part of the same drainage system. The drainage ditch at the Bridge site is a narrow and fast moving. There is a small dam approximately 1meter high at this site. The area just below was sampled. The site begins with a width of about 5m and a depth of about 0.5m. The depth of this site remained constant throughout the year with the rainy days being the exception. The depth decreased to about 30 centimeters 10m from the dam and got deeper again about 30m from the dam. The steep banks along the dam are made of cement and continue for about 4m downstream of the dam; soon after, the banks change to clay and is vegetated. Grass was the most abundant vegetation along the banks. The water current of this site was consistently swift throughout the year.

The River site is located on the Rio Grande at Anzalduas Park in Mission, Texas. In order to get a better representation of the specimens found at this site, the area impounded above Anzalduas Dam, and the riffle below the dam were sampled. The collection area above the dam was located at the boat ramp since it was the area of best access. The boat ramp is about 12m wide and is made of cement. The cement at both banks of the ramp continue downward until they meet the main river impoundment. The cement at the bottom stops about halfway from the top of the road to the river. The bottom of this site contains mud, rocks, and hydrilla. There was no marginal vegetation and little current at this site. The water level fluctuated throughout the year, depending upon how much water was being released from Falcon Reservoir upstream and from Anzalduas Dam itself. The riffle area below the dam was about 75m wide. The depth varied throughout the year and ranged from about 1m to 3m or more. The banks contained much vegetation, cane, grasses, and trees. The bottom contained an abundance of rocks, boulders, mud, gravel, and hydrilla.

COMMUNITY STRUCTURE

In order to determine the Mexican tetra importance in the fish communities studied, the community structure of each site was determined using methods similar to those of Wood (1986). Each species was separated, weighed in aggregate (wet weight in grams), and individuals counted. The total number of species, families, species per family, and abundance of all species captured was also determined. The abundance for each species was determined by dividing the total number of each individual species by the total number of all specimens for all species captured. These data will allow me to determine the ranking of the Mexican tetra in relation to all the species at each site.

GROWTH

All tetras captured at each site were measured (SL) and weighed (wet weight). All individuals were placed in 10mm size classes. These classes were analyzed for each site. The size classes allowed me to determine in what months the juveniles appeared and also, it allowed me to create a cohort. The cohort allowed me to estimate the growth rate by observing monthly increases in size. In addition, the lengths and the masses of all tetras sampled at the three sites were compared by a one-way ANOVA and Duncan's new multiple range test to determine if there was any size difference between the three sites. The standard lengths and the masses of the fish at each site were also correlated and a second-degree polynomial determined for each site to better represent the tetra's growth rates.

FECUNDITY

Fecundities, sex ratios and gonadosomatic indices (GSI) were determined for the Mexican tetra. All tetras dissected for fecundity sex ratios and GSIs were measured (SL) and weighed (wet weight in grams). The standard lengths were used to compare male to female standard lengths, and the weights were used for the determination of the GSI.

The number of eggs was estimated for females with ripe eggs. To estimate the number of eggs, a section of the ovary was removed, weighed, and the eggs were counted. This information was then analyzed using the following formula:

$$X = G(E/W),$$

where X is the total number of eggs per specimen, G is the total weight of ovaries, E is the number of eggs in the small section removed from the ovaries, and W is the weight of the eggs from the removed small portion of the ovaries.

A correlation was determined between the standard length and the number of eggs of the females. The egg size was determined for selected females. Ten eggs per female were measured then pooled to obtain a mean egg size.

The sex ratio was also determined. All tetras dissected at each site were pooled and a Chi-square was used to determine any significant differences between the number of males and females. Only the larger fish taken in each collection were chosen for the dissections. Sex determination in small fish is too difficult.

The reproductive season of the Mexican tetra was also determined. To determine the time of reproduction a gonadosomatic index (GSI) was calculated

(Buxton & Garrett 1990). The GSI was determined by removing the gonads from both males and females. The gonads were weighed to the nearest 0.0001g on a Sartorius analytic scale. The following formula was followed for the GSI:

$$GSI = (\text{gonad weight/mass of fish}) \times 100$$

The results were graphed at monthly intervals to show the potential for spawning.

FOOD HABITS

All tetras dissected for fecundity purposes were also analyzed for food habits. The stomachs and intestines were removed from the fish. The food was removed from the guts and examined with a dissecting microscope. Food contents were determined to its lowest taxonomic level possible. Each site was analyzed individually.

RESULTS

PHYSICAL DESCRIPTION OF SITES

The temperatures at the three sites were very similar. The Gate site had a high water temperature of 34C during July and August. The Bridge site had its highest temperature at 34C during June, July and August. The River site had its highest temperature during August at 31C. The lowest temperatures were in January at the Gate site (18C); during December and February in the Bridge site (19C); during December in the River site at 19C (Figure 2). No significant temperature difference was found between the sites.

COMMUNITY STRUCTURE

During the sampling of the three sites, a total of eleven families of fishes were taken (Table 1). The River site contained all eleven families. The Gate and Bridge

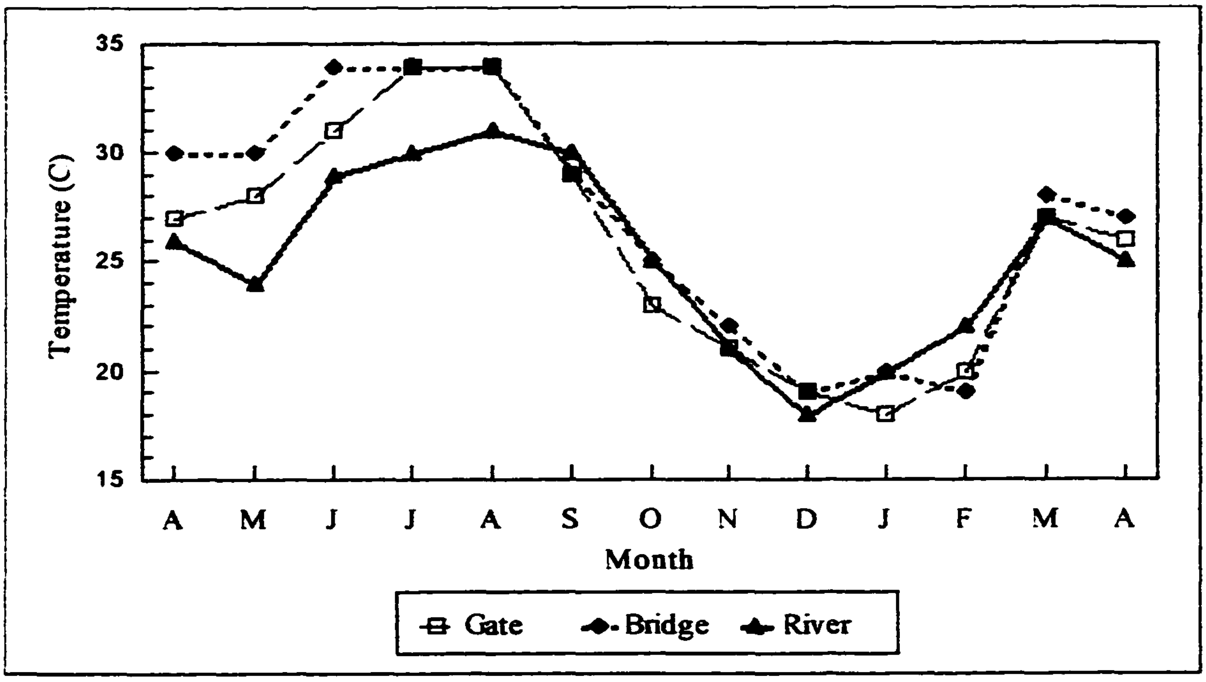

Figure 2. Water temperatures at the three sites during the thirteen month sampling period.

Table 1: Number of families found at the three sites throughout the thirteen-month period from April 1997 through April 1998. Numbers in parenthesis depict the numbers of species per family.

RIVER	GATE	BRIDGE
Clupeidae (2)		
Cyprinidae (1)	Cyprinidae (1)	Cyprinidae (3)
Characidae (1)	Characidae (1)	Characidae (1)
Ictaluridae (1)		
Belonidae (1)		
Cyprinodontidae (3)	Cyprinodontidae (2)	Cyprinodontidae (2)
Poeciliidae (2)	Poeciliidae (3)	Poeciliidae (3)
Atherinidae (1)	Atherinidae (1)	Atherinidae (1)
Centrarchidae (5)	Centrarchidae (4)	
Percidae (1)		
Cichlidae (2)	Cichlidae (2)	Cichlidae (2)

sites contained seven and six families, respectively. The families common to all three sites were the Cyprinidae, Characidae, Cyprinodontidae, Poeciliidae, Atherinidae, Centrarchidae, and Cichlidae. All of these, except the family Centrarchidae, were common among the Gate and Bridge sites. The families Clupeidae, Ictaluridae, Belonidae, and Percidae were found at the River site but were absent from the other two sites.

Four to seven families were represented at the Gate site throughout the year (Figure 3). This number fluctuated from four families in April and December 1997 to seven families in July, September, November 1997 and May 1998.

The Bridge site showed a range in the number of families from four to six through the thirteen-month study. A total of eight months had the modal number of five families. Throughout the year, the usual number of families captured was either five or six with October and December 1997 being the exceptions with only four families being taken.

The River site showed the greatest range in the number of families captured. It fluctuated from three to nine families throughout the thirteen-month period. The fewest families captured at this site were in February 1998. Nine families were obtained in April 1998. Four months of the thirteen-month study period showed the modal number of eight families captured.

The number of species obtained at the Gate site fluctuated from five to twelve (Figure 4). The lowest number of species captured at this site was five during April 1997 and the highest, twelve, during June 1997. The modal number of species captured

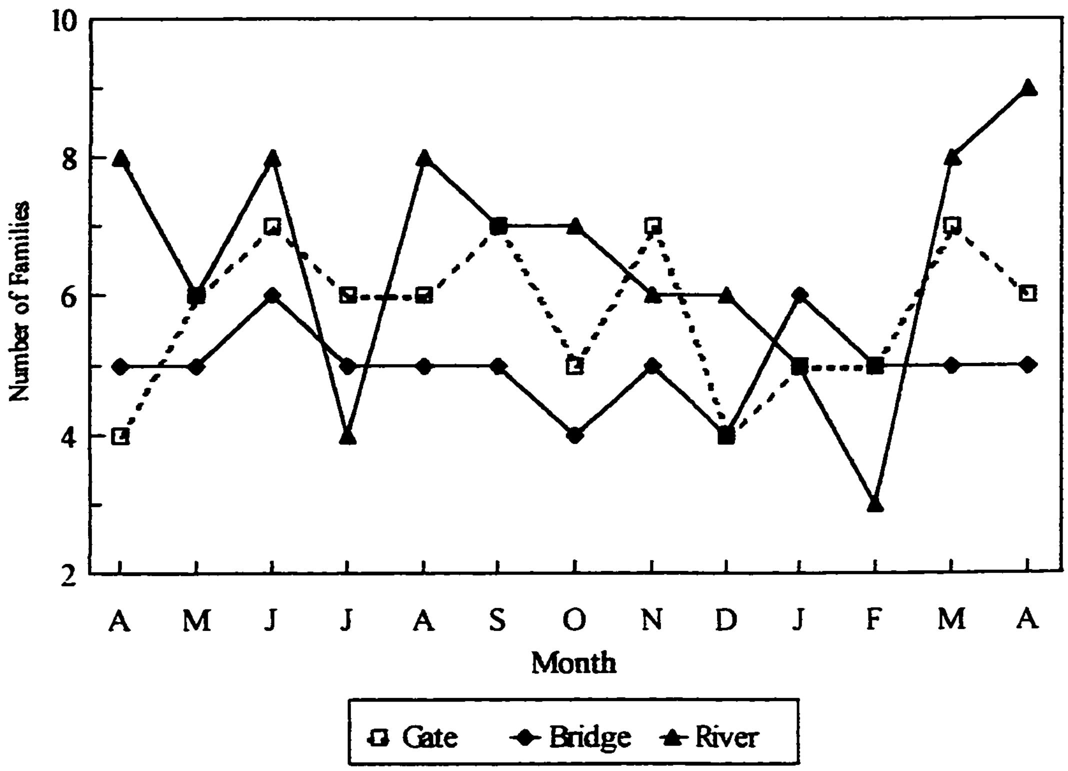

Figure 3. Number of families captured per month at the three sites: Gate, Bridge, and River, during the thirteen month sampling period.

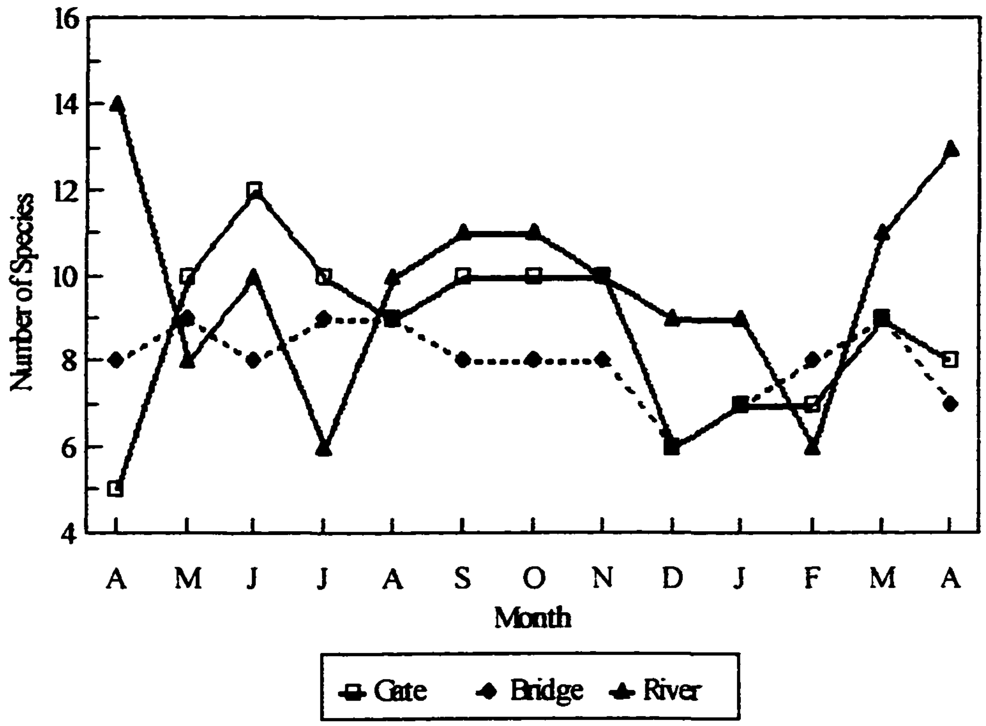

Figure 4. Number of species captured per month at the three sites from April 1997 through April 1998.

at this site was ten species. At the Bridge site, the lowest and highest number of species captured were six and nine species, respectively. The fewest species were captured in December 1997 and the modal number of species captured at this site was eight species. The River site was the most variable site in terms of the number of species captured with a range of between six and fourteen species captured per sample and the modal number of species at this site was ten species.

The greatest number of specimens taken at the Gate site was 3421 specimens, captured in July 1997 (Table 2). The second greatest number of specimens collected was during August 1997 with 2017, and third was in December 1997 with 1960 specimens. The fewest specimens (119) were captured during the April 1997 sample. Of the 16 species captured at the Gate site during the 13-month period, the most common species at this site were *Astyanax mexicanus* (Mexican tetra), *Cyprinodon variegatus* (sheepshead minnow), *Gambusia affinis* (western mosquitofish), *Poecilia formosa* (Amazon molly), *Poecilia latipinna* (sailfin molly), and *Menidia beryllina* (inland silverside). Of these, the sailfin molly and the sheepshead minnow were present in every collection. The Mexican tetra, mosquitofish, Amazon molly, and the inland silverside were present at 12 out of 13 collections. The least common species captured were *Dorosoma cepedianum* (gizzard shad), *Fundulus grandis* (gulf killifish), and *Lepomis microlophus* (redear sunfish) which were each taken only once through the thirteen-month period. The species in greatest relative abundance at this site was commonly the sailfin molly.

Table 2. Species relative abundances based on numbers at the Gate site from April 1997 to April 1998. Shown are the percentages of each species to the total captures for each month. N equals the total number of specimens captured each month.

	1997						MONTH						1998
Species	A	M	J	J	A	S	O	N	D	J	F	M	A
Dorosoma cepedianum							0.1						
Dorosoma petenense							0.1	0.3					
Cyprinus carpio			0.5		0.1	0.1		0.3				0.6	
Astyanax mexicanus		2.2	2.5	2.7	3.6	2.1	0.6	1.7	2.1	5.9	1.7	3.7	1.4
Cyprinodon variegatus	37.0	16.3	7.8	0.2	0.7	2.9	47.6	7.3	21.5	54.1	59.0	1.2	4.3
Fundulus grandis		1.2											
Gambusia affinis		19.7	18.4	28.6	40.6	36.6	0.3	9.1	3.8	3.1	0.1	18.0	30.1
Poecilia formosa	0.8	24.3		3.7	4.1	9.2	19.8	26.9	7.9	6.5	7.7	14.9	7.1
Poecilia latipinna	5.0	22.9	1.6	62.9	41.2	20.9	30.9	42.1	63.3	29.2	31.1	35.4	56.0
Menidia beryllina	54.6	10.1	53.8	1.2	5.9	17.3		12.2	1.5	1.2	0.3	25.5	0.9
Lepomis gulosus			0.7			0.1							
Lepomis macrochirus	2.5	0.3	0.5	*			0.2	0.1				0.3	0.1
Lepomis microlophus			4.6										
Micropterus salmoides		3.0	7.1										
Cichlasoma cyanoguttatum			2.3	0.6	3.5	5.1	0.2	0.1		0.1			0.1
Tilapia aurea		0.1	0.2	0.1	0.4	5.7	0.2				0.1	0.3	
N	119	1282	435	3421	2017	770	1192	770	1960	1738	949	322	1080

*<0.1%

The Mexican tetra, at the Gate site, had a very low relative abundance that ranged from 0.8% to 5.9%. The sheepshead minnow, present in all collections, had an abundance that ranged from 0.2% during July 1997 to a relative abundance of 59.0% during February 1998. The western mosquitofish, absent only from the April 1997 sample, had a relative abundance which ranged from 0.1% during February 1998 to 40.6% during August 1997. The amazon molly ranged in relative abundance from absent in the July 1997 sample to 26.9% during November 1997. Sailfin mollies ranged in abundance from 1.7% during June 1997 to 63.3% during December 1997. As the most abundant species captured at the Gate site, the sailfin molly had an abundance greater than 20% in 11 of the 13 samples.

The inland silverside, absent during October 1997, ranged in relative abundance from 0.9% during April 1998 to 54.6% during the April 1997 sample. *Cichlasoma cyanoguttatum* (Rio Grande cichlid) and introduced *Tilapia aurea* (blue tilapia) were present in eight collections. Both cichlids had relative abundances that ranged from absent to their highest, 5.1%.

Thirteen species were collected at the Bridge site during the study (Table 3). The months with the greatest number of specimens collected were in May 1997 with 1580 specimens, June 1997 with 1374 specimens, and May 1998 with 973 specimens. The month with the fewest specimens captured was during the January 1998 sample with only 28 specimens.

The species that were common at this site were Mexican tetras, sheepshead minnows, gulf killifish, western mosquitofish, amazon mollies, sailfin mollies, and Rio

Table 3. Species relative abundances based on numbers at the Bridge site from April 1997 to April 1998. Shown are the percentages of each species to the total captures for each month. N equals the total number of specimens captured each month.

	1997						MONTH						1998
Species	A	M	J	J	A	S	O	N	D	J	F	M	A
Dorosoma cepedianum								0.2					
Cyprinus carpio		0.1	3.4	0.8	1.1	0.1							
Cyprinella lutrensis	0.2			0.5	0.3					10.7	0.6	0.2	0.8
Pimephales vigilax		0.1											
Astyanax mexicanus	0.2	50.9	42.4	14.9	53.6	21.0	11.6	25.0	21.7	17.9	2.7	1.9	3.9
Cyprinodon variegatus	65.3	16.0	10.5	25.1	16.4	31.3	9.8	6.8	28.5	42.9	6.0	1.9	55.1
Fundulus grandis	0.2	0.2		0.3	0.5	0.1	0.1	0.5				0.3	
Gambusia affinis	1.3	16.4	21.9	24.1	8.2	9.1	0.1	1.4	2.7	3.6	1.2	1.2	2.2
Poecilia formosa	6.2	1.6	1.8	13.8	6.6	17.9	66.0	52.4	33.3	17.9	26.8	63.5	35.4
Poecilia latipinna	25.8	14.4	15.8	18.2	10.8	17.8	11.3	12.5	13.7		59.3	28.0	2.5
Menidia beryllina	0.7		0.1									1.1	0.1
Cichlasoma cyanoguttatum		0.4	4.2	2.4	2.6	2.8	0.6	1.2	0.2	3.6	1.8	2.0	
Tilapia aurea						0.5				1.5			
N	449	1580	1374	665	379	905	726	424	526	28	332	973	895

Grande cichlids. The Mexican tetra was present in every collection and had an abundance that ranged from 0.2% during April 1997 to 53.6% during August 1997. During six of the months, the relative abundance of the tetra was no less than 20%. The sheepshead minnow, also present at every collection, had abundances that ranged from 1.9% in May 1998 to 65.3% during the April 1997 sample. The gulf killifish was present in eight of the collections. This species had a very low relative abundance, ranging from absent to 0.5% during August 1997. The mosquitofish, present in all collections, had its greatest relative abundance during the July 1997 sample at 24.1% and its lowest (0.1%) during October 1997. The Amazon molly had its lowest abundance of 1.6% during May 1997 and its highest during October with 66.0%. The sailfin molly, present in 12 of 13 collections, had a range in relative abundance from absent to 59.3% in February 1998. The Rio Grande cichlid was present at eleven collections and had an abundance ranging from absent to 4.2% in June 1997. The rarest species captured were the gizzard shad, which appeared only once throughout the study, and the blue tilapia, which was captured only twice during the collection period (Table 3).

The River site contained the greatest number of species with nineteen captured during the 13-month period (Table 4). The greatest number of specimens were taken in August 1997 (3141 specimens). The August 1998 and May 1997 collections contained 505 and 367 specimens respectively. The January 1998 sample contained the fewest specimens (19). Only April 1997 and April 1998 samples contained more than 500 specimens.

Table 4. Species relative abundances based on numbers at the River site from April 1997 to April 1998. Shown are the percentages of each species to the total captures for each month. N equals the total number of specimens captured each month.

	1997						MONTH						1998
Species	A	M	J	J	A	S	O	N	D	J	F	M	A
Dorosoma cepedianum				3.6		2.9	2.7			10.5			1.2
Dorosoma petenense				29.9	43.4	5.0				10.5			5.2
Cyprinella lutrensis	5.2		1.8		0.8		28.2		60.8	5.3		4.0	
Astyanax mexicanus	0.9	3.5	0.5		2.5	5.0		2.0		5.3		29.0	0.2
Ictalurus punctatus						0.7						1.0	
Strongylura marina	*		0.5		1.6	2.9	2.7					1.0	0.8
Cyprinodon variegatus	1.9		0.5										
Fundulus grandis		7.1											
Lucania parva	13.9	2.5	3.7		0.8		2.7	8.2	3.9			2.0	0.2
Gambusia affinis	1.6	0.5	2.3		1.6			1.5	2.9		10.8	7.0	0.4
Poecilia formosa	1.7												
Menidia beryllina	49.8	57.2	6.0	17.0		0.7	4.5	68.4	24.5	5.3	32.4	19.0	20.6
Lepomis auritus	0.4				0.8	0.7	5.5	0.5	1.0	15.8	5.4	1.0	
Lepomis macrochirus	4.5	0.8	14.8	30.4	20.5	14.3	10.9	4.6	1.0	21.1	13.5	0.1	59.4
Lepomis microlophus	0.6					26.4	1.8	2.0	1.0	10.5	18.9	7.0	7.5
Micropterus salmoides	19.4	28.1	13.4	8.8	24.6	34.3	34.5	9.2	3.9	15.8	18.9	20.0	3.2
Percina macrolepida **													0.8
Cichlasoma cyanoguttatum	0.2	0.3	3.7	10.3	3.3	7.1	5.5	3.1	1.0				0.2
Tilapia aurea						0.9	0.5					0.4	
N	3141	367	217	194	122	140	110	196	102	19	37	100	505

*<0.1%

**New species in this area

The River site had a greater number of species common to every monthly collection. The most common species at this site were *Cyprinella lutrensis* (red shiner), Mexican tetras, *Strongylura marina* (Atlantic needlefish), *Lucania parva* (rainwater killifish), western mosquitofish, *Menidia beryllina* (inland silverside), *Lepomis auritus* (redbreast sunfish), *Lepomis macrochirus* (bluegill), redear sunfish, *Micropterus salmoides* (largemouth bass), and Rio Grande cichlids. The red shiner was captured in seven of the thirteen samples. In these samples, the species ranged in relative abundance from 0.8% in August 1997 to 60.8% in December 1997. The Mexican tetras ranged in abundance from absent to 29% in March 1998. Mexican tetras were taken in eight collections during the 13-month period. Atlantic needlefish reached their lowest relative abundance during April 1997 (less than 0.1%) and their greatest abundance (2.9%) during the September 1997 sample. Rainwater killifish ranged in abundance from 13.9% in April 1997 to 0.2% in April 1998. Western mosquitofish were present in nine collections and ranged in abundance from 0.4% in April 1998 to 10.8% in February 1998. The inland silverside, taken in twelve of the thirteen collections, reached its greatest relative abundance (68.4%) in November 1997 and its least (0.7%) in September 1997. The redbreast sunfish ranged in abundance from 0.4% in April 1997 to 15.8% in January 1998 in the nine collections in which they were captured. Bluegills were present in every sample and ranged in abundance from 0.1% during March 1998 to 59.4% during April 1998. Redear sunfish were captured in nine collections and ranged in abundance from 0.6% during April 1997 to 26.4% during September 1997. Largemouth bass were taken in all collections and ranged in abundance from 3.2% in April 1998 to 34.5% during the October 1997 sample. Rio Grande cichlids were taken in ten of the thirteen collections. The lowest relative abundance was obtained during April 1997 at 0.2% and the highest at 10.3% during July 1997. Gulf killifish, Amazon mollies, and bigscale logperch (*Percina macrolepida*) were each captured only once during the study.

GROWTH

The growth of the Mexican tetra was estimated by analyzing length frequency distributions for each month and for each site. The number of specimens for each size class was represented as a percentage of all tetras captured at each collection.

At the Gate site, there were a total of four size classes represented (Table 5). The most common size classes at this site were the 21-30mm and the 31-40mm groups. These two classes were represented in at least eleven months in which tetras were captured. There were no tetras captured for the classes less than 10mm or greater than 51mm SL.

At the Bridge site five size classes were found (Table 6). No tetras smaller than 11mm or larger than 61mm were captured. The two months with the highest number of tetras captured were May and June 1997 with 804 and 583 tetras, respectively. The lowest number of tetras captured occurred during April 1997 sample with one specimen taken.

The River site contained the greatest number of size classes with seven (Table 7). During six of the thirteen collections no tetras were captured from this site. In

Table 5. Length frequency distributions for the Gate site during the thirteen-month period from April 1997 to April 1998. The numbers are percentages of the total number of tetras captured each month. The juveniles (11-20mm) appearing in May were considered to have been spawned a month before.

	Size Class (in mm Standard Length)						
Month	1-10	11-20	21-30	31-40	41-50	%	N
April							
May		17.9	75	7.1		100	28
June			36.4	54.5	9.1	100	11
July		40.7	54.9	4.4		100	91
August		12.5	59.7	23.6	4.2	100	72
September			62.5	31.3	6.2	100	16
October			33.3	66.7		100	9
November			69.2	30.8		100	13
December		2.4	14.3	61.9	21.4	100	42
January		2.9	20.2	71.1	5.8	100	104
February			50	43.8	6.2	100	16
March		16.7	83.3			100	12
April			73.3	26.7		100	15

Table 6. Length frequency distributions for the Bridge site during the thirteen-month period from April 1997 to April 1998. The numbers are percentages of the total number of tetras captured each month. The Juveniles (11-20mm) appearing in May were considered to have been spawned a month before.

	Size Class (in mm Standard Length)							
Month	1-10	11-20	21-30	31-40	41-50	51-60	%	N
April				100.0			100	1
May		24.4	68.1	6.6	0.9		100	804
June		21.3	57.4	17.0	4.0	0.3	100	583
July			41.4	37.4	21.2		100	99
August			46.8	40.9	10.3	2.0	100	203
September			42.1	53.2	4.7		100	190
October			15.5	61.9	20.2	2.4	100	84
November			21.7	69.8	7.6	0.9	100	106
December			9.6	59.7	28.9	1.8	100	114
January			20.0		60.0	20.0	100	5
February			11.1	55.6	33.3		100	9
March				88.9	11.1		100	18
April				11.4	77.2	11.4	100	35

Table 7. Length frequency distributions for the River site during the thirteen-month period from April 1997 to April 1998. The numbers are percentages of the total number of tetras captured each month. The juveniles (11-20mm) appearing in April were considered to have been spawned a month before.

	Size Class (in mm Standard Length)									
Month	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	%	N
April		17.2	48.3	6.9	20.7	6.9			100	29
May				7.7	76.9	15.4			100	13
June										
July										
August							100.0		100	3
September						28.6	57.1	14.3	100	7
October										
November					50.0		50.0		100	4
December										
January										
February										
March					24.1	27.6	41.4	6.9	100	29
April						100.0			100	1

addition, the size classes, 11-20mm and 21-30mm were present only once throughout the study and this was the only site where fishes larger than 70mm were captured.

Length to mass relationships were determined for each site. Figure 5 shows the length-mass relationship for all tetras captured at the Gate site. This relationship had a correlation coefficient of 0.96. The length-mass relationship was better expressed by the second-degree polynomial $Y=2E\text{-}05X^{3.0505}$ ($r^2=0.98$), where X represents the standard length of the tetra and Y equals its mass. The smallest tetra captured at this site measured 16mm standard length, and the largest, 47mm. The mean size for tetras at the Gate site was 28.4mm (SD = 7.19; N = 429). The Bridge site had a minimum and maximum size of tetras of 12mm and 63mm, respectively (Figure 6) and a mean of 28.5mm (SD = 7.92; N = 2251). The lengths and masses of the tetras were positively linearly correlated ($r = 0.93$) at this site. The length-mass relationship was better expressed by the second-degree polynomial $Y=3E\text{-}05X^{2.9961}$ ($r^2=0.98$). The tetras captured at the River site had a minimum and maximum size of 13mm and 74mm, respectively, and a mean size of 47.6mm (SD = 15.8; N = 86; Figure 7). A second-degree polynomial expressed the relationship between mass and length as $Y=2E\text{-}05X^{3.1414}$ ($r^2=0.99$).

The lengths for tetras from the three sites were compared by a One-way ANOVA. This showed a statistical difference between the standard lengths of the tetras between the sites with $F_{(2,\,2763)}=228.256$ at $p<0.05$ (Table 8). Duncan's multiple range test showed the river tetra's length to be significantly longer than tetras from the other two sites at the $p<0.05$ level. The river tetras were significantly larger than tetras from drainage ditches.

Table 8. One-way ANOVA comparing standard lengths of tetras between the three sites.

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO
Between groups	2	30456.871	15228.435	228.256*
Within groups	2763	184337.797	66.716	
TOTAL	2765	214794.668		

*p<0.05

The masses of tetras were similarly analyzed. A One-way ANOVA for masses between the three sites showed a statistical difference with $F_{(2, 2759)}=485.232$ (Table 9). Duncan's new multiple range test showed the river tetra's mass to be statistically greater than tetras from the other two sites at $p<0.05$. Further, by observing when the Mexican tetra juveniles first appeared in Tables 5, 6 and 7 one can determine that the tetras grow about 10mm per month.

Table 9. One-way ANOVA comparing masses of tetras between the three sites.

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO
Between groups	2	740.722	370.361	485.232*
Within groups	2759	2105.852	0.763	
TOTAL	2761	2846.575		

*p<0.05

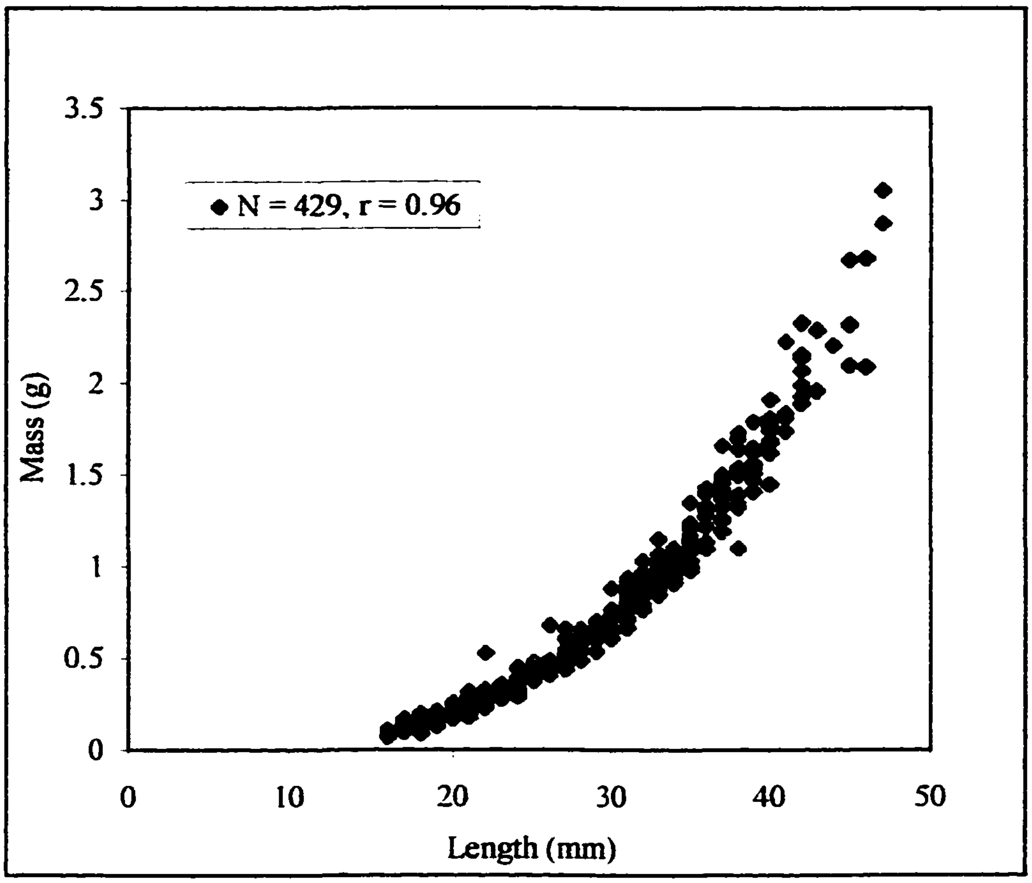

Figure 5. Standard length versus mass relationship for all tetras captured at the Gate site.

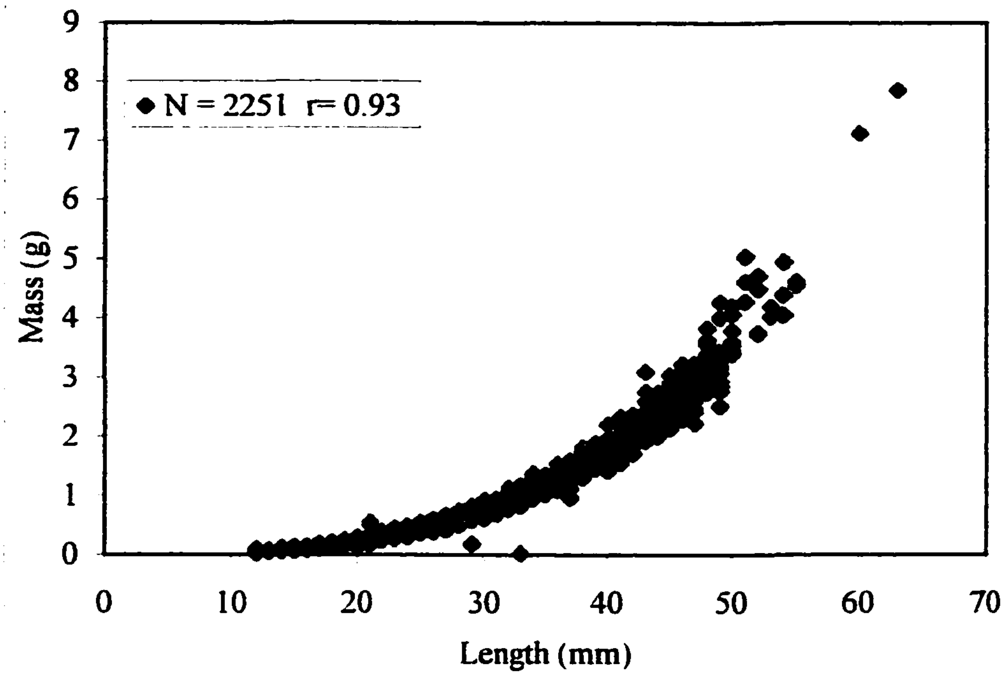

Figure 6. Standard length versus mass relationship for all tetras captured at the Bridge site.

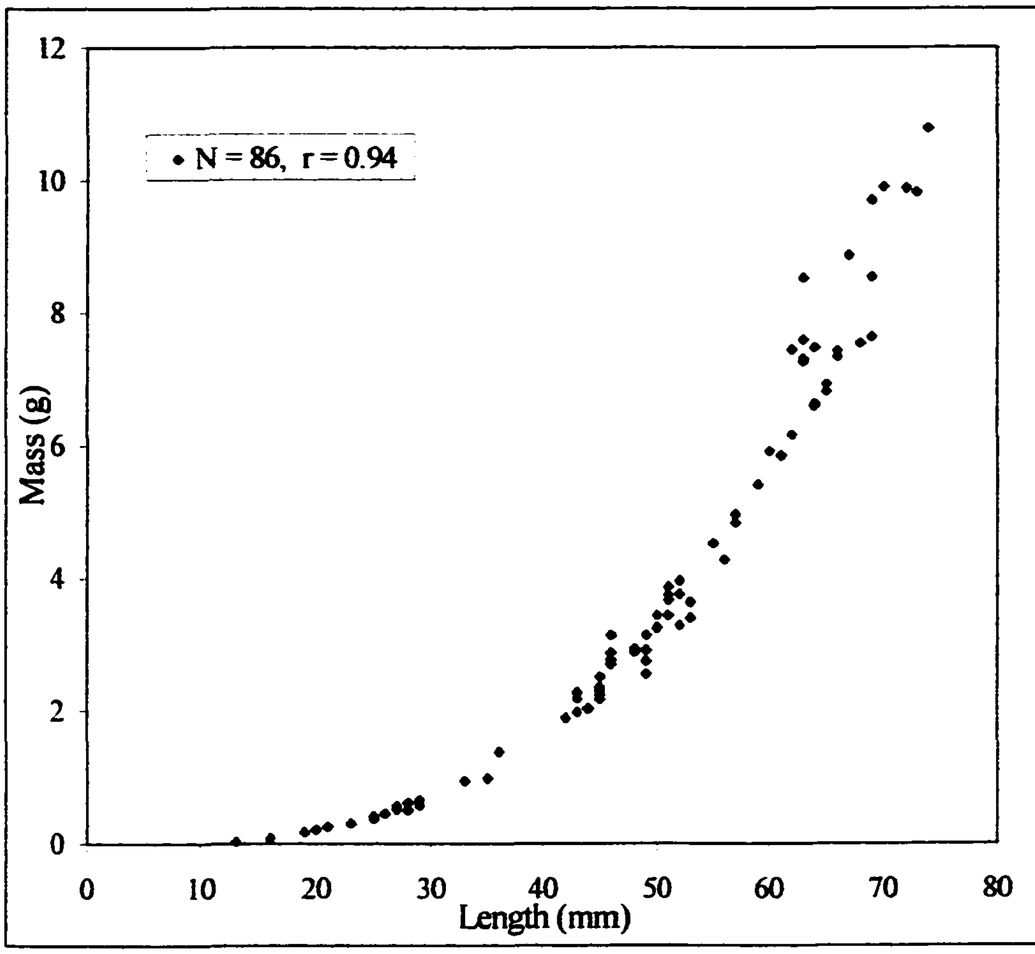

Figure 7. Standard length versus mass relationship for all tetras captured at the River site.

FECUNDITY

The fecundity of the Mexican tetra was determined at each site. Because the Bridge and the Gate sites were in close proximity and because there were not enough specimens captured with ripe eggs at the Gate site, the number of tetras with ripe eggs captured at both sites were pooled (Figure 8). The number of eggs at the combined Bridge-Gate site ranged from 598-7,666 eggs. The tetras at this site had a mean number of eggs of 2,322.6 (SD = 1714.6). The tetra's standard length versus the number of eggs relationship at this site was only weakly correlated (r=0.65; N=15). Tetras at the River site had a mean number of eggs of 3,517.8 (SD=2,306.3; Figure 9). Egg number ranged from 319 to 6,490 eggs/female. The correlation between the number of eggs and standard length was r = 0.79 (N=10). A t-test indicated no significant differences between the number of eggs produced by the tetras in either the river or combined drainage ditch sites (t=1.49, $p<0.05$, df=23).

The diameters of 50 ripe eggs were measured using 10 eggs per individual from five tetras captured at the Bridge site. The size ranged from 0.5mm to 1.0mm, with a mean size of 0.7mm (SD = 0.11).

Mature female lengths (lengths greater than 30mm) were compared at the River and Bridge-Gate sites. Females at the Bridge-Gate site ranged in size from 38 to 63mm SL (mean = 48.9mm; SD = 6.9; N = 15). Females at the River site ranged in size from 51 to 74mm SL (mean = 65.4mm; SD = 8.4; N =10). A t-test indicated that the females at the River site were significantly larger than females at the Bridge-Gate site (t=5.35, df=23, and $p<0.05$).

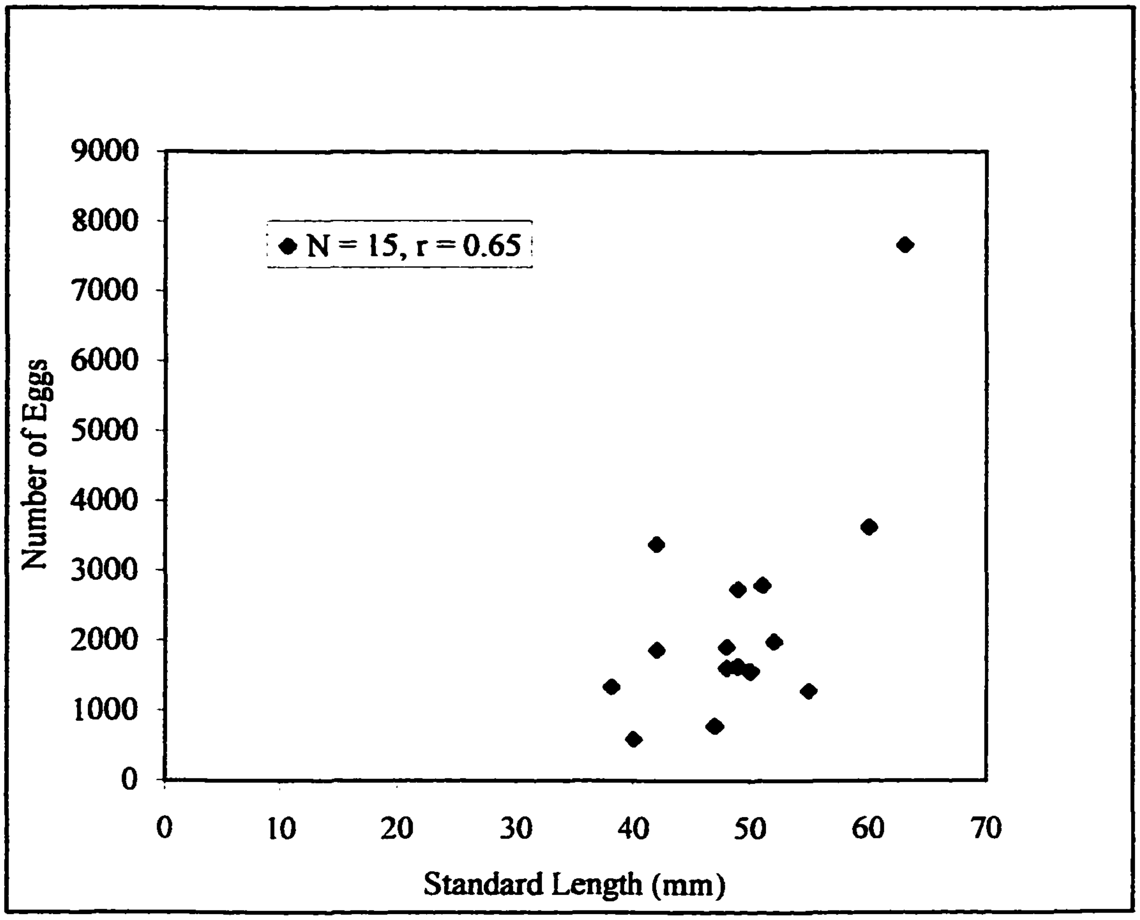

Figure 8. Standard length versus the number of eggs produced by females at the Bridge-Gate site.

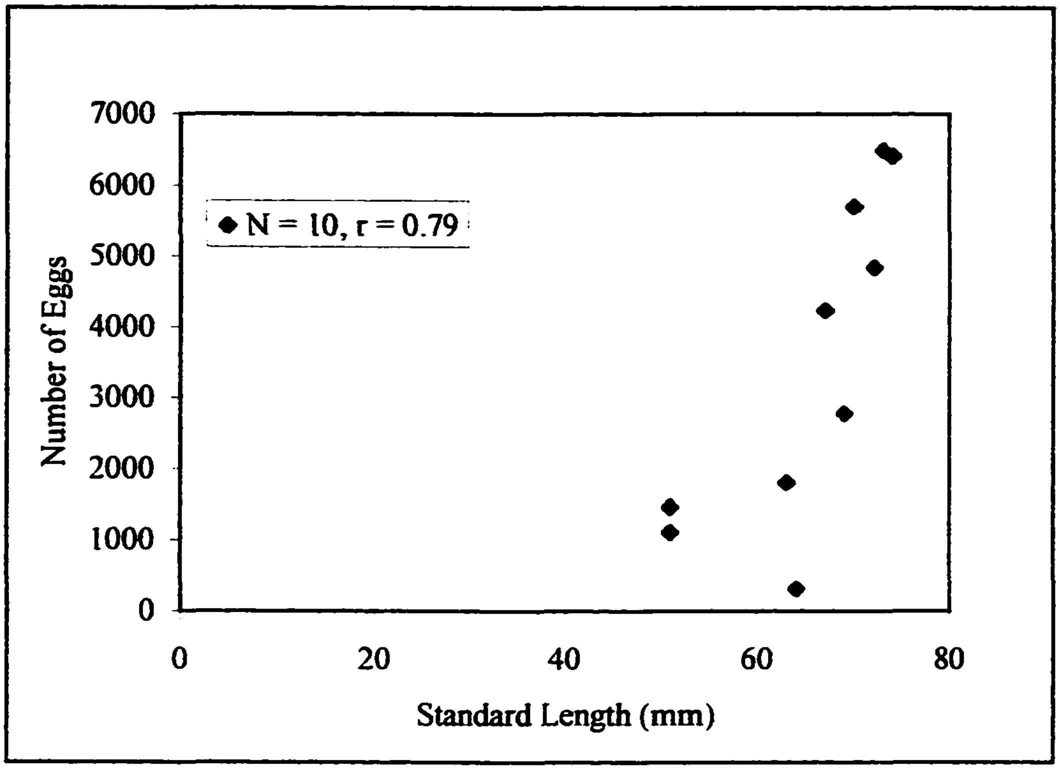

Figure 9. Standard length versus number of eggs produced by females at the River site.

The sex ratio was determined for the tetras at each site. The Gate site showed a significant difference between the numbers of females and males (X^2=4.85, $p<0.05$). A total of 91 specimens were dissected with 35 being females and 56 males. The Bridge and River sites showed similar and significant differences (Bridge site X^2=11.0; River site X^2=21.36, both at $p<0.05$). A total of 176 (110 females and 66 males) and 45 (38 females and 7 males) specimens were dissected for the Bridge and River sites, respectively. The specimens from all sites were pooled and their standard length analyzed. The females ranged in size from 28mm to 74mm SL. The male's ranged in size from 22mm to 56mm SL. An analysis of the mean standard lengths between males and females showed the females being significantly larger than males (t=7.32 and df=309). Female standard length averaged 45.53mm (SD = 8.87) and male standard length averaged 39.03mm (SD = 5.74).

A gonadosomatic index (GSI) was calculated for both sexes at the three sites. Increased gonadal development was noted in females in August and September at the Gate site; in March, April, June, July and November at the Bridge site; and in March and September at the River site (Figures 10, 11, and 12). Males had increased gonadal development in August at the Gate site; in February to April and October at the Bridge site (Figures 13 and 14). The small number (not graphed) of males taken from the River site showed little gonadal development.

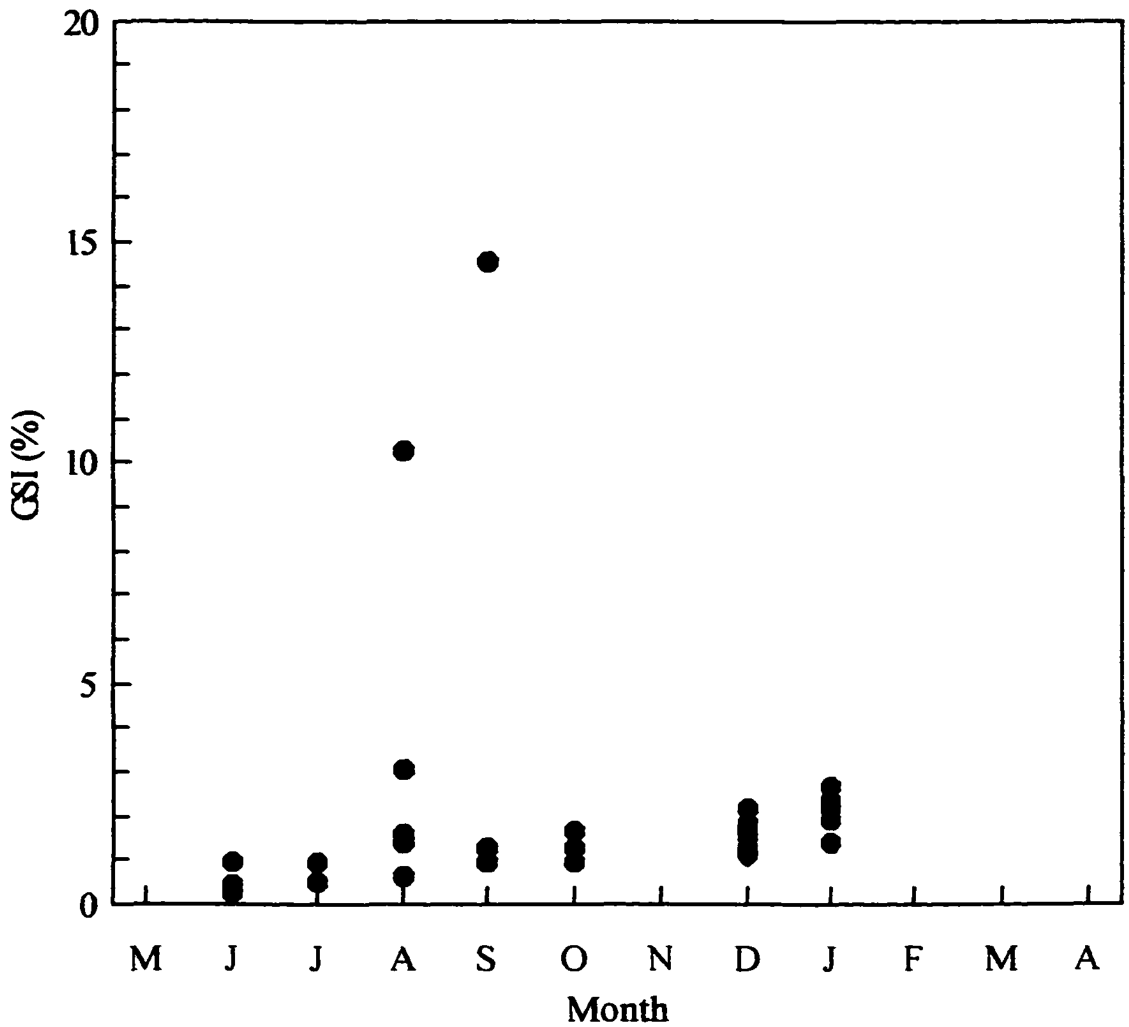

Figure 10. Female gonadosomatic index (GSI) at the Gate site from April 1997 to April 1998. Females with a GSI greater than or equal to 10 were considered as being capable of reproducing.

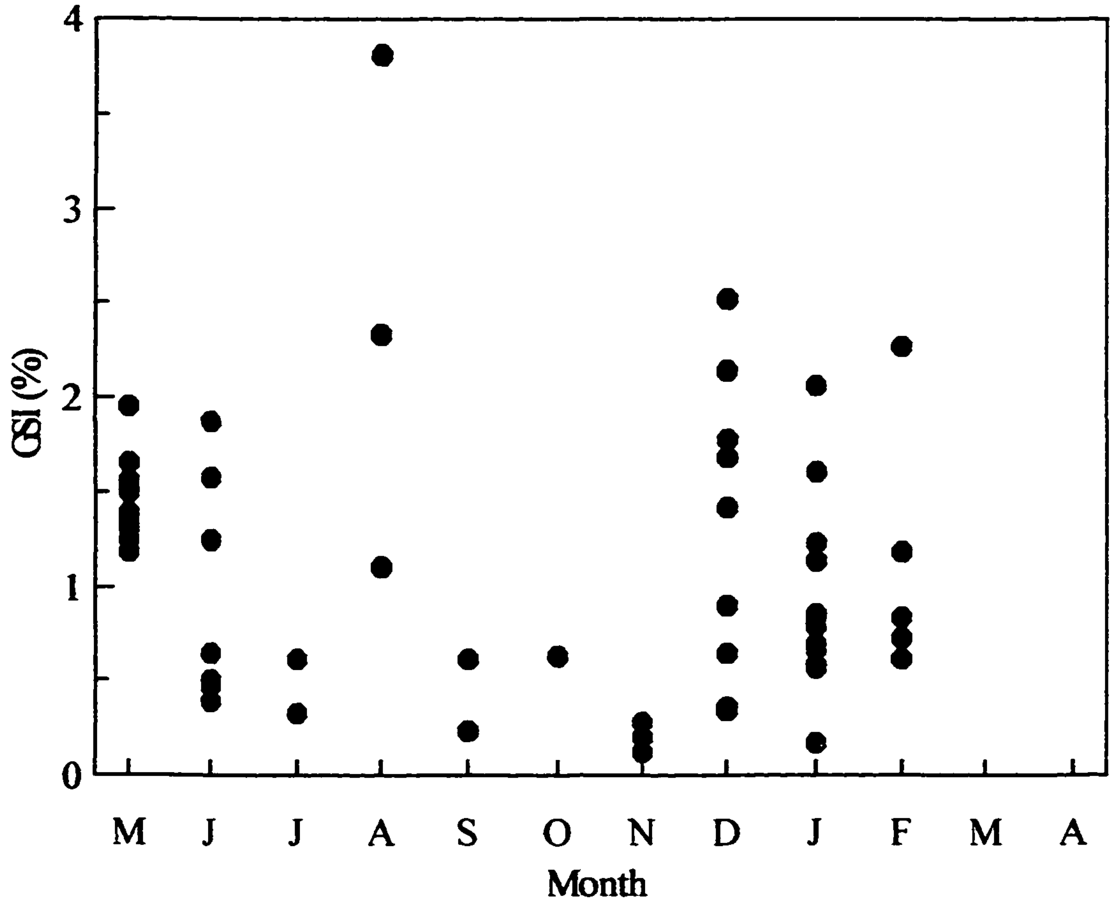

Figure 11. Male gonadosomatic index (GSI) at the Gate site from April 1997 to April 1998. Males with a GSI greater than or equal to 2 were considered as being sexually mature.

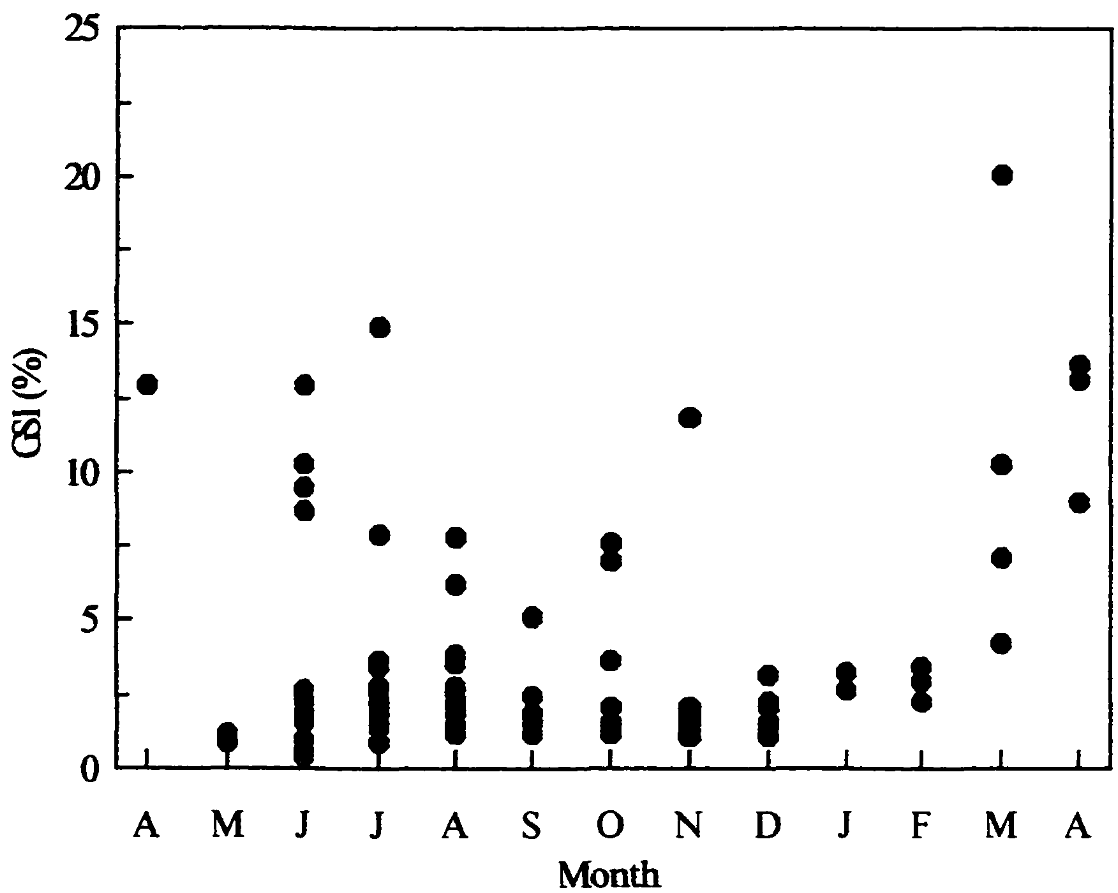

Figure 12. Female gonadosomatic index (GSI) at the Bridge site from April 1997 to April 1998. Females with a GSI greater than or equal to 10 were considered as being capable of reproducing.

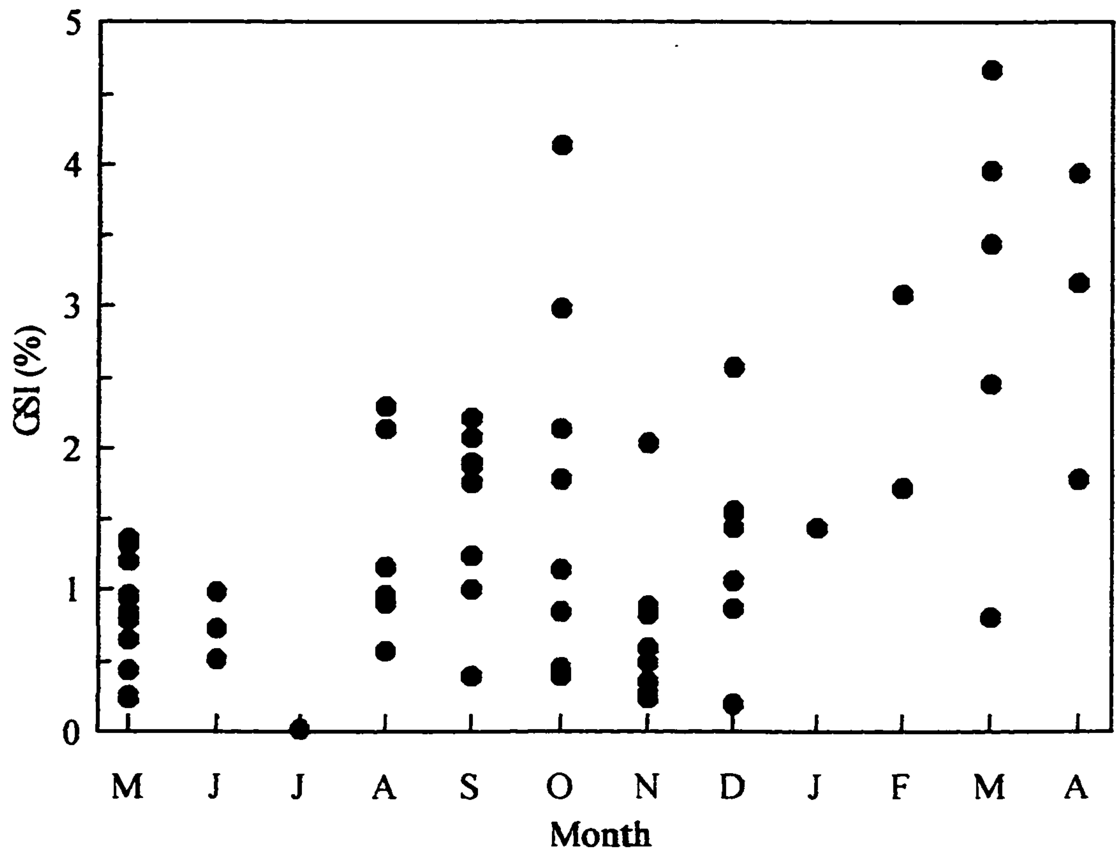

Figure 13. Male gonadosomatic index (GSI) at the Bridge site from April 1997 to April 1998. Males with a GSI greater than or equal to 2 were considered as being sexually mature.

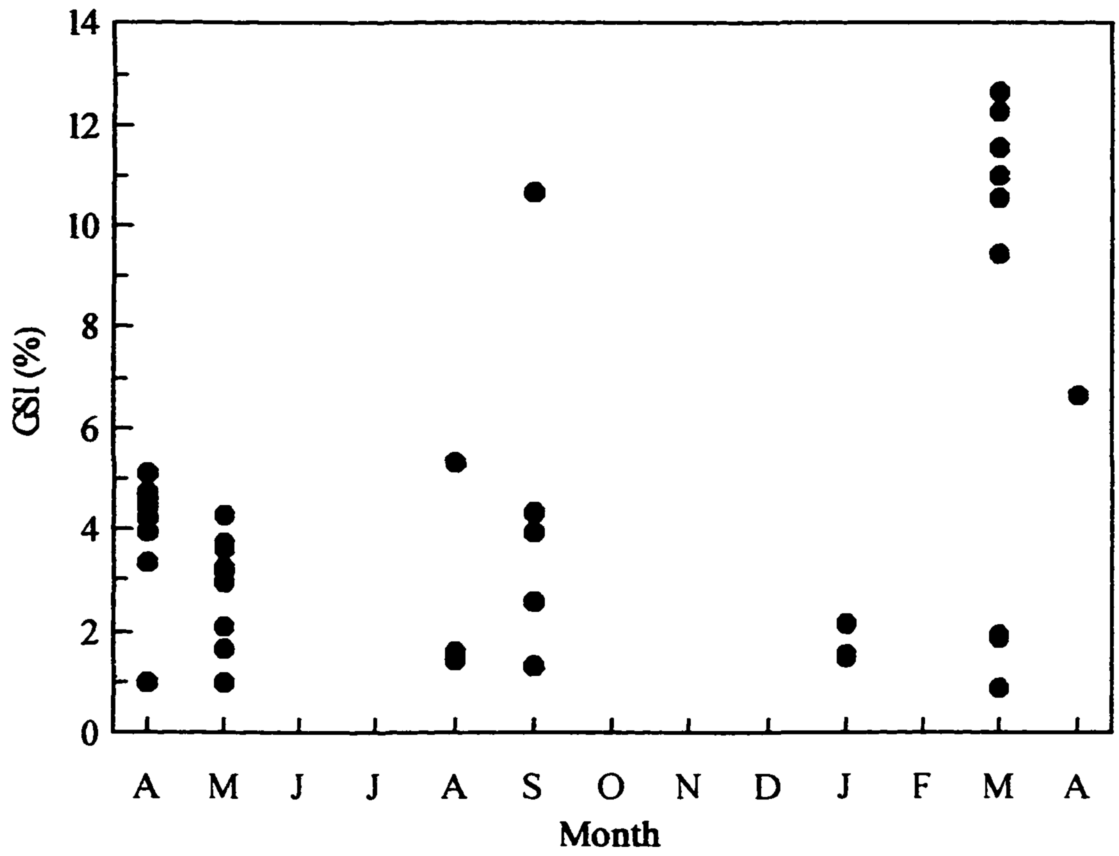

Figure 14. Female gonadosomatic index (GSI) at the River site from April 1997 to April 1998. Females with a GSI greater than or equal to 10 were considered as being capable of reproducing.

FOOD HABITS

The food habits of the tetras were similar at the three sites. The food data from Tables 10, 11 and 12 could be separated into four broad categories: insects, vegetation, fishes, and unknown. Insects were the food most preferred by tetras at all three sites. The following percentages are the totals per site over the 13 month period. At the Gate site 42.7% of the tetras diet consisted of insect material. At the Bridge site insects made up 43.6% of the tetra's food diet, and at the River site, 49.9%. The percentage of vegetation eaten by the tetras was similar at all three sites making up 32.6% at the Gate site, 38.4% at the Bridge site and 30.6% at the River site. Fish material was the least food type preferred by the tetras. Fish material made up 0.6% of the food diet at the Gate site, 5.8% at the Bridge site and 6.7% at the River site. The unknown category made up 24.1% at the Gate site, 12.2% at Bridge site and 12.8% at the River site.

DISCUSSION

COMMUNITY STRUCTURE

The total number of species captured at the Gate, Bridge and River sites throughout the sampling period were 16, 13 and 19, respectively. The fish communities were similar to those described by Edwards and Contreras-Balderas (1991) for the area of the Rio Grande below Falcon Reservoir to Brownsville, Texas. In general, the River Site contained a richer fish fauna than the canal sites, which contained more tolerant species. The relative abundance of the tetra is high (based on ranking) in this portion of its native range. The tetras were ranked based on the relative abundances from Tables 2, 3 and 4.

Table 10. Food habits of the Mexican tetra at the Gate site from April 1997 to April 1998. Numbers represent the percentages of the total diet for a given month for all fishes with food in their stomachs. Lower case f depicts stomachs with food and lower case e depicts stomachs without food.

Food Type	A	M	J	J	A	S	O	N	D	J	F	M	A
Green algae			13.0	18.1	28.7								
Plant parts			55.5	2.5	19.2	75.0		95.0	34.0	50.0			
Nematocera			2.5				6.0						
Animal parts		49.0	7.5	38.1	4.5	12.5	19.0	5.0				30.0	
Hemiptera		14.5		0.6	8.2				34.0		50.0		
Coleoptera				3.1	8.4								5.0
Hymenoptera		0.5		10.9	1.6							10.0	
Diptera									32.0				95.0
Ostracoda		32.0	2.5	0.4								30.0	
Eggs				3.8									
Fish					3.5								
f/e	0/0	10/0	10/0	21/3	21/0	9/1	5/0	5/0	19/1	12/8	1/5	2/0	4/0
Unknown		4.0	19.0	22.5	26.1	12.5	75.0			50.0	50.0	30.0	

Table 11. Food habits of the Mexican tetra at the Bridge site from April 1997 to April 1998. Numbers represent the percentages of the total diet for a given month for all fishes with food in their stomachs. Lower case f depicts stomachs with food and lower case e depicts stomachs without food.

Food Type	A	M	J	J	A	S	O	N	D	J	F	M	A
Green algae		5.0	29.4	57.6	46.8	92.0	15.0	50.0	50.0			39.3	
Plant parts		4.7	13.4	14.0	47.8		5.0			17.5	12.5		
Nematocera	85.0	11.4	0.4	0.8	0.8	4.0		11.0	19.0	18.5	16.0	4.9	80.6
Larvae			0.1						2.0		2.5		
Animal parts		5.4	7.1	4.1	1.3					35.5		9.4	1.6
Hemiptera	5.0	11.4	2.5			2.0		3.0	2.0				0.6
Coleoptera		0.7	0.4					6.0			5.0		
Ephemeroptera		3.4	10.3					2.0	7.0				1.2
Hymenoptera		1.0	0.7	0.7			10.0	4.0	2.0		2.5	2.9	
Odonata			4.5	0.2	0.8			11.0	4.0				
Diptera			0.2			2.0		8.0	14.0	26.0	16.5	1.9	1.8
Oligochaeta			0.1										
Amphipods		29.5	16.8								5.0		
Ostracoda			0.2	0.7			10.0					0.6	
Eggs			0.6	4.2								0.4	8.2
Fish			1.6	2.4	0.8		45.0					12.9	
Lepidoptera				0.1									
Trichoptera										2.5			
Unknown	10.0	27.5	11.9	15.5	2.0		15.0	5.0			37.5	27.9	6.0
f/e	1/0	15/0	25/0	20/0	19/1	20/0	15/5	20/0	20/0	3/0	5/0	9/0	5/0

Table 12. Food habits of the Mexican tetra at the River site from April 1997 to April 1998. Numbers represent the percentages of the total diet for a given month for all fishes with food in their stomachs. Lower case f depicts stomachs with food, and lower case e depicts stomachs without food.

Food Type	A	M	J	J	A	S	O	N	D	J	F	M	A
Green algae					95.0	45.0						5.1	
Plant parts	4.8	1.3				45.0						1.5	
Nematocera	15.8	5.7				6.0		25.0				2.5	
Larvae	1.4												40.0
Larval cases		15.3										1.0	
Animal parts	6.7	36.7			5.0			75.0				9.6	
Hemiptera	3.9											0.3	
Coleoptera		5.5										1.8	60.0
Ephemeroptera	9.2	5.3										1.8	
Hymenoptera	1.4	0.8										0.5	
Odonata		0.9				4.0						3.8	
Diptera		1.8										2.0	
Oligochaeta	0.5	0.6											
Amphipods												5.8	
Ostracoda	8.2											1.2	
Eggs	0.7												
Eyes		1.3											
Crayfish												46.0	
Unknown	47.4	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.1	0.0
f/e	14/0	12/0	0/0	0/0	3/0	5/2	0/0	1/3	0/0	0/0	0/0	10/0	1/0

At the Gate site, the Mexican tetra ranked from absent in April 1997 to its highest ranking (3) in July 1997. This high ranking represented 2.7% of the total numbers of specimens captured during this month. The lowest ranking (8), when the species was taken, occurred in September 1997 representing 2.1% of the total number of specimens captured this month. During four of the collections, the tetras had a relative rank of four, and in three months they had a ranking of five.

At the Bridge site, the tetras ranked from seventh most abundant in April 1997 to first in May, June, and August 1997. These rankings represented 0.2%, 50.9%, 42.4%, and 53.6% of the total number of specimens captured during these months, respectively. During September, October, and November 1997, the tetras ranked second to the rest of the species.

At the River site, the tetras were absent during July, October, December 1997, and February 1998. The tetras ranked ninth most abundant in April 1997 with 0.9% of the total number of specimens captured during this month. During September, November, and December 1997, the tetras ranked sixth, comprising 5.0%, 2.0%, and 5.3% of the total number of specimens captured during these months, respectively. At each site, the number of tetras captured depended upon how fast the seine was pulled. Mexican tetras are very active and aggressive and quite often jumped over the seines eluding capture.

GROWTH

Tetras smaller than 11mm were not captured at any of the sites. The lack of small tetras in the collections may indicate that the reproductive females migrate away from fast moving waters into vegetation to reproduce and that the youngest juveniles were in nursery habitats that were not sampled. The smallest individuals may also have passed through the mesh of the seine. No tetras larger than 50mm were captured at the Gate site and at the Bridge site, no tetras larger than 60mm were ever captured. The River site, in contrast, contained tetras larger than 70mm (Tables 5, 6, and 7).

Overall, the River site had the largest fishes captured compared to the Gate and the Bridge sites. A One-way ANOVA showed significant differences between the mean lengths of the tetras at these three sites (Table 8). Tetras at Gate site had a mean length of 28.4mm (SD = 7.19) and tetras at the Bridge site had a mean length of 28.5mm (SD = 7.92). Duncan's multiple range test indicated that the mean length of tetras at the River site was significantly larger than the other two sites with a mean of 47.6mm (SD = 15.8; $F_{(2, 2763)}$=228.256 at p<0.05).

By following the growth of cohorts (Tables 5-7) at each site from the length-frequency distributions, tetras probably grow at a rate of about 10mm per month at all three sites. The appearance of young juveniles (< 21mm SL) throughout the year at the Gate site suggests that tetras reproduce year round. Furthermore, since tetras grow about 10mm per month, it is likely that they reach sexual maturity within the first year of life. In addition, the tetras life span is probably no longer than two years.

FECUNDITY

No significant differences were found between the number of eggs produced by the tetras from the River site to those produced by the tetras from the combined Bridge and Gate sites. However, the data from Figures 8 and 9 indicate that the smaller females produce fewer eggs than the larger females.

A skewed sex ratio was found upon examination of the gonads of the captured tetras. At the Gate site a total of 56 specimens were males and 35 females (X^2=4.85, p<0.05). The Bridge site had a total of 110 females and 66 males (X^2=11.00, p<0.05), and the River site a total of 38 females and 7 males (X^2=21.36, p<0.05). The sex ratio skewedness could be attributed to several factors. For example, the gonads were studied, most of the time, on mature fish. Also, an analysis of the standard lengths indicated that the females were larger in size than the males; therefore, a bias might have been introduced for females since they were obviously larger than males, and since most of the time the larger specimens were chosen for the dissections. Another factor affecting the sex ratios could be that the males might not school together with the females and therefore would have been less likely captured using seines.

A gonadosomatic index was used to determine the reproductive season for the Mexican tetras. Edwards (1977) stated that the Mexican tetra breeds from late April through September in Waller Creek in Austin, Texas. However, that was a study on introduced specimens far north of their native range. In this study, it was found that the Mexican tetra breeds throughout the year (Tables 5, 6 and 7). One of the reasons for the year round reproduction might be due to the consistently mild to warm temperatures in this region (Figure 2). Further, the data from Table 5 shows that the reproduction of juveniles at the Gate site probably took place in April, June, July, November, December, and February; even though, the GSI in Figure 10 shows only August and September as the possible spawning times for females. Figure 11 indicates a high GSI for males in August, December, January, and February. One possible reason for the longer period of reproductive maturity in the males at this site might be due to the fact that more mature males than females were captured at this site. The size distribution of tetras in table 6 indicates that the first juveniles captured in May were probably spawned in April. The second size class (21-30mm) clearly indicates that reproduction probably took place at the Bridge site from April to January. Gonadosomatic indices in Figures 12 and 13 suggests that the possibility for spawning of females at the Bridge site occurs in April, June, July, November, March and April, and sexual maturity for males from August to April, respectively. Not enough specimens were captured at the River site to make many conclusions about the reproductive period of the tetras. However, data from Table 7 suggests that the juveniles were spawned in March. The GSI for females at the River site shows two possible spawning periods September and March (Figure 14). One reason why there appears to be two spawning periods at the River site is due to the small number of specimens captured at this site.

FOOD HABITS

The Mexican tetra is an opportunistic omnivore (Edwards 1977, Winemiller and Anderson 1998). This study confirms previous observations. Tetras from the Gate site consumed 12 different food types. These included green algae, plant parts, nematocera larvae, hemipterans, hymenopterans, ostracods, fish eggs, and fish parts (Table 10). On occasions, up to 50 hemipterans were found in a single fish, and up to 15 nematocera larvae. Fish parts were found in tetras at both the Gate and Bridge sites (Table 10 and 11), however, none of the fish dissected from the River site had fish in their stomachs. Furthermore, the food types found in the stomachs of the fish captured at the Gate and Bridge sites were easier to identify than those from the River site. Most of the time the food types found in the stomachs of river fish were darker, almost black in color. This suggests that the tetras at the River site feed at different times of the day or on a different type of food than the fish from the Gate and Bridge sites. The fact that the percentage of vegetation eaten at the three sites is almost the same diminishes the possibility that the fish from the river are eating more vegetation than the fishes from the Gate and Bridge sites. Vegetation eaten at this study represent all plant parts such as seeds, flower parts and leaf parts. By the same token, animal parts listed in Tables 10, 11, and 12 represent any animal parts that I could not identify but were insect in origin. Such parts included wings, legs, and thoraxes.

The food habits of the Mexican tetra in the Lower Rio Grade appear to be similar to those reported by Winemiller and Anderson (1998) at Phantom Lake Spring refuge west of Toyahvale in Jeff Davis County, Texas. Winemiller and Anderson (1998) also reported dipterans, coleopterans, ephemeropterans, hymenopterans and amphipods as part of the food habits of the Mexican tetra.

In summary, the Mexican tetra is very abundant in the Lower Rio Grande of Texas. The reason the tetras at the River site have a lower ranking might be due to the fact that at the River site the sampling was much more difficult. It was more difficult due the water depth and the obstructions created by rocks and thick vegetation. At the Gate site, the mud substrate slowed down the seining process, and therefore, allowed many of the tetras to escape. At times, the tetras were observed jumping over the seines. With more effective sampling, I would expect to find a greater number of tetras at both the River and the Gate sites. In order to be more effective at sampling at the Gate site, a longer seine might be used. The reason a longer seine is needed at the Gate site is that the deep mud does not allow a fast pull of the seine. At the River site, more than two people are needed to pull the 10m-bag seine because it becomes extremely heavy.

Besides the few studies of the Mexican tetra on introduced populations and the brief report by Winemiller and Anderson (1998), the life history of the Mexican tetra has been little documented. It was the goal of this study to provide a better understanding of the ecology and life history of this species. In this research, it has been shown that the tetras reproduce year round in their native range. Also, females appear to produce from about 300 to just over 7000 eggs. It has been also shown that the Mexican tetra is an opportunistic omnivore.

While aspects of the life history of the Mexican tetra are now better known, several questions still remain. For example, where are the young juveniles found? How far do females migrate to reproduce and where do males go? Do males actually swim alone or do they school together with the females? In order to answer these questions, I suggest a mark and recapture of the tetras and also a more extensive sampling of a specific area. This would allow a better understanding of where the males are and how far the females migrate to reproduce.

This has been the first study to focus specially on the ecology and life history of the Mexican tetra. Overall, this study has provided a baseline for subsequent studies on the ecology of fishes in the Lower Rio Grande of Texas. In addition, this data will allow other scientists or fisherman to better understand the Mexican tetra, for many people use this species as bait.

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