United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services Field Office
10711 Burnet Road, Suite 200
Hartland Bank Bldg.
Austin, Texas 78758

JUL 22 1997

Nick Carter
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, Texas 78744

Dear Mr. Carter:

Enclosed are our comments on the final report for Project 41: Chihuahuan Desert Fishes Status Survey. We appreciate you providing this report even though all the information has not yet been evaluated. While we will accept the desert fishes report as an interim report, we request a revision before accepting the report as final. We also appreciate Dr. Garrett coming to our office on June 17, 1997, to brief us on his work, and we recognize that he needed more time to fully analyze the data and fill in the details on the report.

In order for the report to be accepted as a final report, it must include the following additional information:

1) Maps for each of the species included in the report. The current report does not include adequate descriptions of the locations where samples were made. It is our understanding that locations were recorded using GPS (Global Positioning System) equipment. If so, sample locations should be reportable in the WGS-84 (World Geodetic System) coordinate system. In order to identify the location of sample sites made without GPS, maps should be marked and annotated as to the location and date of sample. The position and date of sample sites "within each location" is essential information since the "location" for the various efforts may span more than 30 km. All sites sampled by TPWD and cooperators in the study zone (even fish-less sites) should be reported in map form. The results of fish collections in the study area (especially 1991 to present) made by researchers outside the project should also be described, if available.

Maps must include, for each species, the historic range of the species, all collection sites (whether fish were found or not), and current range of the species. Maps should be on 7.5 min topos and each map should have corresponding specific descriptions of sample locations, including GPS reference where available.

2) A survey for the Devil's River minnow and the proserpine shiner within their historic range in Texas, including the Devil's River, Sycamore Creek, San Felipe Creek, Los Moras Creek, Dolan Creek, and Mud Creek. We realize that this will mean additional field work on these species. However, these species were included in the original project description as being included in this study; it appears no collections were made, as part of this project, within the range of these species. Also, the final report would better meet the objectives for these species if surveys include the historic range in Mexico.

3) Documentation of sampling effort: The project proposal called for quantifying the sampling effort at each location sampled. While the report briefly discusses the sampling protocol and equipment, no data are presented that allow for an understanding of the effort expended and area sampled at each site. This information is very important in drawing conclusions about the status of the species. This information should be quantified for each location in the final report, whether subject fish were collected or not. Raw data on sampling effort should also be included.

4) Characterization of water quality: The project proposal calls for characterization of water quality through collection of data on such parameters as dissolved oxygen, temperature, conductivity, and salinity. The report should include any raw data collected on water quality and a discussion and review of the water quality data collected during this project. The project proposal also called for general comments on land use trends near each of the sample sites.

5) Documentation of access: The project proposal called for documentation of "all instances where access to sampling sites was denied or otherwise precluded for the purpose of explaining information gaps." This information should be included in the final report along with documentation that access was granted on properties where collections were made.

Provided below are both general and specific comments on the report. In general, the report needs to be revised to better meet the objectives of the original project proposal and include a more complete data presentation and summary. While the report will be considered acceptable once the five items above are included, addressing the comments below would greatly improve the quality of the report as a comprehensive and thorough assessment of the current status and threats to each of these species.

**GENERAL COMMENTS**

The overall objective of this project was to determine the current status for each of the study species and provide sufficient information for a determination on listing any of the species as threatened or endangered species. Study species include:

| | |
|---|---|
| *Campostoma ornatum* | Mexican stoneroller |
| *Cyprinella proserpina* | proserpine shiner |
| *Dionda diaboli* | Devils River minnow |
| *Notropis chihuahua* | Chihuahua shiner |
| *Notropis jemezanus* | Rio Grande shiner |
| *Ictalurus lupus* | headwater catfish |
| *Ictalurus* sp. | Chihuahuan catfish |
| *Cyprinodon eximius* | Conchos pupfish |
| *Gambusia senilis* | blotched gambusia |
| *Etheostoma grahami* | Rio Grande darter |

We recognize that scientific collecting in Mexico and parts of Texas is difficult work and the investigators are to be commended for enduring those adverse conditions to expand knowledge of Chihuahuan fishes. The final report should acknowledge the field work/contributions made by other scientists at TPWD and those who worked in cooperation with TPWD.

This project was proposed as a coordinated effort including the status of three species in New Mexico (Rio Grande shiner, headwater catfish, and Chihuahuan catfish). We appreciate the effort made by Dr. Garrett to review the current New Mexican range. However, since the corresponding section 6 project in New Mexico has concentrated on the Pecos bluntnose shiner and systematics/taxonomy of the Rio Grande shiner, the range-wide assessment of the status of these three species (regarding distribution and threats) is incomplete. Ideally, the final report should include a summary and documentation of the range, to the best of Dr. Garrett's knowledge, of the Rio Grande shiner, the headwater catfish, and the Chihuahuan catfish in New Mexico. This should include all relevant literature citations and personal communication references.

**Threat Assessment**

The need for threat assessment was included in the project objectives and discussed in meetings between Dr. Garrett and the USFWS prior to initiation of this project. A quality status survey for these species would include compilation and summary of the following data over the period of record as a means of assessing the historic and ongoing threats:

(1) springflow discharge
(2) stream discharge

(3) reservoir construction (habitat fragmentation)
(4) reservoir discharge
(5) surface water diversion
(6) groundwater pumpage
(7) modifications to spring-cienega habitats
(8) wastewater (municipal & industrial) discharges
(9) agricultural chemical use adjacent to or nearby habitats
(10) other water quality or contaminant information that may be available

Aside from physical and chemical effects on habitats, biotic interactions and threats should be characterized, including:
(1) hybridization
(2) presence/effect of non-native and exotic species
(3) predation and competition
(4) parasites/disease

Ideally, the final report should address the magnitude of threats to each of the species with consideration of each of the potential impacts listed above. The threat assessment should be done for each species individually and should be presented in the framework of the five factors presented in section 4(b) of the Endangered Species Act that are considered when making a listing determination. The factors are: 1) present or threatened destruction, modification, or curtailment of its habitat or range, 2) overutilization for commercial, recreational, scientific, or educational purposes, 3) disease or predation, 4) the inadequacy of existing regulatory mechanisms, and 5) other natural or manmade factors affecting its continued existence.

In absence of a thorough threat assessment compiled and discussed by the primary investigator, copies of all the field notes made during the study would be helpful to the Service in understanding certain conditions at sample sites. Dr. Garrett has provided some of these field notes to us already.

**Water Quality**

Ideally, the final report should compare water quality data collected during the present study with information included in the referenced reports, and explain how that information relates to the current status of each species at each of the locations sampled.

**Relative Abundances**

Dr. Garrett has provided us with a table of absolute numbers of fish collected at each site sampled, and we recommend this be included in the final report along with the relative abundances.

**SPECIFIC COMMENTS**

The report would be more informative if the discussion of each species was separated into three sections: 1) historic range, 2) current range, and 3) current status. The discussion of current status should include any documented decline in the distribution and/or abundance.

**Mexican stoneroller**

The report should provide sample sites/dates for other fish surveys mentioned (e.g. IBWC 1994). We recommend the table split out (rather than pooling) Alamito and Terlingua creeks.

The first sentences of paragraph 2 describe the current range as being widespread in Mexico. However, the source is 20 years old. This may be better stated as historic range. In 1977 Contreras-Balderas listed reasons for decline. Did a decline happen in the past 20 years? If yes, are the reasons listed by Contreras-Balderas correct for 1997 or were different or additional factors involved?

**proserpine shiner & Devils River minnow**

The sites sampled did not include the Devils River nor nearby creeks in their known range. No specimens of these species were reported/collected during the project. The report, as currently written, does not meet the project objectives for these two species and, as mentioned above, the final report must include a survey for the Devil's river minnow within it's historic range.

**Chihuahua shiner**

The report states that no specimens were taken downstream of Terlingua Creek, however the next "location" collected downstream was the Rio Grande from its confluence with San Francisco Creek to Dryden takeout. Its status in the drainages of eastern Big Bend NP is unresolved.

**Rio Grande shiner, headwater catfish, & Chihuahuan catfish**

The putative Chihuahuan catfish records for New Mexico, Texas, and Mexico should be compiled and reported. Were historic localities in the Rio Conchos and Rio Grande sampled? Are any citations or localities, other than the Jeff Davis County record of 17 years ago, available for these species?

**blotched gambusia**

It would be informative to note the distribution of typical *senilis* and the black spotted morph Hubbs and Springer (1957) based on collections for this study. Also of interest is the extent to which native and non-native poeciliids occur in current habitats of the blotched gambusia.

**Rio Grande darter**

The report refers to "Table 1 and 2". The Rio Grande darter is not on Table 1 and appears that no Rio Grande darters were collected during the project since there were no sample sites in the lower Pecos River nor the Devils River basin. Three of the four sites in Table 2 refer to collections prior to 1992 and the project. The report needs to synthesize and organize (referenced in space and time) Rio Grande darter collections. The report states that "our collections showed a stable population with a limited range". This statement needs to be qualified as to what is meant by stable and limited range. The report should also describe Rio Grande darter habitat. This project did not make (or report on) collections (post 1980) in the Rio Salado/Rio San Juan basins in Nuevo Leon, Mexico.

**Undescribed pupfish and gambusia species**

Four undescribed species are listed in Table 1. The report should provide more information as to their morphology, distribution, habitats, and identification.

**Summary**

Although the summary gives an overview of the different pressures on the ecosystem, more information on the ichthyofauna needs to be addressed. What is the current status of the fish? What are the primary factors of concern? How have the distributions changed over the last 20 years? How have the abundances changed? These questions would be appropriate to address in the summary.

**Tables**

Table 1: Do dashes represent a zero catch or lack of data?

Table 2: No values are included for total number.

Dr. Garrett agreed to provide all the raw data and field notes related to these studies and he has generously provided notes made by Marsh, Cobb, Edwards, and others. We would also like to have copies of Dr. Garrett's field notes and any other information related to habitat conditions at each of the collection localities. We would like this information as soon as possible so we can review it while the report is being revised.

In addition, we request that TPWD and Dr. Garrett notify our office by August 1, 1997, whether he anticipates that the final report will include a discussion of any of the potential impacts to the species listed under Threat Assessment above so that the Service may proceed to gather relevant information that will not be included in his final report. If you have any questions about our comments or this letter, please call Ruth Stanford, our Section 6 coordinator, at (512) 490-0057.

Sincerely,

Field Supervisor

cc: Gary Garrett, TPWD, Austin, TX
Jerry Bentley, FWS, RO(FA), Alb, NM
Larry Dunkeson, FWS, RO(ES), Alb, NM

FINAL REPORT

As Required By

THE ENDANGERED SPECIES PROGRAM

TEXAS

GRANT NUMBER E-1-8

Endangered and Threatened Species Conservation

Project E410: Chihuahuan Desert Fishes States Survey

Prepared by: Dr. Gary P. Garrett

Andrew Sansom
Executive Director

Gary L. Graham
Program Director, Endangered Species

Robert L. Cook
Director, Wildlife

April 16, 1997

# FINAL REPORT

**State:** Texas **Grant Number:** E-1-8

**Grant Title:** Endangered and Threatened Species Conservation

**Reporting Period:** September 1, 1995 through August 31, 1996

**Project E410:** Chihuahuan Desert Fishes Status Survey

**Objective:** To determine current status of each of the study species and provide for determinations on listing each of these species.

**Cost:** $16,999.95

## PREFACE

The attached manuscript entitled "Chihuanhuan Desert Fishes Status Survey" is submitted to meet the Final Report requirement for this project.

**Prepared by:** Dr. Gary P. Garrett **Date:** March 5, 1997

**Approved by:** **Date:** April 16, 1997

Neil E. Carter
Federal Aid Coordinator

# CHIHUAHUAN DESERT FISHES STATUS SURVEY

Gary P. Garrett

The Chihuahuan Desert of Mexico, Texas and New Mexico contains a wide variety of habitats and many uniquely adapted plants and animals. Although the aquatic segment of the ecosystem, in particular, has undergone substantial modifications in historic times, baseline data for aquatic environments in the Chihuahuan Desert are relatively sparse.

Although large data gaps exist, what is known is somewhat grim. Approximately half of the native fishes of the Chihuahuan Desert are threatened with extinction or already are extinct (Hubbs 1990). Documented extinctions from this area are: Maravaillas red shiner, *Cyprinella lutrensis blairi*; phantom shiner, *Notropis orca*; Rio Grande bluntnose shiner, *Notropis simus simus*; and Amistad gambusia, *Gambusia amistadensis* (Miller et al. 1989). Extirpations include Rio Grande shiner, *Notropis jemezanus* in the New Mexico portion of the Rio Grande (Propst et al. 1987) and Rio Grande silvery minnow, *Hybognathus amarus*, Rio Grande cutthroat trout, *Oncorhynchus clarki virginalis* and blotched gambusia, *Gambusia senilis* in west Texas (Hubbs et al. 1991). Endemic species other than fishes are also being lost from this area (Howells and Garrett 1995).

An ichthyofaunal survey of the drainage basin of the Rio Grande (including the Rio Conchos, Pecos and Devils rivers) in the Chihuahuan Desert (Texas and New Mexico, United States and Chihuahua and Coahuila, Mexico) was initiated in order to develop a comprehensive data set on these ecoregions and to obtain information on current status of several species of fishes that occur there. Species specifically addressed in this study include:

Mexican stoneroller, *Campostoma ornatum*
proserpine shiner, *Cyprinella proserpina*
Devils River minnow, *Dionda diaboli*
Chihuahua shiner, *Notropis chihuahua*
Rio Grande shiner, *Notropis jemezanus*
headwater catfish, *Ictalurus lupus*
Chihuahua catfish, *Ictalurus* sp.
Conchos pupfish, *Cyprinodon eximius*
blotched gambusia, *Gambusia senilis*
Rio Grande darter, *Etheostoma grahami*

Field work on the Devils River minnow project (Garrett et al. 1992) revealed apparent declines in some of the above species. Subsequent discussions by the U.S. Fish and Wildlife Service, Rio Grande Fishes Recovery Team on problems facing fishes throughout the Chihuahuan Desert region of Texas, New Mexico and Mexico led to the formulation of this list, most of which are Category 2 species. Status surveys on each of these species were then recommended to the USFWS Region II, Regional Director. Two more species were added to the list (*N. chihuahua* and *G. senilis*) because they are subject to the same potential threats as those species recommended by the Rio Grande Fishes Recovery Team.

The geographic ranges of these ten species overlap to a large degree. Simultaneous

status surveys are clearly the most cost and time effective means to answer questions on these fishes. This is especially true for those occurring in Mexico.

This project was designed to provide information on the status of each of the study species and can aid in determinations on conservation needs of each of these species. Accurate data is needed to anticipate problems, develop solutions and better manage the aquatic environment. In addition, the information gained by the project will provide useful baseline data for future actions and decisions affecting the management of the Chihuahuan Desert environment in Mexico, Texas and New Mexico.

This information will also be valuable for ecosystem-level decisions concerning economic development, particularly in regards to the North American Free Trade Agreement. Many of the fishes of this region could serve well as biological indicators of system integrity. These regions and their Mexican counterparts are of great biological and sociological importance. Unfortunately, there is a paucity of scientific knowledge of fish community structure and species distributions in the region.

## MATERIALS AND METHODS

Data was derived from locations in the Rio Grande basin of Texas and throughout the Río Conchos system of Chihuahua. The Rio Grande was divided into ecoregions and each was sampled extensively. These regions were: 1) Chihuahuan Desert, 2) Edwards Plateau, 3) South Texas Plains and 4) Gulf Prairies. Our corresponding sites were 1) from near the confluence with Alamito Creek to near Lajitas, and Terlingua Creek, 2) from San Francisco Canyon to Dryden takeout, 3) downstream of Eagle Pass / Piedras Negras, approximately RM 480 - 460, 4) Falcon Dam to approximately 30 km downstream. The Río Conchos was sampled throughout the drainage, beginning at approximately 30 km from its confluence at Cuchillo Parado, downstream of Julimes and at Valle de Zaragosa upstream of Presa de la Boquilla. Tributaries sampled were Río Chuviscar headwaters and near San Diego de Alcalá, springs at San Diego de Alcalá, springs at Ojo Talamantes, Río San Pedro, Río Santa Isabella and springs at Ojo del Rey. The Río Parral was not sampled due to advice from local inhabitants that the waters were too polluted to even wade in.

We intensively sampled contiguous segments of habitat with relatively pristine conditions so as to represent, to the greatest degree possible, the natural biota. We selected a sufficient number of sampling sites within each location and expended effort at each site needed to characterize the fish community. Sites were sampled by seining (3m x 3mm mesh to 10m x 6mm mesh) and electrofishing (backpack and boat) all available habitats. At each collection site, all specimens collected were identified and enumerated. A representative subsample of each species collected was retained. Retained samples were used to assure accurate identification and provide a measure of relative abundance. Data are presented as relative abundance (Tables 1 and 2) so as to facilitate comparisons. Area sampled, sampling duration and habitat characteristics were recorded. In addition, parameters of water quality (e.g., temperature, DO and TDS) and habitat structure (e.g., channel morphology, substrate, flow and depth) were documented.

An assessment of water quality at selected sites in the Rio Grande basin (including the Pecos and Devils rivers) is provided by TNRCC (1994) and a study on toxin presence is provided by IBWC (1994).

## RESULTS

Mexican stoneroller:

*Campostoma ornatum* is listed as Threatened by the Texas Parks and Wildlife Department, Watch List by the Texas Organization for Endangered Species, Threatened by Hubbs et al. (1991), Special Concern by Williams et al. (1989) and Threatened by Miller (1972). In the U.S., this species is primarily limited to clear, flowing tributaries in the Big Bend region (Hubbs 1957). We found it in Terlingua Creek (2 specimens), Alamito Creek and its tributary, Cienega Creek on Big Bend Ranch State Park (Table 1 and 2). Only two species, *C. ornatum* and *Lepomis cyanellus* occur in Cienega Creek and in 1989 *C. ornatum* had a 75% relative abundance. This bottom feeding herbivore prefers gravel/rocky substrate in clear, cool water (Contreras 1977) primarily in fast riffles and pools (Burr 1980). We obtained one specimen (0.01%) in the segment of the Rio Grande near the town of Lajitas (Table 1). In the period 1967-1970 Hubbs and Wauer (1973) found that relative abundance in Tornillo Creek ranged from 0 to 17% and it occurred in only 5 of 11 samples. Apparently the introduced *Fundulus zebrinus* caused displacement of *C. ornatum* because collections prior to the introduction of *F. zebrinus* (around 1954) *C. ornatum* was the most abundant fish in Tornillo Creek (Hubbs and Wauer 1973). Hubbs et al. (1977) found them only in Alamito Creek and the Rio Grande just downstream, but they were in great abundance (48% and 12%, respectively). Bestgen and Platania (1988) also found them in abundance in Cibolo and Alamito creeks (100% and 34%, respectively). In the mainstream Rio Grande they only caught them at two locations, downstream of Presido (<1%) and downstream of Redford (6%). Platania (1990) and IBWC (1994) found none in their studies. Hubbs and Echelle (1973) listed *C. ornatum* as potentially endangered due to the drastic population reductions caused by *F. zebrinus* with potential for further problems caused by siltation, channelization and water depletion. Hubbs (1990) again listed *C. ornatum* as rare or endangered in the Rio Grande with declining water availability as the primary factor.

*Campostoma ornatum* is widespread in Mexico, occurring in the ríos Conchos, del Fuerte, Casas Grandes, del Carmen, Yaqui, Papigochic, Sonora, Nazas, Piaxtla and Trujillo (Burr 1976). Although it occurs throughout the Río Conchos basin, we only found it in abundance in the Río Santa Isabella (Table 1). Some populations are seemingly ephemeral, particularly in highly impacted habitats such as Río Chuviscar. In 1994 they had a relative abundance of 2.4%, in 1995 no specimens could be obtained. Contreras-Balderas (1977) reported them extirpated from the Río Chihuahua (= Chuviscar) and the Río Conchos at Camargo. Our Río Conchos at Julimes is downstream of Camargo and we did not obtain *C. ornatum*. However, our Río Conchos at Zaragosa is upstream of Camargo and there we obtained 31 specimens (0.7%). Contreras-Balderas (1977) lists the reason for decline and extirpation in many Río Conchos fishes is the loss of well-oxygenated, clear, moving water flowing over sand and gravel. The changes are due primarily to lowered water tables, siltation and sewage effluent.

proserpine shiner:

*Cyprinella proserpina* is listed as Threatened by the Texas Parks and Wildlife

Department, Watch List by the Texas Organization for Endangered Species, Threatened by Hubbs et al. (1991), Threatened by Williams et al. (1989) and Threatened by Miller (1972). Its range is limited to the lower Pecos River, the Devils River, San Felipe, Pinto and Las Moras creeks in Texas and Río San Carlos, Coahuila (Hubbs and Miller 1978; Hubbs et al. 1991). It is not found in the mainstream Rio Grande (Matthews 1980) and is intolerant of lentic conditions (Williams et al. 1985). Often locally abundant (Harrell 1978; Platania 1990; IBWC 1994), but apparently extirpated from Pinto and Las Moras creeks and reduced in abundance in the Devils River, San Felipe and Dolan creeks (Garrett et al. 1992).

Devils River minnow:

*Dionda diaboli* is listed as Threatened by the Texas Parks and Wildlife Department, Threatened by the Texas Organization for Endangered Species, Threatened by Hubbs et al. (1991), Threatened by Williams et al. (1989) and Threatened by Miller (1972). Its historic range is limited to the Devils River, San Felipe, Sycamore and Las Moras creeks in Texas and Río San Carlos and Río Sabinas, Coahuila. The range of this species was reduced by the impoundment of Amistad Reservoir and the extirpation of the population from Las Moras Creek (Smith and Miller 1986; Garrett et al. 1992). The species was at one time fairly abundant (Hubbs and Brown 1956), being the sixth-most abundant minnow in the Devils River occurring in clear, fast-flowing water with hard substrate (Harrell 1980a) preferentially occupying the area where spring runs enter the river (Hubbs and Garrett 1990). It has declined in abundance and is rare throughout the remainder of its range (Miller 1978; Garrett et al. 1992).

Chihuahua shiner:

*Notropis chihuahua* is listed as Threatened by the Texas Parks and Wildlife Department, Watch List by the Texas Organization for Endangered Species, Threatened by Hubbs et al. (1991) and Threatened by Miller (1972). This species is typically found in clear, cool water, often associated with nearby springs, over gravel or sandy bottoms (Burr 1980; Burr and Mayden 1981). Our findings agree with the generalization of Burr (1980) that the species occurs sporadically in the Big Bend region of the Rio Grande, but is abundant in tributaries of the Río Conchos (Table 1). Previous findings from studies in the Big Bend region of the Rio Grande ranged from total absence of *N. chihuahua* (Platania 1990; IBWC 1994) to a relative abundance of $\leq 1\%$ (Hubbs and Wauer 1973; Hubbs et al. 1977; Bestgen and Platania 1988). Our collections yielded 2 specimens in the Rio Grande at approximately RM 926, 4 specimens in Alamito Creek and 97 in Terlingua Creek. No specimens were taken downstream of Terlingua Creek (Table1).

Rio Grande shiner:

*Notropis jemezanus* is listed as Watch List by the Texas Organization for Endangered Species, Threatened by Hubbs et al. (1991) and Special Concern by Williams et al. (1989). The historic range included the Rio Grande, Pecos, Conchos, San Juan and Salado drainages (Gilbert 1980). Although Trevino-Robinson (1959) found them well distributed throughout the Rio Grande, almost to the mouth, and Hubbs (1940) noted they were "characteristic of the Rio Grande and its tributaries in New Mexico, Texas and northeastern Mexico", their range been dramatically reduced and their distribution is spotty (Edwards and Contreras-Balderas 1991; Hubbs et al. 1991). None were obtained in the lower Rio Grande by Edwards

and Contreras-Balderas (1991) or by Ruiz-Campos and Contreras-Balderas (1987) in the Río Alamo. They have not been found in the New Mexico portion of the Rio Grande since 1949 (Platania 1991). It still occurs in the Pecos River in New Mexico, but its range has been reduced (Sublette et al. 1990). In 1964, Dietz obtained *N. jemezanus* at 5 of 9 seining stations in the Rio Grande adjacent to Maverick and Webb counties with relative abundances of 1, 2, 5, 29 and 59% (Dietz 1965). In 1954, Hubbs obtained specimens in the Río Conchos (Hubbs et al. 1977), 10 km from the confluence (14%) and near Sanderson Canyon, Terrell County, (7%). In the 1977 survey Hubbs et al. (1977) obtained no *N. jemezanus* in 4 collections between the Río Conchos confluence and Big Bend. In the segment from Maravillas Canyon, Brewster County, to Lozier Canyon, Terrell County, they obtained them at all 13 sites (1% - 22%). Bestgen and Plantania (1988) found them (1%) at only on site, in the Rio Grande near Redford. In the IBWC (1994) study, specimens were obtained at Santa Elena Canyon (1%), near Langtry (1%), in the vicinity of Eagle Pass (8%) and at Laredo (<1%). None were collected at two sites near the confluence with the Río Conchos, at two sites in the vicinity of Del Rio or at seven locations between Laredo and Brownsville. Platania (1990) collected *N. jemezanus* at 5 of 6 sites (<1% - 25%) between Big Bend and Amistad Reservoir, but at only 2 of 25 sites (<1%) between Amistad and Falcon reservoirs. Our surveys also indicate a sparse distribution in the Rio Grande and Río Conchos. They were abundant in the Río Conchos only at Valle de Zaragosa (Table 1). They were also found to be abundant in Independence Creek, a tributary of the Pecos River, but not in the Pecos River (Table 2). This species is part of the Rio Grande-Río Conchos faunal assemblage occupying the mainstream and not dependent on tributaries (Hubbs et al. 1977). They are typically in large open rivers over a sand and gravel substrate (Gilbert 1980).

headwater catfish:

*Ictalurus lupus* is listed as Watch List by the Texas Organization for Endangered Species, Special Concern by Hubbs et al. (1991) and Special Concern by Williams et al. (1989). Gilbert and Burgess (1980) stated that this was "among least known and studied of North American freshwater fishes". Historic range included the Pecos and Rio Grande basins of Texas and New Mexico, the upper Nueces, Guadalupe and Colorado basins, but has been extirpated from all but portions of the Pecos and Rio Grande basins (Kelsch and Hendricks 1990). It reportedly occurs in Mexico in the Río San Fernando, Río Soto la Marina and the endorheic Cuatro Cienegas basin (Miller 1977; Kelsch and Hendricks 1990). Decrease in range was likely due to habitat degradation (Kelsch and Hendricks 1990). Harrell (1978) reported them (<1%) in the Devils River. Hubbs et al. (1977) encountered no *I. lupus* at any of the 33 sampling stations on the Rio Grande. Platania got 23 (5%) at Hinds Spring on upper San Felipe Creek, but none at his other 40 sampling stations. The IBWC study obtained 2 specimens (<1%) at only one location, Río Escondido, Coahuila. In our study we found them in the upper three segments of the Rio Grande, but in low abundance (Table 1). Specimens were also obtained from Independence Creek, Sycamore Creek, Pinto Creek and Las Moras Creek (Table1; Garrett et al. 1992). Only in Las Moras Creek was their relative abundance over 1%. In Mexico, specimens were obtained from the Río San Pedro and the Río Conchos at Cuchillo Parado, Julimes and Zaragosa (Table 1).

Chihuahua catfish:

*Ictalurus* sp. is listed as Special Concern by Hubbs et al. (1991). Very little is known of this undescribed species and none were obtained in our collections. It historically occurred in the Rio Grande basin of New Mexico and Texas, the Río Conchos basin, Chihuahua and the Río San Fernando, Tamaulipas. One specimen was obtained by C. Hubbs, R.J. Edwards and G.P. Garrett in Big Aguja Canyon, Davis Mountains during a May, 1980 collecting trip. Identification was confirmed by R.R. Miller (Univ. of Michigan), who is preparing a manuscript describing the species.

Conchos pupfish:

*Cyprinodon eximius* is listed as Threatened by the Texas Parks and Wildlife Department, Threatened by the Texas Organization for Endangered Species, Threatened by Hubbs et al. (1991) and Threatened by Williams et al. (1989). The widely distributed range for this species is the upper Río Conchos, Río Sauz, Alamito Creek, Terlingua Creek, Tornillo Creek and a disjunct, morphologically distinct population in the Devils River (Miller 1976; Miller 1981; Hubbs and Echelle 1973; Minckley 1980; Hubbs et al. 1991). The population at Dolan Creek was extirpated in 1958 and reestablished in 1979 by moving 200 individuals from the Devils River to Dolan Creek (Garrett 1980; Hubbs and Garrett 1990) where the population now thrives (Garrett et al. 1992). Texas Parks and Wildlife Department now owns Dolan Springs and maintains it as a natural area. Detrimental environmental impacts, reduced water quantity and loss of habitat threaten this species in the U.S. and Mexico (Contreras-Balderas 1977; Williams et al. 1985). Our collections revealed the pupfish were <1% of the fauna in Alamito Creek and were not present in Terlingua Creek (Table 1). These fish are abundant in the Río Chuviscar (13% - 46%) and present in low numbers in headwaters streams of the Río Conchos. Hubbs et al. (1977) also found them in low numbers in the somewhat ephemeral Alamito Creek (2%) and collected one specimen in the Rio Grande downstream of the mouth of Alamito Creek. Bestgen and Platania (1988) reported one specimen (<1%) from Alamito Creek. Platania (1990) and IBWC (1994) reported no specimens of *C. eximius* at any location.

blotched gambusia:

*Gambusia senilis* is listed as Endangered by the Texas Parks and Wildlife Department, Endangered by the Texas Organization for Endangered Species, Extirpated by Hubbs et al. (1991), Special Concern by Williams et al. (1989) and Threatened by Miller (1972). The historic range includes the Río Conchos basin and the Devils River (Hubbs 1958; Guillory 1980). Although Hubbs and Springer (1957) reported their range as Río Conchos downstream as far as Julimes, our collections at Julimes contained no *G. senilis*, but an abundant population was evident further downstream at Río Chuviscar (Table 1). Additionally, they almost completely dominate the fish community in the headwaters of the Río Chuviscar in the mountains northwest of Ciudad Chihuahua. In general, we found them to be abundant and widely distributed in Mexico. The Texas population was isolated by Amistad Reservoir (Hubbs and Echelle 1973) and ultimately eliminated (Hubbs et al. 1991). The Rio Grande Fishes Recovery Team has recommended reestablishment of the Texas population in Devils River State Natural Area from stocks in the Río Chuviscar.

Rio Grande darter:

*Etheostoma grahami* is listed as Threatened by the Texas Parks and Wildlife

Department, Watch List by the Texas Organization for Endangered Species, Threatened by Hubbs et al. (1991), Special Concern by Williams et al. (1989) and Threatened by Miller (1972). It is found in the lower Pecos River, the Rio Grande between the Pecos confluence and Sycamore Creek, Devils River, Dolan Creek, San Felipe Creek, Howard Springs in Texas and Río Sabinas, Coahuila, Río Salado and Río San Juan, Nuevo Leon (Strawn 1961; Harrell 1980b). Much of their habitat was inundated by Amistad Reservoir (Hubbs and Echelle 1973). Harrell found them in the Devils River at 1% relative abundance. The IBWC study found them at only 6 locations with relative abundance ranging from 1% to 8%. Platania (1990) reported one specimen from the Rio Grande in Webb County, a substantial range extension for the species. He also obtained specimens from San Felipe Creek (2%) and in the Rio Grande 10 km downstream of Amistad Reservoir (75%). Our collections also showed a stable population with a limited range (Table 1 and 2).

## SUMMARY

Desert ecosystems are fragile and slow to recover. Some changes may not be recoverable. Deep trenching of streams by erosion from overgrazing and deforestation (Ohmart and Anderson 1982), introductions of exotic species and extinction of native species may cause irreversible damage to these ecosystems. While perturbations such as pollution, reduced groundwater and dam construction are theoretically fixable, recovery to a pristine state is unlikely.

These changes have been gradual and long-term, taking place since the mid-1800s (Miller 1961), but their effects have been compounded over time and are now becoming dramatic. In the early part of the 20$^{th}$ century it was already apparent that water was becoming a major problem in Chihuahua as extensive irrigation projects were initiated (Tamayo and West 1964). Brand (1937) noted "The increasing use of spring and river water for irrigation on the haciendas and colonias of the region has contributed markedly to the lessened flow of the rivers in their lower courses". Clark Hubbs observed that the Río Sauz went entirely dry in 1947 and no surface waters were available in the river valley (Miller 1961). At least 30 springs have gone dry in Chihuahua and Coahuila and river discharges of the Río Nazas, Bolson Mayrán, Río Aguanaval, Bolson Viesca, Río de Nadadores, Río Saltillo, Río Salinas, Río del Carmen and the middle Rio Grande are reduced (Contreras-Balderas and Lozano-Vilano 1994). In Mexico, as in the U.S., irrigation, pollution and introductions of exotic species have taken their toll on arid ecosystems (Contreras-Balderas 1969)

Under these conditions droughts are even more devastating. Droughts not only reduce rainfall, but also cause an increase in groundwater pumping for agricultural and municipal use. Such extreme conditions put stress on fish community equilibrium with more tolerant species gaining a competitive and numerical advantage. Tributary creeks tend to be impacted more severely, yet are critical to the breeding and rearing of young of many of the indigenous species. In the Rio Grande this is particularly true of *Campostoma ornatum* and *Notropis chihuahua* (Hubbs and Wauer 1973).

The Rio Grande and its associated streams hardly resemble the original water course lined with a gallery forest of cottonwoods and willows. Exploitation of limited resources, particularly groundwater pumping, has degraded that environment, caused extirpation and

extinction of species and ultimately, loss of habitat and ecosystems (Smith and Miller 1985). The few relatively natural faunas and fairly intact ecosystems need careful management if they are to be preserved.

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Table 1. Relative abundance of fishes collected in the Río Grande and Río Conchos basins.

**A** = Rio Grande, 1993, from near the confluence with Alamito Creek to near Lajitas

**B** = Alamito and Terlingua creeks, 1993

**C** = Rio Grande, 1992, from San Francisco Canyon to Dryden takeout

**D** = Rio Grande, 1993, vicinity of El Indio, approximately RM 480-460

**E** = Rio Grande, 1994, Falcon Dam to approximately 30 km downstream

**F** = Río Conchos, 1994, Cuchillo Parado, approximately 30 km from its confluence with the Rio Grande

**G** = 1994 Río Chuviscar near San Diego de Alcalá

**H** = 1995 Río Chuviscar near San Diego de Alcalá

**I** = Springs at San Diego de Alcalá, 1994

**J** = Headwaters of the Río Chuviscar, 1995

**K** = Río Conchos, 1994, downstream of Julimes

**L** = Springs at Ojo Talamantes, 1994

**M** = Río Conchos, 1994, at Valle de Zaragosa

**N** = Río San Pedro, 1994

**O** = Río Santa Isabella, 1994, near Riva Palacio

**P** = Río Santa Isabella, 1994, 20 km downstream of Riva Palacio

**Q** = Springs at Ojo del Rey, 1994

Table 1

| Species | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| Lepisosteus oculatus | - | - | - | 0.33 | - | - | - | - | - |
| Lepisosteus osseus | - | - | 0.16 | 0.22 | - | - | - | - | - |
| Dorosoma cepedianum | - | - | 0.47 | 0.44 | - | - | - | - | - |
| Dorosoma petenense | - | - | - | 0.17 | 1.74 | - | - | - | - |
| Campostoma ornatum | 0.01 | 12.60 | - | - | - | - | 2.39 | - | 0.75 |
| Codoma ornata | - | - | - | - | - | - | - | - | - |
| Cyprinella lutrensis | 87.00 | 21.42 | 13.40 | 55.12 | 3.58 | 61.90 | 3.24 | 15.20 | 3.58 |
| Cyprinella venusta | - | - | - | 0.22 | - | - | - | - | - |
| Cyprinus carpio | - | - | - | 0.50 | - | 0.50 | - | - | - |
| Dionda episcopa | - | - | - | - | - | - | 3.38 | - | 9.39 |
| Gila pulchra | - | - | - | - | - | - | - | - | - |
| Macrhybopsis aestivalis | 0.60 | - | 8.26 | 7.64 | 0.56 | - | - | - | - |
| Notropis braytoni | 2.00 | 2.83 | 7.17 | - | - | 0.20 | - | - | - |
| Notropis chihuahua | 0.02 | 5.02 | - | - | - | 2.02 | 21.27 | 4.80 | 6.11 |
| Notropis jemezanus | 0.30 | - | 6.39 | - | - | - | - | - | - |
| Notropis stramineus | 0.20 | - | - | - | - | - | - | - | - |
| Pimephales promelas | 0.20 | 0.05 | - | - | - | 4.54 | - | 0.80 | - |
| Pimephales vigilax | - | - | - | 6.64 | 4.21 | - | - | - | - |
| Rhinichthys cataractae | 0.40 | - | 33.49 | - | - | - | - | - | - |
| Carpiodes carpio | - | - | 3.74 | 0.28 | - | 10.69 | - | - | - |
| Catostomus commbos | - | - | - | - | - | - | - | - | - |
| Cycleptus elongatus | - | - | - | 0.06 | - | - | - | - | - |
| Ictiobus bubalus | 1.70 | - | 1.40 | 0.06 | - | - | - | - | - |
| Moxostoma austrinum | 0.02 | - | - | 1.60 | - | 1.31 | - | - | - |
| Astyanax mexicanus | 0.01 | 0.20 | 0.47 | 8.25 | 2.62 | 1.31 | 0.14 | 1.60 | 3.28 |
| Ameiurus melas | - | - | - | - | - | - | - | - | - |
| Ictalurus furcatus | 0.20 | - | 8.26 | - | - | 0.91 | - | - | - |
| Ictalurus lupus | 0.02 | - | 0.93 | 0.28 | - | 0.10 | - | - | - |
| Ictalurus punctatus | 0.04 | - | 0.16 | - | 0.49 | 0.10 | - | - | - |
| Pylodictis olivaris | 0.03 | - | 2.18 | 0.11 | - | 0.81 | - | - | - |
| Cyprinodon eximius | - | 0.94 | - | - | - | - | 45.21 | 13.00 | - |
| Cyprinodon sp.1 | - | - | - | - | - | - | - | - | 24.74 |
| Cyprinodon sp.2 | - | - | - | - | - | - | - | - | - |
| Cyprinodon variegatus | - | - | - | - | 0.39 | - | - | - | - |
| Fundulus grandis | - | - | - | 1.66 | 0.66 | - | - | - | - |
| Fundulus zebrinus | - | 25.55 | - | - | - | 0.20 | - | - | - |
| Gambusia affinis | 7.10 | 30.72 | 2.49 | 5.70 | 49.04 | - | - | - | - |
| Gambusia senilis | - | - | - | - | - | - | 23.94 | 62.20 | 23.99 |
| Gambusia sp.1 | - | - | - | - | - | - | - | - | 6.11 |
| Gambusia sp.2 | - | - | - | - | - | - | - | - | - |
| Poecilia latipinna | - | - | - | 0.77 | 0.05 | - | - | - | - |
| Menidia beryllina | 0.30 | - | 0.16 | 5.98 | 32.81 | 6.15 | - | - | - |
| Morone chrysops | - | - | 0.31 | - | - | - | - | - | - |
| Morone saxatilis | - | - | - | 0.06 | - | - | - | - | - |
| Lepomis auritus | - | - | - | 0.06 | 2.76 | - | - | - | - |
| Lepomis cyanellus | 0.01 | 0.65 | 9.35 | 0.06 | 0.03 | - | - | 1.60 | 1.34 |
| Lepomis gulosus | - | - | - | - | - | - | - | - | 0.15 |
| Lepomis macrochirus | 0.15 | - | 0.93 | 0.50 | 0.76 | - | - | - | 18.18 |
| Lepomis megalotis | 0.01 | - | - | 0.06 | - | 0.10 | - | - | 1.79 |
| Lepomis microlophus | - | - | - | 0.06 | 0.03 | - | - | - | - |
| Micropterus dolomieu | - | - | - | 1.00 | - | - | - | - | - |
| Micropterus salmoides | - | - | - | 1.27 | 0.14 | 1.01 | - | - | - |
| Etheostoma australe/postii | - | - | - | - | - | - | - | - | - |
| Aplodinotus grunniens | - | - | 0.31 | 0.17 | - | - | - | - | - |
| Cichlasoma cyanoguttatum | - | - | - | 0.06 | 0.12 | - | - | - | - |
| Tilapia aurea | - | - | - | 0.72 | - | 8.17 | 0.42 | 0.80 | 0.60 |
| TOTAL NUMBER | 8,964 | 2,012 | 642 | 1,807 | 6,479 | 992 | 710 | 500 | 671 |

Table 1 (cont.)

| Species | J | K | L | M | N | O | P | Q |
|---|---|---|---|---|---|---|---|---|
| Lepisosteus oculatus | - | - | - | - | - | - | - | - |
| Lepisosteus osseus | - | - | - | - | - | - | - | - |
| Dorosoma cepedianum | - | - | - | - | - | - | - | - |
| Dorosoma petenense | - | - | - | - | - | - | - | - |
| Campostoma ornatum | - | - | - | 0.53 | 0.73 | 14.42 | 1.44 | - |
| Codoma ornata | - | - | - | - | 0.55 | 20.29 | 33.56 | - |
| Cyprinella lutrensis | 0.80 | 33.57 | - | 13.82 | 6.69 | - | 9.11 | 2.54 |
| Cyprinella venusta | - | - | - | - | - | - | - | - |
| Cyprinus carpio | - | - | - | - | - | - | - | - |
| Dionda episcopa | - | - | 0.13 | 0.12 | 18.18 | - | 8.34 | - |
| Gila pulchra | - | - | - | - | - | 6.01 | 0.90 | - |
| Macrhybopsis aestivalis | - | - | - | - | - | - | - | - |
| Notropis buccatus | 0.80 | 1.33 | - | 0.19 | - | - | 0.54 | - |
| Notropis chihuahua | - | 0.20 | 14.40 | 16.48 | 7.05 | 40.99 | 23.36 | - |
| Notropis jemezanus | - | 1.33 | - | 13.61 | - | 0.40 | - | - |
| Notropis stramineus | - | - | - | - | - | - | - | - |
| Pimephales promelas | - | 0.10 | - | 33.39 | 0.79 | 2.40 | 0.59 | - |
| Pimephales vigilax | - | - | - | - | - | - | - | - |
| Rhinichthys cataractae | - | - | - | 0.02 | - | - | - | - |
| Carpiodes carpio | - | 0.20 | - | 0.08 | - | - | - | - |
| Catostomus catostomus | - | - | - | 6.18 | 0.12 | - | - | - |
| Cycleptus elongatus | - | - | - | - | - | - | - | - |
| Ictiobus bubalus | - | - | - | 0.02 | 0.06 | - | - | - |
| Moxostoma austrinum | - | 0.61 | - | 0.42 | 0.12 | - | - | - |
| Astyanax mexicanus | - | - | 6.33 | 0.73 | 5.23 | - | 2.12 | - |
| Ameiurus melas | - | - | - | - | - | 0.13 | 0.09 | 0.13 |
| Ictalurus furcatus | - | - | - | 0.03 | - | - | - | - |
| Ictalurus lupus | - | 0.10 | - | 0.14 | 0.06 | - | - | - |
| Ictalurus punctatus | - | 0.10 | - | - | - | - | 0.05 | - |
| Pylodictis olivaris | - | 0.71 | - | - | - | - | - | - |
| Cyprinodon eximius | - | - | - | 0.56 | 1.16 | - | 0.09 | - |
| Cyprinodon sp.1 | - | - | - | - | - | - | - | - |
| Cyprinodon sp.2 | - | - | - | - | - | - | - | 8.81 |
| Cyprinodon variegatus | - | - | - | - | - | - | - | - |
| Fundulus grandis | - | - | - | - | - | - | - | - |
| Fundulus zebrinus | - | - | - | - | - | - | - | - |
| Gambusia affinis | - | - | - | - | - | - | - | 88.51 |
| Gambusia senilis | 98.39 | - | - | 0.10 | 56.96 | 10.95 | 17.41 | - |
| Gambusia sp.1 | - | - | - | - | - | - | - | - |
| Gambusia sp.2 | - | - | 71.87 | - | - | - | - | - |
| Poecilia latipinna | - | - | - | - | - | - | - | - |
| Menidia beryllina | - | 2.24 | - | - | - | - | - | - |
| Morone chrysops | - | - | - | - | - | - | - | - |
| Morone saxatilis | - | - | - | - | - | - | - | - |
| Lepomis auritus | - | - | - | - | - | - | - | - |
| Lepomis cyanellus | - | - | - | - | 0.06 | - | - | - |
| Lepomis gulosus | - | - | - | - | - | - | - | - |
| Lepomis macrochirus | - | 0.10 | 0.54 | - | - | - | - | - |
| Lepomis megalotis | - | 0.10 | 0.07 | 13.29 | - | 2.00 | 1.80 | - |
| Lepomis microlophus | - | - | - | - | - | - | - | - |
| Micropterus dolomieu | - | - | - | - | - | - | - | - |
| Micropterus salmoides | - | 0.31 | 6.66 | - | - | - | - | - |
| Elbeostoma australe/pottsi | - | - | - | - | - | 2.40 | 0.27 | - |
| Aplodinotus grunniens | - | - | - | - | - | - | - | - |
| Cichlasoma cyanoguttatum | - | - | - | - | - | - | - | - |
| Tilapia aurea | - | 58.98 | - | 0.29 | 2.25 | - | 0.32 | - |
| TOTAL NUMBER | 249 | 980 | 1,486 | 5,891 | 1,645 | 749 | 2,217 | 2,281 |

Table 2. Relative abundance of fishes collected in tributaries of the Rio Grande.

**A** = Elm Creek, Maverick County, 1992

**B** = Independence Creek, Terrell County, 1991

**C** = Pecos River at Independence Creek, 1991

**D** = Cienega Creek, Presido County, 1989

Table 2

| Species | A | B | C | D |
|---|---|---|---|---|
| Dorosoma cepedianum | - | - | - | - |
| Dorosoma petenense | - | - | - | - |
| Campostoma ornatum | - | - | - | 75.00 |
| Cyprinella lutrensis | 43.75 | 18.43 | 82.00 | - |
| Cyprinella proserpinus | - | 24.76 | 3.99 | - |
| Cyprinella venusta | 12.5 | - | - | - |
| Cyprinus carpio | - | - | - | - |
| Dionda argentosa | - | - | - | - |
| Dionda diaboli | - | - | - | - |
| Dionda episcopa | - | 28.98 | 3.55 | - |
| Macrhybopsis aestivalis | - | - | 0.18 | - |
| Notropis amabilis | - | - | - | - |
| Notropis braytoni | - | - | 0.71 | - |
| Notropis chihuahua | - | - | - | - |
| Notropis jemezanus | - | - | - | - |
| Pimephales vigilax | - | 0.19 | 0.89 | - |
| Moxostoma congestum | - | 0.19 | - | - |
| Astyanax mexicanus | - | 0.77 | - | - |
| Ictalurus lupus | - | 0.96 | - | - |
| Cyprinodon eximius | - | - | - | - |
| Cyprinodon hybrids | - | 0.58 | 0.18 | - |
| Lucania parva | - | 0.38 | 0.18 | - |
| Gambusia affinis | 22.92 | - | - | - |
| Gambusia geiseri | - | 3.26 | 0.44 | - |
| Gambusia senilis | - | - | - | - |
| Gambusia speciosa | - | 7.68 | 7.54 | - |
| Menidia beryllina | - | - | 0.09 | - |
| Lepomis auritus | - | 1.73 | - | - |
| Lepomis cyanellus | 2.08 | 0.38 | 0.18 | 25.00 |
| Lepomis macrochirus | 14.58 | 0.19 | - | - |
| Lepomis megalotis | 4.17 | - | - | - |
| Micropterus salmoides | - | 0.38 | - | - |
| Etheostoma grahami | - | 1.34 | 0.09 | - |
| Cichlasoma cyanoguttatum | - | 0.19 | - | - |
| TOTAL NUMBER | | | | |