LONG TERM MONITORING OF SUB-ADULT AND ADULT LARGE-BODIED FISHES IN THE SAN JUAN RIVER: 2017

Interim Progress Report

Final Report
8/3/2018

Funded by the U. S. Bureau of Reclamation
Salt Lake City Projects Office
Agreement # R17PG00084

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Reporting Dates: 1 October 2016 to 30 September 2017

EXECUTIVE SUMMARY

General Information

- A total of 7,959 fishes were collected in the common sampled area (RM 180.0-77.0) during 2017 Adult Monitoring
    - Native fishes accounted for 85.9% of the total catch
    - 128 electrofishing samples
    - 61.08 hours of electrofishing

Native Species:

- Colorado Pikeminnow
    - Likely no wild Colorado Pikeminnow were collected
    - 190 stocked Colorado Pikeminnow were collected
        - Sixth most abundant species collected
        - Overall increasing trend for CPUE of Colorado Pikeminnow in the river for 1+ overwinter periods post-stocking 2003 to 2017
        - Age ranged from age-1 to age-12
            - 3 adult fish (>450 mm TL) collected
            - 4 sub-adult fish (400-449 mm TL) collected
            - 12 large juvenile fish (300-399 mm TL) collected
        - 143 (75.7%) of the 190 known-origin Colorado Pikeminnow were in the river ≤ 365 days post-stocking
            - All 190 Colorado Pikeminnow collected were in the river for at least one overwinter period
- Razorback Sucker
    - No wild Razorback Sucker were collected
    - 340 stocked Razorback Sucker were collected
        - Fourth most abundant species collected
        - Second most Razorback Sucker ever collected during an Adult Monitoring in the common sampled area (RM 180.0-77.0)
        - CPUE of Razorback Sucker that had been in the river for 1+ overwinter periods was similar to previous 6 years
        - Ages ranged from age-2 to age-17
        - Captures ranged from RM 180.0-77.0
        - 118 were collected in Reach 6, 85 in Reach 5, 60 in Reach 4, and 17 in Reach 3.
- Flannelmouth Sucker
    - Most abundant species in the common sampled area (RM 180.0-77.0)
        - Flannelmouth Sucker were the numerically dominant species in Adult Monitoring collections in the common sampled area in the last 19 years
        - Accounted for 50.2% of the total catch
        - Had the widest distribution of any species, being collected in 126 of 128 electrofishing samples (RM 180.0-77.0)
- Bluehead Sucker
    - Among the three most-commonly collected species in each of the last 19 years in the common sampled area (RM 180.0-77.0)

- Second most abundant species collected
  - Accounted for 18.0% of the total catch
  - Collected in 110 of 128 (86%) electrofishing samples (RM 180.0-80.0)

Nonnative Species:

- Channel Catfish
  - Third most abundant species in the common sampled area (RM 180.0-77.0)
    - Accounted for 12.9% of the total catch (n = 1029 fish)
    - Collected in 83.6% of electrofishing samples (RM 166.6-77.0)
    - The majority Channel Catfish were collected in the middle nonnative fish removal section (RM 147.9 – 93.0)
      - CPUE peak occurred from RM 90-77
      - 11 fish captured between PNM and Hogback
- Common Carp
  - Percent of total catch accounted for by this species had decreased steadily from 9.6% in 1999 to 0.4% in 2017
    - Was the fourth most commonly-collected species in 1999
  - The eighth most commonly-collected species
    - 29 common carp collected from RM 180.0-77.0
      - 20 (18.7%) were adult fish (i.e., $\geq$ 250 mm TL)
      - 9 (81.3%) were juvenile fish (i.e., $\leq$ 250 mm TL)
    - Collected in 14.8% of electrofishing samples (RM 180.0-77.0)
    - Less abundant than both endangered Colorado Pikeminnow and Razorback Sucker during Adult Monitoring collections

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INTRODUCTION

Research performed from 1991 to 1997 led to the initiation of several major management actions by the San Juan River Basin Recovery Implementation Program (SJRIP) that are intended to have long-term positive impacts on the native fish community. These included development of flow recommendations for the reoperation of Navajo Reservoir, instituting the mechanical removal of nonnative fishes, modifying or removing three instream water diversion structures to provide fish passage and minimize entrainment, and augmentation efforts for both federally-listed endangered fish species (Colorado Pikeminnow *Ptychocheilus lucius* and Razorback Sucker *Xyrauchen texanus*). To assess the effects of management actions on the fish community over the duration of the SJRIP, a long-term monitoring program was initiated in 1999 (Propst et al. 2000). These standardized long-term monitoring protocols have been updated twice since 1999 (Propst et al. 2006, SJRIP 2012).

One component of long-term monitoring, ***Sub-Adult And Adult Large-Bodied Fish Community Monitoring*** (referred to hereafter as Adult Monitoring) is the primary responsibility of the U. S. Fish and Wildlife Service (USFWS) Grand Junction Fish and Wildlife Conservation Office (GJFWCO) in Grand Junction, CO. However, other state and federal agencies supply personnel, equipment, and logistical support.

Objectives

The objectives of Adult Monitoring (as stated in the FY-2017 workplan) are:

1) Annually, during autumn, document fish community structure, species relative abundance (presented as catch/effort, CPUE) and distribution, and size structure among populations of both native and nonnative large-bodied fishes in San Juan River. Specific emphasis shall be placed upon monitoring the population parameters among the rare San Juan River fish species -- Colorado Pikeminnow, Razorback Sucker, and Roundtail Chub *Gila robusta* (both wild and stocked fish).

2) Obtain data that will aid in the evaluation of the responses (e.g., year-to-year survival, reproduction, recruitment, growth, and condition factor) of both native and nonnative large-bodied fishes to management actions.

3) Continue to perform activities that support other studies and recovery actions being implemented by the SJRIP. For example:
    a. Remove nonnative fish species which may prey upon or compete with native fish species in the San Juan River.

    b. Collect tissue samples from various fish species for stable isotope, genetics, and contaminants studies.

    c. Document hybridization of endangered fishes with native fishes.

    d. When appropriate, document any observed parasites, lesions, or abnormalities on collected fishes. Make these data available to appropriate studies when they occur.

Relationship to the Recovery Program

Adult Monitoring provides data for or makes possible (at least in part) the following Tasks under element numbers 1-5 of the Long Range Plan (SJRIP 2016): 1.1.1.1, 1.1.1.2, 1.2.1.1, 1.2.1.2, 2.3.1.5, 2.3.1.6, 2.3.1.7, 2.3.2.1, 2.6.1.1, 2.6.1.2, 2.6.1.3, 3.1.1.1, 3.1.1.3, 3.1.1.4, 3.1.1.5, 3.1.1.6, 3.1.1.7, 3.2.3.1, 3.2.3.2, 3.2.3.5, 4.1.1.1, 4.1.1.2, 4.1.1.3, 4.1.2.3, 4.1.2.4, 4.1.2.6, 4.1.3.1, 4.1.4.2, 4.1.5.1, 4.1.6.1, 4.1.6.2, 4.1.6.3, 4.1.7.1, 4.1.7.2, 4.2.4.2, 4.2.4.3, 4.4.1.1, 4.4.2.1, 4.4.2.2, 4.4.2.3, 4.4.3.1, 4.4.3.2, 4.4.3.3, 4.4.3.4, 4.5.2.3, 5.2.2.2, 5.2.2.3, 5.2.2.4, and 5.2.2.5. The monitoring protocols discussed in the Methods section of this report reflect those that are currently included in the latest version of the revised SJRIP Monitoring Plan and Protocols (SJRIP 2012).

Study Area

In 2017, the study area for Adult Monitoring began just downstream of the Bloomfield boat landing (RM 196.0) and continued downstream to the Mexican Hat boat landing in Utah (RM 52.7). This study area encompassed six geomorphic reaches of the San Juan River between Navajo Reservoir and Lake Powell. This included the lower 15 miles of Reach 7, four complete reaches (Reaches 6 through 3) and 15.3 miles of Reach 2, reaches defined by Bliesner and Lamarra (2000). The seven geomorphic reaches in their entireties are: Reach 7 (RM 214.0-180.0); Reach 6 (RM 180.0-155.0); Reach 5 (RM 155.0-131.0); Reach 4 (RM 131.0-106.0); Reach 3 (RM 106.0-68.0); and Reach 2 (RM 68.0-17.0). An additional 15 river miles were sampled in the Animas River in July (RM 16 – 1).

METHODS

Field Sampling

Sampling conducted in 2017 followed the protocols for long-term monitoring set forth in the latest version of the Monitoring Plan and Protocols (SJRIP 2012). These sampling protocols were first used during the fall 1999 Adult Monitoring trip. Similar data collected prior to the inception of these sampling protocols (i.e., 1991-1998) are not included in comparative analyses for this report.

Data Analysis

Electrofishing data were pooled for both rafts to obtain total catch numbers by species for the entire sampling trip. Each fish is associated with a sampling event, and each sampling event has a unique amount of effort that each fish is related to. The number of each species was divided by the number of seconds (converted to hours) fished to obtain a catch per unit effort (CPUE) value for each sample, CPUE +1 were then natural log (ln) transformed (for endangered fish to decrease variability that could be cause by stocking), samples were grouped by years to obtain an annual mean ln CPUE or CPUE. Linear regressions were used with the mean ln CPUE or CPUE for each year to indicate an increase, no change, or decrease trend in catch rate values over time for each species and size class.

Based on data collected in past years, essentially all of the endangered Colorado Pikeminnow and Razorback Sucker being collected during Adult Monitoring are fishes that have been stocked during augmentation efforts. Endangered fishes collected during Adult Monitoring were sorted by year of stocking as well as length of time (expressed in number of overwinter periods) that they had been in the river post-stocking. Additionally, since different age-classes of Colorado Pikeminnow were stocked in numerous years, they were further sorted by their age-class at stocking. Ages provided for fish were either determined using PIT tag information for known-age fish or were based on length frequency histograms and observed between-year growth rates. Emphasis in analyzing CPUE, as fish per hour of electrofishing, values was then placed on groups of fish that had been in the river for one or more overwinter periods post-stocking.

Analysis of Razorback Sucker data was slightly different. Since all Razorback Sucker being stocked tended to be older fish (i.e., age-1 to age-3) and since there was only one target stocking size ($\geq$ 300 mm TL) for all Razorback Sucker, catch data for Razorback Sucker were pooled only by number of overwinter periods (i.e., regardless of age at stocking) to calculate CPUE.

The four "common" large-bodied fishes encountered during Adult Monitoring sampling are Flannelmouth Sucker *Catostomus latipinnis*, Bluehead Sucker *Catostomus discobolus*, Channel Catfish *Ictalurus punctatus*, and Common Carp *Cyprinus carpio*. These were the only wild, large-bodied fish species present in the San Juan River in large enough numbers to yield sufficient sample sizes from which statistically valid conclusions could be drawn (based in the common sampled area, i.e., RM 180.0-77.0) across years. Common large bodied fishes were separated by species and life stages, juvenile and adult life stages and for all life stages combined (i.e., juvenile + adult; referred to hereafter as "total CPUE"). CPUE values for each common large-bodied fish species were then compared to previous years' riverwide electrofishing data to evaluate long-term trends. Length data obtained from fish measured at designated miles (DMs) were used to develop riverwide length frequency histograms for wild populations of the four common large-bodied fish species.

RESULTS

The mean river flow (at the Shiprock USGS gage #09368000) during the 2017 Adult Monitoring trip was 648 CFS (Table 1). Overall, the mean river flow in the 19-year period (1999-2017) of Adult Monitoring riverwide sampling was 1032 CFS.

Fourteen fish species and four types of hybrids were collected during the 2017 Adult Monitoring trip (Table 2). This included six native species, two native sucker X native sucker hybrids, two native sucker X nonnative sucker hybrids, and eight nonnative species (Tables 2). Eight species (Flannelmouth Sucker, Bluehead Sucker, Channel Catfish, Razorback Sucker, Speckled Dace, Colorado Pikeminnow, Largemouth Bass, and Common Carp) accounted for 99.4% (7,910 fish) of the total catch. The other six species and four hybrid types contributed only 0.6% (48 fishes) to the total catch in 2017 (Table 2).

Table 1. Summary of dates, river miles (RM) sampled, and mean flow during riverwide Adult Monitoring trips in the San Juan River in New Mexico, Colorado, and Utah, 1999 to 2017.

Beginning Date Of Sampling	Ending Date Of Sampling	River Miles Sampled	Mean Trip Flow At The Shiprock, NM USGS Gage (#09368000) In CFS And (Cubic Meters/Second)
20 September 1999	7 October 1999	RM 180.0-2.9	2,177 CFS (61.6 m^3/sec)
			657 CFS

18 September 2000	10 October 2000	RM 180.0-2.9	(18.6 m^3/sec)
25 September 2001	19 October 2001	RM 180.0-2.9	611 CFS (17.3 m^3/sec)
20 September 2002	7 October 2002	RM 180.0-2.9	458 CFS (12.9 m^3/sec)
22 September 2003	14 October 2003	RM 180.0-2.9	450 CFS (12.7 m^3/sec)
20 September 2004	13 October 2004	RM 180.0-2.9	1,432 CFS (40.5 m^3/sec)
19 September 2005	12 October 2005	RM 180.0-2.9	1,072 CFS (30.3 m^3/sec)
18 September 2006	9 October 2006	RM 180.0-2.9	2,479 CFS (70.1 m^3/sec)
17 September 2007	11 October 2007	RM 180.0-2.9	1,262 CFS (35.7 m^3/sec)
22 September 2008	15 October 2008	RM 180.0-2.9	638 CFS (18.1 m^3/sec)
21 September 2009	14 October 2009	RM 180.0-2.9	532 CFS (15.0 m^3/sec)
20 September 2010	12 October 2010	RM 180.0-2.9	762 CFS (21.5 m^3/sec)
12 September 2011	29 September 2011	RM 180.0-52.9	615 CFS (17.4 m^3/sec)
10 September 2012	28 September 2012	RM 195.0-52.9	804 CFS (22.7 m^3/sec)
9 September 2013	27 September 2013	RM 195.0-52.9	2626 CFS (74.3 m^3/sec)
8 September 2014	26 September 2014	RM 195.0-52.9	789 CFS (22.4 m^3/sec)
7 September 2015	29 September 2015	RM 195.0-2.9	831 CFS (23.5 m^3/sec)
12 September 2016	30 September 2016	RM 195.0-52.9	762 CFS (21.6 m^3/sec)
11 September 2017	29 September 2017	RM 195.0-52.9	648 CFS (18.4 m^3/sec)
18-year statistics: Mean = 1032 CFS (29.2 m^3/sec)			

Table 2. Total number of fishes collected during the 2017 Adult Monitoring trip in the common sampled area (RM 180.0-77.0).

Species (Status)[a]	Number Collected	Percent Of Total[b]	Number Of Samples Collected In
Flannelmouth Sucker (N)	3992	50.2	126
Bluehead Sucker (N)	1466	18.4	110
Channel Catfish (I)	1029	12.9	107
Speckled Dace (N)	837	10.5	79
Razorback Sucker (N)	335	4.2	100
Colorado Pikeminnow (N)	190	2.4	86

Largemouth Bass (I)	33	0.4	20
Common Carp (I)	29	0.4	19
Black Bullhead (I)	8	0.1	6
Brown Trout (I)	8	0.1	7
Flannelmouth Sucker X White Sucker (H, I)	7	0.1	6
Flannelmouth Sucker X Bluehead Sucker (H, N)	7	0.1	7
Bluehead Sucker X White Sucker (H, I)	5	0.1	5
Rainbow Trout (I)	4	0.1	4
Roundtail Chub (N)	3	-----	3
Razorback Sucker X Flannelmouth Sucker (H, N)	3	-----	3
White Sucker (I)	2	-----	2
Fathead Minnow (I)	1	-----	1
GRAND TOTAL	7959		
Total Electrofishing Collections In 2017 = 128 Total Electrofishing Effort In 2017 = 61.08 Hours			
2017 Native Fishes = 6833 (85.9% Of The Total Catch) 2017 Introduced Fishes = 1126 (14.1% Of The Total Catch) 2017 Native To Introduced Fishes Ratio = 6.1:1			
a: (N) = Native species; (I) = Introduced species; (H, N) = A hybrid of two native fish species, considered to be a native fish; (H, I) = A hybrid of a native and a nonnative fish species, considered to be an introduced fish b: ----- = less than 0.1%			

Rare Native Fishes

Colorado Pikeminnow

In 2017, 190 Colorado Pikeminnows were captured from RM 180.0-77.0 (Table 3), all presumably stocked. Of the 190 stocked captured Pikeminnow, 32 (16.8%) were collected upstream of the Hogback Diversion (RM 158.6) in 2017. Of the 32 collected above Hogback, 11 were collected above PNM Weir (RM 166.6) all of which, with the exception of one tagged recruiting sub adult (414 mm TL), were untagged age-1 fish stocked at age-0. The other 21 fish were collected between PNM Weir and the Hogback Diversion, one age-4 recruiting sub adult fish that was tagged at RM 65 in 2016, one age-3 fish stocked at age-0, one age-2 fish stocked at age-0, and 19 fish that were age-1 stocked the previous winter at ago-0. Stocking locations for these fish would have been upstream at one of two locations Bloomfield, NM (RM 196) or Berg Park (Animas RM 5.0); fish from downstream stocking locations would have been documented passing through the PNM fish ladder. Like many stocked fish, these fish showed a pattern of initial downstream displacement (Ryden 2000b), followed by upstream movements as they grew and matured (Osmundson et al., 1997a, 1998).

The majority (143 individuals; 75.7%) of the 190 known-origin Colorado Pikeminnows collected in 2017 were in the river ≤ 365 days post-stocking, but still had spent one overwinter period in the river (i.e., they were stocked in November 2016). Numerous large Colorado Pikeminnows were collected; these included 12 fish from 300-399 mm TL (age-2 to age-3 fish), 4 fish from 400-449 mm TL (age-3 to age-4), and 3 fish ≥ 450 mm TL (age-6 to age-12). However, it is important to note that these larger size-class fish were likely all stocked fish. As a point of clarification with stocked fish:

*Where stocked fish are involved, a self-sustaining population must consist of young produced in the wild and recruited to the adult population at the required rates; stocked fish are included in the count of adults **after** their progeny are recruited to adults (USFWS 2002b).*

Comparisons of CPUE among groups of the Colorado Pikeminnow stocked as age-0 fish showed that at age-1, recapture rates were highly variable (indicating either highly variable survival or highly variable recapture probabilities) between years (Figure 1). Between 2003 and 2010, there was a general upward trend in CPUE for fish stocked at age-0 and recaptured at age-1. The observed CPUE in 2017 in the common sampled area, was significantly lower than 2010, but higher than 2003, 2005, 2011, 2015, and 2016. For age-2 catch rate in 2017, CPUE was lower than 2010 and 2011 in the common sampled area but similar to all other years from 2004 to 2016 (Figure 1). Stocked at age-0 CPUE continued to show no change in age-3, age-4, and age-5 fish. Older Colorado Pikeminnows stocked at age-0 were once again present in 2017, this marks the sixth consecutive year that age-6+ fish were captured in the common sampled area during Adult Monitoring (Figure1).

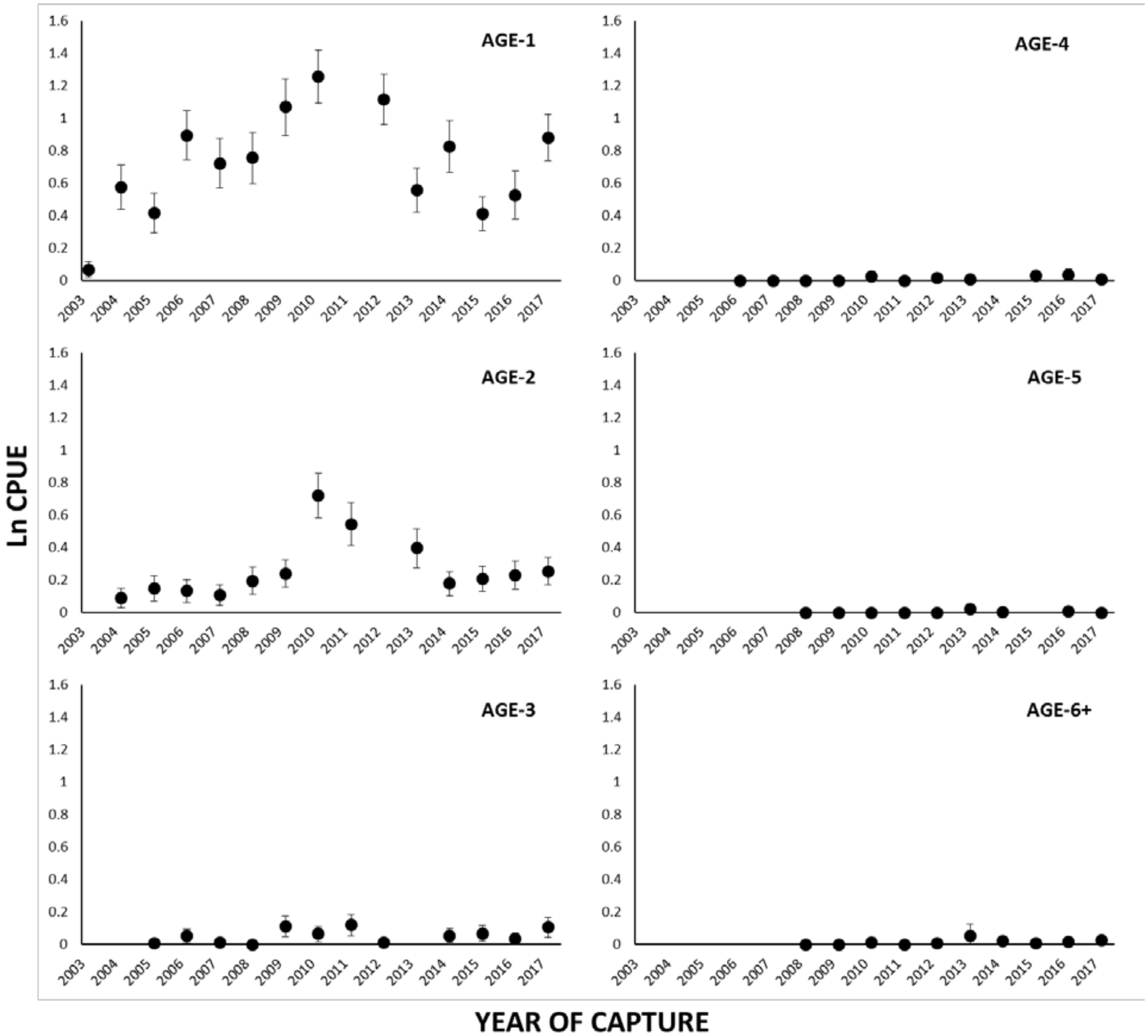

Figure 1. A comparison of CPUE (fish/hr) at age among groups of Colorado Pikeminnow stocked as age-0 fish and captured during subsequent Adult Monitoring trips, 2003 to 2017, RM 180.0-77.0. The mark shows the mean CPUE values for each year-class of fish during a given calendar year. The error bars are 95% CI. Note: No age-0 fish were stocked in the fall of 2010.

CPUE for all Colorado Pikeminnow that were in the river 1+ overwinter periods showed an increasing trend of CPUE from 2003 to 2010 (Figure 2). In 2010, significantly higher numbers of age-2 fish (stocked at age-0 in fall 2008) combined with large numbers of age-1 fish (stocked at age-0 in fall 2009) helped drive the significant increase observed (Figure 1). The large numbers of age-2+ fish were not present since 2013 (Figure 1), which consequently lowered the catch rate significantly (Figure 2). In 2011, there was a significant decline is CPUE for Colorado Pikeminnow, in most years the magnitude of this metric is driven by (i.e., reflective of) fish stocked at age-0 and captured the following year of age-1 (Figure 1), there were no fish stocked in the fall of 2010 due to the Largemouth Bass Virus quarantine in Dexter, thus the drastic decrease. The observed catch rate in 2017 was higher than 2003 through 2005, 2011 and 2015, and only lower than 2010 (Figure 2).

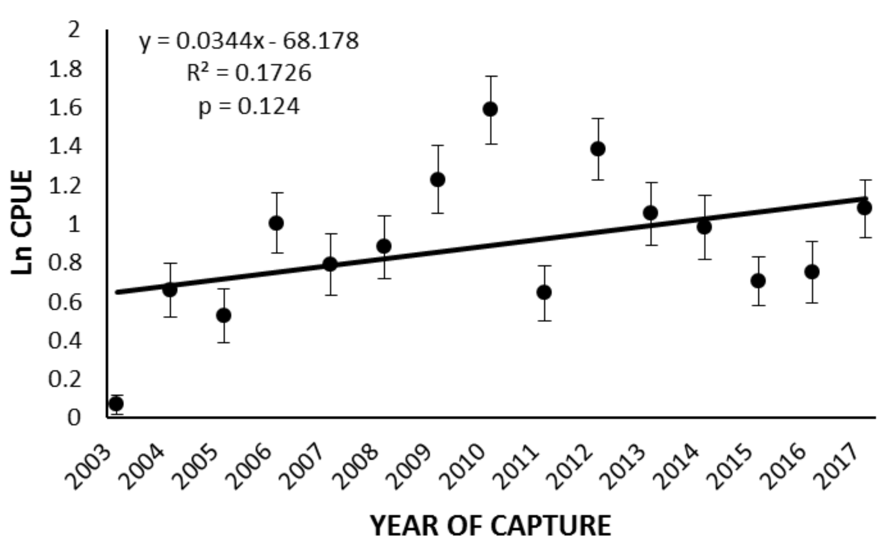

Figure 2. Year-to-year comparison of natural log transformed CPUE for all Colorado Pikeminnow collected on Adult Monitoring trips in the common sampled area (RM 180.0-77.0) from 2003 to 2017 that were in the river for one or more overwinter periods following stocking (regardless of age). The markers show the mean CPUE values for each year, the error bars are 95% CI, and the solid line shows a linear regression between years.

Table 3. Information on stocked Colorado Pikeminnow collected from 2003 to 2017 that had been in the river for 1+ overwinter periods.

Information For Fish Collected During Adult Monitoring Trips (RM 180-77):			Information For Fish That Were In The River For 1+ Overwinter Periods At Time Of Capture:		
Year	Effort (Total Hours Electrofished)	Total Number Collected	Number Of Fish Collected That Were In River 1+ Overwinter Periods	Oldest Year-Class Captured	Number Of Overwinter Periods
2003	51.98	8	8	2002	1
2004	50.25	102	91	2002	1-2
2005	47.31	84	62	2002	1-3
2006	51.19	250	146	2002	1-4
2007	50.64	140	117	2004	1-3
2008	58.77	197	162	2006	1-2
2009	58.34	300	257	2006	1-3
2010	54.96	371	351	1996	1-14
2011	48.68	386	75	2006	1-5
2012	54.51	272	272	2006	1-6
2013	43.95	149	149	2004	1-9
2014	60.73	218	218	2006	1-8
2015	65.62	108	108	2006	1-7
2016	57.89	142	142	2006	1-10
2017	61.08	190	190	2005	1-12

Razorback Sucker

A total of 340 Razorback Suckers were collected in 2017, all of which were assumed to be stocked fish. This was the second highest number ever collected during an Adult Monitoring trip in the common sampled area. Razorback Sucker captures ranged from RM 180.0-77.0 (Figure 3), with 118 being collected in Reach 6, 85 in Reach 5, 60 in Reach 4, and 17 in the portion of Reach 3 that was sampled. Of the 118 individuals captured in Reach 6, 14 were collected upstream of the PNM Weir and fish passage facility (RM 166.6). In contrast, there were only two collections of Razorback Sucker upstream of PNM Weir prior to 2011 sampling.

A total of 37 Razorback Suckers were collected for which either the stocking history, the exact length of the time the fish had been in the river could not be determined, or the fish had been in the river for less than one over winter period (Table 4). The source origins for the other 303 fish are as follows: 142 Ouray National Fish Hatchery – Grand Valley Unit, 141 Southwester Native Aquatic Recourses and Recovery Center (stocked out of Navajo Agricultural Products Industry ponds), 5 Uvalde National Fish Hatchery, and 15 were first tagged in the river.

Comparisons of capture data for Razorback Sucker that were in the river for 1+ overwinter periods and collected during Adult Monitoring trips changed little from 2003 to 2009 (range = 17-36; Table 4). However, in 2010, this number rose to 70 fish, double the value observed in any previous year. There has been a steady increase in the number captured that have been in the river for 1+ overwinter period from 2011 to 2016. For comparison, the number captured in 2017 is 4 times greater than that in 2010 (Table 4). Razorback Suckers collected after 1+ overwinter periods continue to demonstrate a much longer post-stocking persistence (up to 16 overwinter periods) than Colorado Pikeminnows (Table 4). The 2017 CPUE value for Razorback Suckers that were in the river 1+ overwinter periods was similar to that of the previous six years in the common sampled area (Figure 4). There has been an overall significant increase in CPUE from 2003 to 2017, which could be a function of these fish persisting in the river for long periods of time post stocking (Table 4).

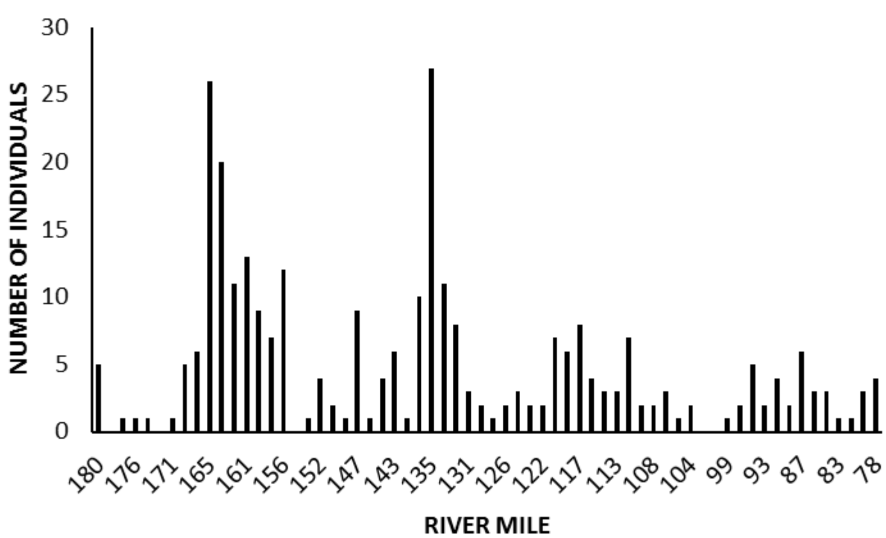

Figure 3. Number of Razorback Suckers caught in 2017 during Adult Monitoring by San Juan river mile

Table 4. Information on stocked Razorback Sucker collected from 2003 to 2017 that had been in the river for 1+ overwinter periods.

Information For Fish Collected During Adult Monitoring Trips (RM 180-77):			Information For Fish That Were In The River For 1+ Overwinter Periods At Time Of Capture:		
Year	Effort (Total Hours Electrofished)	Total Number Collected	Number Of Fish Collected That Were In River 1+ Overwinter Periods	Oldest Year-Class Captured	Number Of Overwinter Periods
2003	51.98	17	17	1992 (1 wild juvenile collected)	1-9 (wild fish; 249 mm TL = age-1 or age--2)
2004	50.25	108	18	1992	1-10
2005	47.31	46	30	1998	1-6
2006	51.19	121	23	1997	1-8
2007	50.64	171	22	1992	1-12
2008	58.77	73	3	2000	1-7
2009	58.34	77	35	1999	1-9
2010	54.96	149	70	1992	1-15
2011	48.68	197	118	1999	1-11
2012	54.51	321	231	1992	1-18
2013	43.95	196	175	2000	1-12
2014	60.73	268	225	1999	1-14
2015	65.62	308	278	1999	1-15
2016	57.89	383	357	2000	1-15
2017	61.08	340	303	2000	1-16

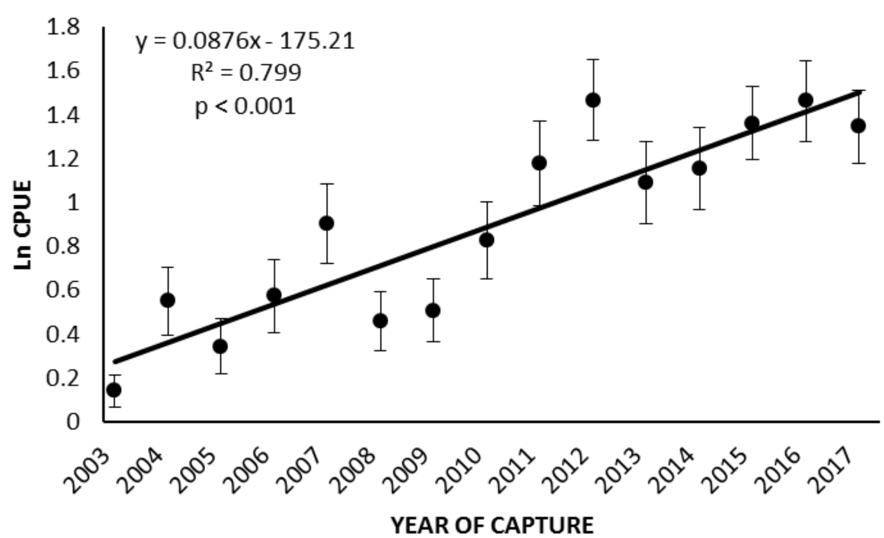

Figure 4. Year-to-year comparison of natural log transformed CPUE for all Razorback Sucker collected on Adult Monitoring trips riverwide (RM 180.0-77.0) from 2003 to 2017 that were in the river for one or more overwinter periods following

stocking (regardless of age). The markers indicate the mean CPUE values for each year, the error bars are 95% CI, and the solid line shows a linear regression between years of capture.

Common Native Fishes

The Flannelmouth Sucker was once again the most common large-bodied fish species collected in the common sampled area (Table 2 and Figure 7), being collected in 126 (99%) electrofishing samples (Table 2). These fish also comprised 50.2% of the total catch for 2017 (Table 2).

The combined adult and juvenile CPUE for Flannelmouth Sucker has shown no significant increase or decrease since 1999 (Figure 5). The 2017 combined CPUE was statistically similar to 11 of the last 18 years and lower than seven of the last 18 years that sampling has occurred in the common sampled area (Figure 5). A comparatively high degree of variation in the year-to-year juvenile CPUE values has been observed from 1999 to 2017 (Figure 5); however, the long-term trend indicated no significant change. In the adult CPUE there has been a significant decline since 1999, largely driven by the high CPUE values in 1999 and 2000.

Bluehead Sucker was the second most commonly-collected large-bodied fish species during 2017 Adult Monitoring observed in 86% of the samples and making up 18.4% of the total catch (Table 2). Bluehead Suckers were collected in Reaches 6-3 in 2017 (from RM 180.0-80.0) with the highest catch from RM 180-155 (Reach 6) (Figure 7).

Long-term trends for Bluehead Sucker juvenile CPUE have shown no significant changes in abundance indices over the last 18 years in the common sampled area (Figure 5), whereas Bluehead Sucker adult and combined age classes have shown a decrease. The 2017 Bluehead Sucker adult CPUE value was lower than 10 of the previous 18 years while the total CPUE was only lower than three of the past 18 years (Figure 5).

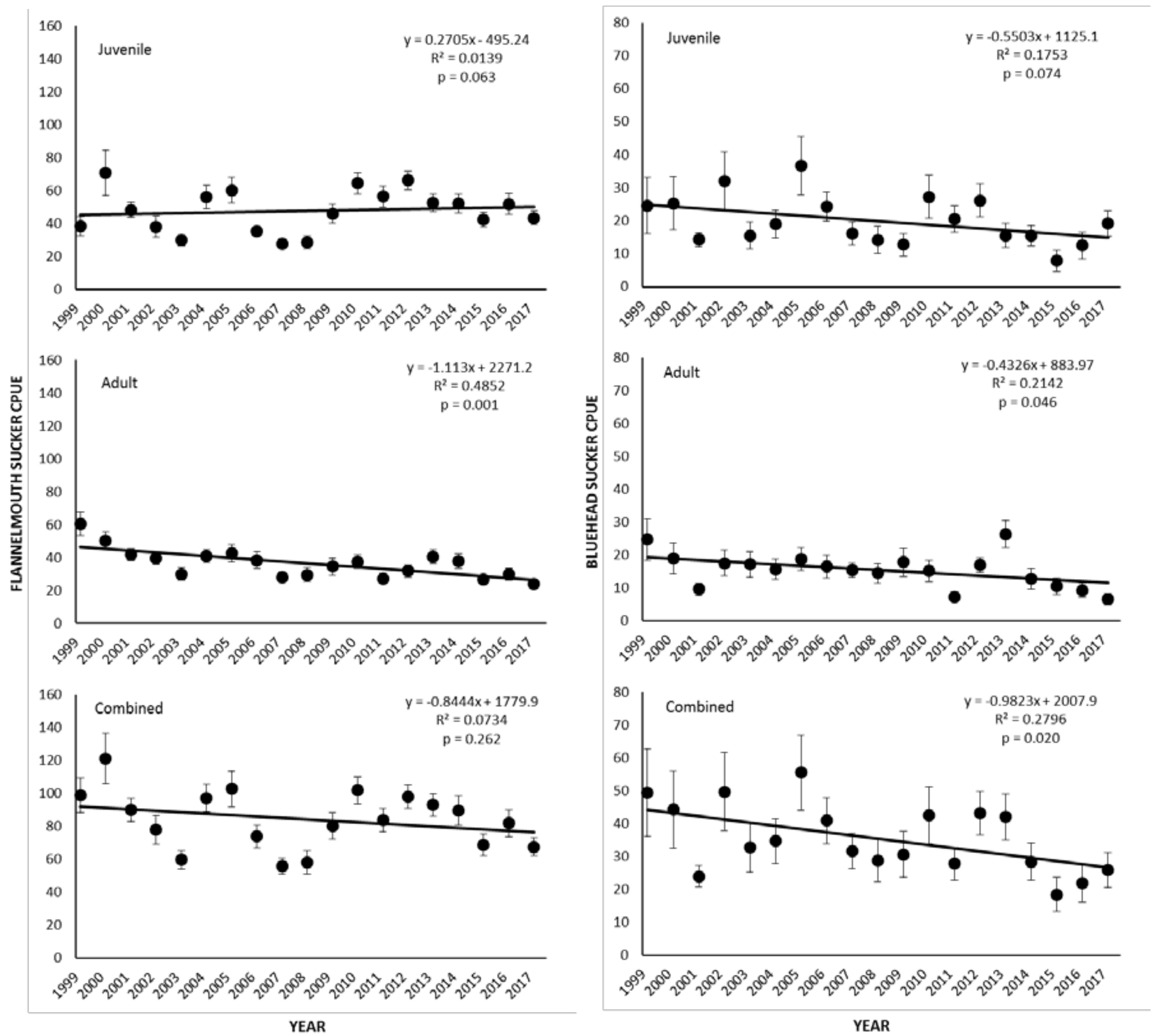

Figure 5. Flannelmouth Sucker and Bluehead Sucker CPUE in the common sampling area (RM 180.0-77.0) on fall Adult Monitoring trips. Flannelmouth juvenile fish (< 410 mm TL; top), adult fish (> 410 mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Bluehead juvenile fish (<300mm TL; top), adult fish (>300mm TL; middle), and for all life stages combined (juveniles + adults; bottom). Error bars are 95% CI. The solid, black sloping line is a linear regression analysis of the mean CPUE values. The statistics are for these regression lines.

Common Nonnative Fishes

In 2017, Channel Catfish was the third most abundant species, making up 12.9% of the total catch (Table 2). This was the fifth lowest total catch point value in the common sampled area since 1999 (Figure 6). Channel Catfish were collected in 83.6% of all electrofishing samples and occurred only below PNM diversion RM 166.6. The peak of Channel Catfish CPUE was centered on river miles 90-77, just downstream of Montezuma Creek to Sand Island, this was twice the catch rate than anything above RM 100 (Figure 7).

There has been no significant change in CPUE for Channel Catfish since 1999 in juvenile and adult size class fish and subsequently in the total CPUE in the common sampled area (Figure 6). Large variations in CPUE in the juvenile size class have been present since 2008 where each year was significantly different than the next until 2017.

Common Carp were the eighth most commonly-collected fish during 2017 Adult Monitoring (Table 2). A total of 29 Common Carp were collected in the common sampled area (Table 2) of which, 9 were juveniles (≤ 250mm TL) and 20 were adults (≥ 250 mm TL). Common Carp were collected from Reaches 6-3 (from RM 180.0-80.0).

In 2017, Common Carp accounted for only 0.4% of the total catch and were collected in 14.8% (n = 19) of electrofishing samples (Table 2). Of the 19 electrofishing samples that had Common Carp, 11 contained a single fish and the other eight contained a combination of two or three. Common Carp adult CPUE hasn't changed significantly since 2007 and has continued to remain significantly lower than the 1999-2006 period (Figure 6). Juvenile Common Carp have not significantly changed since 2005, where 2004 was a higher catch (Figure 6).

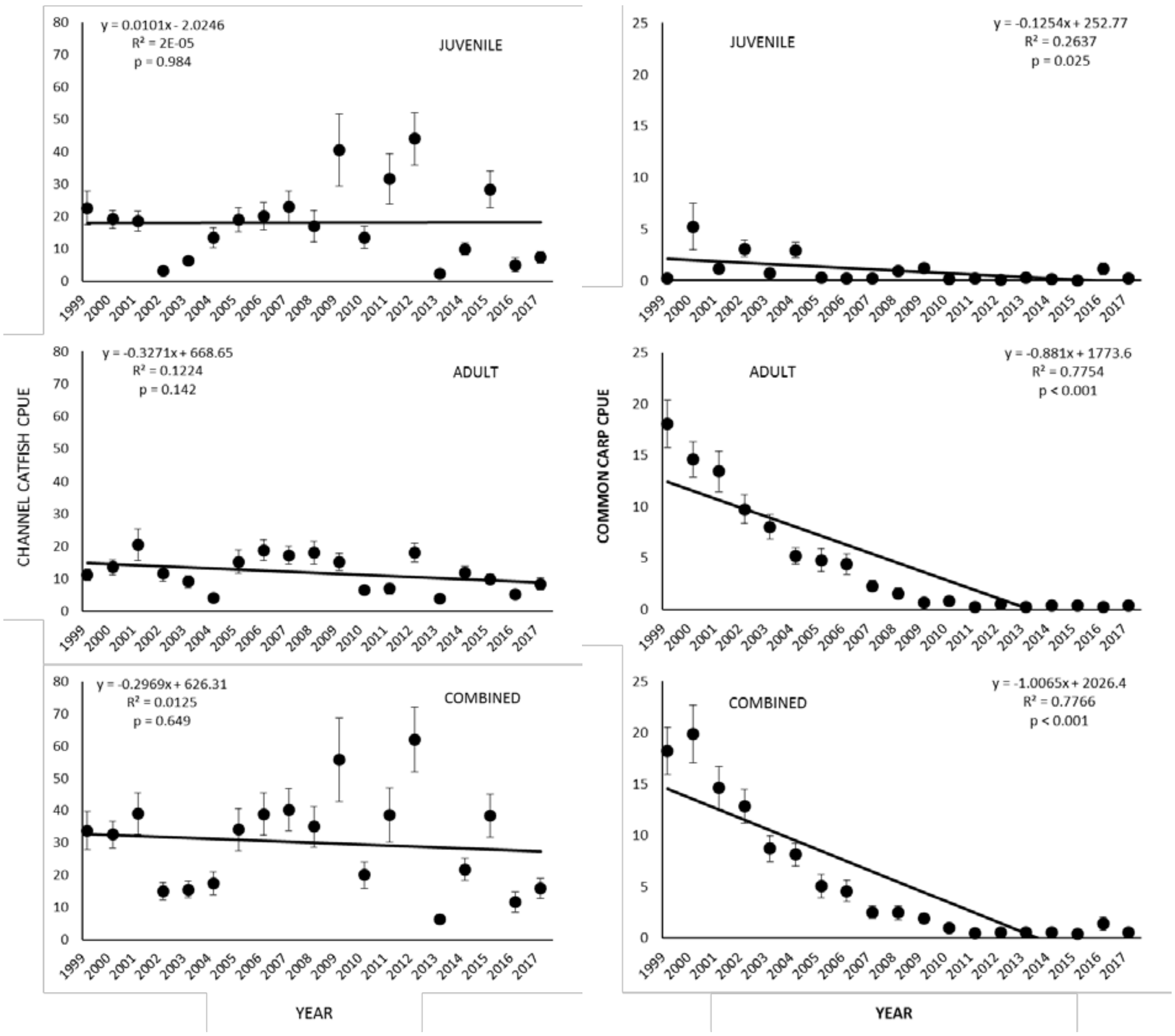

Figure 6. Channel Catfish and Common Carp CPUE in the common sampled area (RM 180.0-77.0) on fall Adult Monitoring trips. Channel Catfish juvenile fish (< 300 mm TL; top), adult fish (≥ 300 mm TL; middle), and for all life stages combined (juveniles + adults; bottom), Common Carp juvenile fish (<250mm TL; top), adult fish (>250mm TL; middle) and for all life stages combined (juveniles + adults; bottom). Error bars are 95% CI. The solid, black sloping line is a linear regression analysis of the mean CPUE values. The statistics are for these regression lines.

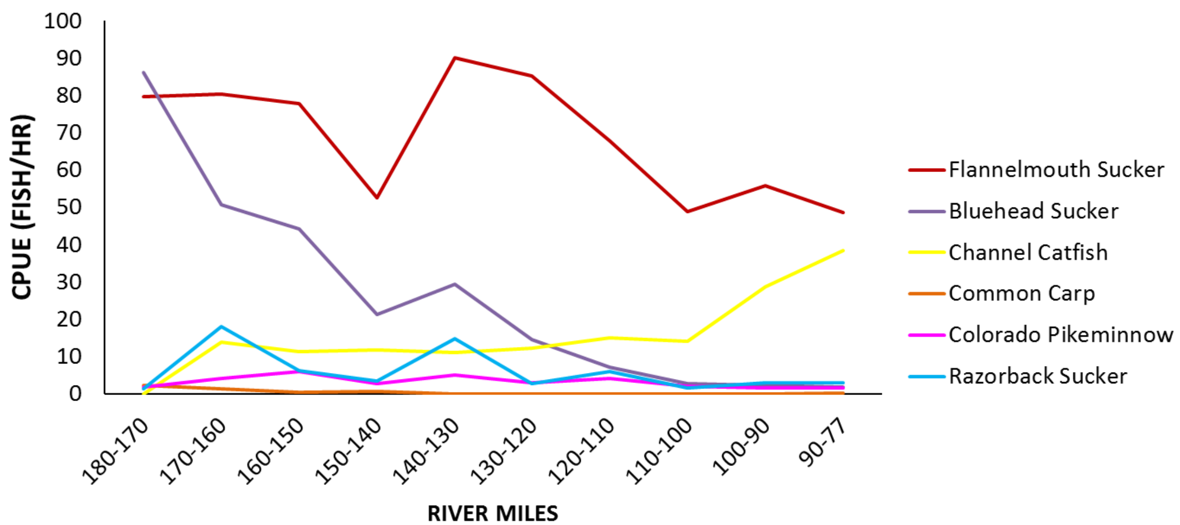

Figure 7. Longitudinal distribution by 10-RM sections of six large-bodied fish species (expressed as total CPUE) in the common sampled area (RM 180.0-77.0) in 2017. All life stages combined.

Fall Sampling in the San Juan River upstream of the Animas River Confluence

On 14 and 15 September 2017, a 15-RM section of the San Juan River upstream of the Animas River confluence was sampled. The purpose of this sampling was to expand Adult Monitoring upstream to document possible range expansion by Colorado Pikeminnow and Razorback Sucker into these upstream areas, as well as documenting the overall makeup of the fish community.

Nine fish species (599 total fishes) were collected during upstream sampling (Table 5). This included six native and three nonnative species. The six native species in descending order of abundance were Flannelmouth Sucker (323 fish), Bluehead Sucker (207 fish), Speckled Dace (25 fish), Razorback Sucker (24 fish), Flannelmouth Sucker X Bluehead Sucker (3 fish), and Colorado Pikeminnow (2 fish). The six native species (584 total fishes) accounted for 97.5% of the total catch during upstream sampling. The three nonnative species in descending order of abundance were Common Carp (12 fish), White Sucker X Flannelmouth Sucker (1 fish), and Brown Trout (1 fish). The non-native species accounted for only 2.5% of the total catch (Table 5).

Table 5. Total number of fishes collected during sampling in the San Juan River upstream of the confluence with the Animas River on the 2017 Adult Monitoring trip.

Species (Status)[a]	Number Collected	Percent Of Total	Number Of Samples Collected In
Flannelmouth Sucker (N)	323	53.92	18
Bluehead Sucker (N)	207	34.56	18
Speckled Dace (N)	25	4.17	11
Razorback Sucker (N)	24	4.01	12
Common Carp (I)	12	2.00	7
Flannelmouth Sucker X Bluehead Sucker (H,N)	3	0.50	3
Flannelmouth Sucker X White Sucker (H,I)	2	0.33	1
Colorado Pikeminnow (N)	2	0.33	2
Brown Trout (I)	1	0.17	1
GRAND TOTAL	599		
Total Electrofishing Collections In 2017 = 18 Total Electrofishing Effort In 2017 = 7.12 Hours			
2017 Native Fishes = 584 (97.5% Of The Total Catch) 2017 Introduced Fishes = 15 (2.5% Of The Total Catch) 2017 Native To Introduced Fishes Ratio = 38.9:1			
a: (N) = Native species; (I) = Introduced species; (H, N) = A hybrid of two native fish species, considered to be a native fish; (H, I) = A hybrid of a native and a nonnative fish species, considered to be an introduced fish			

Native Fishes

Sampling has occurred upstream of the Animas River since 2012, the presence of Razorback Suckers has been documented every year and as far upstream as RM 194.0 (2016 and 2017). Twenty four individual Razorback Suckers were collected during upstream sampling in 2017; these fish ranged in size from 371-506 mm TL and were collected from RM 194-181. Fourteen of the fish were stocked in the fall of 2016; 10 of the 14 were stocked at Bloomfield (RM 196.0) the other four were stocked at Berg Park (Animas RM 5.0); five fish were stocked in the fall of 2015, all of which were stocked in Bloomfield; three fish were stocked in the fall of 2014, all of which were stocked in Bloomfield; one fish was stocked in the fall of 2011 at Berg Park; the last fish was tagged during the 2015 Adult Monitoring at RM 173. Razorback Sucker accounted for the slightly less of the total catch upstream of the Animas (4.0%) as in it did downstream (4.2%) (Table 2, Table 5). Two Colorado Pikeminnow were captured as well, marking only the second year that Colorado Pikeminnow have been documented in the San Juan River above the confluence with the Animas River. Once individual at 165mm TL was untagged and likely stocked the previous winter. The other individual was also untagged and 468mm TL, this is the first adult Colorado Pikeminnow caught in this section of river, given the large size an age class could not be determined.

As in the common sampled area (RM 180.0-77.0) downstream, native Flannelmouth Sucker were the most abundant large-bodied fish species collected (Tables 2, Table 5). They accounted for 53.9% of the total catch upstream of the Animas and San Juan confluence, and 50.2%

downstream. However, their total CPUE was higher in the downstream area (67.5 fish/hr) than it was upstream (44.3 fish/hr).

Native Bluehead Suckers were the second most abundant large-bodied species collected in upstream sampling (Table 5). They accounted for a higher percentage of the total catch upstream of the Animas (34.56%) compared to the downstream common sampled area (18.4%) (Tables 2, Table 5). Their total CPUE was higher upstream as well, with 28.7 fish/hr in the upstream section and 25.8 fish/hr in the downstream riverwide area.

Nonnative Fishes

Common Carp accounted for 2.0% of the total catch in upstream sampling, versus 0.4% in the common sampled area downstream (Tables 2, Table 5). Common Carp upstream total CPUE in 2017 was identical to that of 2014 and 2015 (1.5 fish/hr each year). Downstream in the riverwide area the catch rate was 0.5 fish/hr in 2017. The other two non-native fishes collected upstream of the Animas on the San Juan River were 0.5% of the total catch (White Sucker X Flannelmouth Sucker and Brown Trout) (Table 5).

Sampling in the Animas River upstream of the San Juan River Confluence

Summer sampling occurred in the Animas River on 15 miles of river from Riverside Park, Aztec, NM (A-RM 16.1) to Miller Ave. Bridge (A-RM 1.1) on 3 and 4 July 2017. This trip consisted of two shocking raft for one pass. A total of 818 individual fishes were captured in 7.44 hours of electrofishing (Table 6). Most fishes were natives (89.2%) with the two most abundant being the Bluehead and Flannelmouth suckers (Table 6). Brown Trout, White Suckers, Rainbow Trout, and Common Carp were present in larger numbers compared to fall sampling of the San Juan River upstream of the confluence of the Animas River. (Table 5, Table 6). Razorback Suckers were present as well, and all five were captured below the Farmington Lake Diversion located at A-RM 9.2.

Table 6. Total number of fishes collected during sampling in the Animas River upstream of the confluence with the San Juan River in the summer of 2017.

Species (Status)[a]	Number Collected	Percent of Total	Number of Samples Collected in
Bluehead Sucker (N)	477	52.0	29

Flannelmouth Sucker (N)	329	35.9	29
Rainbow Trout (I)	33	3.6	14
Brown Trout (I)	28	3.1	17
Common Carp (I)	25	2.7	16
White Sucker (I)	7	0.8	5
Razorback Sucker (N)	5	0.5	4
Speckled Dace (N)	5	0.5	14
White Sucker X Bluehead Sucker (H,I)	3	0.33	3
White Sucker X Flannelmouth Sucker (H,I)	3	0.33	3
Flannelmouth Sucker X Bluehead Sucker (H,N)	2	0.22	1
GRAND TOTAL	917		
Total Electrofishing Collections In 2017 = 29 Total Electrofishing Effort In 2017 = 7.44 Hours			
2017 Native Fishes = 818 (89.2% Of The Total Catch) 2017 Introduced Fishes = 99 (10.8% Of The Total Catch) 2017 Native To Introduced Fishes Ratio = 8.3:1			
a: (N) = Native species; (I) = Introduced species; (H, N) = A hybrid of two native fish species, considered to be a native fish; (H, I) = A hybrid of a native and a nonnative fish species, considered to be an introduced fish			

DISCUSSION

Rare Native Fishes

Colorado Pikeminnow

While wild Colorado Pikeminnow likely continue to be absent from our fall Adult Monitoring collections, over the last several years, it has become relatively common to collect over a hundred stocked Colorado Pikeminnow of varying size-classes during Adult Monitoring. The 190 stocked Colorado Pikeminnow collected during 2017 were not the most Colorado Pikeminnow ever collected, however, 2017 did marked the 12th consecutive year that > 100 Colorado Pikeminnow were collected in the common sampled area. Looking back the over-all trend for CPUE has increased since 2003, there has been a large amount of variability during that time period. The increase has been driven by the large increase from 2003 to 2010 (Figure 2), afterwards there was a just as large decrease. The cause of this is unknown however, 2016 and 2017 mark a period where catch rates have leveled off and increase as in the case of 2017.

The collection of three adult fish (> 450 mm TL) and four fish in the recruiting sub-adult size-class (400-449 mm TL) proves that recruitment into the adult population from younger stocked fish is indeed taking place. In all, more individual adult Colorado Pikeminnow were collected during all 2017 sampling (n = 79 individuals), than were collected in the period from June 1991 to October 1994 (n = 17 individuals) when wild adult Colorado Pikeminnow were still present and being collected via electrofishing (STReaMS query, Ryden and Ahlm 1996).

Expanding the range of Colorado Pikeminnow to sections of the San Juan River upstream of PNM Weir was identified as being important to recovery for this species (U. S. Bureau of Reclamation 2001). To date, this range expansion has been accomplished by stocking hatchery-reared fish directly into this river section to account for large downstream movements that have been present after past stocking events, as well as providing upstream passage of fish at the PNM Fish Passage (e.g., Furr 2016). Short-term results seem to indicate that this approach has helped stocked Colorado Pikeminnows retain in higher numbers upstream of PNM Weir. During fall monitoring in 2016 and 2017, Colorado Pikeminnow were documented above the Animas River confluence on the San Juan river. In 2016 there were three untagged age-1 fish, likely stocked the previous fall. In 2017, there was one untagged age-1, again likely stocked the year before, and an untagged adult, which a fish that size has not been documented upstream that far before during Adult Monitoring. Data combined from other San Juan studies, indicate that range expansion appears to be occurring in other areas of the San Juan River Basin as well. Eleven Colorado Pikeminnow were collected from Yellowjacket Canyon, a tributary of McElmo Creek from 2007-2010 (Fresques 2007, 2008, 2009, and 2010). In April 2011, a Colorado Division of Wildlife crew sampling McElmo Creek about a mile upstream of the Yellowjacket Canyon confluence recaptured a Colorado Pikeminnow that had been captured and tagged in Yellowjacket Canyon on 29 September 2010 (296 mm TL: J. White, pers. comm.). In the spring and summer of 2011, 24 individual Colorado Pikeminnows (range = 225-519 mm TL) were collected from the San Juan River arm of Lake Powell (Francis et al. 2013). One additional individual was collected in the summer 2012 (Francis et al. 2017).

On the down side, we know that Colorado Pikeminnows can be lost from the San Juan system in a number of ways. Stocked Colorado Pikeminnows have been documented becoming entrained in two different canals (Trammell 2000, Renfro et al. 2006). In the case of the Hogback canal, 201 Colorado Pikeminnows were documented as being entrained in 2004 (n = 140) and 2005 (n = 61). A fish screen with remote PIT tag antennas has been installed in the Hogback Diversion to divert fish back into the San Juan and detect any fish with PIT tags that would be entrained. Colorado Pikeminnows have been documented in the San Juan River arm of Lake Powell (Francis et al. 2013). However, a large (approximately 10 meter high) waterfall prevents their moving back upstream and into the San Juan River, unless inundated in which case Razorback Sucker have been documented moving past the waterfall upstream (Francis et al. 2013). In addition, in April of 2007 a Colorado Pikeminnow was captured by the UDWR-Moab crew below the water fall at RM -0.5 and released above the water fall, this fish has been recaptured five times since then (Schleicher and Ryden 2013). This method may be labor intensive but does provide passage over the water fall for native fishes. Lastly, a number of studies in the San Juan River have documented negative interactions between Colorado Pikeminnow and nonnative Channel Catfish. These include both predation upon stocked Colorado Pikeminnow by Channel Catfish (e.g., Jackson 2005) as well as Colorado Pikeminnow choking on Channel Catfish and Black Bullhead after attempting to ingest them (e.g., Ryden and Smith 2002, A. Lapahie unpublished data).

Documented reproduction of Colorado Pikeminnow in 8 of the last 9 years (Farrington et al. 2018) indicates that stocked fish that have recruited into adulthood are now successfully spawning. In addition, Colorado Pikeminnows have been documented using areas of the San Juan River basin where they were previously absent. Caution must be taken when interpreting these data, because the San Juan River Colorado Pikeminnow population is essentially still a population of stocked fish.

Razorback Sucker

No definitive wild Razorback Suckers were collected in 2017 in the common sampled area. The 340 stocked Razorback Suckers collected in 2017 was the second highest number ever collected during Adult Monitoring, 89% of the Razorback Suckers caught on the trip had been in the river for one or more overwinter periods. Increased numbers of Razorback Suckers collected in Adult Monitoring coincides with the start of an eight year stocking effort, where more Razorback Suckers were stocked and better handling techniques were used when releasing fish. Unlike the Colorado Pikeminnow, some Razorback Suckers are retaining in the San Juan River for as long as 18 overwinter periods post-stocking (Schleicher and Ryden 2013). In addition, larval Razorback Sucker were collected for the 20th consecutive year (Farrington et al. 2018). The continued collection of larval Razorback Sucker, paired with the presence of older fish indicates that stocked Razorback Suckers are able to spawn successfully in the wild. The presence of a few small untagged Razorback Suckers collected by various studies in 2003 and 2004, when no fish of that size were being stocked indicates that at least some of these larvae had recruited to the age-1 and age-2 year-classes during those particular years (e.g., Jackson 2004, Ryden 2004, Golden and Holden 2005, Jackson 2005). In February 2014, investigators from UDWR-Moab reported capturing and releasing a small (224 mm TL) untagged Razorback sucker during a non-native removal trip from Mexican Hat, UT to Clay Hills boat landing (B. Hines, pers. comm). Sampling during 2017 Adult Monitoring below Sand Island, a presumed wild 252mm TL untagged was captured and released as well.

Like Colorado Pikeminnow, Razorback Suckers appear to be expanding their range upstream beyond PNM Weir, both via stocking and upstream passage through the PNM Fish Passage facility. A total of 139 Razorback Suckers were collected above Hogback Diversion in 2017, 38 of which were collected upstream of PNM weir. For the past six years, there have been Razorback Suckers captured above the Animas River confluence on the San Juan River, 24 in 2017. In addition to sampling on the San Juan, two passes have been completed on the lower 16 river miles of the Animas, one in 2015 (one boat pass) and one in 2017 (two boat pass), and in both passes Razorback Suckers have been documented in the lower nine miles.
Seventy-five Razorback Suckers were collected in the San Juan river arm of Lake Powell in 2011, 72 in 2012, and another 148 individuals in 2017 (Francis et al. 2013, Francis et al. 2017, Francis et all. 2018 in prep.). In addition, database searches have indicated that at least four Razorback Suckers stocked into the San Juan River moved downstream out of the San Juan River, through Lake Powel and back upstream into the Colorado River and Green River, a distance of 477 RM in the most extreme case (T. Francis, pers. comm.). A Razorback Sucker in 2015 was captured on 10 September during Adult Monitoring at RM 95 on the San Juan that was stocked into the Green River at RM 255.4. Thus like the Colorado Pikeminnow, the Razorback Sucker seems to be moving into and exploiting more habitats peripheral to the mainstem San

Juan River. The detection of fish moving between river basins also shows that habitats once thought to be a barrier to this species may indeed be acting more like a highway.

Between 2006 and 2016 there were 24 capture events with Razorback Sucker X Flannelmouth Sucker hybrids during Adult Monitoring in the common sampled area, in 2017 there were 4 additional fish captured. In addition, two Razorback Sucker X Flannelmouth Sucker hybrids were collected in the San Juan River arm of Lake Powell in 2011 (Francis et al. 2013). The presence of these juvenile and adult fish over numerous years points to a low level of successful spawning, survival, retention, and recruitment among this hybrid form. If these Razorback Sucker X Flannelmouth Sucker hybrids are surviving, retaining, and recruiting to adulthood in numbers large enough to document via Adult Monitoring, why then aren't pure Razorback Sucker able to do the same? Every year Razorback Suckers are collected in the river that do not possess a PIT tag. These fish were once considered to be fish that dropped their tag after being stocked or tagged in the river. Fin clips have been taken from these untagged fish and have been given to ASIR to determine the natal origin of these fish through laser ablation and use of stable isotopes.

On the down side, we know that the Razorback Sucker, like the Colorado Pikeminnow can be lost from the San Juan system in a couple of ways. To date, stocked Razorback Suckers have not been documented being entrained in canals -- although data from two canals in Grand Junction, CO indicate that they do become entrained in upper basin canals (B. Schleicher, pers. obs.). However, Razorback Suckers have moved into and now occupy the San Juan River arm of Lake Powell. Until summer 2011 it was assumed that the presence of the waterfall prevented any movement of Razorback Sucker back upstream and into the San Juan River. We now know that at least some of these fish will return upstream if the opportunity presents itself. Lastly, a study in the San Juan River has documented predation upon stocked Razorback Sucker by Channel Catfish (e.g., Jackson 2005).

Despite various sources of loss, and fewer yet larger fish that have been stocked over the years in comparison to Colorado Pikeminnow (Furr 2017), Razorback Sucker continue to persist and spawn in the San Juan River, producing greater numbers of larval fish annually than do Colorado Pikeminnow (Farrington et al. 2018). As with Colorado Pikeminnow, caution must be taken when interpreting these data, because the San Juan River Razorback Sucker population is essentially still a population of stocked fish. Like Colorado Pikeminnow, Razorback Sucker were all but nonexistent in Adult Monitoring collections just 18 years ago. Looking at these data through that lens, their current status (i.e., having numbers of adult fish that we know are consistently reproducing) is encouraging.

Common Native Fishes

The Flannelmouth Sucker remains the most abundant species collected in the San Juan, second in the Animas river, captured in nearly every sample. In addition, Flannelmouth Suckers of all life stages continue to be collected with regularity, showing that reproduction and recruitment are occurring. The long-term trend line for juvenile Flannelmouth Sucker CPUE in the common sampled area has shown great fluctuations, but no significant long-term change since 1999. The long-term trend line for adult Flannelmouth Sucker CPUE riverwide has significantly declined in the last 19 years that riverwide sampling occurred driven by two high values in 1999 and 2000. The exact reason for the marked decline in adult Flannelmouth Sucker CPUE is unknown. There has been some speculation that the stocking of large numbers of large juvenile and adult Razorback Sucker (a potential competitor of Flannelmouth Sucker) could be the reason. However, a small number of Razorback Sucker were stocked prior to 1999 (only 5,100 of the 220,338 stocked to date = 2.3%) when the downward trend began, and most of those were relatively small fish, which PIT tag data shows were not recaptured in high numbers (Furr 2017, Durst 2015). However, this trend does bear close examination in future years. As a whole (juvenile and adult fish combined), the San Juan River Flannelmouth Sucker population has remained relatively stable and widespread in the common sampled area over the last 19 years. This is the case despite: 1) the stocking of over > 5.2 million Colorado Pikeminnow (potential predators) from 2002 to 2016 and 220,338 Razorback Sucker (potential competitors) from 1994-2016; and, 2) repeated intensive electrofishing efforts that are ongoing in the San Juan River.

Bluehead Sucker were the second most common large-bodied fish species collected in the common sampled area upstream in the San Juan River in 2017, and the most common in the lower 16 RM of the Animas River. The Bluehead Sucker population is strongly associated with cobble-dominated habitats in upstream reaches of the San Juan River (i.e., upstream of Reach 4) where 83.3% of captured Bluehead Suckers where found. Over the past 19 years the Bluehead Sucker population has declined slightly in the common sampled area. The long-term trend line for both juvenile and adult Bluehead Sucker CPUE has shown that there has been a significant decrease in this abundance index. The highest CPUE data points for adult Bluehead Suckers were in 1999 and 2013, which show that with a long lived fish species this decline may be statistically significant but may not be biologically significant.

Common Nonnative Fishes

Channel Catfish were the third most abundant species collected in 2017 in the common sampled area (RM 180.0-77.0). Channel Catfish were collected between RM 166.6 to 77.0, being present in 83.6% of samples. Discouragingly, numbers of adult and juvenile Channel Catfish have shown no significant long-term decline in the face of intensive nonnative fish removal efforts by multiple agencies. This demonstrates an impressive capacity for reproduction and recolonization that has, so far, managed to offset many of the impacts made by intensive nonnative fish removal efforts in both the middle and lower nonnative fish removal sections.

In 2001 (the year intensive nonnative fish removal efforts began), the largest numbers of Channel Catfish were collected in the upper nonnative fish removal section, from RM 166.6-147.9 (Ryden 2012). In 2017, the Channel Catfish population was most abundant in the portion of the middle nonnative fish removal section (RM 110.0-77.0) that we sampled (Figure 7).

While the population trends would seem to indicate that nonnative fish removal efforts are ineffective in reducing numbers of this species in the common sampled area, it should be remembered that in the upper nonnative fish removal sections it took several years of hard work in a much shorter area of river to bring numbers of Channel Catfish down significantly. It is anticipated that with the repetition of multiple-pass, intensive nonnative fish removal efforts being applied in all sections of the San Juan River (i.e., enough pressure over a long enough period of time), will make it possible to effectively reduce the number of Channel Catfish in the section of river from Shiprock, NM downstream to Mexican Hat, UT. Removal efforts in 2016 and 2017 had been changed to test the efficacy of this sample design on a smaller scale to be able to increase effort in each river mile. In 2016, there was a significant decrease in the CPUE of both adult and juvenile size class Channel Catfish when compared to CPUE values from 2015 in similar miles. After a replicate effort in 2017, the CPUE for Channel Catfish was similar in both size classes to that of 2016. Speculations had been made that the efficacy of the sampling could have been compromised by higher flows in the spring of 2017 vs 2016, however by the fall; the CPUE for Channel Catfish was unable to determine that.

Common Carp were the eighth most commonly-collected species during 2017 Adult Monitoring in the common sampled area, with 29 fish collected in 128 electrofishing samples. Over the last 19 years, Common Carp numbers have been greatly reduced in sections they have been removed. In the 30 total RM sampled upstream of the confluence of the San Juan and Animas rivers on both rivers there were a total of 37 Common Carp collected, showing a possible continuing source for this species downstream. While the exact causes of the large-scale decline of Common Carp are unknown, nonnative fish removal is a contributing factor in the common sampled area. To put things into perspective, during 1998 Adult Monitoring, 77 adult Common Carp were collected in just one electrofishing sample (RM 163-162), where-as in 2017 there were 66 fish collected in 133 RMs. If there has been a success story associated with the nonnative removal efforts in the San Juan River to date, it would be the marked reduction in numbers of Common Carp in the common sampled area.

Animas Sampling Upstream of the San Juan River Confluence

Standardized Adult Monitoring sampling occurred on the Animas, upstream of the Animas and San Juan River confluence (A-RM 16-1.2) for the second year in 2017, first being in 2015. In 2015, sampling consisted of one raft, one pass, in the spring on the ascending limb of the hydrograph, where-as in 2017, sampling was with two rafts in the summer on the descending limb of the hydrograph. No comparative analysis was provided due to two different timings of the trips. Personal observations has lead me to believe that fish use this section of river more for spawning habitat than occupying it year round as the water in the Animas River is mostly diverted by the time it reaches this section.

ACKNOWLEDGEMENTS

The author would like to thank the many individuals that participated in the field portions of this study from the U.S. Fish and Wildlife Service - Region 6, U.S. Fish and Wildlife Service – Region 2, Utah Division of Wildlife Resources – Moab, and invaluable logistical support was provided Paul Thompson (BIA). Permission to use boat take-outs on private land were graciously granted Mr. Buck Wheeler (Waterflow, NM) and the good folks at Hatch Trading Post (Fruitland, NM). Thank you to the individuals who reviewed this report; Mathew Zeigler (NMDG&F), Dr. John Pitlick (Peer Review), Dr. Stephen Ross (Peer Review), and Dr. Wayne Hubert (Peer Review), comments were appreciated and incorporated.

This study was approved by the Biology and Coordination committees of the San Juan River Recovery Implementation Program. It was funded under agreement #R17PG00084, (previously R13PG40052, R10PG40021, 08-AA-40-2715) administered by Mark McKinstry of the U.S. Bureau of Reclamation's Salt Lake City Projects Office. Fish collections were authorized under collecting permits issued by the Colorado Division of Wildlife, National Park Service – Glen Canyon National Recreation Area, Navajo Nation Department of Fish and Wildlife, New Mexico Department of Game and Fish, and the Utah Division of Wildlife Resources.

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Opinion. Memorandum from Carol DeAngelis, Area Manager, U. S. Bureau of Reclamation, Western Colorado Area Office, Grand Junction, CO to LeRoy Carlson, Colorado State Supervisor, Ecological Services, U. S. Fish and Wildlife Service, 755 Parfet Street #361, Lakewood, CO 80215 (Memo dated 6 July 2001). 18 pp. + attachments.

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Response to comments

Comments on "LONG TERM MONITORING OF SUB-ADULT AND ADULT LARGEBODIED FISHES IN THE SAN JUAN RIVER: 2017", interim report submitted by Ben Schleicher, USFWS

Submitted by John Pitlick, University of Colorado, May 24, 2018

This report combines 2017 monitoring data with data from 14 previous years to assess long-term trends in the abundance of large-bodied fishes in the SJR. The results are informative and highly relevant to program objectives; the report is also very well written. I have a few suggestions for sharpening the presentation of results:

1. Figure 2 and associated discussion:

   a) The data shown in this figure are influenced to some extent by the numbers of fish stocked in the year prior to sampling. This is evident in the large drop in CPUE from 2010-2011, when no fish were stocked in 2010. So, I suggest adding a separate plot showing how many fish were stocked the year prior to sampling, or at least commenting on the range in numbers stocked over time. It is also evident that there is substantial variability in CPUE even in years when they stock roughly same number of fish (~400,000). Any thoughts on what causes these variations? Sampling issues? Predation? Hydrology? One suggestion might be to add a third plot showing the time series of daily flows at Shiprock for the same period to see if there is any relation between CPU and hydrology. **There have been attempts in the past to graphically depict the variation in stocking with CPUE data with both Colorado Pikeminnow and Razorback Sucker. These analyses were asked to be omitted by both the BC and the peer reviewers. I agree with there being other factors that could be**

causing variation in our CPUE and I appreciate your ideas, these will be looked at for the FY18 report that will be more comprehensive.

b) The 2011 data point is interesting because all of these fish are presumably age-2+ or older, correct? And the specific value of LnCPUE, ~0.6, is not that different from several other years, e.g. 2015 and 2016, when many 1000s of fish were stocked. Does this tell us anything about potential benefits of stocking far fewer fish each year? **However this was lower than years immediately adjacent to 2011, this bespeaks to comment 1a where there could be other factors involved.**

c) You can fit a straight line through the entire data set but it looks like the overall trend is upward at first (2003-2010) then downward. I suspect that the mean LnCPUE for the period 2003-2010 would not be significantly different from the mean for the period 2011-2017. So, I suggest you note that the trend was upward from 2003-2010, mostly downward since, and consider indicating this with two separate straight-line relations.

2. Minor points:

- line 452, I suggest rewording as follows: "For comparison, the number captured in 2017 is 4 times greater than that in 2010 (Table 4)." **Changed**

- line 458: change 2001 to 2003, and Figure 3 to Figure 4. **Changed**

- line 490: Figure 7 is referenced here before Figs. 5 and 6. I suggest moving Figure 7 to follow the discussion in this paragraph (then re-number Figs. 5 and 6). **I left the figures as they were placed however I have taken that into consideration for formatting of future reports.**

- Figures 5 and 6: It would help if you label the separate panels juvenile, adult, combined. Also order the discussion in the text to correspond to these same categories. **Changed**

- line 592: granted you only collected 2 CPM, but there is no discussion of CPM in this paragraph. **Added**

- Discussion section, line 661+: There isn't much discussion in this section of the long term trend in CPUE for pikeminnow shown in Figure 2. This is one of the most important findings of this study and I think it merits further discussion, perhaps in the context of the findings from the larval fish studies, i.e. we're getting reproduction but the population is not growing very rapidly. **Added addition dialogue**

Title: Long Term Monitoring of Sub-adult and Adult Large-bodied Fishes in the San Juan River: 2017

Principal Investigator: Benjamin J. Schleicher

Review by Wayne Hubert

It is recognized that this is not a report of a research project, but it is the documentation of monitoring efforts during 2017 with comparisons to previous years. The report is similar to previous years and does a reasonable job of documenting the outcome of the monitoring effort for 2017.

While not specific to the 2017 report, a strong recommendation for future data analyses is that more advanced analytical tools be applied to CPUE data. The larval fish monitoring program of the SJRRIP is using a mixture model approach in SAS (i.e., PROC NLMIXED) where logistic regression is used to model the probability that a site is occupied and lognormal modeling is used to model density given that a site is occupied (see 2017 project report by Farrington et al.). The small-bodied fish monitoring program is using a similar approach involving Delta-GLM which combines logistic and lognormal modeling (see 2017 project report by Zeigler and Ruhl). These approaches overcome issues of high frequencies of zeros and non-normal distributions that plague CPUE data and confound statistical tests.

Constructive criticism is provided to the author for consideration in finalization of the draft.

The Executive Summary is a series of bullet points and subpoints. It is very difficult to follow and the bullets lack context. The report would benefit from a well-written executive summary of two to three paragraphs that summarizes the major achievements and what may have been learned during 2017.

The objectives of Adult Monitoring (line 200) include the following, "3) Continue to perform activities that support other studies and recovery actions being implemented by the SJRIP. For example: a. Remove nonnative fish species which may prey upon or compete with native fish species in the San Juan River. b. Collect tissue samples from various fish species for stable isotope, 219 genetics, and contaminants studies. c. Document hybridization of endangered fishes with native fishes. d. When appropriate, document any observed parasites, lesions, or abnormalities on collected fishes. Make these data available to appropriate studies when they occur." It is not evident in the report which activities or data may be related to nonnative fish removal, collection of tissue samples, documentation of hybrids, or documentation of fish health. Further the methods for collecting tissues, identifying hybridization or assessing various elements of fish health are not described in the methods. The report would benefit from elaboration on the methods used and 2017 findings associated with the various elements of Objective 3. **In the interest of decreasing the length of this report, as per recommendation**

by the program office and has been mentioned in past comments from peer reviewers, I have not elaborated on these objectives. This has been kept vague for many years now to cover the requests from other PI's, agencies, or Tribes to collect additional data not directly associated with Adult Monitoring.

In the Methods it is stated (line 272) that for Colorado Pikeminnow "analysis of variance (ANOVA) was then used on all CPUE values to obtain a mean CPUE value and Tukey's Honestly Significant Difference (Tukey's HSD) multiple-comparison post-hoc tests was used to determine significance to previous years' CPUE with that of 2017." Similarly, regarding Razorback Sucker (line 291) it is stated, "CPUE for Razorback Sucker was calculated and analyzed (ANOVA, Tukey's HSD, $p < 0.10$) as described for Colorado Pikeminnow." Regarding these analyses, an ANOVA involves the testing of differences in means among treatments (i.e., years), it does not yield mean CPUE values. Further, there are assumptions of ANOVA regarding the distributions (i.e., CPUE distributions). Were the CPUE distributions assessed to determine if assumptions were met? If not, what is the likely effect on the resulting p values? Most importantly, while ANOVAs are described in the Methods, the results of the tests are not found in the Results.

Following up on the above comment regarding Objective 3, it is stated in the Results (line 320) that "In general fishes collected during Adult Monitoring appeared to be in good health." Insufficient data are presented to support this conclusion. It is stated (line 321) "Any noticeable instances of abnormalities, parasites, or deformities were noted in the field notes, but the rate of occurrence was low. A total of 12 fish (0.30%) out of 2,399 that had length and 323 weights taken were noted to have some bite marks, sores, or deformities," but these are not sufficient data to draw a conclusion that fishes are "in good health." It is recommended that either this paragraph be omitted or that substantially more data be included to support the conclusion. **Omitted**

Figures 2, 4, 5, and 6 all include regression lines that portray temporal trends in CPUE. No mention of the application of regression analysis is found in the Methods. What are the hypotheses being tested? How were the regression models computed? The computation of the regressions is questioned. Were the regression lines computed using individual CPUE values for each year or mean CPUE values for each year? Individual CPUE values should be used. Given the relatively high r^2 values and low p values observed on several of the figures, it is my guess that mean CPUE values were used. The Methods should include a description of the computation of the regression models, the models should described the Results section, and the Discussion section should provide interpretation of temporal trends that may be indicated by these analyses. **Regression was included in the methods section**

In the Discussion of findings regarding Colorado Pikeminnow (line 722) it is stated that, "reproduction of Colorado Pikeminnow in 7 of the last 11 years indicates that 723 stocked fish that have recruited into adulthood are now successfully spawning." The source(s) of these data should be referenced and included in the Literature Cited. **Corrected**

LONG TERM MONITORING OF SUB-ADULT AND ADULT LARGE-BODIED FISHES IN THE SAN JUAN RIVER: 2017

Benjamin J. Schleicher

Overall you did a good job on reporting the findings of this important monitoring effort in the San Juan River. I do have a number of suggestions and things to consider in your revision. Most important, I have some concerns regarding the assumptions on which parametric statistics, such as one-way ANOVA, are based. There are likely some better approaches for analyzing the monitoring data, for instance the approaches used in the larval and small-bodied sampling studies. Especially at this stage in the recovery program, I think it is particularly important to have as much rigor with the statistical analyses and interpretations as possible.

Specific comments with inserted material in blue:

The meaning of the statements in the executive summary are not always clear. A telegraphic style is ok with me, but make sure there is a consistent pattern of how it is written and that the take-home messages are clear. For instance, the phrase "CPUE of Colorado Pikeminnow in the river for 1+ overwinter periods post-stocking in 2017 was only significantly lower than 2010" doesn't really tell me about long-term trends.

Lines 284-286. Emphasis in analyzing catch per unit effort (CPUE), as fish per hour of electrofishing, values was then placed on groups of fish that had been in the river for one or more overwinter periods post-stocking. I determined the abundance (measured as CPUE, catch per unit effort) of fish that had been in the river for one or more overwintering periods. Is this what you mean?

Line 272. Was alpha set at 0.10 as for Razorback Suckers? Also, if you have set an alpha value to 0.10, why are you using 95% confidence intervals? Why not show a 90% CI? The way it is now, you have regression analyses with an alpha of 0.10 shown on graphs that also indicate 95% confidence intervals-kind of confusing! Finally, provide a published reference offering a basis for adjusting alpha to 0.10 from 0.05. For instance, Brown and Guy (2007) mention the use of significance levels of 0.10 in field studies. I have also included the following material for you to consider in setting probability levels.

Nothing comes without a cost and this is certainly true in hypothesis testing. Consider that you have four outcomes in hypothesis testing, two correct decisions, and two incorrect decisions:

	Outcomes	
	H_o Accepted	H_o Rejected
H_o is true	correct	**Type I Error**
H_o is false	**Type II Error**	correct

So, a Type I error is rejecting a true null hypothesis, such as saying that there are differences in the abundance of fish over time when there really are not. As you change alpha from 0.05 to 0.10, you increase the risk of a type I error. A type II error (Beta) is accepting a false null hypothesis. In your case saying that there are no differences in abundance over time when in fact there are. B and α are inversely related, so as α increases (e.g., you become less restrictive in rejecting the null hypothesis of no change), the risk of a type II error (B) goes down. For the San Juan River Recovery Program, the question that you have to answer is whether it is better to err on the side of ignorance (type II error saying there is no difference when there really is, corresponding to a low value for alpha) rather than saying there is a difference when there really isn't (high value for alpha such as you have done by setting it at 0.10 instead of 0.05). A useful reference for this is Connor and Simberloff (1986), particularly the section beginning on page 158 on Scientific Method in Ecology. (Let me know if you want me to send a pdf of the paper to you.).

While I am dealing with statistical issues, you have not mentioned if you checked for assumptions of ANOVA, which include the assumption of a normal distribution. Note also that confidence intervals assume a normal distribution as well. **Thank you for the insight and clarification of using an alpha of .1 vs .05. The calculations in the paper were with an alpha of .05, the .1 was a typo that was copied between the two spp. I was breaking the assumption of normal distribution for ANOVA tests which is why I removed them from the report. As Dr. Hurbert pointed out "… this is not a report of a research project, but it is a documentation of a monitoring efforts…" this years abbreviated report will not include the ANOVA however in future years when a more detailed report is requested, more robust analyses will be included.**

Lines 386-388. Mention in the Figure legend that no Colorado Pikeminnow were stocked in 2011. Otherwise the gaps in the year class data for 2011-2015 could be confusing. **Noted that no age-0 fish were stocked in the fall of 2010, which would explain the gap starting in 2011**

Line 408. "… and 2015, and only lower than 2011 (Figure 2). ~~(Figure 2)"~~ Another important conclusions based on Figure 2, is that the slope of the line for CPUE vs year from 2003 to 2017 did not differ significantly from zero- not an encouraging find. However, this was likely driven by the lack of stocking of age-0 fish in 2010 that would have depressed CPUE for 2011, 2012 and perhaps later. How did you deal with the effect of a missing year class when analyzing your data for Figure 2? In trying to understand long-term patterns here, if might be worthwhile to repeat the analysis dropping or adjusting the anomalous 2010 data. One way of dealing with missing data, other than just omitting it, would be to enter the estimated cpue for 2011 based on the regression equation. **Data was not omitted if it wasn't there to begin with. Figure 2 is looking at all pikeminnow captured that year regardless of when they were stocked as long as they had been in**

the river for 1 OWP. With a large drop in the data, it tends to show that stocking 400,000 age-0 fish has an effect on the sampling.

Lines 457-459. There has been an overall significant increase in CPUE from 2001 to 2017 (Figure 4), which could be a function of these fish persisting in the river for long periods of time post stocking (Table 4). Since you just mentioned Figure 4 in the previous sentence, you really do not need to repeat it (but if you do, be sure it is cited properly). Figure 4 is certainly encouraging!

Lines 489-490. The Flannelmouth Sucker was once again the most common large-bodied fish species collected in the common sampled area (Table 2 and Figure 7). Figures need to be numbered in the order in which they occur in the document. Hence, Figure 7 should be changed to Figure 5, etc.

Lines 494-497. Figure 5 should be changed to Figure 6. **For re-ordering figures (this is also refers to the next few comment), it was mention by Dr. Pitlick as well, I will take this into consideration on future document, however, they were left as is in this document of monitoring.**

Lines 497-498. "… juvenile CPUE values has been observed from 1999 to 2017 (Figure 5); however, the long-term trend…"

line 505. Figure 7 should be changed to Figure 5.

Line 511. Figure 5 should be changed to Figure 7.

Line 533. Figure 6 should be changed to Figure 8.

Line 548. Change Figure 6 to Figure 8.

Line 737. Schleicher et. al (2013) is not in the literature cited. Also, there is not a period after "et" but there is a period after "al." The former is not an abbreviation but the latter is. **Changed**

Line 756. river miles of the Animas and in ~~bother~~ both passes Razorback Suckers **Changed**

Lines 796-797. "Despite various sources of loss, and the far lesser numbers of fish that have been stocked over the years in comparison to Colorado Pikeminnow..."
In this sentence you are comparing two very different situations based on the assumed level of mortality. The greater numbers of age-0 Colorado Pikeminnows that are stocked relative to the larger Razorback Suckers at stocking is to counteract the greater likelihood of mortality on the small age-0 fish. **Mentioned size difference at stocking**

Line 857. Change the Figure number.

Line 882. To put things into ~~prospective~~, perspective during 1998 **changed**

References:

Brown, M. L., and C. S. Guy. 2007. Science and statistics in fisheries research, p. 1-29. *In*: C. S. Guy and M. L. Brown, eds., Analysis and interpretation of freshwater fisheries data. American Fisheries Society, Bethesda, MD).

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Main document changes and comments

Page 1: *Comment [MPZ1] Matthew P. Zeigler 5/15/2018 7:25:00 AM*

> *Given the presence of wild young-of-year Colorado Pikeminnow in the river in 2016, I am not sure that this can be said with any certainty anymore.* **While the discovery of wild young-of-year (YOY) Colorado Pikeminnow (and Razorback Sucker) is great news, they have been discovered in relatively low abundance. With the calcein marks on hatchery fish being questionably identified after 10 months in a controlled hatchery environment and unknown under natural conditions, coupled that we had no way of discerning wild fish from stocked fish for Pikeminnow, it is this author's belief that all Colorado Pikeminnow captured were stocked fish. Same goes for Razorback Suckers. I will mention that in the near future, I hope that there will be a way to discern between wild and stocked fish and/or there are enough wild YOY fish captured during other studies that a broad statement about all fish captured being stocked cannot be made.**

Page 1: Comment [MPZ2] Matthew P. Zeigler 5/14/2018 4:18:00 PM

> *These are fish that we tagged as age-1 in 2017 correct? How do you know they were all stocked fish?* **See response to [MPZ1]**

Page 2: Comment [MPZ3] Matthew P. Zeigler 5/15/2018 7:25:00 AM

> *This is an increase from 2015 to 2016, it may be best to average over a certain number of years or give only the 1999 and 2017 data*. **Corrected**

Page 5: Comment [MPZ4] Matthew P. Zeigler 5/15/2018 7:26:00 AM

> *This information is repeated from the two sentences above.* **Corrected**

Page 5: Comment [MPZ5] Matthew P. Zeigler 5/14/2018 4:18:00 PM

> *The scientific name for Roundtail Chub should be given here.* **Corrected**

Page 6: Comment [MPZ6] Matthew P. Zeigler 5/14/2018 4:18:00 PM

> *I'd move this sentence to the end of the paragraph to make it flow better. It's difficult to follow where and when you sampled because you bounce to the Animas River sampling in the middle of describing the San Juan River sampling.* **Moved**

Page 6: Comment [MPZ7] Matthew P. Zeigler 5/14/2018 4:18:00 PM

> *What is defined by Bliesner and Lamarra?* **Added**

Page 7: Comment [MPZ9] Matthew P. Zeigler 5/14/2018 4:18:00 PM

> *An ANOVA is used to assess for differences between sample means, not obtain a mean. This should be re-written to accurately describe the statistical analysis that was conducted.* **Removed**

Page 8: Comment [MPZ12] Matthew P. Zeigler 5/14/2018 4:18:00 PM

How were hybrids identified? **Phenotypically ID by the PI but not mentioned as this is an overarching report and not attempting to get down into the weeds with small details like this**

Page 8: Comment [MPZ13] Matthew P. Zeigler 5/14/2018 4:18:00 PM

These aren't species. It should be stated that 14 species and 4 types of hybrids were collected. **Changed**

Page 8: Comment [MPZ14] Matthew P. Zeigler 5/14/2018 4:18:00 PM

Four? **Changed**

Page 11: Comment [MPZ15] Matthew P. Zeigler 5/14/2018 4:18:00 PM

How can this be presumed? **See response to [MPZ1]**

Page 11: Comment [MPZ16] Matthew P. Zeigler 5/14/2018 4:18:00 PM

The actual TL of the captured fish should be given. **Total length given**

Page 11: Comment [MPZ17] Matthew P. Zeigler 5/14/2018 4:18:00 PM

Again, how do you know all of these fish were stocked? **See response to [MPZ1]**

Page 11: Comment [MPZ19] Matthew P. Zeigler 5/14/2018 4:18:00 PM

were captured during Adult Monitoring when it sampled the common area? **Changed**

Page 12: Comment [MPZ20] Matthew P. Zeigler 5/15/2018 7:28:00 AM

I would change the scale of the graphs for age-3 through age-6+. It is impossible to see any changes or differences through time. Also why is CPUE natural log transformed? There is no information on this transformation in the Methods section. **For comparable purposes the scale has been left the same. The very minimal variation is of no importance at this time, merely that there is a presence. Data transformation was added to the methods section.**

Page 13: Comment [MPZ21] Matthew P. Zeigler 5/14/2018 4:18:00 PM

I understand what you are trying to say here, but as currently written this is very confusing. **Reworded**

Page 13: Comment [MPZ22] Matthew P. Zeigler 5/15/2018 7:29:00 AM

There is really no reason to present the line and its equation, R2, and p-value since it isn't statistically significant. Also, the number of significant digits should be the same throughout for this information. **The line is merely to show if there has been an increasing, decreasing, or no trend over time. I understand there is no significance to the line, yet still provide the equation, R^2, and p-value to illistrate**

Page 14: Comment [MPZ23] Matthew P. Zeigler 5/15/2018 7:30:00 AM

Were there no collections of RBS upstream of PNM before 2010 or only in 2010? **Changed**

Page 14: Comment [MPZ24] Matthew P. Zeigler 5/14/2018 4:18:00 PM

This paragraph needs to be clarified. **Clarification of this comment is needed**

Page 17: Comment [MPZ25] Matthew P. Zeigler 5/14/2018 4:18:00 PM

Which years? **Removed as comparative analysis has been removed**

Page 18: Comment [MPZ26] Matthew P. Zeigler 5/14/2018 4:18:00 PM

It may be beneficial to label each of these graphs with the size class. **Done**

Page 19: Comment [MPZ27] Matthew P. Zeigler 5/14/2018 4:18:00 PM

This was stated two lines above. **Removed**

Page 25: Comment [MPZ28] Matthew P. Zeigler 5/14/2018 4:18:00 PM

I do not think this can be stated anymore. **See response to [MPZ1]**

Page 25: Comment [MPZ29] Matthew P. Zeigler 5/14/2018 4:18:00 PM

Could this be a result of sampling effort? A lot of effort was expended in 2017 if you're counting all trips, not justadult monitoring. **The difference in effort would skew the data, however, there was a considerable amount of work being done during that time period attempting to gain as much information from the wild Colorado Pikeminnow as possible as they disappeared from the San Juan later in the 90's. Granted the sampling was not as structured as it is now.**

Page 25: Comment [MPZ30] Matthew P. Zeigler 5/14/2018 4:18:00 PM

one? **Changed**

Page 25: Comment [MPZ31] Matthew P. Zeigler 5/14/2018 4:18:00 PM

This cannot be stated with any certainty. **See response to [MPZ1]**

Page 26: Comment [MPZ33] Matthew P. Zeigler 5/15/2018 7:31:00 AM

Do these interactions have population level affects though? If there is evidence that the effects are population level, thereby affecting recovery, then evidence should be presented here. **The exactly level of effect has not be quantified and it is stated in this report that these projects documented negative interactions. There currently is a diet study that may reveal a level of effect of catfish predation of pikeminnow.**

Page 26: Comment [MPZ34] Matthew P. Zeigler 5/14/2018 4:18:00 PM

When were the other 11% stocked? **The origin of these fish are mentioned on page 15.**

Page 27: Comment [MPZ35] Matthew P. Zeigler 5/14/2018 4:18:00 PM

One pass with two boats? Does each boat count as a pass? **Changed**

Page 28: Deleted Matthew P. Zeigler 5/14/2018 4:10:00 PM

number of studies **Changed**

Page 28: Inserted Matthew P. Zeigler 5/14/2018 4:10:00 PM

Study **Changed**

Page 28: Comment [MPZ38] Matthew P. Zeigler 5/14/2018 4:18:00 PM

This is confusing as currently written. **Reworded**

Page 28: Comment [MPZ39] Matthew P. Zeigler 5/14/2018 4:18:00 PM

How do you explain the significant decline in adult Flannelmouth Sucker then ***?*** **It is stated that I was referring to the combined population of juvenile and adult**

Page 29: Comment [MPZ40] Matthew P. Zeigler 5/15/2018 7:32:00 AM

The data indicates a significant decline, how can you then state that stocking endangered fish and intensive electrofishing has had no effect on the population of Bluehead Sucker? **Was previous stated that it may be statistically significant but may not be biologically. Agreed there has been some effect on Bluehead Suckers but from what, I can't say**