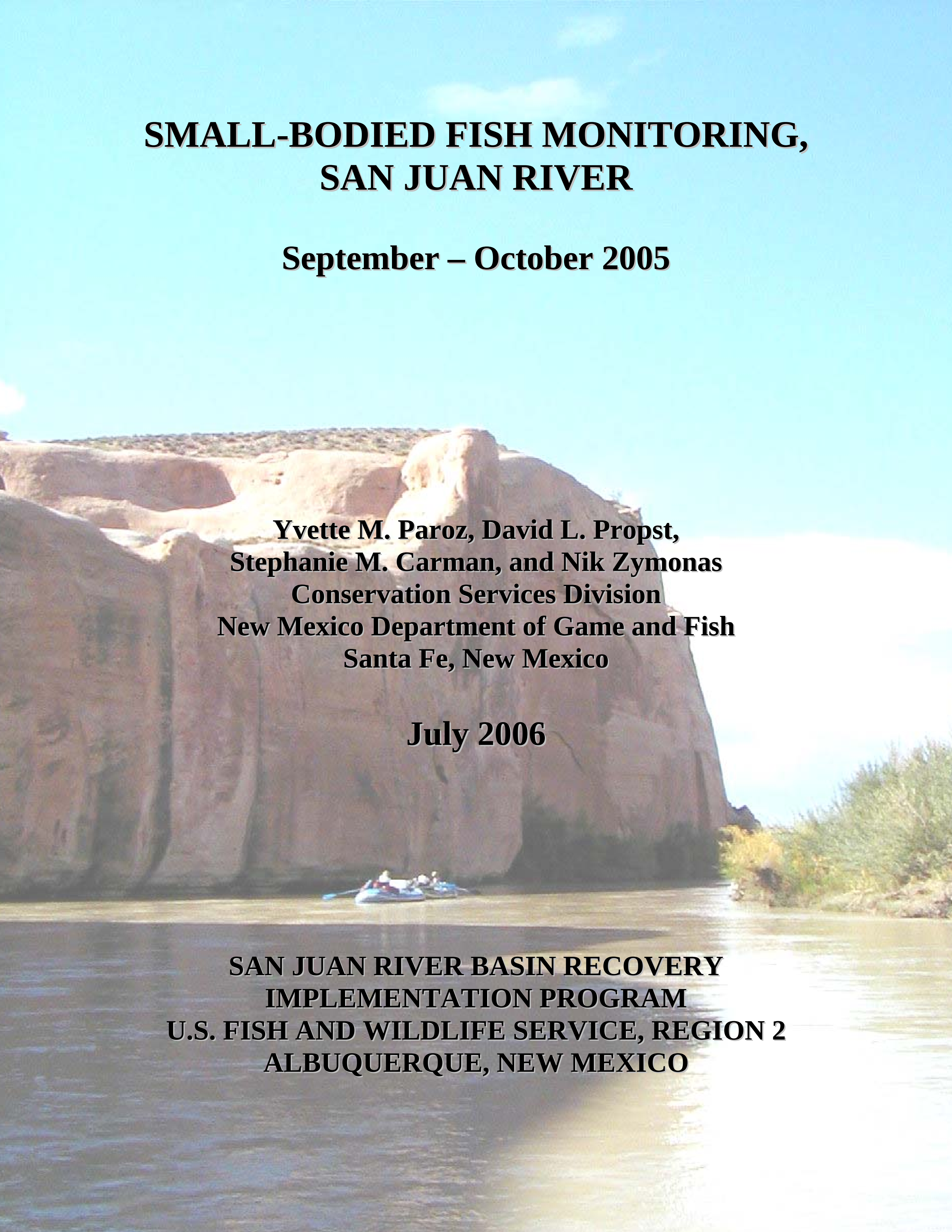

SMALL-BODIED FISH MONITORING, SAN JUAN RIVER

September – October 2005

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SAN JUAN RIVER BASIN RECOVERY
IMPLEMENTATION PROGRAM
U.S. FISH AND WILDLIFE SERVICE, REGION 2
ALBUQUERQUE, NEW MEXICO

EXECUTIVE SUMMARY

Monitoring of the small-bodied fish community of the San Juan River was conducted in September and October in 2005. A total of 6,915 fish were collected. Thirteen fish species were collected in the primary channel and ten in secondary channels and backwaters. Two Colorado pikeminnow were collected in the primary channel; one each in Reaches 2 and 3. One Colorado pikeminnow was collected in a secondary channel in Reach 4. One adult razorback sucker was collected in the primary channel in Reach 5.

A total of 5,975 m^2 of habitat was sampled in the primary channel, 1,040 m^2 in secondary channels, and over 460 m^2 in backwater areas. Primary channel samples were mainly collected in shoal and shore run habitats while secondary channel samples were mainly from run and mid-channel run habitats.

Fish density varied among reaches and channel types. Reaches 6 and 3 had the highest overall density of fishes in primary channel samples. Red shiner was numerically dominant in all primary channel reaches. Speckled dace was second-most abundant in Reaches 6 through 3. Channel catfish was second-most abundant in Reaches 2 and 1. The highest densities of bluehead sucker, flannelmouth sucker, and speckled dace were in Reach 6.

Reach 5 had the highest density of fishes in secondary channel samples. Only one secondary channel was sampled in Reach 6, which was numerically dominated by speckled dace. Speckled dace was also the most abundant species in Reach 3. Red shiner was the most abundant species in secondary channels of other reaches (5 and 4). Backwaters were numerically dominated by red shiner.

Overall fish densities in the 2005 were lower than in 2004   The only commonly collected species that increased in density from 2004 was channel catfish in secondary channels. Simple linear regression analysis of species density over time from 1998-2005 revealed a positive trend for flannelmouth sucker (R=0.695, p=0.056), and bluehead sucker (R=0.713, p=0.047) in the primary channel of the San Juan River.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The following is the annual report for the 2005 monitoring activities for small-bodied fishes. This project was initiated following completion of the San Juan River Seven Year Research Program in 1997, when the San Juan River Basin Recovery Implementation Program Biology Committee recognized the need to monitor San Juan River fish assemblages. Accordingly, autumn sampling of San Juan River small- and large-bodied fishes was conducted in 1998 following procedures used during the Seven Year Research Program. In 1999, autumn sampling of fish assemblages followed procedures detailed in the draft San Juan River Monitoring Plan and Protocols. Beginning in 2000, autumn fish assemblage monitoring followed the protocols detailed in the San Juan Monitoring Plan and Protocols (Propst et al. 2000). Electrofishing to collect small-bodied fishes was added to the sampling methods in 2004.

In 1998, primary and secondary channels sampling was limited to Reaches 5 through 2. In 1999, autumn monitoring of the primary channel was extended upstream to confluence of San Juan and Animas rivers near Farmington and downstream to Clay Hills Crossing. Also beginning in 1999, backwaters, as a distinct habitat, were sampled from Farmington to Clay Hills. Data on small-bodied fishes reported herein were collected from primary channel shoreline habitats, secondary channels, and backwaters from 2000 through 2005. Other than general reference to 1998 and 1999 collections, this annual report focuses on data collected from 2000 through 2005.

Autumn sampling of small-bodied fishes in San Juan River primary and secondary channels, as well as backwaters and embayments, was conducted to aid in characterization and quantification of responses of native and nonnative fishes to flow regimes designed to mimic a natural hydrograph. Specific objectives of this monitoring effort include documenting occurrence of protected species (i.e., roundtail chub, Colorado pikeminnow, and razorback sucker), particularly age-0 individuals; characterizing mesohabitats occupied by protected species and other small-bodied fishes; determining effects of different flow regimes on autumn densities of commonly collected native and nonnative species; and comparing densities of commonly-collected species among primary and secondary channels. Data collected will be used to characterize long-term trends in status (abundance, population size-structure, and recruitment) of individual species.

METHODS

In 1998, autumn monitoring of small-bodied fishes in San Juan River primary and secondary channels and backwaters (including embayments) occurred from Shiprock, New Mexico (RM 149, Reach 5) downstream to Chinle Creek, Utah (RM 68, Reach 3). In 1999, autumn monitoring was extended upstream to the San Juan-Animas rivers confluence (RM 180, Reach 6) and downstream to Clay Hills Crossing (RM 3, Reach 1). The primary channel was sampled at each sampled secondary channel or at 3-mile intervals (designated miles) if no secondary channel was present in a 3-mile reach. In 1999, a secondary channel was sampled only if it occurred within the 1-mile reach to be sampled in every third mile. This protocol excluded a large proportion of secondary channels (30 to 50%, depending upon the starting point of the 3-mile sampling interval). To compensate, beginning in 2000, all secondary channels longer than 200 m having surface water were sampled. All backwaters (greater than 50 m^2), regardless of occurrence within designated miles, were sampled.

From 2000 through 2005, small-bodied fishes were collected from primary channel habitats at 3-mile intervals. Starting point of 3-mile interval count cycled among years such that sampling would begin at RM 180 one year, RM 179 the next year, and RM 178 the third, and back to RM 180 the following year to repeat the cycle. All collections were made using seines hauls or kicking into a seine depending on habitat. In 2004 and 2005, additional collections were made by electrofishing into a bag seine in riffle, run, and shoal habitats. Primary channel electrofishing collections were made every six miles.

Primary channel sample sites were about 200 m long (measured along shoreline). The length of secondary channel sample sites varied depending upon extent of surface water, but was normally 100 to 200 m. Within each site (primary and secondary channels), all mesohabitats (see Bliesner and Lamarra 2000 for definitions) present were sampled in rough proportion to their surface area within a site. Beginning in 2003, data (including fishes collected) from each sampled mesohabitat were recorded separately. Most primary channel mesohabitats sampled were along stream margins, but off-shore riffles and runs (<0.75 m deep) were also sampled. Secondary channel sampling was across the breadth of the wetted channel. All mesohabitats within each site were sampled and sampled area of each was roughly proportional to its total area within a site. Some mesohabitats (e.g., debris pools and riffle eddys) were sampled in greater proportion than their availability. Normally, at least five seine hauls was made at each sample site; however, if habitat was homogeneous, fewer seine hauls were made. All backwaters >50 m^2 associated with the primary channel were sampled and treated as separate sample units. Typically, two seine hauls were made in each backwater; one near its mouth and the second in its upper half. Fish collection data from embayments were grouped with backwater data in 2003, 2004, and 2005. Smaller backwaters were included within primary or secondary channel data sets, as backwater mesohabitats.

Fishes were collected with a drag seine (3.05 x 1.83 m, 3.2 mm mesh) from each mesohabitat. Each catch was inspected to determine presence of protected species and other native fishes. Total length (TL) of each native fish was determined, recorded, and the specimen released. Subsamples of at least 50 individuals of speckled dace collected were measured for each reach, the rest were counted and released. Nonnative fishes were fixed in 10% formalin and returned to the laboratory. Following specimen collection, seined area of each sampled mesohabitat was determined and recorded. Retained specimens were identified and enumerated in the laboratory. Total length was determined for all retained specimens, except collections having more than 250 specimens of a species. For these collections, lengths were obtained for a sub-sample (at least 200 specimens). Personnel of UNM-MSB, Division of Fishes, verified identification of retained protected species. All retained specimens were accessioned to the NMGF Collection of Fishes.

Attributes of spring and summer discharge were obtained from USGS Water Resources Data, New Mexico (1998 et seq.). Shiprock gauge (#09368000) data were used for all calculations. Spring was 1 March through 30 June and summer was from 1 July through 30 September. Species density data were segregated by Geomorphic Reach (Bliesner and Lamarra 2000). Total densities (number of fish per m^2) were determined by dividing total number of specimens by total area sampled within a reach. Simple linear regressions were used to assess trends in species density over time. Shannon-Weiner Diversity Index (H; proportional values transformed to natural log) values were calculated for each Geomorphic Reach each year. Regression analysis was used to compare spring and summer discharge attributes to autumn density of commonly collected secondary and primary channel species from 2000 through 2005. To reduce the effect of disproportionately large values, fish densities were $\log_{10}(x + 1)$ transformed.

Mesohabitats were grouped into thirteen categories. Rapid-velocity mesohabitats included riffle, riffle-plunge, and riffle-run; moderate-velocity included run, mid-channel run, shore run, shoal, and pool-run; slow-velocity included riffle eddy, eddy, and pool;

and embayments and isolated pools were grouped with backwaters. For each mesohabitat class the percent composition of each species was plotted alongside the percent contribution of total sampled area to provide a crude estimate of habitat use patterns of each species.

To plot the abundance of species among years in primary and secondary channels, mean sample density (average autumn density) of each commonly collected species was calculated by averaging densities of each species from all samples (individual mesohabitats) within a reach. Standard error of density estimate of each species from each reach was calculated as the standard deviation of mean reach density divided by the square root of the number of mesohabitats sampled within respective reach. One way ANOVA was used to determine differences between species density in 2004 and 2005. For specific reaches, student's *t* tests were used to assess differences in species densities between 2004 and 2005.

RESULTS

DISCHARGE

The study area experienced relatively high flows in 2005. On May 25, 2005 mean daily discharge peaked at 13,200 cubic feet/second (cfs) (Figure 1). This fairly short but intense discharge peak provided eleven days over 10,000 cfs. Spring mean daily discharge in 2005 was higher than any year since 1998 (Table 1). The lowest spring mean daily discharge was in 2002. Prior to 2005, discharge exceeded 8000 cfs only one day; 2005 had 29 days.

Summer discharge was higher in 2005 than had been measured since 1999 when there were high flows throughout the summer (Table 2); the summer of 1999 had no days where mean discharge was less than 1000 cfs. There was no large summer flow spike (>4000 cfs) in 2005 and only one day had mean daily discharge greater than 3000 cfs. However, there were also fewer low discharge (<500 cfs) days in the summer of 2005 than the previous five years.

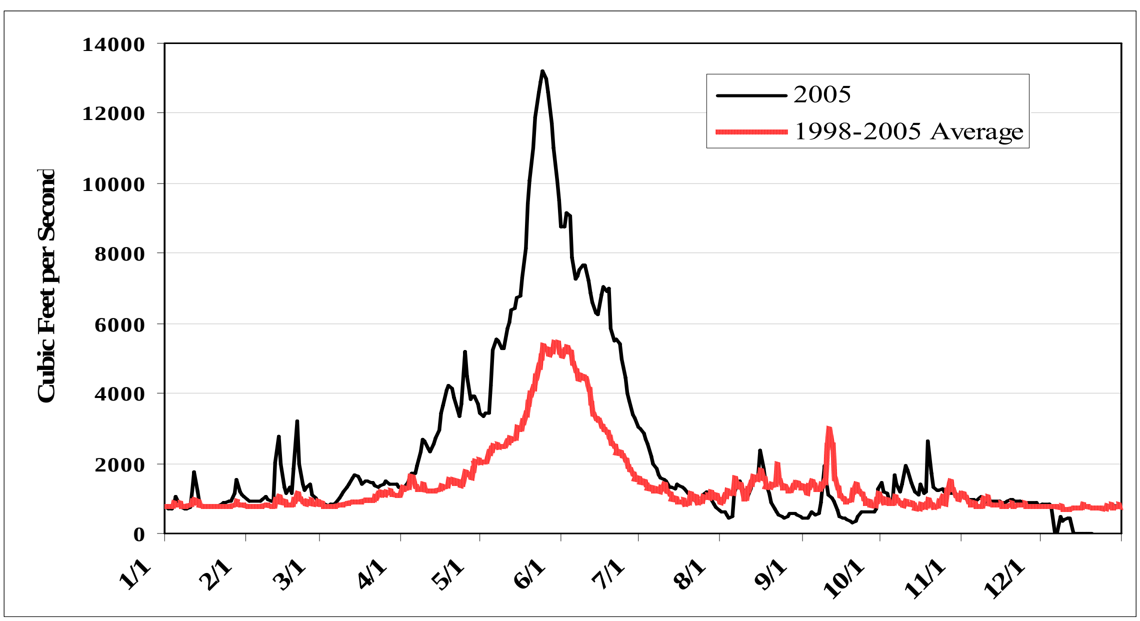

Figure 1. Mean daily discharge (cubic feet/second; cfs) of San Juan River for 2005. Data from USGS Shiprock gage (#09368000).

Table 1. Mean daily discharge (cubic feet/second; cfs) of San Juan River during spring runoff and attributes of spring discharge, 1998 - 2005. Data from USGS Shiprock gage (#09368000).

	WATER YEAR							
MONTH	98	99	00	01	02	03	04	05
March	1141	869	941	1033	664	653	1071	1278
April	1425	1087	1652	1384	533	532	1842	3026
May	5250	3175	2311	4781	644	1621	2652	7983
June	3970	5716	2011	4760	433	1243	1836	6380
Mean (cfs) – Mar-June	2947	2712	1729	2989	569	1015	1828	4667
Days Q >3,000 cfs	48	41	18	47	0	9	8	76
Days Q >5,000 cfs	24	26	1	29	0	0	0	50
Days Q >8,000 cfs	0	0	0	1	0	0	0	18
Days Q >10,000 cfs	0	0	0	0	0	0	0	11

Table 2. Mean daily discharge (cubic feet/second; cfs) of San Juan River during summer and attributes of summer discharge, 1994 – 2005. Data from USGS Shiprock gage (#09368000).

	WATER YEAR							
MONTH	98	99	00	01	02	03	04	05
July	1665	3116	324	690	378	575	585	1461
August	959	5725	602	1132	368	642	398	966
September	655	4157	649	552	1126	1286	1018	684
Mean (cfs) – Jul-Sept	1089	4333	525	791	624	829	667	1037
Days Q >5,000 cfs	0	31	0	0	2	2	0	0
Days Q >4,000 cfs	1	42	0	0	2	3	1	0
Days Q >3,000 cfs	1	71	0	0	2	3	1	1
Days Q >2,000 cfs	11	89	0	5	3	3	6	6
Days Q >1,000 cfs	37	92	1	18	7	13	11	42
Days Q <1,000 cfs	55	0	91	74	85	79	80	49
Days Q <750 cfs	42	0	80	59	79	67	70	40
Days Q <500 cfs	15	0	45	23	74	44	49	17
Number Q spikes	4	1	1	1	1	4	1	4
Spike duration (days)	37	92	7	18	13	12	4	22
Spike mean (cfs)	1802	4333	850	1596	2130	2645	2988	1389

Mean daily discharge varied each year during sampling times (Table 3). The highest discharge was seen when sampling was conducted for the upper reaches in 2004.

In 2005, flows were quite low while sampling was conducted in the upper reaches but then increased to over 1000 cfs during the period that the lower reaches were sampled.

Table 3. Mean daily discharge at Shiprock USGS Gage (936800) at the time of small bodied fish sampling for various reaches from 2000-2005.

			Mean Daily Discharge		
Year	Sampling Dates	Reaches Sampled	Mean	Min	Max
2000	October 2-10	4, 3, 2, 1	736	580	940
	October 16-20	6, 5, 4	806	745	872
2001	September 25 - October 3	4, 3, 2, 1	524	488	566
	October 10-11	5, 4	753	732	774
	October 23-25	6, 5	684	609	768
2002	September 20 - 29	4, 3, 2, 1	408	277	779
	October 7 - 11	6, 5, 4	557	523	639
2003	September 22 - 26	6, 5, 4	360	309	446
	October 6 - 14	4, 3, 2, 1	576	409	1020
2004	September 20 - 24	6, 5, 4	2710	1600	4220
	October 4 - 12	4, 3, 2, 1	815	619	987
2005	September 19-23	6, 5, 4	419	322	605
	October 3 - 12	4, 3, 2, 1	1165	912	1750

PRIMARY CHANNEL SUMMARY

Five native and eight nonnative fish species were collected in the primary channel in 2005 (Table 4). One adult razorback sucker was collected by the small-bodied sampling crew. This was the first time a razorback sucker was collected in this study. Other native species included bluehead sucker, flannelmouth sucker, speckled dace, and Colorado pikeminnow. Two native species, roundtail chub and mottled sculpin, have not been collected since 1999. Nonnative red shiner, channel catfish, and fathead minnow were collected in all years of sampling. Additionally, black bullhead, common carp, plains killifish, western mosquitofish, and green sunfish were collected in 2005. Largemouth bass was collected in 2001 and 2004, but not 2005.

Overall density of fishes collected in 2005 was less than 50% of the mean density from 1998-2004 collections. Red shiner continued to be the most commonly collected fish species in small-bodied sampling in the primary channel (Table 5). For the past three years (2003-2005), speckled dace was the second-most common. Collections in 1999 had the lowest density, while the 2000 collections yielded densities nearly three times as great as the mean. The amount of primary channel area sampled in 2005 was greater than the average amount sampled over the previous seven years.

Table 4. Species collected during small-bodied monitoring in San Juan River primary channel during autumn, 1998-2005. I = introduced and N = native. Six-letter code derived from first three letters of genus and second three from species.

COMMON	SCIENTIFIC	CODE	STATUS	1998	1999	2000	2001	2002	2003	2004	2005
Black bullhead	*Ameiurus melas*	AMEMEL	I					X		X	X
Flannelmouth x bluehead	*C. latipinnis* x *C. discobolus*	LATDIS			X				X		
Bluehead sucker	*Catostomus discobolus*	CATDIS	N	X	X	X	X	X	X	X	X
Flannelmouth sucker	*Catostomus latipinnis*	CATLAT	N	X	X	X	X	X	X	X	X
Mottled sculpin	*Cottus bairdi*	COTBAI	N		X						
Red shiner	*Cyprinella lutrensis*	CYPLUT	I	X	X	X	X	X	X	X	X
Common carp	*Cyprinus carpio*	CYPCAR	I		X	X		X		X	X
Plains killifish	*Fundulus zebrinus*	FUNZEB	I	X		X	X	X	X	X	X
Western mosquitofish	*Gambusia affinis*	GAMAFF	I	X		X	X	X	X	X	X
Roundtail chub	*Gila robusta*	GILROB	N	X	X						
Channel catfish	*Ictalurus punctatus*	ICTPUN	I	X	X	X	X	X	X	X	X
Green sunfish	*Lepomis cyanellus*	LEPCYA	I		X				X	X	X
Largemouth bass	*Micropterus salmoides*	MICSAL	I				X			X	
Fathead minnow	*Pimephales promelas*	PIMPRO	I	X	X	X	X	X	X	X	X
Colorado pikeminnow	*Ptychocheilus lucius*	PTYLUC	N	X						X	X
Speckled dace	*Rhinichthys osculus*	RHIOSC	N	X	X	X	X	X	X	X	X
Razorback sucker	*Xyrauchen texanus*	XYRTEX	N								X
NATIVE			7	5	5	3	3	3	3	4	5
NONNATIVE			9	5	5	6	6	7	6	9	8

Table 5. Fishes collected in San Juan River primary channel during autumn inventories, 1998 – 2005. Geomorphic Reaches 6 and 1 not sampled in 1998.

1998		1999		2000		2001		2002		2003		2004		2005	
Species	N	Species	N	Species	N	Species	N	Species	N	Species	N	Species	N	Species	N
CYPLUT	590	CYPLUT	1071	CYPLUT	20114	CYPLUT	3102	CYPLUT	7124	CYPLUT	1715	CYPLUT	9924	CYPLUT	2497
RHIOSC	461	RHIOSC	395	GAMAFF	1025	RHIOSC	342	PIMPRO	1116	RHIOSC	511	RHIOSC	4690	RHIOSC	1234
ICTPUN	187	PIMPRO	48	PIMPRO	1490	PIMPRO	136	RHIOSC	533	ICTPUN	366	PIMPRO	1119	ICTPUN	401
PIMPRO	32	CATLAT	8	RHIOSC	161	GAMAFF	59	ICTPUN	231	CATLAT	142	ICTPUN	597	PIMPRO	281
CATLAT	8	ICTPUN	8	CATLAT	33	CATLAT	20	GAMAFF	165	PIMPRO	90	CATDIS	284	CATLAT	111
PTYLUC	4	GAMAFF	6	ICTPUN	35	CATDIS	8	CATLAT	141	GAMAFF	37	CATLAT	254	CATDIS	90
CATDIS	5	CATDIS	3	CATDIS	18	ICTPUN	13	CATDIS	61	CATDIS	28	GAMAFF	129	GAMAFF	16
GAMAFF	2	CYPCAR	1	CYPCAR	8	FUNZEB	3	CYPCAR	23	FUNZEB	21	FUNZEB	29	CYPCAR	3
GILROB	1	GILROB	1	FUNZEB	3	CYPCAR	1	FUNZEB	15	LEPCYA	2	CYPCAR	6	PTYLUC	2
FUNZEB	1	LATDIS	1			MICSAL	1	AMEMEL	4	LATDIS	1	MICSAL	4	AMEMEL	1
		LEPCYA	1									PTYLUC	4	FUNZEB	1
		COTBAI	1									AMEMEL	2	LEPCYA	1
												LEPCYA	1	XYRTEX	1
TOT N	1291		1544		22887		3685		9413		2913		17042		4639
AREA	1601		4883		4510		3091		3564		3935		7787		5975
DENSITY	0.81		0.32		5.07		1.19		2.64		0.74		2.19		0.78

Sampled area in the primary channel was categorized into thirteen mesohabitats (Table 6). Nearly 30% of the sampled area was shoal habitat. Run, shore run, and mid-channel run cumulatively comprised approximately 30% of the sampled area. Backwaters and isolated pools made up less than 5%. Reach 3 had the most primary channel area sampled (over 1600 m^2), while only 123 m^2 was sampled in Reach 1.

Overall, approximately 30% of the speckled dace collected in the primary channel were found in riffle habitats (Figure 2). Forty percent of fathead minnows were found in backwaters associated with the primary channel. Very few red shiners were found in swift habitats. Bluehead sucker and flannelmouth sucker were fairly evenly distributed among several mesohabitat types.

Table 6. Mesohabitats (percent of total habitat sampled in respective reach) sampled in San Juan River primary channel during autumn 2005 monitoring. Mesohabitats are arranged from rapid (left) to slow (right) water velocity.

			Mesohabitat												
			Rapid Velocity			Moderate Velocity				Slow Velocity			Backwater		
Reach	Reach Length (km)	Total area (m^2)	Riffle	Riffle run	Run	Mid channel run	Shore run	Shoal	Pool run	Riffle eddy	Eddy	Pool	Embayment	Backwater	Isolated pool
6	40.0	888.6	161.4	71.5	20.5	34.1	204.8	221.7		89.1	27.7	7.0	21.1	29.7	
5	38.4	955.6	103.9	97.5	35.9	29.7	107.8	311.2	25.8	75.8	98.3	33.0		36.7	
4	38.4	823.4	108.5	62.2	148.6	62.7	145.2	130.3		34.4	69.3	36.9	23.1	2.2	
3	62.4	1634.5	296.3	69.9	296.8	47.6	288.3	370.3		49.5	97.5	14.5	24.4	33.0	46.4
2	81.6	1461.2	86.7	36.0	31.9	26.4	378.2	568.0		41.8	241.2	31.2			19.8
1	27.2	123.1				14.3	25.7						13.2	83.1	
Habitat Percent			12.86%	5.66%	9.07%	3.65%	19.54%	27.21%	0.44%	4.94%	8.97%	2.08%	1.17%	3.14%	1.12%

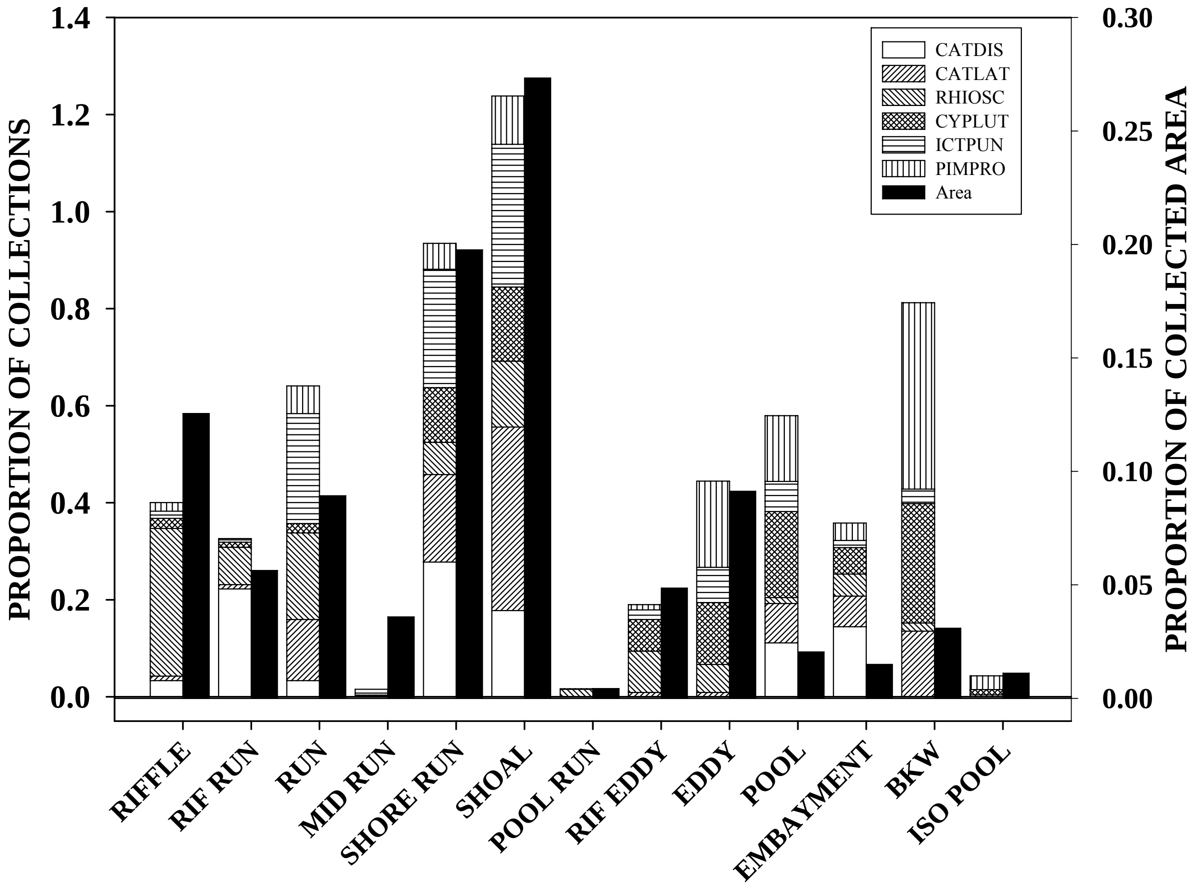

Figure 2. Distribution of sampled area and fishes from the primary channel of the San Juan in autumn 2005 among various mesohabitat categories.

SECONDARY CHANNELS SUMMARY

Most fish species sampled in secondary channels of the San Juan were also found in the primary channel (Table 7). Yellow bullhead was the only species collected exclusively in secondary channels. Common carp and plains killifish were not found in secondary channels in 2005. Colorado pikeminnow was found in secondary channels in each of the past two years. In total, four native and six nonnative species were found in secondary channels in 2005.

Table 7. Species collected during small-bodied monitoring in San Juan River secondary channel during autumn, 1998-2005. I = introduced and N = native. Six-letter code derived from first three letters of genus and second three from species.

COMMON	SCIENTIFIC	CODE	STATUS	1998	1999	2000	2001	2002	2003	2004	2005
Black bullhead	*Ameiurus melas*	AMEMEL	I	X			X	X	X	X	X
Yellow bullhead	*Ameiurus natilis*	AMENAT	I	X			X				X
Bluehead sucker	*Catostomus discobolus*	CATDIS	N	X	X	X	X	X	X	X	X
Flannelmouth sucker	*Catostomus latipinnis*	CATLAT	N	X	X	X	X	X	X	X	X
Mottled sculpin	*Cottus bairdi*	COTBAI	N		X						
Red shiner	*Cyprinella lutrensis*	CYPLUT	I	X	X	X	X	X	X	X	X
Common carp	*Cyprinus carpio*	CYPCAR	I	X		X	X	X	X	X	
Plains killifish	*Fundulus zebrinus*	FUNZEB	I	X		X	X	X	X	X	
Western mosquitofish	*Gambusia affinis*	GAMAFF	I	X	X	X	X	X	X	X	X
Roundtail chub	*Gila robusta*	GILROB	N	X	X						
Channel catfish	*Ictalurus punctatus*	ICTPUN	I	X	X	X	X	X	X	X	X
Green sunfish	*Lepomis cyanellus*	LEPCYA	I	X	X					X	
Largemouth bass	*Micropterus salmoides*	MICSAL	I			X	X		X	X	
Rainbow trout	*Oncorhynchus mykiss*	ONCMYK	I				X				
Fathead minnow	*Pimephales promelas*	PIMPRO	I	X	X	X	X	X	X	X	X
Colorado pikeminnow	*Ptychocheilus lucius*	PTYLUC	N	X	X	X				X	X
Speckled dace	*Rhinichthys osculus*	RHIOSC	N	X	X	X	X	X	X	X	X
NATIVE			6	5	5	6	4	3	3	4	4
NONNATIVE			11	8	9	5	7	10	7	9	6

Similar to the primary channel, red shiner has been the most-commonly collected species in each year of sampling (Table 8) in secondary channels. Speckled dace was the second-most abundant species in 2005 collections. However, fathead minnow was the second-most abundant the previous five years (2000-2004). Total density in 2005 was less than half that of average total density from 1998 through 2004. Area sampled in secondary channels in 2005 was less than previous years. The largest amount of secondary channel habitat sampled as well as the highest fish density was in 2000.

Table 8. Fishes collected in San Juan River secondary channel during autumn inventories, 1998 – 2005. Geomorphic Reaches 6 and 1 not sampled in 1998.

1998		1999		2000		2001		2002		2003		2004		2005	
Species	N	Species	N	Species	N	Species	N	Species	N	Species	N	Species	N	Species	N
CYPLUT	741	CYPLUT	272	CYPLUT	11135	CYPLUT	1847	CYPLUT	6424	CYPLUT	1627	CYPLUT	7080	CYPLUT	926
RHIOSC	597	RHIOSC	114	PIMPRO	1503	PIMPRO	226	PIMPRO	1781	PIMPRO	310	PIMPRO	2127	RHIOSC	171
PIMPRO	162	PIMPRO	20	GAMAFF	1314	RHIOSC	193	GAMAFF	470	RHIOSC	232	RHIOSC	1351	ICTPUN	114
ICTPUN	138	CATDIS	4	CYPCAR	309	GAMAFF	113	RHIOSC	224	CATLAT	153	GAMAFF	133	PIMPRO	108
GAMAFF	113	CATLAT	4	RHIOSC	158	CATLAT	27	CATLAT	99	ICTPUN	65	CATDIS	122	GAMAFF	45
CATLAT	13	ICTPUN	4	CATLAT	45	ICTPUN	20	FUNZEB	60	GAMAFF	32	CATLAT	122	CATLAT	24
FUNZEB	4	GAMAFF	3	ICTPUN	27	FUNZEB	19	CATDIS	53	CATDIS	24	ICTPUN	115	CATDIS	7
CYPCAR	2	COTBAI	2	CATDIS	17	CATDIS	11	ICTPUN	37	FUNZEB	11	FUNZEB	32	AMEMEL	3
GILROB	2	GILROB	1	MICSAL	9	AMEMEL	3	CYPCAR	27	AMEMEL	7	CYPCAR	10	AMENAT	1
CATDIS	2	PTYLUC	1	FUNZEB	5	CYPCAR	2	AMEMEL	8	CYPCAR	2	AMEMEL	6	PTYLUC	1
AMENAT	2	LEPCYA	1	PTYLUC	3	AMENAT	1			MICSAL	1	MICSAL	6		
PTYLUC	1					ONCMYK	1					PTYLUC	4		
LEPCYA	1					MICSAL	1					LEPCYA	1		
TOT N	1178		426		14508		2464		9183		2464		11109		1400
AREA	1904		1356		1914		1346		1468		1480		1802		1040
DENSITY	0.934		0.315		7.58		1.831		6.255		1.665		6.165		1.346

Nearly 40% of secondary channel area sampled was run, mid-channel run, and shore run habitat (Table 9). No embayment, backwater, or isolated pool habitats were sampled in association with secondary channels in 2005. The largest amount of secondary channel area sampled was in Reach 5. Very little secondary channel habitat was sampled in Reach 6. While shoal habitat made up over 13% of the area sampled in secondary channels, relatively few fish were collected there (Figure 3), unlike primary channel shoal habitats. Collections in secondary channel riffle habitats were mainly composed of speckled dace and bluehead sucker.

Table 9. Mesohabitats (percent of total habitat sampled in respective reach) sampled in San Juan River secondary channels during autumn 2005 monitoring. Mesohabitats are arranged from rapid (left) to slow (right) water velocity.

			Mesohabitat											
			Rapid Velocity			Moderate Velocity				Slow Velocity			Backwater	
Reach	Number of secondary samples	Total area (m^2)	Riffle	Riffle run	Run	Mid channel run	Shore run	Shoal	Pool run	Riffle eddy	Eddy	Pool	Embayment	Backwater
6	4	59.4	9.5			10.6		16.9			22.4			
5	26	475.4	47.1	42.9	54.1	75.2	24.9	88.5	26.7	46.4		69.7		
4	21	348.2	28.8	42.6	73	73.1	14.7	33		11.7		71.3		
3	9	157.1	18.5		68.6	17.6	20.7			28.4		3.3		
Habitat Percent			9.99%	8.22%	18.82%	16.97%	5.79%	13.30%	2.57%	8.32%	2.15%	13.87%	0%	0%

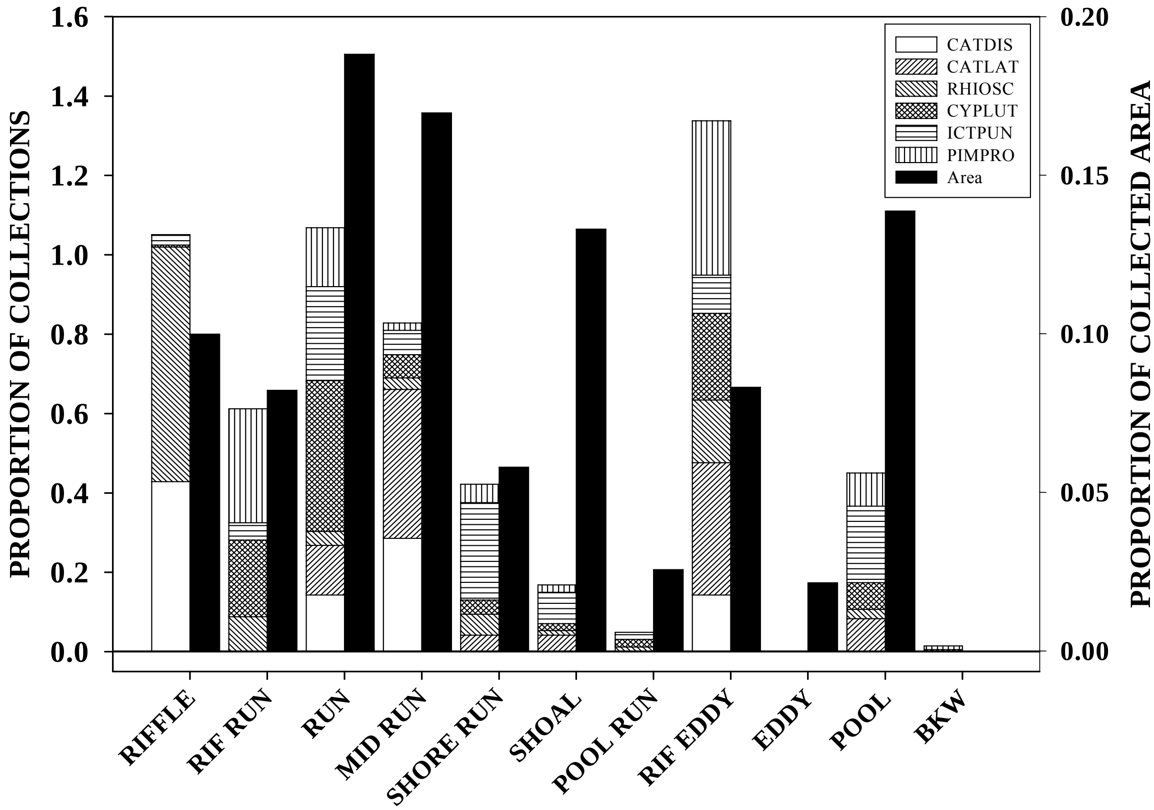

Figure 3. Distribution of sampled area and fishes from secondary channels of the San Juan in autumn 2005 among various mesohabitat categories.

OVERALL TRENDS IN PRIMARY AND SECONDARY CHANNELS

Density of native fishes has been similar in primary and secondary channels since 1998 (Figure 4). Highest overall densities of speckled dace and bluehead sucker occurred in 2004 samples. Though 2005 densities were lower than in 2004, simple linear regressions indicate a trend of increasing densities for both flannelmouth sucker and bluehead sucker from 1998 through 2005 in primary channel samples (Table 10).

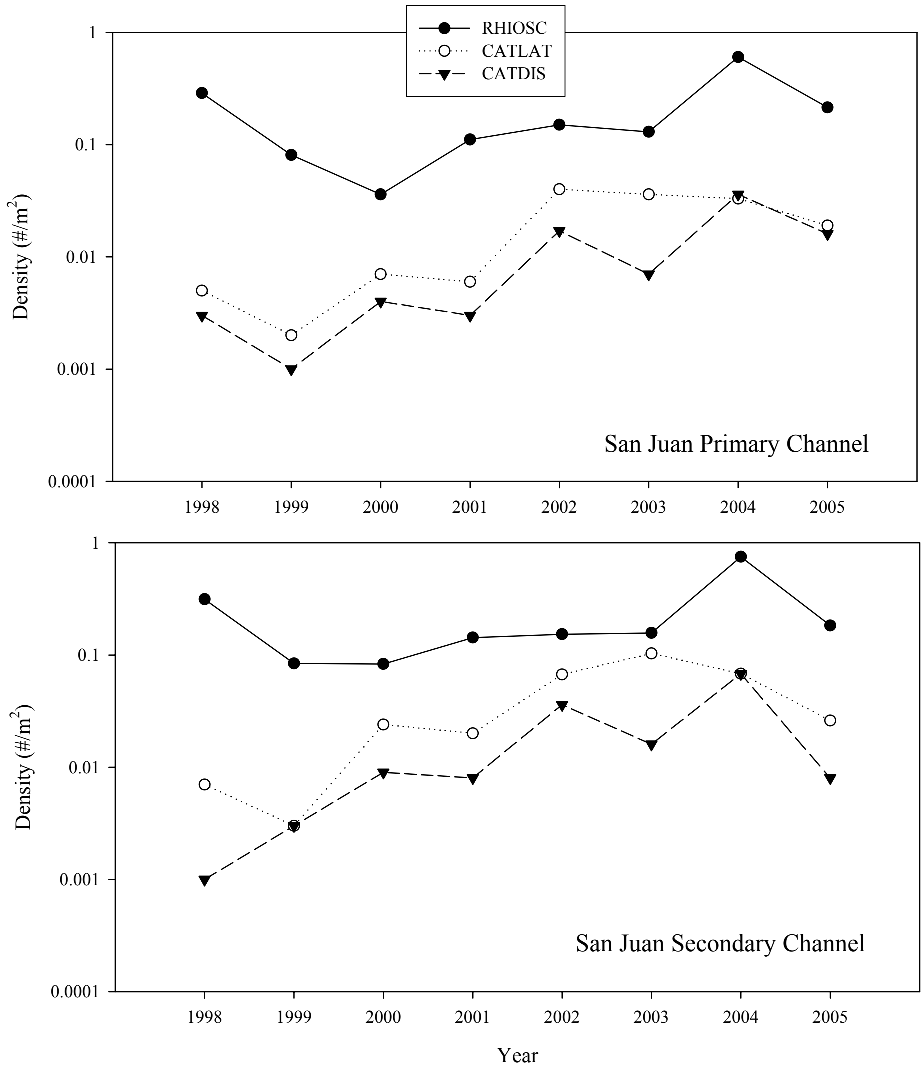

Figure 4. Overall density (total number/total area sampled) of commonly collected native fishes in autumn sampling of the San Juan.

Table 10. Simple linear regression of overall density of commonly collected fishes versus collection year from 1998 - 2005.

	Primary		Secondary	
Species	R	*p*	R	*p*
CYPLUT	-0.11	0.795	0.161	0.703
PIMPRO	0.05	0.907	0.307	0.459
ICTPUN	0.234	0.577	0.554	0.154
RHIOSC	0.391	0.338	0.349	0.396
CATLAT	0.695	0.056	0.611	0.108
CATDIS	0.713	0.047	0.542	0.165

Overall density of commonly collected nonnative fish species has been variable over time (Figure 5). Trends in the densities of fathead minnow and red shiner have mirrored each other's annually alternating (increase/decrease) pattern since 1998. Channel catfish density was lowest in 1999 and has generally increased, especially in secondary channels. If 1998 densities are excluded from analysis, simple linear regression for 1999-2005 shows a significant increasing trend for density of channel catfish in both primary (R=0.843, p=0.017) and secondary channel (R=0.909, p=0.005) samples.

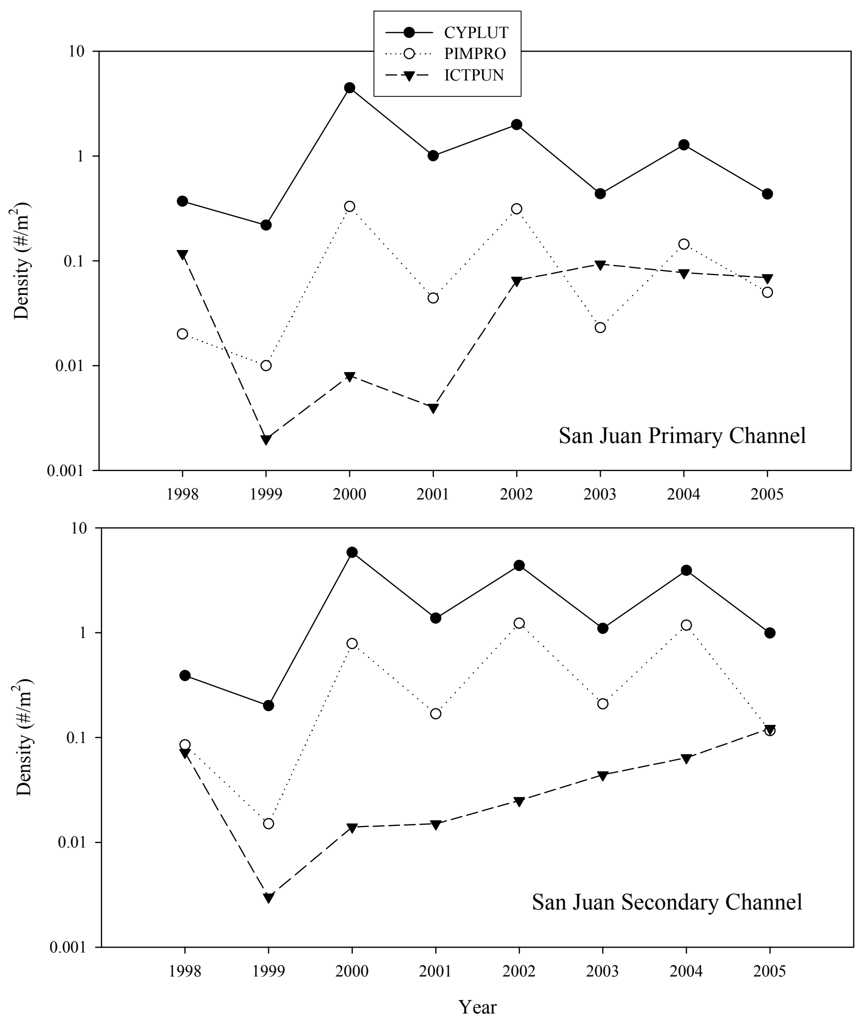

Figure 5. Overall density (total number/total area sampled) of commonly collected nonnative fishes in autumn sampling of the San Juan.

In 2005, approximately 45% of the fishes sampled in primary channels were native; while less than 20% of those sampled in secondary channels were native. Samples in 2000 had the lowest proportion of natives (Figure 6). Primary and secondary channels had similar native/nonnative composition from 1998 through 2002. Recent samples (2003 through 2005) indicated an increasing proportion of natives in the primary channel while their proportion in secondary channel samples has remained fairly constant.

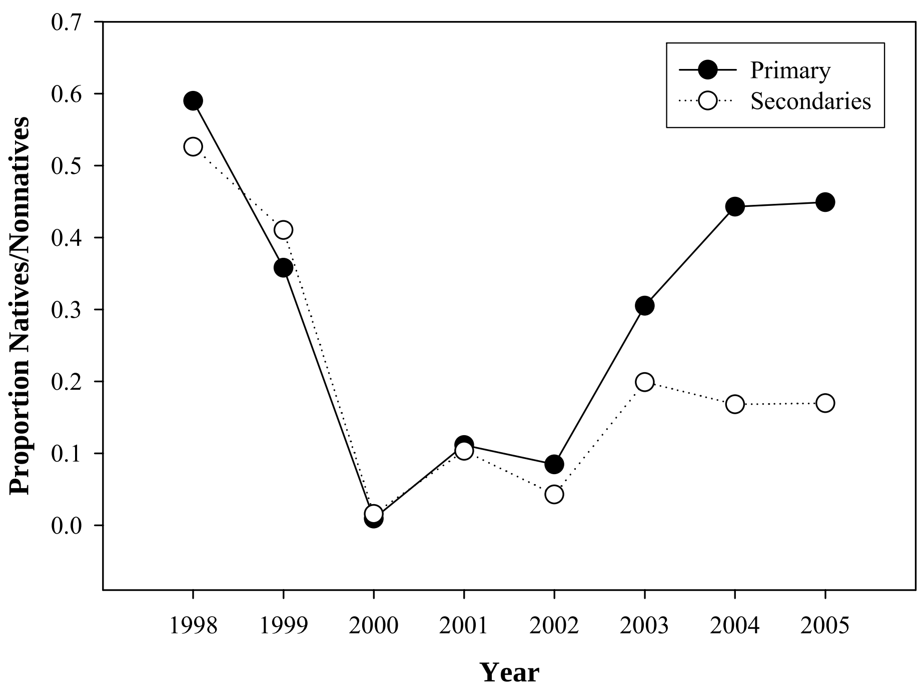

Figure 6. Relative abundance of native and nonnative species collected in autumn sampling on the San Juan River from 1998-2005.

BACKWATER SUMMARY

Three native and seven nonnative fish species were collected in large backwaters of the San Juan in 2005 (Table 11). Colorado pikeminnow has not been collected in a backwater since 2000. Largemouth bass was collected only in backwaters in 2005; none was collected in primary or secondary channel areas this year.

Table 11. Species collected in San Juan River backwaters during autumn, 1999 – 2005, inventories. N = native and I = nonnative. Six-letter code derived from first three letters of genus and species of each taxon.

COMMON	SCIENTIFIC	CODE	STATUS	1999	2000	2001	2002	2003	2004	2005
Black bullhead	*Ameiurus melas*	AMEMEL	I		X	X	X	X		
Bluehead sucker	*Catostomus discobolus*	CATDIS	N		X	X	X	X	X	X
Flannelmouth sucker	*Catostomus latipinnis*	CATLAT	N	X	X	X	X	X	X	X
Red shiner	*Cyprinella lutrensis*	CYPLUT	I	X	X	X	X	X	X	X
Common carp	*Cyprinus carpio*	CYPCAR	I		X	X	X		X	X
Plains killifish	*Fundulus zebrinus*	FUNZEB	I		X	X	X		X	X
Western mosquitofish	*Gambusia affinis*	GAMAFF	I		X	X	X	X	X	X
Channel catfish	*Ictalurus punctatus*	ICTPUN	I	X	X	X	X	X	X	X
Green sunfish	*Lepomis cyanellus*	LEPCYA	I			X	X	X		
Bluegill	*Lepomis macrochirus*	LEPMAC	I		X					
Largemouth bass	*Micropterus salmoides*	MICSAL	I		X					X
Fathead minnow	*Pimephales promelas*	PIMPRO	I	X	X	X	X	X	X	X
Colorado pikeminnow	*Ptychocheilus lucius*	PTYLUC	N	X	X					
Speckled dace	*Rhinichthys osculus*	RHIOSC	N	X	X	X	X	X	X	X
NATIVE			4	3	4	3	3	3	3	3
NONNATIVE			10	3	9	9	7	6	6	7

Similar to primary and secondary channels, red shiner has been the most commonly collected species in backwaters in all years (Table 12). Fathead minnow has consistently been second-most abundant species in backwaters. In 2005, more flannelmouth suckers were collected in backwaters than primary or secondary channels. Flannelmouth sucker numbers in backwaters in 2005 was considerably greater than in previous years. Overall fish density in backwaters was relatively low in 2005 compared to the average from 1999 through 2005; similar densities were noted in 1999 and 2003. The amount of backwater area sampled in 2005 was slightly less than 80% of average area sampled in previous years.

Table 12. Fishes collected in San Juan River backwaters during autumn inventories, 1999 – 2005.

1999		2000		2001		2002		2003		2004		2005	
Species	N	Species	N	Species	N	Species	N	Species	N	Species	N	Species	N
CYPLUT	438	CYPLUT	23898	CYPLUT	4408	CYPLUT	4453	CYPLUT	309	CYPLUT	1031	CYPLUT	536
PIMPRO	10	PIMPRO	878	PIMPRO	401	PIMPRO	1634	PIMPRO	129	PIMPRO	319	PIMPRO	122
RHIOSC	8	GAMAFF	659	CATDIS	71	GAMAFF	132	GAMAFF	17	FUNZEB	24	CATLAT	114
ICTPUN	2	AMEMEL	106	GAMAFF	39	CYPCAR	35	AMEMEL	12	GAMAFF	15	CATDIS	69
PTYLUC	1	ICTPUN	44	RHIOSC	19	RHIOSC	37	ICTPUN	10	ICTPUN	10	GAMAFF	16
		CYPCAR	46	CATLAT	6	ICTPUN	40	CATLAT	6	RHIOSC	10	RHIOSC	12
		CATLAT	33	CYPCAR	4	AMEMEL	14	CATDIS	3	CYPCAR	3	FUNZEB	3
		CATDIS	27	ICTPUN	4	CATLAT	22	RHIOSC	3	CATDIS	2	MICSAL	2
		MICSAL	24	FUNZEB	3	CATDIS	5	LEPCYA	1	CATLAT	1	CYPCAR	1
		RHIOSC	5	AMEMEL	3	FUNZEB	9					ICTPUN	1
		FUNZEB	3	LEPCYA	1	LEPCYA	3						
		LEPMAC	2										
		PTYLUC	1										
TOT N	459		25727		4957		6385		490		1415		876
AREA	242		1576		607		559		313		271		464
DENSITY	1.90		16.32		4.86		11.42		1.57		5.21		1.89

BLUEHEAD SUCKER

The primary channel in Reach 6 continued to have the highest densities of bluehead sucker in 2005. However, none was collected in Reach 6 secondary channels in

2005, where relatively high densities were found in previous years. Bluehead sucker was also absent from primary channel collections in Reach 4 and Reach 1.

Generally, for the study area as a whole, density of bluehead sucker was not significantly different in 2005 than 2004 in primary ($f_{1,681}$=2.176, p=0.141) but was significantly lower in secondary channels ($f_{1,175}$=4.363, p=0.038). Considering each reach independently, bluehead sucker densities in 2005 were significantly lower than in 2004 in all reaches and channels ($t > 1.75_{(\geq 17df)}$, $p < 0.05$), except Reach 6 primary and Reach 3 secondary sampling (Figure 7).

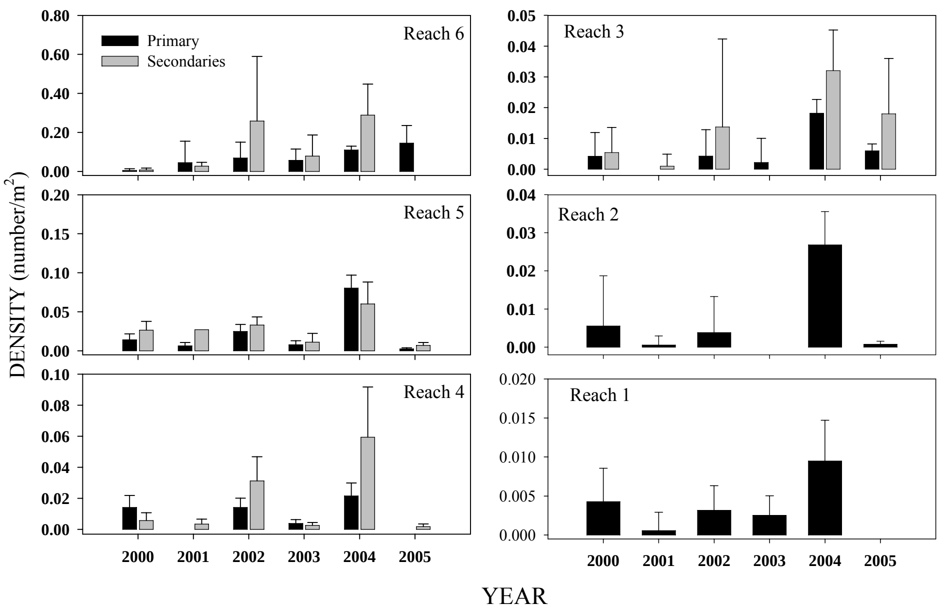

Figure 7. Average autumn densities of bluehead sucker in the primary and secondary channels of the San Juan River, 2000-2005. Error bars represent one standard error. Note change in scale of y-axis.

Bluehead sucker was found in a variety of mesohabitats in 2005 (Figure 8). Normally, specimens were collected in moderate- to fast-velocity habitats in the primary channel, but a few were collected in pools and embayments in Reach 6. Few (n = 7) bluehead suckers were collected in secondary channels in 2005.

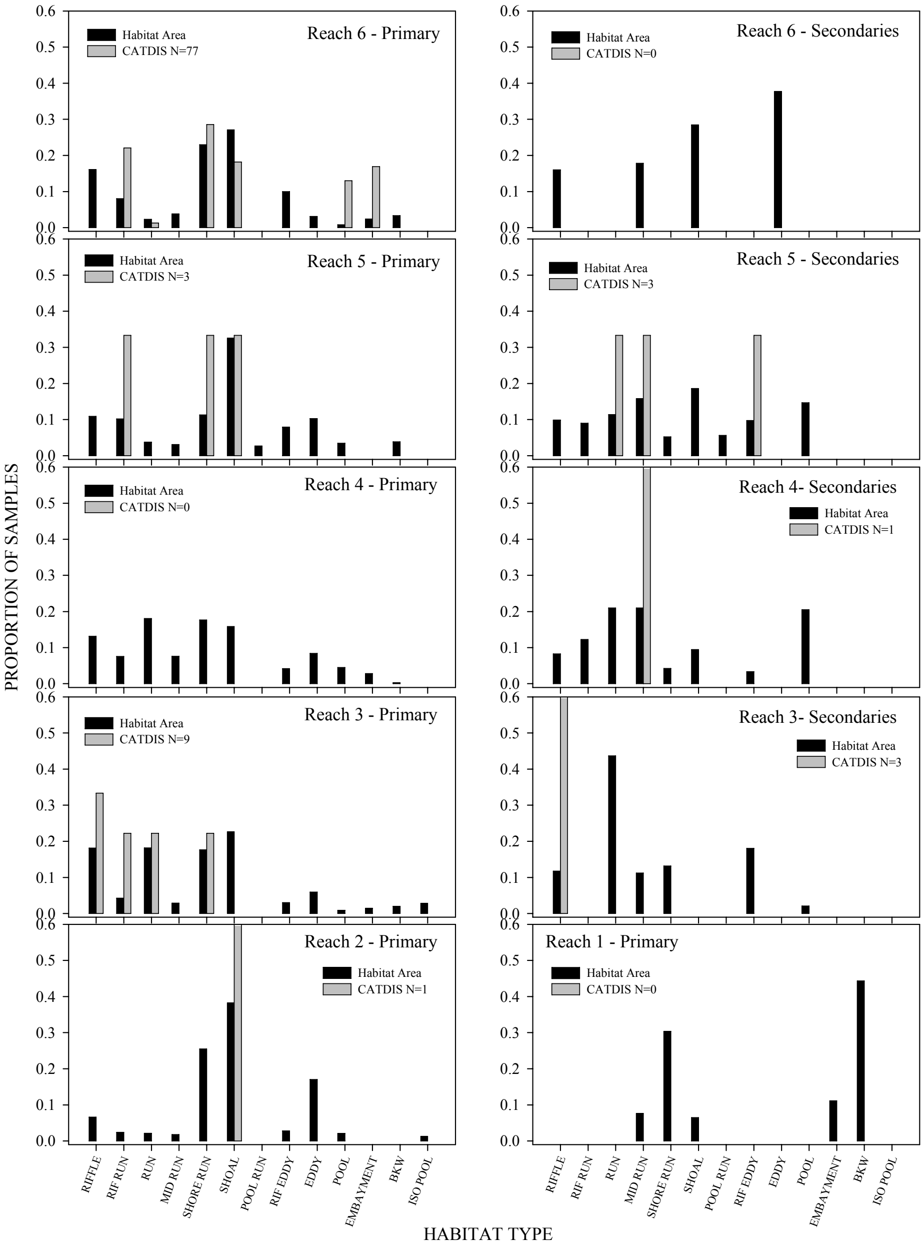

Figure 8. Occurrence of bluehead sucker and area sampled among mesohabitats in autumn sampling, San Juan River, 2005.

FLANNELMOUTH SUCKER

Reach 6 also held the highest densities of flannelmouth sucker through the years (Figure 9). For most years and reaches, slightly higher densities of flannelmouth sucker were found in secondary channels than in the primary channel. No flannelmouth was collected in Reach 1 in 2005. Combining all reaches, there were no significant differences between the density of flannelmouth sucker in 2004 and 2005 in primary ($f_{1,681}$=1.344, p=0.247) or secondary channels ($f_{1,175}$=2.239, p=0.136). However, densities of flannelmouth sucker were significantly lower in 2005 than in 2004 for Reaches 5, 4, and 1 primary channel and Reach 4 secondary channels ($t > 1.75_{(\geq 29df)}$, $p < 0.05$).

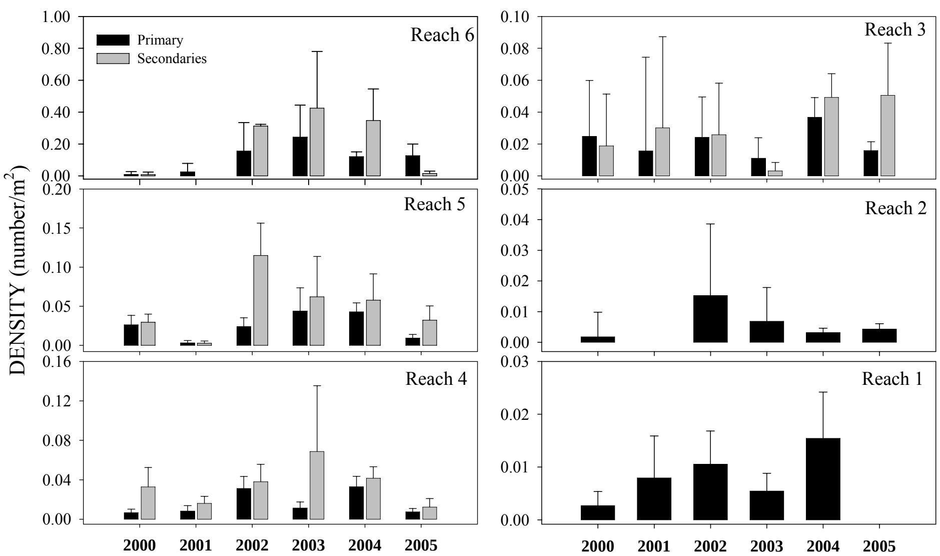

Figure 9. Average autumn densities of flannelmouth sucker in the primary and secondary channels of the San Juan River, 2000-2005. Error bars represent one standard error. Note change in scale of y-axis.

In 2005, flannelmouth sucker was found in all mesohabitats sampled. Most were collected in moderate- to slow-velocities in Reach 6 (Figure 10). More flannelmouth suckers were sampled in the primary channel of Reach 6 than the rest of primary or secondary channel samples combined. Interestingly, nearly as many flannelmouth suckers were found in large Reach 6 backwaters as in the rest of the river. Only one flannelmouth sucker was collected in backwater habitat in Reaches 5 through 1.

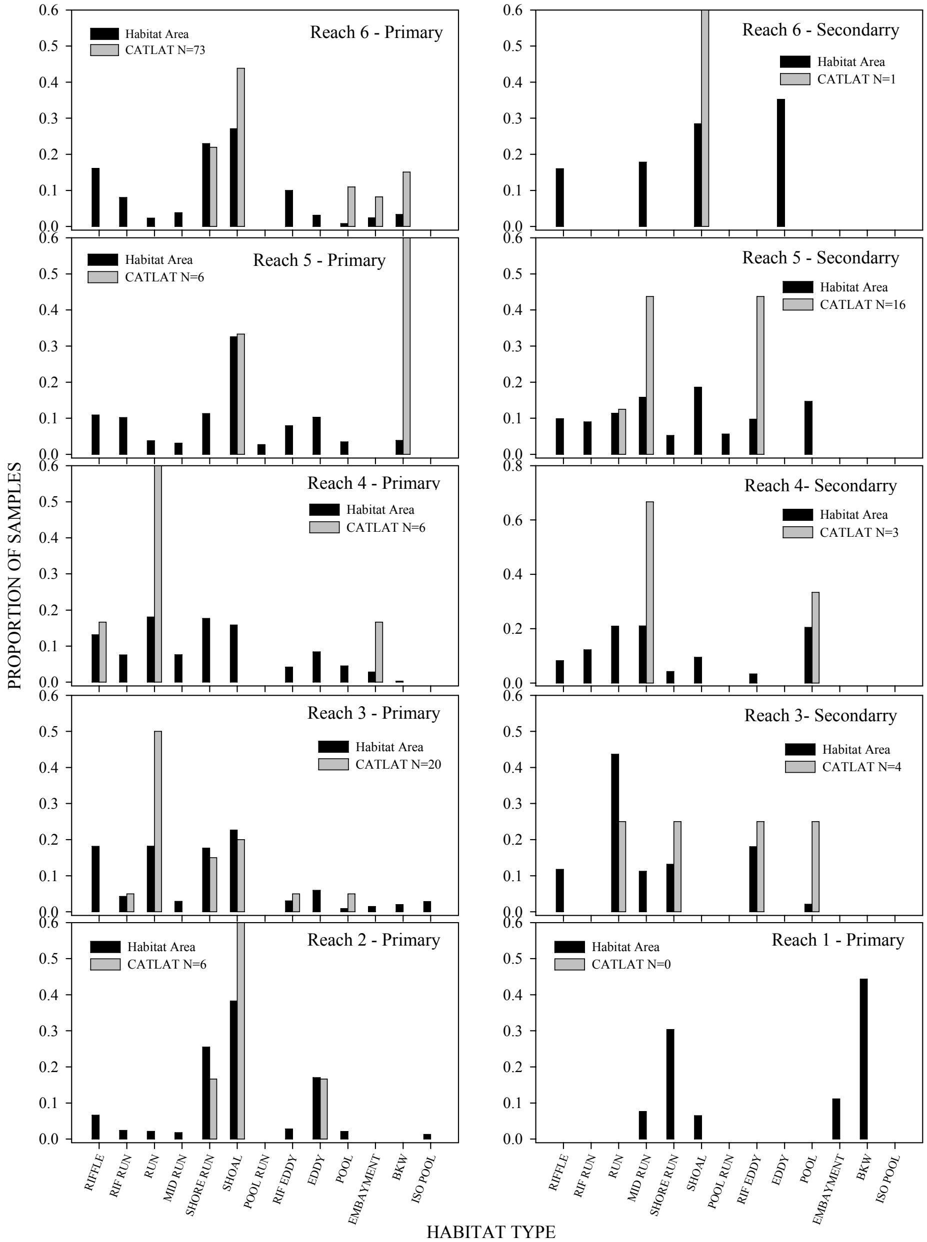

Figure 10. Occurrence of flannelmouth sucker among mesohabitats in autumn sampling, San Juan River, 2005.

SPECKLED DACE

Speckled dace was found in primary and secondary channels in all reaches in 2005. For the study area as a whole, speckled dace density was significantly lower in 2005 than 2004 in both primary ($f_{1,681}$=17.841, p<0.001) and secondary channels

($f_{1,175}$=6.519, p=0.012). By reach, densities were lower in 2005 than in 2004, except for Reach 1 where density increased (Figure 11). Significant decreases were evident in primary and secondary channels of Reaches 5 and 6 and secondary channels in Reach 4 (t > $1.75_{(\geq 17df)}$, p < 0.05). The highest density of speckled dace in all Reaches was in 2004, except for Reach 1 and 2, when highest densities of speckled dace were in 2002.

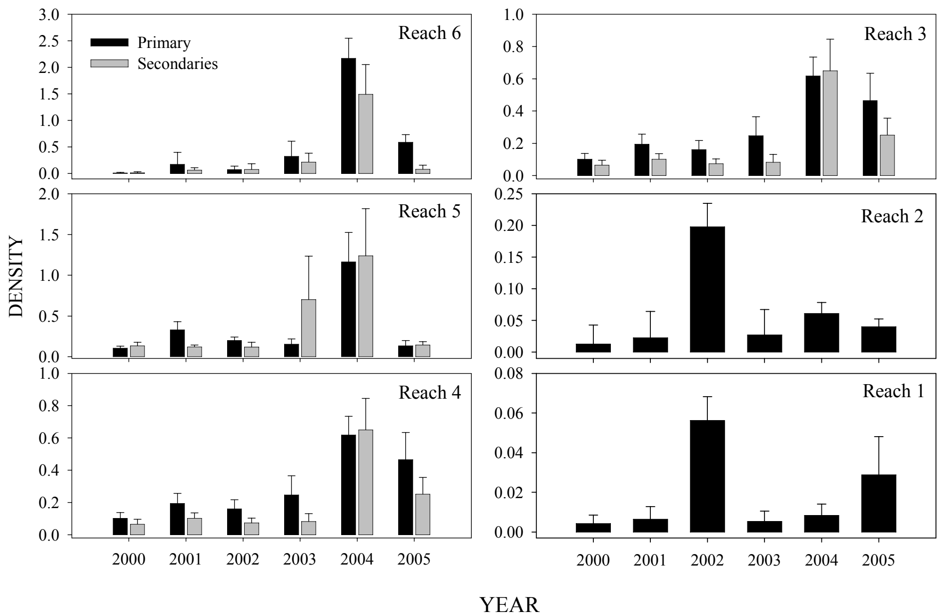

Figure 11. Average autumn densities of speckled dace in the primary and secondary channels of the San Juan River, 2000-2005. Error bars represent one standard error. Note change in scale of y-axis.

Speckled dace was consistently found in riffle and riffle run mesohabitats in 2005 (Figure 12). However, they occurred in all other mesohabitats. Speckled dace had a higher likelihood of being sampled in swift water habitats in secondary channels, but in the primary channel they were more evenly distributed among mesohabitats.

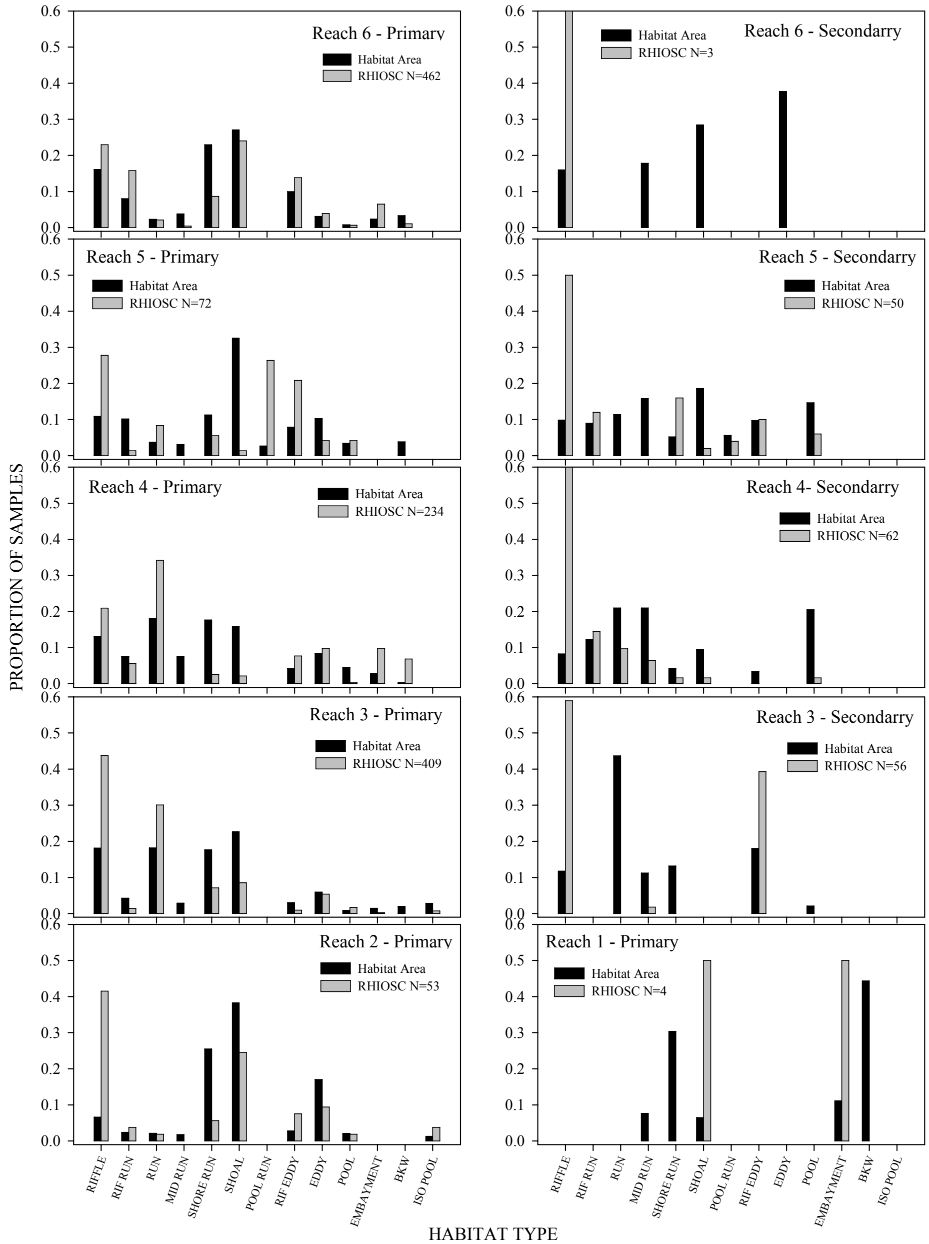

Figure 12. Occurrence of speckled dace among mesohabitats in autumn sampling, San Juan River, 2005.

RED SHINER

Compared to 2004 levels, the density of red shiner decreased in 2005 in both in primary ($f_{1,681}$=4.780, p=0.029) and secondary channels ($f_{1,175}$=12.413, p=0.001); particularly in Reaches 5 and 2 in the primary channel and all secondary channels (t >

$1.75_{(\geq 17df)}$, $p < 0.05$). Highest densities of red shiner varied among Reaches 6 through 3 primary and secondary channels from 2000-2005 (Figure 13). Most reaches had their highest densities of red shiner in 2000, except for Reaches 3 and 2 where similarly high densities were found through 2002.

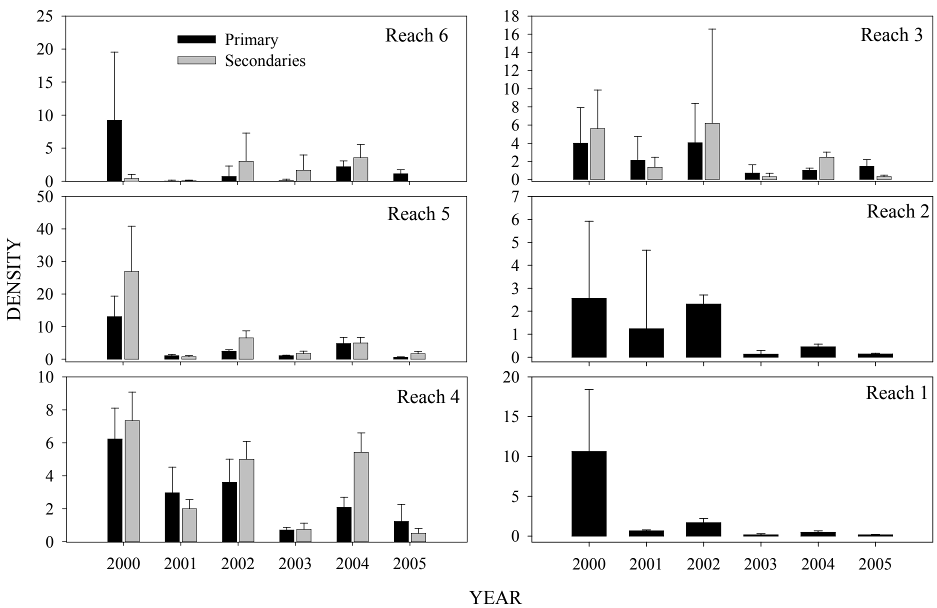

Figure 13. Average autumn densities of red shiner in the primary and secondary channels of the San Juan River, 2000-2005. Error bars represent one standard error. Note change in scale of y-axis.

In 2005, red shiner was more likely to be sampled in slower-velocity primary channel mesohabitats, although a few individuals were found in each type of mesohabitat sampled (Figure 14). Red shiner was distributed among slow, moderate, and rapid velocities in secondary channels. No red shiner was found in Reach 6 secondary channels in 2005.

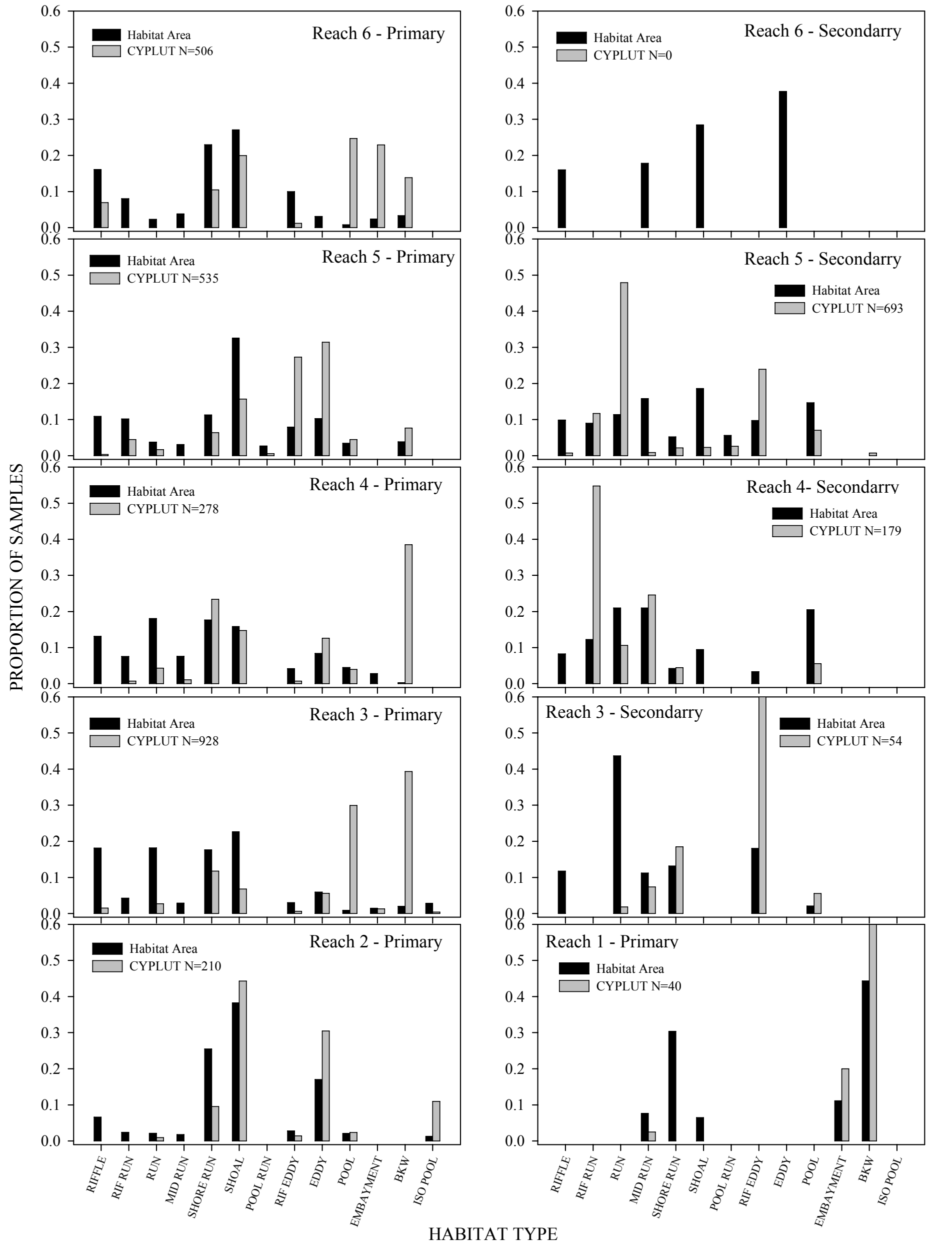

Figure 14. Occurrence of red shiner among mesohabitats in autumn sampling, San Juan River, 2005.

CHANNEL CATFISH

Density of channel catfish was highest in Reaches 4 and 3 (Figure 15). Overall, there was no significant change in densities from 2004 to 2005 in primary ($f_{1,681}$=0.106, p=0.745) or secondary channels ($f_{1,175}$=1.585, p=0.210). In 2005, there was a significant decrease in density from 2004 levels in Reach 5 primary channels ($t = 3.12_{(106df)}$, $p < 0.05$). There was an increase in channel catfish density in Reach 3 secondary channels ($t = 1.40_{(143df)}$, $p < 0.10$) in 2005. Only two catfish were collected in Reach 6 in the last six years, both in 2004 in the primary channel.

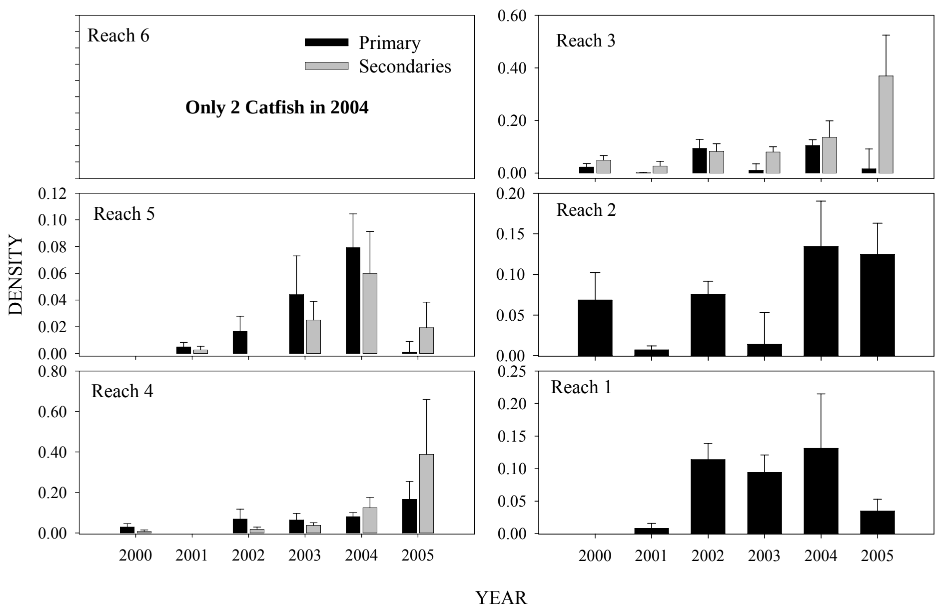

Figure 15. Average autumn densities of channel catfish in the primary and secondary channels of the San Juan River, 2000-2005. Error bars represent one standard error. Note change in scale of y-axis.

Channel catfish was collected in a variety of mesohabitats in 2005 (Figure 16). However, a majority of channel catfishes was found in moderate-velocity mesohabitats. At least a few channel catfish were collected in eddy habitat, if it was sampled in a given reach. Very few channel catfish (n = 3) were collected in Reach 5.

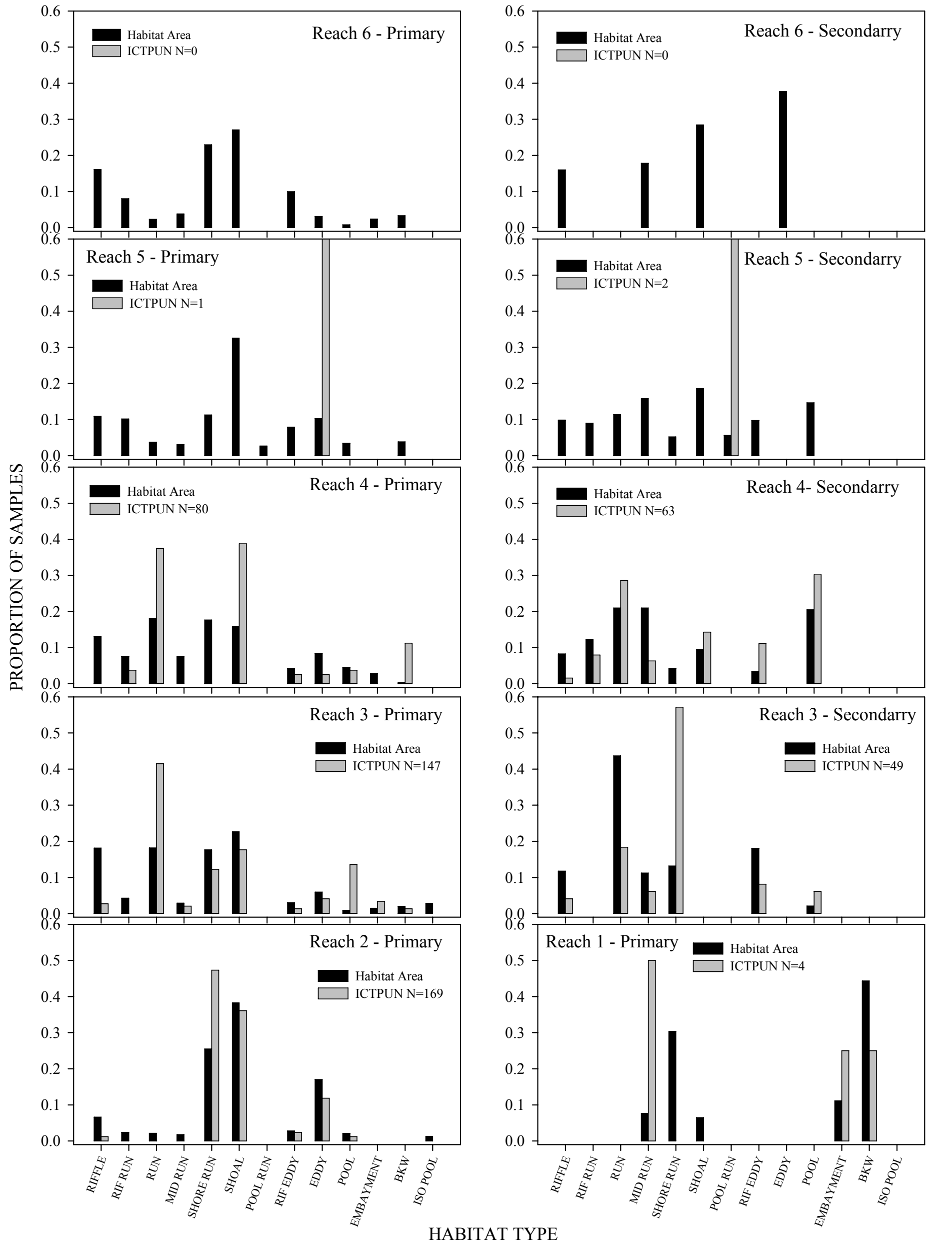

Figure 16. Occurrence of channel catfish among mesohabitats in autumn sampling, San Juan River, 2005.

FATHEAD MINNOW

Considering the entire study reach, 2005 density was somewhat, but not significantly, lower than 2004 density in primary ($f_{1,681}$=2.682, p=0.102) and secondary channels ($f_{1,175}$=2.370, p=0.125). Fathead minnow was irregularly collected in Reach 6

(Figure 17). Reach 5 had a significant decrease in fathead minnow densities in both primary and secondary channels from 2004 to 2005 ($t > 1.75_{(\geq 49df)}$, $p < 0.05$). Reach 4 had a similar decrease in secondary channel densities ($t > 3.25_{(60df)}$, $p < 0.05$). Generally, fathead minnow was more common in secondary channels.

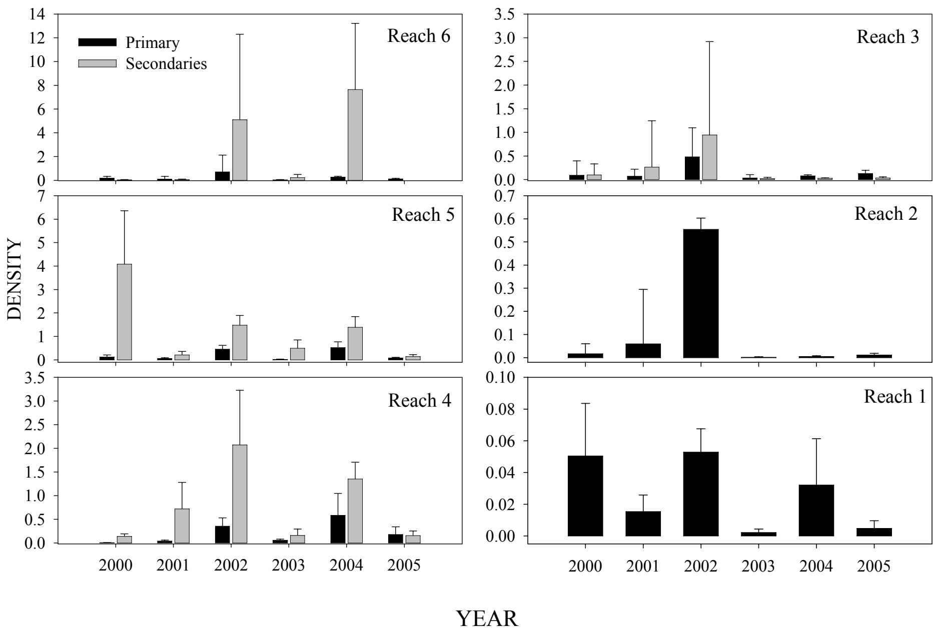

Figure 17. Average autumn densities of fathead minnow in the primary and secondary channels of the San Juan River, 2000-2005. Error bars represent one standard error. Note change in scale of y-axis.

Fathead minnow was not collected in riffles in any Reach in 2005 (Figure 18). Generally fathead minnow had a patchy distribution and was more likely to be sampled in slower velocity habitats. If backwater habitat was present, fathead minnow was present. No fathead minnow was found in Reach 6 secondary channels.

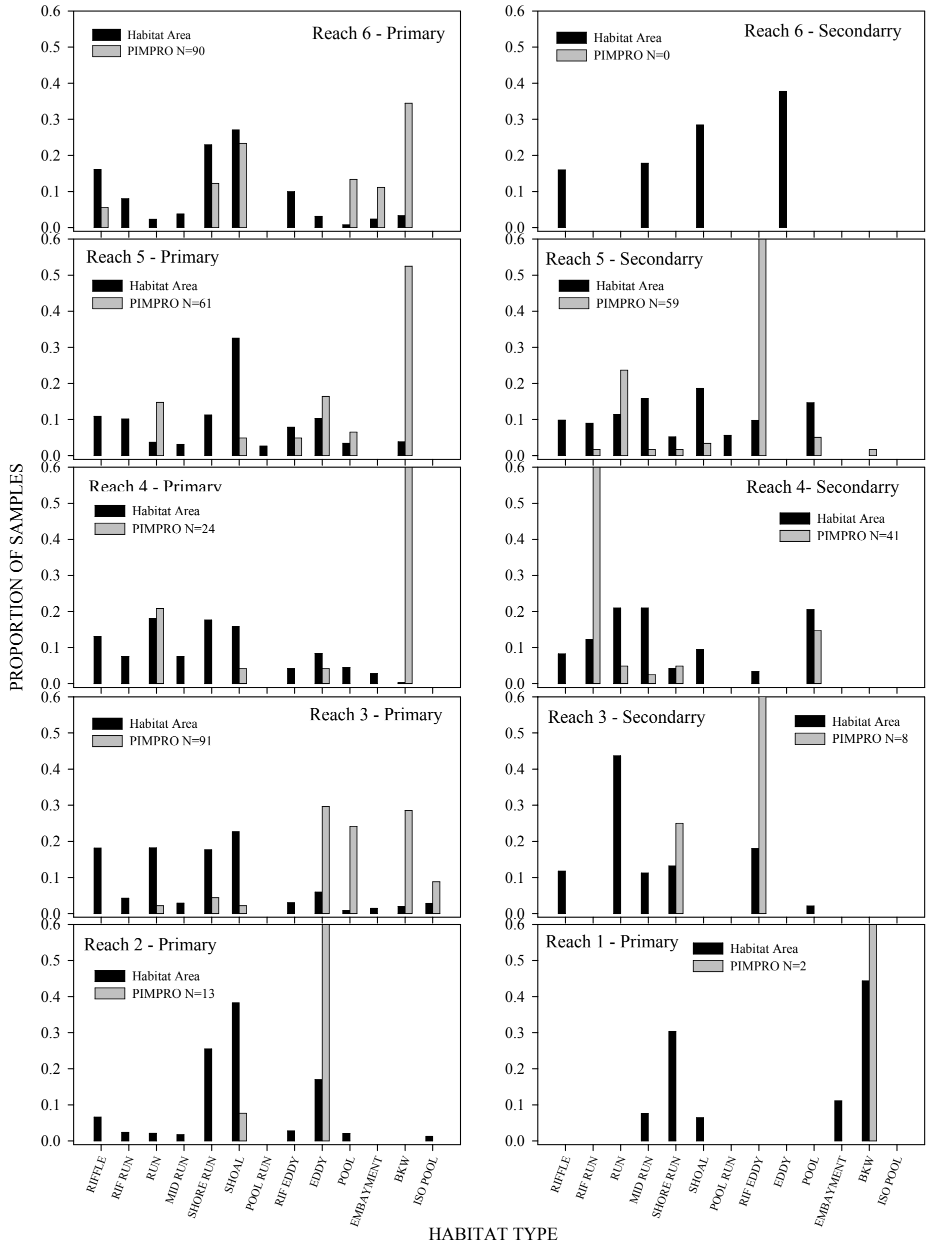

Figure 18. Occurrence of fathead minnow among mesohabitats in autumn sampling, San Juan River, 2005.

REACH 6 SUMMARY

Seven species were collected in the primary channel in Reach 6 in 2005 (Table 13). Red shiner was the most commonly collected, with speckled dace a close second. Those two species comprised nearly 80% of the fishes collected in 2005 in Reach 6. No catfish, bass, or carp was collected in Reach 6 primary channel in 2005. Total fish density was highly variable among years, and density in 2005 was less than half of mean density from 2000 through 2004. Relative abundance of native and nonnative fishes was similar in 2005 and diversity was slightly higher than in 2004 (Figure 19). In 2000, nearly all of the fishes collected in Reach 6 primary channels were nonnatives. The highest proportion of native fishes in the last six years of sampling was in 2003.

Only one small secondary channel was sampled in Reach 6 in 2005; less than one third of the area collected in 2004 (Table 14). Three speckled dace and one flannelmouth sucker were collected. It was the lowest density of fishes in six years for Reach 6 secondary channels. It was also the first time in six years that no nonnative fish was collected (Figure 20).

Table 13. Number and density (number/m^2) of fishes in San Juan River primary channel in Geomorphic Reach 6 during autumn, 2000– 2005.

2000			2001			2002			2003			2004			2005		
SPECIES	N	DENSITY	SPECIES	N	DENSITY	SPECIES	N	DENSITY	SPECIES	N	DENSITY	SPECIES	N	DENSITY	SPECIES	N	DENSITY
CYPLUT	2058	7.221	PIMPRO	51	0.108	CYPLUT	316	0.704	RHIOSC	123	0.302	CYPLUT	2530	2.377	CYPLUT	506	0.568
GAMAFF	202	0.712	RHIOSC	48	0.102	PIMPRO	229	0.51	CATLAT	101	0.248	RHIOSC	1914	1.798	RHIOSC	462	0.519
PIMPRO	38	0.133	CYPLUT	35	0.074	CATLAT	74	0.164	CYPLUT	55	0.136	PIMPRO	238	0.224	PIMPRO	90	0.101
RHIOSC	2	0.007	GAMAFF	26	0.055	GAMAFF	40	0.089	CATDIS	21	0.052	CATLAT	117	0.11	CATDIS	77	0.087
CATLAT	2	0.007	CATLAT	12	0.026	CATDIS	35	0.078	GAMAFF	19	0.047	CATDIS	94	0.088	CATLAT	73	0.082
CATDIS	1	0.004	CATDIS	5	0.011	RHIOSC	33	0.073	PIMPRO	14	0.034	GAMAFF	43	0.04	GAMAFF	4	0.005
FUNZEB	1	0.004	CYPCAR	1	0.002	FUNZEB	5	0.011				MICSAL	3	0.003	FUNZEB	1	0.001
			FUNZEB	1	0.002							FUNZEB	2	0.002			
												ICTPUN	2	0.002			
												CYPCAR	1	0.001			
												LEPCYA	1	0.001			
TOTAL N	2304			179			732			333			4945			1213	
AREA	285			471			449			407.2			1064			890	
DENSITY	8.084			0.38			1.786			0.818			4.64			1.36	
H	0.401			1.649			1.435			1.498			1.076			1.270	

Table 14. Number and density (number/m^2) of fishes in San Juan River secondary channel in Geomorphic Reach 6 during autumn, 2000– 2005.

2000			2001			2002			2003			2004			2005		
SPECIES	N	DENSITY	SPECIES	N	DENSITY	SPECIES	N	DENSITY	SPECIES	N	DENSITY	SPECIES	N	DENSITY	SPECIES	N	DENSITY
GAMAFF	87	0.713	GAMAFF	25	0.073	PIMPRO	415	4.428	CYPLUT	570	2.421	PIMPRO	638	3.426	RHIOSC	3	0.050
CYPLUT	58	0.475	RHIOSC	20	0.058	GAMAFF	269	2.892	CATLAT	100	0.425	RHIOSC	279	1.498	CATLAT	1	0.017
CYPCAR	9	0.074	CYPLUT	19	0.056	CYPLUT	246	2.631	RHIOSC	64	0.272	CYPLUT	269	1.445			
PIMPRO	5	0.041	PIMPRO	18	0.053	FUNZEB	36	0.387	PIMPRO	54	0.229	CATDIS	52	0.279			
MICSAL	4	0.033	CATDIS	9	0.026	CATLAT	29	0.312	GAMAFF	21	0.089	CATLAT	51	0.274			
RHIOSC	2	0.016	FUNZEB	2	0.006	CATDIS	27	0.289	CATDIS	19	0.081	GAMAFF	42	0.226			
CATLAT	1	0.008	MICSAL	1	0.003	RHIOSC	8	0.086	CYPCAR	2	0.008	FUNZEB	4	0.021			
CATDIS	1	0.008	ONCMYK	1	0.003	CYPCAR	5	0.053	MICSAL	1	0.004	MICSAL	4	0.021			
												CYPCAR	1	0.005			
TOTAL N	168			94			1035			831			1340			4	
AREA	122			342			93			235.4			186			59.4	
DENSITY	1.377			0.275			11.129			3.53			7.204			0.0168	
H	1.203			1.649			1.434			1.09			1.402			0.563	

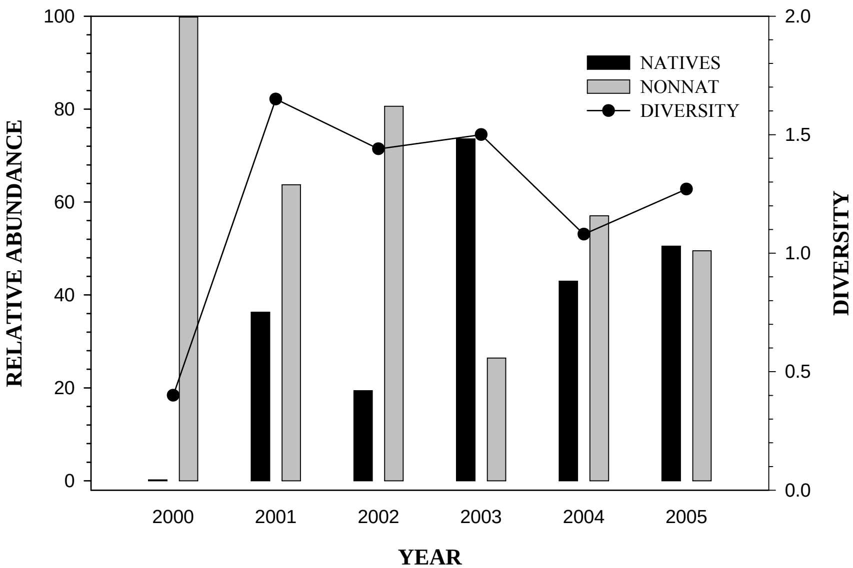

Figure 19. Relative abundance of native and nonnative fishes and assemblage diversity in Reach 6 primary channels.

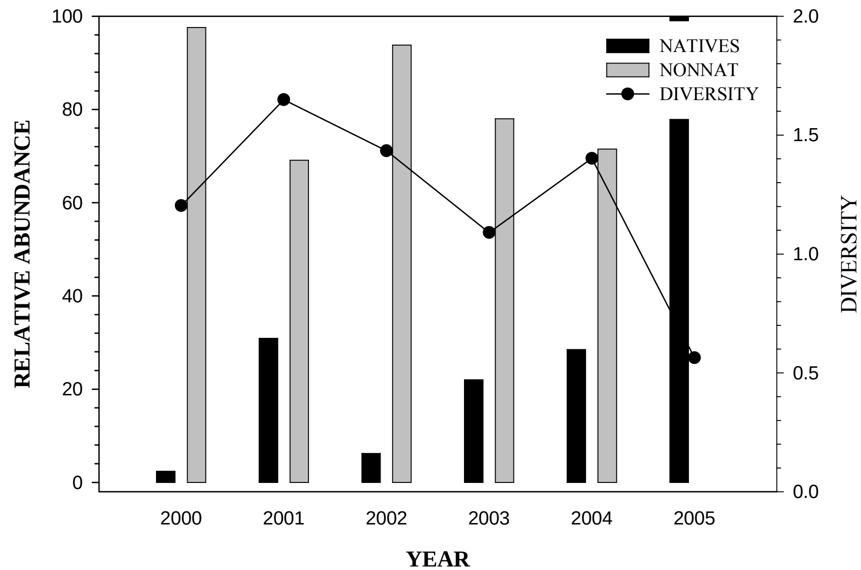

Figure 20. Relative abundance of native and nonnative fishes and assemblage diversity in Reach 6 secondary channels.

After having no backwater sampled in Reach 6 in 2004, six were sampled in 2005 (Table 15). Red shiner was the most commonly collected species each year that backwaters were sampled. Flannelmouth sucker was never abundant in backwaters in previous years, but in 2005, one-hundred-thirteen individuals were collected in Reach 6 backwaters. Sixty-nine bluehead suckers were also found in 2005.

Table 15. Number and density (number/m^2) of fishes in San Juan River backwaters in Geomorphic Reach 6 (RM 180 – RM 155) during autumn, 2000 – 2005.

2000			2001			2002	2003			2004	2005		
SPECIES	N	DEN	SPECIES	N	DEN		SPECIES	N	DEN		SPECIES	N	DEN
						N				**N**			
CYPLUT	481	4.076	CYPLUT	708	23.6	**O**	CYPLUT	10	0.333	**O**	CYPLUT	399	2.375
PIMPRO	162	1.373	PIMPRO	191	6.367		PIMPRO	8	0.267		CATLAT	113	0.673
GAMAFF	66	0.56	CATDIS	70	2.333	**B**	CATLAT	2	0.067	**B**	PIMPRO	75	0.446
MICSAL	16	0.136	GAMAFF	25	0.833	**A**	GAMAFF	2	0.67	**A**	CATDIS	69	0.411
CATDIS	6	0.051	FUNZEB	2	0.067	**C**				**C**	GAMAFF	12	0.071
CYPCAR	5	0.042	CYPCAR	1	0.033	**K**				**K**	RHIOSC	10	0.059
RHIOSC	2	0.017	RHIOSC	1	0.033	**W**				**W**			
CATLAT	2	0.017	CATLAT	1	0.033	**A**				**A**			
FUNZEB	2	0.017	AMEMEL	1	0.033	**T**				**T**			
						E				**E**			
						R				**R**			
						S				**S**			
N Backwtr	3			2				2				6	
N FISH	741			1001				22				678	
AREA	118			30				30				168	
DENSITY	6.28			33.367				0.733				4.04	
H	1.025			0.885				1.162				1.219	

REACH 5 SUMMARY

Density of fishes in 2005 in Reach 5 primary channel was the lowest in six years (Table 16), less than 20% of average density from 2000 through 2004. Red shiner was the most abundant fish in all years. Speckled dace has been second-most abundant for past three years. A single razorback sucker was collected for the first time in small-bodied monitoring. No carp, plains killifish, or largemouth bass was collected in Reach 5 primary channel in 2005. Nonnative fishes comprised nearly 90% of the sample in 2005 (Figure 21). Nonnatives have numerically dominated the collections (>70%) in Reach 5 for six years.

Density of fishes in Reach 5 secondary channels was also lower in 2005 than in any year since 2001 (Table 17). Red shiner and fathead minnow were the most commonly collected species for six years. No common carp, plains killifish, or largemouth bass was collected in 2005. For six years, nearly 90% of the collections were nonnative fishes in Reach 5 secondary channels (Figure 22). Lowest diversity was in 2000 and 2005, while highest diversity was found in 2001 and 2004. Colorado pikeminnow was collected in both primary and secondary channels of Reach 5 in 2004, but none was found in 2005.

Similar to 2004, seven species were collected in Reach 5 backwaters in 2005 (Table 18). No bluehead sucker or common carp was collected in 2005; plains killifish and flannelmouth sucker were collected. Fish density was the lowest in six years, with the second-greatest area sampled. Backwater area sampled was greatest in 2000. Red shiner and fathead minnow were the most commonly collected species from 2000 through 2005.

Table 16. Number and density (number/m^2) of fishes in San Juan River primary channel in Geomorphic Reach 5 during autumn, 2000– 2005.

2000			2001			2002			2003			2004			2005		
SPECIES	N	DENSITY	SPECIES	N	DENSITY	SPECIES	N	DENSITY	SPECIES	N	DENSITY	SPECIES	N	DENSITY	SPECIES	N	DENSITY
CYPLUT	5219	10.522	CYPLUT	376	0.855	CYPLUT	1033	2.311	CYPLUT	363	0.929	CYPLUT	3325	2.522	CYPLUT	535	0.560
GAMAFF	250	0.504	RHIOSC	122	0.277	PIMPRO	206	0.461	RHIOSC	49	0.125	RHIOSC	1421	1.078	RHIOSC	72	0.075
RHIOSC	44	0.088	PIMPRO	19	0.043	GAMAFF	80	0.179	GAMAFF	15	0.038	PIMPRO	321	0.244	PIMPRO	61	0.064
PIMPRO	42	0.085	GAMAFF	14	0.032	RHIOSC	76	0.17	CATLAT	14	0.036	CATDIS	95	0.072	GAMAFF	9	0.009
CATLAT	10	0.02	CATDIS	2	0.005	CATDIS	10	0.022	ICTPUN	14	0.036	ICTPUN	84	0.064	CATLAT	6	0.006
CATDIS	6	0.012	ICTPUN	2	0.005	CATLAT	8	0.018	PIMPRO	7	0.018	GAMAFF	44	0.033	CATDIS	3	0.003
FUNZEB	1	0.002	CATLAT	1	0.002	ICTPUN	7	0.016	CATDIS	2	0.006	CATLAT	39	0.03	ICTPUN	1	0.001
			MICSAL	1	0.002	CYPCAR	2	0.005				FUNZEB	5	0.004	XYRTEX	1	0.001
												CYPCAR	3	0.002			
												PTYLUC	3	0.002			
												MICSAL	1	0.001			
TOTAL N	5572			537			1428			464			5341			688	
AREA	496			440			447			390.8			1318			955	
DENSITY	11.234			1.22			3.195			1.187			4.045			0.72	
H	0.296			0.865			0.94			0.838			1.045			0.787	

Table 17. Number and density (number/m^2) of fishes in San Juan River secondary channels in Geomorphic Reach 5 (RM 155 – RM 131) during autumn 2000 - 2005.

2000			2001			2002			2003			2004			2005		
SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN
CYPLUT	8984	22.074	CYPLUT	219	0.619	CYPLUT	2790	6.906	CYPLUT	426	1.41	CYPLUT	1723	6.680	CYPLUT	693	1.458
PIMPRO	1352	3.322	PIMPRO	38	0.107	PIMPRO	592	1.465	PIMPRO	143	0.473	PIMPRO	460	1.780	PIMPRO	59	0.124
GAMAFF	812	1.995	RHIOSC	35	0.099	GAMAFF	195	0.483	RHIOSC	81	0.268	RHIOSC	319	1.240	RHIOSC	50	0.105
CYPCAR	160	0.393	GAMAFF	29	0.082	CATLAT	51	0.126	ICTPUN	6	0.02	GAMAFF	39	0.150	GAMAFF	43	0.090
RHIOSC	48	0.118	FUNZEB	2	0.006	RHIOSC	49	0.121	GAMAFF	4	0.013	CATDIS	19	0.070	CATLAT	16	0.034
CATLAT	10	0.025	CATLAT	1	0.003	FUNZEB	16	0.04	CATDIS	3	0.01	CATLAT	15	0.060	CATDIS	3	0.006
CATDIS	8	0.02	ICTPUN	1	0.003	CATDIS	14	0.035	CATLAT	3	0.01	ICTPUN	9	0.030	ICTPUN	2	0.004
MICSAL	3	0.007				CYPCAR	11	0.027	FUNZEB	3	0.01	CYPCAR	7	0.030	AMEMEL	1	0.002
						AMEMEL	1	0.002				FUNZEB	7	0.030			
												PTYLUC	3	0.010			
												AMEMEL	2	0.010			
												LEPCYA	1	0.000			
												MICSAL	1	0.000			
N	11377			325			3719			669			2605			867	
AREA	407			354			404			302			258			475	
DENSITY	27.953			0.918			9.205			2.214			10.097			1.83	
H	0.725			1.039			0.842			1.018			1.036			0.791	

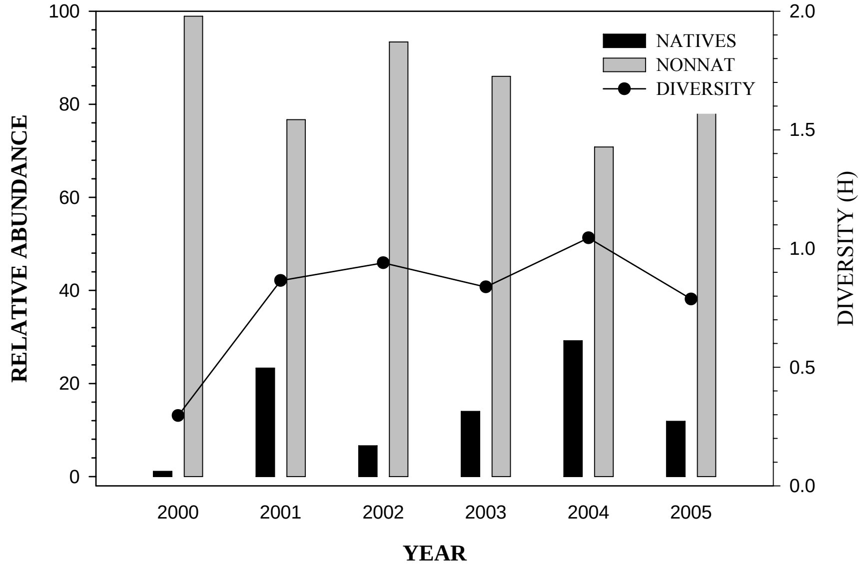

Figure 21. Relative abundance of native and nonnative fishes and assemblage diversity in Reach 5 primary channel.

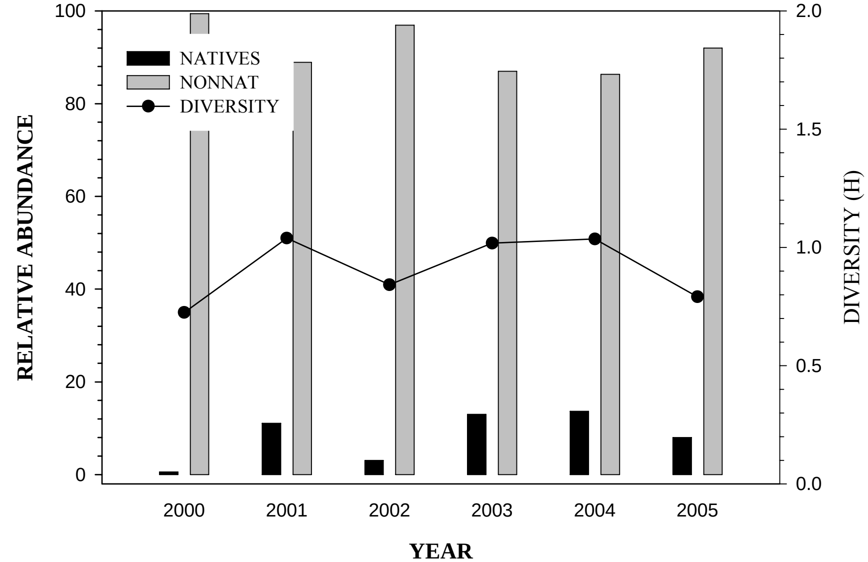

Figure 22. Relative abundance of native and nonnative fishes and assemblage diversity in Reach 5 secondary channels.

Table 18. Number and density (number/m^2) of fishes in San Juan River backwaters in Geomorphic Reach 5 (RM 155 – RM 131) during autumn 2000 - 2005.

2000			2001			2002			2003			2004			2005		
SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN
CYPLUT	4965	15.965	CYPLUT	909	5.476	CYPLUT	875	8.413	PIMPRO	101	0.842	CYPLUT	262	7.005	CYPLUT	93	0.427
PIMPRO	274	0.881	PIMPRO	65	0.392	PIMPRO	250	2.404	CYPLUT	98	0.817	PIMPRO	36	0.963	PIMPRO	33	0.151
GAMAFF	118	0.379	RHIOSC	3	0.018	GAMAFF	12	0.115	CATLAT	4	0.033	RHIOSC	6	0.16	GAMAFF	4	0.018
CATDIS	8	0.026	CATDIS	1	0.006	CATLAT	7	0.01	GAMAFF	4	0.033	GAMAFF	3	0.08	FUNZEB	3	0.014
CYPCAR	4	0.013	CATLAT	1	0.006	CATDIS	1	0.01	CATDIS	2	0.017	CATDIS	2	0.053	RHIOSC	2	0.009
CATLAT	3	0.01	GAMAFF	1	0.006	CYPCAR	1	0.01	RHIOSC	1	0.008	CYPCAR	2	0.053	CATLAT	1	0.005
RHIOSC	1	0.003	LEPCYA	1	0.006	FUNZEB	1	0.01				ICTPUN	1	0.027	ICTPUN	1	0.005
ICTPUN	1	0.003															
MICSAL	1	0.003															
N Backwtr	9			6			6			5			2			5	
N	5375			983			1147			210			312			137	
AREA	311			166			104			120			37.4			218	
DENSITY	17.289			3.944			11.058			1.75			8.342			0.628	
H	0.333			0.31			0.636			0.928			0.6			0.922	

REACH 4 SUMMARY

Only five species were collected in Reach 4 primary channel in 2005, the fewest in six years (Table 19). Fish density was also lower than in previous years. Red shiner was the most abundant species for six years; speckled dace were second-most abundant. No bluehead sucker was captured in the primary channel of Reach 4 in 2005. The proportion of native species and assemblage diversity has increased each of the past six years (Figure 23).

Ten species were collected in Reach 4 secondary channels in 2005, including one Colorado pikeminnow (Table 20). Colorado pikeminnow had not been collected in Reach 4 secondary channels since 2000. Fish density was lower in 2005 that in preceding 5 years. Red shiner was the most commonly collected species in all years. Fathead minnow second-most common from 2001 through 2004; however, channel catfish ranked second in 2005. Proportion of native fishes was higher in 2005 than in previous 5 years (Figure 24). Though not consistent, it appears that diversity is increasing over time.

Only one backwater was sampled in Reach 4 in 2005 (Table 21). Three red shiner and one fathead were found in 19 m^2 of habitat. This was the lowest fish density and least amount of habitat sampled in Reach 4 backwaters in six years. The highest fish density in backwaters was in 2000 when 9 backwaters were sampled. Fathead minnow and red shiner were the most commonly collected species in all years.

Table 19. Number and density (number/m^2) of fishes in San Juan River primary channel in Geomorphic Reach 4 during autumn 2000 - 2005.

2000			2001			2002			2003			2004			2005		
SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN
CYPLUT	3616	3.649	CYPLUT	1007	3.334	CYPLUT	1704	3.221	CYPLUT	370	0.698	CYPLUT	1955	1.252	CYPLUT	278	0.338
RHIOSC	50	0.051	RHIOSC	62	0.205	PIMPRO	151	0.327	RHIOSC	127	0.24	RHIOSC	641	0.41	RHIOSC	234	0.284
GAMAFF	11	0.011	PIMPRO	12	0.04	RHIOSC	92	0.2	ICTPUN	37	0.07	PIMPRO	419	0.268	ICTPUN	80	0.097
CYPCAR	4	0.004	GAMAFF	5	0.017	ICTPUN	34	0.074	PIMPRO	30	0.057	ICTPUN	119	0.076	PIMPRO	24	0.029
CATLAT	4	0.004	CATLAT	2	0.007	GAMAFF	17	0.037	CATLAT	5	0.009	CATLAT	34	0.022	CATLAT	6	0.007
ICTPUN	4	0.004	FUNZEB	2	0.007	CATLAT	17	0.037	FUNZEB	4	0.008	GAMAFF	27	0.017			
PIMPRO	3	0.003				CATDIS	7	0.015	CATDIS	2	0.004	CATDIS	19	0.012			
CATDIS	1	0.001				CYPCAR	4	0.009	LATDIS	1	0.002	FUNZEB	18	0.012			
FUNZEB	1	0.001				FUNZEB	2	0.004	LEPCYA	1	0.002	AMEMEL	1	0.001			
N	3794			1090			2029			577			3234			622	
AREA	991			302			461			530			1562			823	
DENSITY	3.828			3.609			4.401			1.091			2.07			0.755	
H	0.129			0.334			0.671			1.065			1.163			1.162	

Table 20. Number and density (number/m^2) of fishes in San Juan River secondary channel in Geomorphic Reach 4 during autumn 2000 - 2005.

2000			2001			2002			2003			2004			2005		
SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN
CYPLUT	2792	5.132	CYPLUT	708	2.192	CYPLUT	1502	4.457	CYPLUT	467	0.981	CYPLUT	3943	5.356	CYPLUT	179	0.514
CYPCAR	118	0.217	PIMPRO	131	0.406	PIMPRO	509	1.51	PIMPRO	102	0.214	PIMPRO	1008	1.369	ICTPUN	63	0.181
GAMAFF	77	0.141	RHIOSC	43	0.133	RHIOSC	24	0.071	CATLAT	48	0.101	RHIOSC	578	0.785	RHIOSC	62	0.178
PIMPRO	74	0.136	GAMAFF	38	0.118	CATLAT	10	0.03	RHIOSC	44	0.092	ICTPUN	58	0.079	PIMPRO	41	0.118
RHIOSC	31	0.057	FUNZEB	16	0.05	CYPCAR	8	0.024	ICTPUN	25	0.053	GAMAFF	46	0.062	CATLAT	3	0.009
MICSAL	11	0.02	CATLAT	4	0.012	CATDIS	8	0.024	FUNZEB	7	0.015	CATDIS	34	0.046	AMEMEL	2	0.006
CATLAT	9	0.016	ICTPUN	3	0.009	ICTPUN	6	0.018	AMEMEL	4	0.008	CATLAT	26	0.035	GAMAFF	2	0.006
PTYLUC	3	0.005	CATDIS	1	0.003	AMEMEL	3	0.009	GAMAFF	4	0.008	FUNZEB	21	0.029	AMENAT	1	0.003
CATDIS	2	0.004	AMENAT	1	0.003	GAMAFF	3	0.009	CATDIS	2	0.004	AMEMEL	4	0.005	CATDIS	1	0.003
ICTPUN	2	0.004	CYPCAR	1	0.003	FUNZEB	2	0.006				CYPCAR	2	0.003	PTYLUC	1	0.003
FUNZEB	1	0.002										MICSAL	1	0.001			
N	3111			946			2075			703			5722			355	
AREA	544			323			337			476			736			348	
DENSITY	5.719			2.929			6.22			1.477			7.774			1.02	
H	0.483			0.892			0.741			1.149			0.966			1.354	

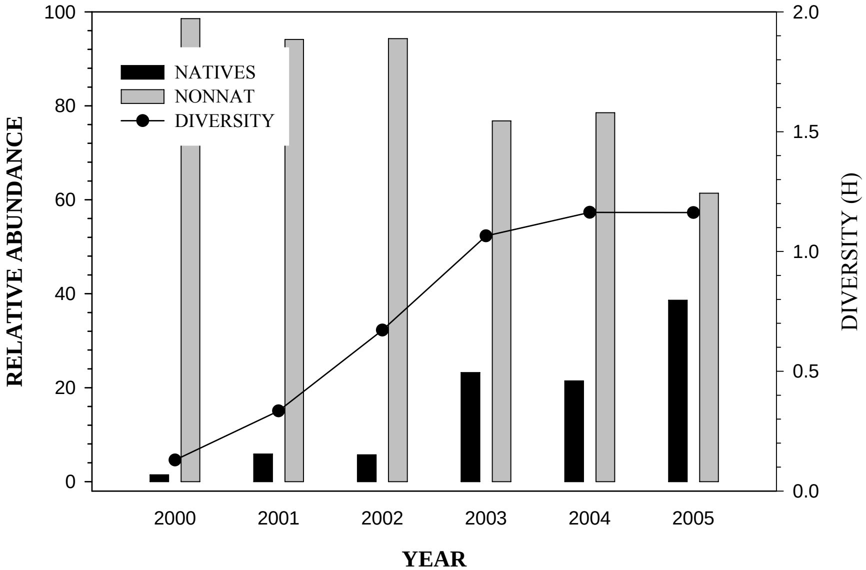

Figure 23. Relative abundance of native and nonnative fishes and assemblage diversity in Reach 4 primary channel.

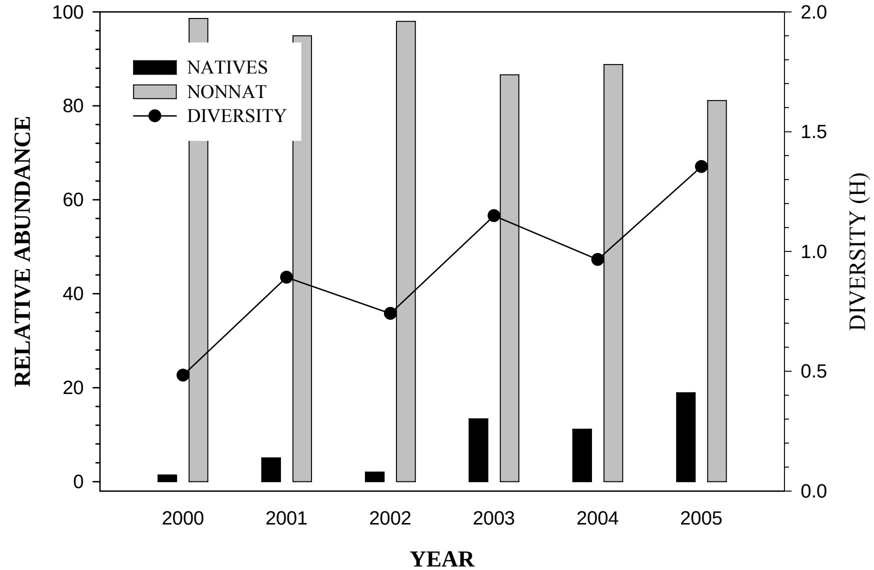

Figure 24. Relative abundance of native and nonnative fishes and assemblage diversity in Reach 4 secondary channels.

Table 21. Number and density (number/m^2) of fishes in San Juan River backwaters in Geomorphic Reach 4 during autumn 2000 - 2005.

2000			2001			2002			2003			2004			2005		
SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN
CYPLUT	4965	15.965	CYPLUT	909	5.476	CYPLUT	875	8.413	PIMPRO	101	0.842	CYPLUT	262	7.005	CYPLUT	3	0.157
PIMPRO	274	0.881	PIMPRO	65	0.392	PIMPRO	250	2.404	CYPLUT	98	0.817	PIMPRO	36	0.963	PIMPRO	1	0.052
GAMAFF	118	0.379	RHIOSC	3	0.018	GAMAFF	12	0.115	CATLAT	4	0.033	RHIOSC	6	0.160			
CATDIS	8	0.026	CATDIS	1	0.006	CATLAT	7	0.010	GAMAFF	4	0.033	GAMAFF	3	0.080			
CYPCAR	4	0.013	CATLAT	1	0.006	CATDIS	1	0.010	CATDIS	2	0.017	CATDIS	2	0.053			
CATLAT	3	0.010	GAMAFF	1	0.006	CYPCAR	1	0.010	RHIOSC	1	0.008	CYPCAR	2	0.053			
RHIOSC	1	0.003	LEPCYA	1	0.006	FUNZEB	1	0.010				ICTPUN	1	0.027			
ICTPUN	1	0.003															
MICSAL	1	0.003															
BKWS N	9			6			6			5			2			1	
N	5375			983			1147			210			312			4	
AREA	311			166			104			120			37.4			19.1	
DENSITY	17.289			3.944			11.058			1.750			8.342			0.209	
H	0.333			0.310			0.636			0.928			0.600			0.562	

REACH 3 SUMMARY

Nine species were collected in Reach 3 primary channel in 2005, including one Colorado pikeminnow (Table 22). Red shiner and speckled dace were the most commonly collected species four out of the last six years. Fish density in Reach 3 primary channel was lower in 2005 than in previous 5 years. Highest fish densities were found in 2002. The area sampled in 2005 was the second-greatest in six years of sampling; greatest was in 2004. Relative abundance of native and nonnative species and species diversity was similar in 2004 and 2005 (Figure 25).

For the first time in six years, speckled dace was the most commonly collected species in Reach 3 secondary channels in 2005 (Table 23). However, red shiner and channel catfish were nearly as common. The area sampled in 2005 in Reach 3 secondary channels was the lowest in six years and density was second-lowest among monitoring years. The lowest density was measured in 2003, highest in 2000. The proportion of native to nonnative species was higher in 2005 than the previous five years of sampling, and assemblage diversity was highest in 2005 (Figure 26).

Only one backwater was sampled in Reach 3 in 2005 (Table 24). Ten red shiner, two fathead, and a common carp were collected in less than 10 m^2. This was less than 5% of the average backwater area sampled in Reach 3. Diversity in 2005 was also lower than previous years. Red shiner has been the most commonly collected species since 2000. Fathead minnow was second-most common 4 of 6 years.

Table 22. Number and density (number/m^2) of fishes in San Juan River primary channel in Geomorphic Reach 3 during autumn 2000 - 2005.

2000			2001			2002			2003			2004			2005		
SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN
CYPLUT	3247	3.286	CYPLUT	1298	1.940	CYPLUT	3162	3.639	CYPLUT	719	0.668	CYPLUT	1425	0.690	CYPLUT	928	0.568
GAMAFF	182	0.184	RHIOSC	93	0.139	PIMPRO	413	0.475	RHIOSC	181	0.168	RHIOSC	639	0.309	RHIOSC	409	0.250
PIMPRO	69	0.070	PIMPRO	43	0.064	RHIOSC	269	0.310	ICTPUN	117	0.109	ICTPUN	205	0.099	ICTPUN	147	0.090
RHIOSC	48	0.049	GAMAFF	11	0.016	ICTPUN	55	0.061	PIMPRO	37	0.034	PIMPRO	130	0.063	PIMPRO	91	0.056
CATLAT	14	0.014	CATLAT	3	0.005	GAMAFF	25	0.028	CATLAT	12	0.011	CATLAT	55	0.026	CATLAT	20	0.012
ICTPUN	7	0.007	ICTPUN	2	0.003	CATLAT	21	0.024	FUNZEB	12	0.011	CATDIS	39	0.019	CATDIS	9	0.006
CATDIS	3	0.003				CYPCAR	13	0.014	CATDIS	2	0.002	GAMAFF	9	0.004	GAMAFF	2	0.001
CYPCAR	3	0.003				FUNZEB	8	0.009	GAMAFF	2	0.002	FUNZEB	4	0.002	AMEMEL	1	0.001
						CATDIS	4	0.004				CYPCAR	2	0.001	PTYLUC	1	0.001
						AMEMEL	2	0.002									
N	3573			1450			3972			1082			2508			1608	
AREA	988			669			869			1077			2066			1635	
DENSITY	3.616			2.167			4.571			1.005			1.214			.984	
H	0.326			0.339			0.560			1.050			1.212			1.148	

Table 23. Number and density (number/m^2) of fishes in San Juan River secondary channel in Geomorphic Reach 3 during autumn 2000 - 2005.

2000			2001			2002			2003			2004			2005		
SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN
CYPLUT	4885	5.073	CYPLUT	901	1.347	CYPLUT	1886	3.742	CYPLUT	164	0.351	CYPLUT	1145	2.129	RHIOSC	56	0.356
GAMAFF	338	0.351	RHIOSC	95	0.142	PIMPRO	265	0.526	RHIOSC	43	0.092	RHIOSC	175	0.325	CYPLUT	54	0.344
RHIOSC	77	0.080	PIMPRO	39	0.058	RHIOSC	143	0.283	ICTPUN	34	0.073	ICTPUN	48	0.071	ICTPUN	49	0.312
PIMPRO	72	0.75	CATLAT	22	0.033	ICTPUN	31	0.061	PIMPRO	11	0.024	CATLAT	30	0.056	PIMPRO	8	0.051
CATLAT	25	0.026	GAMAFF	21	0.031	CATLAT	9	0.018	AMEMEL	3	0.006	PIMPRO	21	0.039	CATLAT	4	0.025
ICTPUN	25	0.027	ICTPUN	16	0.024	FUNZEB	6	0.012	GAMAFF	3	0.064	CATDIS	17	0.032	CATDIS	3	0.019
CYPCAR	22	0.023	AMEMEL	2	0.003	CATDIS	4	0.008	CATLAT	2	0.004	GAMAFF	6	0.011			
CATDIS	6	0.006	CYPCAR	1	0.001	AMEMEL	4	0.008	FUNZEB	1	0.002						
FUNZEB	3	0.003	CATDIS	1	0.001	CYPCAR	3	0.006									
						GAMAFF	3	0.006									
N	5456			1099			2354			261			1442			174	
AREA	963			669			504			467			537			157	
DENSITY	5.666			1.643			4.671			0.559			2.685			1.108	
H	0.351			0.568			0.540			1.149			0.770			1.383	

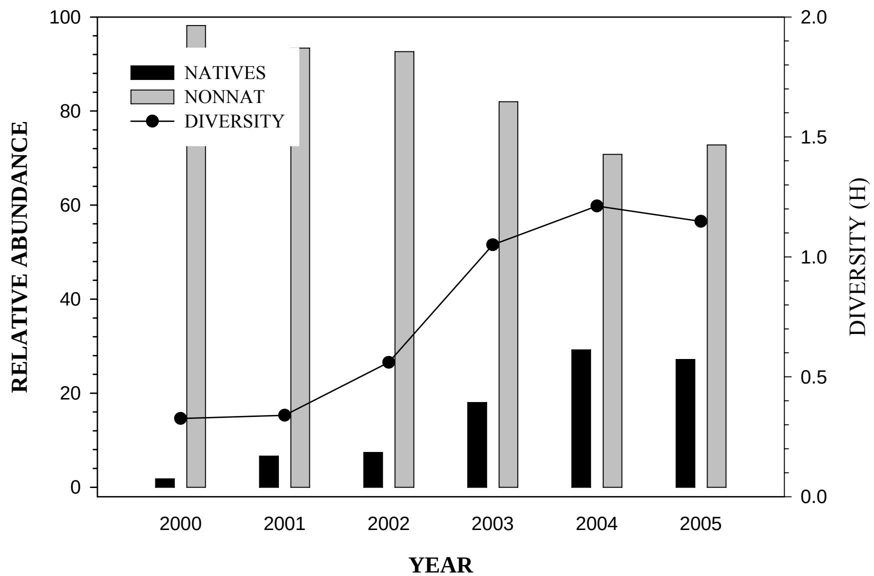

Figure 25. Relative abundance of native and nonnative fishes and assemblage diversity in Reach 3 primary channel.

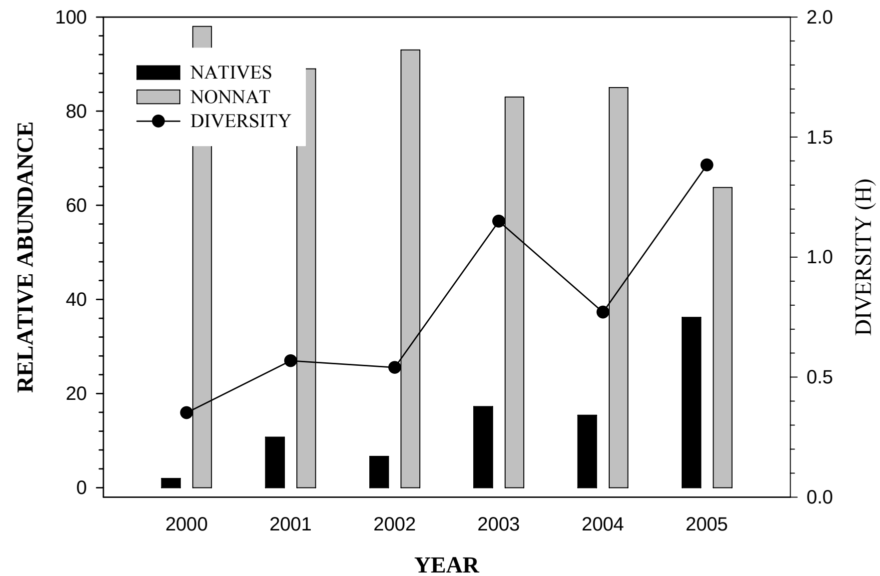

Figure 26. Relative abundance of native and nonnative fishes and assemblage diversity in Reach 3 secondary channels.

Table 24. Number and density (number/m^2) of fishes in San Juan River backwaters in Geomorphic Reach 3 during autumn 2000 - 2005.

2000			2001			2002			2003			2004			2005		
SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN
CYPLUT	2606	7.642	CYPLUT	2053	12.293	CYPLUT	1881	8.214	CYPLUT	63	1.340	CYPLUT	763	3.484	CYPLUT	10	1.053
GAMAFF	267	0.783	PIMPRO	104	0.623	PIMPRO	674	2.943	GAMAFF	11	0.234	PIMPRO	281	1.283	PIMPRO	2	0.211
PIMPRO	83	0.243	GAMAFF	12	0.072	GAMAFF	45	0.196	PIMPRO	3	0.064	FUNZEB	24	0.110	CYPCAR	1	0.105
AMEMEL	106	0.311	RHIOSC	3	0.018	RHIOSC	28	0.122	ICTPUN	2	0.043	GAMAFF	12	0.055			
CATLAT	5	0.015	CYPCAR	1	0.006	ICTPUN	22	0.096	AMEMEL	1	0.021	ICTPUN	9	0.041			
CYPCAR	4	0.012	ICTPUN	1	0.006	CYPCAR	17	0.074	RHIOSC	1	0.021	RHIOSC	4	0.018			
ICTPUN	2	0.006	FUNZEB	1	0.006	AMEMEL	6	0.026				CATLAT	1	0.005			
PTYLUC	1	0.003				CATLAT	6	0.026				CYPCAR	1	0.005			
FUNZEB	1	0.003				FUNZEB	5	0.022									
						LEPCYA	2	0.009									
						CATDIS	1	0.004									
BKWS N	8			8			8			2			5			1	
N	3072			2175			2687			81			1095			13	
AREA	341			167			229			47			219			9.5	
DENSITY	9.009			13.024			11.734			1.723			5.000			1.368	
H	0.447			0.190			0.582			0.789			0.807			0.299	

REACH 2 SUMMARY

Ten species were collected in Reach 2 primary channel, the most in six years of sampling (Table 25). Included was a Colorado pikeminnow, the first collected by small-bodied sampling in Reach 2. Red shiner and channel catfish were the most commonly collected species for each of the past 4 years. In 2005, more area was sampled than in any previous year, but the second-lowest density was in 2005. Highest fish density was in 2000. The proportion of natives has remained relatively constant (approximately 10%) for the immediate past four years (Figure 27). Species diversity has been on an increasing trend since 2000.

Two backwaters were sampled in Reach 2 in 2005 (Table 26). Three species: red shiner, fathead minnow, and largemouth bass were found. Red shiner and fathead minnow were the most commonly collected species in Reach 2 backwaters in 5 of the 6 years. In 2005, backwater fish density was slightly higher than the previous two years sampling.

Table 25. Number and density (number/m^2) of fishes in San Juan River primary channel in Geomorphic Reach 2 during autumn 2000 - 2005.

2000			2001			2002			2003			2004			2005		
SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN
CYPLUT	2310	1.577	CYPLUT	638	0.637	CYPLUT	407	0.380	ICTPUN	162	0.141	CYPLUT	546	0.466	CYPLUT	210	0.142
GAMAFF	44	0.030	RHIOSC	18	0.018	ICTPUN	105	0.098	CYPLUT	132	0.115	ICTPUN	149	0.127	ICTPUN	169	0.114
ICTPUN	20	0.014	PIMPRO	16	0.016	RHIOSC	43	0.040	RHIOSC	29	0.086	RHIOSC	73	0.062	RHIOSC	53	0.036
PIMPRO	19	0.013	ICTPUN	7	0.007	PIMPRO	32	0.030	CATLAT	8	0.007	CATDIS	34	0.029	PIMPRO	13	0.009
RHIOSC	16	0.011	GAMAFF	3	0.003	CATLAT	17	0.016	FUNZEB	4	0.003	GAMAFF	6	0.005	CATLAT	6	0.004
CATDIS	6	0.004	CATDIS	1	0.001	CATDIS	4	0.004	GAMAFF	1	0.001	CATLAT	5	0.004	CYPCAR	2	0.001
CATLAT	2	0.001				GAMAFF	3	0.003	LEPCYA	1	0.001	AMEMEL	1	0.001	CATDIS	1	0.001
						CYPCAR	3	0.003	PIMPRO	1	0.001	PIMPRO	1	0.001	GAMAFF	1	0.001
						AMEMEL	1	0.001							PTYLUC	1	0.001
															LEPCYA	1	0.001
N	2417			683			615			338			815			457	
AREA	1465			1002			1072			1147			1171			1484	
DENSITY	1.650			0.682			0.574			0.295			0.696			0.308	
H	0.205			0.264			0.810			0.771			1.012			1.224	

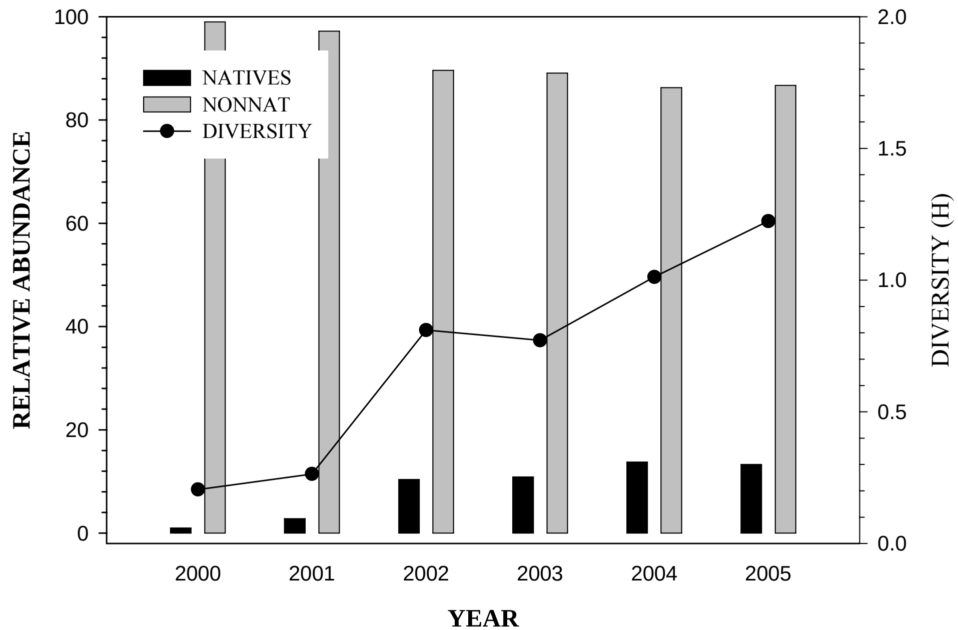

Figure 27. Relative abundance of native and nonnative fishes and assemblage diversity in Reach 2 primary channel.

Table 26. Number and density (number/m^2) of fishes in San Juan River backwaters in Geomorphic Reach 2 during autumn 2000 - 2005.

2000			2001			2002			2003			2004			2005		
SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN
CYPLUT	2750	8.567	CYPLUT	30	0.417	CYPLUT	49	0.754	CYPLUT	18	0.439	CYPLUT	6	0.390	CYPLUT	31	0.626
PIMPRO	144	0.449	PIMPRO	9	0.125	PIMPRO	36	0.554	ICTPUN	8	0.195	PIMPRO	2	0.130	PIMPRO	11	0.222
GAMAFF	114	0.355	CATLAT	1	0.014	CYPCAR	2	0.031	PIMPRO	1	0.024				MICSAL	2	0.040
ICTPUN	37	0.115				CATLAT	1	0.015	LEPCYA	1	0.024						
CATLAT	9	0.028				ICTPUN	1	0.015									
CYPCAR	5	0.016															
CATDIS	3	0.009															
RHIOSC	2	0.006															
MICSAL	1	0.003															
BKWS N	8			5			4			2			2			2	
N	3065			40			89			25			8			44	
AREA	321			72			65			41			15.4			49.5	
DENSITY	9.548			0.556			1.369			0.610			0.519			0.888	
H	0.351			0.428			0.467			0.317			0.562			0.734	

REACH 1 SUMMARY

Five species were collected in the primary channel of Reach 1 in 2005 (Table 27). Similar to other years, red shiner comprised nearly 80% of the fishes collected. Speckled dace was the only native species collected in 2005. Flannelmouth sucker was collected each of the previous 5 years sampling and bluehead sucker 4 of the previous 5 years. Fish density and area sampled was lower in 2005 than previous years. Native species did not make up more than 10% of collections in Reach 1 primary channel collections from 2000 through 2005 (Figure 28).

No backwater was sampled in Reach 1 from 2003 through 2005 (Table 28). From 2000 to 2002, red shiner was the most commonly collected species in Reach 1 backwaters, comprising over 95% of the fish collected. In 2000, fish density was nearly ten times higher than in 2001 and 2002.

Table 27. Number and density (number/m^2) of fishes in San Juan River primary channel in Geomorphic Reach 1 during autumn 2000 - 2005.

2000			2001			2002			2003			2004			2005		
SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN
CYPLUT	3664	12.856	CYPLUT	142	0.686	CYPLUT	502	2.154	CYPLUT	76	0.198	CYPLUT	143	0.531	CYPLUT	40	0.128
GAMAFF	336	1.179	PIMPRO	3	0.014	ICTPUN	30	0.113	ICTPUN	36	0.094	ICTPUN	38	0.141	RHIOSC	4	0.021
PIMPRO	17	0.060	CATLAT	2	0.010	PIMPRO	15	0.056	CATLAT	2	0.005	PIMPRO	10	0.037	ICTPUN	4	0.021
CATLAT	2	0.007	ICTPUN	2	0.010	RHIOSC	15	0.056	RHIOSC	2	0.005	CATLAT	4	0.015	PIMPRO	2	0.011
RHIOSC	1	0.004	RHIOSC	1	0.005	CATLAT	3	0.011	CATDIS	1	0.003	CATDIS	3	0.011	CYPCAR	1	0.005
CATDIS	1	0.004	FUNZEB	1	0.005	CATDIS	1	0.004	FUNZEB	1	0.003	RHIOSC	2	0.007			
FUNZEB	1	0.004				CYPCAR	1	0.004	PIMPRO	1	0.003						
N	4025			151			567			119			200			51	
AREA	285			207			266			383			269			187	
DENSITY	14.123			0.729			2.132			0.311			0.743			0.272	
H	0.245			0.259			0.387			0.906			0.892			0.794	

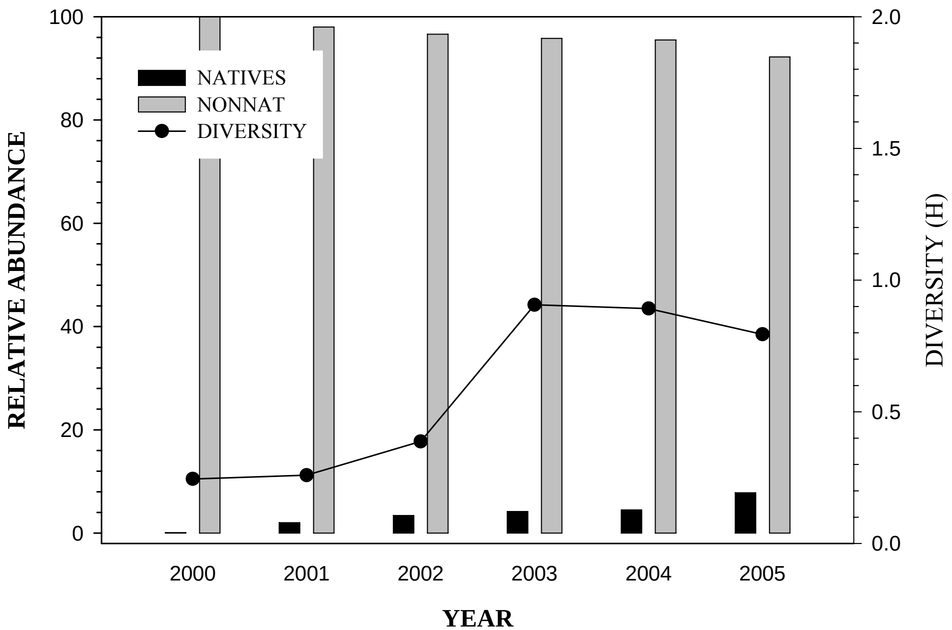

Figure 28. Relative abundance of native and nonnative fishes and assemblage diversity in Reach 1 primary channel.

Table 28. Number and density (number/m^2) of fishes in San Juan River backwaters in Geomorphic Reach 1 (RM 17 – RM 0) during autumn, 2000 – 2005.

2000			2001			2002			2003	2004	2005
SPECIES	N	DEN	SPECIES	N	DEN	SPECIES	N	DEN			
CYPLUT	4769	31.977	CYPLUT	97	2.425	CYPLUT	99	2.25	**NO BACKWATERS**	**NO BACKWATERS**	**NO BACKWATERS**
GAMAFF	91	0.419	PIMPRO	1	0.025	PIMPRO	14	0.318			
PIMPRO	57	0.263	RHIOSC	1	0.025	ICTPUN	8	0.182			
CATLAT	9	0.042	ICTPUN	1	0.025	CYPCAR	1	0.023			
CATDIS	9	0.042	GAMAFF	1	0.025	AMEMEL	1	0.023			
ICTPUN	4	0.018	CATLAT	1	0.025	GAMAFF	1	0.023			
CYPCAR	3	0.014									
LEPMAC	2	0.009									
BKWS N	7			4			2				
N	4944			104			124				
AREA	217			40			44				
DENSITY	22.783			2.6			2.818				
H	0.157			0.325			0.501				

DENSITY VERSUS DISCHARGE

There were few significant correlations of fish density in the primary channel with discharge attributes for the 2000 through 2005 period (Table 29). In Reach 5, density of red shiner was negatively associated with summer flows. Densities of flannelmouth sucker and bluehead sucker were positively related to the number of low summer discharge (<500 cfs) days in Reach 4.

There were more significant correlations for secondary channels, especially for nonnative species. In Reach 6, red shiner density was negatively associated with high spring discharge and density of all nonnatives was positively associated with number of low summer discharge (<500 cfs) days. Density of nonnative species (namely red shiner) was negatively associated with summer flows in secondary channels in Reaches 5-3. In Reach 5 secondary channels, bluehead sucker density was positively related to spring discharge and flannelmouth sucker density was positively related to low summer discharge (<500 cfs) days. No other native species densities were significantly correlated to discharge in secondary channels.

Table 29. Regression analysis results for density of commonly collected fish species in the San Juan River versus average mean daily spring discharge, average mean daily summer discharge, and days mean daily summer discharge less than 500 cfs from 2000-2005. Shaded areas indicate significant relationship ($p<0.05$)

Reach 6 Primary

	SPRING Q		SUMMER Q		<500 CFS	
	R	*p*	R	*p*	R	*p*
NATIVES	0.049	0.926	0.214	0.683	0.048	0.928
CATDIS	0.072	0.893	0.379	0.458	0.221	0.674
CATLAT	-0.500	0.313	0.200	0.705	0.441	0.381
RHIOSC	0.148	0.779	0.167	0.752	-0.060	0.911
NONNATIVES	-0.230	0.661	-0.740	0.096	0.329	0.524
CYPLUT	-0.170	0.745	-0.680	0.137	0.246	0.638
GAMAFF	-0.240	0.653	-0.680	0.138	0.173	0.743
ICTPUN	-0.100	0.850	-0.210	0.686	0.168	0.750
PIMPRO	-0.460	0.356	-0.480	0.338	0.783	0.065

Reach 6 Secondary

	SPRING Q		SUMMER Q		<500 CFS	
	R	*p*	R	*p*	R	*p*
NATIVES	-0.500	0.315	-0.230	0.666	0.522	0.288
CATDIS	-0.620	0.194	-0.420	0.413	0.795	0.059
CATLAT	-0.720	0.103	-0.130	0.799	0.664	0.151
RHIOSC	-0.200	0.707	-0.150	0.770	0.207	0.695
NONNATIVES	-0.850	0.013	-0.580	0.227	0.955	0.003
CYPLUT	-0.880	0.020	-0.400	0.433	0.857	0.029
GAMAFF	-0.630	0.178	-0.620	0.191	0.860	0.028
ICTPUN						
PIMPRO	-0.560	0.246	-0.440	0.386	0.799	0.057

Reach 5 Primary

	SPRING Q		SUMMER Q		<500 CFS	
	R	*p*	R	*p*	R	*p*
NATIVES	-0.170	0.743	-0.260	0.617	0.205	0.697
CATDIS	-0.290	0.578	-0.400	0.435	0.410	0.419
CATLAT	-0.700	0.121	-0.350	0.500	0.547	0.262
RHIOSC	-0.130	0.807	-0.230	0.656	0.163	0.757
NONNATIVES	-0.460	0.358	-0.880	0.021	0.497	0.316
CYPLUT	-0.420	0.402	-0.860	0.026	0.440	0.382
GAMAFF	-0.370	0.472	-0.750	0.083	0.380	0.459
ICTPUN	-0.420	0.409	-0.150	0.777	0.358	0.456
PIMPRO	-0.500	0.312	-0.470	0.342	0.817	0.047

Reach 5 Secondary

	SPRING Q		SUMMER Q		<500 CFS	
	R	*p*	R	*p*	R	*p*
NATIVES	0.529	0.281	0.499	0.313	-0.270	0.599
CATDIS	0.821	0.045	0.771	0.072	-0.570	0.235
CATLAT	-0.620	0.192	-0.530	0.275	0.894	0.016
RHIOSC	-0.190	0.716	-0.190	0.717	0.204	0.699
NONNATIVES	-0.640	0.164	-0.940	0.006	0.693	0.127
CYPLUT	-0.640	0.168	-0.940	0.005	0.685	0.133
GAMAFF	-0.270	0.604	-0.730	0.101	0.316	0.541
ICTPUN	-0.200	0.703	0.057	0.915	0.071	0.893
PIMPRO	-0.580	0.232	-0.980	0.019	0.648	0.164

Reach 4 Primary

	SPRING Q		SUMMER Q		<500 CFS	
	R	*p*	R	*p*	R	*p*
NATIVES	0.099	0.853	0.370	0.470	0.033	0.951
CATDIS	-0.650	0.158	-0.450	0.374	0.861	0.028
CATLAT	-0.550	0.257	-0.340	0.503	0.815	0.048
RHIOSC	0.199	0.705	0.451	0.370	-0.100	0.851
NONNATIVES	-0.460	0.357	-0.810	0.053	0.463	0.355
CYPLUT	-0.230	0.664	-0.710	0.114	0.314	0.544
GAMAFF	-0.410	0.417	0.194	0.713	0.096	0.856
ICTPUN	0.080	0.880	0.488	0.327	0.157	0.766
PIMPRO	-0.530	0.282	-0.360	0.486	0.767	0.075

Reach 4 Secondary

	SPRING Q		SUMMER Q		<500 CFS	
	R	*p*	R	*p*	R	*p*
NATIVES	-0.030	0.954	-0.040	0.938	0.085	0.873
CATDIS	-0.360	0.480	-0.380	0.457	0.546	0.262
CATLAT	-0.570	0.241	0.047	0.929	0.294	0.572
RHIOSC	0.079	0.882	-0.030	0.956	0.006	0.991
NONNATIVES	-0.580	0.227	-0.900	0.015	0.694	0.126
CYPLUT	-0.580	0.227	-0.930	0.006	0.663	0.151
GAMAFF	0.038	0.942	-0.540	0.271	-0.200	0.703
ICTPUN	0.695	0.125	0.794	0.059	-0.500	0.317
PIMPRO	-0.510	0.305	-0.430	0.396	0.717	0.109

Reach 3 Primary

	SPRING Q		SUMMER Q		<500 CFS	
	R	*p*	R	*p*	R	*p*
NATIVES	-0.060	0.909	0.188	0.722	0.362	0.480
CATDIS	-0.010	0.992	-0.120	0.826	0.179	0.735
CATLAT	-0.480	0.340	-0.460	0.353	0.752	0.085
RHIOSC	-0.030	0.953	0.245	0.640	0.328	0.526
NONNATIVES	-0.470	0.347	-0.730	0.101	0.563	0.245
CYPLUT	-0.450	0.374	-0.730	0.103	0.523	0.287
GAMAFF	-0.200	0.707	-0.660	0.154	0.159	0.764
ICTPUN	-0.060	0.914	0.443	0.379	0.127	0.811
PIMPRO	-0.490	0.322	-0.370	0.473	0.763	0.078

Reach 3 Secondary

	SPRING Q		SUMMER Q		<500 CFS	
	R	*p*	R	*p*	R	*p*
NATIVES	0.378	0.461	0.290	0.577	0.004	0.994
CATDIS	0.266	0.610	0.070	0.895	0.003	0.995
CATLAT	0.248	0.635	-0.200	0.698	-0.120	0.828
RHIOSC	0.371	0.469	0.358	0.486	0.021	0.969
NONNATIVES	-0.460	0.363	-0.890	0.018	0.603	0.206
CYPLUT	-0.500	0.307	-0.920	0.008	0.627	0.182
GAMAFF	-0.210	0.697	-0.580	0.223	0.060	0.909
ICTPUN	0.731	0.099	0.806	0.053	-0.490	0.322
PIMPRO	-0.430	0.399	-0.740	0.091	0.549	0.249

Reach 2 Primary

	SPRING Q		SUMMER Q		<500 CFS	
	R	*p*	R	*p*	R	*p*
NATIVES	-0.450	0.370	0.181	0.732	0.236	0.652
CATDIS	-0.270	0.608	-0.280	0.587	0.289	0.578
CATLAT	-0.430	0.391	0.201	0.702	0.151	0.776
RHIOSC	-0.360	0.485	0.253	0.628	0.239	0.648
NONNATIVES	-0.140	0.793	-0.750	0.083	0.140	0.792
CYPLUT	-0.100	0.849	-0.730	0.101	0.094	0.859
GAMAFF	-0.170	0.746	-0.670	0.143	0.123	0.816
ICTPUN	-0.140	0.794	0.384	0.452	0.234	0.655
PIMPRO	-0.210	0.693	-0.320	0.536	0.429	0.396

Reach 1 Primary

	SPRING Q		SUMMER Q		<500 CFS	
	R	*p*	R	*p*	R	*p*
NATIVES	-0.450	0.367	-0.330	0.525	0.776	0.070
CATDIS	-0.490	0.328	-54.000	0.264	0.544	0.264
CATLAT	-0.560	0.250	-0.680	0.140	0.562	0.246
RHIOSC	-0.250	0.627	-0.070	0.888	0.594	0.214
NONNATIVES	-0.360	0.481	-0.800	0.055	0.377	0.461
CYPLUT	-0.340	0.504	-0.790	0.061	0.362	0.480
GAMAFF	-0.130	0.802	-0.600	0.210	0.072	0.892
ICTPUN	-0.590	0.220	-0.180	0.728	0.665	0.149
PIMPRO	-0.470	0.341	-0.850	0.030	0.683	0.135

Mean daily discharge during sampling varied among years (Figure 29). During sampling in the upper reaches, discharge was highest in 2004, while in the lower reaches the highest discharge at time of sampling occurred in 2005.

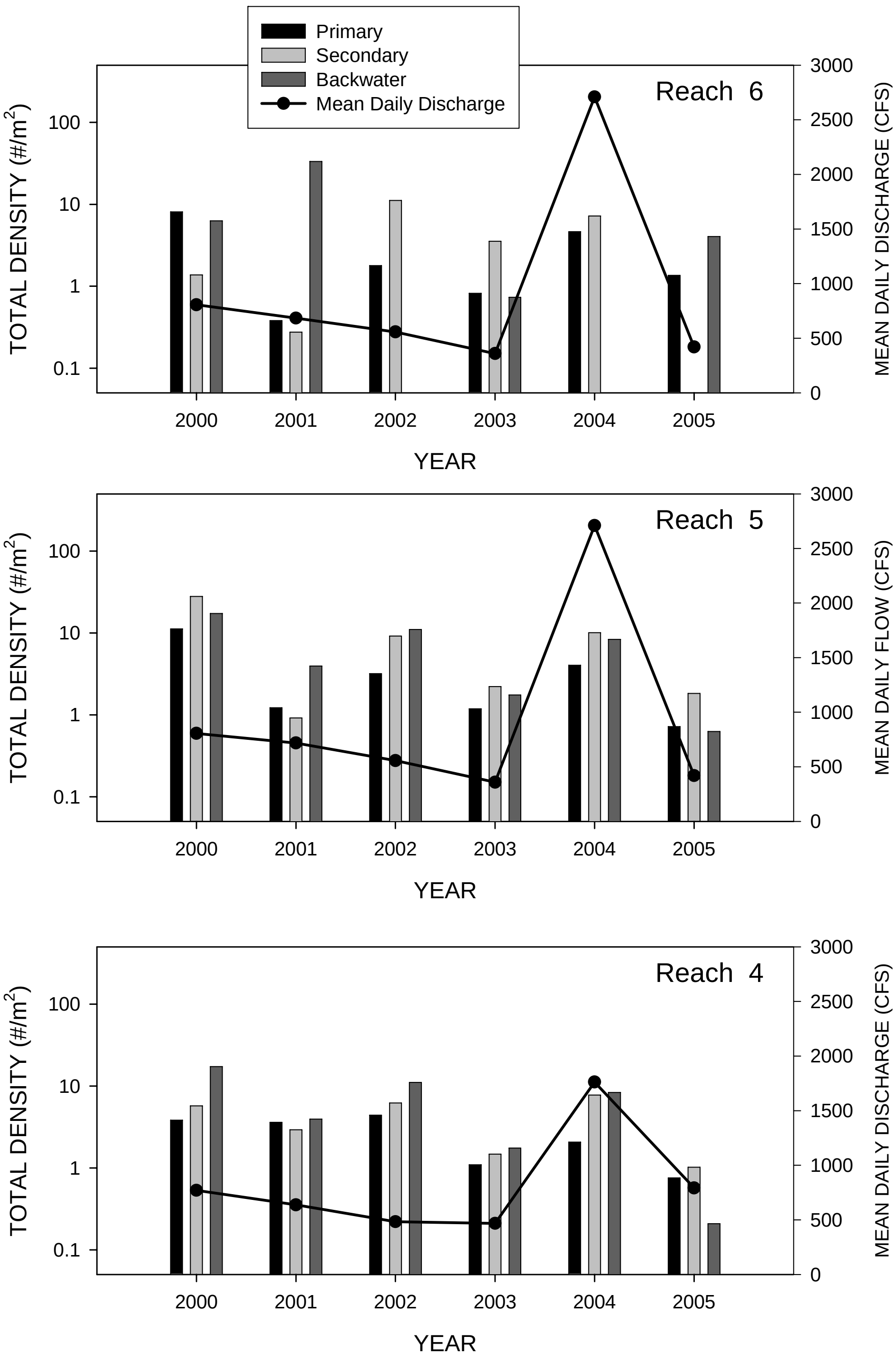

Figure 29. Total sample density (total number of fish captured/total area sampled) and mean daily discharge during sampling for Reaches 6-4, San Juan River, New Mexico. Note log scale for density axis.

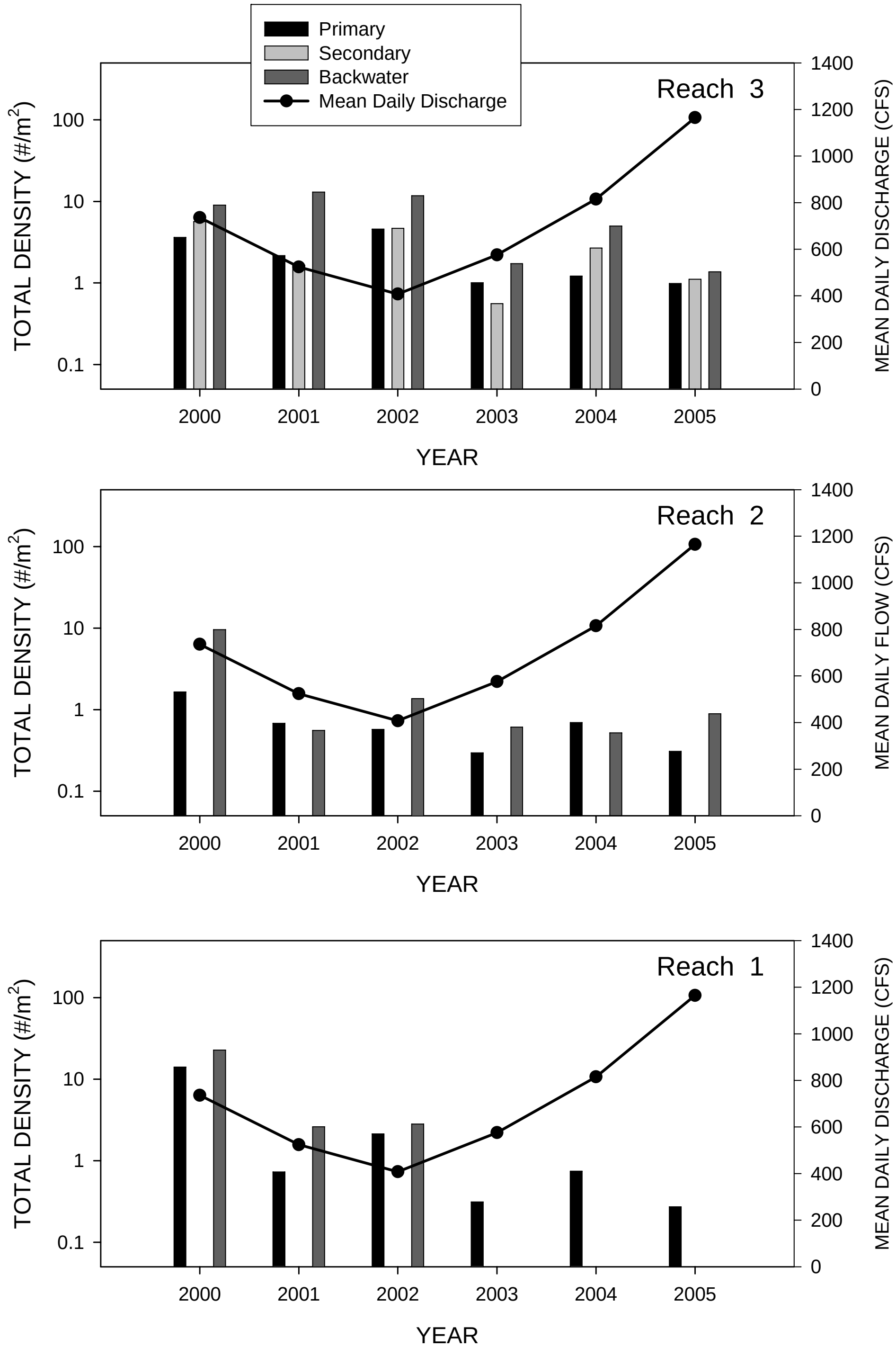

Figure 30. Total sample density (total number of fish captured/total area sampled) and mean daily discharge during sampling for Reaches 3-1, San Juan River, New Mexico. Note log scale for density axis.

RARE FISHES – 2005

For the sixth consecutive year roundtail chub was not collected in small-bodied sampling on the San Juan. However, for the first time, razorback sucker (n = 1, 403 mm TL) was collected in a shoal habitat in the primary channel in 2005 (Table 30). Three Colorado pikeminnow were collected, two in the primary channel and one in a secondary channel.

Table 30. Rare fishes collected in autumn sampling of the San Juan River.

Species	Channel	Reach	Total Length (mm)	Habitat
XYRTEX	Primary	5	403	Shoal
PTYLUC	Primary	3	166	Shore run
PTYLUC	Primary	2	289	Eddy
PTYLUC	Secondary	4	179	Shoal

SPECIES LONGITUDINAL DISTRIBUTIONS – 2005

Overall density of fishes varied among reaches. Reaches 6 and 3 had the highest fish density (1.36 and 0.98 fish/m^2) in the primary channel while Reaches 2 and 1 had the lowest (0.31 and 0.27 fish/m^2). For secondary channels, Reach 5 had the highest fish density (1.83 fish/m^2) and Reach 6 the lowest (0.02 fish/m^2).

Densities of commonly collected native species in the primary channel generally decreased in a downstream direction, similar to the pattern seen in 2004 (Figure 31). However, Reach 5 had lower densities than Reaches 4 and 3. Density increased downstream in secondary channels. This was opposite the 2004 pattern of downstream decreases. Speckled dace was the most commonly collected native species in all reaches.

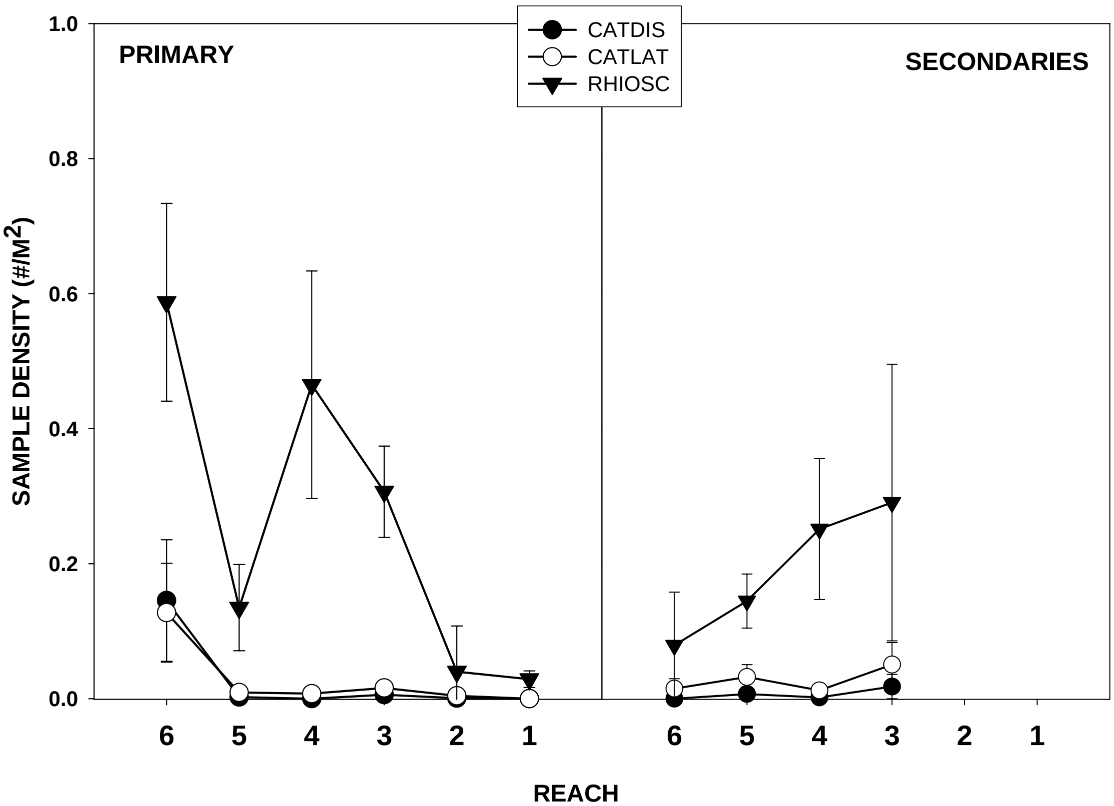

Figure 31. Longitudinal density patterns of commonly collected native fish species in primary and secondary channels, San Juan River, 2005. Error bars represent standard error of sample densities.

Nonnative fishes did not follow similar patterns. Red shiner densities in the primary channel were higher in Reaches 6 through 3 than Reaches 2 and 1 (Figure 32). Reach 5 secondary channels had the highest density of red shiner. Channel catfish densities increased slightly in secondary channels in a downstream direction. Fathead minnow densities did not suggest a longitudinal pattern.

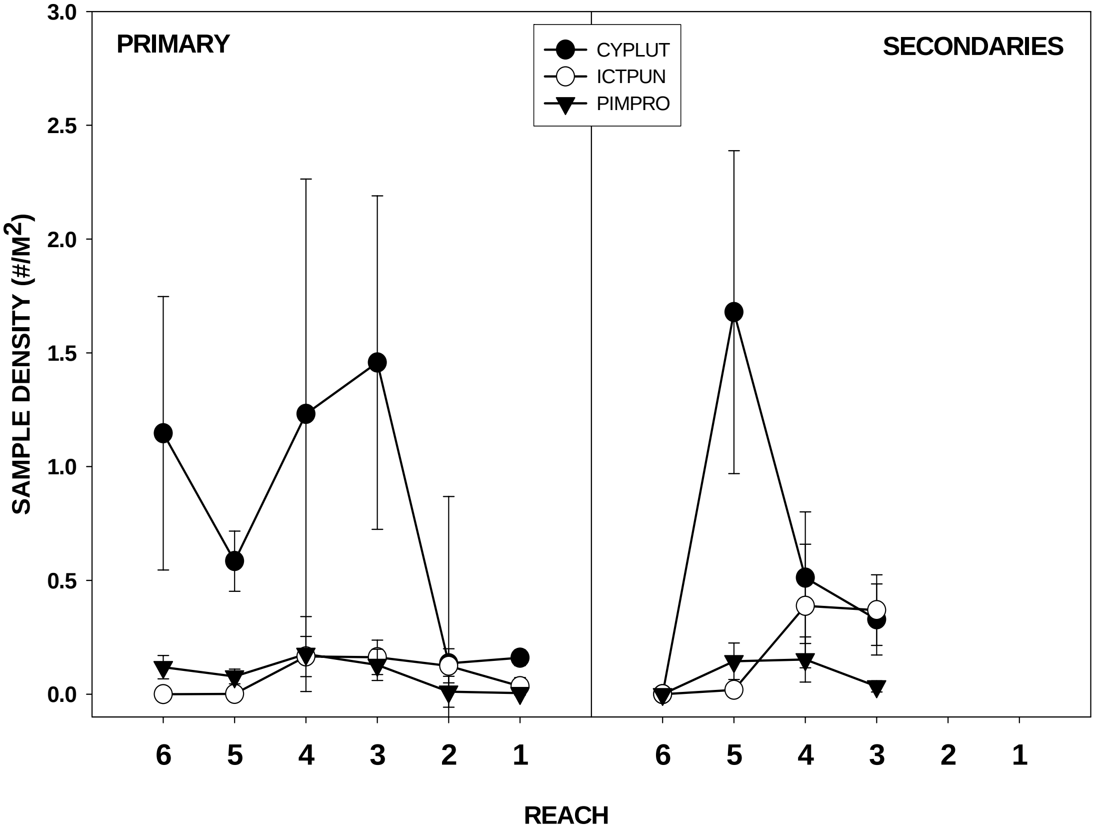

Figure 32. Longitudinal density patterns of commonly collected nonnative fish species in primary and secondary channels, San Juan River, 2005. Error bars represent standard error of sample densities.

MEAN TOTAL LENGTH – 2005

Generally, fishes collected in secondary channels were larger than their counterparts collected in the primary channel (Figure 33). Red shiner ($t = -18.0_{(3402\ df)}$, $p < 0.005$), fathead minnow ($t = -3.03_{(387\ df)}$, $p < 0.005$), and speckled dace ($t = -4.37_{(1275\ df)}$, $p < 0.005$) collected in the primary channel were significantly smaller than those collected in secondary channels. Western mosquito fish was the only species that was larger in the primary channel ($t = 2.51_{(59\ df)}$, $p < 0.01$). Size differences were not quite as significant for species that attain larger body sizes due to greater variance in sizes:

bluehead sucker ($t = -0.28_{(95\ df)}$, $p < 0.10$), flannelmouth sucker ($t = -1.5_{(135df)}$, $p < 0.10$), and channel catfish ($t = -1.48_{(505\ df)}$, $p < 0.10$).

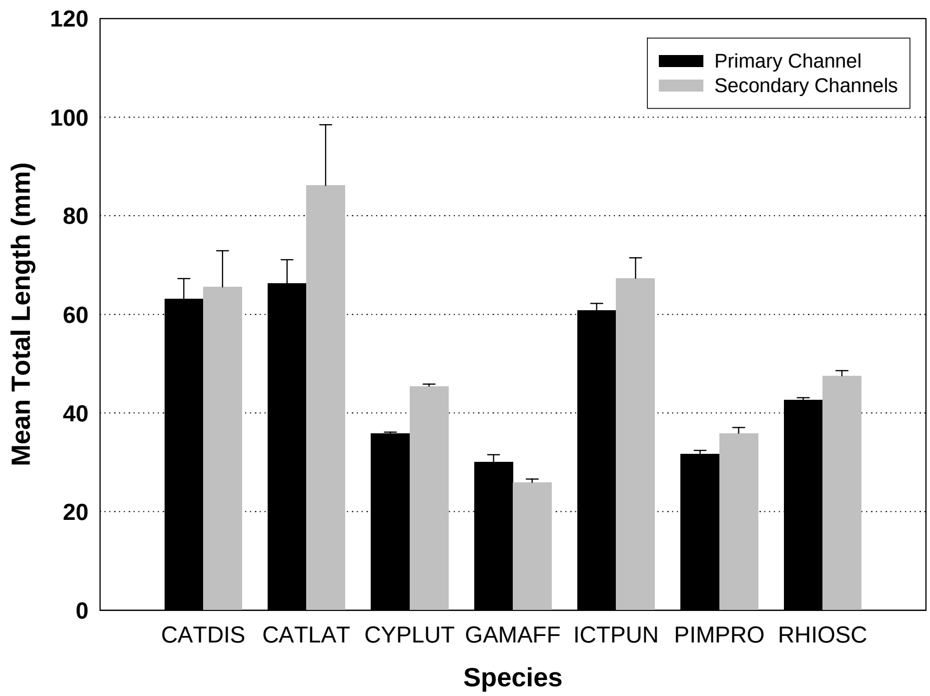

Figure 33. Mean total length of commonly collected species in primary and secondary channels, San Juan River, 2005. Error bars represent standard error of mean total length.

ELECTROFISHING AND SEINING COMPARISON – 2005

In 2004, electrofishing into a bag seine was added to the sampling methods. This method was added in an attempt to capture size and species of fishes that were perhaps underrepresented by the seine-only collections in small-bodied fish monitoring. Electrofishing was conducted in riffles in Reaches 6, 4, and 3. Speckled dace was the only species collected in 146 m^2 (Table 31). In comparison, 459 m^2 of riffle habitat was sampled using kick sampling into seines for the same reaches and six species were collected. Subsamples of fish were measured for each collection method. On average, the speckled dace collected with the aid of electrofishing were significantly larger than those collected by kick sampling ($t = 6.19_{(254\ df)}$, $p < 0.005$).

Table 31. Fish species collected in riffle habitats of the primary channel in Reaches 6, 4, and 3, San Juan River, 2005.

	CATDIS		CATLAT		CYPLUT		ICTPUN		PIMPRO		RHIOSC	
	Electro fishing	Seining	Electro fishing	Seining	Electro fishing	Seining	Electro fishing	Seining	Electro fishing	Seining	Electro fishing	Seining
Total N	0	3	0	1	0	49	0	4	0	5	70	264
Mean TL		177.67		205.00		38.00		142.67		40.40	71.55	52.83
St. Dev TL		12.66				14.46		149.29		6.31	12.90	13.89

DISCUSSION

The San Juan River is a hydrologically dynamic system where changing flows alter habitat structure and availability on a daily and seasonal basis. These changes, in turn, influence density of fish species and their spatial distribution in the system. Sampling conducted during autumn each year is aimed at collecting data that reflect and reveal the essence of the system and how it has changed or not over the preceding monitoring period. Basic assumptions are that sampling occurs under similar conditions each year and that there is minimum variation in sampling efficiency among years. If these assumptions are satisfied, then changes, or lack, in species density or spatial distribution should reflect overall assemblage changes. Since structured monitoring of San Juan River fish assemblages began in 2000, discharge during autumn sampling ranged from about 200 cfs to over 4000 cfs. Nonetheless, there does not appear to be a correlation between discharge at time of small-bodied fish assemblage monitoring and fish density. Thus, changes in density are assumed to represent response of fishes to numerous environmental factors, including those associated with mimicry of a natural flow regime.   .

A specific task of small-bodied monitoring is to document survival of age-0 Colorado pikeminnow and razorback sucker during their first months of life. The larval fish monitoring effort has regularly collected age-0 razorback suckers since 1998, but only 3 larval Colorado pikeminnow have been collected since 2001 (Brandenburg and Farrington 2006), Age-0 individuals of neither species has been collected during autumn small-bodied fishes monitoring efforts (this study) and few, if any, wild-spawned individuals of either species, have survived to adulthood (Ryden 2006, Jackson 2006). Paucity of adult Colorado pikeminnow is likely a primary reason so few larval specimens have been collected since 2001, but reproduction by razorback sucker has been annually documented since 1998. It is unlikely wild-spawned age-0 Colorado pikeminnow will be regularly collected during autumn small-bodied fishes monitoring efforts until an adult population is present. Failure to collect wild-spawned age-0 razorback sucker during autumn monitoring is a bit more perplexing, but is likely because survival to autumn is low or nonexistent or sampling methods (seining) are not appropriate. Inadequacy of sampling methods does not seem a likely reason as methods used on San Juan River are the same as used elsewhere in Colorado River drainage. Rather, absence of age-0 razorback sucker in autumn monitoring is likely because of low post-larvae survival. To date, no study has been initiated to determine why survival of wild-spawned San Juan River razorback sucker is so low, or absent. In addition, only marginal effort has been made to determine what factors limit survival of stocked age-0 Colorado pikeminnow.

A primary justification for operation of Navajo Reservoir to mimic the natural hydrograph was to enhance or improve status of protected as well as other native fishes. Presumably, natural flow regime mimicry would concurrently negatively influence nonnative fishes. The general increase in native small-bodied fishes relative abundance in both primary and secondary channel habitats would seem to suggest that native fishes have responded positively to a mimicked natural hydrograph. However, only bluehead sucker autumn density in Reach 5 was significantly, and positively, related to spring discharge. Elevated summer discharge generally negatively influenced (but only occasionally significantly) nonnative fishes autumn density. Interpretations of analyses and discernment of trends are compromised by limited power of analyses (i.e., only 6 data points per analysis). An equally important restraint on data interpretation is the effect of below average flows for much of most years since 2000; average mean daily discharge during spring did not exceed 3000 cfs in any year except 2005 and there were extended periods of low flow (<500 cfs) during summer of all years except 2001 and 2005. Despite strong cautions against over-extending interpretations of these data, it does appear that status of native fishes has improved since natural flow regime mimicry began in 1998.

SUMMARY

PRIMARY CHANNEL

1. Five native and eight nonnative species were collected in 2005. Since 1998, seven native and nine nonnative species were captured in San Juan River primary channel habitats during small-bodied monitoring (Reaches 6-1).
2. A single razorback sucker was collected in Reach 5 primary channel, the first for small-bodied monitoring studies.
3. Red shiner was the most common species in all years.
4. Speckled dace was second-most common species, except for 2000 when western mosquitofish was and 2002 when fathead minnow were second-most common.
5. Greatest number of specimens was collected in 2000 (n=22,887) and 2004 (n=17,042).
6. The greatest primary channel area sampled was in 2004 (7787 m^2) and second-was in 2005 (5975 m^2).
7. Greatest native fish density (0.65 fish/m^2) was in 2004 and least (0.05 fish/m^2) was in 2000. Native fish density in 2005 was 0.24 fish/m^2.
8. Greatest nonnative fish density (5.02 fish/m^2) was in 2000 and least (0.23 fish/m^2) was in 1999. Nonnative fish density in 2005 was 0.54 fish/m^2.
9. More flannelmouth and bluehead sucker were collected in samples from 2002 through 2005 than in 1998 through 2001. Densities of both species were highest in 2004.
10. Shoal was the most commonly sampled mesohabitat in the primary channel in 2005.

SECONDARY CHANNELS

1. Six native and eleven nonnative species have been collected in secondary channels of the San Juan River since 1998.
2. Yellow bullhead was found in secondary channels in 1998, 2001, and 2005 but was never found in the primary channel of the San Juan River.
3. Red shiner was the most commonly collected species in San Juan River secondary channels in all years.
4. Fathead minnow was second-most common from 2000 through 2004; speckled dace was second-most common in 1998, 1999, and 2005.
5. The greatest number of fish collected in secondary channels was in 2004 (n=11,109) and fewest in 2005 (n=1040).
6. The greatest secondary channel area sampled was in 2000 (1914 m^2) and least was in 2005 (1040 m^2).
7. Overall density was highest in 2002 (6.26 fish/m^2) and lowest in 1999 (0.32 fish/m^2). 2005 density was 1.35 fish/m^2.
8. Run mesohabitats (run, mid-channel run, and shore run) comprised nearly 40% of the area sampled in secondary channels in 2005.
9. In secondary channels, bluehead sucker and speckled dace were found mainly in riffle habitats in 2005.
10. Colorado pikeminnow was found in secondary channels of the San Juan River in 1998, 1999, 2000, 2004, and 2005.

BACKWATERS

1. Since 1999, four native and ten nonnative fish species have been collected in backwaters of the San Juan River.
2. Colorado pikeminnow was found in backwater habitat in 1999 and 2000. No other rare fish species has been collected in backwaters.
3. Red shiner and fathead minnow have numerically dominated backwater collections since 1999, comprising over 95% of the sample in all years, except 2003 and 2005.
4. Though usually collected, flannelmouth sucker was never numerous in backwater areas, except in 2005; 113 individuals were collected in Reach 6 backwaters.
5. In 2000, over 25,700 fish were collected in backwater areas including 23,898 red shiners. The lowest number of fish collected was in 1999 (n=459).
6. The most backwater area sampled was in 2000 (1576 m^2); least in 1999 (242 m^2).
7. The highest fish density in backwaters was in 2000 (16.32 fish/ m^2); lowest was in 2003 (1.57 fish/ m^2).

COMMON SPECIES SUMMARIES

1. Bluehead sucker density was highest in Reach 6 in 2005. The majority were found in moderate- and fast-velocity mesohabitats. Density of bluehead sucker in 2005 was lower than 2004 in most reaches and channels.

2. There was a large concentration of flannelmouth sucker in Reach 6 backwaters in 2005. In most years, Reach 6 primary and secondary channels had the highest density of flannelmouth sucker.
3. Densities of speckled dace were generally lower in 2005 than 2004, except Reach 1. It was consistently found in riffle and run mesohabitats in 2005.
4. Density of red shiner significantly decreased in secondary channels of all reaches in 2005. The highest density of red shiner was in 2000. Red shiner was found most often in slow-velocity mesohabitats in 2005.
5. Reaches 4 and 3 had the highest density of channel catfish in recent years. Only two individuals have been found in Reach 6 since 2000. Channel catfish was found most often in slow- and moderate-velocity mesohabitats.
6. Density of fathead minnow decreased in 2005 in Reach 5 primary and secondary channels and Reach 4 secondary channels from 2004 levels. Fathead minnow was often sampled in slower-velocity mesohabitats, especially backwaters.

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