

**Documenting the occurrence, spatial distribution, and incidence of introgression in wild
age-1 Razorback Sucker in the San Juan River 2020**

Principal Investigator:

Benjamin Schleicher
U.S. Fish and Wildlife Service
Grand Junction Fish and Wildlife Conservation Office
445 West Gunnison Ave, Suite 140
Grand Junction, Colorado 81501
(970) 628-7205
benjamin_schleicher@fws.gov

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Introduction

A surprisingly high level of Razorback Sucker recruitment was observed in the San Juan River from fish spawned in 2018 and that overwintered into 2019. In 2018, a total of 199 wild juvenile Razorback Sucker was collected by ASIR, KSU, UDWR, and NMFWCO during the summer, and it was the first time the small-bodied monitoring crew (NMDGF) collected wild juveniles in the fall ($n = 6$). Whereas, larval Razorback Sucker were collected as high as River Mile (RM) 180.0 (Farrington per. com.), the vast majority of the wild juvenile fish (87%) were collected between RMs 120.0-50.0, potentially due to the higher level of sampling that occurred in this reach. In the spring of 2019, a single pass sampling effort from RM 149.9-3.0 collected an additional wild 45 age-1 Razorback Suckers between RMs 119.0-17.0, documenting overwinter survival of this cohort. Because the observed reproductive success of the wild Razorback Sucker cohort in 2018-2019 was unprecedented in the San Juan River, many questions remain about environmental causes of this strong year-class, current levels of natural annual recruitment, and the reproductive ecology of the species, in general, in this repatriated system.

While it is rare for populations of Razorback Sucker anywhere to demonstrate natural recruitment past the larval stage, factors that led to successful recruitment in the San Juan River remain elusive. Overwinter survival of wild-spawned age-0 Razorback Sucker have been detected in Lake Mead as well as intermittently in the upper Colorado River Basin both on the Colorado and Green Rivers, however, never at levels observed in the San Juan River in 2018-2019. Because several management activities occurred concurrently in 2018 (e.g., transplanting Razorbacks Sucker adults over the waterfall and increased passage rates at PNM weir) as well as 2018 being an extremely low water year, it is difficult to identify a single cause of this reproductive success. The collection of wild age-1 fish in the spring of 2019 indicated this size of Razorback Sucker are susceptible to capture by electrofishing rafts, are distinguishable from similar-sized Flannelmouth Sucker (although only with close scrutiny), and that they were present in some, but not all reaches of the river. The current water year (2019) has an extremely high spring runoff and is in sharp contrast to the low water year of 2018. While it is unclear what level of reproductive success will be observed in 2019, we think it is imperative to attempt to collect wild age-1 Razorback Sucker to further aid our understanding of natural recruitment in the system and how reproductive success may relate to the river's hydrology.

We think it is important to sample wild age-1 Razorback Suckers in the spring before any potential snow-melt driven runoff may cause actual or apparent mortality through fish movement and emigration. Additionally, in order to track the relative abundance and lifespan of these individuals, biologists will need to implant PIT tags into as many of these fish as possible. However, based on the growth rates of wild fish we observed in 2018, our 'window' may be relatively short to tag known wild fish before they breach the 300 mm TL size limit of our stocked fish. For example, the average size of wild age-0 fish in fall 2018 was nearly 150 mm TL. If they experience similar growth rates next summer (~ 1 mm/day), these wild fish could easily be >300 mm TL by fall 2019. Wild age-1 fish captured in spring 2019 exhibited little overwinter growth, but to date, there are no subsequent recapture data of these fish to assess growth of age-1 Razorback Sucker through their second summer of life. We will need a much better understanding of the growth rate of these fish if we are to assess the ability of our current sampling periodicity to discern wild from hatchery Razorback Sucker.

While we were confident wild age-1 Razorback Sucker were positively identified during the spring trip in 2019, identification required very close inspection as some of the smaller individuals looked very similar to age-1 Flannelmouth Sucker. Indeed, some field personnel even suggested a few individuals might be Razorback Sucker X Flannelmouth Sucker hybrids due to their intermediate appearance. We propose that a

genetic assessment is needed to quantify any putative hybridization as well as a more definitive check on identified Razorback Sucker of this size. We proposed to photograph and fin clip every Razorback Sucker <300 mm for genetic analyses using single nucleotide polymorphisms (SNPs) obtained using next-generation sequencing. These analyses should allow for the identification of purebred Razorback Sucker and Flannelmouth Sucker as well as any F₁ or F₂ crosses. These samples can be added to the already planned larval Razorback Sucker parental assignment analyses at the Southwestern Native ARRC from the KSU translocation scope of work.

Finally, we know relatively little about the occurrence and spatial distribution of wild juvenile age-1 Razorback Suckers in the San Juan River because there have not been dedicated efforts targeting them in the spring when their smaller size would distinguish them from hatchery stock. While 2018 was a low water year, it still is not clear if a typical or above average water year will produce age-1 fish, largely because we have not been sampling during this springtime period. Therefore, a sampling pass that covers nearly the entire river would lend insight to the spatial distribution of juveniles and assess the likelihood that there is more wild recruitment than we have been aware, as well as help identify reaches of the river that may be more conducive to recruitment.

Based on our reasoning above, we propose a sampling trip in 2020, similar to the 2019 spring trip, aimed at addressing the following questions:

1. At what level is the Razorback Sucker population in the San Juan River experiencing annual, age-1 recruitment?
 - Assessing incidence of overwinter recruitment, regardless of water year, would inform the potential time-frame to recovery in the San Juan River as well as other management actions.
2. What is the size variation of wild age-1 Razorback Sucker in the spring and what is the likelihood individuals will be >300 mm TL by fall?
 - Our capacity to track the success of wild cohorts will rest on our ability to identify wild fish, especially when they surpass 300 mm TL.
 - If age-1 wild fish will likely be >300 mm TL by late summer or fall, the Program may need to shift sampling temporally to increase the number of tagged ‘known’ wild fish.
3. Does the spatial distribution of wild age-1 Razorback Sucker indicate spatial variation in recruitment success?
 - Gaining insights into reaches of the river that support wild age-1 Razorback Sucker would potentially lend insight into habitat requirements of wild fish.
4. Are putative wild age-1 Razorback Sucker purebred in origin?
 - Assessing levels of any potential hybridization and introgression should be a first step in assuring these recruits will provide for biologically viable and self-sustaining population of Razorback Sucker in the San Juan River.
 - Matching photographs of individuals with their genetic evaluation and assignment will help field crews increase their ability to recognize age-1 Razorback Sucker.

Methods

To address the questions above, the methods in this SOW are similar to the SOW for Wild Age-1 Razorback

Sucker Monitoring in 2019. Specifically, we propose to conduct a single pass (two electrofishing rafts) in the spring (March or April) 2020 between Shiprock, NM and Clay Hills, UT (RM 147.9-2.9). Each river mile will serve as a sample unit. Due to the apparent difficulty in distinguishing age-1 Razorback Sucker and Flannelmouth Sucker, all sucker individuals <300 mm TL will be netted and closely examined. To help keep catch rates of endangered fishes as high as possible, Razorback Sucker <300 mm TL and all size/age classes of Colorado Pikeminnow will be netted, based on evidence that the cooler water will minimize the stress on the smaller size classes of Colorado Pikeminnow (Clark et al. 2018). Endangered fish (>130 mm TL Razorback Sucker and Colorado Pikeminnow) without a PIT tag will be implanted with one, and all relevant biological data will be recorded for each individual. All Razorback Suckers <300 mm TL will be photographed and have a small fin clip taken to assess their genetic status, which will follow the molecular methods outlined in the KSU translocation scope of work. All fish will then be returned to their river mile of capture.

Deliverables

A draft report will be submitted to the Program Office by 31 March 2020 and a final report will be completed at the end of the three year study period. All data will be submitted to the Program Office by 31 December 2020.

Budget

Age-1 Razorback Sucker monitoring

Personnel/Labor Costs (Federal Salary + Benefits)

Description	Rate/HR	TOTAL
Principal Biologist (GS-11/7) – 141 hours		\$7,591.44
(1 person X 14 days/trip X 1 trip – hotel and camp)	\$53.84	
(+ 61 hours overtime each)	\$53.84	
Bio. Tech. Crew Leader (GS-6/3) - 165 hours		\$5,534.82
(1 person X 14 days/trip X 1 trip – hotel and camp)	\$27.74	
(+ 69 hours overtime each)	\$41.62	
Biological Technicians (GS-5/1) – 495 hours		\$28,536.30
(3 people X 14 days/trip X 1 trip – hotel and camp)	\$23.40	
(+ 69 hours overtime each)	\$35.10	
PERSONNEL/LABOR TOTAL		\$41,662.56

Permitting; Coordination; Data Input, Analysis, Management & Presentation; Report Writing; Office & Administrative Support (Federal Salary + Benefits)

Description	Rate/HR	TOTAL
Administrative Officer (GS-9/8) – 24 hours	\$42.98	\$1,031.52
Principal Biologist (GS-11/7) – 24 hours	\$53.84	\$3,445.76
Project Leader (GS-14/6) – 16 hours	\$82.57	\$1,321.12
PERMITTING, DATA INPUT, ETC		\$5,798.40

Travel and Per Diem (Based on Published FY-2017 Federal Per Diem Rates)

Description	RATE	TOTAL
Hotel Costs		
1 night (in Cortez, CO)	\$94.00	\$470.00
Per Diem (Hotel Rate)		
1 day X 5 people (in Cortez, CO)	\$61.00	\$305.00
camp rate	\$36.00	\$2,340.00
TRAVEL/PER DIEM TOTAL		\$3,115.00

Equipment and Supplies

Vehicle Maintenance & Gasoline (@ \$365/month lease = \$12.17 per day based on 30 days in an “average” month + \$0.43/mile)

Description	Mileage Rate	TOTAL
Vehicle Mileage		
San Juan River sampling - spring:		
GJ to Cortez to Shiprock to Clay Hills to GJ	\$0.43	\$858.14
VEHICLE LEASE		
San Juan River sampling - spring:		
GJ to Cortez to Shiprock to Clay Hills to GJ	\$12.35	\$518.81
Generator Gasoline		
San Juan River sampling - spring: 2.5 Gallons/day	\$3.00	\$195.00
Shuttle Services (Shiprock to Clay Hills)	\$400.00	\$1,200.00
Vehicle Maint. & Gasoline		\$2,771.95

Description	TOTAL
Genetic analysis at Southwestern Native Aquatic Resource and Recovery Center (SNARRC) for a maximum of 100 samples	\$5,000.00

Exact use of the money in this section of the budget will vary from year to year depending on what equipment needs to be maintained, repaired, or replaced, but use of these funds for a “typical” field season for one study **COULD** include the following:

Raft trailer maintenance	
Annual trailer maintenance & safety inspection	\$788.20
Replace/repair trailer suspension, trailer lights, winch handle/straps/gears, trailer jack stand, wheel bearings	
Replace trailer tires – 2 per year @ \$77 each	\$154.00
Signal light pigtail adapters – 2 @ \$15 each	\$30.00
Generator maintenance	
Spark plugs for generators – 5 at \$2.20 each	\$11.00
Synthetic oil for generators - 5 quarts at \$6.30 each	\$31.50
Generator repair/tune-up - 9 hrs @ \$70/hr = parts	\$703.79
Sampling gear (needs to be regularly replaced)	
Hip boots – 2 pair at \$75/pair	\$150.00
Breathable chest waders - 2 pair @ \$120/pair	\$240.00
NRS Type IV life jackets – 2 @ \$130 each	\$260.00
Electrical Gloves - 3 pairs @ \$75/pair	\$225.00
Dura-Frame electrofishing dip nets – 1 @ \$630 each + fr	\$630.00
Raft frame &/or boat hull repair	
Aluminum welding – 7 hours @ \$95/hr	\$665.00
Raft repair kits	
Raft glue (urethane/hypalon) – Four 4-oz. cans @ \$24.9	\$100.00
NRS raft patch material – 5 feet @ \$37/ft	\$185.00
Toluene – 1 qt @ \$17.95/qt	\$18.00
Equipment tie-downs - NRS HD-brand tie-down straps, each boat needs:	
Ten 2-ft straps - 10 @ \$4.20 each	\$42.00
Five 3-ft straps - 5 @ \$4.30 each	\$21.50
Ten 4-ft straps - 10 @ \$4.70 each	\$47.00
Five 6-ft straps 5 @ \$5.05 each	\$25.25
Five 9-ft straps 5 @ \$5.70 each	\$28.50
Five 12-ft straps 5 @ \$6.15 each	\$30.75
Raft rigging materials, each boat needs:	
D-style carabiners - 10 @ \$8.25 each	\$82.50
Mesh rig bag – 1 @ \$50 each	\$50.00
Yeti 125-quart coolers – 1 @ \$500 each	\$550.00
5-gallon plastic gasoline jerry cans – 5 @ \$40 each	\$200.00
20 lb. propane tanks – 1 @ \$55 each	\$55.00
Eddy Out Aluminum Dry Box (36L x 16H x 16D) - 1 at \$3	\$375.00
Cans for 1st aid & tool kits, raft repair kits, etc. - 20 @ \$1	\$380.00
Rafting oars, oar blades, and oar rowing sleeves	
Carlisle 10-foot oar shafts – 2 @ \$100 each	\$200.00
Carlisle Oars blades – 4 @ \$65 each	\$260.00
Oar sleeves – 4 @ \$18 each	\$72.00
Camping Gear	
NRS Canyon Dry Box (kitchen cook kit storage) - 1 at \$1	\$165.00
NRS campsite counter (18"W X 68" L X 40" H) - 1 at \$299	\$299.95
Roll-A-Table (32" X 32" table, 27" legs) - 2 at \$99.95 eac	\$199.90
2-man tent (1/person), ~ 1 year life-span - 6 at \$99.99 e	\$599.94
Partner Steel 16" 4-burner camp stove - 1 at \$359.00	\$359.00
River bags	
NRS 3.8 heavy-duty Bill's Bag 110L – 1 @ \$160 each	\$160.00
NRS Tuff Sacks 25L - 5 @ \$ 35 each	\$175.00

Pesola brand spring scales	
# 20010 Micro-Line 10 gram – 1 @ \$68.75	\$68.75
# 20030 Micro-Line 30 gram – 1 @ \$61.60	\$61.60
# 20100 Micro-Line 100 gram – 1 @ \$61.60	\$61.60
# 40300 Medio-Line 300 gram – 1 @ \$73.15	\$73.15
# 40600 Medio-Line 600 gram – 1 @ \$73.15	\$73.15
# 42500 Medio-Line 2,500 gram – 1 @ \$71.45	\$71.45
# 41002 Medio-Line 1,000 gram – 1 @ \$73.15	\$73.15
# 80005 Macro-Line 5 kg – 1 @ \$150.15	\$150.15
# 80010 Macro-Line 10 kg – 1 @ \$155.65	\$155.65
NRS E-160 Self-Bailing Raft - 1 at \$6,125.00	\$6,125.00

Equipment Maintenance, Repair, & Replacement Subtotal \$15,483.43

Requested 2020 Equipment

6% of Personnel, Permitting, Travel, and Vehicle Maint. \$3,200.87

Other potential uses for these same funds include replacing hand tools (ratchet and sockets, screw drivers, vise grips, pliers, Allen wrenches, crescent wrenches, hammer, etc.), WD-40, bailing wire, duct tape, electrical supplies (12 and 14 gage wire for the boats, junction boxes, extra male & female plugs, wire nuts, fuses, Ohm meter, electrical tape), batteries (C, AA and AAA), lanterns, lantern mantles, small “pony” propane bottles for lanterns, Gott 5-gallon water jugs, shovels, 5-gallon buckets, cargo nets, fix chips or cracks in vehicle windshields, bulbs, lenses, and wiring to fix trailer lights and pigtales, new electrofishing spheres, wire rope for replacing stainless steel electrofishing cathodes, camping kitchen gear (anodized dutch ovens X 2, plates, cups, bowls silverware, pots, pans, griddle), data books, pre-printed Rite-In-The-Rain data sheets, pencils, repair/replace river maps, etc.

	TOTAL
USFWS-GJFWCO Total	\$56,548.78
USFWS R6 Admin Overhead (3.00%)	\$1,696.46
SNARRC Genetic Analysis	\$5,000.00
USFWS Region 6 Total	\$63,245.25