MONITORING THE STATUS, HABITAT ASSOCIATION, AND SEASONAL OCCURRENCE OF RIO GRANDE SILVERY MINNOW IN THE VICINITY OF THE MONTAÑO BRIDGE, ALBUQUERQUE, NEW MEXICO

FINAL REPORT

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INTRODUCTION

Fish assemblages in most of the arid regions of North America have been affected by man-induced disturbances such as hydrologic manipulations, habitat alteration, and the introduction of non-native species. Over half of the cyprinid taxa recently listed as endangered, threatened, or of special concern were from desert streams in the American Southwest or west (Williams et al., 1989). Included in that list were several taxa from the Rio Grande basin.

The Rio Grande is one of the longest rivers in North America traversing almost 2,000 miles from its headwaters in the San Juan Mountains of southern Colorado before emptying into the Gulf of Mexico. The Rio Grande, the second largest drainage basin in the American Southwest, is surpassed in size only by the Colorado River Basin. In New Mexico, the mainstem is approximately 500 miles long and drains nearly 20% of the state.

The native ichthyofauna of the New Mexico portion of the Rio Grande is believed to have consisted of between 16 and 27 species (Hatch, 1985; Smith and Miller, 1986; Propst et al., 1987), four of which were endemic to the basin. Of the latter, Rio Grande shiner (Notropis jemezanus), phantom shiner (Notropis orca), and Rio Grande bluntnose shiner (Notropis simus simus) no longer occur in the New Mexico portion of the Rio Grande (Bestgen and Platania, 1990). Rio Grande shiner was known from 81 specimens in eight collections in the Rio Grande in New Mexico and has not been taken there since 1949 (Platania, 1991). Phantom shiner and Rio Grande bluntnose shiner were last collected in the Rio Grande in 1939 and 1964, respectively and are extirpated (Chernoff et al., 1982; Bestgen and Platania, 1990). Rio Grande silvery minnow (Hybognathus amarus) is the only endemic Rio Grande fish surviving in New Mexico and occurs in <5% of its total former range (Bestgen and Platania, 1991).

The aforementioned four species comprised a guild of short-lived (3-5 years) mainstream cyprinids which were apparently especially susceptible to reduction and alteration of stream discharge. Changes in stream hydrology were most closely associated with construction of mainstream dams and irrigation withdrawals. Additional factors which were thought to have contributed to the decline and demise of the native Rio Grande fish fauna were municipal, agricultural and industrial pollution, channel modifications and the introduction of several non-native predaceous game fishes.

Rio Grande silvery minnow formerly was relatively abundant and widespread in the Rio Grande, occurring from near Española, New Mexico to the Gulf of Mexico (Bestgen and Platania, 1991). Recent studies in the Rio Grande Basin documented the loss of this species from Rio Grande upstream of Cochiti Dam and downstream of Elephant Butte Reservoir. Rio Grande silvery minnow has been extirpated from its former range in the Pecos River and replaced by a congener, plains minnow (Hybognathus placitus). This 90-95% reduction in range was due, in part, to water resource development and resulted in the listing of this endemic cyprinid as a federal endangered species (U.S. Department of the Interior, 1994). Critical habitat has been proposed as the Rio Grande between the NM State Highway 22 bridge (directly below the out-fall of Cochiti Dam) and the San Marcial Railroad bridge. This study was a short-term monitoring effort that attempted to assess potential impact of construction activities and conservation measures on Rio Grande ichthyofauna.

Concern was expressed by the U.S. Fish and Wildlife Service regarding potential effects of instream construction activities on Rio Grande silvery minnow. This study was designed as a monitoring effort that would provide information on the status and biology of the Rio Grande silvery minnow in the vicinity of the Montaño Bridge, Albuquerque. Information expected to be gained from this work was: 1) determine the status (relative commonness) of Rio Grande silvery minnow in the vicinity of the Montaño Bridge, Albuquerque, 2) determine seasonal changes in the abundance of Rio Grande silvery minnow populations in the study area, 3) determine seasonal habitat associations

of this species and 4) develop recommendations to reduce negative impacts of bridge construction and associated habitat modification on Rio Grande silvery minnow and its preferred habitats. This suite of information was necessary to provide preliminary recommendations on measures that could be taken to minimize adverse effects of bridge construction activities on Rio Grande silvery minnow and associated riverine ichthyofauna.

STUDY AREA AND METHODS

The study area consisted of three sites (=stations) in the Rio Grande, Albuquerque. Three sampling stations were selected based on their relative location to the construction site, accessibility, and habitat diversity (Figure 1). The uppermost monitoring site was near the Corrales Main Canal out-fall return and about 1.0 miles upstream of the Montaño Bridge construction site and 2.0 miles downstream of the Paseo del Norte Bridge. This site was chosen because of its proximity, lack of disturbance from construction activities, and high degree of habitat heterogeneity. The second monitoring station was at the Montaño Bridge construction site. Fish monitoring at the second sampling station was conducted immediately up and downstream of construction activities. The lowermost collection locality was the Central Avenue bridge which was about 4.5 miles downstream of Montaño Bridge. Like the uppermost locality, this site was easily accessible and had a relatively high amount of instream habitat heterogeneity.

Riverine habitat in the study area was typical of the Rio Grande between Bernalillo and Isleta, New Mexico. The river channel was broad and meandered over sand substrate and consisted of runs with pools occurring at low flows near channel margins. Instream debris was most prominent during winter and was generally located in low-velocity habitats or along shorelines. Debris piles usually consisted of tumbleweeds and woody vegetation. Flow was perennial in this reach of the Middle Rio Grande and there were no natural tributaries in the study area.

Sampling was conducted every other month starting in October 1995 (prior to instream construction activities) and concluding in October 1996. Site length depended on habitat heterogeneity and the distribution of mesohabitats at the site but was usually about 200 m in length. Fish were sampled by rapidly drawing a two-person 10' x 6' small mesh (3/16") seine through short discrete mesohabitats (usually <10 m). The length, mesohabitat type and species composition of each seine haul was determined. Only short and discrete mesohabitats (i.e., portion of a riffle) were sampled. All available aquatic mesohabitat types were sampled regardless of whether fish were generally caught in those areas.

Upon capture, most fish were fixed in 10% formalin and returned to the laboratory for identification. Most specimens >250 mm total length were identified, counted, and returned alive to the water. Effort expended at each site was determined as the number of fish collected per 100 m^2 of water sampled. Retained specimens were curated into the Fish Division of the Museum of Southwestern Biology at the University of New Mexico, as stipulated by New Mexico Department of Game and Fish collecting permit regulations.

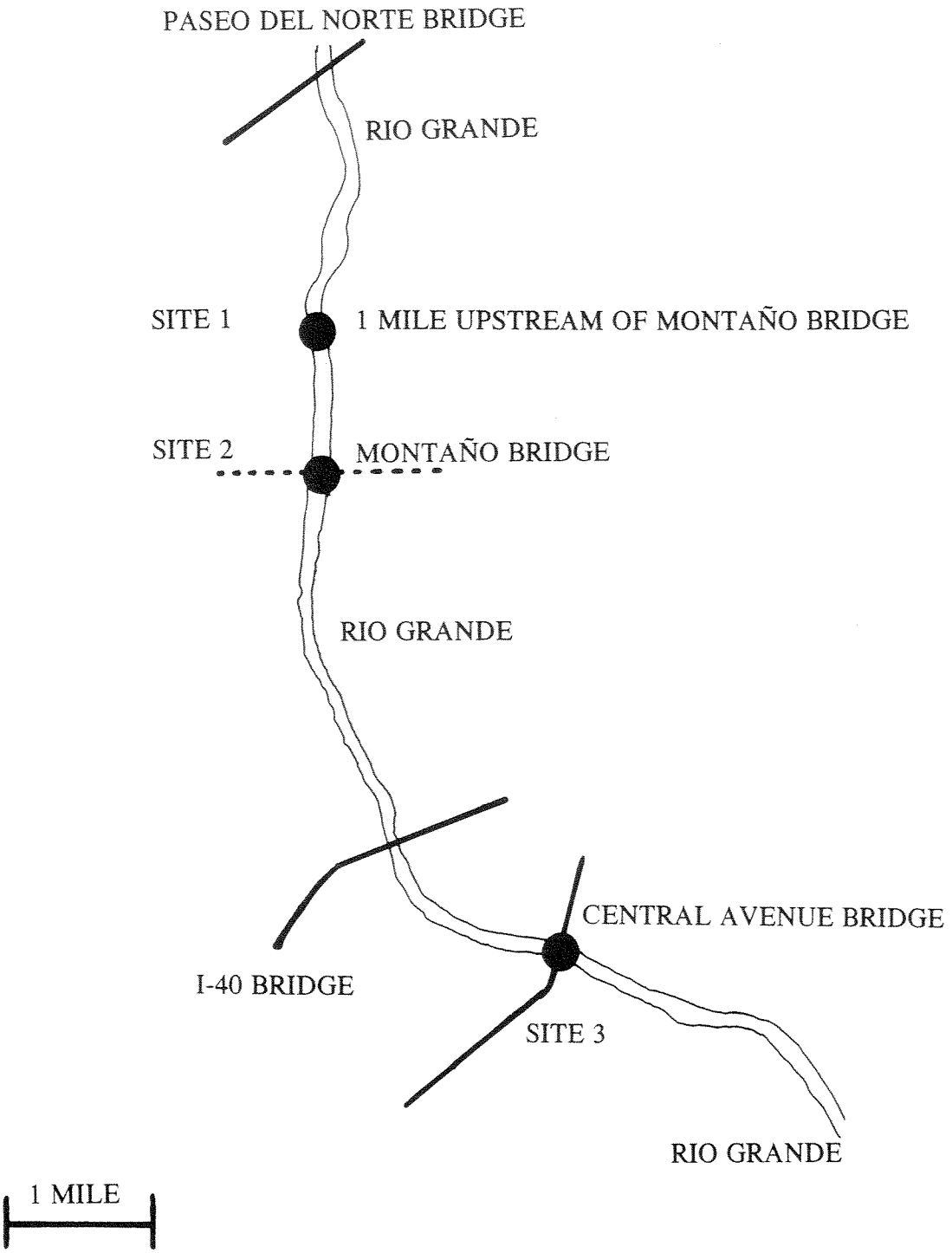

Figure 1. Location of sampling sites in the study area.

RESULTS

A total of 4,306 fish comprising five orders, eight families and 19 species were collected during this study (Table 1). There were notable differences in the abundance of individual fish species. The 11 most common species accounted for 99.6% of the total catch by number. Conversely, the remaining eight species were represented by five or fewer specimens and a cumulative total of 20 individuals.

While the sucker family was represented by only two species, river carpsucker and white sucker, they were the two most abundant taxa collected during this survey and comprised 47.1% of the total catch. The cyprinid family (carps and minnows) was the most species-rich family being represented by six species. This group of fishes accounted for 31.3% (n=1,349) of the total catch with the number of specimens per species ranging from 44 to 440 (Table 2). The bullhead catfishes (=ictalurids), the third most abundant family of fishes, was represented by three species. Almost all of the ictalurids collected were channel catfish (n=466, 99.4%). Sunfishes were the second most species-rich family with four species. Members of this group were rare as none of those four species was represented by more than three individuals.

There was relatively little difference in the overall abundance of native versus non-native fishes despite the latter group being comprised of more than twice the number of species as the former. The six native taxa were represented by only two families and accounted for 56.6% of the total catch. Native fish ranged in abundance from 57 to 1,131 specimens. The 13 species of non-native fishes represented all eight families taken during this survey and ranged in abundance from 1 to 899 individuals.

Faunal composition by site

Site 1 - Upstream of Montaño Bridge

This site produced 15 species and 1,572 fishes (Table 3). The trend in overall species abundance at site 1 was similar to that observed for the overall study. Sucker species were the two most abundant taxa accounting for almost 50% of the site 1 catch. Cyprinids were the most speciose and second most abundant family. While the six cyprinid species taken during this study were present at all three sites, they reached their greatest level of abundance at this locality (n=554, 41.1%).

Rio Grande silvery minnow was the seventh most common fish and fourth most abundant minnow species at this site. Silvery minnow was taken during five of the seven site 1 sampling forays and reached its greatest level of abundance at this locality. It accounted for 5.5% of the site 1 catch. This was also the only site that yielded three different species of sunfish and the only location where white bass were collected.

Site 2 - Montaño Bridge

The Montaño Bridge site produced 14 species and 30.9% (n=1,332) of the fish taken during this survey (Table 4). As at the upstream sampling station, river carpsucker were the most abundant species. However, white sucker, which were 14.9% (n=234) of the catch upstream, were only 6.3% (n=84) of the catch at this site. There were only minor differences in the relative abundances of the six cyprinid species collected here as compared with site 1. Common carp, fathead minnow and flathead chub were less abundant at site 2 than site 1 while red shiner, Rio Grande silvery minnow and longnose dace comprised about the same proportion of the fish community at both sites. Rio

Table 1. Scientific and common names of fish collected from October 1995 to October 1996 in the Rio Grande in the vicinity of the Montaño Bridge, New Mexico.

Scientific Name	Common Name
Order Clupeiformes	
Family Clupeidae	herrings
Dorosoma cepedianum	gizzard shad
Order Cypriniformes	
Family Cyprinidae	carps and minnows
Cyprinella lutrensis	red shiner
Cyprinus carpio	common carp
Hybognathus amarus	Rio Grande silvery minnow
Pimephales promelas	fathead minnow
Platygobio gracilis	flathead chub
Rhinichthys cataractae	longnose dace
Family Catostomidae	suckers
Carpiodes carpio	river carpsucker
Catostomus commersoni	white sucker
Order Siluriformes	
Family Ictaluridae	bullhead catfishes
Ameiurus melas	black bullhead
Ameiurus natalis	yellow bullhead
Ictalurus punctatus	channel catfish
Order Cyprinodontiformes	
Family Poeciliidae	livebearers
Gambusia affinis	western mosquitofish
Order Perciformes	
Family Percichthyidae	temperate basses
Morone chrysops	white bass

Table 1. Scientific and common names of fish collected from October 1995 to October 1996 in the Rio Grande in the vicinity of the Montaño Bridge, New Mexico.

Scientific Name	Common Name
Order Perciformes	
Family Centrarchidae	sunfishes
Lepomis cyanellus	green sunfish
Lepomis macrochirus	bluegill
Micropterus salmoides	largemouth bass
Pomoxis annularis	white crappie
Family Percidae	perches
Perca flavescens	yellow perch

Table 2. Summary of ichthyofaunal composition and collection data from October 1995 to October 1996 in the Rio Grande in the vicinity of the Montaño Bridge, New Mexico.

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	% OF TOTAL	FREQUENCY OF OCCURRENCE[2]	% FREQUENCY OF OCCURRENCE[2]
HERRINGS					
gizzard shad	I	5	0.12	1	5.26
CARPS AND MINNOWS					
red shiner	N	440	10.22	15	78.95
common carp	I	44	1.02	5	26.32
Rio Grande silvery minnow	N	183	4.25	14	73.68
fathead minnow	N	440	10.22	15	78.95
flathead chub	N	185	4.30	16	84.21
longnose dace	N	57	1.32	10	52.63
SUCKERS					
river carpsucker	N	1131	26.27	13	68.42
white sucker	I	899	20.88	15	78.95
BULLHEAD CATFISHES					
black bullhead	I	1	0.02	1	5.26
yellow bullhead	I	2	0.05	15	5.26
channel catfish	I	466	10.82	18	94.74
LIVEBEARERS					
western mosquitofish	I	427	9.92	14	73.68
TEMPERATE BASSES					
white bass	I	3	0.07	1	5.26
SUNFISHES					
green sunfish	I	3	0.07	3	15.79
bluegill	I	2	0.05	2	10.53
largemouth bass	I	1	0.02	1	5.26
white crappie	I	3	0.07	3	15.79
PERCHES					
yellow perch	I	14	0.33	3	15.79
TOTAL		4,306			

[1] N = native; I = introduced
[2] Frequency and % frequency of occurrence in total number of samples taken during this study (n = 19)

Table 3. Summary of ichthyofaunal composition and collection data from October 1995 to October 1996 in the Rio Grande 1 mile upstream of the Montaño Bridge, New Mexico.

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	% OF TOTAL	FREQUENCY OF OCCURRENCE[2]	% FREQUENCY OF OCCURRENCE[2]
HERRINGS					
gizzard shad	I	-	-----	-	-----
CARPS AND MINNOWS					
red shiner	N	129	8.21	6	85.71
common carp	I	25	1.59	1	14.29
Rio Grande silvery minnow	N	86	5.47	5	71.43
fathead minnow	N	201	12.79	5	71.43
flathead chub	N	98	6.23	6	85.71
longnose dace	N	15	0.95	3	42.86
SUCKERS					
river carpsucker	N	546	34.73	5	71.43
white sucker	I	234	14.89	5	71.43
BULLHEAD CATFISHES					
black bullhead	I	-	-----	-	-----
yellow bullhead	I	-	-----	-	-----
channel catfish	I	150	9.54	7	100.00
LIVEBEARERS					
western mosquitofish	I	74	4.71	7	100.00
TEMPERATE BASSES					
white bass	I	3	0.19	1	14.29
SUNFISHES					
green sunfish	I	-	-----	-	-----
bluegill	I	1	0.06	1	14.29
largemouth bass	I	1	0.06	1	14.29
white crappie	I	1	0.06	1	14.29
PERCHES					
yellow perch	I	8	0.51	1	14.29
TOTAL		1,572			

[1] N = native; I = introduced
[2] Frequency and % frequency of occurrence in total number of samples taken at this site (n=7)

Table 4. Summary of ichthyofaunal composition and collection data from October 1995 to October 1996 in the Rio Grande at the Montaño Bridge, New Mexico.

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	% OF TOTAL	FREQUENCY OF OCCURRENCE[2]	% FREQUENCY OF OCCURRENCE[2]
HERRINGS					
gizzard shad	I	-	-----	-	-----
CARPS AND MINNOWS					
red shiner	N	107	8.03	4	57.14
common carp	I	11	0.83	2	28.57
Rio Grande silvery minnow	N	61	4.58	6	85.71
fathead minnow	N	128	9.61	5	71.43
flathead chub	N	44	3.30	5	71.43
longnose dace	N	16	1.20	5	71.43
SUCKERS					
river carpsucker	N	520	39.04	5	71.43
white sucker	I	84	6.31	5	71.43
BULLHEAD CATFISHES					
black bullhead	I	1	0.08	1	14.29
yellow bullhead	I	-	-----	-	-----
channel catfish	I	146	10.96	6	85.71
LIVEBEARERS					
western mosquitofish	I	206	15.47	4	57.14
TEMPERATE BASSES					
white bass	I	-	-----	-	-----
SUNFISHES					
green sunfish	I	3	0.23	3	42.86
bluegill	I	-	-----	-	-----
largemouth bass	I	-	-----	-	-----
white crappie	I	1	0.08	1	14.29
PERCHES					
yellow perch	I	4	0.30	1	14.29
TOTAL		1,332			

[1] N = native; I = introduced
[2] Frequency and % frequency of occurrence in total number of samples taken at this site (n = 7)

Grande silvery minnow were taken during six of the seven site 2 sampling dates. The number of individuals collected per sample ranged from 1 to 33 and totaled 61.

This site yielded the largest number of western mosquitofish (n=206) taken during this survey. In addition, the only specimens of black bullhead (n=1) and green sunfish (n=3) were taken at the Montaño Bridge sampling locality.

Site 3 - Central Avenue Bridge

The five sampling forays at this downstream-most locality yielded 15 species and 32.6% of the total catch (Table 5). The two sucker species collectively accounted for over 45% of the sample. White sucker was the most abundant species comprising 41.4% of the catch while river carpsucker represented only 4.6% of the sample. There were several differences in the abundance of cyprinids at this site when compared with the upstream two localities. Site 3 produced the most red shiner and longnose dace while yielding the fewest Rio Grande silvery minnow and fathead minnow. Rio Grande silvery minnow were collected during three of the five sampling efforts at this site. The Central Avenue Bridge site was the only locality where gizzard shad and yellow bullhead were collected during this survey.

Catch Rates at sampling stations

There were notable trends in the catch rate of fishes at the three site during this survey (Figure 2). The general pattern was of increasing catch rate from October 1995, a peak during June 1996 which was followed immediately by a marked decrease in August 1996 and concluded with a slight increase in October 1996. Catch rates during June 1996 at all sites were significantly greater than those observed throughout the rest of the study. The final sampling effort was the only one that produced similar catch rates at all three sites.

Site 1 had the highest individual catch rate (378 fish/100 m^2) and second greatest average catch rate (78.5 fish/100 m^2). There was little difference in the catch rate at this site during the first two sampling efforts, but by February 1996 the catch rate had doubled as compared to the previous month. The large drop in the catch rate of fish at site 1 between February (55.8 fish/100 m^2) and April (6.1 fish/100 m^2) 1996 is difficult to explain. During the latter trip, there was less water in the channel and fish were not as concentrated in debris (=winter habitat) as they were during February. It is possible that the drop in water level forced fish to seek alternate habitats outside of this study site.

The marked increase in catch rate at site 1 during June 1996 is due to the concentration of large numbers of young-of-the-year fish in low-velocity habitats such as backwaters and pools. During the sampling trip two months later (August), flow was considerably higher due to recent rainstorm events. This increase in the volume of water resulted in the dispersal of fishes throughout the channel and a lower catch rate.

The mean catch rate of 62.2 fish/100 m^2 at the Montaño Bridge was the lowest of the three study sites. As at the other sites, there was a decrease in catch rates between October and December 1995. However, unlike the other localities, the catch rate at rate the Montaño Bridge site remained low in February 1996. There appeared to be less instream debris piles at this site than at upstream or downstream localities. The absence of these winter habitats and abundance of high velocity habitats were probably responsible for the low winter capture rates at this site.

Table 5. Summary of ichthyofaunal composition and collection data from October 1995 to October 1996 in the Rio Grande downstream of the Montaño Bridge, New Mexico.

SPECIES	RESIDENCE STATUS[1]	TOTAL NUMBER OF SPECIMENS	% OF TOTAL	FREQUENCY OF OCCURRENCE[2]	% FREQUENCY OF OCCURRENCE[2]
HERRINGS					
gizzard shad	I	5	0.36	1	20.00
CARPS AND MINNOWS					
red shiner	N	204	14.55	5	100.00
common carp	I	8	0.57	2	40.00
Rio Grande silvery minnow	N	36	2.57	3	60.00
fathead minnow	N	111	7.92	5	100.00
flathead chub	N	43	3.07	5	100.00
longnose dace	N	26	1.85	2	40.00
SUCKERS					
river carpsucker	N	65	4.64	3	60.00
white sucker	I	581	41.44	5	100.00
BULLHEAD CATFISHES					
black bullhead	I	-	-----	-	-----
yellow bullhead	I	2	0.14	1	20.00
channel catfish	I	170	12.13	5	100.00
LIVEBEARERS					
western mosquitofish	I	147	10.49	3	60.00
TEMPERATE BASSES					
white bass	I	-	-----	-	-----
SUNFISHES					
green sunfish	I	-	-----	-	-----
bluegill	I	1	0.07	1	20.00
largemouth bass	I	-	-----	-	-----
white crappie	I	1	0.07	1	20.00
PERCHES					
yellow perch	I	2	0.14	1	20.00
TOTAL		1,402			

[1] N = native; I = introduced
[2] Frequency and % frequency of occurrence in total number of samples taken at this site (n=5)

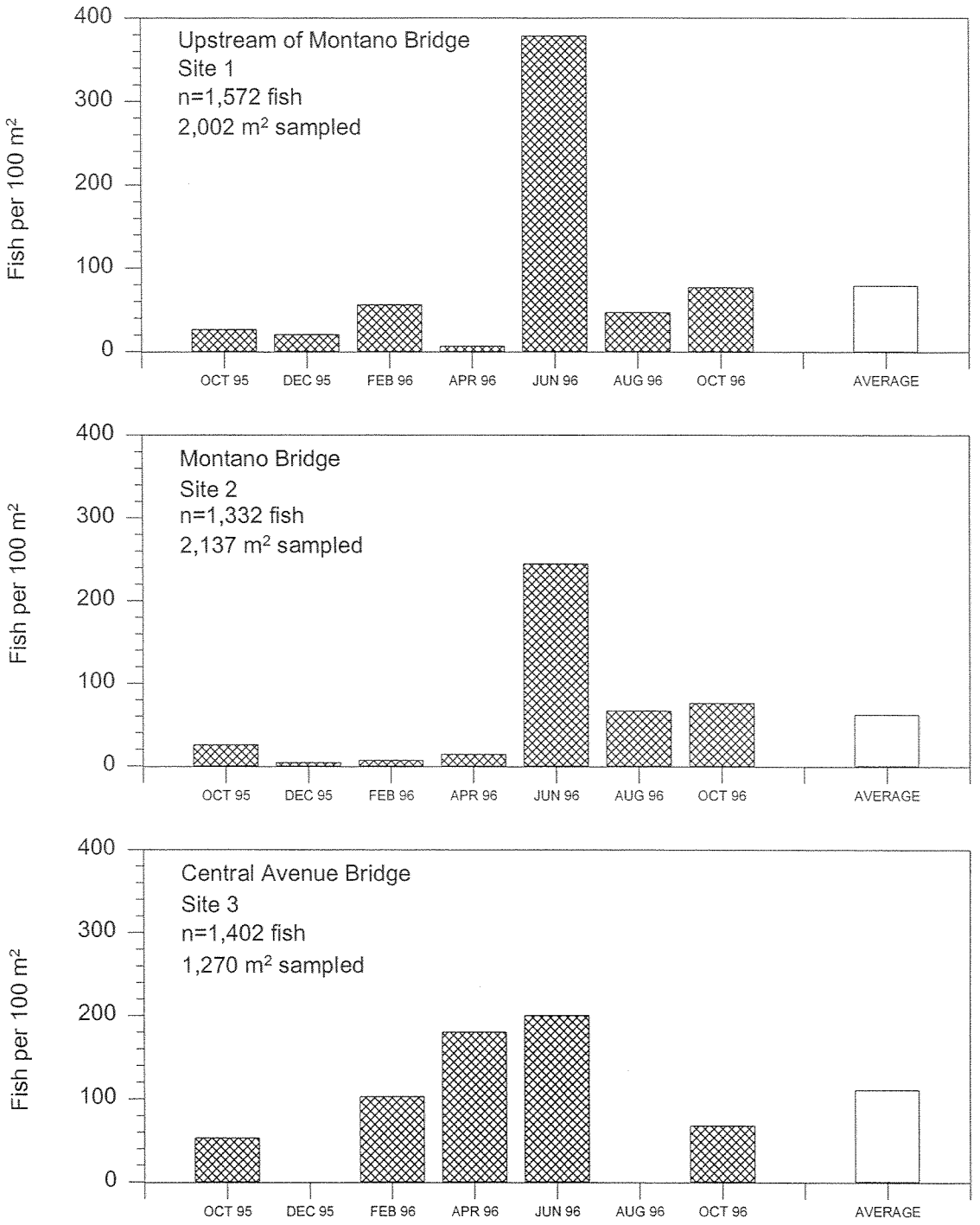

Figure 2. Catch rates of fishes during the Montaño Bridge study at three Rio Grande sampling sites.

Water levels in the river had dropped between February and April 1996 and fish appear to have dispersed throughout site 2. By June 1996, larval and young-of-the-year fish were common throughout site 2 resulting in increased rates of capture. As at the other sites, the capture rate dropped between June and August 1996 but remained relatively high in October 1996.

The capture rate of fish at the Central Avenue bridge site was the least consistent of the three localities. In October 1995, the catch rate was 52.7 fish/100 m^2 which was twice as high as either of the other two sampling stations. In February 1996, the catch rate at Central Avenue was up to 102.5 fish/100 m^2; again twice as high as the other stations. The April 1996 catch rates at site 3 reached 180 fish/100 m^2 while the other sites were 6 and 14 fish/100 m^2. Conversely, in June 1996, the catch rate at the upstream two sites surpassed that achieved at Central Avenue. The final sampling foray (October 1996) yielded similar catch rates at all three site.

Rio Grande silvery minnow

This species was the eighth most abundant fish and comprised 4.25% (n=183) of the total catch. The majority (n=86, 47.0%) of Rio Grande silvery minnow were captured at site 1 while 33.3% (n=61) were taken at the Montaño Bridge site (Table 6). Individual silvery minnow taken during this study ranged in length between 37 and 77 mm standard length (SL).

Rio Grande silvery minnow was present in 14 of the 19 sampling forays (73.7%) but occurred in only 15 of the 319 (4.7%) individual seine hauls made during this project. The median number of Rio Grande silvery minnow collected was 4 with 13.1 being the average number per sample in which they were taken. Nine of the 15 samples that contained Rio Grande silvery minnow contained eight or fewer individuals. There was at least one collection per sampling station that yielded a relatively large number of this species. The first sample (October 1995) at the Montaño Bridge site produced 33 Rio Grande silvery minnow which was over half of all silvery minnow ultimately taken at that site. The February 1996 samples yielded the largest single collections for the other two sites (site 1 =56, site 3 =34).

Although winter collections (December and February) comprised only two of the seven (28.8%) sampling forays, they produced 64.5% (n=118) of all Rio Grande silvery minnow taken during this study. At site 1, 76 of the Rio Grande silvery minnow (88.4%) collected at that locality were taken during winter with 56 individuals being collected in a single seine haul. All 76 winter collected Rio Grande silvery minnow were taken from instream debris piles with 56 individuals occurring in a large woody debris pile located on the edge of a main channel run.

Winter samples at the Central Avenue bridge produced similar results with 94.4% (n=34) of Rio Grande silvery minnows being collected during winter. As at site 1, all winter collected Rio Grande silvery minnow occurred in instream debris piles. The Montaño Bridge site yielded the smallest number of Rio Grande silvery minnow from winter collections (n=8). Five of those specimens were taken in a debris pile located in a secondary channel pool while the remaining three individuals were taken in a secondary channel pool.

During the rest of the year, Rio Grande silvery minnow was collected in mesohabitats characterized by low-velocity and relatively shallow waters. Secondary channel runs and pools were the most common habitats where this species occurred during the remainder of the study. Those mesohabitats are relatively rare especially when compared to the moderate to high velocity and deep habitats that numerically dominate this reach of the Rio Grande.

Table 6. Summary of ichthyofaunal composition and collection data from October 1995 to October 1996 in the Rio Grande in the vicinity of the Montaño Bridge, New Mexico.

SPECIES	RESIDENCE STATUS[1]	UPSTREAM OF MONTAÑO BR.	AT MONTAÑO	DOWNSTREAM OF MONTAÑO BR.	TOTAL
HERRINGS					
gizzard shad	I	-	-	5	5
CARPS AND MINNOWS					
red shiner	N	129	107	204	440
common carp	I	25	11	8	44
Rio Grande silvery minnow	N	86	61	36	183
fathead minnow	N	201	128	111	440
flathead chub	N	98	44	43	185
longnose dace	N	15	16	26	57
SUCKERS					
river carpsucker	N	546	520	65	1131
white sucker	I	234	84	581	899
BULLHEAD CATFISHES					
black bullhead	I	-	1	-	1
yellow bullhead	I	-	0	2	2
channel catfish	I	150	146	170	466
LIVEBEARERS					
western mosquitofish	I	74	206	147	427
TEMPERATE BASSES					
white bass	I	3	-	-	3
SUNFISHES					
green sunfish	I	-	3	-	3
bluegill	I	1	-	1	2
largemouth bass	I	1	-	-	1
white crappie	I	1	1	1	3
PERCHES					
yellow perch	I	8	-	2	14
TOTAL		1,572	1,332	1,402	4,306

[1] N = native; I = introduced

CONCLUSIONS

Construction of the Montaño Bridge required modification of the river channel, most of which occurred during the winter months. The general pattern of construction was to build an earthen roadway from the west bank to mid-channel and divert most of the flow into the remaining, constricted natural channel. Undiverted water passed through several large diameter culverts buried in the earthen roadway. Once all of the necessary construction activities were completed (i.e., driving and setting of pillars), the roadway was removed and the process repeated along the east bank.

The first inventory of the fishes for this project (24 October 1995) was conducted prior to the initiation of any instream construction activities. By the time we conducted the August 1996 sampling foray, instream construction of the bridge appeared complete there was no apparent need for additional instream work that would involve modification of the channel. The final sampling period was in October 1996.

During this study, we collected 183 Rio Grande silvery minnow of which 61 (33.3%) were taken at were taken at the Montaño Bridge site. The absence of larval silvery minnow from our samples was likely an artifact of the timing of our collections. The June 1996 sample was probably too early to capture larvae while silvery minnow collected in late August had already developed from larvae to juveniles. While Rio Grande silvery minnow was taken throughout the study area, individuals were more abundant at the upstream sampling station. Given that flow is perennial in the study area, a limiting factor may be presence of suitable habitat during a particular phase of this species life-history. This investigation was able to document a strong winter habitat association. Rio Grande silvery minnow was collected only where there were low-velocity habitats and instream cover. The December 1995 and February 1996 collections that produced the most fish were those associated with instream debris. In addition, the majority of Rio Grande silvery minnow were taken during those two sampling efforts. It is likely that there are specific similar habitat associations during other portions of the year by different size-classes.

The results the winter portion of this monitoring project compared well with a concurrent study we conducted in the Middle Rio Grande downstream of Isleta Diversion Dam. From January to March 1996, we performed a winter habitat use study of Rio Grande silvery minnow for the U.S. Army Corps of Engineers (Dudley and Platania, 1996). During that study, over 70% of collections that produced Rio Grande silvery minnow were made in mesohabitats that contained debris piles. Rio Grande silvery minnow was consistently found over small substrata, at moderate depths and in low velocity water throughout the course of the winter habitat use study. Most other fish taken were also associated with low velocity habitats or debris piles.

Seasonal shifts in habitat use by fishes are well documented in lotic systems (Facey and Grossman, 1992; Rincon and Loboncervia, 1993; Cunjak, 1996). The habitat selection and behavior of fishes during winter is largely dictated by energetic constraints and avoidance of deleterious physicochemical conditions (Riehle and Griffith, 1993; Baras, 1995; Cunjak, 1996). There are negative bioenergetic consequences to fishes if they maintain their position in the water column during winter because of decreases in metabolic benefits and decreases in swimming ability (Facey and Grossman, 1990; Facey and Grossman, 1992; Rincon and Loboncervia, 1993). Daily activity budgets have also been significantly correlated to water temperature and may be a mechanism to maintain thermal homeostasis over the seasons (Baras, 1995). Fish often seek areas of cover during winter because of the reduced water velocities and protection afforded by these areas. This is a critical factor, especially in winter when fish are relatively inactive and rarely feed, as the costs of maintaining position in the water column are greatly reduced in lower water velocities.

The summer mesohabitats utilized almost without exception by most YOY fishes, especially Rio Grande silvery minnow, are relatively shallow areas of low or no water velocity over fine particulate substratum. These conditions are most frequently encountered in backwaters and secondary channels pools that were not directly associated with the main river channel. It is important that low velocity nursery mesohabitats be maintained during this period.

The following recommendations are suggested to minimize impact on fish populations in the Rio Grande. 1) Instream debris which existed prior to construction should not be removed. These debris-piles provide refuge and habitat which is particularly important during winter months. 2) An attempt should be made to minimize disturbance of stream channel morphology and substrate. This included limiting the amount of time for instream construction activities. Too much high velocity habitat will eliminate areas frequently occupied by adult Rio Grande silvery minnow and will scour the substrate. 3) The number and surface area of artificially created low velocity (depositional) habitats should be low, especially during May and June. Rio Grande silvery minnow spawns during May and June producing semi-buoyant eggs which need to be carried by the current to develop. If those eggs are carried into a low velocity areas, they may be covered with silt and die. 4) The amount of silt and erosional materials entering the river due to construction activities needs to be minimized. Excessive silt will degrade natural conditions and may result in faunal aquatic community changes. Mechanisms to prevent these events were employed during the construction of the Montaño Bridge and appeared to be successful. 5) Prevent the introduction of toxic construction related materials into the river, particularly concrete and petroleum. These materials can directly or indirectly result in the death of fishes and other aquatic organisms.

The management recommendations proposed in this study were primarily designed to limit disturbance to native fishes. It is difficult to separate the effectiveness of such recommendations from the natural dynamic nature of fish populations and influence of annual and seasonal flow on the aquatic community. Conversely, it is relatively easy to relate the loss of individuals to a catastrophic event such as would result from the spill of toxic material.

This study was designed to assess the effectiveness of the management recommendations, but instead to determine if there were large scale impacts due to construction activities. There was no indication that construction activities in the vicinity of the Montaño Bridge site adversely affected the Rio Grande fish fauna. The shifts in relative abundance of Rio Grande fishes documented during this study were observed throughout the Middle Rio Grande and were not attributable to bridge construction. Future construction activities in the Middle Rio Grande will also need to be closely monitored to ensure minimal disturbance to the aquatic ecosystem.

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