FISH STUDIES ON THE MIDDLE RIO GRANDE, NEW MEXICO

1995 - 1999

Prepared for

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LIST OF ABBREVIATIONS AND ACRONYMS

A.	*Ameiurus*
ANOVA	Analysis of Variance
AUG	August
BOR	Bureau of Reclamation
CPUE	Catch-Per-Unit-Effort
DEC	December
DC	Direct Current
e.g.,	for example,
et al.	and others
FEB	February
Fig(s).	Figure(s)
g	grams
i.e.,	that is,
kg	kilograms
kV	kilovolts
L.	*Lepomis*
LFCC	Low Flow Conveyance Channel
LSD	Least Significant Differences
min	minute
mm	millimeters
N	number
NCSS	Number Cruncher Statistical Systems
OCT	October
P	Probability
P.	*Pomoxis*
pers. com.	personal communication
sec	second
SEP	September
USFWS	U.S. Fish and Wildlife Service
vs.	versus
W	weight

1.0 INTRODUCTION

As part of an ongoing monitoring program, the U.S. Bureau of Reclamation (BOR) conducted investigations to compile baseline fish community data for the Middle Rio Grande at several study reaches in north-central New Mexico. The BOR is responsible for stabilizing eroding banks along the Middle Rio Grande and many bank habitat modification activities have been implemented since 1995. Specifically, several eroding river banks along this system have been modified by placement of rock riprap and jetty structures.

Fishery surveys were conducted by BOR prior to 1995 along the Middle Rio Grande; specifically, along the Santo Domingo, Cochiti and San Felipe Pueblos (Hiebert 1990a, 1990b). Data collected from these past investigations were used to develop and implement bank stabilization plans and subsequent mitigation surveys. A primary purpose of performing fishery surveys since 1995 was to collect data prior to, during and after bankline construction for assessing effects of bank modification activities implemented along the Middle Rio Grande.

Studies performed since 1995 were initiated to assess and document temporal and spatial changes in fish density, biomass, and species diversity and distribution along eight reaches from September 1995 to October 1999. An important purpose of conducting fishery investigations along the Middle Rio Grande was to document abundance and distribution of the Rio Grande silvery minnow *Hybognathus amarus*, a federal and state listed endangered species. These studies were also performed to document fish community trends at reaches above and below the Cochiti Dam and to identify differences in fish density, biomass and diversity relative to specific habitat types.

Plateau Ecosystems Consulting, Inc. was contracted by BOR to organize, analyze and report fish community data collected on the Middle Rio Grande from September 1995 to October 1999. The purpose of this report is to provide a summary of data analysis results from information collected during the entire study period along all study reaches of the Middle Rio Grande.

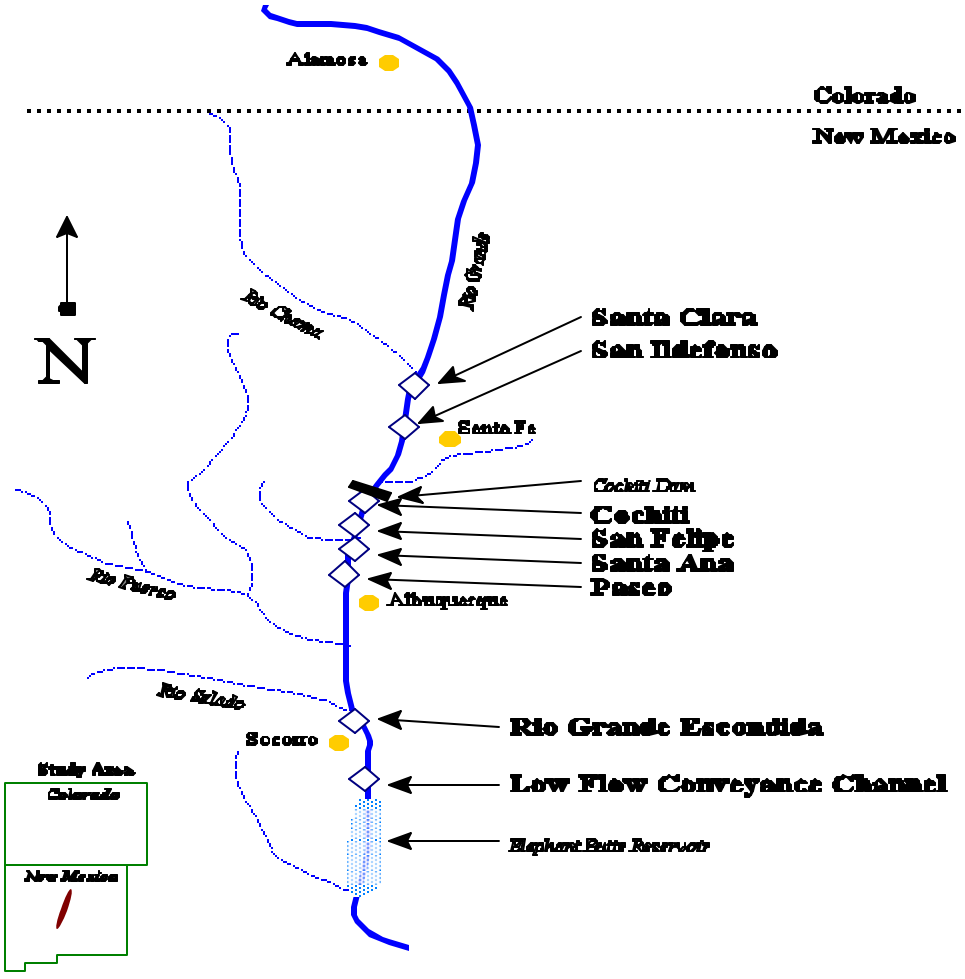
2.0 STUDY AREA

The Rio Grande originates in Colorado's San Juan Mountains and flows south entering New Mexico near the north-central town of Costilla. The river meanders south nearly 500 miles near the relatively populous areas of Sante Fe, Albuquerque, Socorro and Las Cruces before exiting the state near Sunland Park. Flowing through arid high-desert regions of New Mexico, the Rio Grande serves as a valuable resource to the region, providing domestic and agricultural water supplies, electricity through hydropower generation, and multiple recreational opportunities.

Eight study reaches were selected in a section of river extending from Espanola southward beyond Socorro (Fig. 2-1). Sites within the Santa Clara and San Ildefonso Pueblos were located above Cochiti Dam. The remaining six reaches, including those within the Cochiti, San Felipe, Santa Ana, Rio Grande Escondida and Paseo Pueblos, and the Low Flow Conveyance Channel (LFCC), were located downstream of Cochiti Dam.

The Middle Rio Grande within the study area was representative of a low to moderate gradient stream. Study reaches other than LFCC were primarily representative of natural habitat consisting of vegetated, cutbank and eroded sandy banks (Appendix Figs. A-1, A-2 and A-3). Many of these eroded bank areas along the entire study area have been modified by placement of riprap and jetties (Appendix Figs. A-4 and A-5). Limited backwater habitat occurred within the Cochiti Pueblo study reach. Bank areas within the Santa Ana Pueblo reach, which was surveyed most by BOR, have been historically modified by placement of jetties and riprap. This study reach was believed to be the uppermost distribution limit of the Rio Grande silvery minnow (S. Hiebert, BOR, pers. com.), and therefore, habitat restoration and hydraulic modifications along this reach have been a priority.

General habitat within the LFCC study reach, which was located immediately upstream of Elephant Butte Reservoir (Fig. 2-1), differed considerably from the other study sites. Habitat within this reach was more representative of lentic conditions, with deep, low gradient channels and stable canal banks (Appendix Fig.



A-6).

FIGURE 2-1. - Illustration of the general study area and sampling sites along the Middle Rio Grande, New Mexico, where fishery investigations were conducted from 1995 to 1999 by the Bureau of Reclamation.

3.0 METHODS

Fish surveys were conducted by BOR biologists along eight study reaches of the Middle Rio Grande from September 1995 through October 1999. Within each reach, varying number of electrofishing passes were conducted along specific habitat types, including natural (defined as not altered), backwater, riprap and jetty areas. Sample efforts varied among sites (e.g., a single month at the LFCC reach; nine months over a five-year period at the Santa Clara reach). Differences among sampling intervals occurred due to timing requirements based on bank stabilization construction schedules and flow limitations.

A Smith-Root 1.5 kV pulsed-DC electroshocking raft (Appendix Figs. A-6 and A-7) was used to sample designated passes along the study reaches. The electroshocking unit was set up with two sphere anodes and adjusted to produce 2.0-3.5 amps at 30 pulses per second. Water conductance varied from 240 to 800 µs/cm upstream to downstream. Sampling effort was measured by time (sec) electrofished. Captured fish were identified to species, measured for total length (mm), weighed (g), and released (Appendix Fig. A-8). Data were recorded relative to sample reach and habitat pass. Sampling by habitat pass allowed for replication and subsequent statistical inference.

Data analyses for each study reach during each sample period included calculations of species richness (measured by number of species observed), total catch-per-unit-effort (CPUE) by number and weight, and CPUE by number relative to specific habitat types. CPUEs by number and weight were calculated as number and kg of fish captured per 10-minute electrofishing interval, respectively. Mean lengths and weights for each species sampled during all survey periods were calculated. At each study reach, percent compositions by number and weight of all species sampled were estimated for each sample period. Mean CPUE (by number) and species richness were estimated for each reach by habitat type (i.e., for natural, backwater, riprap and jetty).

Data collected from individual habitat passes within specific study reaches were used as replicates for formulating spatial and temporal statistical comparisons. Spatial differences (i.e., among all study reaches

for same sample periods) of species richness and CPUE by number for all study reaches were identified using one-way analysis of variance (ANOVA) (Green 1979; Steel and Torrie 1980). If significant differences of these parameters were identified, then Fisher's least significant differences multiple-comparison test (LSD) was used to evaluate observed differences (Steel and Torrie 1980). Temporal differences (i.e., for same study reach during different sample periods) of species richness and CPUE by number for all study reaches were evaluated using ANOVA and LSD when three or more sampling periods were available, or using a two-sample t-test (Steel and Torrie 1980) when only two periods were sampled. Mean CPUE by number (i.e., for all fish) and species richness observed in specific habitat types were spatially compared using a two-sample t-test. Only data collected from specific reaches and periods having at least two degrees of freedom were used to compare CPUE by number and species richness in habitat types. Habitat statistical comparisons included natural versus riprap, natural versus jetty, and natural versus backwater. Data were insufficient for generating other habitat comparisons relating to fish CPUE and species richness.

All data were tested for randomness. If data exhibited non-normal distributions, then equivalent non-parametric tests for ANOVA (Kruskal-Wallis one-way ANOVA) and t-tests (Mann-Whitney U test) were used to evaluate statistical differences (Steel and Torrie 1980). All data were analyzed and statistical inferences were performed using the computer program, Number Cruncher Statistical Systems (NCSS; Hintze 1997, 1998a, 1998b).

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4.0 RESULTS AND DISCUSSION

Analyses of fish species assemblages are often used to identify effects of human and natural disturbances to aquatic ecosystems more effectively than analysis of a single species (Karr 1981). Moreover, assessment of fish assemblages in different habitats may provide information about conditions for optimal recruitment of fish populations (Tonn et al. 1983). Many "prairie" rivers contain surprisingly diverse fish faunas (Schlosser 1982; Ross et al. 1985; Steedman 1988), and such systems are greatly influenced by the complexity of available habitat (Gorman and Karr 1978; Schlosser 1982).

Discussed below are data analysis results for: 1) fish distribution along the study area, 2) temporal fish community trends by reach, 3) spatial trends by sample period, and 4) CPUE and species richness comparisons by habitat type. Rio Grande silvery minnow distribution and relative abundance along the entire study area are discussed. Considerations of fish distribution and abundance above and below the Cochiti Dam are also discussed.

4.1 OVERALL FISH DISTRIBUTION

A total of 26 fish species, representing nine families, was collected along the Middle Rio Grande study area from 1995 to 1999. (Appendix Tables B-1 and B-2). Fish diversity was greatest at the San Felipe and Paseo reaches, each supporting 16 species. The San Ildefonso Pueblo reach, a site above Cochiti Dam, produced only seven species during the study (Appendix Table B-1). Common carp *Cyprinus carpio* was the only species observed at all study reaches. Flathead chub *Platygobio gracilis* and white sucker *Catostomus commersoni* were considered to be common along the study area and were observed at seven of the sites. Longnose dace *Rhinichthys cataractae*, primarily a lotic species, was observed at six of the study reaches and did not extend below the Paseo reach. The Rio Grande chub *Gila pandora* was considered to be rare within the study area and was only captured at the uppermost Santa Clara Pueblo reach. The Rio Grande silvery minnow was only observed at the Santa Ana Pueblo, Paseo and Rio Grande Escondida reaches during electrofishing investigations. However, this species may have occurred within the LFCC reach during

previous surveys (Appendix Table B-2).

Figure 4-1 compares general fish composition at the upper five study reaches (Santa Clara, San Ildefonso, Cochiti, San Felipe and Santa Ana) by total capture number during the survey conducted in August 1996. Warmwater, native riverine species (excluding white sucker) were predominant by number at the upper two reaches, which were above the Cochiti Dam. A warmwater, reservoir type fish composition was observed at the Cochiti reach (i.e., just below the dam) and extended to a fair degree to the San Felipe and Santa Ana reaches (Fig. 4-1). The common carp - white sucker group was predominant at the lower three reaches (below the dam), and was well represented at the upper two reaches, by total capture number during August 1996 (Fig. 4-1). This species group dominated composition by total capture weight at all of these study reaches during the same sample period (Fig. 4-2).

4.2 TEMPORAL STUDY REACH RESULTS

4.2.1 Santa Clara

A total of 11 fish species representing five families was sampled on the Santa Clara study reach between September 1995 and October 1999 (Appendix Table B-1). Total number of fish sampled ranged from a low of 39 in December 1995, to 236 in October 1999 (Appendix Table B-3). For the entire study period, CPUE by number of all fish ranged from 97 (December 1995) to 359 fish/10-min (September 1994) (Appendix Table B-4). CPUE by weight ranged from 52 (September 1995) to 148 kg/10-min (October 1999) (Appendix Table B-4). Longnose dace dominated percent composition by number in September 1995 (41%) and August 1996 (56%) (Appendix Table B-4). White suckers dominated percent composition by number in December 1995 and 1996 (64 and 45%, respectively), August 1997 (38%), February 1998 and 1999 (53 and 58%, respectively), and October 1999 (38%) (Appendix Table B-4). White suckers and common carp comprised over 50% by number over the entire study period (Fig. 4-3). These two species also comprised over 80% by weight over the study period (Fig. 4-4) and were the only species observed at all study reaches, with the exception of white sucker at the LFCC reach.

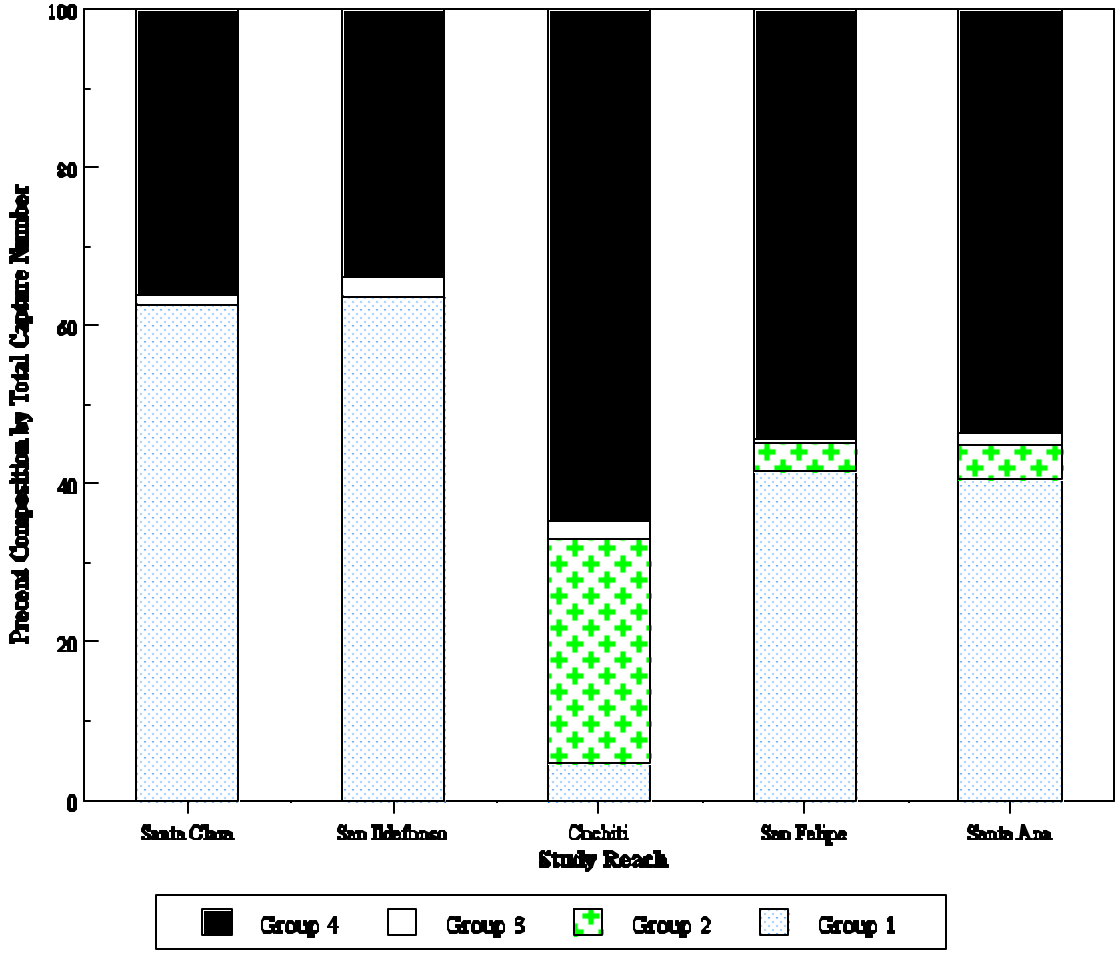

FIGURE 4-1. - Comparison of percent composition by total capture number of fish species sampled at the upper five study reaches along the Middle Rio Grande, New Mexico, in August 1996. The Paseo, Rio Grande Escondida, and Low Flow Conveyance Channel reaches were not surveyed during this period. Group 1 represents a general native warmwater riverine fish classification (including channel catfish, flathead chub, longdose dace, red shiner, and river carpsucker). Group 2 represents a general warmwater reservoir type fish classification (including black bullhead, bluegill, fathead minnow, gizzard shad, green sunfish, largemouth bass, western mosquitofish, white bass, yellow bullhead, and yellow perch). Group 3 represents a general coldwater fish classification, including brown and rainbow trout. Group 4 represents the common carp - white sucker classification. This group was placed in a separate classification to illustrate predominance, but could be included in either the riverine or reservoir type classifications.

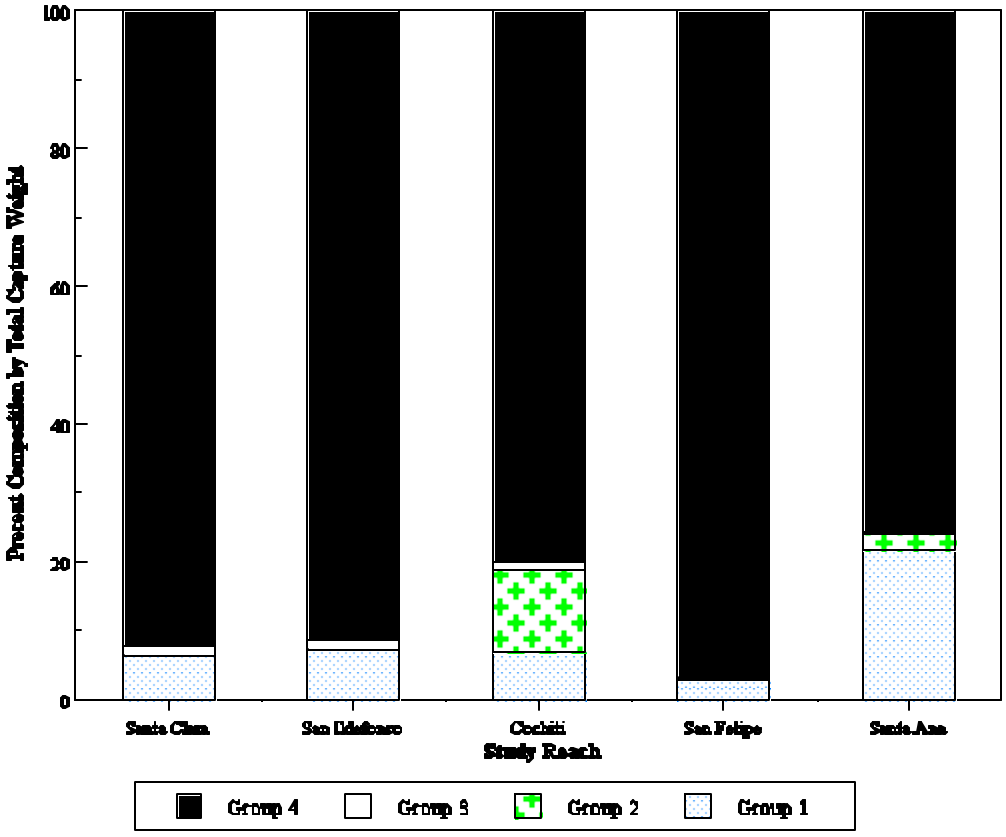

FIGURE 4-2. - Comparison of percent composition by total capture weight (kg) of fish species sampled at the upper five study reaches along the Middle Rio Grande, New Mexico, in August 1996. The Paseo, Rio Grande Escondida, and Low Flow Conveyance Channel reaches were not surveyed during this period. Group 1 represents a general native warmwater riverine fish classification (including channel catfish, flathead chub, longdose dace, red shiner, and river carpsucker). Group 2 represents a general warmwater reservoir type fish classification (including black bullhead, bluegill, fathead minnow, gizzard shad, green sunfish, largemouth bass, western mosquitofish, white bass, yellow bullhead, and yellow perch). Group 3 represents a general coldwater fish classification, including brown and rainbow trout. Group 4 represents the common carp - white sucker classification. This group was placed in a separate classification to illustrate predominance, but could be included in either the riverine or reservoir type classifications.

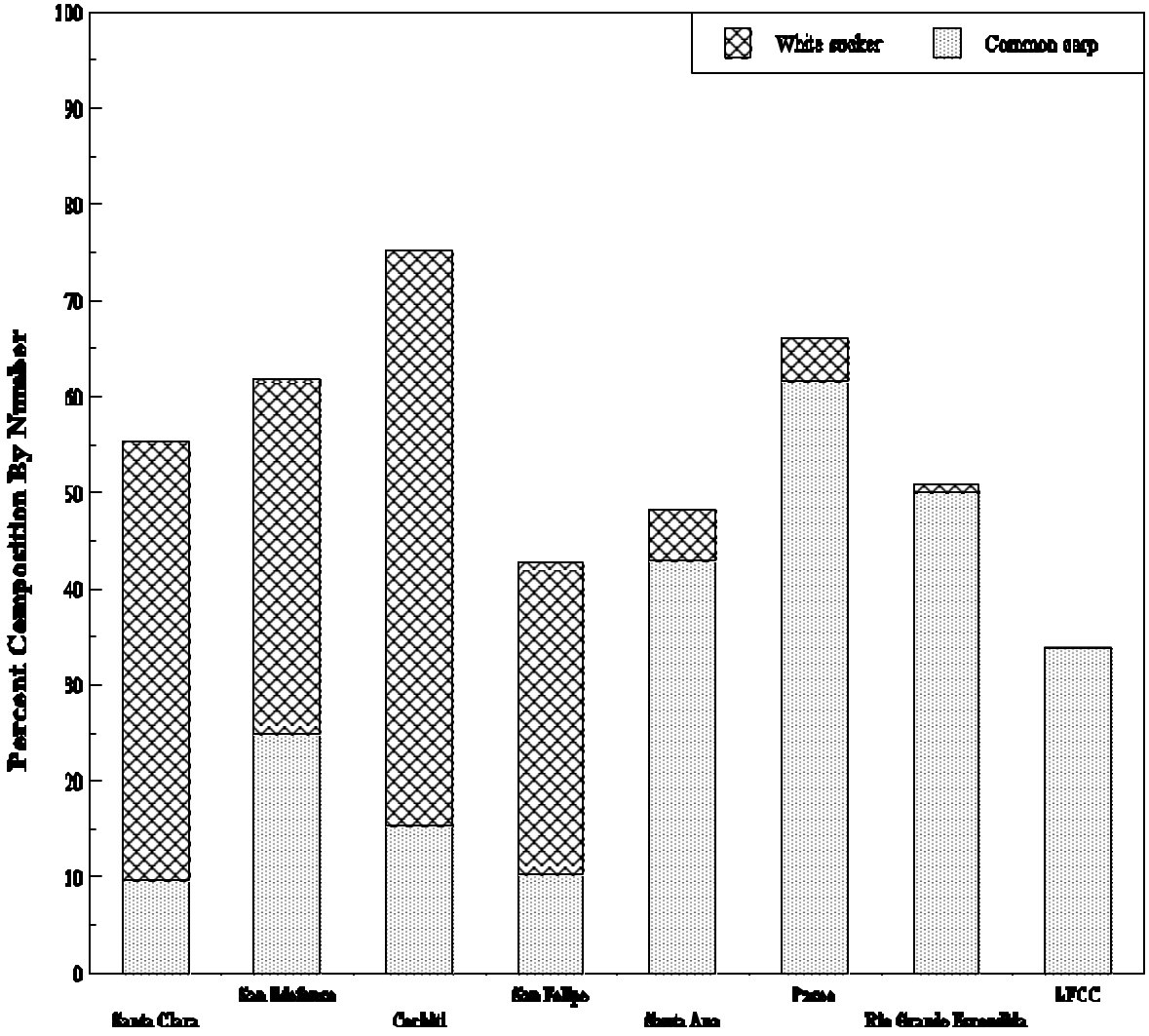

FIGURE 4-3. - Comparison of mean percent composition by number of white sucker and common carp sampled at eight study reaches of the Middle Rio Grande, New Mexico, from September 1995 to October 1999.

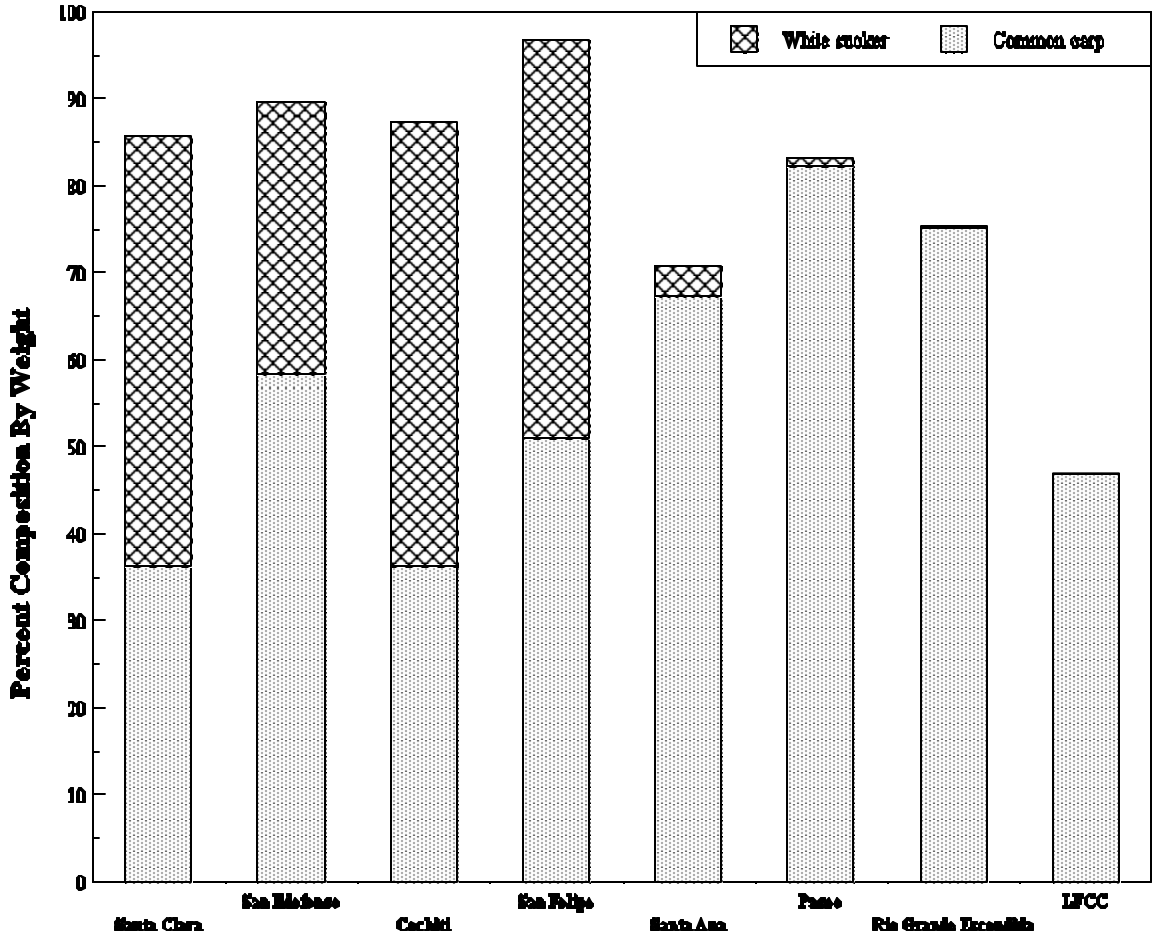

FIGURE 4-4. - Comparison of mean percent composition by weight of white sucker and common carp sampled at eight study reaches of the Middle Rio Grande, New Mexico, from September 1995 to October 1999.

CPUE totals observed in December 1995, February 1998, and February 1999 were significantly less than those measured in August 1996, December 1996 and October 1999 at the Santa Clara reach (Kruskal-Wallis one-way ANOVA and LSD; $P<0.05$). The numbers of species observed in December 1995 was significantly less than those measured in September 1995, August 1996, December 1996, August 1997, February 1999, and October 1999 (ANOVA and LSD; $P<0.05$). The numbers of species observed in February 1998 was significantly less than those observed in September 1995, December 1996, August 1997, and October 1999 (ANOVA and LSD; $P<0.05$).

4.2.2 San Ildefonso

A total of seven species representing four families, the lowest representation of species richness measured along the study area, was sampled on the San Ildefonso study reach (Appendix Table B-1). Total number of fish sampled increased from 30 in December 1995 to 154 in August 1996 (Appendix Table B-5). For both sample periods, CPUE by number of all fish ranged from 67 (December 1995) to 249 fish/10-min (August 1996) (Appendix Table B-6). Total CPUEs by weight were similar for both sample periods, estimated at 64 kg/10-min (Appendix Table B-6). Common carp and white sucker comprised 90% of composition by number and 87% by weight in December 1995. Longnose dace dominated riocent composition by number in August 1996 (61%). In August 1996 common carp and white sucker comprised 91% of composition by weight (Appendix Table B-6). White suckers and common carp comprised over 60% by number (Fig. 4-3) and approximately 90% by weight (Fig. 4-4) over the entire study period.

CPUE by total number of fish observed in December 1995 was significantly less than that measured in August 1996 at the San Ildefonso reach (Mann-Whitney U-test; $P<0.05$). Species richness observed in December 1995 was significantly less than that measured in August 1996 (Mann-Whitney U-test; $P<0.05$).

4.2.3 Cochiti

Fourteen fish species representing seven families were sampled on the Cochiti study reach between

December 1995 and February 1999 (Appendix Table B-1). Total capture number ranged from 119 fish in February 1999 to 300 fish in August 1996 (Appendix Table B-7). For the entire study period, CPUE by number of all fish ranged from 166 (February 1999) to 292 fish/10-min (August 1996) (Appendix Table B-8). CPUE by weight ranged from 211 (August 1996) to 278 kg/10-min (February 1999) (Appendix Table B-8). Longnose dace dominated percent composition by number in December 1995 (16%), whereas white suckers were predominant by number in August 1996 (56%), December 1996 (66%), and February 1999 (58%) (Appendix Table B-8). For the entire study period, white suckers and common carp comprised approximately 75% by number (Fig. 4-3). White suckers and common carp dominated percent composition by weight over the study period (Fig. 4-4; Appendix Table B-8).

CPUEs by total number of fish observed in December 1995, August 1996, December 1996, and February 1999 were not significantly different at the Cochiti reach (Kruskal-Wallis one-way ANOVA; $P>0.05$). Similarly, number of species observed in December 1995, August 1996, December 1996, and February 1999 was not found to be significantly different (ANOVA; $P>0.05$).

4.2.4 San Felipe

The San Felipe reach included nine species of fish from four families, the largest represented by cyprinids (Appendix Table B-1). Total capture numbers increased steadily from 77 to175 among sample periods (Appendix Table B-9). Longnose dace were relatively abundant during all sample periods, where CPUEs were measured at 71 (September 1995), 39 (December 1995), and 90 fish/10-min (August 1996) (Appendix Table B-10). Percent compositions of common carp by number and weight decreased readily from September 1995 to August 1996, while white sucker numbers increased during the same period (Fig. 4-5; Appendix Table B-10). Overall, white suckers were predominant by number and weight along the San Felipe Pueblo reach throughout the study period (Figs. 4-3 and 4-4).

CPUEs by total number of fish observed in September 1995, December 1995, and August 1996 were not significantly different at the San Felipe reach (Kruskal-Wallis one-way ANOVA; $P>0.05$). In addition, number of species observed in September 1995, December 1995, and August 1996 was not found to be

significantly different (ANOVA; P>0.05).

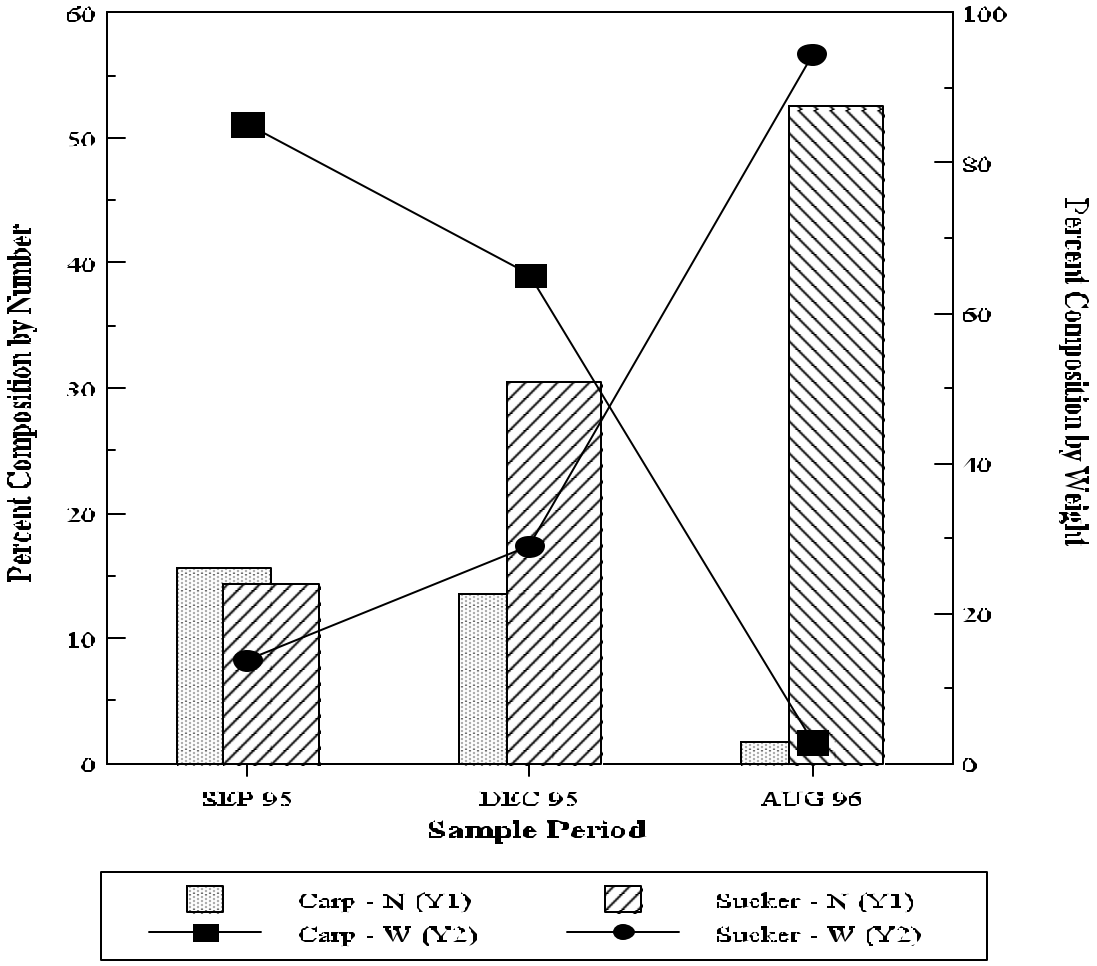

FIGURE 4-5. - Comparisons of percent compositions by number and weight of common carp and white sucker sampled during September 1995 (*SEP 95*), December 1995 (*DEC 95*), and August 1996 (*AUG 96*) along the San Felipe Pueblo study reach. (*Carp - N* = percent composition of common carp by number; *Carp - W* = percent composition of common carp by weight; *Sucker - N* = percent composition of white sucker by number; *Sucker - W* = percent composition of white sucker by weight).

4.2.5 Santa Ana

The Santa Ana reach, which received the most sampling effort throughout the study, had the greatest species representation of all Middle Rio Grande study reaches, with 16 species from seven families, including the Rio Grande silvery minnow (Appendix Table B-2). Total catch per sampling period varied with each effort (Appendix Table B-11). Common carp were relatively abundant throughout the study period, where CPUE ranged from 6 (September 1995) to 126 fish/10-min (December 1996) (Appendix Table B-12). Common carp were primarily dominant by number and weight from December 1995 through October 1999 (Figs. 4-3 and 4-4; Appendix Table B-12). Longnose dace (33%) and western mosquitofish *Gambusia affinis* (68%) were most abundant in September and October 1995, respectively (Appendix Table B-12). Rio Grande silvery minnows were sampled only in December 1996 (at 2 fish/10-min) and August 1997 (at 25 fish/10-min) (Appendix Table B-12).

CPUEs by total number of fish observed in September 1995 and February 1999 were significantly less than those measured in December 1996 and August 1997 (Kruskal-Wallis one-way ANOVA and LDS; $P<0.05$). CPUEs by total number of fish observed in August 1996 were significantly less than those measured in December 1996 (Kruskal-Wallis one-way ANOVA and LSD; $P<0.05$). Number of species observed in February 1998 was significantly less than those measured in August 1997 and October 1999; species richness in February 1999 was significantly less than those measured in September 1995, August 1997 and October 1999 (ANOVA and LSD; $P<0.05$).

4.2.6 Paseo

The Paseo study reach was surveyed only in October 1999. Ten species of fish representing four families, primarily cyprinids, were observed during the study period (Appendix Table B-2). Total capture number was

156 fish (Appendix Table B-13), primarily consisting of common carp (75 fish/10-min), channel catfish *Ictalurus punctatus*(21 fish/10-min), and river carpsucker *Carpiodes carpio* (10 fish/10-min) (Appendix Table B-14). One Rio Grande silvery minnow was captured, yielding a CPUE of 0.8/10-min (Appendix Table B-14). Percent compositions by number and weight were dominated by common carp (Figs. 4-3 and 4-4). Temporal statistical analyses were not performed for the Paseo reach due to lack of replication.

4.2.7 Rio Grande Escondida

The Rio Grande Escondida reach yielded 10 fish species from four families in February 1999 (Appendix Table B-2). Salmonids, centrarchids and perchids were not observed at this study reach. This sample period yielded a total capture number of 120 fish (Appendix Table B-15), and was dominated by common carp (50%) and Rio Grande silvery minnows (18%) (Appendix Table B-16). Common carp dominated the percent composition by weight, estimated at 75% (Appendix Table B-16). No temporal statistical comparisons were made for the Rio Grande Escondida reach due to lack of replication.

4.2.8 Low Flow Conveyance Channel (LFCC)

Seven families and 14 species of fish were documented at the LFCC study reach (Appendix Table B-2), which was investigated in October 1995 and December 1996. Total catch numbers increased from 77 in October 1995 to 190 in December 1996 (Appendix Table B-17). Gizzard shad *Dorsoma cepedianum*, which exhibited relatively high percent compositions by number (66%) and weight (42%), dominated the catch in October 1995, while common carp dominated by number (56%) and weight (68%) in December 1996 (Figs. 4-3 and 4-4; Appendix Table B-18). White suckers were not collected during either period.

CPUEs by total number of fish observed in October 1996 were significantly less than those measured in December 1996 at the LFCC reach (two-sample t-test; $P<0.05$). Numbers of species observed in October 1996 and December 1996 were not significantly different (two-sample t-test; $P>0.05$).

4.3 CPUE AND SPECIES RICHNESS SPATIAL COMPARISONS

Catch-per-unit-effort (by number) and species richness were statistically analyzed for evaluation of spatial comparisons among study reaches surveyed during the eight sample periods from September 1995 to October 1999. Only comparisons of reaches with same sample periods were performed. Presented below includes a summary of these analyses.

4.3.1 September 1995 Surveys

CPUEs and species richness observed in September 1995 were not found to be significantly different at the Santa Clara, San Felipe, and Santa Ana Pueblo study reaches (ANOVA; $P>0.05$).

4.3.2 December 1995 Surveys

CPUEs by total number of fish observed in December 1995 at the San Ildefonso Pueblo reach were significantly less than those measured at the Cochiti Pueblo reach (Kruskal-Wallis one-way ANOVA and LSD; $P<0.05$). Number of species observed in December 1995 at the San Ildefonso reach was significantly less than that measured at the Cochiti reach (ANOVA and LSD; $P<0.05$).

4.3.3 August 1996 Surveys

CPUEs by total number of fish observed in August 1996 at the Santa Ana Pueblo reach were significantly less than those measured at the Cochiti reach (Kruskal-Wallis one-way ANOVA and LSD; $P<0.05$). Species richness observed in August 1996 was not significantly different at the Santa Clara, San Ildefonso, Cochiti, San Felipe and Santa Ana reaches (Kruskal-Wallis one-way ANOVA; $P>0.05$).

4.3.4 December 1996 Surveys

CPUEs by total number of fish observed in December 1996 at the LFCC reach were significantly less than

those measured at the Santa Clara reach (Kruskal-Wallis one-way ANOVA and LSD; $P<0.05$). Number of species observed in December 1996 at the Cochiti reach was significantly less than that measured at the LFCC reach (ANOVA and LSD; $P<0.05$). Species richness reported in December 1996 at the Santa Ana reach was significantly less than that measured at the LFCC reach (ANOVA and LSD; $P<0.05$).

4.3.5 August 1997 Surveys

CPUEs by total number of fish observed in August 1997 were not significantly different at the Santa Clara and Santa Ana reaches (Mann-Whitney U-test; $P>0.05$). Species richness observed in August 1997 was not found to be significantly different at the Santa Clara and Santa Ana reaches (two-sample t-test; $P>0.05$).

4.3.6 February 1998 Surveys

CPUEs and species richness observed in February 1998 were not deemed significantly different at the Santa Clara and Santa Ana reaches (two-sample t-test; $P>0.05$).

4.3.7 February 1999 Surveys

CPUEs by total number of fish observed in February 1999 at the Santa Ana reach were significantly less than those measured at the Cochiti reach (ANOVA and LSD; $P<0.05$). Number of species reported in February 1999 at the Santa Ana reach was significantly less than those documented at the Santa Clara and Rio Grande Escondida reaches (ANOVA and LSD; $P<0.05$). Species richness observed in February 1999 at the Cochiti reach was significantly less than that reported at the Rio Grande Escondida reach (ANOVA and LSD; $P<0.05$).

4.3.8 October 1999 Surveys

CPUEs by total number of fish observed in October 1999 at the LFCC reach were significantly less than those measured at the Santa Ana and Santa Clara reaches (ANOVA and LSD; $P<0.05$). CPUEs observed in October 1999 at the Paseo reach were significantly less than those measured at the Santa Clara reach (ANOVA and LSD; $P<0.05$). CPUEs measured in October 1999 at the Santa Ana reach were significantly less than those observed at the Santa Clara reach (ANOVA and LSD; $P<0.05$). Number of species observed in October 1999 was not found to be significantly different at the Santa Clara, Santa Ana, Paseo and LFCC reaches (ANOVA; $P>0.05$).

4.4 HABITAT COMPARISONS

Physical habitat evaluation is important in determining distribution and abundance of fish species in lotic systems (Gorman and Karr 1978; Binns and Eiserman 1979). Bowen et al. (1998) suggested that both short-term persistence and annual variation in habitat availability are important for maintaining diverse fish assemblages.

Comparisons of mean CPUEs (by number) and number of fish species were formulated to evaluate fish communities sampled in natural, riprap, jetty and backwater habitats during the eight sampling periods from September 1995 to October 1999. Statistical inferences were made only for those study reaches and sampled habitat passes where at least two degrees of freedom were available. These statistical comparisons were completed for natural versus riprap, natural versus jetty, and natural versus backwater habitats. Other relative comparisons (e.g., riprap versus jetty) were completed, and are presented in Appendix Tables B-19 through B-30.

4.4.1 Overall Comparisons

The Santa Clara and Santa Ana Pueblo study reaches were surveyed most during fishery investigations along the Middle Rio Grande. Natural, jetty and riprap habitats were well represented at these sites. At the Santa Clara Pueblo reach, all three of these habitat types were sampled during August 1997, February 1998, and February 1999. Mean CPUE for all species sampled in August 1997 at natural habitat was relatively greater

than those measured at jetty and riprap habitats (Fig. 4-6). Mean CPUEs reported at natural habitats during February 1998 and February 1999 were relatively less than those documented at jetty and riprap habitats. Mean CPUEs measured at jetty and riprap habitats during all three sample periods were similar (Fig. 4-6).

Natural, jetty and riprap habitats were all surveyed for fish at the Santa Ana Pueblo reach during seven sampling episodes from September 1995 to October 1999. Mean CPUEs for all species sampled at natural habitat were greatest only during the September 1995 and February 1998 surveys (Fig. 4-7). Riprap habitat exhibited greatest CPUEs during December 1995, December 1996, and October 1999. Mean CPUEs for all habitats during August 1997 and February 1999 were relatively similar (Fig. 4-7).

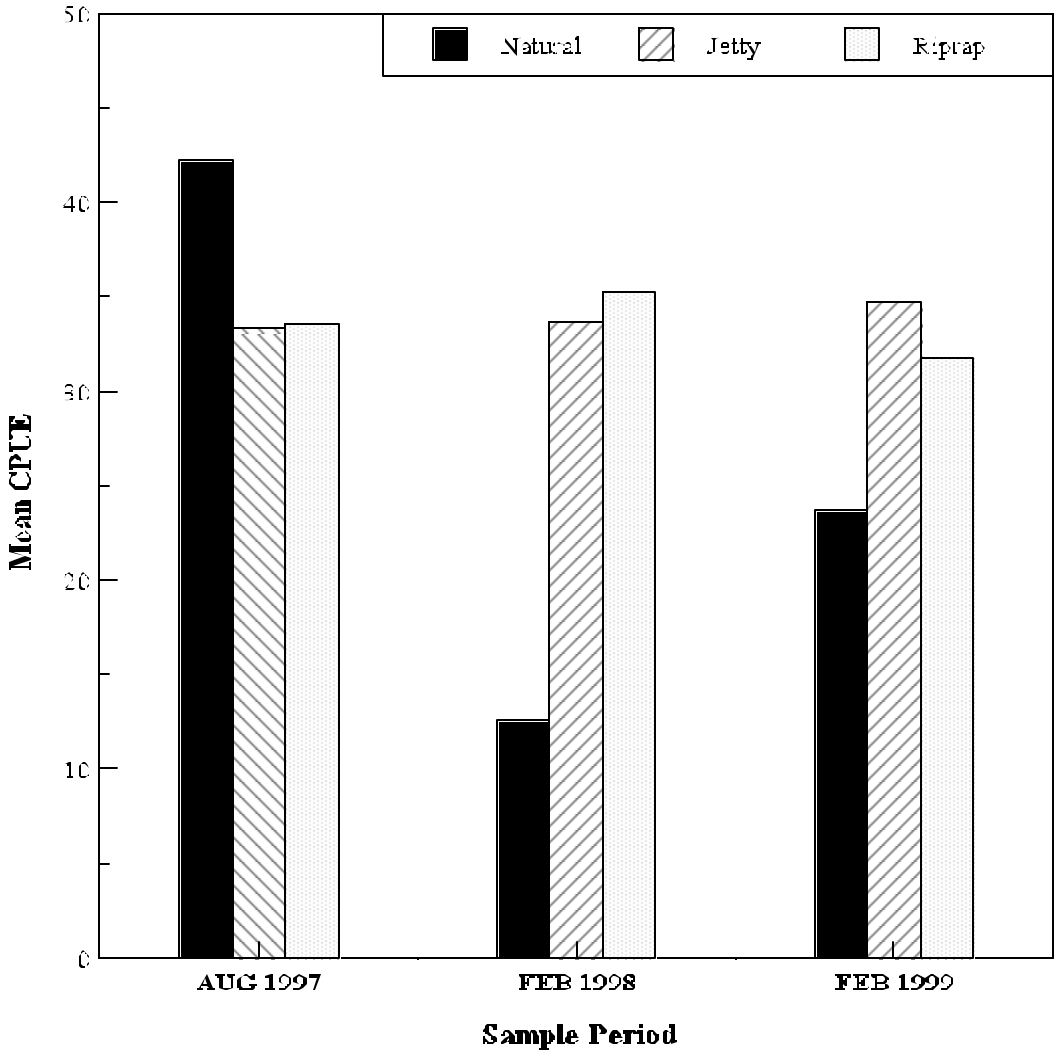

FIGURE 4-6. - Comparison of mean catch-per-unit-effort (CPUE) of all fish species sampled in natural, jetty and riprap habitats at the Santa Clara Pueblo study reach reported during surveys conducted in August (AUG) 1997, February (FEB) 1998, and February 1999, Middle Rio Grande, New Mexico.

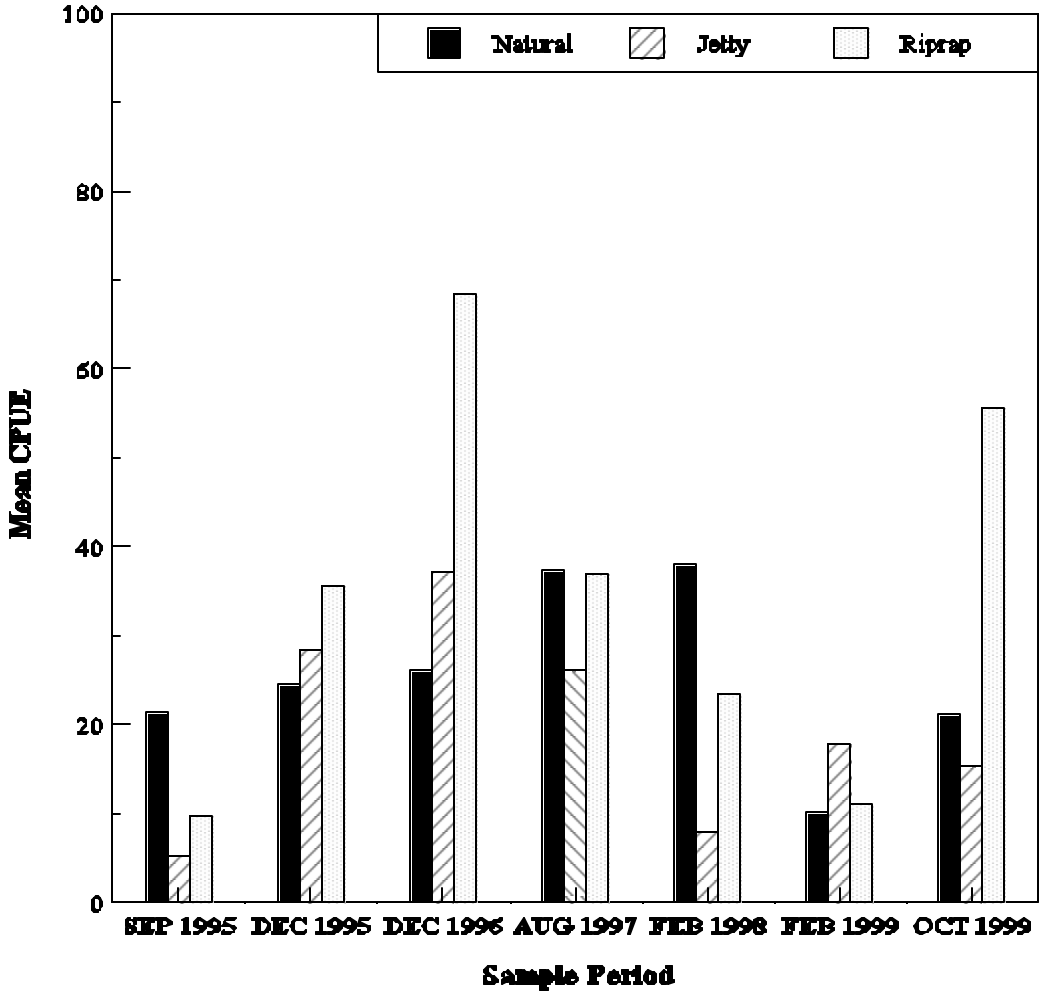

FIGURE 4-7. - Comparison of mean catch-per-unit-effort (CPUE) of all fish species sampled in natural, jetty and riprap habitats at the Santa Ana Pueblo study reach reported during surveys conducted from September 1995 to October 1999,

Middle Rio Grande, New Mexico.

4.4.2 Natural vs. Riprap

Mean CPUEs for natural and jetty habitats at the Santa Clara reach were greatest in August 1996 and September 1995, respectively; both estimated at 60 fish/10-min (Appendix Table B-19). Mean CPUE measured for riprap habitat was 62 fish/10-min in December 1996 (Appendix Table B-19). CPUEs and species richness observed at the Santa Clara reach (Appendix Tables B-19 and B-20) in December 1996, February 1998 and October 1999 were not significantly different between natural and riprap habitats (two-sample t-test; $P>0.05$).

Mean CPUE and number of species were greatest in riprap habitat (versus natural) at the San Felipe reach during the entire study period (Appendix Tables B-21 and B-22). However, mean CPUEs measured at this reach in December 1995 were not significantly different between natural and riprap habitat types (two-sample t-test; $P>0.05$). Species richness reported for this same period also was not significantly different between natural and riprap habitats (two-sample t-test; $P>0.05$).

4.4.3 Natural vs. Jetty

Mean CPUEs for natural habitat were relatively higher than those reported for jetty habitat at the San Ildefonso reach in both December 1995 and August 1996 (Appendix Table B-23). Mean number of species reported for natural and jetty habitats during the two sample periods varied (Appendix Table B-24).

Mean CPUEs and number of species documented for the Cochiti reach were relatively higher in jetty habitat in December 1995 and natural habitat in August 1996 (Appendix Tables B-25 and B-26). Mean CPUE and species richness were also relatively higher in jetty habitat, compared to natural habitat, in February 1999 at the Rio Grande Escondida reach (Appendix Table B-27).

Mean CPUEs and species richness at the Santa Ana reach (Appendix Tables B-28 and B-29) in August 1996, December 1996, and February 1999 were not significantly different between natural and jetty habitats (two-sample t-test; P>0.05). In addition, mean CPUEs and number of species reported at the Paseo reach (Appendix Table B-30) in October 1999 were not significantly different between natural and jetty habitats (two-sample t-test; P>0.05). Fish sampled in natural habitat had a relatively higher mean CPUE, while jetty habitat yielded a relatively greater mean number of species captured (Appendix Table B-30).

4.4.4 Riprap vs. Jetty

Mean CPUE and species richness for riprap was compared to jetty habitat at the Santa Clara, Cochiti, and Santa Ana reaches. Riprap mean CPUEs were relatively similar to those reported for jetty habitat during August 1997, February 1998 and 1999 (Appendix Table B-25). Mean numbers of species captured at this reach during the same sample periods were relatively higher in riprap versus jetty habitat (Appendix Table B-26). When sampled, riprap habitat yielded relatively higher mean CPUEs and number of species than those documented for jetty habitat at the Santa Ana reach between September 1995 and October 1999 (Appendix Tables B-28 and B-29). Statistical comparisons for these habitat types were not performed to due lack of replication.

4.4.5 Backwater vs. Natural

Backwater habitat was only observed and sampled at the Cochiti study reach. There were no clear differences of CPUEs of fish observed in any habitat type in December 1995 and August 1996 (Appendix Table B-25). However CPUEs were relatively higher in backwater habitat (as compared to natural, jetty and riprap areas) in December 1996 and February 1999 (Appendix Table B-25). CPUEs observed in natural and backwater habitats were not significantly different (two-sample t-test; P>0.05).

In general, number of species observed throughout the study period at the Cochiti reach was relatively greater in backwater habitat compared to all other habitat types (Appendix Table B-26). However, these differences were not significant (two-sample t-test; P>0.05).

4.5 RIO GRANDE SILVERY MINNOW DISTRIBUTION AND ABUNDANCE

The decline in native fish fauna in Southwestern riverine streams has been attributed to altered flow regimes caused by damming, and to predatory and competitory effects of nonnative fishes (Miller 1961; Minckley and Deacon 1968). Recent studies have demonstrated that parasitism also contributes to declines of the Southwest's native fish communities (Brouder and Hoffnagle 1997; Robinson et al. 1998).

The Rio Grande silvery minnow (Appendix Fig. A-9) was historically one of the most abundant and widespread fishes in the Rio Grande Basin (USFWS 1993; Bestgen and Propst 1996), but now only occurs from Cochiti Dam downstream to approximately Elephant Butte Reservoir, New Mexico (Bestgen and Propst 1996; Propst 1999). Platania (1995) indicated that this species is least common in uppermost reaches, and most common in lowermost reaches of its current range. The Rio Grande silvery minnow has been threatened by effects of river channelization and dewatering, habitat degradation, and competition from nonnative fish species (Platania 1995; Bestgen and Propst 1996; Propst 1999). Propst (1999) suggested that seasonal and annual abundance of this species vary considerably.

Forty-four Rio Grande silvery minnows were sampled at three study reaches during the entire study period. The Santa Ana Pueblo reach yielded 21 specimens, one captured in December 1996 and 20 in August 1997. Over 90% of the Rio Grande silvery minnows collected in August 1997 at the Santa Ana reach were observed in natural habitat (Fig. 4-8).

Twenty-two Rio Grande silvery minnows were captured at the Rio Grande Escondida reach in February 1999, with a CPUE of 16 fish/10-min; second only to common carp. The CPUE for this sample period was 25 fish/10-min (third highest). One Rio Grande silvery minnow was sampled at the Paseo Pueblo reach in October 1999. Rio Grande silvery minnows were not observed near or above Cochiti Dam. Mean total lengths of specimens sampled along the study area ranged from 54 to 101 mm during the entire study period.

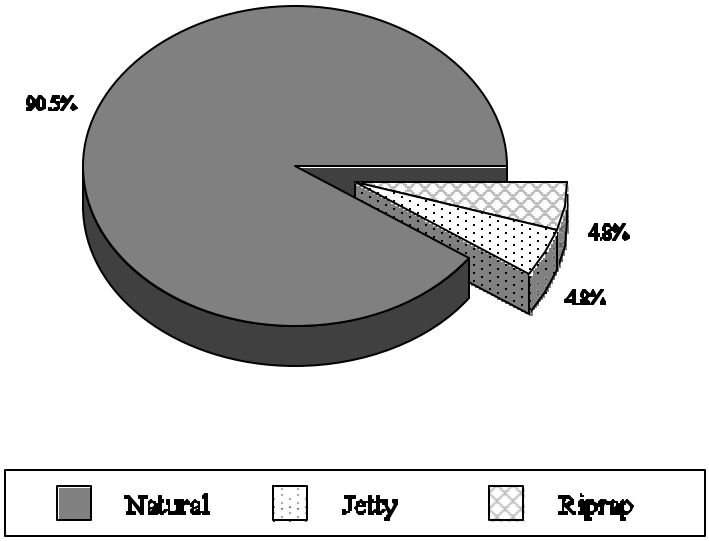

FIGURE 4-8. - Comparison of Rio Grande silvery minnow capture numbers in natural, jetty and riprap habitats at the Santa Ana Pueblo study reach, Middle Rio Grande, New Mexico, August.

4.6 FISH DISTRIBUTION AND ABUNDANCE RELATED TO COCHITI DAM

Altered flow and temperature regimes, as well as related habitat modifications (Carlson and Muth 1989), in mainstream reaches below dams often restrict fish recruitment (Hickman 1983). Dam operations may affect larval and juvenile fish more than they affect adults due to cold water release effects on embryonic development (Marsh 1985) and reduced swimming performance (Childs and Clarkson 1996). Previous studies have demonstrated that fish abundance and diversity are lower downstream of dams, as compared to unregulated stream reaches (Kinsolving and Bain 1993; Travnichek and Maceina 1994; Scheidegger and Bain 1995).

Total numbers of fish species observed above Cochiti Dam throughout the study period were 11 and 7 at the Santa Clara and San Ildefonso Pueblo reaches, respectively (Appendix Table B-1). Numbers of species

observed below the dam throughout the study were relatively higher, ranging from 9 at the San Felipe reach to 16 at the Santa Ana reach (Appendix Tables B-1 and B-2). Species observed below Cochiti Dam, but not represented above the dam during the study, included gizzard shad, Rio Grande silvery minnow, smallmouth buffalo *Ictiobus bubalus*, black bullhead *Ameiurus melas*, yellow bullhead *A. natalis*, flathead catfish *Pylodictis olivaris*, western mosquitofish, white bass *Morone chrysops*, green sunfish *Lepomis cyanellus*, bluegill *L. macrochirus*, longear sunfish *L. megalotis*, black crappie *Pomoxis nigromaculatus*, white crappie *P. annularis*, and yellow perch *Perca flavescens* (Appendix Tables B-1 and B-2). Only the Rio Grande chub was restricted upstream of Cochiti Dam, and only observed at the uppermost Santa Clara Pueblo reach (Appendix Table B-1). During August 1996, 7 species were observed at each of the two reaches above Cochiti Dam, while from 8 to 11 species were recorded at the three reaches immediately below the dam (Fig. 4-9).

Statistical analyses revealed that number of species reported in December 1995 at the San Ildefonso Pueblo reach (above dam) was significantly less than that observed at the Cochiti study reach (immediately below dam). However, this same comparison in August 1996 was not significant. Numbers of species observed in August 1997 and February 1998 at Santa Clara (above dam) were not significantly different than those reported for Santa Ana, but were significantly higher at Santa Clara in February 1999. Comparisons for October 1999 showed that numbers of species documented at Santa Clara were not significantly different than those observed at the Santa Ana, Paseo and LFCC reaches. These results suggest that species richness, in general, may be greater below Cochiti Dam, but varies seasonally.

Comparisons of CPUEs between upstream and downstream reaches relative to Cochiti Dam were reflective of highly variable fish abundances throughout the entire study area. In September 1995, CPUEs measured at Santa Clara were not significantly different than those recorded for the San Felipe and Santa Ana Pueblo reaches. CPUEs observed in December 1995 at San Ildefonso were significantly less than those documented for Cochiti. Santa Clara CPUEs reported in August 1997 and February were not significantly different than those for the Santa Ana reach.

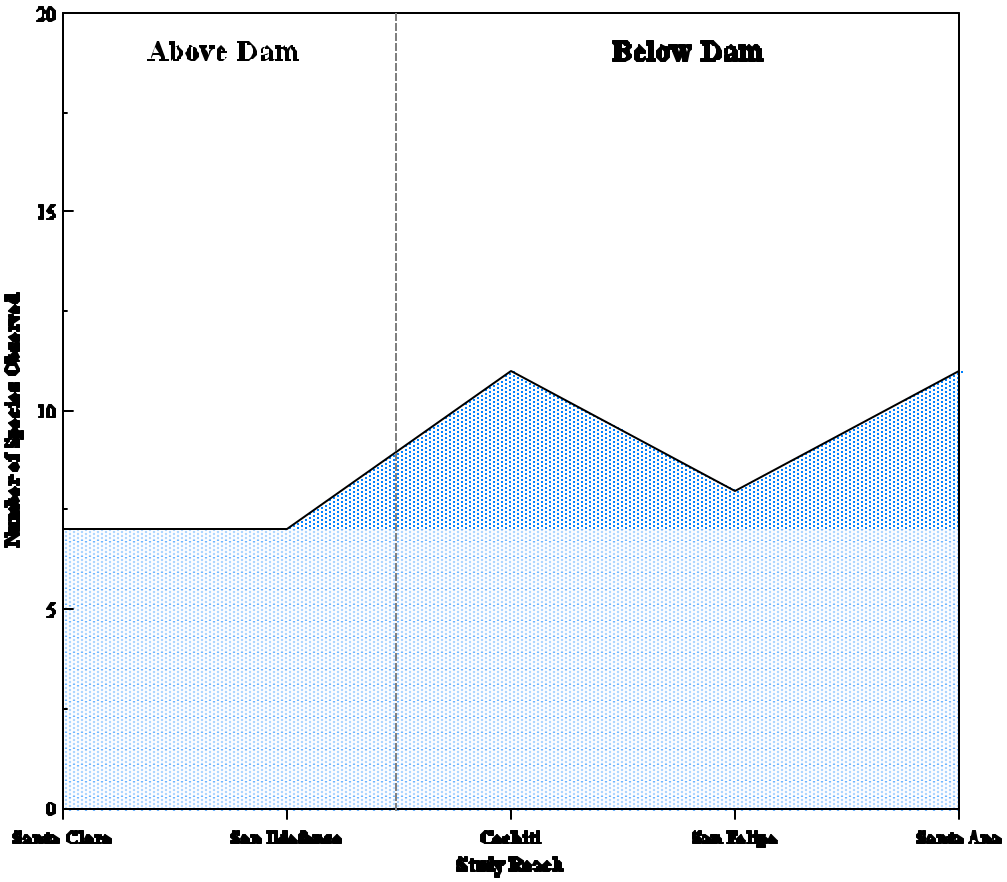

FIGURE 4-9. - Total number of fish species collected at the two study reaches above Cochiti Dam vs. the number observed at the three reaches immediately below the dam along the Middle Rio Grande, New Mexico, August 1996.

5.0

CONCLUSIONS

Fish community data collected from eight reaches along the Middle Rio Grande from September 1995 to October 1999 were assessed to document overall populations trends. These results showed that fish distribution differed, relative to presence and absence, between reaches above and below Cochiti Dam. Fish abundances varied greatly among study reaches and sample periods, indicating no clear longitudinal trends. Moreover, there were no clear indications that the observed number of species and abundances of fish were related to specific habitat types or bank alterations.

Species composition (by both number and weight) was dominated by common carp and white sucker along the entire study area throughout the study period, indicating that these species account for most of the fish biomass in the Middle Rio Grand. White sucker abundance and biomass, however, decreased in a downstream manner. The Rio Grande silvery minnow, an endangered species, was sampled from three study reaches well below the Cochiti Dam. This species was not observed near or above the dam, thereby supporting distribution evaluations completed by past investigators.

Data collected by BOR during this study indicated that the Santa Ana Pueblo reach represented the uppermost distribution limit of the Rio Grande silvery minnow. In addition, it appeared that this reach supported relatively greater densities of this fish than all other sites. It also appeared that natural, unaltered bank areas were important to this species, as the majority of specimens were collected in these habitats.

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APPENDIX A
PROJECT PHOTOGRAPHS

FIGURE A-1. - Example of an area, or "project curve", on the Middle Rio Grande, New Mexico, considered by the Bureau of Reclamation to have potential for habitat modification for stabilization of eroding banks. Photograph provided by S. Hiebert.

FIGURE A-2. - Example of an area on the Middle Rio Grande, New Mexico, considered to exhibit "natural" habitat with relatively stable banks. These areas were not, in general, considered to be beneficial candidates for bank stabilization activities. Photograph provided by S. Hiebert.

FIGURE A-3. - Example of an area on the Middle Rio Grande, New Mexico, considered to exhibit natural habitat with highly eroding banks; classified during the project as "cutbanks". These areas were, in general, considered to be beneficial candidates for bank stabilization activities. Photograph provided by S. Hiebert.

FIGURE A-4. - An area on the Middle Rio Grande, New Mexico, where banks were modified by placement of rock riprap to control bank erosion. Photograph provided by S. Hiebert.

FIGURE A-5. - An area on the Middle Rio Grande, New Mexico, where banks were modified by placement of rock riprap (or rockbarb) to control bank erosion. Photograph provided by S. Hiebert.

FIGURE A-6. - Photograph showing general habitat conditions along the Low Flow Conveyance Channel (LFCC) of the Middle Rio Grande, New Mexico. Photograph provided by S. Hiebert.

FIGURE A-7. - Photograph of a Smith-Root electrofishing raft used by the Bureau of Reclamation to conduct fishery surveys along the Middle Rio Grande, New Mexico. Photograph provided by S. Hiebert.

FIGURE A-8. - Photograph of Bureau of Reclamation biologists collecting fisheries data from studies conducted on the Middle Rio Grande, New Mexico. Photograph provided by S. Hiebert.

FIGURE A-9. - Photograph of a Rio Grande silvery minnow *Hybognathus amarus* collected on the Middle Rio Grande, New Mexico, by Bureau of Reclamation biologists. Photograph provided by S. Hiebert.

APPENDIX - B
DATA SUMMARIES

TABLE B-1. - Fish species sampled during electrofishing surveys on the Santa Clara, San Ildefonso, Cochiti, and San Felipe sites of the Middle Rio Grande, New Mexico, 1995-1999. Nomenclature based on Robins et al. (1991). (X = present; – = absent).

Common Name	Scientific Name	Santa Clara	San Ildefonso	Cochiti	San Felipe
Clupeidae (herrings)					
Gizzard shad	*Dorsoma cepedianum*	--	--	X	--
Cyprinidae (carps and minnows)					
Red shiner	*Cyprinella lutrensis*	--	X	X	X
Common carp	*Cyprinus carpio*	X	X	X	X
Rio Grande chub	*Gila pandora*	X	--	--	--
Rio Grande silvery minnow	*Hybognathus amarus*	--	--	--	--
Fathead minnow	*Pimephales promelas*	X	--	--	X
Flathead chub	*Platygobio gracilis*	X	X	--	X
Longnose dace	*Rhinichthys cataractae*	X	X	X	X
Catostomidae (suckers)					
River carpsucker	*Carpiodes carpio*	X	--	X	--
White sucker	*Catostomus commersoni*	X	X	X	X
Ictaluridae (bullhead catfishes)					
Black bullhead	*Ameiurus melas*	--	--	X	--
Channel catfish	*Ictalurus punctatus*	X	X	--	--

TABLE B-1. - Continued.

Common Name	Scientific Name	Santa Clara	San Ildefonso	Cochiti	San Felipe
Salmonidae (trouts)					
Rainbow trout	*Oncorhynchus mykiss*	X	--	X	--
Brown trout	*Salmo trutta*	X	X	X	X
Centrarchidae (sunfishes)					
Green sunfish	*Lepomis cyanellus*	--	--	X	X
Bluegill	*Lepomis macrochirus*	--	--	X	--
Largemouth bass	*Micropterus salmoides*	X	--	X	--
White crappie	*Pomoxis annularis*	--	--	--	X
Black crappie	*Pomoxis nigromaculatus*	--	--	X	--
Percidae (perches)					
Yellow perch	*Perca flavescens*	--	--	X	--
Total Number of Species		**11**	**7**	**14**	**9**

TABLE B-2. - Fish species sampled during electrofishing surveys on the Santa Ana, Paseo, Rio Grande Escondida, and Low Flow Conveyance Channel (LFCC) sites of the Middle Rio Grande, New Mexico, 1995-1999. Nomenclature based on Robins et al. (1991). (X = present; – = absent).

Common Name	Scientific Name	Santa Ana	Paseo	Rio Grande Escondida	LFCC
Clupeidae (herrings)					
Gizzard shad	*Dorsoma cepedianum*	--	--	X	X
Cyprinidae (carps and minnows)					
Red shiner	*Cyprinella lutrensis*	X	X	--	X
Common carp	*Cyprinus carpio*	X	X	X	X
Rio Grande silvery minnow	*Hybognathus amarus*	X	X	X	X[1]
Fathead minnow	*Pimephales promelas*	X	--	X	X
Flathead chub	*Platygobio gracilis*	X	X	X	X
Longnose dace	*Rhinichthys cataractae*	X	X	--	--
Catostomidae (suckers)					
River carpsucker	*Carpiodes carpio*	X	X	X	X
White sucker	*Catostomus commersoni*	X	X	X	--
Smallmouth buffalo	*Ictiobus bubalus*	--	--	X	X
Ictaluridae (bullhead catfishes)					
Black bullhead	*Ameiurus melas*	X	X	--	--
Yellow bullhead	*Ameiurus natalis*	X	--	--	X
Channel catfish	*Ictalurus punctatus*	X	X	X	X
Flathead catfish	*Pylodictis olivaris*	--	--	--	X

TABLE B-2. - Continued.

Common Name	Scientific Name	Santa Ana	Paseo	Rio Grande Escondida	LFCC
Salmonidae (trouts)					
Brown trout	*Salmo trutta*	X	--	--	--
Poeciliidae (livebearers)					
Western mosquitofish	*Gambusia affinis*	X	--	--	X
Percichthyidae (temperate basses)					
White bass	*Morone chrysops*	X	X	--	X
Centrarchidae (sunfishes)					
Green sunfish	*Lepomis cyanellus*	X	--	--	--
Bluegill	*Lepomis macrochirus*	X	--	--	--
Longear sunfish	*Lepomis megalotis*	--	--	--	X
Largemouth bass	*Micropterus salmoides*	--	--	--	X
Total Number of Species		**16**	**16**	**9**	**15**[2]

[1] This species was not captured during electrofishing surveys conducted on LFCC from 1995 to 1999. However, this species was observed during other BOR surveys (i.e., seining surveys) during the same sample period.

[2] Total number of species for the LFCC site accounts for occurrence of the Rio Grande silvery minnow.

TABLE B-3. - Summary of total capture numbers, mean total lengths, and mean weights for fish sampled at the Santa Clara site, Middle Rio Grande, New Mexico, September 1995 - October 1999.

Sampling Period / Species	Total Number Captured	Mean Total Length (mm)	Mean Weight (kg)
September 1995			
Brown trout	9	233.22	0.13
Common carp	6	337.50	0.85
Flathead chub	11	80.91	0.01
Longnose dace	52	64.00	0.01
Rio Grande chub	4	91.50	0.03
White sucker	44	237.84	0.26
Total	**126**	--	--
December 1995			
Brown trout	7	282.86	0.26
Common carp	4	559.00	2.30
Longnose dace	3	56.33	0.01
White sucker	25	378.00	0.65
Totals	**39**	--	--
August 1996			
Brown trout	2	199.50	0.18
Channel catfish	1	453.00	0.93
Common carp	4	509.00	1.77
Flathead chub	8	105.88	0.01
Longnose dace	85	70.67	0.01
River carpsucker	1	111.00	0.02
White sucker	51	284.20	0.39
Total	**152**	--	--

TABLE B-3. - Continued..

Sampling Period / Species	Total Number Captured	Mean Total Length (mm)	Mean Weight (kg)
December 1996			
Brown trout	24	247.79	0.18
Channel catfish	4	558.00	2.23
Common carp	15	487.93	1.80
Flathead chub	31	94.87	0.03
Longnose dace	28	70.82	0.01
River carpsucker	1	409.00	0.72
Rio Grande chub	4	153.25	0.06
White sucker	86	252.62	0.30
Total	**193**	--	--
August 1997			
Brown trout	14	215.21	0.11
Common carp	17	505.82	1.80
Fathead minnow	1	43.00	0.01
Flathead chub	24	100.38	0.01
Largemouth bass	1	110.00	0.02
Longnose dace	57	76.23	0.01
Rainbow trout	1	200.00	0.08
White sucker	72	283.78	0.35
Total	**187**	--	--
February 1998			
Brown trout	19	187.58	1.18
Channel catfish	4	554.00	1.67

Common carp	9	516.33	1.99

TABLE B-3. - Continued.

Sampling Period / Species	Total Number Captured	Mean Total Length (mm)	Mean Weight (kg)
Flathead chub	6	116.17	0.01
Longnose dace	9	65.67	0.04
Rainbow trout	2	317.00	0.33
White sucker	56	339.32	0.55
Total	**105**	--	--
February 1999			
Brown trout	11	334.64	0.40
Channel catfish	2	500.00	1.18
Common carp	37	495.62	1.83
Flathead chub	1	151.00	0.03
Longnose dace	8	72.63	0.01
Rainbow trout	2	289.00	0.35
White sucker	84	382.61	0.75
Total	**145**	--	--
October 1999			
Brown trout	35	202.60	0.14
Channel catfish	11	480.00	1.42
Common carp	22	509.86	1.93
Flathead chub	5	65.20	0.01
Longnose dace	73	58.92	0.01

White sucker	90	304.33	0.44
Total	**236**	--	--

TABLE B-4. - Catch per unit effort (CPUE) and percent (%) composition by number and weight of fish sampled during electrofishing surveys on the Santa Clara site, Middle Rio Grande, December 1995 - October 1999. CPUE by number (No.) represented by number of fish sampled per 10 minute period. CPUE by weight (Wt.) represented by kg sampled per 10 minute period.

Sampling Period / Species	CPUE by No.	CPUE by Wt.	% Comp. by No.	% Comp. by Wt.
September 1995				
Brown trout	25.67	3.27	7.14	6.32
Common carp	17.11	14.48	4.76	27.93
Flathead chub	31.37	0.16	8.73	0.33
Longnose dace	148.32	0.74	41.27	1.43
Rio Grande chub	11.41	0.31	3.17	0.60
White sucker	125.50	32.91	34.92	63.44
Totals	**359.38**	**51.87**	--	--
December 1995				
Brown trout	17.40	4.60	17.95	6.75
Common carp	9.95	22.87	10.26	33.55
Longnose dace	7.46	0.04	7.69	0.07
White sucker	62.16	40.65	64.10	59.63
Totals	**96.97**	**68.16**	--	--
August 1996				
Brown trout	5.62	0.98	1.32	1.19
Channel catfish	2.81	2.61	0.66	3.17

Common carp	11.23	19.93	2.63	24.19
Flathead chub	22.47	0.32	5.26	0.37
Longnose dace	238.70	2.51	55.92	3.03
River carpsucker	2.81	0.05	0.66	0.07
White sucker	143.22	56.01	33.55	67.97

TABLE B-4. - Continued.

Sampling Period / Species	CPUE by No.	CPUE by Wt.	% Comp. by No.	% Comp. by Wt.
Totals	**426.85**	**82.41**	–	–
December 1996				
Brown trout	34.01	6.17	12.44	6.39
Channel catfish	5.67	12.63	2.07	13.09
Common carp	21.26	38.23	7.77	39.64
Flathead chub	43.93	1.28	16.06	1.32
Longnose dace	39.68	0.56	14.51	0.57
River carpsucker	1.42	1.01	0.52	1.06
Rio Grande chub	5.67	0.32	2.07	0.34
White sucker	121.88	36.27	44.56	37.59
Totals	**273.53**	**96.47**	**--**	**--**
August 1997				
Brown trout	18.33	2.10	7.49	2.73
Common carp	22.25	40.02	9.09	52.21
Fathead minnow	1.31	0.01	0.53	0.02
Flathead chub	31.42	0.38	12.83	0.50
Largemouth bass	1.31	0.03	0.53	0.03

Longnose dace	74.62	1.06	30.48	1.38
Rainbow trout	1.31	0.10	0.53	0.14
White sucker	94.25	32.94	38.50	42.97
Totals	**244.80**	**76.64**	--	--
February 1998				
Brown trout	24.87	29.47	18.10	28.69

TABLE B-4. - Continued.

Sampling Period / Species	CPUE by No.	CPUE by Wt.	% Comp. by No.	% Comp. by Wt.
Channel catfish	5.24	8.73	3.81	8.50
Common carp	11.78	23.39	8.57	22.78
Flathead chub	7.85	0.11	5.71	0.10
Longnose dace	11.78	0.05	8.57	0.05
Rainbow trout	2.62	0.85	1.90	0.83
White sucker	73.31	40.11	53.33	39.05
Totals	**137.45**	**102.70**	--	--
February 1999				
Brown trout	11.28	4.46	7.59	3.14
Channel catfish	2.05	2.42	1.38	1.70
Common carp	37.95	69.62	25.52	49.00
Flathead chub	1.03	0.03	0.69	0.02
Longnose dace	8.21	0.08	5.52	0.06
Rainbow trout	2.05	0.72	1.38	0.51
White sucker	86.15	64.74	57.93	45.57
Totals	**148.72**	**142.07**	--	--
October 1999				
Brown trout	50.40	7.15	14.83	4.82

Channel catfish	15.84	22.49	4.66	15.18
Common carp	31.68	61.07	9.32	41.21
Flathead chub	7.20	0.04	2.12	0.03
Longnose dace	105.13	0.53	30.93	0.36
White sucker	129.61	56.93	38.14	38.41
Totals	**339.86**	**148.21**	--	--

TABLE B-5. - Summary of total capture numbers, mean total lengths, and mean weights for fish sampled at the San Ildefonso site, Middle Rio Grande, New Mexico, December 1995 - August 1996.

Sampling Period / Species	Total Number Captured	Mean Total Length (mm)	Mean Weight (kg)
December 1995			
Channel catfish	2	520.00	1.75
Common carp	12	477.92	1.45
Longnose dace	1	71.00	0.01
White sucker	15	321.27	0.51
Total	**30**	--	--
August 1996			
Brown trout	4	256.00	0.15
Channel catfish	1	535.00	1.90
Common carp	15	466.53	1.47

Flathead chub	2	88.00	0.01
Longnose dace	94	68.30	0.01
Red shiner	1	51.00	0.01
White sucker	37	293.89	0.38
Total	**154**	--	--

TABLE B-6. - Catch per unit effort (CPUE) and percent (%) composition by number and weight of fish sampled during electrofishing surveys on the San Ildefonso site, Middle Rio Grande, December 1995 - August 1996. CPUE by number (No.) represented by number of fish sampled per 10 minute period. CPUE by weight (Wt.) represented by kg sampled per 10 minute period.

Sampling Period / Species	CPUE by No.	CPUE by Wt.	% Comp. by No.	% Comp. by Wt.
December 1995				
Channel catfish	4.47	7.83	6.67	12.24
Common carp	26.83	39.00	40.00	60.98
Longnose dace	2.24	0.01	3.33	0.03
White sucker	33.54	17.11	50.00	26.75
Totals	**67.08**	**63.94**	--	--
August 1996				

Brown trout	6.46	0.94	2.60	1.49
Channel catfish	1.61	3.07	0.65	4.80
Common carp	24.22	35.57	9.74	55.60
Flathead chub	3.23	0.03	1.30	0.05
Longnose dace	151.76	1.37	61.04	2.15
Red shiner	1.61	0.01	0.65	0.03
White sucker	59.74	22.99	24.03	35.94
Totals	**248.63**	**63.97**	--	--

TABLE B-7. - Summary of total capture numbers, mean total lengths, and mean weights for fish sampled at the Cochiti site, Middle Rio Grande, New Mexico, December 1995 - February 1999.

Sampling Period / Species	Total Number Captured	Mean Total Length (mm)	Mean Weight (kg)
December 1995			
Black bullhead	1	95.00	0.01
Black crappie	1	202.00	0.14
Brown trout	2	380.50	0.85
Channel catfish	7	658.43	1.52
Common carp	26	556.35	2.65
Largemouth bass	6	314.50	0.74
Longnose dace	36	45.72	0.01
Rainbow trout	6	350.17	0.57
River carpsucker	8	445.50	1.14
Red shiner	1	565.00	2.71
White sucker	133	384.64	1.11

Total	**227**	--	--
August 1996			
Black bullhead	39	55.87	0.09
Bluegill	9	59.78	0.04
Brown trout	5	328.00	0.55
Channel catfish	1	380.00	4.10
Common carp	25	563.04	2.96
Gizzard shad	7	93.71	0.02
Green sunfish	1	95.00	0.01
Largemouth bass	24	203.54	0.91
Longnose dace	3	81.33	0.01
Rainbow trout	2	166.50	0.06
River carpsucker	10	454.00	1.08

TABLE B-7. - Continued.

Sampling Period / Species	Total Number Captured	Mean Total Length (mm)	Mean Weight (kg)
White sucker	169	157.14	0.59
Western mosquitofish	1	35.00	0.01
Yellow perch	4	69.50	< 0.01
Total	**300**	--	--
December 1996			
Black bullhead	3	63.00	0.01
Bluegill	1	33.00	0.01
Brown trout	3	383.00	0.83
Channel catfish	4	68.50	0.01
Common carp	43	567.72	3.04

Gizzard shad	1	433.00	1.01
Largemouth bass	5	453.20	2.02
Longnose dace	4	81.00	0.01
Rainbow trout	3	503.33	1.51
River carpsucker	11	436.45	1.15
White sucker	177	178.19	1.14
Western mosquitofish	2	29.50	0.01
Yellow perch	10	75.00	0.01
Total	**267**	--	--
February 1999			
Black bullhead	1	263.00	0.33
Brown trout	5	364.20	0.83
Common carp	30	577.93	3.17
Largemouth bass	3	357.33	0.79

TABLE B-7. - Continued.

Sampling Period / Species	Total Number Captured	Mean Total Length (mm)	Mean Weight (kg)
Rainbow trout	4	293.25	0.40
River carpsucker	7	439.29	1.31
White sucker	69	439.97	1.26
Total	**119**	--	--

TABLE B-8. - Catch per unit effort (CPUE) and percent (%) composition by number and weight of fish sampled during electrofishing surveys on the Cochiti site, Middle Rio Grande, December 1995 - February 1999. CPUE by number (No.) represented by number of fish sampled per 10 minute period. CPUE by weight (Wt.) represented by kg sampled per 10 minute period.

Sampling Period / Species	CPUE by No.	CPUE by Wt.	% Comp. by No.	% Comp. by Wt.
December 1995				
Black bullhead	0.94	0.01	0.44	< 0.01
Black crappie	0.94	0.13	0.44	0.06
Brown trout	1.88	1.58	0.88	0.68
Channel catfish	6.56	9.99	3.08	4.29

Common carp	24.38	64.68	11.45	27.77
Largemouth bass	5.63	4.14	2.64	1.78
Longnose dace	33.76	0.17	15.86	0.07
Rainbow trout	5.63	3.18	2.64	1.37
River carpsucker	7.50	8.58	3.52	3.68
Red shiner	0.94	2.54	0.44	1.09
White sucker	124.72	137.87	58.87	59.21
Totals	**212.87**	**232.88**	--	--
August 1996				
Black bullhead	37.93	3.41	13.00	1.62
Bluegill	8.75	0.37	3.00	0.17
Brown trout	4.86	2.67	1.67	1.27
Channel catfish	0.97	3.99	0.33	1.89
Common carp	24.32	72.07	8.33	34.09
Gizzard shad	6.81	0.14	2.33	0.06
Green sunfish	0.97	0.01	0.33	< 0.01
Largemouth bass	23.34	21.24	8.00	10.05
Longnose dace	2.92	0.01	1.00	0.01

TABLE B-8. - Continued.

Sampling Period / Species	CPUE by No.	CPUE by Wt.	% Comp. by No.	% Comp. by Wt.
Rainbow trout	1.95	0.11	0.67	0.06
River carpsucker	9.73	10.51	3.33	4.97
White sucker	164.38	96.85	56.33	45.82
Western mosquitofish	0.97	0.00	0.33	< 0.01
Yellow perch	3.89	0.01	1.33	< 0.01

Totals	**291.80**	**211.39**	--	--
December 1996				
Black bullhead	2.15	0.01	1.12	0.01
Bluegill	0.72	0.00	0.37	< 0.01
Brown trout	2.15	1.78	1.12	0.68
Channel catfish	2.87	0.01	1.50	0.01
Common carp	30.86	93.95	16.10	35.98
Gizzard shad	0.72	0.72	0.37	0.28
Largemouth bass	3.59	7.26	1.87	2.78
Longnose dace	2.87	0.01	1.50	0.01
Rainbow trout	2.15	3.25	1.12	1.25
River carpsucker	7.89	9.06	4.12	3.47
White sucker	127.04	144.98	66.29	55.53
Western mosquitofish	1.44	0.01	0.75	< 0.01
Yellow perch	7.18	0.04	3.75	0.02
Totals	**191.63**	**261.11**	--	--
February 1999				
Black bullhead	1.40	0.46	0.84	0.17
Brown trout	6.98	5.78	4.20	2.08

TABLE B-8. - Continued.

Sampling Period / Species	CPUE by No.	CPUE by Wt.	% Comp. by No.	% Comp. by Wt.
Common carp	41.88	132.62	25.21	47.68
Largemouth bass	4.19	3.32	2.52	1.19
Rainbow trout	5.58	2.25	3.36	0.81
River carpsucker	9.77	12.80	5.88	4.60

White sucker	96.31	120.92	57.98	43.47
Totals	**166.11**	**278.15**	**--**	**--**

TABLE B-9. - Summary of total capture numbers, mean total lengths, and mean weights for fish sampled at the San Felipe site, Middle Rio Grande, New Mexico, September 1995 - August 1996.

Sampling Period / Species	Total Number Captured	Mean Total Length (mm)	Mean Weight (kg)
September 1995			
Brown trout	1	149.00	0.03
Common carp	12	411.92	1.89
Flathead chub	1	87.00	0.01
Longnose dace	50	87.64	< 0.01
White crappie	2	162.50	0.05
White sucker	11	159.82	0.33
Total	**77**	--	--
December 1995			
Brown trout	3	261.00	0.33
Common carp	19	271.37	1.30
Flathead chub	34	131.44	0.02
Green sunfish	1	77.00	0.01
Longnose dace	38	80.47	0.01
Red shiner	2	67.50	0.01
White crappie	1	250.00	0.23
White sucker	43	218.81	0.25
Total	**141**	--	--
August 1996			
Brown trout	1	117	0.01
Common carp	3	248.33	0.24
Fathead minnow	5	58.00	< 0.01
Flathead chub	1	161.00	0.04
Green sunfish	1	36.00	0.01

TABLE B-9. - Continued.

Sampling Period / Species	Total Number Captured	Mean Total Length (mm)	Mean Weight (kg)
Longnose dace	71	79.08	0.01
Red shiner	1	70.00	0.01
White sucker	92	149.85	0.26
Total	**175**	--	--

TABLE B-10. - Catch per unit effort (CPUE) and percent (%) composition by number and weight of fish sampled during electrofishing surveys on the San Felipe site, Middle Rio Grande, September 1995 - August 1996. CPUE by number (No.) represented by number of fish sampled per 10 minute period. CPUE by weight (Wt.) represented by kg sampled per 10 minute period.

Sampling Period / Species	CPUE by No.	CPUE by Wt.	% Comp. by No.	% Comp. by Wt.
September 1995				
Brown trout	1.14	0.04	1.30	0.11
Common carp	16.94	32.08	15.58	85.19
Flathead chub	1.41	0.01	1.30	0.04
Longnose dace	70.59	0.24	64.94	0.64
White crappie	2.82	0.15	2.60	0.41
White sucker	15.53	5.14	14.29	13.65
Totals	**108.71**	**37.65**	--	--
December 1995				
Brown trout	3.06	0.99	2.13	2.59
Common carp	19.36	25.08	13.48	65.09
Flathead chub	34.64	0.86	24.11	2.22
Green sunfish	1.02	0.01	0.71	0.03
Longnose dace	38.72	0.23	26.95	0.61
Red shiner	2.04	0.01	1.42	0.03
White crappie	1.02	0.23	0.71	0.61
White sucker	43.81	11.11	30.50	28.85
Totals	**143.67**	**38.52**	--	--
August 1996				
Brown trout	1.27	0.01	0.57	0.04
Common carp	3.80	0.91	1.71	2.84
Fathead minnow	6.33	0.02	2.86	0.08

TABLE B-10. - Continued.

Sampling Period / Species	CPUE by No.	CPUE by Wt.	% Comp. by No.	% Comp. by Wt.
Flathead chub	1.27	0.05	0.57	0.16
Green sunfish	1.27	0.01	0.57	0.04
Longnose dace	89.87	0.79	40.57	2.44
Red shiner	1.27	0.01	0.57	0.04
White sucker	116.46	30.34	52.57	94.41
Totals	**221.52**	**32.14**	**--**	**--**

TABLE B-11. - Summary of total capture numbers, mean total lengths, and mean weights for fish sampled at the Santa Ana site, Middle Rio Grande, New Mexico, September 1995 - October 1999.

Sampling Period / Species	Total Number Captured	Mean Total Length (mm)	Mean Weight (kg)
September 1995			
Channel catfish	4	430.75	0.82
Common carp	5	449.80	1.37
Flathead chub	14	93.36	0.01
Longnose dace	21	66.29	0.01
River carpsucker	1	363.00	0.54
Red shiner	6	54.50	0.01
White bass	2	224.50	0.15
White sucker	10	237.90	0.26
Total	**63**	--	--
October 1995			
Flathead chub	3	114.00	0.01
Green sunfish	3	69.00	0.01
Western mosquitofish	13	26.54	< 0.01
Total	**19**	--	--
December 1995			
Brown trout	1	159.00	0.03
Channel catfish	15	483.40	1.39
Common carp	48	504.02	1.74
Flathead chub	1	135.00	0.02
Longnose dace	3	58.33	0.01
River carpsucker	8	366.00	0.53

TABLE B-11. - Continued.

Sampling Period / Species	Total Number Captured	Mean Total Length (mm)	Mean Weight (kg)
White sucker	1	359.00	0.58
Total	**77**	--	--
August 1996			
Brown trout	1	300.00	0.28
Channel catfish	6	445.50	1.21
Common carp	25	484.12	1.54
Flathead chub	3	224.33	0.29
Green sunfish	1	109.00	0.02
Longnose dace	9	70.44	0.01
River carpsucker	8	362.00	0.50
Red shiner	2	50.00	0.01
White bass	1	451.00	1.12
White sucker	12	283.33	0.33
Yellow bullhead	1	183.00	0.07
Total	**69**	--	--
December 1996			
Channel catfish	27	436.52	1.07
Common carp	79	481.53	1.55
Flathead chub	1	110.00	0.01
Longnose dace	2	62.50	0.01
River carpsucker	27	374.48	0.58
Rio Grande silvery minnow	1	101.00	0.01
White bass	1	346.00	0.76
White sucker	5	311.80	0.39

TABLE B-11. - Continued.

Sampling Period / Species	Total Number Captured	Mean Total Length (mm)	Mean Weight (kg)
Total	**143**	–	--
August 1997			
Bluegill	1	169.00	0.12
Channel catfish	3	460.67	1.15
Common carp	44	471.52	1.45
Fathead minnow	1	62.00	0.01
Flathead chub	5	75.80	0.01
Longnose dace	15	58.93	0.01
River carpsucker	6	334.00	0.46
Red shiner	48	50.25	0.01
Rio Grande silvery minnow	20	53.90	0.01
White bass	2	277.50	0.36
White sucker	6	182.00	0.38
Total	**151**	--	--
February 1998			
Brown trout	1	491.00	1.07
Channel catfish	7	495.29	1.29
Common carp	71	519.59	1.99
Flathead chub	1	56.00	0.01
River carpsucker	9	373.33	0.60
White bass	1	532.00	0.77
White sucker	2	228.50	0.16
Total	**92**	--	--

TABLE B-11. - Continued.

Sampling Period / Species	Total Number Captured	Mean Total Length (mm)	Mean Weight (kg)
February 1999			
Black bullhead	2	140.00	0.05
Brown trout	1	452	0.48
Channel catfish	14	381.57	0.84
Common carp	52	508.52	1.93
Longnose dace	4	56.25	0.01
River carpsucker	11	356.00	0.53
White bass	1	381.00	1.20
Total	**85**	--	--
October 1999			
Black bullhead	2	92.50	0.01
Bluegill	1	170.00	0.11
Brown trout	1	124.00	0.02
Channel catfish	24	458.67	1.26
Common carp	88	487.82	1.72
Flathead chub	2	86.00	0.01
Longnose dace	3	83.33	0.01
River carpsucker	15	361.93	0.54
Red shiner	5	55.00	0.01
White bass	7	191.14	0.21
White sucker	4	162.00	0.14
Total	**152**	--	--

TABLE B-12. - Catch per unit effort (CPUE) and percent (%) composition by number and weight of fish sampled during electrofishing surveys on the Santa Ana site, Middle Rio Grande, September 1995 - October 1999. CPUE by number (No.) represented by number of fish sampled per 10 minute period. CPUE by weight (Wt.) represented by kg sampled per 10 minute period.

Sampling Period / Species	CPUE by No.	CPUE by Wt.	% Comp. by No.	% Comp. by Wt.
September 1995				
Channel catfish	4.87	4.00	6.35	23.77
Common carp	6.08	8.32	7.94	49.42
Flathead chub	17.03	0.14	22.22	0.87
Longnose dace	25.55	0.13	33.33	0.79
River carpsucker	1.22	0.66	1.59	3.90
Red shiner	7.30	0.04	9.52	0.22
White bass	2.43	0.37	3.17	2.24
White sucker	12.17	3.18	15.87	18.86
Totals	**76.65**	**16.83**	--	--
October 1995				
Flathead chub	11.78	0.15	15.79	33.33
Green sunfish	11.78	0.04	15.79	25.00
Western mosquitofish	51.04	0.20	68.42	41.67
Totals	**74.60**	**0.47**	**--**	**--**
December 1995				
Brown trout	2.08	0.06	1.30	0.03
Channel catfish	31.16	43.26	19.48	19.04
Common carp	99.71	173.88	62.34	76.52
Flathead chub	2.08	0.05	1.30	0.02
Longnose dace	6.23	0.03	3.90	0.02
River carpsucker	16.62	8.76	10.39	3.86

TABLE B-12. - Continued.

Sampling Period / Species	CPUE by No.	CPUE by Wt.	% Comp. by No.	% Comp. by Wt.
White sucker	2.08	1.19	1.30	0.53
Totals	**159.95**	**227.23**	--	--
August 1996				
Brown trout	1.49	0.42	1.45	0.50
Channel catfish	8.92	10.78	8.70	12.92
Common carp	37.17	57.22	36.23	68.59
Flathead chub	4.46	1.29	4.35	1.55
Green sunfish	1.49	0.02	1.45	0.04
Longnose dace	13.38	0.15	13.04	0.18
River carpsucker	11.90	5.90	11.59	7.08
Red shiner	2.97	0.01	2.90	0.02
White bass	1.49	1.67	1.45	2.00
White sucker	17.84	5.85	17.39	7.02
Yellow bullhead	1.49	0.10	1.45	0.12
Totals	**102.60**	**83.41**	**--**	**--**
December 1996				
Channel catfish	42.99	46.11	18.88	17.07
Common carp	125.78	194.74	55.24	72.09
Flathead chub	1.59	0.02	0.70	0.01
Longnose dace	3.18	0.02	1.40	0.01
River carpsucker	42.99	24.95	18.88	9.24
Rio Grande silvery minnow	1.59	0.02	0.70	0.01
White bass	1.59	1.21	0.70	0.45
White sucker	7.96	3.09	3.50	1.14

TABLE B-12. - Continued.

Sampling Period / Species	CPUE by No.	CPUE by Wt.	% Comp. by No.	% Comp. by Wt.
Totals	**227.67**	**270.15**	–	--
August 1997				
Bluegill	1.27	0.15	0.66	0.16
Channel catfish	3.80	4.37	1.99	4.70
Common carp	55.70	80.63	29.14	86.70
Fathead minnow	1.27	0.01	0.66	0.01
Flathead chub	6.33	0.04	3.31	0.04
Longnose dace	18.99	0.09	9.93	0.11
River carpsucker	7.59	3.52	3.97	3.78
Red shiner	60.76	0.30	31.79	0.33
Rio Grande silvery minnow	25.32	0.13	13.25	0.14
White bass	2.53	0.90	1.32	0.97
White sucker	7.59	2.86	3.97	3.08
Totals	**191.14**	**93.00**	**--**	**--**
February 1998				
Brown trout	1.23	1.32	1.09	0.68
Channel catfish	8.62	11.14	7.61	5.73
Common carp	87.38	174.16	77.17	89.50
Flathead chub	1.23	0.01	1.09	0.01
River carpsucker	11.08	6.63	9.78	3.41
White bass	1.23	0.95	1.09	0.49
White sucker	2.46	0.39	2.17	0.20
Totals	**113.23**	**194.60**	**--**	**--**

TABLE B-12. - Continued.

Sampling Period / Species	CPUE by No.	CPUE by Wt.	% Comp. by No.	% Comp. by Wt.
February 1999				
Black bullhead	2.08	0.09	2.35	0.08
Brown trout	1.04	0.50	1.18	0.40
Channel catfish	14.53	12.22	16.47	9.84
Common carp	53.98	104.00	61.18	83.76
Longnose dace	4.15	0.02	4.71	0.02
River carpsucker	11.42	6.09	12.94	4.91
White bass	1.04	1.25	1.18	1.00
Totals	**88.24**	**124.17**	--	--
October 1999				
Black bullhead	2.20	0.02	1.32	< 0.01
Bluegill	1.10	0.12	0.66	0.06
Brown trout	1.10	0.02	0.66	0.01
Channel catfish	26.43	33.24	15.79	16.63
Common carp	96.91	166.27	57.89	78.84
Flathead chub	2.20	0.02	1.32	0.01
Longnose dace	3.30	0.03	1.97	0.02
River carpsucker	16.52	8.92	9.87	4.23
Red shiner	5.51	0.03	3.29	0.02
White bass	7.71	1.63	4.61	0.77
White sucker	4.40	0.60	2.63	0.29
Totals	**167.38**	**210.90**	--	--

TABLE B-13. - Summary of total capture numbers, mean total lengths, and mean weights for fish sampled at the Paseo site, Middle Rio Grande, New Mexico, October 1999.

Sampling Period / Species	Total Number Captured	Mean Total Length (mm)	Mean Weight (kg)
October 1999			
Black bullhead	2	168.00	0.07
Channel catfish	27	309.48	0.72
Common carp	96	457.02	1.40
Flathead chub	3	111.67	0.03
Longnose dace	2	69.00	0.01
River carpsucker	13	356.00	0.50
Red shiner	4	58.75	0.01
Rio Grande silvery minnow	1	85.00	0.01
White bass	1	376.00	0.82
White sucker	7	221.57	0.21
Total	**156**	--	--

TABLE B-14. - Catch per unit effort (CPUE) and percent (%) composition by number and weight of fish sampled during electrofishing surveys on the Paseo site, Middle Rio Grande, October 1999. CPUE by number (No.) represented by number of fish sampled per 10 minute period. CPUE by weight (Wt.) represented by kg sampled per 10 minute period.

Sampling Period / Species	CPUE by No.	CPUE by Wt.	% Comp. by No.	% Comp. by Wt.
October 1999				
Black bullhead	1.55	0.10	1.28	0.08
Channel catfish	20.98	15.20	17.31	12.03
Common carp	74.58	104.08	61.54	82.37
Flathead chub	2.33	0.07	1.92	0.06
Longnose dace	1.55	0.01	1.28	0.01
River carpsucker	10.10	5.08	8.33	4.03
Red shiner	3.11	0.02	2.56	0.01
Rio Grande silvery minnow	0.78	0.01	0.64	0.01
White bass	0.78	0.64	0.64	0.50
White sucker	5.44	1.15	4.49	0.91
Totals	**121.19**	**126.35**	--	--

TABLE B-15. - Summary of total capture numbers, mean total lengths, and mean weights for fish sampled at the Rio Grande Escondida site, Middle Rio Grande, New Mexico, February 1999.

Sampling Period / Species	Total Number Captured	Mean Total Length (mm)	Mean Weight (kg)
February 1999			
Channel catfish	16	266.44	0.31
Common carp	60	421.80	1.10
Fathead minnow	1	67.00	0.01
Flathead chub	3	108.67	0.02
Gizzard shad	2	189.50	0.07
River carpsucker	11	320.91	0.85
Rio Grande silvery minnow	23	65.73	0.01
Smallmouth buffalo	3	692.67	2.34
White sucker	1	235.00	0.24
Total	**120**	**--**	**--**

TABLE B-16. - Catch per unit effort (CPUE) and percent (%) composition by number and weight of fish sampled during electrofishing surveys on the Rio Grande Escondida site, Middle Rio Grande, February 1999. CPUE by number (No.) represented by number of fish sampled per 10 minute period. CPUE by weight (Wt.) represented by kg sampled per 10 minute period.

Sampling Period / Species	CPUE by No.	CPUE by Wt.	% Comp. by No.	% Comp. by Wt.
February 1999				
Channel catfish	11.62	3.56	13.33	5.58
Common carp	43.59	47.89	50.00	75.10
Fathead minnow	0.73	0.00	0.83	0.01
Flathead chub	2.18	0.04	2.50	0.06
Gizzard shad	1.45	0.09	1.67	0.15
River carpsucker	7.99	6.82	9.17	10.70
Rio Grande silvery minnow	16.71	0.10	19.16	0.16
Smallmouth buffalo	2.18	5.10	2.50	8.00
White sucker	0.73	0.17	0.83	0.27
Totals	**87.18**	**63.78**	--	--

TABLE B-17. - Summary of total capture numbers, mean total lengths, and mean weights for fish sampled at the Low Flow Conveyance Channel site, Middle Rio Grande, New Mexico, December 1996 - October 1999.

Sampling Period / Species	Total Number Captured	Mean Total Length (mm)	Mean Weight (kg)
October 1995			
Channel catfish	4	463.25	0.98
Common carp	9	448.67	1.15
Flathead catfish	1	558.00	2.00
Fathead minnow	1	43.00	0.01
Flathead chub	1	52.00	0.01
Gizzard shad	51	184.43	0.34
River carpsucker	2	313.00	0.15
Red shiner	3	52.67	0.01
Smallmouth buffalo	3	506.67	2.38
Western mosquitofish	2	37.50	0.01
Total	**77**	--	–
December 1996			
Channel catfish	24	414.79	1.11
Common carp	106	388.39	0.88
Gizzard shad	22	312.82	0.35
Longear sunfish	7	95.71	0.02
Largemouth bass	2	227.00	0.24
River carpsucker	3	375.00	0.65
Red shiner	4	42.75	0.01

Smallmouth buffalo	3	451.00	1.45
White bass	16	178.5	0.09
Yellow bullhead	3	200.00	0.19
Total	**190**	--	--

TABLE B-18. - Catch per unit effort (CPUE) and percent (%) composition by number and weight of fish sampled during electrofishing surveys on the Low Flow Conveyance Channel site, Middle Rio Grande, December 1996 and October 1999. CPUE by number (No.) represented by number of fish sampled per 10 minute period. CPUE by weight (Wt.) represented by kg sampled per 10 minute period.

Sampling Period / Species	CPUE by No.	CPUE by Wt.	% Comp. by No.	% Comp. by Wt.
October 1995				
Channel catfish	3.01	2.95	5.19	9.55
Common carp	6.78	7.81	11.69	25.26
Flathead catfish	0.75	1.51	1.30	4.87
Fathead minnow	0.75	0.00	1.30	0.02
Flathead chub	0.75	0.00	1.30	0.02
Gizzard shad	38.42	13.03	66.23	42.12
River carpsucker	1.51	0.23	2.60	0.73
Red shiner	2.26	0.01	3.90	0.05
Smallmouth buffalo	2.26	5.38	3.90	17.39
Western mosquitofish	1.51	0.01	2.60	0.02
Totals	**58.00**	**30.92**	--	--
December 1996				
Channel catfish	33.50	37.12	12.63	19.48
Common carp	147.96	130.25	55.79	68.36
Gizzard shad	30.71	10.78	11.58	5.66
Longear sunfish	9.77	0.21	3.68	0.11

Largemouth bass	2.79	0.67	1.05	0.35
River carpsucker	4.19	2.70	1.58	1.42
Red shiner	5.58	0.03	2.11	0.01
Smallmouth buffalo	4.19	6.06	1.58	3.18
White bass	22.23	1.92	8.42	1.01
Yellow bullhead	4.19	0.80	1.58	0.42
Totals	**265.21**	**190.52**	--	--

TABLE B-19. - Mean catch per unit effort (CPUE; number captured per 10 minute electrofishing unit) of fish sampled in selected habitat types on the Santa Clara site, Middle Rio Grande, New Mexico, September 1995 - October 1999. Number of habitat units sampled are shown in parentheses (NS = not sampled).

Sample Period	Natural	Jetty	Riprap
September 1995	21.18 (4)	60.00 (1)	NS
December 1995	16.92 (3)	16.11 (1)	NS
August 1996	60.29 (3)	NS	38.82 (1)
December 1996	41.86 (6)	NS	61.97 (3)
August 1997	42.20 (7)	33.33 (1)	33.51 (2)
February 1998	12.62 (5)	33.64 (10)	35.24 (3)
February 1999	23.70 (7)	34.74 (1)	31.72 (2)
October 1999	51.08 (6)	NS	55.33 (3)

TABLE B-20. - Mean number of fish species captured in selected habitat types during electrofishing surveys on the Santa Clara site, Middle Rio Grande, New Mexico, September 1995 - October 1999 (NS = not sampled).

Sample Period	Natural	Jetty	Riprap
September 1995	4.75	4.00	NS
December 1995	2.50	2.00	NS
August 1996	4.33	NS	4.00
December 1996	4.67	NS	5.00
August 1997	4.57	3.00	3.50
February 1998	3.20	1.00	3.33
February 1999	3.71	3.00	4.00
October 1999	4.17	NS	4.67

TABLE B-21. - Mean catch per unit effort (CPUE; number captured per 10 minute electrofishing unit) of fish sampled in selected habitat types on the San Felipe site, Middle Rio Grande, New Mexico, September 1995 - August 1996. Number of habitat units sampled are shown in parentheses.

Sample Period	Natural	Riprap
September 1995	7.17 (3)	56.84 (1)
December 1995	5.81 (4)	37.48 (3)
August 1996	30.98 (4)	56.14 (2)

TABLE B-22. - Mean number of fish species captured in selected habitat types during electrofishing surveys on the San Felipe site, Middle Rio Grande, New Mexico, September 1995 - August 1996.

Sample Period	Natural	Riprap
September 1995	3.00	4.00

December 1995	2.25	3.33
August 1996	2.75	4.00

TABLE B-23. - Mean catch per unit effort (CPUE; number captured per 10 minute electrofishing unit) of fish sampled in selected habitat types on the San Ildefonso site, Middle Rio Grande, New Mexico, December 1995 and August 1996. Number of habitat units sampled are shown in parentheses.

Sample Period	**Natural**	**Jetty**
December 1995	10.87 (6)	2.33 (1)
August 1996	47.38 (7)	6.25 (1)

TABLE B-24. - Mean number of fish species captured in selected habitat types during electrofishing surveys on the San Ildefonso site, Middle Rio Grande, New Mexico, December 1995 and August 1996.

Sample Period	**Natural**	**Jetty**
December 1995	1.50	2.00
August 1996	3.29	2.00

TABLE B-25. - Mean catch per unit effort (CPUE; number captured per 10 minute electrofishing unit) of fish sampled in selected habitat types on the Cochiti site, Middle Rio Grande, New Mexico, December 1995 - February 1999. Number of habitat units sampled are shown in parentheses (NS = not sampled).

Sample Period	Natural	Jetty	Riprap	Backwater
December 1995	33.85 (4)	45.34 (3)	NS	31.18 (2)
August 1996	60.13 (5)	32.20 (1)	NS	44.94 (1)
December 1996	32.90 (6)	25.24 (2)	NS	62.94 (3)
February 1999	28.53 (5)	20.66 (1)	5.50 (1)	103.00 (1)

TABLE B-26. - Mean number of fish species captured in selected habitat types during electrofishing surveys on the Cochiti site, Middle Rio Grande, New Mexico, December 1995 - February 1999 (NS = not sampled).

Sample Period	Natural	Jetty	Riprap	Backwater
December 1995	2.75	4.67	NS	4.00
August 1996	3.40	3.00	NS	10.00
December 1996	3.50	4.00	NS	3.67
February 1999	2.20	3.00	3.00	5.00

TABLE B-27. - Mean catch per unit effort (CPUE; number captured per 10 minute electrofishing unit) of fish sampled, and mean number of species captured, in selected habitat types on the Rio Grande Escondida site, Middle Rio Grande, New Mexico, February 1999. Number of habitat units sampled are shown in parentheses.

Parameter	Natural	Jetty
CPUE	15.81 (6)	23.75 (1)
Number of Species	4.33	5.00

TABLE B-28. - Mean catch per unit effort (CPUE; number captured per 10 minute electrofishing unit) of fish sampled in selected habitat types on the Santa Ana site, Middle Rio Grande, New Mexico, September 1995 - October 1999. Number of habitat units sampled are shown in parentheses (NS = not sampled).

Sample Period	Natural	Jetty	Riprap
September 1995	21.47 (3)	5.32 (2)	9.62 (1)
October 1995	NS	8.18 (1)	20.00 (1)
December 1995	24.63 (3)	28.48 (2)	35.61 (1)
August 1996	19.08 (4)	12.48 (3)	NS
December 1996	26.22 (4)	37.06 (3)	68.38 (1)
August 1997	37.49 (5)	26.18 (2)	36.92 (1)
February 1998	38.02 (2)	7.82 (3)	23.38 (1)
February 1999	10.23 (5)	17.93 (3)	11.11 (1)
October 1999	21.26 (4)	15.46 (2)	55.50 (2)

TABLE B-29. - Mean number of fish species captured in selected habitat types during electrofishing surveys on the Santa Ana site, Middle Rio Grande, New Mexico, September 1995 - October 1999 (NS = not sampled).

Sample Period	Natural	Jetty	Riprap
September 1995	4.67	3.00	5.00
October 1995	NS	2.00	3.00
December 1995	3.33	3.00	2.00
August 1996	4.00	3.33	NS

December 1996	3.75	3.67	4.00
August 1997	4.40	3.50	9.00
February 1998	2.50	1.67	4.00
February 1999	1.80	2.67	2.00
October 1999	5.50	3.50	3.50

TABLE B-30. - Mean catch per unit effort (CPUE; number captured per 10 minute electrofishing unit) of fish sampled, and mean number of species captured, in selected habitat types on the Paseo site, Middle Rio Grande, New Mexico, October 1999. Number of habitat units sampled are shown in parentheses.

Parameter	**Natural**	**Jetty**
CPUE	26.48 (5)	21.91 (4)
Number of Species	3.60	5.00