SMALL-BODIED FISH MONITORING, SAN JUAN RIVER
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SAN JUAN RIVER BASIN RECOVERY IMPLEMENTATION PROGRAM
U.S. FISH AND WILDLIFE SERVICE, REGION 2
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EXECUTIVE SUMMARY

Monitoring of small-bodied fished was conducted in the San Juan River from 1998 through 2008. Native fish numbers remained relatively stable for the duration of the study, though there was a slight decline in flannelmouth sucker in the primary channel from 2003 through 2008. Nonnative small-bodied fishes (mainly red shiner and fathead minnow) became increasingly rare in the San Juan; the greatest decline occurred between 2005 and 2006. Density of age-0 channel catfish changed little.

No age-0 razorback sucker were collected during small-bodied fishes monitoring, although spawning was documented in each of the last 11 years (Brandenburg and Farrington 2008). Other sucker species in the river, bluehead and flannelmouth suckers, were collected in sufficient numbers to track cohorts across years (using data from larval and adult monitoring efforts). The 2004 year classes of flannelmouth and bluehead sucker were the last that recruited well into the adult population. Larval densities of these species were not good predictors for abundance of these species in autumn monitoring or recruitment into the adult population.

Age-0 Colorado pikeminnow were collected in 1998, 2000, and 2007. All were likely stocked individuals. Age-1+ pikeminnow were collected each year beginning in 2004. Abundance of small fishes that are potential prey for Colorado pikeminnow was lower in 2006 through 2008 than previous years (2003 through 2005).

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INTRODUCTION

Small-bodied and age-0 fishes numerically dominate the San Juan River fish assemblage and likely are essential to recovery of Colorado pikeminnow and influence abundance of razorback sucker young. Small-bodied fishes are an important component of the diet of young Colorado pikeminnow, but also may prey on or compete with larval and age-0 razorback sucker and Colorado pikeminnow (Franssen et al. 2007). Annual autumn sampling of shallow-water habitats is undertaken to obtain information on fishes that occur in these habitats as well as relating this information towards the progress of recovery of Colorado pikeminnow and razorback sucker and conservation of the native fish assemblage of the San Juan River.

As set forth in Section 5.7 of the San Juan River Basin Recovery Implementation Program (SJRIP) Long-Range Plan, a long-term monitoring program "to identify changes in the endangered and other native species populations, status, distributions and habitat conditions" was to be developed by the SJRIP Biology Committee. The ichthyofaunal monitoring portion of the San Juan River Monitoring Plan and Protocols (Propst, et al., 2000) was divided into three primary areas; larval fishes, young-of-year/small-bodied fishes, and sub-adult and adult/large-bodied fishes. The portion of the San Juan River to be monitored extends from the confluence of the Animas and San Juan rivers (Farmington) to Lake Powell (Clay Hills Crossing) (Figure 1).

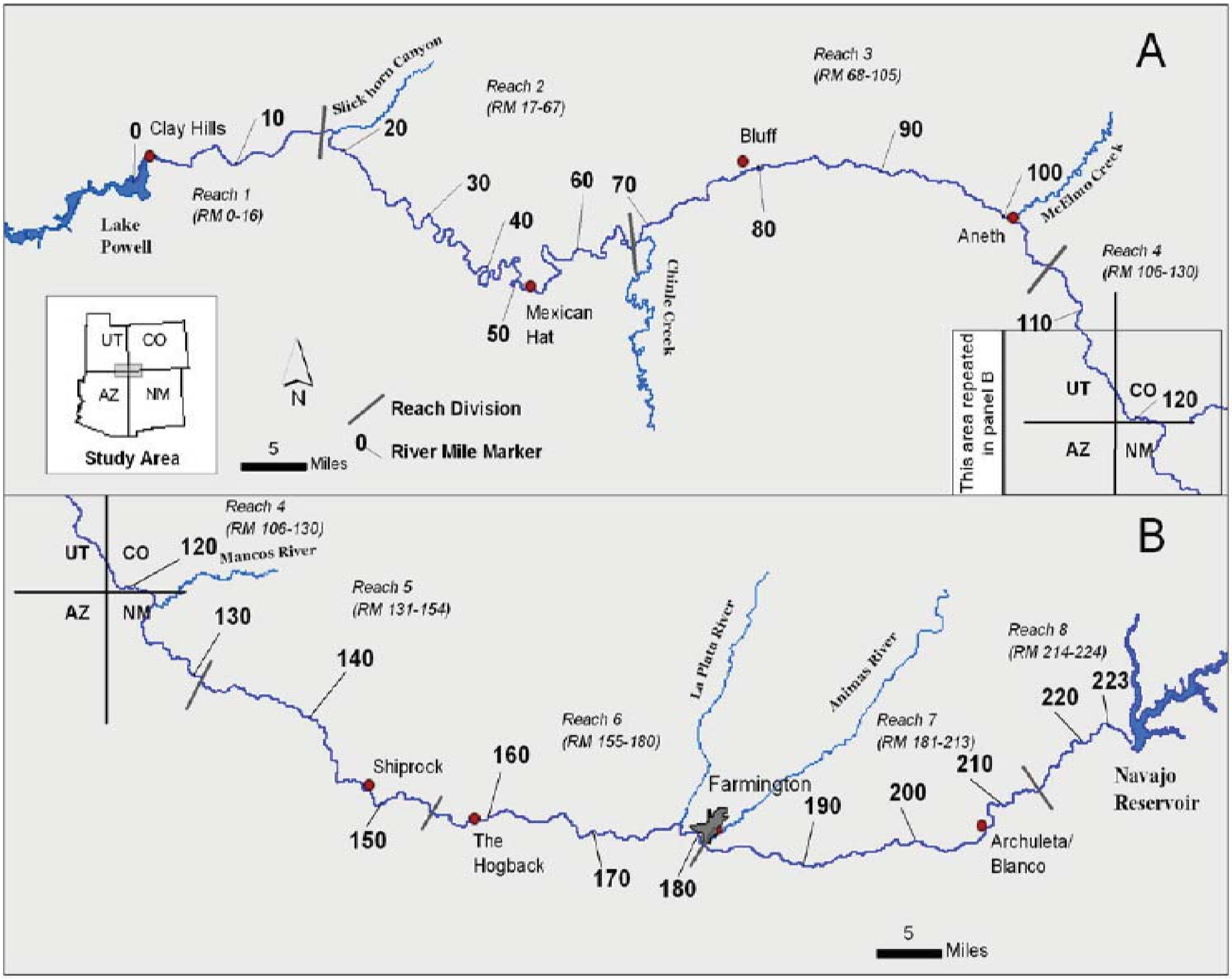

Figure 1. Map of the San Juan River. Study area begins at the confluence of the Animas River near Farmington, NM downstream to Clay Hills Crossing, UT.

Autumn monitoring of small-bodied and age-0 fishes of the San Juan River is designed to characterize survival and recruitment of wild-spawned Colorado pikeminnow and razorback sucker, survival of stocked age-0 Colorado pikeminnow, provide information on habitat use by wild and stocked individuals, monitor status and habitat use by potential Colorado pikeminnow prey and competitors of both Colorado pikeminnow and razorback sucker, and provide data to assess the effects of flow on density of small-bodied and age-0 fishes. Specific objectives of the small-bodied/young-of-year portion of the San Juan River monitoring effort are to:

1. document primary channel shoreline and near-shoreline mesohabitat, secondary channel, and backwater use by age-0 Colorado pikeminnow, razorback sucker, and roundtail chub;

2. obtain data that will aid in the evaluation of the responses (e.g., reproduction, recruitment, and growth) of native and nonnative fishes to different flow regimes and other management actions (e.g., impediment modification);

3. track trends in species populations (e.g., abundance and relative condition), and

4. characterize patterns of mesohabitat use by common native and nonnative small-bodied fishes (including age 0 flannelmouth sucker, bluehead sucker, common carp, and channel catfish).

Data obtained during small-bodied fishes monitoring efforts will be available to all San Juan River Basin Recovery Implementation Program researchers and may be used in conjunction with data obtained in other studies to evaluate management activities.

To date this study has documented the decline in the density of small-bodied nonnative fishes (red shiner and fathead minnow) starting in 2005. Native fish densities have been stable. The February 2009 Biology Committee meeting requested that annual reports in 2009 focus on information that may pertain to recovery of Colorado pikeminnow and razorback sucker. Summary information on all species is included, but specific information is focused around these two species. Analyses in this report mainly focus on data collected since 2003. Earlier data (1998-2002) are available and may be obtained from New Mexico Department of Game and Fish.

METHODS

In 1998, autumn monitoring of small-bodied fishes in wadeable habitats of the San Juan River primary and secondary channels and backwaters (including embayments) occurred from Shiprock, New Mexico (RM 147.9, Reach 5) downstream to Chinle Creek, Utah (RM 68.6, 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 adequately sample these habitats, beginning in 2000, all secondary channels longer than 200 m and having surface water during monitoring were sampled. All backwaters (greater than 50 m^2), regardless of occurrence within designated miles, were sampled.

Small-bodied fishes were collected from primary channel habitats at 3-mile intervals. Small-bodied monitoring occurs in conjunction with adult monitoring. Sample intervals are coordinated to occur in miles that are skipped by the adult monitoring crews. All collections were made by pulling a seine through a mesohabitat or kicking into a seine. There were several years that exploratory methods were added. 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 sixth mile. In 2007 and 2008, additional sampling was conducted using a combination of bag-block seining, similar to methods used by Robertson and Holden (2007), and straight seining in an effort to capture more age-1+ Colorado pikeminnow than might be captured during standardized monitoring. There was no significant difference detected between the collections made with these additional methods so all data was grouped for analysis.

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. River mile, GPS readings (UTM NAD83), and water quality information (pH, conductivity, and temperature) were recorded for each site. 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 within a site were recorded separately.

Most primary channel mesohabitats sampled were along stream margins, but off-shore riffles and runs (<0.75 m deep) were sampled also. Secondary channel sampling was across the breadth of the wetted channel. All available wadeable mesohabitats within a site were sampled. Uncommon mesohabitats (e.g., debris pools and backwaters were sampled in greater proportion to their availability than common mesohabitats (e.g., runs). Normally, at least five seine hauls (= five mesohabitats) were made at each sample site; however, if habitat was homogeneous, fewer seine hauls sometimes were made. Where there was comparatively high habitat diversity, more seine hauls frequently were made. The intent was to sample all mesohabitat types available at a site. All large backwaters >50 m^2 associated with the primary channel were sampled. 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 through 2008.

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 measured, recorded, and the specimen released. Subsamples of at least 50 individuals of speckled dace collected were measured for each reach; the remainder were counted and released. Nonnative fishes were fixed in 10% formalin and returned to the laboratory. Following specimen collection, the seined area of each sampled mesohabitat was measured and recorded. Retained specimens were identified and enumerated in the laboratory. Total length was measured for all retained specimens, except collections having more than 250 specimens of a species. For these collections, lengths were obtained for a sub-sample (a haphazard selection of at least 200 specimens). In 2008, small catostomids were preserved to verify identification in the laboratory. Personnel of UNM-MSB, Division of Fishes, verified identification of retained specimens. All retained specimens were accessioned to the University of New Mexico Museum of Southwestern Biology—Division of Fishes. For each seine haul, habitat type, area seined, depth in 5 locations within seined area, dominant substrate, and any cover associated with the habitat were recorded.

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 1 July through 30 September. Species density data were segregated by Geomorphic Reach (Bliesner and Lamarra 2000).

Mean sample density from 2003-2008 was calculated as the mean of individual seine haul densities. Mean sample densities were used in regression analysis of summer discharge to autumn density of commonly collected secondary and primary channel species from 2003 through 2008. Regression of density and discharge from 2000 through 2008 was computed using mean sample density plotted with time (density prior to 2003 was calculated as number of fish divided by total area sampled).

Mesohabitats were grouped into general categories (shoal, run, riffle, pool, eddy, backwater). There were several specialized pockets of habitat that did not fall into these general categories (e.g., debris piles and plunge pools). These were excluded from habitat graphs because of low number of samples from these mesohabitats. For each mesohabitat class, the mean sample density of each species in it was plotted for each year. This representation of mesohabitat association provided a crude estimate of habitat use by each species. ANOVA was used to determine if there were differences in the densities of each species among the various habitats.

Regression, correlation, ANOVA, and post hoc analyses (Tukey HSD) were performed using STATISTICA® software. Due to the natural variability seen with age-0 fish populations, probability values of <0.10 were considered significant (Brown and Guy 2007). Analyses in this report mainly focused on data collected since 2003. Earlier data (1998-2002) are available from New Mexico Department of Game and Fish.

RESULTS AND DISCUSSION

PRIMARY CHANNEL SUMMARY

Four native and seven nonnative species were collected in the primary channel of the San Juan River in 2008 (Table 1). No young-of year razorback sucker has been collected in this study; a single razorback sucker adult was captured in 2005. Colorado pikeminnow were collected from 1998 through 2000 and 2004 through 2007. Young-of-year were collected in 1998, 2000 and 2007; likely all stocked individuals. Roundtail chub and mottled sculpin have not been collected since 1999.

Native fishes numerically dominated collections from 2006 through 2008 (Table 2). Speckled dace was nearly three times more common in 2007 and 2008 than the next most abundant species, channel catfish. Red shiner was the most common species collected from 1998 through 2005, but in 2006 and 2007 it was third-most common. Fathead minnow were rare in collections from 2006 through 2008.

Table 1. Species collected during small-bodied fishes autumn monitoring of San Juan River primary channel, 1998-2007. 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***	***2006***	***2007***	***2008***
Red shiner	*Cyprinella lutrensis*	CYPLUT	I	X	X	X	X	X	X	X	X	X	X	X
Common carp	*Cyprinus carpio*	CYPCAR	I		X	X		X		X	X			X
Roundtail chub	*Gila robusta*	GILROB	N	X	X									
Fathead minnow	*Pimephales promelas*	PIMPRO	I	X	X	X	X	X	X	X	X	X	X	X
Colorado pikeminnow	*Ptychocheilus lucius*	PTYLUC	N	X						X	X	X	X	X
Speckled dace	*Rhinichthys osculus*	RHIOSC	N	X	X	X	X	X	X	X	X	X	X	X
Bluehead sucker	*Catostomus discobolus*	CATDIS	N	X	X	X	X	X	X	X	X	X	X	X
Flannelmouth sucker	*Catostomus latipinnis*	CATLAT	N	X	X	X	X	X	X	X	X	X	X	X
Flannelmouth x bluehead	*C. latipinnis* x *C. discobolus*	LATDIS			X				X					
Razorback sucker	*Xyrauchen texanus*	XYRTEX	N								X			
Black bullhead	*Ameiurus melas*	AMEMEL	I					X		X	X	X		X
Yellow bullhead	*Ameiurus natalis*	AMENAT	I									X		
Channel catfish	*Ictalurus punctatus*	ICTPUN	I	X	X	X	X	X	X	X	X	X		X
Plains killifish	*Fundulus zebrinus*	FUNZEB	I	X		X	X	X	X	X	X			X
Green sunfish	*Lepomis cyanellus*	LEPCYA	I		X				X	X	X			X
Largemouth bass	*Micropterus salmoides*	MICSAL	I				X			X			X	
Western mosquitofish	*Gambusia affinis*	GAMAFF	I	X		X	X	X	X	X	X	X	X	X
Mottled sculpin	*Cottus bairdi*	COTBAI	N		X									
NATIVE			7	5	5	3	3	3	3	4	5	4	4	4
NONNATIVE			9	5	5	6	6	7	6	9	8	6	4	7

Table 2. Fishes and mean sample densities (number/m^2) collected in San Juan River primary channel during autumn inventories, 2003 – 2008

	2003			2004			2005			2006			2007			2008		
Species	N	Density	StdError	N	Density	StdError	N	Density	StdError	N	Density	StdError	N	Density	StdError	N	Density	StdError
CYPLUT	1706	0.5243	0.0801	9830	1.8335	0.3551	2521	0.8478	0.2573	164	0.0357	0.0061	204	0.0310	0.0072	190	0.0314	0.0084
CYPCAR				6	0.0012	0.0006	3	0.0005	0.0004							2	0.0006	0.0004
PIMPRO	90	0.0353	0.0137	1119	0.2416	0.0749	281	0.0920	0.0322	44	0.0058	0.0049	32	0.0043	0.0026	24	0.0053	0.0036
PTYLUC				4	0.0005	0.0002	2	0.0003	0.0002	8	0.0013	0.0005	23	0.0031	0.0010	3	0.0004	0.0002
RHIOSC	511	0.1655	0.0292	4690	0.7643	0.1026	1234	0.2689	0.0412	2401	0.7378	0.4880	2177	0.2653	0.0377	1192	0.2007	0.0244
CATDIS	27	0.0068	0.0021	283	0.0463	0.0056	90	0.0267	0.0160	154	0.0404	0.0229	53	0.0066	0.0017	58	0.0158	0.0098
CATLAT	140	0.0622	0.0231	255	0.0441	0.0072	111	0.0289	0.0131	62	0.0120	0.0028	227	0.0221	0.0073	101	0.0117	0.0039
LATDIS	1	0.0002	0.0002															
XYRTEX							1											
AMEMEL				2	0.0005	0.0004	1	0.0006	0.0006	3	0.0004	0.0004				1	0.0005	0.0005
ICTPUN	366	0.0912	0.0144	603	0.0887	0.0161	401	0.0960	0.0245	336	0.0695	0.0090	697	0.0835	0.0109	533	0.0718	0.0096
FUNZEB	21	0.0056	0.0028	30	0.0051	0.0034	1	0.0003	0.0003							2	0.0001	0.0001
LEPCYA	2	0.0004	0.0003	1	0.0004	0.0004	1	0.0003	0.0003							1	0.0001	0.0001
MICSAL				4	0.0009	0.0005							1	0.0004	0.0004			
GAMAFF	37	0.0093	0.0059	127	0.0239	0.0075	16	0.0067	0.0035	4	0.0009	0.0007	8	0.0012	0.0009	5	0.0034	0.0028
Total N	2913			17042			4639			3175			2766			2217		
Total Area	3994			7768			5985			5446			9038			7469		
Density	0.73			2.19			0.78			0.58			0.31			0.36		

SECONDARY CHANNELS SUMMARY

Most fish species found in the San Juan River primary channel also were found in its secondary channels (Table 3). Colorado pikeminnow was collected in secondary channels in each of the past four years. Roundtail chub and mottled sculpin have not been collected in San Juan River secondary channels since 1999. Razorback sucker has never been collected in a secondary channel during small-bodied fishes monitoring. Four native and 10 nonnative species were found in secondary channels in 2008. Largemouth bass and plains killifish, both nonnative species and not collected since 2004, were collected in 2008.

Speckled dace was the most abundant species in San Juan River secondary channels from 2006 through 2008 (Table 4). Red shiner was the most common species from 1998 through 2005. In 2007 and 2008 speckled dace was six times more abundant than red shiner in secondary channels.

Table 3. Species collected during small-bodied monitoring in San Juan River secondary channels during autumn, 1998-2007. 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***	***2006***	***2007***	***2008***
Red shiner	*Cyprinella lutrensis*	CYPLUT	I	X	X	X	X	X	X	X	X	X	X	X
Common carp	*Cyprinus carpio*	CYPCAR	I	X		X	X	X	X	X				X
Roundtail chub	*Gila robusta*	GILROB	N	X	X									
Fathead minnow	*Pimephales promelas*	PIMPRO	I	X	X	X	X	X	X	X	X	X	X	X
Colorado pikeminnow	*Ptychocheilus lucius*	PTYLUC	N	X	X	X				X	X	X	X	X
Speckled dace	*Rhinichthys osculus*	RHIOSC	N	X	X	X	X	X	X	X	X	X	X	X
Bluehead sucker	*Catostomus discobolus*	CATDIS	N	X	X	X	X	X	X	X	X	X	X	X
Flannelmouth sucker	*Catostomus latipinnis*	CATLAT	N	X	X	X	X	X	X	X	X	X	X	X
Black bullhead	*Ameiurus melas*	AMEMEL	I	X			X	X	X	X	X			X
Yellow bullhead	*Ameiurus natalis*	AMENAT	I	X			X				X	X		X
Channel catfish	*Ictalurus punctatus*	ICTPUN	I	X	X	X	X	X	X	X	X	X	X	X
Rainbow trout	*Oncorhynchus mykiss*	ONCMYK	I				X							
Plains killifish	*Fundulus zebrinus*	FUNZEB	I	X		X	X	X	X	X				X
Green sunfish	*Lepomis cyanellus*	LEPCYA	I							X				
Largemouth bass	*Micropterus salmoides*	MICSAL	I						X	X				X
Western mosquitofish	*Gambusia affinis*	GAMAFF	I	X	X	X	X	X	X	X	X	X	X	X
Mottled sculpin	*Cottus bairdi*	COTBAI	N		X									
NATIVE			6	5	6	4	3	3	3	4	4	4	4	4
NONNATIVE			11	9	5	7	10	8	8	8	6	5	4	9

Table 4. . Fishes and mean sample densities (number/m^2) collected in San Juan River secondary channel during autumn inventories, 2003 – 2008

	2003			2004			2005			2006			2007			2008		
Species	N	Density	StdError	N	Density	StdError	N	Density	StdError	N	Density	StdError	N	Density	StdError	N	Density	StdError
CYPLUT	1636	1.6186	0.4463	7171	4.2304	0.6358	921	0.9532	0.3283	154	0.1205	0.0368	168	0.0691	0.0194	221	0.0820	0.0434
CYPCAR	2	0.0016	0.0011	10	0.0088	0.0040										5	0.0029	0.0015
PIMPRO	325	0.2417	0.0930	2239	1.8800	0.7865	106	0.1218	0.0502	27	0.0347	0.0233	4	0.0017	0.0017	117	0.0383	0.0183
PTYLUC				4	0.0046	0.0023	1	0.0005	0.0005	2	0.0011	0.0008	15	0.0083	0.0027	6	0.0013	0.0006
RHIOSC	238	0.2454	0.06121	1364	07976	0.1667	172	0.2013	0.0507	251	0.2131	0.0410	821	0.4256	0.1042	1017	0.5288	0.1178
CATDIS	24	0.0167	0.0082	123	0.0827	0.0259	7	0.0064	0.0033	62	0.0256	0.0134	13	0.0057	0.0024	87	0.0202	0.0115
CATLAT	145	0.1103	0.0531	124	0.0899	0.0293	25	0.0278	0.0099	61	0.0296	0.0131	87	0.0410	0.0205	195	0.0602	0.0295
AMEMEL	9	0.0057	0.0024	6	0.0050	0.0031	3	0.0045	0.0031	4	0.0049	0.0030				3	0.0018	0.0013
AMENAT							1	0.0010	0.0010							3	0.0017	0.0011
ICTPUN	79	0.0551	0.0139	116	0.0991	0.0278	114	0.2099	0.1086	42	0.0193	0.0053	225	0.0935	0.0163	110	0.0387	0.0119
FUNZEB	11	0.0048	0.0025	32	0.0295	0.0173										4	0.0021	0.0014
LEPCYA				1	0.0007	0.0007												
MICSAL	1	0.0016	0.0016	6	0.0037	0.0020										10	0.0073	0.0052
GAMAFF	32	0.0258	0.0099	154	0.1584	0.0618	45	0.0463	0.0437	4	0.0058	0.0038	1	0.0004	0.0004	80	0.0236	0.0088
Total N	2464			11109			1400			607			1334			1858		
Area	1438			1789			1009			1679			2525			2619		
Density	1.71			6.21			1.38			0.36			0.53			0.71		

OVERALL TRENDS IN PRIMARY AND SECONDARY CHANNELS

Riverwide densities of native fishes varied year to year. Speckled dace was the most abundant native fish in all years (Figure 2). From 2003 through 2008 there was a slight decrease in the density of flannelmouth sucker in the primary channel (Table 5). Density of Colorado pikeminnow increased from zero in 2003 through 2007, but was substantially lower in 2008 than 2007.

Small-bodied nonnative fishes, red shiner and fathead minnow, have significantly decreased in the San Juan from 2003 through 2008 (Table 5); the greatest decrease in abundance occurred in 2006 (Figure 3). From 2000 to 2008 there was a strong negative relationship between summer discharge at the Shiprock Gage (appendix Figuer A1 & Table A1) and density of red shiner and fathead minnow in primary and secondary channels (r >[-0.715], p<0.03). Mean summer daily discharge between 2000 and 2004 (692 cfs) was lower ($t_{(7)}$=2.36, p=0.002) than 2005 through 2008 (1079 cfs). There was no detectable change in the density of channel catfish.

Table 5. Results of regression analysis on mean sample density of fishes over time from 2003-2008. (Degrees of freedom 1, 2010). Shaded area indicates significant results.

		Primary		Secondary	
	SPECIES	*r*	*p*	*r*	*p*
Native	CATDIS	-0.024	0.278	-0.070	0.066
	CATLAT	-0.081	0.000	-0.056	0.143
	PTYLUC	0.055	0.013	0.040	0.297
	RHIOSC	-0.018	0.413	0.015	0.709
Introduced	CYPLUT	-0.131	0.000	-0.284	0.000
	ICTPUN	-0.026	0.244	-0.043	0.262
	PIMPRO	-0.078	0.000	-0.100	0.009

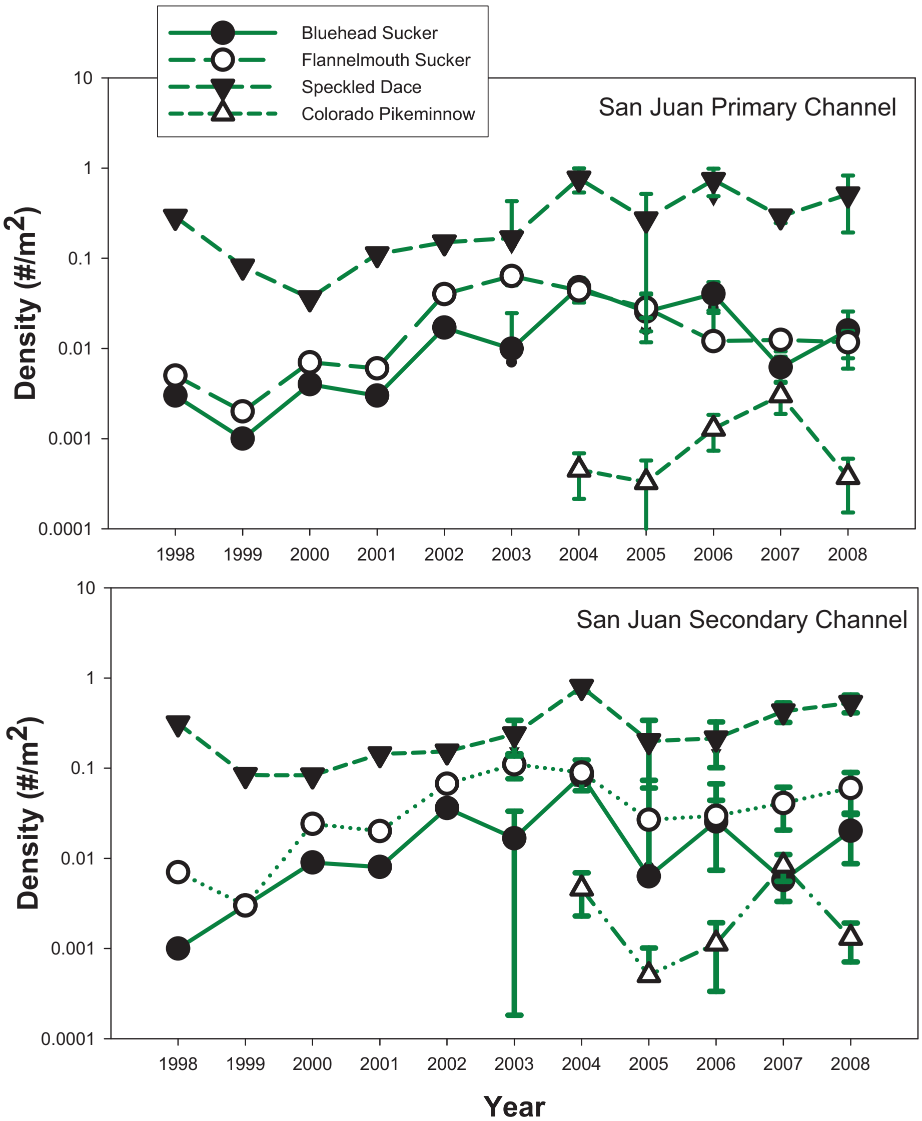

Figure 2. River-wide density (total number/total area sampled) from 1998 through 2002 and mean seine-haul density (and associated standard error) from 2003 through 2008 of commonly collected native fishes in autumn sampling of the San Juan River. Note log scale for density. Error bars represent $\pm$ 1 SE.

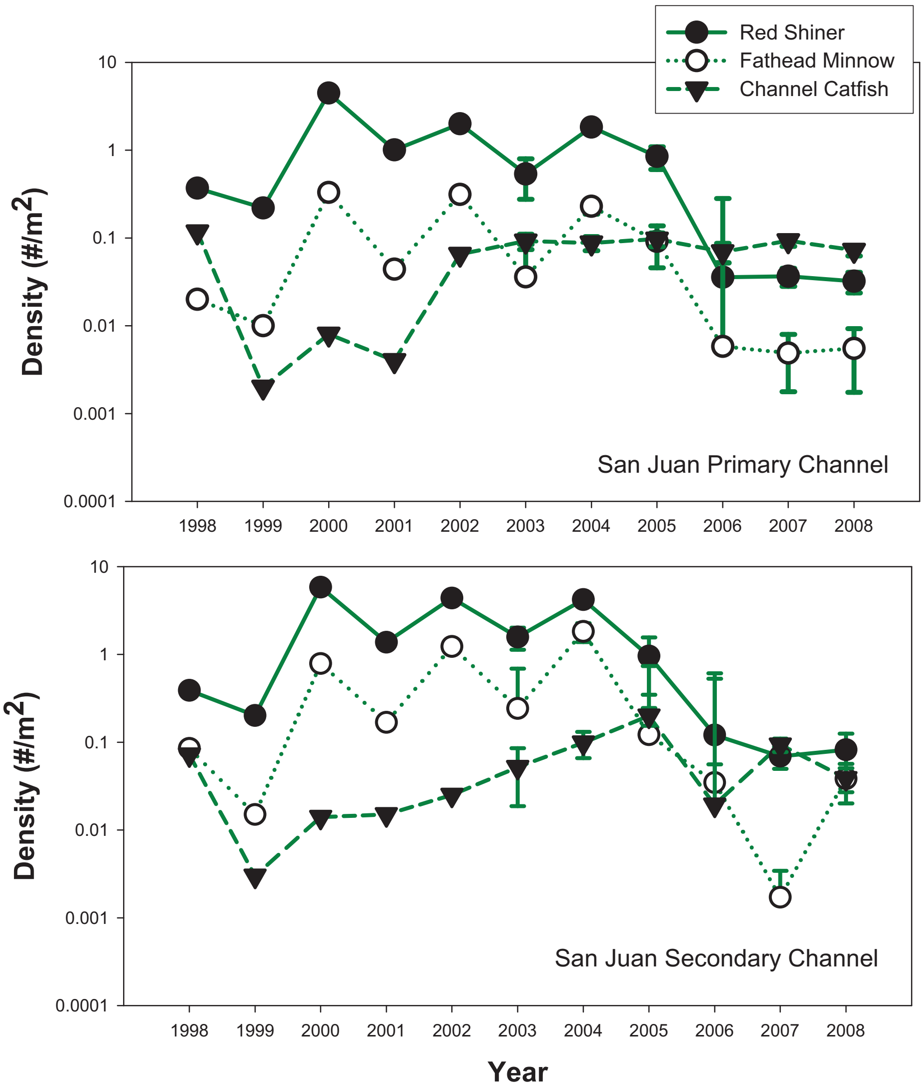

Figure 3. River-wide density (total number/total area sampled) from 1998 through 2002 and mean seine-haul density (and associated standard error) from 2003-2008 of commonly collected nonnative fishes in autumn sampling of the San Juan River. Note log scale for density. Error bars represent $\pm$ 1 SE.

LARGE BACKWATER SUMMARY

Four native and eight nonnative species were collected in San Juan River large backwaters in 2008. One age-1+ Colorado pikeminnow was collected in 2008. Twenty-one Colorado pikeminnow were collected in large backwaters in 2007, 18 of these were age-0 (almost certainly recently stocked individuals). Prior to 2007 Colorado pikeminnow had not been collected in a large backwater since 2000 (Table 6). Red shiner was the most abundant species in large backwaters in all years (Table 7).

Table 6. Species collected in San Juan River backwaters during autumn, 1999 – 2008, 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	2006	2007	2008
Red shiner	*Cyprinella lutrensis*	CYPLUT	I	X	X	X	X	X	X	X	X	X	X
Common carp	*Cyprinus carpio*	CYPCAR	I		X	X	X		X	X		X	X
Fathead minnow	*Pimephales promelas*	PIMPRO	I	X	X	X	X	X	X	X	X	X	X
Colorado pikeminnow	*Ptychocheilus lucius*	PTYLUC	N	X	X							X	X
Speckled dace	*Rhinichthys osculus*	RHIOSC	N	X	X	X	X	X	X	X	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	X
Black bullhead	*Ameiurus melas*	AMEMEL	I		X	X	X	X					
Yellow bullhead	*Ameiurus natalis*	AMENAT	I									X	
Channel catfish	*Ictalurus punctatus*	ICTPUN	I	X	X	X	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
Green sunfish	*Lepomis cyanellus*	LEPCYA	I			X	X	X					X
Bluegill	*Lepomis macrochirus*	LEPMAC	I		X								
Largemouth bass	*Micropterus salmoides*	MICSAL	I		X					X			X
NATIVE			4	3	4	3	3	3	3	3	1	4	4
NONNATIVE			10	3	9	9	7	6	6	7	2	5	8

Table 7. Fishes and mean sample densities collected in San Juan River backwaters during autumn inventories, 2003 – 2008.

	2003			2004			2005			2006			2007			2008		
Species	*N*	*Den*	*Std. Error*	*N*	*Den*	*Std. Error*	*N*	*Den*	*Std. Error*	*N*	*Den*	*Std. Error*	*N*	*Den*	*Std. Error*	*N*	*Den*	*Std. Error*
CYPLUT	301	1.7454	0.4953	1033	3.6789	0.1984	566	1.2821	0.2102	3	0.0725	0.0513	67	0.0845	0.0054	288	0.5588	0.1032
CYPCAR				3	0.0102	0.0020	1	0.0053	0.0012				1	0.0032	0.0005	2	0.0051	0.0008
PIMPRO	241	2.4151	1.3993	319	1.0457	0.0721	122	0.2182	0.0163	2	0.0394	0.0063	12	0.0129	0.0015	35	0.1122	0.0691
PTYLUC													21	0.0280	0.0024	1	0.0026	0.0026
RHIOSC	4	0.0182	0.0094	10	0.0345	0.0164	12	0.0179	0.0110	1	0.0242	0.0242	30	0.0407	0.0159	116	0.2098	0.1114
CATDIS	3	0.0431	0.0276	2	0.0081	0.0022	69	0.1346	0.0265				1	0.0010	0.0002	6	0.0126	0.0011
CATLAT	6	0.0431	0.0276	1	0.0038	0.0010	114	0.1556	0.0207				4	0.0049	0.0005	26	0.0654	0.0071
AMEMEL	12	0.0472	0.0445															
AMENAT													1	0.0036	0.0036			
ICTPUN	10	0.0373	0.0305	10	0.0411	0.0050	1	0.0022	0.0005				64	0.0991	0.0061	36	0.0773	0.0078
FUNZEB	1	0.0043	0.0043	24	0.0603	0.0098	3	0.0034	0.0008							1	0.0033	0.0033
LEPCYA	1	0.0108	0.0108													1	0.0030	0.0030
MICSAL							2	0.0132	0.0030							6	0.0154	0.0111
GAMAFF	20	0.1342	0.0812	17	0.0583	0.0059	26	0.0499	0.0077							23	0.0156	0.0100
Total N	490			1415			876			6			198			541		
Area	245			274			489			53			723			486		
Density	2.00			5.16			1.79			0.11			0.27			1.11		

In 2008, nearly 60% of fishes collected in the primary and 70% in secondary channels were native (Figure 4). The lowest proportion of native fishes in primary and secondary channels occurred in 2000 (<2%) whereas the greatest proportion of native fishes occurred in the primary channel in 2006 (83%). The first year the proportion of native fishes was noticeably higher in secondary channels than the primary channel was 2008. Backwaters were numerically dominated by nonnative species in all years. The period of lowest native density coincides with years of low summer discharge.

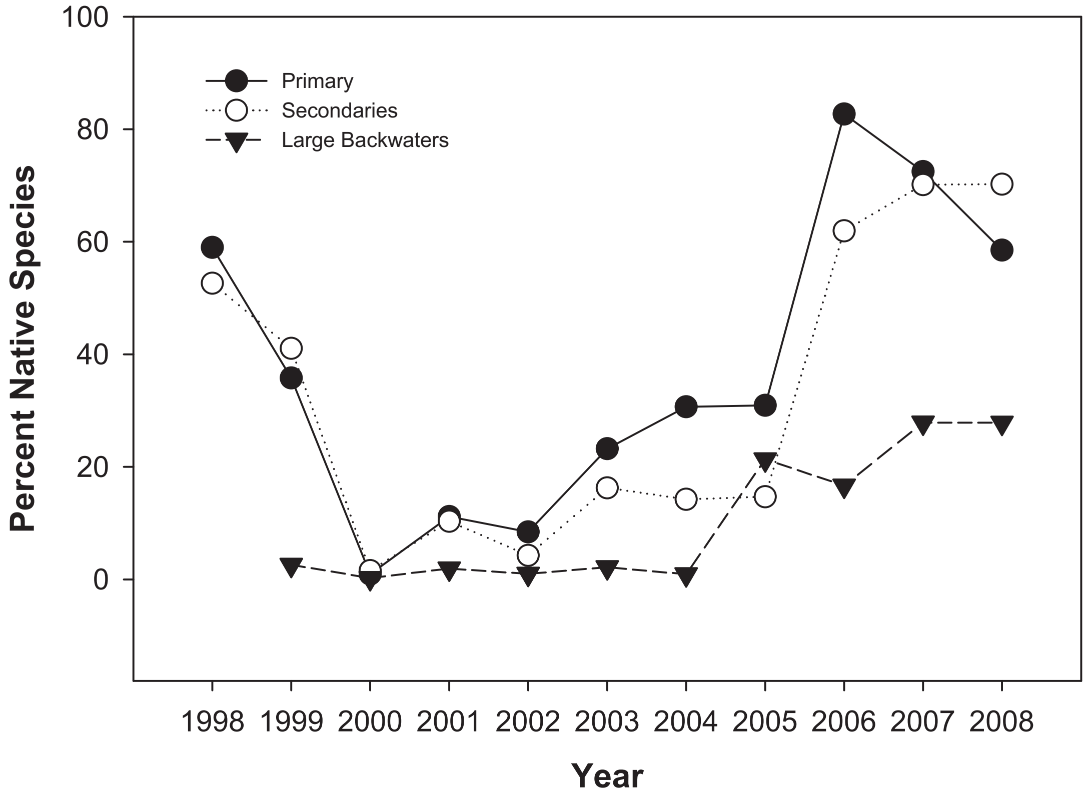

Figure 4. Percent of native species collected in autumn sampling on the San Juan River from 1998 through 2008.

HABITAT

The proportion of samples taken in each habitat type was relatively consistent from 2003 through 2008. The greatest number of samples was taken in run habitats in primary and secondary channels (Figure 5); approximately 80% of the San Juan River is comprised of run habitats (Bliesner and Lamarra 2007). In all years, except 2006, approximately 10% of the samples are taken in backwaters associated with the primary channel. Riffle habitats generally comprised 10% of the samples in primary and secondary channels.

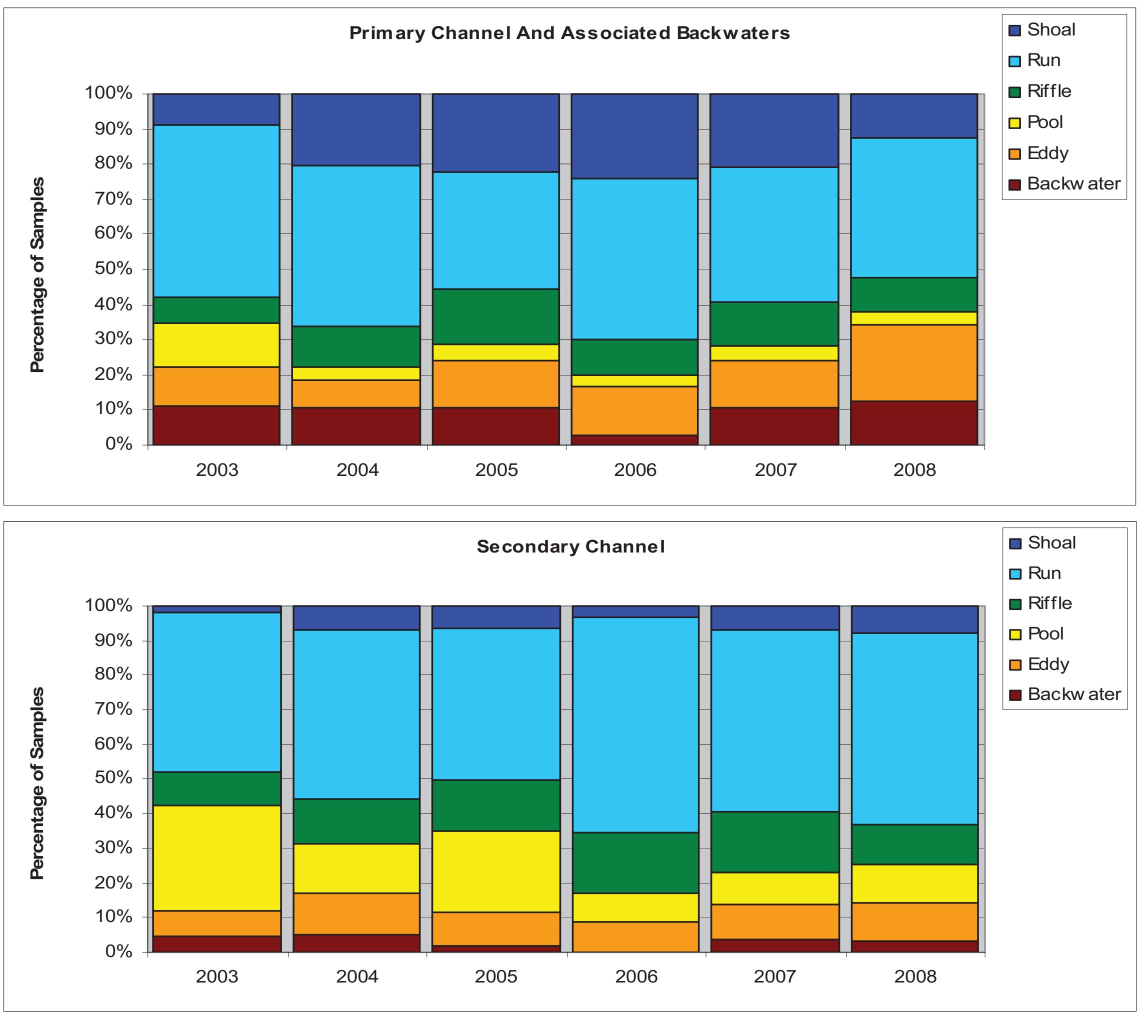

Figure 5. Proportion of samples taken within various habitats in primary and secondary channels of the San Juan River (2003-2008).

RARE FISHES INFORMATION SUMMARY

Razorback sucker and other native suckers

No young-of-year razorback sucker has been collected during small-bodied monitoring on the San Juan River though one adult razorback sucker was collected in 2005. Larval razorback sucker were collected by larval sampling for the past 11 years (Brandenburg and Farrington 2008). However, no young-of-year razorback sucker has been collected by larval sampling later than July in any year.

Similarly, numbers of commonly collected sucker species generally decrease in larval collections in late summer months. The majority of these individuals are possibly moving into habitats that are not sampled by larval fish crews, which concentrate on low-velocity, near-shore habitats. There is little information on habitat use of juvenile razorback sucker in the San Juan. Larval sampling crews collected single specimens of age-1 razorback sucker in 2004 and 2006. One was collected in an edge pool and the other in a shore run habitat.

Adult razorback sucker in the Green River were observed mainly in habitats greater than 1 m deep, with sandy substrates (Tyus 1987). Collections of juvenile razorback suckers are throughout its range. In the upper Colorado River basin, studies indicate that floodplain habitats are important habitats for development of larval razorback sucker, although nonnative predators within the floodplain decreased recruitment success (Christopherson et al. 2004). Floodplain areas were often warmer and had greater abundance of zooplankton than the main channel habitats, presumably enabling faster growth. Tributary streams may also provide important habitats for spawning and rearing (Minckley 1973). McElmo Creek was noted as a likely spawning location for razorback sucker in the San Juan (Brandenburg and Farrington 2008).

BLUEHEAD AND FLANNELMOUTH SUCKER

Although young-of-year razorback sucker have not been collected during San Juan River small-bodied monitoring there is likely relevant information that can be gleaned from collections of common suckers. Bluehead and flannelmouth suckers were collected in various habitat types (Figures 6 & 7). Large aggregations of both sucker species were periodically found in low-velocity habitats, including backwaters and pools. The density of flannelmouth sucker in the primary channel was greatest in pools and backwaters associated with the primary channel ($F_{(2, 2086)}$=39.217, $p<0.01$), but not in secondary channels. There were no significant relationships between bluehead sucker density and habitat types in either channel type.

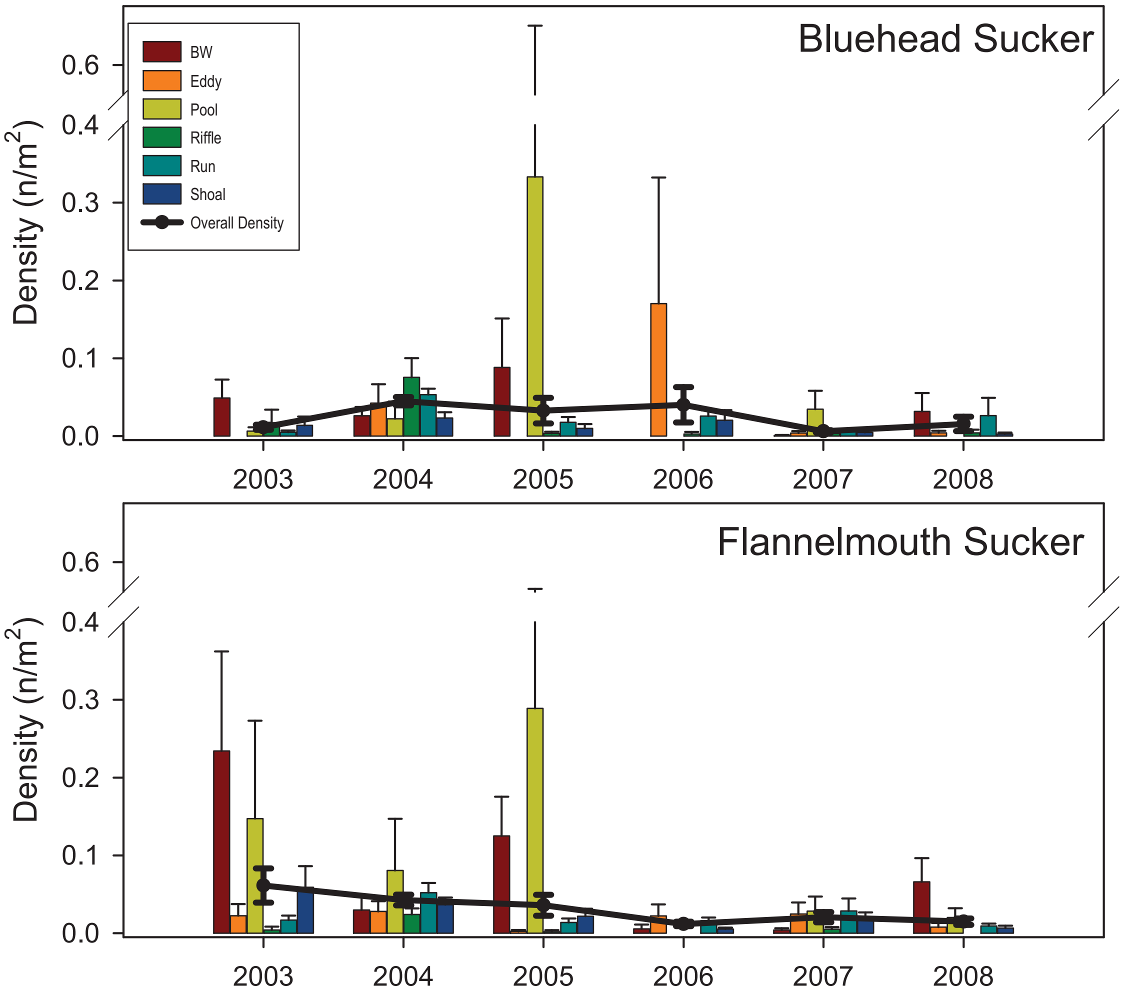

Figure 6. Density of bluehead and flannelmouth sucker in habitats associated with the primary channel (including large backwaters) of the San Juan River, 2003-2008. Error bars are 1 standard error.

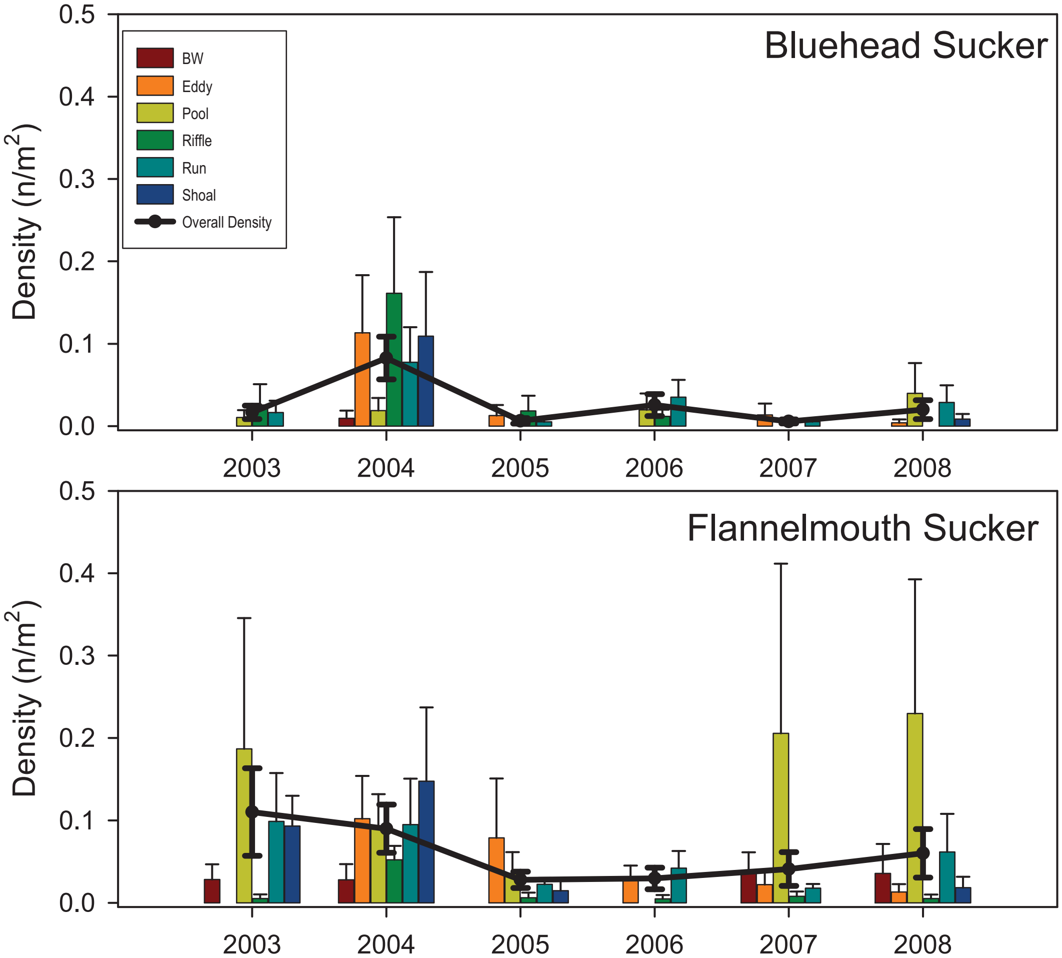

Figure 7. Density of bluehead and flannelmouth sucker in habitats associated with secondary channels of the San Juan River, 2003-2008. Error bars are 1 standard error.

The mean depth habitats from which small-bodied fishes were collected was 0.301 m (SE = 0.003). The maximum depth that collections are obtained is about 1.5 meters, but seining efficiency in unconfined habitats greater than 0.75m deep was likely low. The mean depth of samples containing bluehead sucker was 0.278 meters (SE = 0.008), and those containing flannelmouth sucker was 0.285 meters (SE = 0.008). Both sucker species were collected in habitats with various substrate types (Figure 8). Although large samples of flannelmouth sucker were periodically collected in slow-water habitats with sand and silt substrates, there was no significant effect of substrate on density of flannelmouth or bluehead sucker ($F_{(4df)}<1.57$, $p>0.19$).

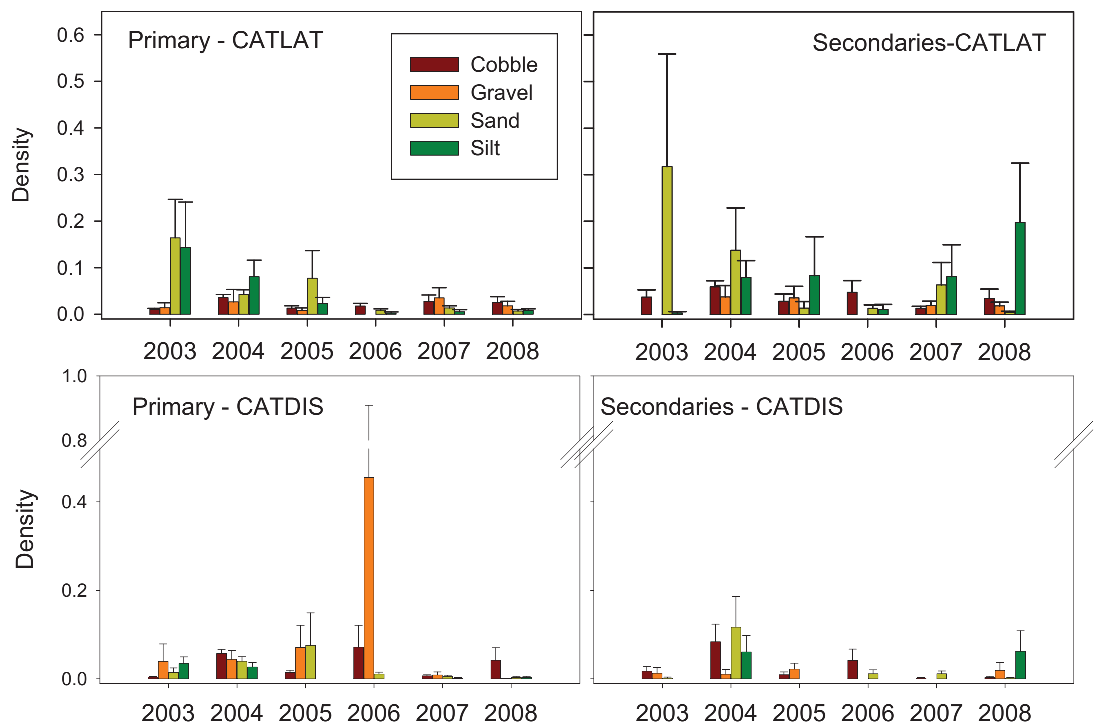

Figure 8. Density of flannelmouth sucker and bluehead sucker captured over various substrates in the San Juan River, 2003-2008. Error bars represent 1 standard error. Note change in Y-axis scale.

Recruitment of larval fish into the adult population is an important aspect of recovery that has been problematic for razorback sucker in the San Juan. There was not a clear relationship between the catch-per-unit-effort (CPUE) of commonly collected suckers captured during larval fish monitoring and CPUE for young-of-year suckers captured during small-bodied monitoring (Figure 9 & 10).

To aid in discerning potential relationships between larval CPUE (and thus, reproductive success) and small-bodied CPUE (and thus recruitment success, at least to early juvenile), a simple model (appendix Table A2) was developed to determine how well CPUE of larvae at various times of year predicted the CPUE of young-of year collected during autumn monitoring. For both species, the CPUE of young-of-year collected in August was the best predictor of how many were collected during fall monitoring; expected values were within confidence intervals 6 of 6 years for flannelmouth sucker and 5 of 6 years for bluehead sucker. For example, average CPUE for young-of-year flannelmouth sucker in small-bodied monitoring from 2003 through 2008 was 2.14 (SE 1.82) times the CPUE of August larval surveys. The only year that larval razorback suckers were collected in August was 2005. If detection/retention of razorback sucker was similar to flannelmouth sucker calculations, 4 ± 8 razorback would have been collected by small-bodied monitoring in 2005. Although there was not a clear relationship, it appeared that sucker CPUE in autumn small-bodied and adult monitoring was correlated with their August CPUE.

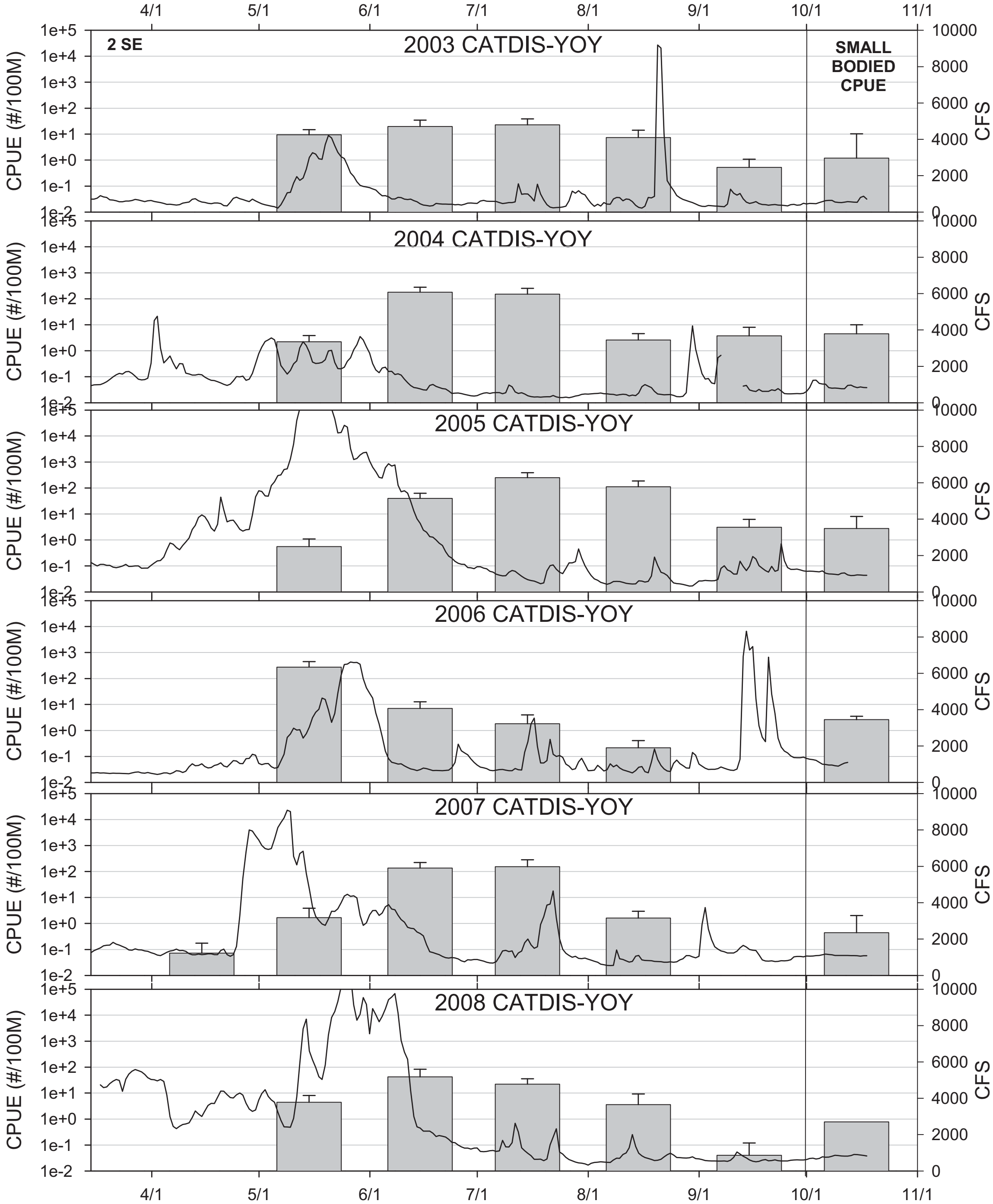

Figure 9. Bars represent catch-per-unit-effort for young-of-year bluehead sucker during San Juan River larval and small-bodied monitoring. Error bars represent 2 standard errors. Line represents discharge at Shiprock Gage, NM in the San Juan River 2003-2008.

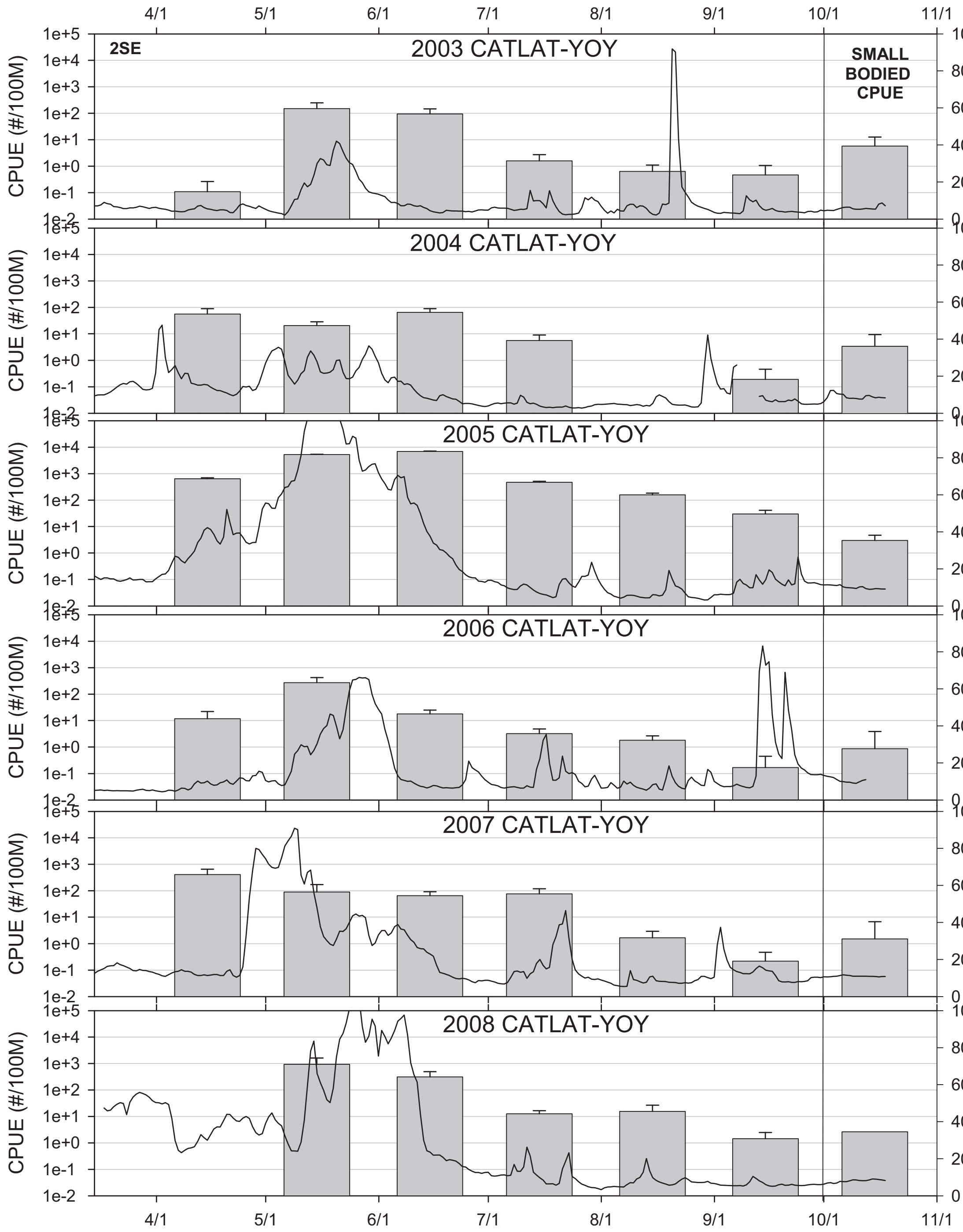

Figure 10. Bars represent catch-per-unit-effort for flannelmouth sucker young-of-year during San Juan River larval and small-bodied monitoring. Error bars represent 2 standard error. Line represents discharge at Shiprock Gage, NM in the San Juan River 2003-2008.

Year classes were tracked through time using length-frequency histograms. There was a strong cohort of bluehead sucker in 2004 that carried through 2008 (Figure 11). Flannelmouth sucker had strong year classes both in 2003 and 2004 (Figure 12). Neither species had good recruitment for the 2005 year class, although both had relatively abundant young-of-year in autumn 2005. Recruitment appeared to be low for 2006 and 2007 as well.

Young-of-year suckers were generally less than 100 mm TL by autumn.   Young-of-year for both species were smaller in 2005 and 2008 than other years (Figure 13). Flannelmouth sucker spawned in 2004 were larger than young-of-year collected in other years. Larger larvae may be more successful at surviving to next year, and thus to the adult population than smaller individuals; faster growth rates may reduce the time that larvae are vulnerable to predation by co-occurring small-bodied fish and invertebrate predators in nursery areas (Bestgen 2008, Christopherson et al. 2004). Time of spawning also has an effect on size of young-of-year suckers in autumn. Spawning for all sucker species extended over a longer period in 2005 than 2004 (Brandenburg and Farrington 2008).

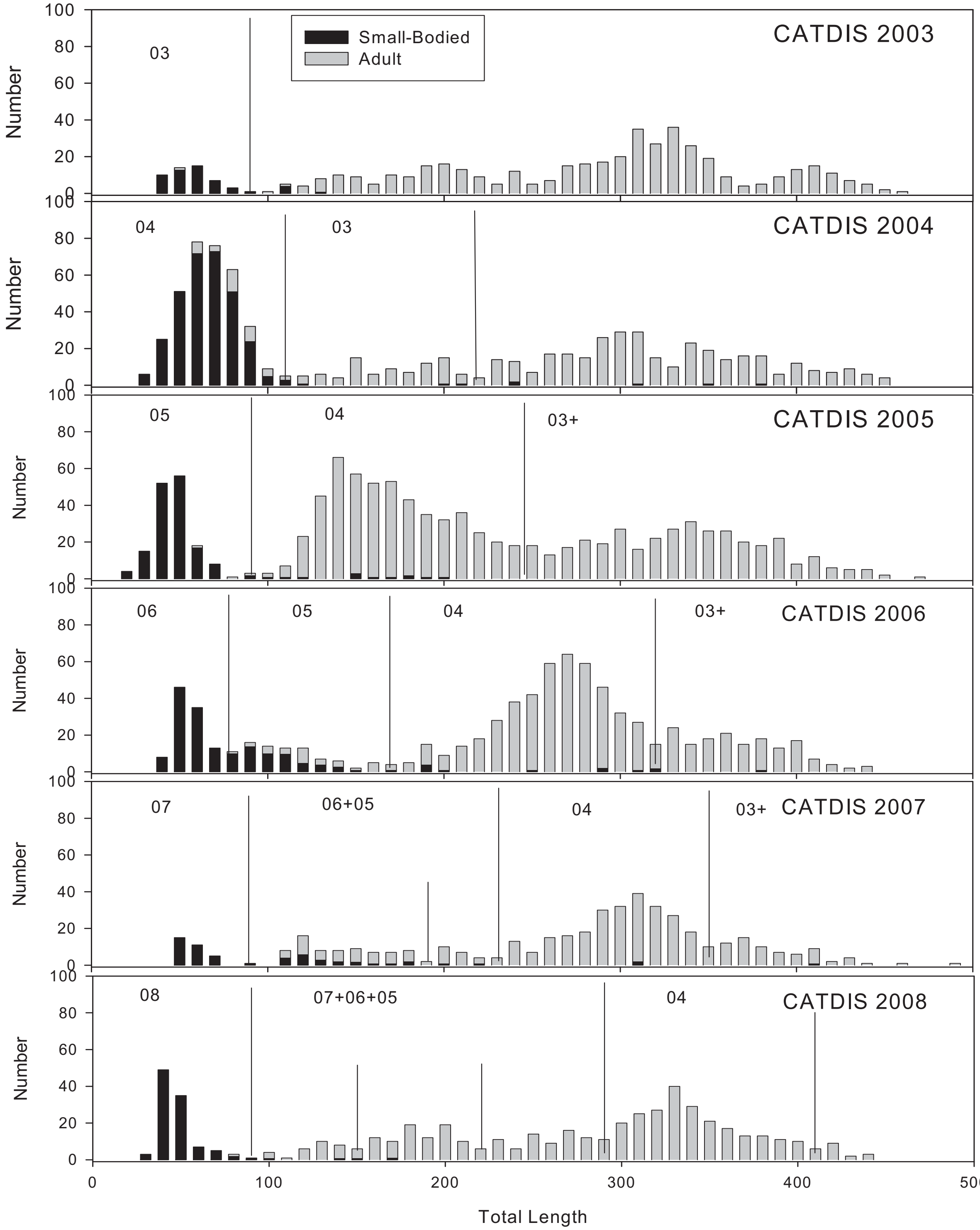

Figure 11. Length frequency histogram and approximate year class for bluehead sucker collected during fall monitoring by small-bodied and adult monitoring efforts on the San Juan River, 2003-2008. Vertical bars approximate breaks in year class cohorts.

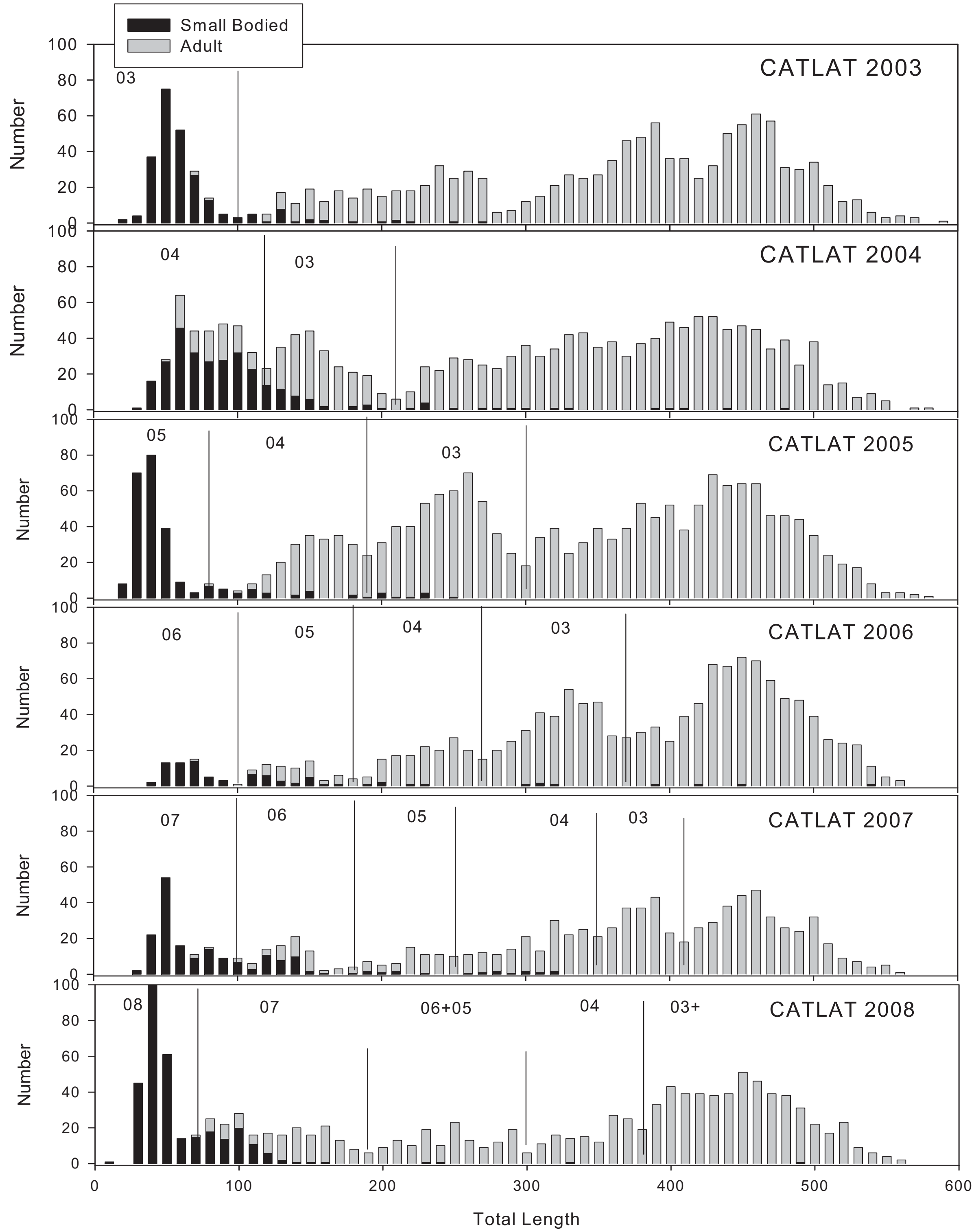

Figure 12. Length frequency histogram and approximate year class for flannelmouth sucker collected during fall monitoring by small-bodied and adult monitoring efforts on the San Juan River, 2003-2008. Vertical bars approximate breaks in year class cohorts.

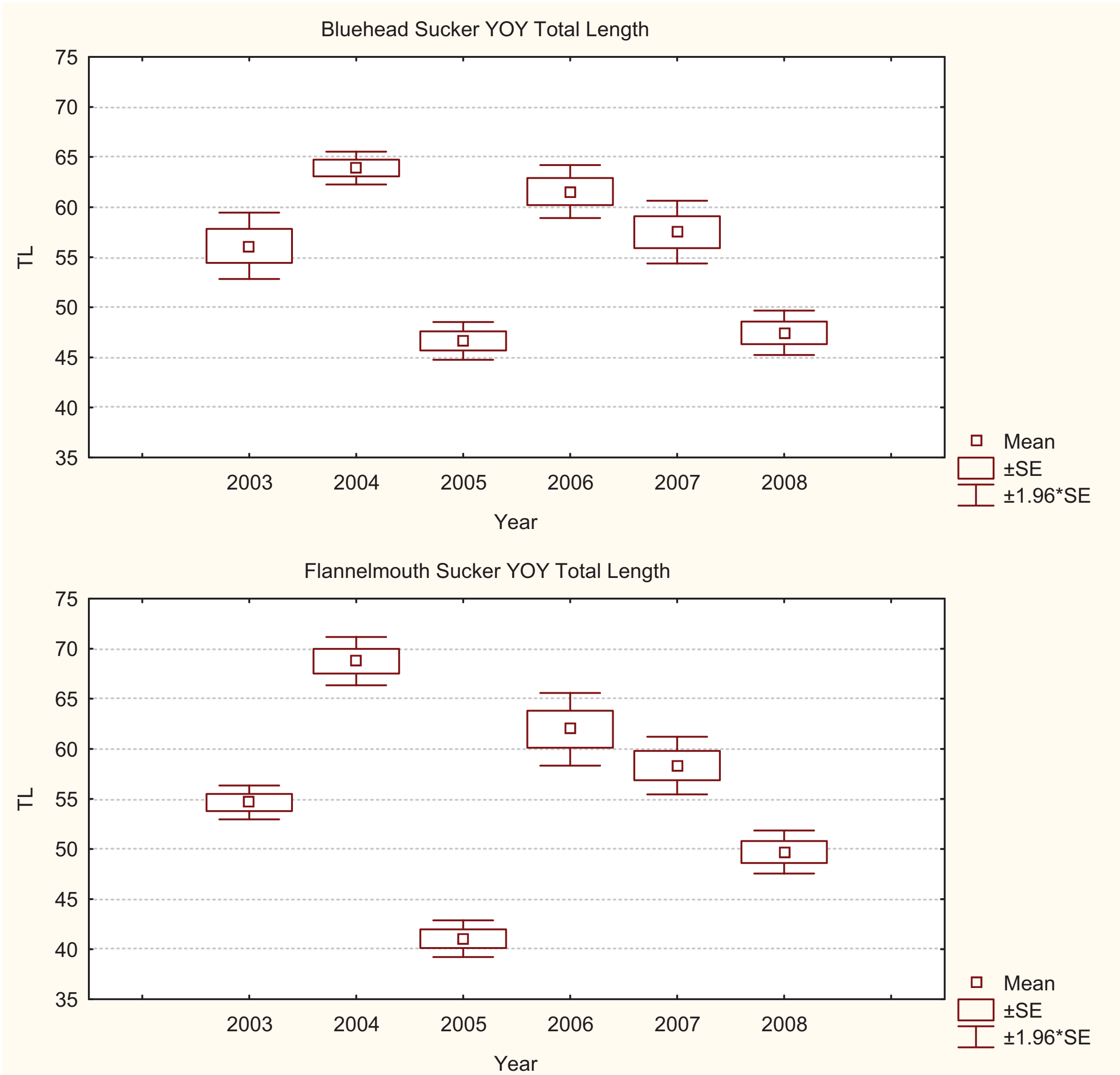

Figure 13. Mean total length of young-of-year bluehead and flannelmouth sucker in the San Juan River 2003-2008.

Colorado Pikeminnow

Young-of-year Colorado pikeminnow were collected by small-bodied monitoring in 1998, 2000, and 2007 (Table 8). Stocking of larval or young-of-year Colorado pikeminnow occurred in each of these years prior to small-bodied monitoring, so it is probable that these specimens were captive-bred individuals (Ryden 2006). Total length of these fish averaged 50 mm (SE 1.74). Twenty-four young-of-year Colorado pikeminnow were captured in September and October from 1987 through 1994, prior to initiation of small-bodied monitoring in 1998 (Table 9) (Platania et al., 2000). These fish were smaller than captures since 1996, averaging 26 mm (SE 1.21) in September and 32 mm (SE 1.76) in October.

Age-1+ Colorado pikeminnow were collected by small-bodied monitoring in each year, except 2001, 2002, and 2003. Most age-1+ Colorado pikeminnow were captured in Reach 5. Only one age-1+ and one recently stocked young-of-year have been collected in Reach 1.

Table 8. Summary of Colorado pikeminnow captures by small-bodied monitoring in the San Juan River, 1998 -2008. Blue highlight indicates recently stocked young-of –year.

		Reach						
Year	***Length Category***	***6***	***5***	***4***	***3***	***2***	***1***	***Grand Total***
1998	70			1				5
	80				1			
	130		2	1				
1999	120		1					2
	230		1					
2000	50			1				2
	90				1			
2004	160		2					8
	170			1				
	180		2					
	200		1					
	210		1					
	230			1				
2005	170				1			3
	180			1				
	290					1		
2006	140	1	1					10
	150	1	1					
	180		1		1			
	190					1		
	200	1						
	210				1			
	280				1			
2007	40				6	2		59 Total, (*28 Recently Stocked YOY)
	50				17	2	1	
	120	2						
	130		1					
	140	1	4					
	150	2	6		2			
	160	2		1	1		1	
	170	1	1	3	1			
	180		1		1			
2008	130		1					10
	140	1	1	1				
	150		2	1	1			
	170		1					
	210				1			
Grand Total		12	27	9	34	6	2	90

Table 9. Size of young-of year Colorado pikeminnow collected in September and October in the San Juan River, 1987-1994 (Platania 2000).

	September		October	
Year	***Number***	***Total Length***	***Number***	***Total Length***
1987	16	17-32mm	2	28-38
1990	1	34		
1992	1	23		
1993	5	19-32	4	29-36
1994	1	25		
Total	24		6	
Mean		26.1		32.2
SE		1.21		1.76

The density of Colorado pikeminnow captured in the primary channel was greatest in backwater habitats ($F_{(5, 2081)}$=5.3269, $p<0.01$), although most of these captures were recently stocked age-0 individuals in 2007 (Figure 14). If these individuals were removed from the analysis, there was no significant difference in the density of age-1+ Colorado pikeminnow across habitat types in the primary channel ($F_{(5, 2037)}$=.69188, p=0.63). In secondary channels, the density of pikeminnow in shoal habitats was higher than other habitat types ($F_{(5, 658)}$=2.8045, p=0.02).

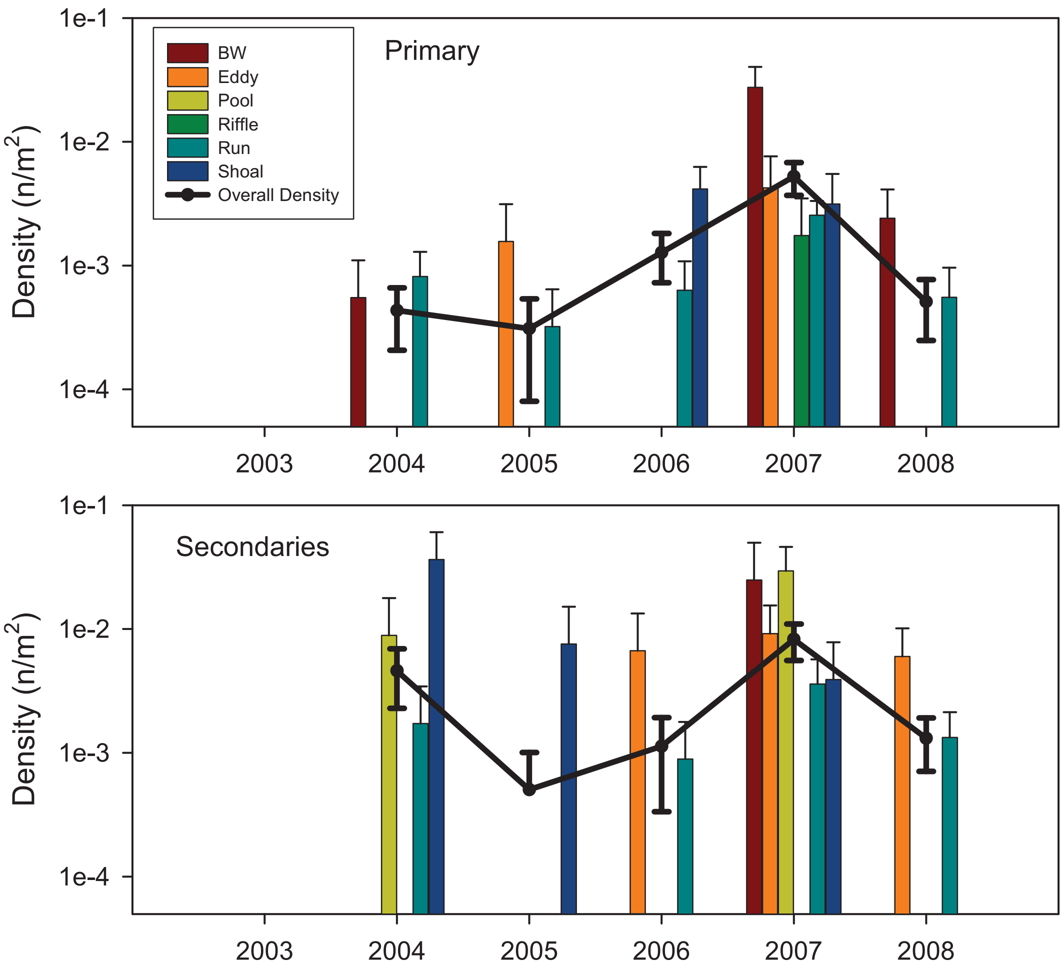

Figure 14. Density of Colorado pikeminnow in habitats associated with primary (including large backwaters) and secondary channels of the San Juan River 2003-2008. Error bars are 1 standard error, note log scale on Y-axis.

There was no significant effect of substrate on density of Colorado pikeminnow collected in the primary channel, but there were higher densities associated with sand and silt substrates in secondary channels ($F_{(3, 640)}$=3.4002, p=0.02) (Figure 15). The average depth of samples that contained Colorado pikeminnow was 0.263 m (SE 0.02).

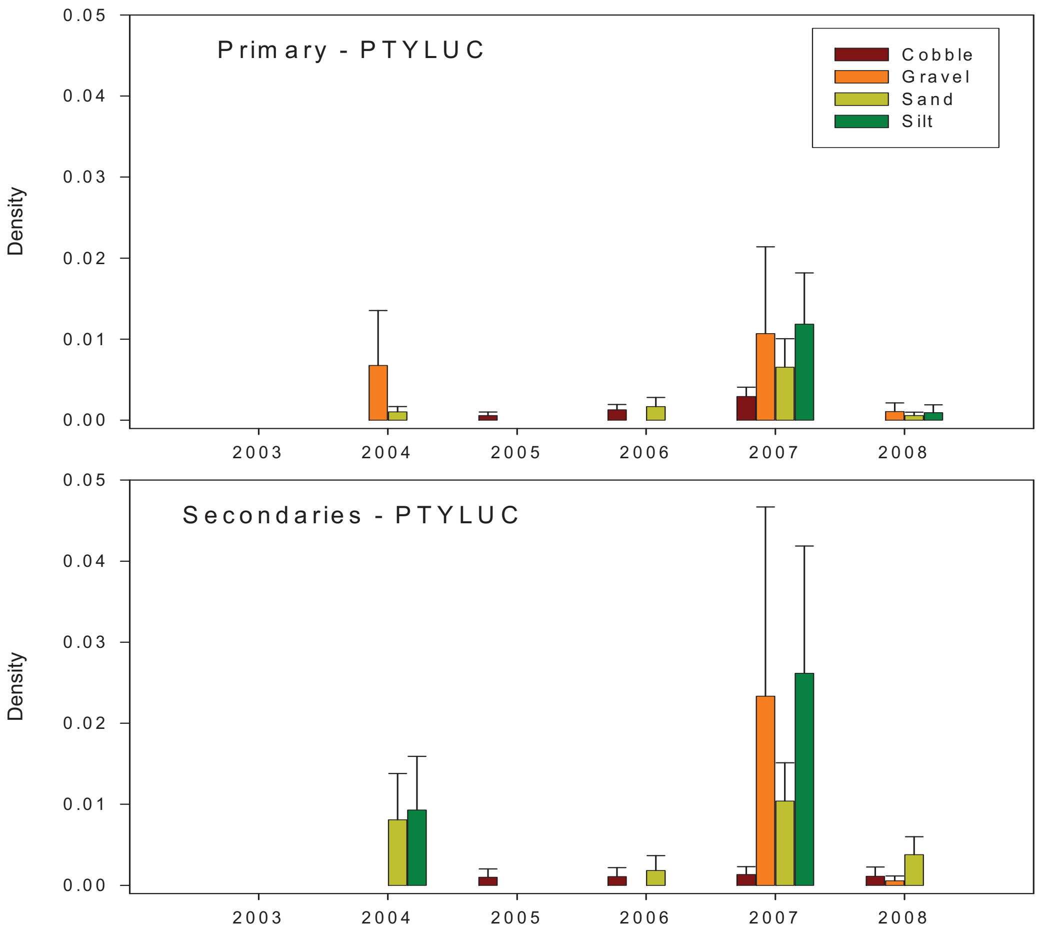

Figure 15. Density of Colorado pikeminnow captured over various substrates in the San Juan River, 2003-2008. Error bars represent 1 standard error.

Young Colorado pikeminnow are thought to switch from insectivory to primarily piscivory between 50-200 mm total length (Vanicek and Kramer 1969, Franssen et al. 2007). Franssen et al. (2007) reported that the maximum prey size for Colorado pikeminnow was dependant on the prey species. Colorado pikeminnow could consume red shiner up to 37% and native suckers up to 43% of their total length.

Figures 16 and 17 demonstrate the availability of potential prey with total length less than 40% of Colorado pikeminnow total length up to 200 mm from 2003-2008. All species captured were considered potential prey except channel catfish and species of bullhead catfishes. In most years, reaches 6 and 5 contained the greatest density of small fishes, 2005 being the exception. The density of small fishes in reaches 2 and 1 was less than 0.01 for the past two years. For all years, there was not a suitable prey base of small fish in autumn for Colorado pikeminnow stocked as age-0; survival of these fish was therefore largely, if not entirely, dependent on macroinvertebrates. Appropriate-sized fish prey were not available until the following spring, when larval fish of appropriate size for small Colorado pikeminnow to consume were present.

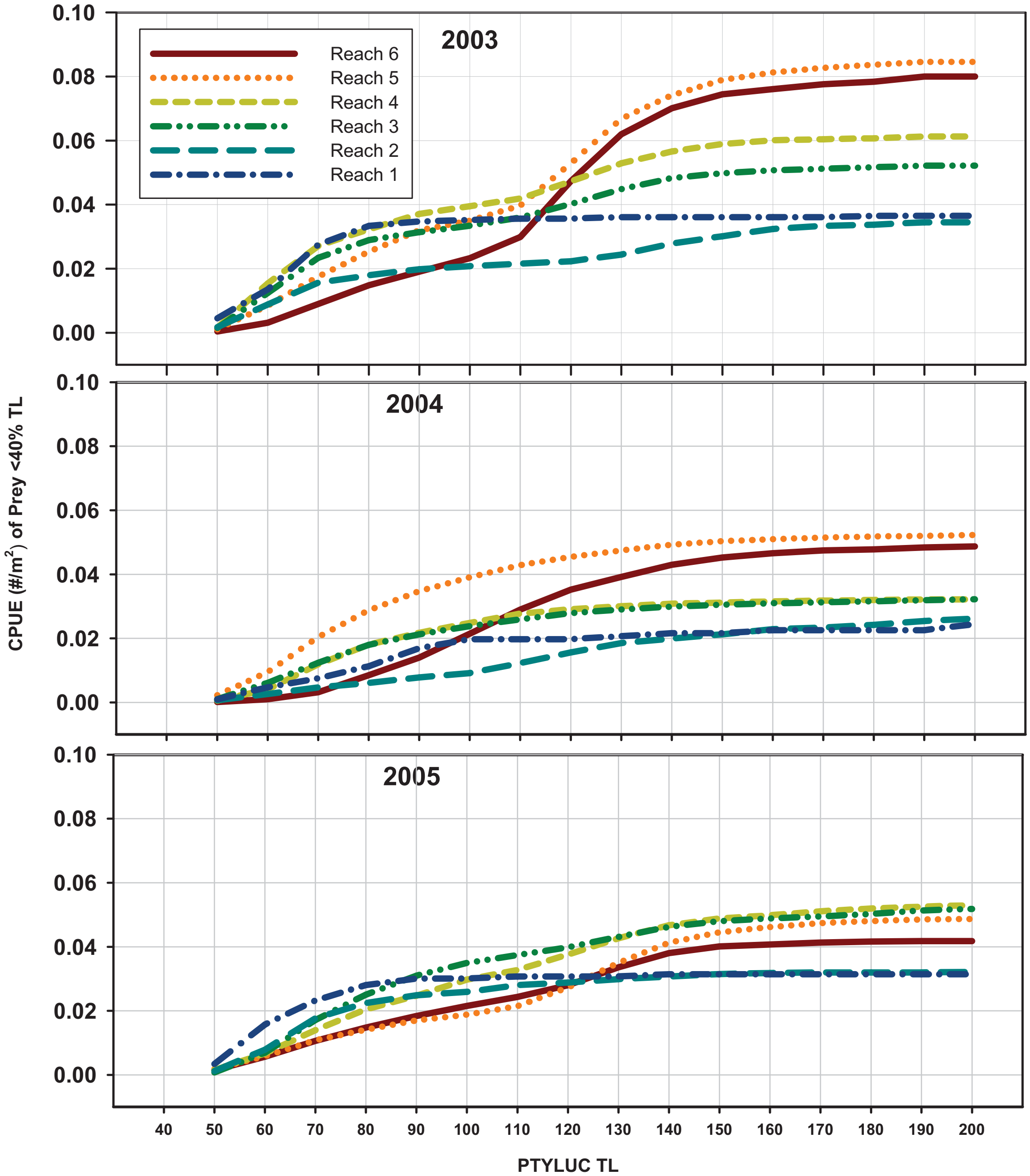

Figure 16. Density of prey species <40% TL of Colorado pikeminnow TL for each reach in the San Juan River from 2003-2005.

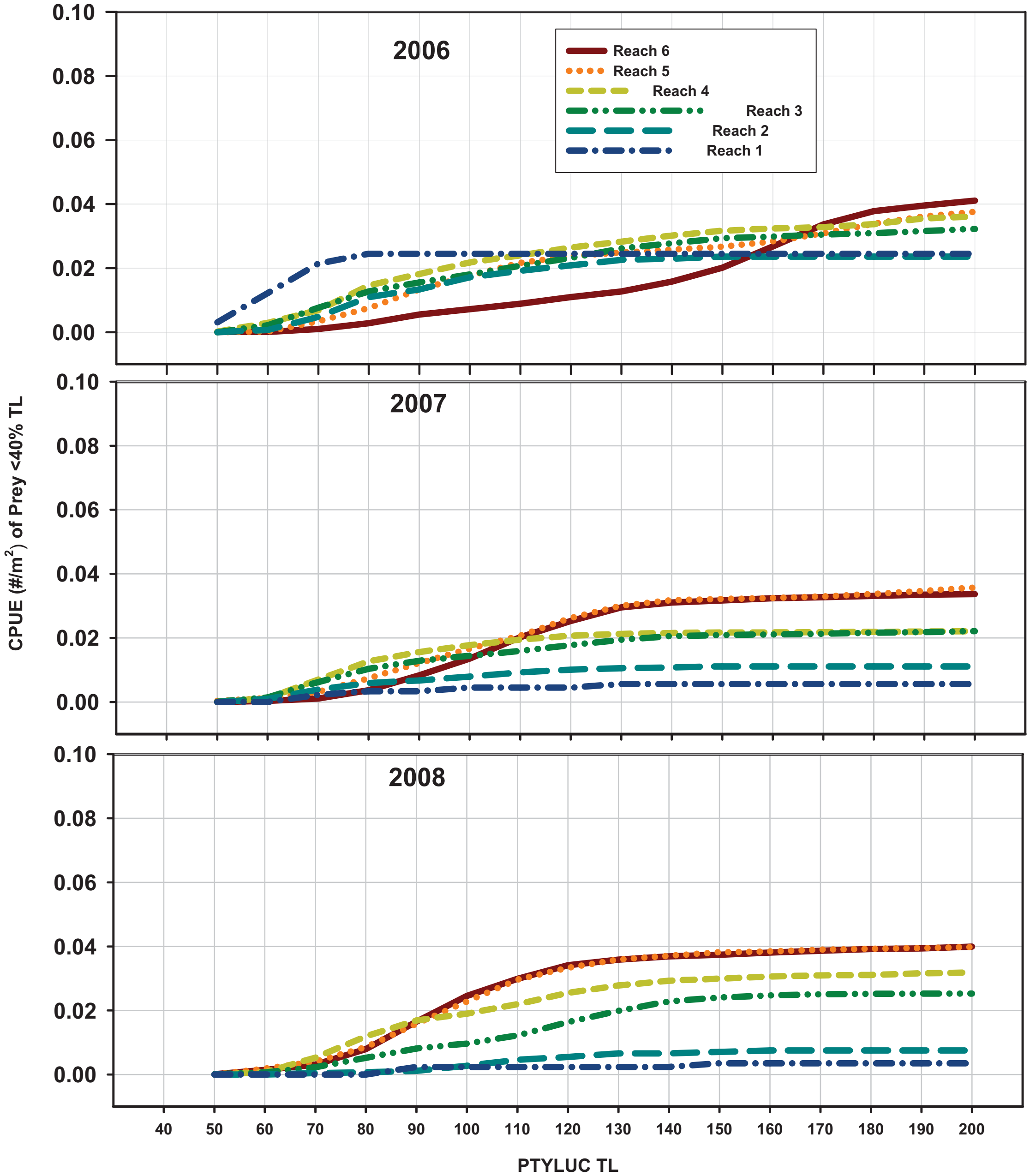

Figure 17. Density of prey species <40% TL of Colorado pikeminnow TL for each reach in the San Juan River from 2006-2008.

RECOMMENDATIONS

The data set associated with small-bodied monitoring is useful for filling information gaps between larval fish collections and recruitment into the adult population. There is a wealth of information that might be inferred about the community dynamics of the San Juan River that may prove to be useful in understanding the factors that are important to the recovery of Colorado pikeminnow and razorback sucker.

In order to detect occurrence of post-larval stages of razorback sucker there may need to be focused studies to determine the most effective sampling methods. If suckers are habitat generalists or mainly using habitats that are common in the river (i.e. runs) it is unlikely that many will be collected without intense effort. Current sampling methods appear appropriate for detecting presence young-of-year Colorado pikeminnow, who tend to use low-velocity habitats. Alternative sampling methods, particularly for age-0 (early juvenile) razorback sucker, should be evaluated. However, any changes in current methods should be designed to minimally compromise the integrity of the existing dataset for riverwide community monitoring.

Paucity of small fish prey in the fall and winter may compromise survival of stocked Colorado pikeminnow, especially if macroinvertebrate densities are low as well. A study to investigate relationship of food availability for young Colorado pikeminnow and their survival may shed some light on the apparent low recruitment into the adult population. Food abundance for developing razorback sucker also may be limiting because of the rarity of high-productivity inundated floodplain habitats.

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APPENDIX A

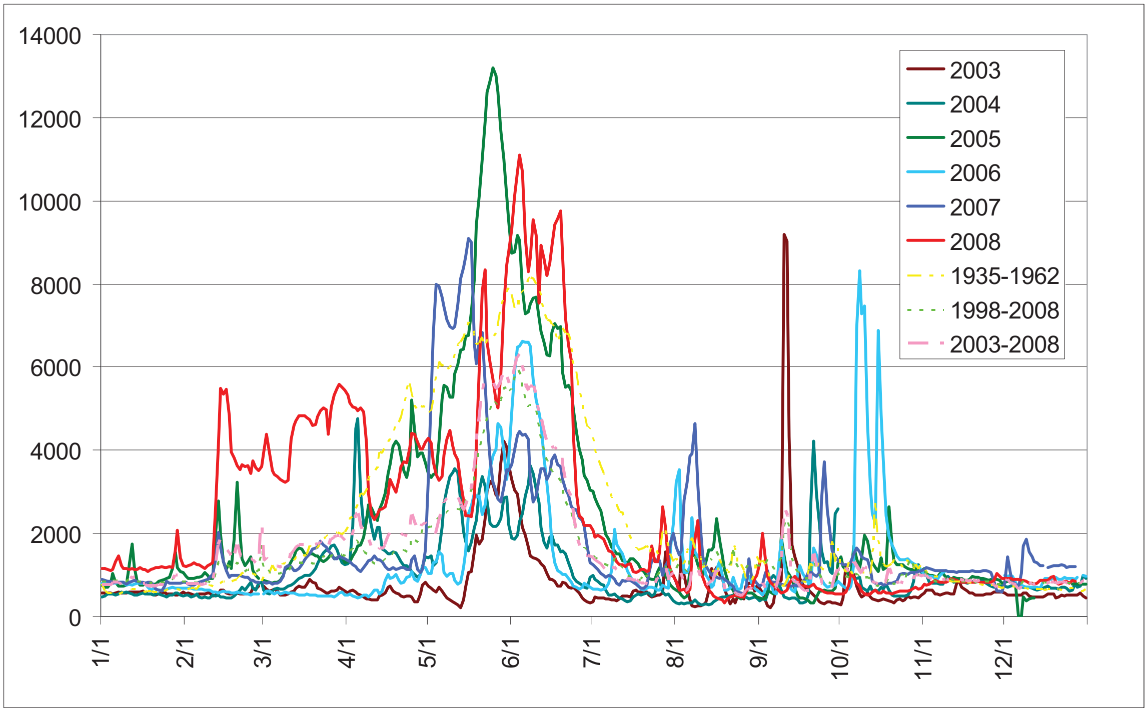

Figure A1. Mean daily discharge at Shiprock gage (USGS 936800) for the San Juan River 2003-2008.

Table A1. Mean daily discharge data from Shiprock gage (USGS 936800) for the San Juan River 1998-2008.

	YEAR											MEAN		
Month	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**1935-1962**	**1998-2008**	**2003-2008**
March	1141	882	941	1033	664	653	1043	1278	537	1276	4483	1540	1265	1598
April	1425	1160	1652	1384	533	532	1829	3026	760	1244	3789	4017	1609	1988
May	5250	3238	2311	4781	644	1621	2406	7983	2284	6050	4780	6517	3530	3815
June	3970	5876	2011	4760	433	1243	1836	6380	3136	3250	7450	6884	3710	4010
Spring Average	2951	2777	1727	2988	570	1015	1778	4666	1675	2967	5117	4728	2526	2850
July	1665	3116	326	690	358	575	585	1461	967	1054	1463	2319	1121	1010
August	959	5731	602	1132	368	642	398	966	1196	1518	740	1278	1273	788
September	644	4298	649	552	1126	1301	1120	684	904	1178	787	1109	1207	960
Summer Average	1094	4383	524	794	612	834	696	1041	1024	1251	999	1574	1200	919
Spring (March - June)														
Days>3000	48	41	18	47	0	9	14	76	23	48	102	84	34	36
Days>5000	24	26	1	29	0	0	0	50	9	21	47	63	16	21
Days>8000	0	0	0	1	0	0	0	18	0	5	22	3	0	0
Days>10000	0	0	0	0	0	0	0	11	0	0	4	0	0	0
Summer (July - September)														
Days>5000	0	31	0	0	2	2	0	0	0	0	0	0	0	0
Days>4000	1	42	0	0	2	3	1	0	0	1	0	2	0	0
Days>3000	1	72	0	0	2	3	1	1	2	6	0	7	0	0
Days>2000	10	90	0	5	3	3	6	6	5	9	5	16	3	2
Days>1000	36	92	1	18	7	12	11	41	33	41	37	77	71	29
Days<1000	55	0	91	74	85	79	80	50	59	51	55	14	19	61
Days<750	42	0	80	61	80	67	70	40	36	13	41	2	0	30
Days<500	15	0	45	23	74	43	49	17	0	0	11	0	0	0

Table A2- Simplistic model for predicting fall CPUE for young-of-year catostomid species in the San Juan River.

	Average Ratio				Predicted Numbers												Ratio of EXPECTED/OBSERVED							
trip	CATLAT	LAT-Se	Count	Year	2003	+/- 2SE	2004	+/- 2SE	2005	+/- 2SE	2006	+/- 2SE	2007	+/- 2SE	2008	+/- 2SE	2003	2004	2005	2006	2007	2008	Average	SE
	smb/larval	YOY	sampled	CATLAT	217		229		222		55		150		286									
04/15	10.60619	4.600957	5		612	531	1047	909	794	689	761	661	1304	1131	1179	1023	2.82	4.57	3.58	13.84	8.69	4.12	6.27	1.73
05/15	0.037861	0.043945	6		2	5	4	9	3	7	3	6	5	11	4	10	0.01	0.02	0.01	0.05	0.03	0.01	0.02	0.01
06/15	0.032447	0.043895	6		2	5	3	9	2	7	2	6	4	11	4	10	0.01	0.01	0.01	0.04	0.03	0.01	0.02	0.01
07/15	0.788638	0.746003	6		46	86	78	147	59	112	57	107	97	183	88	166	0.21	0.34	0.27	1.03	0.65	0.31	0.47	0.13
08/15	2.148453	1.818758	5		124	210	212	359	161	272	154	261	264	447	239	404	0.57	0.93	0.72	2.80	1.76	0.84	1.27	0.35
09/15	7.321775	3.277034	6		422	378	723	647	548	490	526	470	900	806	814	729	1.95	3.16	2.47	9.56	6.00	2.85	4.33	1.19
trip	CATDIS	DIS-SE	Count																					
04/15	6.113354	2.361245	1		353	272	604	466	457	353	439	339	751	580	680	525	7.20	1.73	2.95	3.18	19.27	6.54	6.81	2.64
05/15	1.262266	1.088376	6		73	126	125	215	94	163	91	156	155	268	140	242	1.49	0.36	0.61	0.66	3.98	1.35	1.41	0.55
06/15	0.091984	0.12751	6		5	15	9	25	7	19	7	18	11	31	10	28	0.11	0.03	0.04	0.05	0.29	0.10	0.10	0.04
07/15	0.263733	0.270675	6		15	31	26	53	20	41	19	39	32	67	29	60	0.31	0.07	0.13	0.14	0.83	0.28	0.29	0.11
08/15	2.433718	2.953211	6		140	341	240	583	182	442	175	424	299	726	271	657	2.87	0.69	1.17	1.27	7.67	2.60	2.71	1.05
09/15	5.93842	2.357277	4		343	272	586	465	444	353	426	338	730	579	660	524	6.99	1.68	2.87	3.09	18.71	6.35	6.62	2.57
				Area Sampled	5769.53		9873.3		7482.96		7178.48		12290.29		11117.84									
		YOY	sampled	CATDIS	49		349		155		138		39		104									
		YOY	sampled	CATLAT	217		229		222		55		150		286									

				xyrtex cpue larval 2003		2004		2005		2006		2007		2008		
		conversion	se	average		se	average	se	average	se	average	se	average	se	average	se
04/15	04/15			0	0	0	0	0	0	0.449877	0.369813	0.025253	0.025253	0	0	
05/15	05/15	1.41	0.985	16.69424	5.510263	0.841314	0.482344	0.195385	0.112364	7.053048	2.808988	2.038815	1.237067	5.313268	2.14943	
06/15	06/15	0.075	0.25	8.044627	6.951236	1.315299	0.56942	0.605436	0.318957	0	0	4.534841	1.344031	2.296102	0.68802	
07/15	07/15	0.5	0.5	0	0	0	0	0.292649	0.21257	0	0	0.032603	0.032603	0.106199	0.076031	
08/15	08/15	2.14	1.8	0	0	0	0	0.029193	0.029193	0	0	0	0	0	0	
09/15	09/15	11	3	0	0	0	0	0	0	0	0	0	0	0	0	
	PREDICTIONS OF OCT XYRTEX			pred	+/- 2SE	pred	+/- 2SE	pred	+/- 2SE	pred	+/- 2SE	pred	+/- 2SE	pred	+/- 2SE	
04/15	04/15			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
05/15	05/15			1358.08	626.30	117.12	93.82	20.62	16.56	713.89	397.24	353.31	299.52	832.92	470.77	
06/15	06/15			34.81	200.53	9.74	28.11	3.40	11.93	0.00	0.00	41.80	82.59	19.15	38.25	
07/15	07/15			0.00	0.00	0.00	0.00	10.95	15.91	0.00	0.00	2.00	4.01	5.90	8.45	
08/15	08/15			0.00	0.00	0.00	0.00	4.67	7.86	0.00	0.00	0.00	0.00	0.00	0.00	
09/15	09/15			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
			Average	232.15	137.80	21.14	20.32	6.61	8.71	118.98	66.21	66.19	64.35	142.99	86.25	

Sum of YOY?	Species	
Year	CATDIS	CATLAT
2003	49	217
2004	349	229
2005	155	222
2006	138	55
2007	39	150
2008	104	286
Grand Total	834	1159