

SAN JUAN RIVER RECOVERY IMPLEMENTATION PROGRAM

FY 2021 ANNUAL REPORT

PROJECT: 19a

Project Title

San Juan River Demographic Monitoring 2021

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Abstract:

Downlisting criteria for Razorback Sucker and Colorado Pikeminnow requires the establishment of 5,500 and 800 adults, respectively, within the San Juan River. In order to understand progress towards recovery for these species in the San Juan River, estimates of adult abundance was required. Beginning in 2019, demographic monitoring was initiated to evaluate population sizes. This was proposed as a three-year effort that was interrupted in 2020 due to sampling restrictions. In 2021 sampling was reinitiated for the second year of the study. The mean estimate of adult Razorback Sucker was 2987 (2661 – 3384, 95% confidence intervals [CI]), which was much larger than what was estimated for the

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number of juveniles (mean = 149; 61 - 501 95% CI). Mean abundance estimates for Colorado Pikeminnow were calculated according to age categories. For age-2 fish mean estimate in 2021 was 570 (279 – 1293 95% CI), 165 (77-394 95% CI) age-3 fish, and finally age-4 and older fish had a mean of 445 (186 – 1246 95% CI).

Study Schedule:

Ongoing

Relationship to LRP:

Define relationship to LRP

Accomplishment of FY 2022 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Colorado Pikeminnow

Sampling occurred from 24 August through 27 September. Three electrofishing passes were completed from Shiprock Bridge (river mile (RMI) 147.9) to Sand Island boat launch (RMI 76.5). Pass 1 took place from 24 August to 30 August, pass 2 took place from 7 September to 13 September, and the final pass took place from 21 September to 27 September.

Two hundred and eighty-three capture events yielded 268 individual Colorado Pikeminnow across all three passes. Colorado Pikeminnow were collected during all three passes in 2021: 76 from pass 1, 97 from pass 2, and 110 from pass 3. Total length (TL) of Colorado Pikeminnow ranged from 87 mm to 810 mm (Figure 1). Weight of Colorado Pikeminnow ranged from 9 g to 5100 g. Captures spanned the entire length of the sampling area (RMI 147.9 to 76.5). All Colorado Pikeminnow received a 134khz passive integrated transponder (PIT) tag prior to release if one was not present upon capture. The largest peak for size of Colorado Pikeminnow on a length frequency histogram was between 167 and 200mm TL, representative of an age-1 age class (Figure 1).

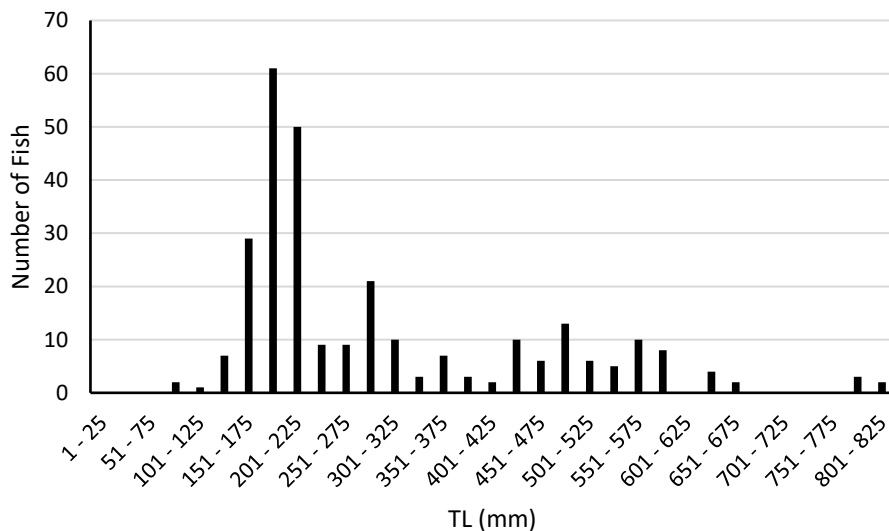


Figure 1. Length frequency histogram for Colorado Pikeminnow, 25mm TL denominations

Multiple age classes of Colorado Pikeminnow were captured on all three trips. There were 99 individual age-1 fish captured and no recaptures occurred between passes. Since there were no recaptures of age-1

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Colorado Pikeminnow, this age class was omitted from the analysis. Once within trip recaptures were removed, there were 83 individual age-2 captures with four recaptures in subsequent passes; 24 individual age-3 fish captures with one recapture in a subsequent pass, and 62 individual age-4 captures with three recaptures on subsequent passes (Table 1).

Table 1. Captures of individual Colorado Pikeminnow (CS) and Razorback Sucker (RZ) by age class for each trip and recapture combination.

	TRIP 1	TRIP 2	TRIP 3	TRIP 1&2	TRIP 1&3	TRIP 2&3	ALL TRIPS
CS Age-2	15	22	42	1	1	2	0
CS Age-3	3	9	11	0	0	1	0
CS Age-4	24	18	17	1	2	0	0
RZ ADULT	227	241	509	30	55	57	15
RZ JUVENILE	10	2	18	0	0	2	0

Three parameters were proposed to be estimated for this project using program MARK (White 2019): age-specific capture probabilities (per pass), age-specific survival (annual), and age-specific abundance estimates (annual). Age-specific survival cannot be estimated until after the third year of data collection is complete due to limitations within the model. So for this report we estimated the other two parameters using closed captured full likelihood P and C model. Age classes were designated by total length of fish, age-1 100-199 mm TL, age-2 200-299 mm TL, age-3 300-399 mm TL, and age-4+ ≥ 400 mm TL. This older group was classified into one category because previous length-age estimating tools did not perform well (i.e., Ryden 2006). We assessed six different model structures and ranked them using AIC (Akaike 1973). Three base line models were assessed: M(0) where there is no variation in probabilities of capture (p) or recaptures (c) over time, M(t) where there is variation in probability of capture (p) and recapture (c), among passes, and M(b) where there is no variation over time but there is a behavioral effect where (p) is not equal to (c). Three other models were assessed that investigated differences between age classes of Colorado Pikeminnow (Table 2). The best fitting model for Colorado Pikeminnow was the M(t) age2=age3, where p and c were equal in age-2 and age-3 fish and different for age-4 fish (Table 2).

Table 2. Results from AIC rankings for Colorado Pikeminnow captures between Shiprock, NM and Sand Island boat ramp, UT during 2021 sampling.

Model	AICc	Delta AICc	AICc Weights	Model Likelihood	Num. Par	Deviance	-2log(L)
{Mt Age 2=Age 3}	-627.6058	0	0.90971	1	9	21.8628	-645.9679
{Mt}	-622.8758	4.73	0.08547	0.094	12	20.3233	-647.5074
{M0 all ages =}	-616.1776	11.4282	0.003	0.0033	4	43.5735	-624.2573
{M0 Age 2=Age 3}	-614.1477	13.4581	0.00109	0.0012	5	43.5632	-624.2675
{M0}	-612.0995	15.5063	0.00039	0.0004	6	43.5632	-624.2675
{Mb}	-611.828	15.7778	0.00034	0.0004	9	37.6406	-630.1902

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Age specific capture probabilities for Colorado Pikeminnow showed no statistical difference between passes within any of the age classes based on overlapping 95% confidence intervals. Estimates for age-2,3 fish ranged from 0.03 to 0.08 between passes with 95% confidence intervals ranging from 0.01 to 0.18. Age-4 estimates ranged from 0.04 to 0.06 with 95% confidence intervals ranging from 0.01 to 0.18 (Figure 2). MARK outputs can be found in Appendix I.

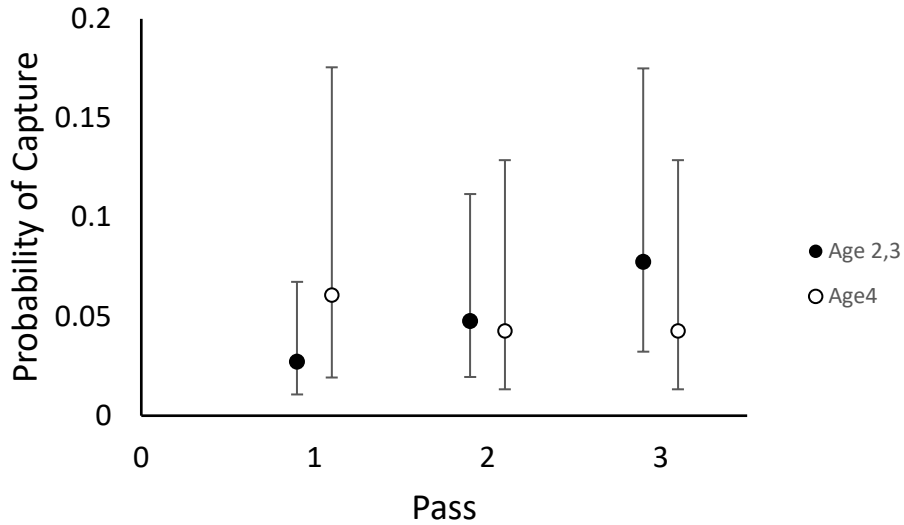


Figure 2. Age specific capture probabilities per pass for Colorado Pikeminnow captured in 2019. Error bars represent upper and lower 95% confidence intervals.

Age specific abundances estimates were also calculated using program MARK using Huggins P and C closed capture model. Abundance estimate for age-2 fish was 570 fish with 95% confidence intervals between 279 and 1293 fish. Age-3 estimate was 165 fish with 95% confidence intervals ranging from 77 to 394. Finally, age-4 fish had an estimate of 445 fish with 95% confidence intervals between 186 and 1246 individuals (Figure 3). MARK output values can be found in Appendix I.

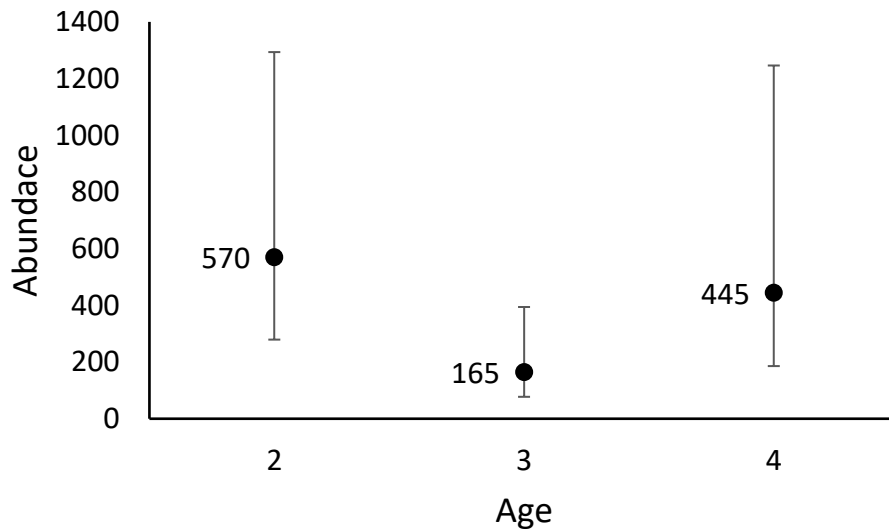


Figure 3. Age specific abundance estimates for Colorado Pikeminnow between San Juan River miles 147.9 to 76.0. Vertical Lines represent 95% confidence intervals.

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Razorback Sucker

A total of 1,395 capture events yielded 1,172 individual Razorback Sucker during all the three passes (Table 1). Total length ranged from 102 mm to 600 mm, and weights ranged from 9 g to 2160 g. The length frequency histogram formed a normal distribution with a peak around 451 – 475mm TL (Figure 4). Captures spanned the entire length of the sampling area (RMI 147.9 to 76.0). Of the 1395 captures, 62 (4.4%) of these were fish that did not have a PIT tag present upon capture. One was too small to tag. Also, four fish escaped prior to being scanned for a tag.

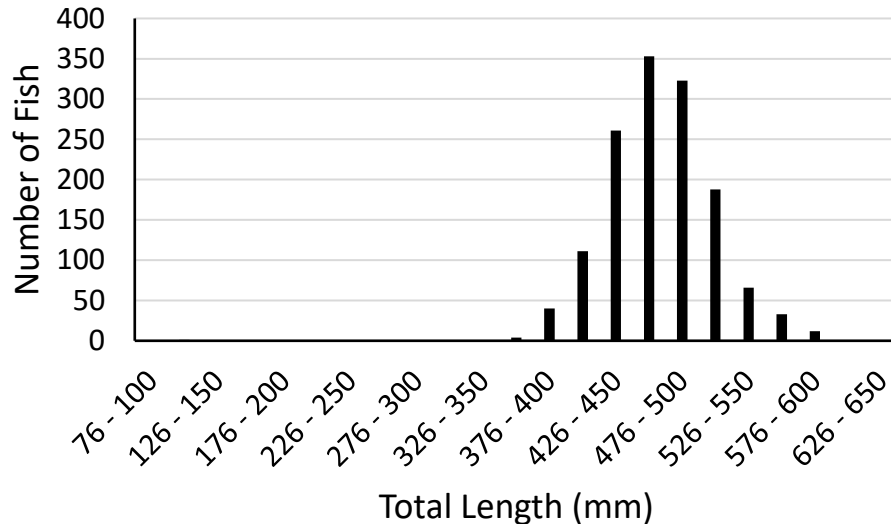


Figure 4. Length frequency histogram for Razorback Sucker captured, 25mm TL denominations

A total of 977 adult Razorback Suckers (400+mm TL) were captured on only a single pass, 227 on trip 1, 241 on trip 2, and 509 on trip 3. A total of 142 fish were recaptured during two passes and 15 fish were recaptured on all three passes. Juvenile Razorback (0-399mm TL) numbers were drastically smaller than adults, a total of 30 were captured on a single trip with only 2 fish being recaptured on multiple passes (Table 1).

The number of Razorback Sucker captured on passes 1 and 2 were similar. There was a substantial increase in the number of Razorback Sucker captured during pass 3 (Table 1).

Age class specific capture probabilities were calculated for each pass using program MARK and running closed capture full likelihood P and C model. Unlike Colorado Pikeminnow, the M(t) model was by far the best fitting model where probability of capture and recapture vary over time (Table 3). Capture probabilities were similar between all three passes for juvenile Razorback Suckers (<400mm TL), as well as passes 1 and 2. The only significant difference observed was for adult age class (≥ 400 mm TL) fish during pass 3, which was significantly higher than any other capture probability based on confidence intervals that do not overlap (Figure 5).

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Table 1. Results from AIC rankings for all life stages of Razorback Sucker combined

Model	AICc	Delta AICc	AICc Weights	Model Likelihood	Num. Par	Deviance	-2log(L)
{Mt}	-10433.3	0	1	1	8	26.7445	-10449.3
{Mb}	-10354.5	78.8008	0	0	6	109.5635	-10366.5
{M0}	-10273.8	159.5382	0	0	4	194.3133	-10281.8

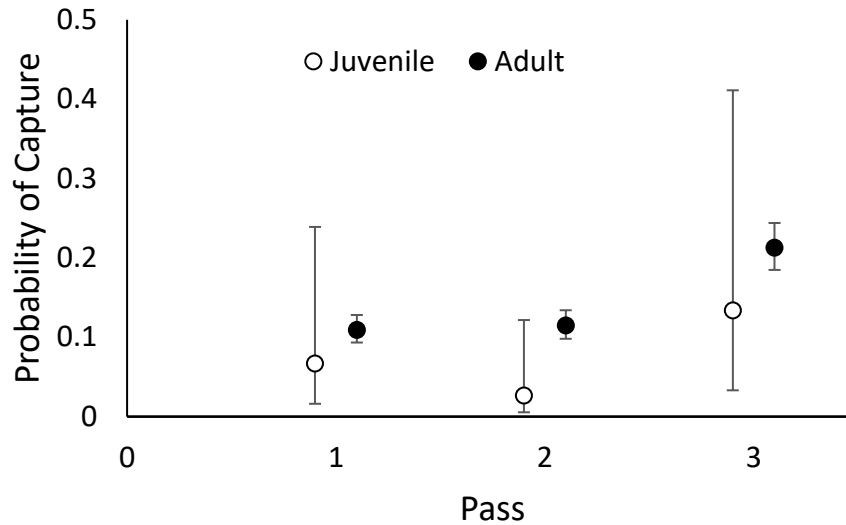


Figure 5. Age class specific capture probabilities for three sampling passes on the San Juan River between river miles 147.9 and 76.0. Age classes are separated into juvenile and adult age class. Confidence intervals are 95%.

Juvenile and adult Razorback Sucker abundance estimates were calculated using program MARK. Juvenile abundance was estimated to be 149 individuals with upper and lower 95% confidence intervals of 501 and 61 individuals respectively. Adult abundance was estimated to be 2987 individuals with upper and lower 95% confidence intervals ranging from 3384 to 2661 individuals respectively (Figure 6) MARK outputs are in Appendix I.

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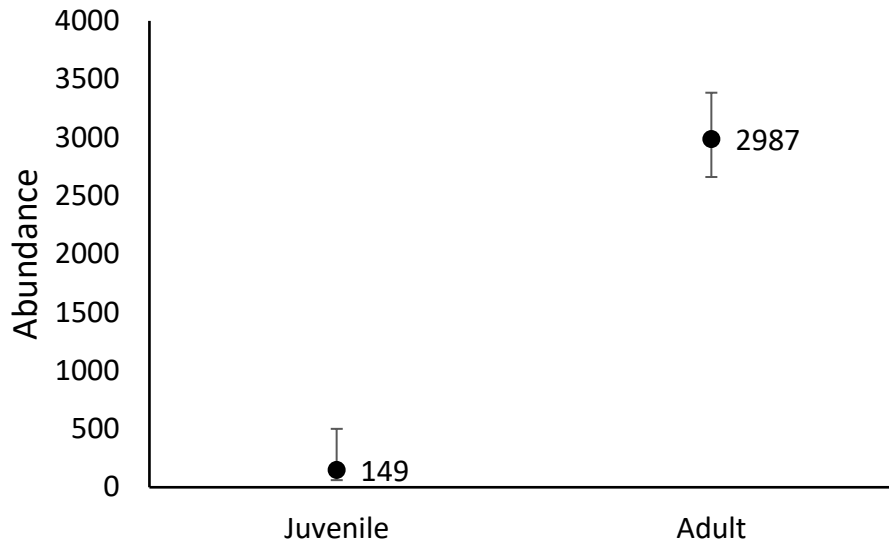


Figure 6. Age class specific abundance estimates for Razorback Sucker between San Juan River miles 147.9 to 76.0. Confidence intervals are 95%.

Additional noteworthy observations:

In addition to standard Demographic Monitoring efforts for which only endangered fish were to be captured, 23 Flannelmouth Suckers were captured as well. These fish ranged in size from 140mm TL to 240mm TL and were fin clipped for genetic analysis. These clips will be evaluated to assess the genetic purity of individuals to determine if hybridization is happening with native suckers and is failing to be documented in smaller size classes.

Razorback Sucker x Flannelmouth Sucker (herein, hybrids) were captured as well on all three passes totaling 62 individuals. These fish ranged in size from 217 to 524mm TL and were all fin clipped for genetic testing. Two of these fish were recaptured in subsequent passes during Demographic Monitoring and eight other fish recaptured from other efforts; six of which have come from age-1 Razorback Sucker Monitoring, one from non-native removal, and one from a previous years Demographic Monitoring.

Recommendations

We recommend continuing with Demographic Monitoring in FY22 as planned. Continue to use sampling methods as described in the original SOW to allow for comparative analyses from year to year. We also recommend continuing to sample hybrids and other rare fish other than the two targeted species (i.e., Colorado Pikeminnow and Razorback Sucker), so we can gain a better understanding of the hybridization patterns in the San Juan River.

Project Status:

Ongoing

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Literature Cited

Akaike, H. 1973. Information theory and an extension of the maximum likelihood principle. Pages 267–281 in B.N. Petrov and F. Csáki, editors. Proceedings of the Second International Symposium on Information Theory. Akadémiai Kiadó, Budapest, Hungary.

Ryden, D.W. 2006. Augmentation of Colorado Pikeminnow in the San Juan River: 2005. U.S. Fish and Wildlife Service Colorado River Fisheries Project. Grand Junction, CO. 20 pp.

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Appendix I

Output for Figure 3. Capture probabilities per pass for Colorado Pikeminnow with 95% Confidence Intervals

Pass	Age	Estimate	SE	LCI	UCI
1	2,3	0.02722	0.012829	0.01071	0.067444
2	2,3	0.047635	0.02134	0.019506	0.111707
3	2,3	0.077577	0.033785	0.032261	0.175033
1	4	0.060715	0.034692	0.019242	0.175577
2	4	0.042725	0.024989	0.013297	0.128782
3	4	0.042725	0.024989	0.013297	0.128782

Output for Figure 7. Age specific abundance estimates for Colorado Pikeminnow between San Juan River miles 147.9 to 76.0. Vertical Lines represent 95% confidence intervals.

Age	Estimate	Standard			CV
		Error	LCI	UCI	
2	570.2249	238.9654	279.1215	1293.414	0.419072
3	164.5284	73.91862	77.34167	394.2215	0.449276
4	444.7016	240.1808	185.6888	1246.105	0.540094

Output for Figure 6. Age class specific capture probabilities for three sampling passes on the San Juan River between river miles 147.9 and 76.0. Age classes are separated into juvenile and adult age class. Confidence intervals are 95%.

Pass	Age	Estimate	SE	LCI	UCI
1	Juvenile	0.066962	0.047049	0.016139	0.238965
2	Juvenile	0.026785	0.021489	0.00544	0.121638
3	Juvenile	0.133924	0.089205	0.033115	0.411129
1	Adult	0.109459	0.008829	0.093315	0.128002
2	Adult	0.114815	0.009159	0.098047	0.134024
3	Adult	0.212893	0.015085	0.184821	0.243953

Output for Figure 7. Age class specific abundance estimates for Razorback Sucker between San Juan River miles 147.9 to 76.0. Confidence intervals are 95%.

Age	Estimate	SE	LCI	UCI	CV
Juvenile	149.3381	94.49223	61.35053	501.0963	0.63274
Adult	2987.417	183.7494	2660.824	3383.87	0.061508