

*FISCAL YEAR 2018  
ANNUAL BUDGET AND  
WORK PLAN*



*Approved August 1, 2017*

SJRRIP FY2018 AWP Budget Estimate (Approved August 1, 2017)								FCPP Available Funding and Balance
SOW	Title	Agency	2018 Hydropower Revenue	BOR Capital Funding	Partner In-Kind Funding	FCPP Funded Projects	2018 Grand Totals	
<b>Element 1 - Management and Augmentation of Populations and Protection of Genetic Integrity</b>								<b>\$40,600</b>
7	Horsethief Canyon Ponds O&M at Ouray NFH	FWS, GJ	\$38,140				\$38,140	
8	Stocking & Acclimation of Age-0 CPM & Age-1+ RBS	FWS, ABQ	\$30,746				\$30,746	
9	Colorado Pikeminnow Fingerling Production (combined with 10)	FWS, SNARRC	\$111,877				\$111,877	
10	Rearing Razorback Suckers (combined with 9)	FWS, SNARRC	\$88,674				\$88,674	
11	RBS Augmentation/NAPI Pond Management	NN, FWS	\$134,832				\$134,832	
12	SJRIP PIT Tags (purchase)	BR	\$19,400			\$40,600	\$60,000	
<b>Subtotal</b>			<b>\$423,669</b>	<b>\$0</b>	<b>\$0</b>	<b>\$40,600</b>	<b>\$464,269</b>	<b>\$0</b>
<b>Element 2 - Protection, Management, and Augmentation of Habitat</b>								<b>\$153,045</b>
13	Maintenance and Operation of SJR Hydrology Model	BR, SLC	\$82,160				\$82,160	
14	Stream Gaging and Flow Measurements	BR, USGS	\$8,500				\$8,500	
15	Operation of PNM Fish Passage Structure	NN	\$112,779				\$112,779	
16	San Juan and Animas Rivers Temp Gauges	BR	\$22,000				\$22,000	
C-1	Capital Projects Management	BR		\$50,000			\$50,000	
C-2	Repair of Capital Projects (e.g., fish passage, fish weir) <sup>1</sup>	PNM				\$50,000	\$50,000	
C-3	Fruitland Diversion Dam Fish Passage and Screens <sup>2</sup>	NN		\$972,000			\$972,000	
FCPP	Habitat Assessment	ERI	\$0			\$82,184	\$82,184	
FCPP	SJR Habitat Restoration Phase III <sup>3</sup>	TNC/NN		\$350,000			\$350,000	
<b>Subtotal</b>			<b>\$225,439</b>	<b>\$1,372,000</b>	<b>\$0</b>	<b>\$132,184</b>	<b>\$1,729,623</b>	<b>\$20,861</b>
<b>Element 3 - Management of Non-Native Aquatic Species</b>								<b>\$50,361</b>
17	SJR Nonnative Species Monitoring and Control <sup>1</sup>	FWS, UDWR	\$499,160			\$50,361	\$549,521	
<b>Subtotal</b>			<b>\$499,160</b>	<b>\$0</b>	<b>\$0</b>	<b>\$50,361</b>	<b>\$549,521</b>	<b>\$0</b>
<b>Element 4 - Monitoring and Evaluation of Fish and Habitat in Support of Recovery Actions</b>								<b>\$103,463</b>
18	UCR and SJR Centralized PIT tag database	CSU CNHP	\$15,000				\$15,000	
19	Sub-Adult/Adult Lg-Bodied Fish Monitoring	FWS, GJ	\$135,579				\$135,579	
20	YOY/Small-Bodied Fish Monitoring	NMDGF	\$96,274		\$40,000		\$136,274	
21	RBS/CPM Larval Surveys (Combined SOW)	ASIR	\$248,099				\$248,099	
21a	RBS/CPM Larval Surveys -Upstream Expansion of Study Area	ASIR	\$34,142				\$34,142	
22	Specimen Curation/Identification	UNM	\$51,881				\$51,881	

23	Integration of Long-term Monitoring Data	UNM	\$100,428				\$100,428	
26	SJR Catfish Diet Study (2 -yr. study)	KSU	\$32,565			\$65,853	\$98,418	
27	Growth rates larval Razorback Sucker in the SJR (1-yr study)	ASIR	\$74,812				\$74,812	
28	CPM Calcein Mark Interactions (3-year study)	NMDGF, FWS	\$55,280				\$55,280	
30	Razorback suckers in SJR-Lake Powell complex (4-yr project)	KSU	\$106,462				\$106,462	
32	PIT Tag Antennas O&M & Evaluation of Data	BR, FWS	\$10,899			\$38,351	\$49,250	
34	2018 Nonnative Control Program Assessment Workshop	BR, FWS	\$0				\$0	
	<b>Subtotal</b>		<b>\$961,421</b>	<b>\$0</b>	<b>\$40,000</b>	<b>\$104,204</b>	<b>\$1,105,625</b>	<b>(\$741)</b>
<b>Element 5 - Program Coordination and Assessment of Progress Toward Recovery</b>								<b>\$126,000</b>
35	Base Funds and Contract Management BR	BR, SLC	\$223,255				\$223,255	
36	Peer Review <sup>3</sup>	BR, FWS	\$60,000				\$60,000	
37	Program Management FWS	FWS, ABQ	\$316,561		\$200,424		\$516,985	
38	Remote Biologist	FWS, NMFWCO	\$38,351				\$38,351	
FCPP	SJRRIP Biologist (FCPP/NMEP)	FWS	\$0			\$126,000	\$126,000	
	<b>Subtotal</b>		<b>\$638,167</b>	<b>\$0</b>	<b>\$200,424</b>	<b>\$126,000</b>	<b>\$964,591</b>	<b>\$0</b>
<b>Element 6 - Information and Education</b>								
39	Education and Outreach (funds transfer to UCRRIP)	FWS, ABQ	\$17,100				\$17,100	
	<b>Subtotal</b>		<b>\$17,100</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$17,100</b>	
	<b>SJRRIP Total</b>		<b>\$2,764,956</b>	<b>\$1,372,000</b>	<b>\$240,424</b>	<b>\$453,349</b>	<b>\$4,830,729</b>	<b>\$20,120</b>
	Estimated Base Funds (2017 Amt. x 0% CPI)/FCPP Funds		\$2,764,956			\$473,469		
	Hydropower Revenue-Funded Projects		\$2,764,956			\$453,349		
	Carry over from FY2017							
	Estimated available 2018 funds to expenditures		\$0			\$20,120		
<b>Notes</b>								
<sup>1</sup> Placeholder; <sup>2</sup> Reclamation capital funds or state capital NFWF funds; <sup>3</sup> Cost estimate								

**Rearing Endangered Fish at the  
Horsethief Canyon Native Fish Facility Ponds  
for Stocking into the San Juan River  
Draft Fiscal Year FY-2018 Project Proposal  
Updated: 4 May 2017**

Principal Investigators:

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Current Contract or Agreement number(s):  
R13PG40052 for USFWS – Grand Junction, CO

Reporting Dates: 10/1/2017 through 9/30/2018

**Rearing Endangered Fish at the Horsethief Canyon Native  
Fish Facility Ponds for Stocking into the San Juan River  
Fiscal Year 2018 Project Proposal  
1 March 2017**

Principal Investigator: Dale Ryden, Thad Bingham & Brian Scheer  
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## **Introduction**

Along with workplan 11, “Razorback Sucker Augmentation/NAPI Pond Management,” this workplan is intended to supply the San Juan River Basin Recovery Implementation Program (SJRBRIP) with a reliable source of endangered Razorback Sucker (*Xyrauchen texanus*) with which to help restore a self-sustaining population via annual fall stocking events.

The Ouray National Fish Hatchery – Grand Valley Unit (NFH-GVU) consists of several distinct facilities located in and around Grand Junction, CO. One of these facilities is the Horsethief Canyon Native Fish Facility (HCNFF) pond complex (about 7½ miles west of the main hatchery building) near Fruita, CO. The other facility used for this workplan is the 24-Road Hatchery, an intensive water reuse hatchery building, utilizing a municipal water source, thus insuring good water quality, clarity, and freedom from parasites.

The HCNFF consists of 22 ponds, ranging in size from 0.1 to 0.5 surface acres, with a total surface acreage for the entire facility of 6.2 acres. Each pond is 5-6 feet deep and is equipped with a fabric liner to prevent seepage. Each pond also has a concrete kettle and drain structure to facilitate draining and concentrating of fish for ease of harvest. This facility is a multi-species broodstock, production, and rearing facility dedicated to rearing the three endangered Colorado River fishes: Razorback Sucker, Humpback Chub (*Gila cypha*), and Bonytail (*Gila elegans*).

Until 2012, the operation and maintenance (O&M) of the entire Ouray NFH-GVU complex (Project 29a: Operation and Maintenance of Ouray National Fish Hatchery – Grand Valley Unit) was funded by Upper Colorado River Endangered Fish Recovery Program (UCREFRP). On 25 March 2010, the Coordination Committee of the SJRBRIP voted to cost-share 1/6 of the operation and maintenance costs for the HCNFF pond complex. This equates to a total of one surface acre of pond rearing and production space (either two 0.5 acre ponds, or four 0.25 acre ponds).

## **Methods**

Currently, the one surface acre of grow-out ponds allotted to the SJRBRIP is being used to rear Razorback Sucker that are progeny of 15-20 paired matings of appropriate genetic lineage, produced annually from Razorback Sucker broodstock being held at HCNFF. Spawning takes place at the HCNFF each spring around mid-April, depending upon ambient water temperatures. After spawning, fertilized eggs are transported to the 24-Road Hatchery building where they are reared in flow-through egg jars until they hatch into larvae. Several weeks after spawning, larval Razorback Sucker are then stocked back out into grow-out ponds at HCNFF for the remainder of their age-0 growing season. At the end of their age-0 growing season, the Razorback Sucker grow-out ponds are drained and the young fish are transported back into the 24-Road hatchery building where they continue to be fed and reared in a warm,

climate-controlled, indoor environment overwinter, thus allowing fish to continue grow even during the coldest months of the year.

Several months after they have been brought back into the hatchery, young Razorback Sucker are implanted with PIT tags. This usually happens at 100-200 mm TL. PIT-tagging young Razorback Sucker several months after they are transferred to the hatchery building (i.e., after they have settled down from being moved into the hatchery building from the HCNFF grow-out ponds) helps reduce stress on these animals and allows them to have abundant time to heal in the hatchery building after being PIT-tagged, but prior to being stocked back into the HCNFF grow-out ponds for their age-1 growing season (which usually happens in late March). Prior to being PIT-tagged, fish are taken off of feed for 48 hours and aren't fed again for at least 24 hours after PIT-tagging. This helps reduce stress as well as allowing the fish's intestinal tract to empty and retract, thus reducing the possibility of accidentally puncturing an intestine during implantation of a PIT tag. After PIT-tagging, fish are monitored in circular hatchery tanks for both PIT tag loss and delayed mortality (both tag loss and mortality due to PIT-tagging are very low; < 0.5% annually).

During the spring of their age-1 year these Razorback Sucker, now about 200 mm TL, are released back into the grow-out ponds. They are not handled again until the fall of that same year. When ponds are harvested, every individual Razorback Sucker is measured (a subset are also weighed) and scanned for a PIT tag. This happens at the end of the age-1 growing season (October/November), just prior to stocking. Harvest operations consist of taking fish off of feed 48 hours before harvest, draining grow-out ponds and passively gathering fish into the concrete kettles as the pond drains, anesthetizing fish (using MS-222), measuring fish (all fish), weigh fish (a subset of fish from each pond; minimum of 50 fish per pond), and checking fish for PIT tags. If a PIT tag is found to be missing at this point (which is very rare), then a new PIT tag is implanted prior to the fish being loaded for transport and stocking into the San Juan River. Fish are lifted from grow-out ponds to the stocking truck using a Palfinger brand boom crane with an attached fish basket. They are then transported to the appropriate stocking site, tempered following appropriate USFWS protocols, and stocked as either a hard- or soft-release, as per directions from the SJRBRIP and the U. S. Fish and Wildlife Service's New Mexico Fish and Wildlife Conservation Office (NMFWCO).

Daily operation and maintenance of the HCNFF ponds and the 24-Road hatchery includes regularly checking and making appropriate adjustments to water quality (dissolved oxygen, pH, nitrates/nitrites, etc.), maintenance, cleaning, and replacement of air distribution systems (air stones, air pads, oxygen cylinders), calculating proper feed ratios and distributing proper types and sizes of feed based on fish life stage, size, and pond/tank densities, cleaning of fish ponds/tanks, checking fish for diseases and applying appropriate treatments for sick/infected fish when necessary, maintenance of pumps, filters (e.g., fluidized sand, drum, UV), and air distribution systems, maintenance of vehicles, equipment and grounds, scheduling and performing USFWS and state-mandated annual fish health inspections and Aquatic Invasive Species inspections, applying for and obtaining state fish importation permits, collection and QA/QC of PIT tag database files, submission of data files to the SJRBRIP, preparation of annual reports, etc.

### **Products/Deliverables**

PIT tag files will include all Razorback Sucker handled and scanned at time of pond harvest (including all fish that were re-tagged), immediately prior to stocking. Following QA/QC of the data, this file is submitted the SJRBRIP and the NMFWCO. While the SJRBRIP has requested Razorback Sucker that are  $\geq 300$  mm TL, they are actually getting age-1 fish that are meeting the Upper Colorado River Basin's minimum size requirements of  $\geq 350$  mm TL. The mean stocking size for most lots of Razorback Sucker sent to the San Juan River is closer to 365-375 mm TL.

It is anticipated that 2,000-4,000 Razorback Sucker ( $\geq 300$  mm TL) can be reared in the one surface acre of ponds allotted to the SJRBRIP. Razorback Sucker of the appropriate target stocking size will be made available to the SJRBRIP in October/November of each calendar year for stocking (after the annual fall fish community monitoring studies are completed). All stockings of Razorback Sucker will be coordinated with personnel from the SJRBRIP office and the NMFWCO.

### **Changes in Future Management Strategies for HCNFF**

The SJRBRIP will have the option to change the management approach and species being reared in their one surface acre of pond space as they see fit, but will need to coordinate such changes with Ouray NFH-GVU hatchery staff, allowing enough lead time to prepare for changes in importation/exportation permitting, purchasing of feed proper for the sizes and species of fish being reared, etc. Changes in numbers or sizes of fish desired, species being reared, etc. may lead to adjustments in future years' budgets. For instance, if the SJRBRIP decides to rear Colorado Pikeminnow (a species not currently being held on station at Ouray NFH-GVU), appropriate lead time will be needed to arrange attaining young fish from another facility.

### **Cost Share with Upper Colorado River Endangered Fish Recovery Program**

The SJRBRIP's Coordination Committee voted to cost-share 1/6 of the O&M costs for the HCNFF pond complex. However, the O&M of the HCNFF ponds is in reality part of a much larger picture of the overall O&M of the Ouray NFH-GVU itself. So, the following staffing breakdowns were used to determine the overall O&M of the entire Ouray NFH-GVU:

- 1) 24-Road Hatchery building will require 100% staffing for 6 months of the year
- 2) 24-Road Hatchery building will require 50% staffing for the other 6 months of the year
- 3) Peter's ponds complex, Horsethief SWA ponds & lease-free grow-out ponds will require 10 % staffing for 6 months of the year
- 4) The HCNFF ponds will require 40% staffing for 6 months of the year
  - a. One-sixth of the O&M of the HCNFF ponds will be paid for by the SJRBRIP

So, for areas where there are shared costs at the HCNFF ponds, an example of a \$100 cost/year to the UCREFRP, would cost the SJRBRIP:

- \$100 (full year cost) X .50 (the 1/2 year that the HCNFF ponds operate) = \$50
- \$50 (the 1/2 year that the HCNFF ponds operate) X .40 (40% staffing) = \$20
- \$20 (1/2 year at 40% staffing) X 0.167 (1/6 cost to SJRBRIP) = \$3.34

So, the dollar cost to SJRBRIP is \$3.34 per \$100 (3.34%) of UCREFRP Project 29a. In other words, take the actual dollar cost to UCREFRP of Project 29a X 0.0334 for all shared costs.

**NOTE:** There are also costs included in the budget that are unique to the SJRBRIP alone. These costs will not be prorated, but charged at 100% rate to the SJRBRIP (see budget for details).

### **Possible Outyear Cost Adjustments**

If the SJRBRIP decides to change stocking strategies (species, sizes, times of year at which fish are being stocked, etc.) outyear budgets may need to be adjusted to account for this. The costs presented in this workplan represent the best estimates we can develop, based on the species, numbers, and timing of fish to be stocked from our facility to the San Juan River.

## **FY-2018 Budget:**

(Based on an anticipated FY-2018 costs)

### **Costs Shared by UCREFRP and SJRBRIP (i.e. O&M Costs)**

#### **Personnel/Labor Costs (Federal Salary + Benefits)**

	<b>UCREFRP Project 29a</b>	<b>SJRBRIP Cost</b>
Principal Biologists (GS-11) – 1,960 hours @ \$56.27/hr X 2 people (130 total hours covered by SJRBRIP or 65 hr/person)	220,578	7,367
Biological Technician (GS-7) – 1,960 hours @ \$35.75/hr (65 total hours covered by SJRBRIP)	70,070	2,340
Biological Technicians (GS-5) – 600 hours @ \$26.48/hr X 2 people (40 total hours covered by SJRBRIP or 20 hr/person)	31,776	1,061
Overtime:		
Biological Technician (GS-7) – 120 hours overtime @ \$53.63/hr (4 total hours of overtime hours covered by SJRBRIP)	6,436	215
Biological Technician (GS-5) – 40 hours @ \$39.72/hr X 2 people (2.7 total hours covered by SJRBRIP or 1.35 hr/person)	3,178	106
<b>Subtotal</b>	332,038	11,090

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

Project Leader (GS-14) – 320 hours @ \$88.50/hr (10.7 total hours covered by SJRBRIP)	28,320	946
Administrative Officer (GS-9) – 320 hours @ \$47.44/hr (10.7 total hours covered by SJRBRIP)	15,181	507
<b>Subtotal</b>	43,501	1,453

#### **In-Kind Services**

Bozeman Fish Technology Center		
Grind and sift fish food for larval Razorback Sucker	<\$2,898>	<97>

#### **Operations (Fish Food, Chemicals and Fertilizer, Hatchery Supplies, Vehicles and Fuel, Electricity)**

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##### **Fish Food (from Skretting USA)**

Actual costs = 4 orders of fish food per year (1 order per fiscal quarter) at \$18,350 each = \$73,400. The line items below represent one of our four orders (placed April 2016). This fish food order will last us 90 days. We have several different sizes of fish on station, thus the different sizes of food in each order.

Trout # 1 Crumble: 1,000 lbs @ \$1.18 per lb = \$1,180  
 Trout # 2 Crumble: 1,000 lbs @ \$1.17 per lb = \$1,170  
 1.0 mm RZ Grower 2,000 lbs @ \$1.00 per lb = \$2,000  
 2.0 mm RZ Grower 4,000 lbs @ \$1.00 per lb = \$4,000

3.0 mm RZ Grower 8,000 lbs @ \$1.00 per lb = \$8,000  
 4.0 mm RZ Grower 2,000 lbs @ \$1.00 per lb = \$2,000  
**Fish Food Subtotal** 73,400 2,452

#### Chemicals and Fertilizer

Exact use of the money in this line item will vary from year to year depending on specific chemical/fertilizer/herbicide needs in a particular year. It will also depend on if there are outbreaks of pathogens that need to be treated (e.g., "Ich") in a given year. Funds for a "typical" field season for one study would likely include the following:

Sodium Bicarbonate (pH increaser) = \$5,600

Eighty 50-lb bags @ \$70 per bag annually

Copper Sulfate = \$4,825

Ten 50-lb bags (pellets) @ \$95 each = \$950

50 gallons 10% solution @ \$77.50/gallon  
 = \$3,875

Spartan Sparquat 256 Germicidal Cleaner = \$300

10 gallons @ \$30 per gallon

Chloram-X (dechloriator) = \$1,440

Sixteen 10 lb buckets (4/case, 4 cases/year)  
 @ \$90/bucket

Finquel brand MS-222 anesthetic = \$900

Two 1 kg bottles @ \$450/bottle

Chloramine-T = \$880

Two 55-lb containers @ \$440 per container

Formalin (10% fixative) = \$2,100

Four 55-gallon drums @ \$275 each

Specialized Haz-Mat shipping @ \$1,000

Denatured ethyl alcohol = \$760

Eight 5-gallon jugs @ \$95 per jug

Distilled water = \$300

Ten 2-gallon jugs @ \$30 per jug

Stress Coat (slime coat replacement) = \$290

Two 5-gallon containers @ \$145 each

No-Foam De-Foamer = \$210

6 gallons @ \$35/gallon

Weed killer (2,4-D and Roundup) = \$3,200

2,4-D 40 quarts of concentrate @ \$35 each

Roundup 10 gallons concentrate @ \$180 each

Aquashade (water colorant) = \$3,000

50 gallons @ \$60 per gallon

Dimilin 25W (for anchor worm control) = \$5,000

Twenty 5 lb boxes @ \$250 per 5 lb box

**Chemicals and Fertilizer Subtotal** 28,805 962

#### Hatchery Supplies and Equipment Repair and Replacement

Exact use of the money in this line item will vary from year to year depending on specific equipment repair, replacement, or upgrade needs in a particular year. Funds for a "typical" field season for one study would likely include the following:

Egg hatching jars – Model J30 = \$455		
5 @ \$85/each		
24-hr belt feeder = \$2,700		
Repair/replace 10 annually @ \$270 each		
Waders = \$225		
Replace 3 pair annually @ \$75 each		
Duraframe dip nets = \$1,500		
Replace 5 annually @ \$300 each		
Digital scale repair, replace battery, recalibration = \$1,500		
(3 scales per year @ \$500 per service per scale)		
YSI brand water chemistry meters = \$2,000		
(dissolved oxygen, pH, salinity) – repair, replace, recalibrate annually		
HVAC service = \$1,200		
Done annually		
Service fish food cooler refrigeration unit = \$750		
Done annually		
Service the backup generator = \$700		
Done annually		
Pump & motor maintenance/service = \$5,700		
Labor & parts to rebuild:		
One portable water pump/year = \$1,700		
One hatchery motor/pump set/year = \$4,000		
Fluorescent hatchery lights = \$2,200		
Replace ½ of all hatchery lights annually		
Tank Cleaning Supplies = \$235		
Scotch-Brite pads, scrubbing handles		
Maintenance tool replacement = \$400		
Screwdrivers, crescent wrenches, monkey wrenches, vise grips, hammers, rubber mallets, ratchets & sockets, drills & drill bits, chop saw blades		
Plumbing supplies = \$2,000		
PVC pipe, couplers, primer & glue		
Refill compressed oxygen bottles = \$2,500		
50 per year @ \$50 each		
Air stones, tubing couplers, hose clamps = \$1,500		
0.4” air stones – 20 @ \$50 each = \$1,000		
Tubing, couplers, hose clamps = \$500		
Screens and pond boards = \$3,700		
10 screens @ \$300/screen		
PVC lumber for making screen frames		
Metal mesh for making screens		
Redwood pond boards		
100 boards (2” X 8” X 6’) @ \$7 each = \$700		
Koch rings = \$500		
For aerating water in packed columns		
Sand = \$2,000		
For sand filters - 1 pallet = twenty 80 lb bags		
<b>Hatchery Supplies Subtotal</b>	<b>31,765</b>	<b>1,061</b>

## Office Supplies

Staples, copier paper, pencils/pens, paperclips,  
note pads, cleaning supplies, toilet paper, paper  
towels, etc.

**Office Supplies Subtotal**      1,500      50

## Vehicles (maintenance &amp; repair) and fuel

Vehicles: GSA-lease rate (@ \$365/month lease = \$12.17 per  
day based on 30 days in an "average" month + \$0.33/mile)

Hatchery pickup truck = \$9,803

24-Road Hatchery Building to Horsethief Canyon Native  
Fish Facility ponds (45 mile round trip X 1 vehicle X  
365 days per year = 16,425 total miles per year)

## Fuel

Diesel fuel = \$350

For Kubota tractor – one 55-gallon drum of diesel @  
\$250 (includes fuel, barrel & delivery)

For back-up generator at hatchery – 25 gallons @  
\$4.00/gallon

Repair/replace shocks, struts, brakes = \$800

**Vehicles and Fuel Subtotal**      10,953      366

Electricity = \$6,800

For pump and spawning shed at the Horsethief State  
Wildlife Area brood ponds

8 months operation at \$850/month

**Electricity Subtotal**      6,800      227

**Operations Subtotal**      153,223      5,118

**Subtotal for All Shared Costs**      528,762      17,661

**Costs Unique to SJRBRIP (Harvest, PIT-Tagging & Stocking Costs)****Personnel/Labor Costs (Federal Salary + Benefits)****SJRBRIP  
Cost****Pond Harvest, PIT-Tagging, Stocking and Database Management**

Principal Biologist (GS-11) – 80 hours @ \$56.27/hr      4,502

(2 days X 2 people/day for fish harvest)

(6 days X 1 person/day for PIT-tagging)

Biological Technician (GS-7) – 136 hours @ \$35.75/hr      4,862

(2 days for fish harvest)

(6 days for PIT-tagging)

(5 days for database and records management)

(2 stocking trips X 2 days each X 1 person)

Biological Technician (GS-5) – 320 hours @ \$26.48/hr      8,474

(2 days X 3 people/day for fish harvest)

(6 days X 5 people/day for PIT-tagging)

(2 stocking trips X 2 days each X 1 person)

**Subtotal**      17,838

**Lodging and Per Diem (Based on Published FY-2017 GSA Per Diem Rates)**

Lodging		
2 nights lodging in Farmington, NM X 2 people at \$91.00/night =		364
Per Diem		
4 days hotel rate (Farmington, NM) X 2 people at \$51/day =		<u>408</u>
	<b>Subtotal</b>	<b>772</b>

**Fuel**

Stocking truck (gets 8 miles per gallon) X 2 trips from Grand Junction, CO to Farmington, NM (660 miles round trip) X 2 trips (= 1,320 total miles) = 170 gallons of gas at \$4.00/gallon		678
Water pump for tempering fish = 20 gallons gas at \$4.00/gallon		<u>80</u>
	<b>Subtotal</b>	<b>758</b>

**Subtotal for Costs Unique to SJRBRIP** 19,368

**Total of All Costs Incurred by SJRBRIP:**

<b>USFWS-CRFP (Grand Junction, CO) Total</b>	37,029
<b>USFWS Region 6 Administrative Overhead (3.00%)</b>	<u>1,111</u>
<b>USFWS Region 6 Total</b>	<b>38,140</b>

**Cost/Fish Comparison:**

Workplan total cost in FY-2018 = \$38,140

Estimated production in FY-2018 = 2,000-4,000 fish

For 2,000 Razorback Sucker produced, the cost/fish = \$19.07

For 3,000 Razorback Sucker produced, the cost/fish = \$12.71

For 4,000 Razorback Sucker produced, the cost/fish = \$ 9.54

**Augmentation of  
Age-0 Colorado pikeminnow and Age-1+ razorback sucker  
in the San Juan River  
Fiscal Year 2018 Project Proposal**

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Period of Performance: 10/1/2017 through 9/30/2018

## **Background**

Colorado Pikeminnow (*Ptychocheilus lucius*) and Razorback Sucker (*Xyrauchen texanus*) are federally-listed endangered fishes found in the San Juan River. The San Juan River Recovery Implementation Program (SJ RIP) was initiated in 1992 to protect and recover populations of both Colorado Pikeminnow and Razorback Sucker in the San Juan River Basin (Basin) while water development proceeds in compliance with all applicable federal, state, and tribal laws (SJ RIP 2014). Recovery of Colorado Pikeminnow, as listed in the recovery goals, is dependent on the maintenance of a wild population of at least 2,600 adults in the Green River subbasin and at least 700 adults in the Upper Colorado River subbasin, as well as a target of 1,000 age 5+ (>300 mm TL) in the San Juan River subbasin. Delisting criteria include a self-sustaining population that exceeds 800 adults maintained in the San Juan River subbasin. Razorback sucker recovery criteria are dependent on the establishment of four self-sustaining populations of 5,800 adult fish each; two populations in the Upper Colorado River Basin (one population in the Green River subbasin, the other in either the Colorado River or San Juan River subbasins) and two populations in the Lower Colorado River Basin (SJ RIP 2014).

Fish community monitoring during the SJ RIP's seven year research period, 1991-1997, identified few wild Colorado Pikeminnow inhabiting the San Juan River. This prompted investigation into the feasibility and implementation of augmenting the population with hatchery reared fish. As a result of these findings, an experimental stocking of Colorado Pikeminnow was conducted by Utah Department of Wildlife Resources in 1996 with the purposes of evaluating dispersal and retention of stocked Colorado Pikeminnow and determining the availability, use, and selection of habitats by early life stages of Colorado Pikeminnow (Ryden 2008). Stockings of larval, sub-adult, and adult fish after this initial stocking resulted in the subsequent recapture of stocked fish suggesting that Colorado Pikeminnow could survive in the San Juan River. In 2003, *An Augmentation Plan for Colorado Pikeminnow In The San Juan River* was finalized (Ryden 2003). This plan, and later amendments, called for the annual stocking of  $\geq 300,000$  age-0 and  $\geq 3,000$  age 1+ fish in the San Juan River until 2009. In early 2010 a revised plan, *Augmentation of Colorado Pikeminnow (Ptychocheilus lucius) in the San Juan River: Phase II, 2010-2020* (Furr 2010), was written to direct the continuation of stockings through 2020. Phase II augmentation reflects changes requested by the SJ RIP Biology Committee by discontinuing the stocking of Passive Integrated Transponder tagged age-1+ Colorado Pikeminnows in exchange for stocking increased numbers of age-0 fish ( $n \geq 400,000$ ).

Similarly, after the failure to collect any wild Razorback Sucker in the San Juan River during three years of intensive studies (1991-1993) the SJ RIP Biology Committee initiated an experimental stocking program for Razorback Sucker in the San Juan River (Ryden and Pfeifer 1994). Experimental stocking was implemented to provide needed insight about recovery potential and habitat suitability for the Razorback Sucker in the San Juan River between river mile (RM) 158.6 at the Hogback Diversion structure near Waterflow, NM and Lake Powell near Clay Hills, UT RM 3 (Maddux et al. 1993). Subsequently, Critical Habitat for Razorback Sucker and Colorado Pikeminnow was designated as between the Hogback Diversion structure (RM 158.6) downstream to Neskahai Canyon (RM-35.0) in Lake Powell; approximately 35 river miles below the waterfall which demarcates RM 0.0 on the San Juan River (USFWS 1994). Between March 1994 and October 1996, 942 Razorback Suckers were stocked into the San Juan River at four stocking sites (RM 158.6, 136.6, 117.5, and 79.6). Data gathered on these fish

identified habitat types being used year-round by Razorback Sucker in the San Juan River, and provided information on movements, survival, and growth rates. Based on the successes of the experimental stocking study, a full-scale augmentation effort for Razorback Sucker in the San Juan River was initiated with the *Five-Year augmentation plan for razorback sucker in the San Juan River* (Ryden 1997). In February 2003 the SJRIP-BC extended the augmentation effort for Razorback Sucker with *An augmentation plan for razorback sucker in the San Juan River: An addendum to the five-year augmentation plan for razorback sucker in the San Juan River* (Ryden 2003). However, due to changes in augmentation protocols and difficulties in producing requested numbers of fish the eight-year addendum to the original plan was delayed in initiation until 2009. The current augmentation plan (2009-2016) calls for the stocking of 91,200 Razorback Suckers over an 8-year period, or  $\geq 11,400$  fish per year, from a combination of fish reared in a hatchery (currently, Ouray National Fish Hatchery – Grand Valley Unit [Ouray NFH-GVU] or the Southwest Native Aquatic Resources and Recovery Center [SNARRC]) and Razorback Suckers that are grown out in ponds on Navajo Agricultural Products Industry (NAPI) land. A revised *Augmentation Plan for Razorback Sucker in the San Juan River Basin* (Furr 2016, *draft*) was submitted to the Program’s Biology Committee in February 2016 for review and is being finalized. It has been recommended that the Program continue to stock all available Razorback Sucker into the San Juan River and its tributaries with a goal of stocking  $\geq 6,500$  fish ( $\geq 300$ mm TL) annually.

The augmentation programs for the Colorado Pikeminnow and Razorback Sucker populations in the San Juan River are related to the 2016 SJRIP Long Range Plan (LRP). These activities are specifically addressed in the following Elements, Goals, Actions, and Tasks:

## **Element 1. Specific goals, actions, and tasks**

**Goal 1.1—** Establish a Genetically and Demographically Viable, Self-Sustaining CPM and RBS Populations.

**Action 1.1.1** Develop plans for rearing and stocking for CPM and RBS.

**Task 1.1.1.1** Review and update augmentation plan for CPM and adjust stocking goals as scheduled.

**Task 1.1.1.2** Review and update augmentation plan for RBS and adjust stocking goals as needed.

**Action 1.1.2** Produce, rear, and stock sufficient numbers of CPM to meet stocking goals of augmentation plan.

**Task 1.1.2.2** Stock at least 400,000 age-0 (50–55 mm TL) CPM annually into the San Juan River.

**Task 1.1.2.3** Opportunistically stock available CPM in excess of those described above.

**Action 1.1.3** Produce, rear, and stock sufficient numbers of RBS to meet stocking goals of augmentation plan.

**Task 1.1.3.4** Stock at least 91,200 RBS (> 300 mm TL) during eight year stocking period or 11,400 per year.

**Task 1.1.3.5** Opportunistically stock available RBS in excess of the 11,400 per year described above.

**Goal 1.2—** Identify and Implement Strategies for Improving the RBS and CPM Augmentation Program and Genetic Integrity.

**Action 1.2.1** Implement methods to evaluate status and success of stocked RBS and CPM.

**Task 1.2.1.2** Identify, describe, and implement strategies for improving survival and retention of stocked razorback sucker and Colorado pikeminnow, including acclimation prior to

stocking, size of fish stocked, time and location of stocking, physiological conditioning, and predator avoidance.

In addition to SJRIP Program priorities, the stocking of fish reared at U.S. Fish and Wildlife Service (Service) hatcheries in the Southwest Region (Region 2; New Mexico, Arizona, Texas and Oklahoma) are subject to Regional Policy No. 03-06, "Stocking of fish and other aquatic species". This policy applies to production, transport, and stocking for Service hatchery production and incorporates guidance and requirements from FWS Fish Health Policy (713 FWM 1-5), Policy for Controlled Propagation of Species Listed under the Endangered Species Act (Federal Register 65:183), and goals and objectives of the FWS Strategic Plan for the Fisheries Program. The Service's Fish and Wildlife Conservation Offices are the primary conduit for satisfaction of Policy requirements and ensures compliance with needs relative to fish health, stocking requests and priorities, deviation from approved stocking requests, pre-stocking treatments (e.g. nonnative fish removal from stocking sites), and applicable environmental compliance. The New Mexico Fish and Wildlife Conservation Office (NMFWCO) is the pertinent field office for the processing of SJRIP stocking requests under this policy directing the change in lead coordination and stocking responsibilities from FWS Region 6 to Region 2.

### **Objectives for Fiscal Year 2018**

1. Annually stock  $\geq 400,000$  age-0 Colorado Pikeminnow, and investigate methods for batch-marking hatchery released fish for verifiable in-field identification.
2. Stock all available RBS ( $> 300$  mm TL), with the intent to stock  $\geq 6,500$  fish per year until the population becomes self-sustaining.\* No RBS  $< 300$  mm TL will be stocked.
3. Analyze collected data, begin drafting a new Colorado Pikeminnow augmentation plan, and modify/update plans for both Razorback Sucker and Colorado Pikeminnow as needed.

\*the target number of Razorback Sucker and Colorado Pikeminnow to be stocked in subsequent years will be able to be adjusted (increased or decreased as appropriate) in response to known population changes (e.g., a known level of recruitment, observed changes to apparent survival, increased retention and distribution, etc.) determined to have occurred in any given year.

### **Methods and Approach**

- Objective 1. Coordinate with SNARRC, to procure and stock Colorado Pikeminnows according to guidelines set forth in Augmentation of Colorado Pikeminnow (*Ptychocheilus lucius*) in the San Juan River: Phase II, 2010-2020 (Furr 2010).
  - Age-0 Colorado Pikeminnows will be annually reared and harvested by SNARRC and delivered via standard distribution unit to the San Juan River. Fish will be stocked in the fall of each year, post irrigation season, to reduce the risk of fish entrainment in irrigation canals. When possible, age-0 Colorado Pikeminnow will be acclimatized to a variety of conditions (i.e. flow, temperature, physical/environmental characteristic, etc.) within an *in situ* enclosure for up to 72 hours prior to release into the San Juan River. A study is being conducted to determine the feasibility and efficacy of batch-marking all hatchery produced Colorado Pikeminnow with Calcein. If a reliable batch-marking method is identified, Calcein or another method, then future stockings should incorporate this technology to assist in detecting, and verifying, wild produced and recruiting fish.
- Objective 2. Coordinate with SNARRC, Navajo Nation Department of Fish and Wildlife (NNDFW), and Ouray NFH-GVU to procure and stock Razorback Suckers according to guidelines set forth in Augmentation Plan for Razorback Sucker in the San Juan River Basin (Furr 2016, draft).

- SNARRC will stock approximately 10,500 Razorback Suckers ( $\geq 200$  mm total length) into three NAPI ponds (3,500 fish/pond; ). Grow-out, harvesting, and stocking via standard distribution unit into the San Juan River will be conducted by NNDFW annually with assistance from NMFWCO. When possible, fish will be stocked in the fall of each year, post irrigation season, to eliminate the risk of fish entrainment in irrigation canals. Ouray NFH-GVU will provide the SJRIP Augmentation Program with 2,000-4,000 Razorback Suckers ( $\geq 300$  mm TL) annually. Currently, all Razorback Suckers from Ouray NFH-GVU will be hard released at four specified locations as part of a stocking Source and Location comparison being conducted by NNDGF, the SJRIP Program Office, and NMFWCO. By comparing differences in subsequent recapture rates, this stocking study will aid the Program in comparing survival and retention of fish stocked from Ouray NFH-GVU vs. NAPI, and determine if fish from either source had better survival and retention rates at a particular stocking location(s). Once data has been analyzed, location of stockings may be adjusted to maximize apparent survival (e.g., retention) or to more equally distribute the population longitudinally. Only fish  $\geq 300$  mm TL will be stocked into the San Juan River beginning in 2017. Fish  $\leq 299$  mm TL will be held until they reach  $\geq 300$  mm TL before being stocked, or used for other purposes. This will help distinguish wild recruiting Razorback Sucker from stocked fish.

Objective 3. New Mexico FWCO, in conjunction with the Program Office, will analyze all pertinent stocking information including, but not limited to: timing, location, environmental conditions, size of fish, numbers stocked, and subsequent apparent survival from various stockings; and population estimates, age-class structure, longitudinal distribution, and reach specific densities resulting from stocked fish. These data will then be incorporated into the augmentation efforts and written plans for both Colorado Pikeminnow and Razorback Sucker.

In support of these Objectives the New Mexico FWCO will continue to conduct field excursions to identify suitable stocking sites throughout the basin (e.g., tributaries, secondary channels, etc.). [Site selection for Colorado Pikeminnow will continue under in *Stocking plan and protocol for the augmentation of Colorado Pikeminnow (Ptychocheilus lucius) in the San Juan River* (Furr and Davis 2009) and stocking locations and protocols for Razorback Sucker will be outlined in *Augmentation Plan for Razorback Sucker in the San Juan River Basin* (Furr 2016, draft). Modifications to protocols and plans will be made to reflect new data as it becomes available.]

### **Products/Schedule**

An electronic data file will be provided for inclusion in the centralized database by 31 December 2018. A draft summary report detailing findings will be submitted to the San Juan River Implementation Program, Biology Committee, by 31 March 2019. Revisions will be completed and a final annual report will be submitted by 1 June 2019.

### **Literature Cited**

Furr, D. W. and J. E. Davis. 2009. Stocking Plan and Protocol for the Augmentation of Colorado pikeminnow (*Ptychocheilus lucius*) in the San Juan River. U.S. Fish and Wildlife Service, San Juan River Recovery Implementation Program, Albuquerque, NM. 13 pp.

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- U.S. Fish and Wildlife Service. 2002. Colorado pikeminnow (*Ptychocheilus lucius*) Recovery Goals: amendment and supplement to the Colorado Squawfish Recovery Plan. U.S. Fish and Wildlife Service, Mountain-Prairie Region (6), Denver, CO.



**COLORADO PIKEMINNOW PRODUCTION and RAZORBACK  
REARING at the SOUTHWESTERN ARRC, Dexter, NM  
San Juan River  
FY2018  
(2017 -2021)**

**IA# R13PG0035**

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In October of 2012 Dexter National Fish Hatchery and Technology Center's name was officially changed to the Southwestern Native Aquatic Resources and Recovery Center (Southwestern ARRC). The facility is located in the Pecos River Valley of southeastern New Mexico, 200 miles southeast of Albuquerque, 20 miles south of Roswell, and one mile east of Dexter on State Road 190.

The following scope of work identifies the facilities and methodologies that will be used to continue producing 400,000 age-0 Colorado pikeminnow (CPM) and 3,000 300+mm and 11,000, 200 mm razorback sucker (RBS) for use by the San Juan River Recovery Implementation Program (SJRIP) to meet its augmentation objectives for the species in the San Juan River. The primary purpose being the distribution of CPM to the San Juan River and RBS to existing grow-out ponds located on the, Navajo Nation, Navajo Agricultural Products Industry (NAPI) ponds. Southwestern ARRC has developed production guides for both species based on historical growth rates and produces large numbers of each species for distribution throughout the upper and lower Colorado River Basin.

The U.S. Fish and Wildlife Service (USFWS) has developed extensive infrastructure and expertise at Southwestern ARRC to successfully contribute to recovery programs and the facility has been totally devoted to the maintenance, propagation and culture of threatened and endangered fish species for forty years. During that period it has successfully cultured razorback sucker, bonytail, humpback chub and Colorado pikeminnow of the Colorado River system and currently maintains large genetically diverse broodstocks. Over the years staff have developed successful spawning, culture and distribution methodologies for the species that are still used today. The facility utilizes an abundant water supply to produce over 2.0 million fish annually.

### Facilities

Situated on the northern fringes of the Chihuahua Desert, the elevation at Dexter is 3,500 feet; average rainfall is 12 inches, and the growing season of 180-200 days. Station facilities include: Administration/Laboratory Building; Fish Culture Building; Isolation/Quarantine Building; Maintenance/Shop Building; Vehicle Storage Building; Equipment Storage Building; Feed Building; General Storage Building.; three government houses; one mobile home, two RVs and one RV space.

Fish culture facilities in operation consist of 76 earthen/lined ponds ranging in size from 0.1-1.0 acres, four (6' X 40') fiberglass raceways, four (8' X 40') concrete raceways, Twenty (2' X 12') rectangular fiberglass tanks, forty (4') fiberglass circular tanks, fifty (3') fiberglass circular tanks and 80 ten-gallon and 20 forty-gallon aquariums. The facility utilizes three water reuse systems in the fish culture building. Phase III Facility Improvement Project was completed on June 5, 2003.

### Water

An abundant supply of fish culture water is supplied by five shallow aquifer wells (150 feet in depth) capable of pumping a combined 2,000+ gallons per minute. The well water is a constant 64<sup>0</sup> F, pH of 7.5-8.5, total hardness of 2,100 ppm, and total dissolved solids of 3,500 ppm. Water rights, allocated through the New Mexico State Engineer's Office, total 2,185.5 acre-feet per annum or 10,927.5 acre-feet per five-year water period. Waste water from all fish culture operations collects in two sumps on the southeastern area of the facility and provides year round water to the wetlands.

## **I. Colorado Pikeminnow Production**

### **Background**

Once very common throughout the Colorado River Basin, Colorado pikeminnow have declined from historic levels and are now found primarily in the Upper basin of the Colorado River.

Various factors have contributed to the decline of the specie including alteration of natural stream flows and temperature regimes, loss of habitat and habitat fragmentation as a result of water development and the introduction of nonnative fish species.

Colorado pikeminnow are native to the San Juan River. Its historic distribution included the entire mainstem San Juan River up to Rosa, New Mexico, located approximately 25 miles upstream from present day Navajo Dam. Currently the species is considered extremely rare and the small population is estimated at less than 20 adults. This small group of fish has persisted in the San Juan River since the closure of Navajo Dam in 1962. Recent studies being conducted by the San Juan Recovery Implementation Program (SJRIP) indicate that the Colorado pikeminnow is reproducing and recruiting in the river to at least a limited degree, however the low numbers collected do not satisfy recovery goal requirements for the specie. The Recovery criteria calls for a target of 1,000 subadult fish established by the end of a five year down listing period, and 800 adults maintained during the 7 year delisting period. The Upper Colorado River Endangered Fish Recovery Program has recommended that the wild population be increased by augmenting with hatchery produced fish. The initial **Augmentation Plan For Colorado Pikeminnow In The San Juan River (Phase I)**, (Ryden 2003) called for annual stocking of age-0 fish over an eight year Period (2002-2009). A modified work plan was developed and incorporated into the augmentation program in 2005. Under the amended plan; (Addendum #1 to Augmentation Plan For Colorado

Pikeminnow In The San Juan River (Ryden 2005)), age-1 fish were produced at Dexter from 2006-2010 to augment the age-0 stockings in the San Juan River. The augmentation plan (**Phase I**) for age-0 and age-1+ Colorado pikeminnow ended in 2010. Augmentation efforts identified in the **Phase II** (2010 – 2020) **Augmentation Of Colorado Pikeminnow (*Ptychocheilus lucius*) In The San Juan River Plan**, (Furr 2009); focuses primarily on culturing and stocking increased numbers of age-0 fish. Current facility and broodstock capabilities at Southwestern ARRC allow for  $\geq 400,000$  age-0 Colorado pikeminnow to be produced and stocked annually. These stocking targets were started in 2016 and will continue in subsequent years unless further production capacity is identified and/or stocking targets are modified by the SJRIP.

Southwestern ARRC has been the leader in propagating and culturing Colorado pikeminnow (*Ptychocheilus lucius*) since 1981. The facility maintains several captive stocks as genetic reserves and has successfully produced fish for the Upper and Lower Colorado River Basin programs and the SJ RIP. The main emphasis has been on examining the reproductive biology of the species, broodstock development and culturing age-0, 1 and adult fish. This work plan proposes the production of 400,000 age-0 fingerlings (50 mm TL) annually for reintroduction in the San Juan River.

The funding requested also covers costs associated with proper care of the broodstock necessary to successfully carry out this project for future years and aide in restoration of the species.

Stocking will require coordination with New Mexico Fish & Wildlife Conservation Office, Navajo Nation Department of Fish and Wildlife.

### **Objectives**

- (1) Produce 400,000 age-0 fingerlings (50 mm) for stocking in the San Juan River annually from 2017- 2021.
- (2) Transport and distribute 400,000 age-0 Colorado pikeminnow from Dexter, NM to the San Juan River.
- (3) Maintain 400 Colorado pikeminnow broodstock for recovery efforts. In addition, develop new broodstock derived from wild fish collections from the upper Colorado River basin from 2017 -2021.

### **Methods**

Broodstock consists of 200 (F1) and 450 (F2) adults. These fish are 1999, 2004 and 2006 year- class (YC) progeny from wild adults collected from the Yampa, Green and Colorado Rivers, respectively. In 2006 staff began culturing a second broodstock of 500 (F2) individuals for future use. This stock is referred to as the 06CRDX lot, derived from the 1991 broodstock.

In 2018 a maximum of 50 paired matings (1 female X 1 male) will be spawned from the 1999 YC broodstock. Given the past history of hormonal induced ovulation, 38 females (75%) should produce viable eggs during a given year. All members of the broodstock are PIT tagged and records of spawning pairs are maintained at Southwestern ARRC.

### **Spawning**

Broodfish will be harvested from the culture pond in early May, males and females sorted and held indoor for spawning. Ovulation will be induced with intraperitoneal injections of common carp pituitary (CCP) at the rate of 4 mg/kg of body weight. When eggs can be expelled using slight pressure, a female will be stripped and milt added from one male. Each individual egg lot will be enumerated, incubated and kept separate in Heath Trays until hatching occurs, approximately 96 hours following fertilization at a constant water temperature of 72°F.

### Rearing Ponds

To meet the production goal of 400,000 age-0 (50mm) fish, rearing ponds will be stocked at the following densities:

#### Age-0 Growth: (June thru October - 150 day growing period)

Pond 1A-	.73	Surface acre lined	@ 100,000 fry
Pond 2A-	.87	Surface acre lined	@ 100,000 fry
Pond 5A-	.94	Surface acre lined	@ 100,000 fry
Pond 6D-	.25	Surface acre lined	@ 100,000 fry
Pond 7D-	.25	Surface acre lined	@ 100,000 fry

Rubber and plastic lined ponds will be used for production. Fertilization and slow filling of ponds will start 10 to 14 days prior to stocking. Staff will ensure that water quality is monitored. Temperature, dissolved oxygen and pH readings will be taken twice daily at 7:00am and 3:00 pm at the deepest part of the pond.

If the dissolved oxygen drops to  $\leq 3$  mg/l, supplemental aeration will be started. All feeding, fertilization and chemical applications will be stopped till adequate oxygen levels are restored. Aerators will be run all night for several days till the oxygen is back up to acceptable levels, (5-7 mg/l). Staff will avoid handling fish for 7 -10 days following a stress related circumstance.

Zooplankton and invertebrate insect populations are cultured with the proper fertilization regime.

Four types of fertilizer will be used:

- 1) Alfalfa meal
- 2) Alfalfa pellets
- 3) Cottonseed meal
- 4) Super phosphate

Initial fertilization rates for ponds are 100 lbs. of cottonseed meal, 100 lbs of alfalfa meal or pellets and 3 lbs of super phosphate. Follow up rates are administered on Monday and Thursday with 10 lbs cottonseed meal, and 10 lbs, alfalfa meal or pellets.

Water temperature, dissolved oxygen (DO) and pH readings will be taken in all rearing ponds daily. All readings will be recorded on record charts. If morning DO readings are below 3.0 or above 13.0 all fertilization will be stopped until DO's are brought back to accepted levels. If pH readings are greater than 9.5 fertilization will be terminated.

Feeding Schedule

Fish will be sampled at the end of every month. Size, weight and over all condition will be recorded. Feed amounts will be adjusted and projected for the upcoming month. Trout starter, #1 and #2 feed will be used and purchased from SKRETTING ( formerly Nelson and Sons, Silver Cup), Murray, Utah. Age-0 fish will be fed three to four times daily at approximately 9:00am, 11:00am, 1:00pm and 3:00pm.

Feeding rates are based on water temperature and fish densities in the ponds and will be calculated as follows:

- water temp  $\geq$  80 °F feed 3 % BW per day, Mon, Wed and Fri.
- water temp 61-78 °F feed 2 % BW per day, Mon thru Fri.
- water temp  $<$  60 °F feed 1.5 % BW per day, Mon and Thurs.

Staff will use the following guide to determine the proper particle size to offer the fish. Feed sizes will be mixed at ½ rations of each size when making the transition to the next larger size feed.

<u>Fish Size</u>	<u>Particle Size</u>
Fry	Starter
20mm	#1 crum
40mm	#2 crum
2-3"	1.0 mm

Schedule

Broodfish will be spawned in May 2018 and age-0 fish reared in rubber and plastic lined ponds from June - October 2018.

Projected Harvest Dates and Delivery Date

Age -0 fish will reach the target size of 50mm by the end of October of each year. The fish will be harvested from the ponds the final week of October and hauled and distributed into the San Juan River the first full week in November of each year.

Projected Duration Of Project:

This work is continuation of activities initiated in 2002 in support of the San Juan RIP Colorado pikeminnow augmentation effort (2002-2009) identified in the **Augmentation Plan For Colorado Pikeminnow (CPM) In The San Juan River**, (Ryden 2003). Current and future augmentation targets for the species are listed in the **Phase II Augmentation Of Colorado Pikeminnow (*Ptychocheilus lucius*) In The San Juan River Plan**, (Furr 2009). Under Phase II, augmentation efforts focus on culturing and stocking  $\geq$ 400,000 age-0 Colorado pikeminnow annually from 2010-2020 or as directed by the San Juan Recovery Implementation Program.

**II. Rearing Razorback Sucker at the Southwestern ARRC**Background**Lake Mohave Razorback Sucker Broodfish**

Razorback sucker (RASU) have been maintained and cultured at The Southwestern ARRC since 1981. The captive broodstock represent the Lake Mohave population. Three separate broodstocks are maintained; the 1981, Paired Mated(PM) and Wild Caught(WC) broodstocks. The PM stock is comprised of 90 unique family groups produced from paired matings of wild caught adults spawned at Willow Beach NFH from 1994 to 2004. The WC broodstock consists of six year classes of larvae and juvenile wild-caught fish from Lake Mohave from 2000 to 2005. These fish were captured as fry from eight locations throughout Lake Mohave and given the designation of (WC) future broodstock .

From 2001-2013 production of subadult razorbacks at Southwestern ARRC has yielded excellent survival and growth. The overall survival for razorback sucker grown to 450mm is 90.5%, while 85% of the fish achieved the target growout size in two years. Spawning and growing season consists of fish being spawned in the early spring and fry stocked in to earthen or lined ponds and grown out-door from April to October. Total dissolved oxygen and temperature are monitored daily and fish feed on phyto and zooplankton produced in fertilized ponds for approximately 45 days at which time they are offered a prepared razorback suckerdiet.

Fingerlings are routinely held and cultured in the Fish Culture building during the months of January - March to prevent mortalities associated with outdoor over wintering. In the fall of the year when the fish reach target size they are harvested from the ponds and transferred to the Fish Culture building for sorting and tagging. Following a 7 to 10 day rest and recovery period they are loaded into distribution trucks and hauled to their stocking locations. Southwestern ARRC staff have successfully hauled 300+mm razorbacks to the San Juan river and razorbacks and

Bonytail to Lake Mohave, Arizona, in the lower Colorado River. The distribution trips to the San Juan average 400 miles (8 hours) and the trips to Lake Mohave average 660 miles (12 hours) of hauling time in one direction.

## **Production Plan**

### Objectives:

The main objective of this proposed work is to spawn razorback sucker adults and rear up to 11,000, 200mm fish annually and deliver them to existing grow-out ponds located on the Navajo Indian Irrigation Project.

Additional objectives of the work include:

- (1) Improve, maintain and staff facilities at Southwestern ARRC to rear and distribute the target number of fish.
- (2) Rear approx. 1,000, 300+mm sized RBS annually for stocking into the San Juan River.
- (3) Passive Integrated Transponder (PIT) tag all fish prior to stocking into the The San Juan River and NAPI ponds. PIT tags will be provided by the SJRIP.
- (4) Maintain razorback sucker captive broodstock for recovery efforts.

### Methods

Captive propagation activities include spawning a minimum of 20 pairs of broodstock, incubating fertilized eggs, enumerating and stocking of swimup fry into rearing ponds, harvest of target sized fish from ponds, PIT tagging and distribution to the NAPI ponds near Farmington, NM on the Navajo Nation.

The project will utilize indoor and outdoor facilities. All spawning and incubation activities will be conducted indoor in the Fish Culture building. Razorback sucker will be initially reared in 2 earthen or lined ponds and in June of each year transferred to 3 ponds at surface acres of 0.79, 0.89 and 0.98.

### Rearing Ponds

To meet the production goal of 11,000 (200mm) fish, rearing ponds will be stocked at the following densities:

#### Age 0 Growth: (April thru May - 60 day growing period)

Pond 1- .72 acre @ 12,000 fry

Pond 2- .79 acre @ 12,000 fry

#### Age I Growth: (June thru October - 150 day growing period)

Harvest Age I fish; enumerate and stock fingerlings into 3 ponds.

Pond 1- .79 acre @ 6,000 fingerlings

Pond 2- .89 acre @ 6,000 fingerlings

Pond 3- .98 acre @ 6,000 fingerlings

Earthen and lined ponds will be used for production. In earthen ponds the bottoms will be packed and graded prior to receiving fish. Non-level pond bottoms can hinder fish harvest and aquatic vegetation can entrap fish at harvest time. Fertilization and slow filling of ponds will start 10 to 14 days prior to stocking. Staff will ensure that water quality is monitored. Temperature, dissolved oxygen and pH readings will be taken twice daily at 7:00am and 3:00 pm at the deepest part of the pond.

If the dissolved oxygen drops to  $\leq 3$  mg/I, supplemental aeration will be started. All feeding, fertilization and chemical applications will be stopped till adequate oxygen levels are restored. Aerators will be run all night for several days till the oxygen is back up to acceptable levels, (5-7 mg/l). Staff will avoid handling fish for 7 -10 days following a stress related circumstance.

### Pond Vegetation Control and Fertilization

Sonar, Diuron or Barrier will be used in earthen ponds to control rooted aquatic vegetation. Staff will use granular form when possible and broadcast the entire pond bottom at the recommended rates.

Diuron – 2.0 lbs. per acre (dry broadcast) Barrier- 100  
lbs. per acre (dry broadcast)

Copper sulfate (CUSo4) will be used to control floating filamentous algae blooms. Treatments will began

approximately 45 days after fish are stocked into the ponds and repeated every 30 days. Application rates in ponds are 5 to 8 lbs per acre. A secondary benefit derived from using  $\text{CuSO}_4$  is its effectiveness in controlling external parasites.

Zooplankton and invertebrate insect populations are cultured with the proper fertilization regime. Four types of fertilizer will be used:

- 1) Alfalfa meal
- 2) Alfalfa pellets
- 3) Cottonseed meal
- 4) Super phosphate

Initial fertilization rates for earthen ponds are 100 lbs of cottonseed meal, 100 lbs of alfalfa meal or pellets and 3 lbs of super phosphate. Follow up rates are administered on Monday and Thursday with 10 lbs cottonseed meal, and 10 lbs, alfalfa meal or pellets.

Water temperature, dissolved oxygen (DO) and pH readings will be taken in all rearing ponds daily. All readings will be recorded on record charts. If morning DO readings are below 3.0 or above 13.0 all fertilization will be stopped until DO's are brought back to accepted levels. If pH readings are greater than 9.5 fertilization will be terminated.

#### Feeding Schedule

Fish will be sampled at the end of every month. Size, weight and over all condition will be recorded. Feed amounts will be adjusted and projected for the upcoming month. Razorback grower (0301) feed will be used and purchased from SKRETTING (formerly Nelson and Sons, Silver Cup), Murray, and Utah. Fish will be fed twice daily, once at 9:00am and at 2:00pm.

Feeding rates are based on water temperature and fish densities in the ponds and will be calculated as follows:

- water temp  $\geq 80$  °F feed 3 % BW per day, Mon, Wed and Fri.
- water temp 61-78 °F feed 2 % BW per day, Mon thru Fri.
- water temp  $< 60$  °F feed 1.5 % BW per day, Mon and Thur.

Staff will use the following guide to determine the proper particle size to offer the fish. Feed sizes will be mixed at ½ rations of each size when making the transition to the next larger size feed.

<u>Fish Size</u>	<u>Particle Size</u>
2-3"	1.0 mm
4-6"	2.0 mm
6-8"	3.0 mm

#### Schedule

Broodfish will be spawned in March and the fish reared in earthen ponds for their first growing season (April – October); held indoor during winter (November - March) and stocked into the NAPI ponds in April of 2018. Target sized fish are available for distribution in spring and fall of each year.

### Projected Harvest Dates and Delivery Date

Year 2018 marks the thirteenth year of razorback production at Southwestern ARRC for distribution to the NAPI ponds. In 2007 a new single cohort fish rearing strategy was adopted by the San Juan RIP for the NAPI ponds. Since 2006, staff have stocked a total of 83,942 razorback's averaging 225mm in length into East and West Avocet and Hidden ponds and in 2012 and 2016 stocked an additional 1,000 target sized RBS into the San Juan River annually.

An additional 11,000 will be stocked into the NAPI ponds in April 2017. Based on historical growth rates for razorback at Dexter, the production target of 1,000, 300mm sized fish will require a two year period and a fifteen month period for achieving the 11,000, 200mm fish. Fish delivery will be in the spring of each year based on the new rotational production plan (single cohort). Approximately 11,000 fish will be stocked each trip and Dexter staff will coordinate the deliveries with the Navajo Nation Department of Fish and Wildlife, BIA and USFWS FWCO personnel. The estimated duration of the program is scheduled for a total of 18 years (2005- 2023).

### PIT Tagging

Starting in 2012 all fish stocked from Dexter into the San Juan River and NAPI ponds are PIT tagged prior to stocking. The fish will be graded and sorted approximately 6 to 8 weeks before the scheduled stocking date. Fish that average 200mm will be PIT tagged and allowed to recover for a minimum of 10 to 14 days after each handling. The PIT tagged fish will be scanned for tag retention and any fish that lost a tag will be retagged prior to shipping.

### Projected Duration Of Project:

This project was initiated in January 2005 in support of the SJRIP razorback augmentation effort (2004-2011) identified in the **Five-Year Augmentation Plan For Razorback Sucker In The San Juan River** (Ryden 1997, 2003). Current and future augmentation targets for the species are listed in the "draft" **Augmentation Plan For Razorback Sucker In The San Juan River Basin**, (Furr 2016). The rearing of razorback sucker subadults at Southwestern ARRC could potentially continue till 2023 (BOR RFP 04-SF-40-2250). Under the new plan, augmentation efforts focus on culturing and providing 11,000, 200mm sized razorback sucker to the Navajo Nation, NAPI ponds fish rearing project annually from 2016-2023 or as directed by the San Juan Recovery Implementation Program.

## **General Fish Husbandry Requirements and Conditions**

### Predator Control

Historically, Southwestern ARRC has not experienced excessive avian or mammal predation on fish stocks. Salamander, crayfish, frog and turtle infestation of ponds are nonexistent. On an annual basis specific ponds are covered with bird netting during the winter months to eliminate predation by migrating birds. An additional strategy employed by the staff is the harvest and holding of stocks of fish indoor during the winter months of November to March. Razorback suckers reared for this project will be maintained indoor in two 40,000 gallon systems during the winter months. These systems contain biofiltration, supplemental aeration, temperature control and alarm systems.

### Handling and Transport Protocol

Transport of all fish will follow guidelines described in the USFWS Protocols for Biological Investigations developed by Dr. Gary Carmichael, retired U.S. Fish & Wildlife Service employee. The

protocol is as follows:

1. When Colorado pikeminnow and razorback fingerlings, subadults and broodfish are handled they will be placed in a .5% salt bath to help in osmoregulation and reduce the effects of handling stress.
2. Temperature should be 5 degrees Fahrenheit lower in the hauling truck than in the river.
3. Drivers must be informed of and follow a specified route.
4. Transport water will contain 0.5 percent NaCl (18.9 grams per gallon).
5. Oxygen levels will be greater than 6.0 mg/L as determined with an oxygen meter.
6. Nets must be functional. Aeration equipment must be in place and must be used. A fish holding container will be a minimum of 5 gallons in size and fish densities will not exceed 1 lb of fish per gallon of water. Small delta mesh (1/8") will be present to transfer the fish from one container to another, although it is preferred to have water to water transfer. Oxygenation/aeration equipment will be in place and working.
7. Prior to transfer and after the fish are concentrated, they should be quickly placed in the transport tank. When using nets to place fish in transfer buckets or tanks, nets should not be overloaded. The fish on the bottom will be crushed. Using a wet transfer with buckets is preferable. When emptying the nets and buckets, care will be taken to avoid adding algae and mud to the transport tank. Before loading, dissolved oxygen levels should be at saturation.
8. Immediately after loading, all equipment on the transport vehicle should be re-checked and the vehicle should depart. Oxygen concentrations and temperatures should be monitored at a minimum of every hour.
9. During unloading tempering water should be present and functional, and thermometers should be used to match water temperatures. Hauling water temperatures should be equal to receiving water temperature.

**\*Acclimatizing the fish to the receiving water temperature will be conducted in increments of 2° F or (1°C) towards equalizing per 30 minutes time. Due to the high alkalinity and TDS of Southwestern Native ARRC water, staff will temper and acclimate the transported fish to the receiving water quality for a minimum of 1 hour prior to release. This process will allow sufficient time for the fish to osmoregulate to the receiving water quality. Tempering can be accomplished in the shipping tank by adding receiving water to the tank at given intervals.**

#### Fish Health Monitoring Protocols

All fish should be handled with the best animal husbandry practices available. A feeding schedule will be developed and followed daily. All tanks will be cleaned of uneaten food and feces daily. A daily log recording times of feeding, water temperature and comments on fish health will be maintained. If fish are maintained in a re-circulating system, all filters and pumps will be routinely cleaned and monitored. If fish

are held in ponds O2 levels will be closely monitored. At least once a year, a fish health inspection will be conducted to examine fish for bacterial, viral and parasitic infections. Normally 60 fish per lot are sacrificed for an adequate sample. However, in the case of endangered or rare fish of genetic importance, numbers sampled may be less, depending upon availability. Non-lethal methods, if available, will be employed to obtain samples. Condition factors will be calculated on an annual basis and data added to a RBS database. Wet mounts will be examined for parasites and bacteria. Routine condition exams will be conducted and an examination will be conducted on all lots one month prior to delivery to the San Juan River and NAPI ponds on the Navajo Nation. Brood and refuge stock will have health checks annually and only when needed to minimize handling stress.

The U.S. Fish and Wildlife Service, Dexter Fish Health Program will provide bacterial and viral testing for razorback propagation and rearing activities. Treatment of disease will be the responsibility of the Southwestern ARRC fish culture staff. Fish health experts are available to advise on proper treatment, and to examine fish for infection.

#### Disposition of Fish

All fish propagated and cultured for this project are made available to the SJRIP for stocking and meeting augmentation requirements identified in the Phase II (2010 – 2020) **Augmentation Of Colorado Pikeminnow (*Ptychocheilus lucius*) In The San Juan River Plan**, (Furr 2009) and the “draft” (2016-2023) **Augmentation Plan For Razorback Sucker In The San Juan River** (Furr 2016). In the case of catastrophic loss (>25% of the stock) at Southwestern Native ARRC, up to 1,000 individuals will be collected for testing and diagnosis to determine (if possible) reason for loss. A written statement describing the loss will be provided immediately to the US Fish and Wildlife Service (Service) Fisheries Division and the SJRIP Coordinator, Albuquerque, NM; followed by a detailed report of the diagnosis once results are available.

Excluded from these reporting requirements are gametes and fish lost to natural attrition, including but not limited to non-viable eggs prior to hatch and incidental predation mortalities. As per the guidelines identified in the 2003 Memorandum of Understanding between the Service and University of New Mexico, Division of Fishes, Museum of Southwestern Biology (MSB), fish carcasses (specimens) will be provided to the MSB who serves as the repository for vouchered specimens of native fishes. Any additional mortalities above the 1,000 mark will be recorded in the annual Threatened and Endangered Species report and disposed of by burial onsite or at a local land fill.

If any concerns are identified leading to potential questions about stocking of fish, in the instance of fish having cleared the Service’s fish health testing for reportable pathogens and other agents of concern using established Fish Health Center SOPs and those of the American Fisheries Society – Fish Health Section Blue Book, the SJRIP has 30 days to formally respond with recommendations on the disposition of the fish. After 30 days, if no response is provided, in writing, the disposition action for the fish will be at the discretion of the Service.

#### Reporting

A draft annual progress report detailing fish culture and distribution activities will be completed and provided to the SJRIP by January 31, 2019.

#### **Literature Cited:**

- Furr, W. D. 2009. Augmentation Plan, Augmentation of Colorado Pikeminnow (*Ptychocheilus lucius*) In the San Juan River, Phase II 2010-2020. U. S. Fish and Wildlife Service, Albuquerque, NM. 15 pages.
- Furr, W. D. 2016. Augmentation Plan For Razorback Sucker In The San Juan River Basin 2016-2023. U. S. Fish and Wildlife Service, Albuquerque, NM. 16 pages.
- Hamman, R. 1985. Induced spawning of hatchery -reared razorback sucker. Prog. Fish-Cult.. 47(3): 187-189
- Ryden, D. W. 2003. An Augmentation Plan For Colorado Pikeminnow In The San Juan River. U. S. Fish and Wildlife Service, Grand Junction , Co. 63 pp. + appendices.
- Ryden, D. W. 2003. An augmentation plan for razorback sucker in the San Juan River: An addendum to the five-year augmentation plan for razorback sucker in the San Juan River (Ryden 1997). U. S. Fish and Wildlife Service, Grand Junction, CO. 32 pp.
- Ryden, D. W. 2005. *Draft* Addendum #1, Stocking Age-1 Fish To Supplement Ongoing Augmentation Efforts. An Augmentation Plan For Colorado Pikeminnow In The San Juan River, U.S. Fish and Wildlife Service, Grand Junction , Co. 3 pp.

**Budget**

RE: Colorado Pikeminnow Fingerling Production and Razorback Rearing of Adults and Subadults at the Southwestern ARRC, Dexter, NM. The following costs are associated with producing and stocking 400,000 age-0 CPM fingerlings; 1,000, 300+mm RBS and 11,000, 200 mm subadults into the NAPI ponds on the Navajo Nation and the San Juan River in 2018.

Identified costs also include maintaining Colorado pikeminnow and razorback broodstock for recovery efforts.

**Budget -Detailed Spending Plan 2018****I. Colorado Pikeminnow Fingerling Production****O&M Labor Costs**

The labor costs identified for 2017 are broken down as follows, and include fringe benefits and payroll additives for each position identified:

Southwestern Native Aquatic Resources and Recovery Center

(2) Fish Biologist (1,280 hours -16pay periods) - GS 482-9 @ \$34.29/hr. = \$43,902

\* Supervision, spawning, fish health and water quality monitoring, feeding, harvest and prep for distribution.

(1) Admin. Officer (240 hours- 3pay periods) - GS 341-9 @ \$33.55/hr. =\$ 8,053

\* Budget tracking, purchasing, data base management & reporting.

**Subtotal = \$51,955**

**Equipment and Supplies:**

Liquid oxygen and compressed oxygen 12 cylinders @ \$86.34 \$ 1,036 Airgas

Spawning Supplies \$ 1,037

Hormones (CCP 5 vials @ \$207.55 per 10ml/vial)

Fish health sampling prior to stocking \$ 2,239 Lab

supplies for bacti, viral and parasite testing.

Culture equipment (nets, seines, screens, etc.) \$ 2,283 Eager,

Memphis Net & Twine

Pond management supplies, Barrier \$289.79/50# bag (20 bags) \$ 5,795 Van

Diest

Fish feed,1.75/lb., 6,000 lbs. \$10,506

SKRETTING

Cyclical Maintenance costs for: \$ 1,638

Tractors, mowers, gators, sweepers used in pond maintenance

**Subtotal \$ 24,534**

**Utilities:**

Pumping costs	
Electrical 200,257 kwh @ .0997	\$19,966
Heating water for hatching eggs to swim-up	
Natural gas 1,525 ccf @ 1.049	\$ 1,600
<b>Subtotal</b>	<b>\$21,566</b>

**Reintroduction Costs:**

## Salaries

GS-9 Fish Biologist	
24 hrs. @ \$34.29	\$ 823
GS-7 Fish Biologist	
24 hrs. @ \$25.49	\$ 612
WG-7 Maintenance Worker	
24 hrs. @ \$23.22	\$ 557
WG-5 Bio Science technician	
24 hrs. @ \$17.38	\$ 417
Lodging & Per Diem \$123/day (Dexter to Farmington, NM and return)	
\$126.75/trip x 2 trips x 4 employees =	\$1,014
Fuel costs and truck maintenance 1200 miles @ \$5.951	\$7,141
<b>Subtotal</b>	<b>\$10,564</b>

**Annual subtotal (CPM)****(O & M Direct Costs)** **\$ 108,619****II. Rearing Razorback Sucker at the Southwestern ARRC**O&M Labor Costs

The labor costs identified in the 2017 Scope of Work are broken down as follows, and include fringe benefits and payroll additives for each position identified:

Southwestern Native Aquatic Resources and Recovery Center

- (1) Fish Biologist (1,040 hours -13pay periods) - GS 482-9 @\$34.30/hr. = \$ 35,671  
 \* Supervision, spawning, fish health and water quality monitoring, feeding, harvest and distribution.

(1) Administrative Officer (160 hours- 2pay periods) - GS 341-9@\$33.55/hr. = \$5,367

\* Budget tracking, purchasing, data base management & reporting.

**Subtotal = \$41,038**

### Materials and Supplies

Cost based on SNARRC's historical purchases:

#### Fish Health

Fish health sampling prior to stocking  
Lab supplies for bacti, viral and parasite testing. \$ 1,292

#### Fish Culture Supplies

Nets, seines, tubs, screens. \$ 2,184  
Wet lab supplies (pipets, petri dishes, slides, probes, markers) \$ 290  
Theriputents- salt, Oxytetracycline, formalin, MS-222, stress coat \$ 695  
Liquid and compressed oxygen for fish distribution \$ 232

#### Feed

Production diet RBS0301 (2.0 tons) 4,000 lbs. \$ 1.64 per lb. \$ 6,560

#### Spawning Supplies

Hormones (HCG 10 vials @ \$ 57.88 per 10ml/vial) \$ 578

#### Fertilizer

Alfalfa pellets (1,000 lbs. ) .296/lb. \$ 296  
Inorganic - Super Phosphate (10 bags) 8.65/bag \$ 86

#### Chemicals- Aquatic Vegetation Control

Barrier- (6 bags) \$289.77/bag \$ 1,798  
Diuron -(2 bags) \$ 88.58/bag \$ 177

**Subtotal = \$14,188**

#### Services

Utilities & Equipment Maintenance  
\* Electrical, fuel and phone \$ 5,150  
\* Boiler system, heat exchanger maintenance \$ 1,158  
\*#1 well and water tower and pumping station maintenance \$14,291

**Subtotal = \$ 20,599**

### Travel

- Fish stocking/distribution.

Dexter to Farmington (NAPI) & return- (1640 miles @ 5.951 per mile  
DX truck) = \$ 9,759

Fuel and routine vehicle maintenance.

Perdiem- \$126per day X 2 trips X 2 individuals. = \$ 507  
**Subtotal = \$10,266**

**Annual subtotal (RBS)**

**O&M DIRECT COSTS \$86,091**

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**I. Colorado Pikeminnow Fingerling Production \$108,619**

**II. Rearing Razorback Sucker Subadults at the Southwestern ARRC \$86,091**

**Annual total: \$194,710**

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**3 % Administrative Overhead \$ 5,841**

**TOTAL REQUESTED FOR 2018 \$ 200,551**

**Projected out year funding request:**

FY 2019 - \$206,590

FY 2020 - \$212,788

FY 2021 - \$219,172

# **Razorback Sucker Augmentation at NAPI Grow-Out Ponds**

## **Fiscal Year 2018 Project Proposal**

Principal Investigators: Jeffrey Cole, Kim Yazzie  
Navajo Nation Department of Fish and Wildlife  
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## Razorback Sucker Augmentation at NAPI Grow-Out Ponds

### Fiscal Year 2018 Project Proposal

Principal Investigators: Jeff Cole, Kim Yazzie  
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#### **Background**

The Long Range Plan for recovery of endangered fishes in the San Juan River calls for propagation and augmentation of razorback sucker, *Xyrauchen texanus*<sup>17</sup>, (RBS). Avocet East and West and Hidden ponds on Navajo Agricultural Products Industry (NAPI) lands will grow out RBS for stocking into the San Juan River in 2018.

Avocet Pond was originally a single pond built for watering cattle. On March 2, 1998 Avocet was divided into 2 ponds known as Avocet East and West. Avocet West is 3.4 acres and holds 18 acre-feet of water. Avocet West has a siphon for draining the pond. Avocet East is 3.52 acres and holds 19.6 acre-feet of water. Avocet East had no siphon when the ponds were divided, so draining was accomplished by renting a battery of water pumps. A siphon was installed in Avocet East during FY 2008 and the water can now be managed independent of Avocet West and without the need for pumping.

In October of 1999, Hidden Pond was built to rear razorback sucker. Hidden Pond is 2.83 acres. The dam was breached due to a storm event and the fish were lost. The dam was re-built in FY 2000 and a toe drain and spillway were built to protect the dam. Hidden Pond was lined with bentonite and contoured and a kettle was installed to facilitate fish harvest. A siphon was installed in July 2003. A salamander fence was installed around the Hidden Pond perimeter in August of 2003 to exclude predatory tiger salamanders.

Responsibility for Management of the NAPI ponds was originally shared between the U.S. Fish and Wildlife Service (Service), Bureau of Indian Affairs (BIA), Keller-Bliesner Engineering<sup>14</sup> and Ecosystems Research Institute. The Service was responsible for determining which ponds would receive RBS and when. In addition, the Service conducted sample counts and harvested the ponds with the assistance of the BIA. Keller-Bliesner was responsible for design and construction of the Six Pack ponds and re-construction of Hidden Pond. The BIA was responsible for monitoring water quality and Ecosystems Research was responsible for fertilization of the ponds and for developing a pond management plan.

Original pond management was for multiple cohorts to be raised in the ponds. Harvesting would be done passively with fyke nets so that the ponds would not be drained on an annual basis. In FY 2007, it was determined to change pond management direction. All of the ponds would be drained and harvested and single cohort management would replace the multiple cohort approach. During the first harvesting and draining of a Six-pack Pond, high mortality resulted when the number of fish remaining in the pond could not be removed before they succumbed to the rapidly warming water. Adjustments were made to reduce the mortality in future harvesting and draining events. The adjustments consisted of increasing the trapping effort prior to de-watering to reduce the number of fish remaining in the pond. In addition, the final fish removal would be accomplished with a higher pool of water to slow the warming of the water during the time of final harvest. This resulted in less mortality.

The Navajo Nation Department of Fish and Wildlife (NNDFW) was contracted to assume responsibility for daily management of the NAPI ponds in 2007. The Service assists the NNDFW with pond harvest as needed.

The ponds have been fenced and electric lines have been installed at each of the ponds. Aerators have been installed at each of the ponds to improve water quality. Water quality issues have caused fish mortalities in some of the ponds in the past. Water quality issues appear to have been much improved since the installation of the 2016 aerators and air lines.

## **Objectives**

### **(NAPI Ponds Management)**

Manage razorback sucker grow-out in East Avocet, West Avocet, and Hidden ponds to provide an additional source of RBS to supplement the augmentation program. Harvest, Passive Implant Transponder (PIT) tag, and stock razorback sucker from the three grow-out ponds into the San Juan River, in order to assist in fulfilling the tasks and objectives outlined in the current version of *An Augmentation Plan for Razorback Sucker in the San Juan River* (Ryden 2003).

- 1) Manage three grow-out ponds using a single cohort strategy; including passive and active harvest techniques. East and West Avocet ponds will be utilized this year and Hidden pond will be fallowed<sup>20</sup>. Our passive harvest percentage is at 3% and active harvest number is at 100% of fish removed. Increasing Fyke net use for this year per pond from 2 to 4, this will aide with our passive harvest numbers percentage increase. Potential kettle construction will start with Hidden this current year pending budget approval and the others to follow each year till all are completed<sup>21</sup>.
- 2) Annually stock 3,500 ( $\geq$  200mm) razorback sucker per pond.
- 3) Harvest all ponds on an annual basis.
  - a. All Razorback Sucker will be scanned for a PIT tag and the number will be recorded. If tag cannot be detected, fish will be implanted with a PIT tag prior to stocking into the San Juan River<sup>1</sup>.
  - b. From recent conversations among the Biology Committee, it has been decided that stocking of any Razorback <300mm TL into the San Juan River will no longer be acceptable<sup>2</sup>.
  - c. Stock ~ 4,200 to 6,300 fish based on 40-60% return.
    - 3c. Investigate and utilize multiple stocking localities. Locations are determined by USFWS, but PNM release site is a constant location for stocking<sup>22</sup>.
- 4) Experimentally acclimatize, as guided by SRRIP – Biology Committee, razorback sucker from the NAPI ponds<sup>3</sup>. Current method of acclimatization is performing a Hard and Soft release techniques. This technique is conducted during passive fall harvest of NAPI fish<sup>19</sup>.

## **Location**

The RBS grow-out ponds are located in Block III of Region 2 on NAPI lands, south of Farmington, New Mexico. Avocet East and West are located NW of the intersection of N 4062 and N 4087, which is approximately 3 miles southwest of the Ojo Amarillo NHA Housing Subdivision. Hidden Pond is located SE of the intersection of N 4087 and N 4095 approximately 1 mile northwest of the NAPI Region II Complex.

## **Methods/Approach**

The NNDFW will be responsible for overall management of the NAPI ponds regarding daily management duties, harvesting, and stocking. The Service, Region 2, will be responsible for coordinating the stocking of the ponds with Southwestern Native Aquatic Resource and Recovery Center<sup>4</sup> and NNDFW per US Fish and Wildlife Service Region 2 stocking policy. The NNDFW will be responsible for daily management of the three grow out ponds on NAPI with assistance by the Service, Region 2. Harvesting, tagging, and stocking will be conducted by NNDFW, with assistance from the Service if additional personnel are needed. Associated data management and reporting for the project will be handled by staff from the NNDFW.

Pond management requires that staff monitor and record water quality and quantity, and feed the fish on a daily

basis. Water quality samples parameters include dissolved oxygen concentrations, pH, water temperature and conductivity. Measurements are taken twice a day from each corner of the ponds.<sup>10</sup> Fish food calculations are calculated each month after sample counts have been conducted. Using the pond temperature, we are able to calculate the growth percentage and input that into the overall feed calculation and feeding rate. The calculation is [(lbs./fish)\*growth rate\*total number of fish in pond]<sup>15</sup> In additional, staff manages water quantity to ensure that water quality is optimal. Maintenance includes operating and repairing valves and aerators, evaluating the pond perimeters for erosion problems, repairing fences, monitoring aquatic vegetation and maintaining a log book and database for management of the ponds.

During FY 2018, East Avocet, West Avocet, and Hidden ponds will be managed for a single cohort of RBS. NNDFW will implement passive harvest using fyke nets to trap, tag, and stock RBS into the SJR for several days or months prior to dewatering the ponds. As the ponds are dewatered, NNDFW and Service staff will work together to do the final RBS removal, tagging, and stocking into the SJR.

Whenever the ponds are drained, they will be evaluated for structural stability. Areas away from ponds that may be impacted by dewatering will also be evaluated. Staff will identify and document any structural damage to the ponds and dewatering areas if necessary. Feasibility will determine whether improvements are made or not. This proposal does not include any maintenance or repair work that is major and requires mobilization of heavy equipment and is outside of the constraints of this budget.

### **Products/Schedule**

In the spring of 2018, Southwest Native Aquatic Resources and Recovery in Dexter, NM will deliver 10,500 ≥ 200 mm RBS to the three NAPI grow-out ponds. In the fall of 2018, the NAPI ponds will be de-watered and the RBS, which are targeted to be ≥ 300 mm will be harvested and transported to the San Juan River for stocking. A database summarizing numbers of fish, stocking locations and PIT tag numbers will be submitted to the USFWS. A draft report will be submitted by 31 March 2019 and finalized by 1 June 2019.

### **Budget Fiscal Year 2018 for the NAPI Grow-out Ponds - NNDFW**

<b>Personnel (salary and benefits)</b>	<b>NNDFW</b>
1 FTE Fisheries Biologist X \$44,055	\$44,055
Temporary Wildlife Technician	\$5,856
Fringe Benefits \$44,055 X 45.6%	\$20,089
Fringe Benefits Temp. X 8.4%	\$492
<b>Personnel Subtotal</b>	<b>\$70,492</b>
<b>Travel</b>	
1 Tribal Vehicle	\$17,000
Per Diem Lodging and Meals	\$1,000
<b>Travel Subtotal</b>	<b>\$18,000</b>
Office Supplies and Equipment	\$ 500
General Operating Supplies (includes fish transport costs, i.e. oxygen, salt, stress coat, etc.)	\$2,500
Electricity Cost (aeration)	\$1000
Feed Cost (1.30/ lb. - 5000)	\$6,500
Uniforms	\$500
Fuel – Propane, cannon guns	\$200
Printing/Binding/Photocopying	\$100

Repairs and Maintenance – Paint, sealant, lubricants, water pump repairs	\$1,000
<b>Support Subtotal</b>	<b>\$12,300</b>
<b>Total</b>	<b>\$100,792</b>
<b>Administrative charge (17.0%)</b> <b>\$100,792 X .17</b>	<b>\$17,135</b>
<b>Navajo Nation Total</b>	<b>\$117,927</b>

**Budget Fiscal Year 2018 for the NAPI Grow-out Ponds – USFWS - NMFWCO**

<b>Personnel (salary and benefits)</b>	<b>USFWS - NMFWCO</b>
Daily Pond Mgmt. 2 FTE USFWS – Fish Biologist (GS – 9/7) @ \$2,342	\$2,342
(GA – 11/7) @ \$2010	\$2,010
Bio Science Tech (GS – 5/1) (2 ppl) @ \$4,889	\$4,890
Admin Officer (GS -9/8) @ 1,716	\$ 1,716
<b>Personnel Subtotal</b>	<b>\$10,958</b>
<b>Travel</b>	
Per diem (full day) @ 16 x \$51.00	\$816
Per diem (full day) @ 16 x \$38.25	\$612
Hotel Cost @ 32 x \$91.00	\$2,912
<b>Travel Subtotal</b>	<b>\$4,340</b>
Vehicle Fuel	
1 truck x 4 trips – ABQ to Farmington, NM – 366 RT + 150mi/trip local commute @2,063 mi x \$0.54	\$1,115
<b>Equipment</b>	<b>\$1,115</b>
<b>Support Subtotal for NAPI – NMFWCO only</b>	<b>\$16,413</b>
<b>Administrative charge (0.03%)</b> <b>\$16,413/.03 X .03</b>	<b>\$492</b>
<b>NMFWCO Total</b>	<b>\$16,905</b>

Navajo Nation \$117,927  
NMFWCO \$ 16,905  
**Grand Total \$134,832**

**SJRIP PIT TAGS  
2018 Project Proposal**

Mark McKinstry UC-735  
Bureau of Reclamation  
125 South State Street, Room 6107  
Salt Lake City, UT 84138-1147  
Phone 801-524-3835  
FAX 801-524-5499  
mmckinstry@uc.usbr.gov

**BACKGROUND:**

PIT tags are used to individually mark fish for use in movement studies and for mark-recapture estimates in the San Juan River Basin. PIT tags are not specific to any particular project, but are used by several different projects. PIT tags and readers purchased for the SJRIP will be combined with the purchase made for the UCRIP to save money by purchasing larger quantities and save expenses associated with administering the contract. All PIT tags and readers will be shipped to USFWS in Grand Junction C/O Travis Francis at:

U.S. Fish and Wildlife Service  
Colorado River Fishery Project &  
Ouray Nat'l. Fish Hatchery - Grand Valley Unit  
445 West Gunnison Ave., Suite 140  
Grand Junction, Colorado 81501-5711  
(970) 628-7204

**TASKS – 2018**

1. Purchase PIT tags and readers and distribute to end-users

In FY2018, \$60,000 is allocated in the workplan to purchase 25,000 PIT tags and associated equipment (readers, antennas, implanters, etc.). The purchase of this equipment will be done under a new contract to be awarded in FY2016.

**FY 2018 BUDGET**

<b>Funding source</b>		<b>Projected expenditure in FY18</b>
FY2018 Annual funding		\$60,000
<b>Total</b>		<b>\$60,000</b>

**Projected funding:**

**FY-2019** \$60,000.00

**FY-2020** \$70,000.00

## **FY 2018 Project Proposal San Juan River Basin Hydrology Model Operation and Maintenance**

Susan Behery  
Bureau of Reclamation  
185 Suttle St. Suite 2  
Durango, CO 81303  
Phone 970-385-6560  
sbehery@usbr.gov

**Relationship to SJRIP:** Supports Program goals and management by developing, operating and maintaining a hydrology model of the San Juan Basin. The model is key to hydrological analysis of water development scenarios or other scenarios in relation to the flow recommendations.

### **Background:**

The San Juan Basin Hydrology Model (SJBHM) is a hydrologic model of the San Juan River Basin. The SJBHM actually consists of a series of models including evapotranspiration models, a natural flow model in StateMod, and a simulation model in Riverware. Revisions and modifications to the models and supporting data have occurred through a multi-year model development and validation phase. The FY2018 scope of work includes updates to data as available, annual operation and maintenance of the model and data management. FY2018 activities will also include continued streamlining of model processes as new Riverware updates and methods allow, and incorporation of extensive comments as appropriate from the validation process for Gen 4. The Bureau of Reclamation has the primary responsibility for model development and O&M.

Once approved, the model will be available to generate and analyze runs associated with Section 7 Consultations and/or special requests from the Biology or Coordination Committees related to the flow recommendations or other hydrological aspects of the Program.

### **Objective:**

The objective for this work is to ensure that the San Juan Basin Hydrology Model is available for run requests. This will be accomplished by developing and incorporating a revised hydrologic baseline as well as potential flow recommendation scenarios. Adjusting model configurations or operating rules to incorporate new data and/or scenarios and evolving the data set forward through time is also necessary. The FY2018 request also includes funds to continue coordination and interaction with the Program participants and their technical designees.

### **Deliverables:**

An annual hydrology meeting detailing the accomplishments of the model development, data development and model runs will be held for program participants. A report of the meeting will be provided to the coordination committee. In addition, data, documentation and reports from model runs will be provided throughout the model run process. The modified model(s) and supporting data and scripts will also be delivered / made available.

### **Task Descriptions:**

**Task 1: Model Modifications** In collaboration with the SJRIP Program Office, implement and document any changes to the model based on the comments received during the validation period for Gen 4.

**Task 2: Model Maintenance** Includes maintenance of the actual model as well as the supporting data and software. Maintain data to evolve the data set forward through time. This includes an annual update (when available) of USGS data, Reclamation data, New Mexico non-irrigation data, New Mexico irrigation data, Arizona and Utah depletions, Colorado depletions, climate data, and natural flow data. Data must be obtained from various sources and processed for compatibility with the multiple data loaders. Load updated data into the model, run and test the new data. Adjust model configuration, methodologies, or assumptions, as needed. New Riverware updates and versions include streamlined methods that will be adopted when appropriate. Update and expand documentation to reflect current state of model. Update and maintain data management interfaces and other software associated with the data and models. Apply all Riverware updates and patches as they become available. Provide technology transference to Reclamation's Western Colorado Area Office and Fish and Wildlife Service staff in the details of maintaining the data and models. Technology transfer will continue as model, data and software updates take place to ensure that several people are trained in the maintenance of the model.

**Task 3: Model Runs and Analyses** Generate and analyze model runs associated with the implementation of a revised hydrologic baseline, revised flow recommendation scenarios, Section 7 consultations or special requests from the Biology and/or Coordination Committees and/or special work groups. A consultation or scenario run usually requires model reconfiguration and the implementation of operating criteria. Provide technology transference to Reclamation's Western Colorado Area Office and Fish and Wildlife Service staff in the details of maintaining the data and models, and in operating the models. Technology transfer will continue as model runs and analyses are being executed to ensure that several people are trained in the operation of the model.

**Task 4: Program Management and Coordination** Attend or provide written reports for Coordination Committee meetings, as needed, to update the committee on the model status and model results. Attend and assist in conducting Hydrologic Baseline Workgroup meetings to provide model status updates, present results, and work on developing the revised hydrologic baseline. Conduct an annual hydrology meeting of Program participants to review and solicit input on accomplishments and activities relating to the model for the previous year, status of the model, and proposed activities for the coming year; and provide a report on the meeting to the Coordination Committee for their review and approval. Develop the FY2019 budget and track FY2018 expenditures.

#### Budget Summary FY 2018

Model Modifications	\$24,000
Model Maintenance	\$16,560
Model Runs	\$18,000
Program Management	\$23,600
<b>Grand Total</b>	<b>\$82,160</b>

<b>FY-2019</b>	<b>\$79,400</b>	†
<b>FY-2020</b>	<b>\$81,800</b>	†
<b>FY-2021</b>	<b>\$84,250</b>	†

† Assumes ongoing model maintenance, model runs, tech transfer, documentation and program management and includes ~3% adjustment.

**Task 1 Model Development**

A) Labor	Task	Salary		Total		Total cost	
		total/hr		Days			
	Revision and incorporation of Gen 4						
	Validation Comments	\$90		15		\$10,800	
	Continued Tech Transfer	\$90		10		\$7,200	
B) Travel	Purpose	Dest.	Trips	Days/ Trip	Airfare/ Trip	Lodging, expenses /day	Total Cost
	Reclamation meeting with SJRIP	ABQ	1	2	\$500	\$250	\$1,000
C) Other Costs	Task						Total Cost
		Riverware Technical Support					

**Task 2 Model Maintenance**

A) Labor	Task	Salary		Total		Total cost
		total/hr		Days		
	Data Updates as Available	\$90		10		\$7,200
	Software Updates	\$90		3		\$2,160
	Methodology updates as needed	\$90		10		\$7,200

**Task 3 Model Runs**

A) Labor	Task	Salary		Total		Total cost
		total/hr		Days		
	Model Runs and Analyses	\$90		25		\$18,000

**Task 4 Program Management Coordination**

A) Labor	Task	Salary		Total		Total cost	
		total/hr		Days			
	Meetings and Coordination	\$90		25		\$18,000	
	Budget	\$90		5		\$3,600	
B) Travel	Purpose	Dest.	Trips	Days/ Trip	Airfare/ Trip	Lodging, expenses /day	Total Cost
	Reclamation to Workgroup Meetings	ABQ	2	2	\$500	\$250	\$2,000

**Improve Stream Gaging and Flow Measurements  
San Juan River Basin Recovery Implementation Program  
Fiscal Year 2018 Project Proposal**

Susan Behery  
Bureau of Reclamation  
185 Suttle St. Suite 2  
Durango, CO 81303  
Phone 970-385-6560  
sbehery@usbr.gov

**Background:**

There are five United States Geological Survey (USGS) streamflow gaging stations on the main stem of the San Juan River that are very important to management of the river and the operation of Navajo dam to implement the San Juan Recovery Implementation Program (SJRIP) flow recommendations. Stream gaging data on the San Juan River are necessary to reliably implement and revise the SJRIP flow recommendations.

**Study Area:**

San Juan River Basin in New Mexico

**Objective:**

Provide funding to the USGS to take additional flow measurements as needed at the four San Juan River gages in New Mexico. The four gages are San Juan near Archuleta, San Juan at Farmington, San Juan at Shiprock, and San Juan at Four Corners. (Note: Base cost for operation of the stations is paid for by non-Program funds.)

**Products:**

1. Improved flow measurement and more accurate gage readings.
2. Technical presentation at the end of the year from USGS summarizing the activities completed and the value of obtaining additional readings.

**Budget FY-2018:**

Objective: Provide funding to USGS for 12 additional flow measurements at the four San Juan River Gages in NM.	Staff days	Labor	Travel	Equipment and supplies
Personnel	7.5	6,900		
Travel			1,600	
Equipment and supplies				0
<b>Total</b>				<b>\$8,500</b>

**Estimated Outyear Funding (Based on 3% adjustment for inflation)**

Fiscal Year 2019	\$8,755
Fiscal Year 2020	\$9,018
Fiscal Year 2021	\$9,289

# **Operation of Public Service Company of New Mexico Fish Passage Structure**

## **Fiscal Year 2018 Project Proposal**

Principal Investigators: Jeffrey Cole, Kim Yazzie  
Navajo Nation Department of Fish and Wildlife  
Box 1480 Window Rock, AZ 86515  
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## Operation of Public Service Company of New Mexico Fish Passage Structure

### Fiscal Year 2018 Project Proposal

Principal Investigators: Jeffrey Cole, Kim Yazzie  
Navajo Nation Department of Fish and Wildlife  
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#### **Background**

The Power Company of New Mexico (PNM) Diversion Dam was constructed in 1971. The 3.25-foot high diversion dam (weir) is located on the San Juan River about 12 miles downstream of Farmington, New Mexico near the town of Fruitland at River Mile 166.6. Facilities at the diversion include a concrete weir, a series of screened intake structures, an intake channel, a settling channel, and a pump house.

Water flows over the dam into a stilling basin created by a concrete apron. The stilling basin is the width of the river. The presence of the dam and the basin creates a barrier to fish moving upstream. As flows increase, the difference in the upstream and downstream water levels is reduced. Although water levels are reduced, water velocities increase and the weir provides an impediment to upstream fish movement. Recovery studies conducted as part of the SJRRIP have shown that some fish are able to move upstream past the weir but their specific method of movement is not known and the number of fish discouraged from upstream movement by the presence of the weir is also unknown. One possible method of upstream movement could occur during high river flows. When the flow in the San Juan River is above 7,000 cfs, some of the flow goes around the dam making it possible for fish to go around the dam at these higher flows.

A need has been identified by the San Juan River Basin Recovery Implementation Program (SJRRIP) to restore endangered fish passage upstream past the PNM Diversion Dam. The purpose of establishing fish passage was to protect and recover native Colorado pikeminnow (*Ptychocheilus lucius*) and razorback sucker (*Xyrauchen texanus*) populations in the San Juan Basin while water development proceeds in compliance with all applicable Federal and State laws, including fulfillment of Federal trust responsibilities to the Southern Ute Indian Tribe, Ute Mountain Ute Tribe, Jicarilla Apache Nation and the Navajo Nation. In addition, other native fish species would benefit from restored passage. The facility has been operated and maintained by the Navajo Nation Department of Fish and Wildlife (NNDFW) since it was built in 2003. The U.S. Fish and Wildlife Service (Service), Bureau of Reclamation (BOR), Bureau of Indian Affairs (BIA), Navajo Indian Irrigation Project (NIIP), Navajo Agricultural Products Industry (NAPI), and PNM have provided the NNDFW with technical assistance, planning assistance, environmental clearance, maintenance and improvements to the facility and its access points.

The fish passage has facilitated movement of pikeminnow and razorback suckers upstream into a 50 mile stretch of river, which is historical habitat of these species.

#### **Study Area**

Public Service Company of New Mexico Diversion Dam is located at RM 166.6.

#### **Methods/Approach**

The Fish Passage facility will be operated from April 1 to October 31, 2018. The fish passage traps fish attempting to move upstream of the facility. All fish that are caught in the trap are transported to a sorting table. All fish are identified and enumerated. Non-endangered native fish are released upstream of the facility. Rare native fishes are scanned for a pit tag, weighed and measured, marked with a pit tag if they do not have one and then released upstream of the facility. All non-native fishes are removed from the

river system permanently. When feasible, channel catfish are transported to area fishing lakes that already have channel catfish in their systems to support the tribal sport-fishing program.

Daily operation and maintenance includes cleaning of surface and submerged trash, debris, silt, and river-born algae from the trash racks and bar screens in the fore-bay of the fish passageway, and aluminum conduit screens in the fish trap. The amount of algae, debris, trash, and sediment that accumulates daily at this site is seasonally variable, depending upon flow magnitude and water volume during the water year. Maintenance also includes painting as necessary to control corrosion, lubrication of moving equipment, and checking fluid levels in gearboxes and cooling radiators, as necessary. Representatives from the NNDFW, BOR, PNM and the Service will perform an inspection of the facility every 3 years. In the event of a significant flood event, representatives from the NNDFW will notify BOR, PNM and FWS and appropriate parties will inspect the facility for damage, as necessary.

The Fish Passage Program maintains a database of all fish processed through the facility. Staff that operate this facility also have initiated a public outreach and education program that will continue in FY' 2018. School groups visit the facility to learn about the purpose of the facility and the endangered fish program on the San Juan River.

Objectives of this project are as follows:

1. Determine the use of the fish passage by juvenile and adult native and nonnative fishes.
2. Identify any Colorado pikeminnow congregations that may be related to the spawning period in the San Juan River.
3. Operate and maintain<sup>5</sup> the facility in a manner that assures long-term benefit.

This proposal does not include any maintenance or repair work that is major and requires mobilization of heavy equipment and is outside of the constraints of this budget.

### **Products/Schedule**

The Fish Passage facility will be operated from April 1 to October 31, 2018. During the operation season the passage is operating 24 hours a day, 7-days a week. Each channel is checked daily and are sorted for Native and Non-natives<sup>1</sup>.

Data will include definitive numbers of species, numbers per species, and seasonal use and distribution by species. Our numbers on Razorback Suckers seem to be greater before the high flow regime and later in the season when flows taper out. The 2016 numbers were 42 before the high flow period (March to May) and 30 at the end of the season (Sept. and Oct.). As for the Colorado Pikeminnow they seem to peak after the monsoon season flow spikes. The 2016 data showed 129 species to move thru the facility during the months of July and August<sup>2</sup>. Identification of Colorado Pikeminnow congregations will be observed and noted based off flow regime and monsoon season trend. As 2016 showed our Pikeminnow numbers occurred at the tail-end of the monsoon season for San Juan County<sup>6</sup>.

NNDFW staff will prepare and submit monthly reports and one draft and final annual report. USFW Service staff will assist NNDFW with data analysis and draft and final report preparation, if needed.

NNDFW staff will attend SJRRIP Biology Committee meetings and provide reports as needed throughout the year.

Fiscal Year – 2018 Budget for the PNM Fish Passage Structure

Personnel (salary and benefits)	NNDFW
1 FTE Fisheries Biologist X \$44,055	\$44,055
Temporary Wildlife Technician	\$5,856
Fringe Benefits \$44,055 X 45.6%	\$20,089
Fringe Benefits Temp. X 8.4%	\$492
<b>Personnel Subtotal</b>	<b>\$70,492</b>
<b>Travel</b>	
1 Tribal Vehicle	\$17,000
Per Diem Lodging and Meals	\$1,000
<b>Travel Subtotal</b>	<b>\$18,000</b>
Office Supplies	\$ 500
Office Equipment	\$1,000
General Operating Supplies Plumbing supplies, Hardware Supplies, Neoprene Waders, rubber boots, wet suit, landscaping supplies	\$3,500
Nenahnezad Phone	\$ 800
Uniforms	\$500
Printing/Binding/Photocopying	\$100
Repairs and Maintenance – Paint, sealant, lubricants, water pump repairs	\$1,000
<b>Support Subtotal</b>	<b>\$7,400</b>
Training and Conference Registration	\$500
	Base Funding
<b>Total</b>	<b>\$96,392</b>
<b>Administrative charge (17.0%)</b> <b>\$96,392X.17</b>	<b>\$16,387</b>
<b>Grand Total</b>	<b>\$112,779</b>

**SJRIP San Juan and Animas Rivers Temperature Gauges  
2018 Project Proposal**

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Bureau of Reclamation  
125 South State Street, Room 6107  
Salt Lake City, UT 84138-1147  
Phone 801-524-3835  
FAX 801-524-5499  
mmckinstry@uc.usbr.gov

**BACKGROUND:**

Temperature information is required at several gauges in the San Juan River at the following locations:

09355500 - San Juan River near Archuleta, NM - Real time on web

09365000 - San Juan River at Farmington, NM - Real time on web

09364500 - Animas River at Farmington, NM - Stand alone temperature probe until we can get access to install a wired probe.

09381010 - San Juan River at Four Corners, CO - Real time on web (after we configure our database on Monday).

**METHODS:**

River Temperature Gauges

The USGS has installed and maintains 4 temperature probes in the San Juan basin per our agreement. Probes were installed at:

09355500 - San Juan River near Archuleta, NM - Real time on web

09365000 - San Juan River at Farmington, NM - Real time on web

09364500 - Animas River at Farmington, NM - Stand alone temperature probe until we can get access to install a wired probe.

09381010 - San Juan River at Four Corners, CO - Real time on web

Data will be displayed real time via the USGS NWISweb.

**The probes are maintained by USGS with the following contact:**

Jay Cederberg  
Albuquerque Field Office Chief  
USGS, New Mexico Water Science Center  
5338 Montgomery Blvd., NE, Suite 400  
Albuquerque, NM 87109  
505.830.7924 | fax: 505.830.7986  
[cederber@usgs.gov](mailto:cederber@usgs.gov)  
web: <http://nm.water.usgs.gov>

**TASKS – 2018**

1. Operate and maintain water temperature probes at four different locations in the San Juan River Basin

**FY 2016 BUDGET**

<b>Task</b>	<b>Expenditure in FY2018</b>
Temperature probes @ \$5500/ea	\$22,000
<b>Total</b>	<b>\$22,000</b>

**Projected funding:**  
**FY-2019** \$23,000.00  
**FY-2020** \$24,500.00

*Ecosystems Research Institute, Inc.*



# **San Juan River Basin Recovery Implementation Program Habitat Monitoring 2017-18**

**Technical Proposal**

**July 2017**

## Introduction

In 1998, flow recommendations were developed by the SJRIP for the San Juan River below the confluence with the Animas River (River Mile 180). The details of the flow recommendations were heavily based upon river channel and habitat response to flows determined from a 7-year research study of channel morphology and habitat. In 1999, long-term monitoring was established to monitor channel and habitat response to flows. The protocols were continuations of those established during the 7-year research period and continued through 2004. From 1992 to 2007, the river-wide habitat mapping was conducted by ERI staff.

During the data integration process of 2004–2005, it became evident that backwater habitat types during base flow periods (800-1500 cfs) had been reduced in number and surface area beginning in September, 1995. Backwater surface areas between River miles 2 to 180 had decreased from 140,000 m<sup>2</sup> in September 1995 to less than 20,000 m<sup>2</sup>, river wide by October 2003. From 2005 to 2015, backwater surface areas have stabilized at approximately 30,000 to 40,000 m<sup>2</sup>. However, during 2016, the area of backwaters increased to over 90,000 m<sup>2</sup>. It was hypothesized that the characteristics of the 2016 San Juan River spring runoff (magnitude, duration, etc.) were instrumental in the increase in low velocity habitats.

The data integration analysis in 2005 also indicated that complex channel reaches (those with high habitat diversity, islands, multi-threaded channels and complex channel margins) correlated to native fish abundance. Furthermore, capture of Young-of-year (YOY) endangered fish also tended to correlate with channel complexity. Finally, backwater and low velocity habitats were more likely to occur in these reaches with high complexity.

Standardized habitat monitoring for the San Juan River was included in the 2000 monitoring plan and was reviewed and revised for the 2011 to 2015 monitoring project. Those revisions were formalized in the 2012 San Juan River Monitoring Plan and Protocols. The initial five- year effort with the revised habitat protocols was completed in 2015.

The final report on this 5-year monitoring effort concluded that there has been a significant loss in critical habitats over time (significant negative regression slope) and that certain low – flow antecedent conditions were correlated with these habitat losses.

As noted previously, several of these habitat characteristics, (Total Wetted Area, Island Count, and Low Velocity Habitats) increased after the 2016 San Juan River spring runoff. Currently, the Bureau of Reclamation is predicting that the 2017 spring runoff will be above average and similar to the 2016 flows.

The 2017-18 habitat monitoring will document the impacts of the 2017 hydrograph on the newly created critical habitats from 2016 and evaluate the mechanisms hypothesized to have created or reduced the amount of these habitats (threshold flows and/or duration in magnitude of flows for 2017).

Within the major goals of the SJRIP monitoring program, the results of this proposed project will in part meet goal number (2) “Track changes in abiotic parameters, including water quality, channel morphology, and habitat, important to the fish community in particular and the aquatic community in general”. Specifically, the major tasks to be undertaken are:

- Task 1) Arrange the acquisition of high-resolution digital imagery from Rm (180) to Rm (-10, (confluence with Lake Powell) and prepare maps for field verifications. Aerial imagery will be obtained from a consultant contracted by the Program Office
- Task 2) Field Habitat Mapping (verification of flowing secondary channel types, backwaters, embayments, islands and total wetted areas under summer baseflow conditions) in critical complex areas of the San Juan River
- Task 3) Post-process the planform geometry into ARC GIS and determine density and area for each habitat type.
- Task 4) Analysis data and prepare a final report describing the effects of the 2017 high flow hydrograph on the habitats and secondary channel types found in 2015 and created in 2016.

The proposal time frame is from July 1, 2017 to September 31, 2018.

## **Project Justification**

The SJRIP has, as one of its two primary goals, the conservation of populations of Colorado pikeminnow and razorback sucker in the San Juan River basin. To aid in the evaluation of achievement of these program goals, the following monitoring plan goals were developed (San Juan Draft Monitoring Protocols, 2010):

- 1) Track the status and trends of endangered and other fish populations in the San Juan River;
- 2) Track changes in abiotic parameters, including water quality, channel morphology, and habitat, important to the fish community in particular and the aquatic community in general;
- 3) Utilize data collected under Goals 1 and 2 to help assess progress towards recovery of endangered fish species; and,
- 4) Assess effectiveness of management actions, implemented flows, and intra- and inter-annual variability in flows on recovery of Colorado pikeminnow, razorback sucker and population status of other fish species.

Relative to this proposal, SJRIP goal (2) and (4) above will be met in part. Specifically, achievement of this goal will occur through the tracking of species important backwaters (numbers and areas), as well as channel complexity necessary for all life stages of the two rare fish in the San Juan River. Updating the existing database and comparing the current information will provide a status and trends.

## Project Objectives

The specific objectives of this work-plan correspond to the overall objectives of the monitoring protocols (2012). Specifically the direct linkage of objectives between this study and protocol objectives (by number) that are in common include:

**Objective 1)** Annually, following spring runoff, document abundance and distribution of key habitats and geomorphic features (backwaters, embayments, islands and total wetted area) that indicate the response of the river channel and habitat to antecedent runoff conditions and specific management actions... *(Specifically determine the impact of the 2017 high water hydrograph on habitat planform).*

**Objective 8)** Develop relationships between habitat availability and antecedent flow conditions. Use key habitats for this analysis. *(The hydrograph for 2016 has produced more days above 8,000 and 5,000 cfs since the high flows of 2008 and produced the most backwater area since 1995. Evaluate if the existing relationships between habitat densities and antecedent conditions are still valid for the habitat densities that will occur after the 2017 spring runoff).*

**Objective 9)** Track long-term trends of habitat availability

### **Task 1. Develop high-resolution Digital Imagery for Rm -10 to Rm 180.**

The San Juan River will be flown and digital images captured at a resolution of 10 centimeters. Images will be printed with a 20% overlap between images and placed in plastic overlays. Field mapping will be on these plastic sheets and will cover key reaches of the river where overhanging vegetation conceals the entrance of secondary channels.

### **Task 2 Field Habitat Mapping**

Field verification of flowing secondary channel types will occur during the summer base-flow period (2017).

Using these habitat categories at a scale of 1" = 200', map directly onto field images developed in Task 1. All flowing secondary channels, main channel splits, island splits and cobble/sand bar splits will be noted and included as total wetted area.

### **Task 3) Post-process the planform geometry into ARC GIS and determine density and area for each habitat type.**

Once the digital frames with the field mapping have been registered, ArcGIS will be used to digitize the boundaries of the wetted secondary channels. In addition backwaters, embayments islands and in-stream sand/cobble bars will be mapped. The data will be processed and summarized by river-mile to match existing datasets.

#### **Task 4) Prepare a final report describing the effects of the 2017 high flow hydrograph on the habitats and secondary channel types compared to 2015 and 2016**

A final report will examine the relationships between hydrology (especially recent antecedent hydrology conditions prior to image capture and mapping) and habitat conditions (density and area) throughout the river. Trend analysis will be performed on all habitat types mapped to assess trend with time and flow at mapping. Trends with time will be analyzed with raw data (habitat count and area by river-mile with time) and with data normalized for flow at mapping where flow is a covariate. Antecedent conditions will be calculated and relationships to habitat abundance compared to previously developed relationships.

One of the following hypotheses to be addressed for the 2017 data depending upon the hydrologic conditions prior mapping.

H<sub>01</sub> : If the spring runoff is greater than the average runoff, TWA, Island Count and Backwater Type area will increase compared to the 2016 habitat characteristics (density and area)

H<sub>02</sub> : If the spring runoff is equal to the average runoff, TWA, Island Count and Backwater Type area will remain the same compared to the 2016 habitat characteristics (density and area)

H<sub>03</sub> : If the spring runoff is less than the average runoff, TWA, Island Count and Backwater Type area will not change compared to the 2016 habitat characteristics (density and area)

As part of the habitat post processing analysis, backwater and embayments will be divided into several types. These types of backwaters include those associated with main channel point bars and point bars on islands. In addition, backwaters associated with dry secondary channels and dry island split channels will be defined and quantified by river mile (count and area). Recent analysis has resulted in all historical backwater data being reclassified into these categories.

#### **Schedule**

Base photography will be acquired in late July or early August 2017 (flow permitting). Frame capture, rectification, and photo-interpretation will be completed by September 15, 2016. Field mapping will occur by the end of September, 2017. ARC GIS data transfer will be completed by December 31, 2017. The draft annual report will be completed by March 31, 2018 with the final report due June 1, 2018.

#### **Deliverables**

- 1) Aerial images of channel at a flow between 500 and 1,000 cfs.

- 2) Polygon area, perimeter and geo-referenced location of backwaters, embayments, islands, and channel margins
- 3) Flow at mapping (flight date) for each USGS gage. Distribution and abundance (area and density) of backwaters, embayments and total wetted area in response to antecedent runoff condition and other management actions. Channel complexity (e.g. island count and total wetted area per river mile)
- 4) Date of mapping
- 5) Antecedent runoff hydrograph
- 6) Data summarized by river mile, geomorphic reach and full range
  - An annual draft report prepared and submitted by March 31, 2018
  - A final report submitted by June 1, 2018
  - Attendance at the annual report meeting

Although numerous comments were received by the Peer Reviewers concerning the potential expansion of the habitat-monitoring program, this proposal does not include the suggested additional work elements. It was felt that due to limited time and the need to fully document the potential planform changes resulting from two successive above average flow releases from Navajo Reservoir, the 2018 program would focus only on river-wide habitat structure. Additional work elements will be prioritized and proposed as part of the SOW process for 2019.

## APPENDIX A

# Qualifications of Investigators

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The project team will be made up of staff from Ecosystems Research Institute, Inc (ERI) ERI has extensive experience on the San Juan River and its tributaries having annually mapping aquatic habitats since 1991. In addition, the principal (Dr. Vincent Lamarra, ERI ) has a long-standing presence on the Biology Committee of the SJRIP. Mr. Daniel Lamarra of ERI will be responsible for the field and laboratory habitat portion of the work elements. Mr. Daniel Lamarra has mapped the habitats used by the SJRIP for the last five years, including the RERI Phase I and II channels. That same group of scientists at ERI will be used on this project. This will result in a consistent database between the current project and the historical information gathered by the program.

In addition, these scientists have written numerous reports dealing with habitat quality, habitat and fish interactions as well as the effect of physical factors (temperature) on fish distributions in the San Juan River.

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## APPENDIX B

### Budget for 2018 Habitat Monitoring

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#### Budget: 2018

TASK	Labor	Direct Costs	Total by Task
Contractor Image Capture	No Charge	No Charge	No Charge
<b>Task 1 Map Preparation</b>			
<i>Image Clipping and Capture</i>	\$2,060	\$1,267	\$3,327
<b>Task 2 Field Verification</b>			
<i>Habitat and Channel determination</i>	\$9,594	\$1,184	\$10,778
<b>Task 3 Post Process</b>			
<i>Image rectification</i>	\$2,060		\$2,060
<i>Digitizing Waters Edge</i>	\$16,758		\$16,758
<i>Back Water/ Embayment Identification</i>	\$8,654		\$8,654
<b>Task 4 Final Report and Presentation</b>			
<i>Data Analysis</i>	\$21,745	\$984	\$22,729
<i>Reporting</i>	\$17,008	\$870	\$17,878
<b>Total Cost Estimate</b>	<b>\$77,879</b>	<b>\$4,305</b>	<b>\$82,184</b>

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**Nonnative Species Monitoring and Control from Shiprock, New Mexico to Mexican Hat, Utah San Juan River**

**Fiscal Year 2018 Project Proposal**

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**Goal**

Continue to quantify effects of nonnative fish removal by raft-mounted electrofishing on native and nonnative fishes in the San Juan River and to inform the San Juan River Basin Recovery Implementation Program's Biology Committee on the utility and practicality of the nonnative fish removal program.

**Link to Long Rang Plan**

Reducing the impacts of nonnative fishes has been identified as a critical Program Element in the San Juan River Basin Recovery Implementation Program's Long Range Plan (2015). Goals, Actions, and Tasks associated with this Element and encompassed within this scope of work include:

**Goal 3.1—Control Problematic Nonnative Fishes**

Action 3.1.1 Develop, implement, and evaluate the most effective strategies for reducing problematic nonnative fish.

Task 3.1.1.1 Mechanically remove nonnative fish to achieve objectives.

Task 3.1.1.3 Remove nonnative fish during Program research and monitoring activities.

Task 3.1.1.4 Conduct annual review of the success of the nonnative fish control strategy.

Task 3.1.1.7 Evaluate and implement effective alternative nonnative fish reduction methods.

Secondarily, nonnative fish removal crews collect both spatial and temporal data on rare fish encountered during sampling efforts. These data have been used in assessing progress towards recovery and to evaluate the augmentation programs for both Colorado Pikeminnow (*Ptychocheilus lucius*) and Razorback

Sucker (*Xyrauchen texanus*). Additional Long Range Plan Actions and Tasks associated with this task include, but are not limited, to the following:

Goal—4.1 Monitor Fish Populations of the San Juan River Basin

Action 4.1.3 Collect data on the endangered native and nonnative fish communities during other Program management activities, when possible.

Task 4.1.3.1 Collect data on the endangered fish and native fish community during nonnative fish control activities to aid in tracking the presence, status and trends of endangered fish populations.

### **Overview**

Since implementation of annual intensive nonnative fish removal in 2000, the structure of the fish community in the San Juan River has changed substantially (Franssen et al. 2014a). On an annual basis, Colorado Pikeminnow and Razorback Sucker densities (i.e., CPUE) have increased over time, nonnative Common Carp (*Cyprinus carpio*) densities have decreased, and Channel Catfish (*Ictalurus punctatus*) densities have decreased but only in upper reaches of the river (Franssen et al. 2014a, Franssen et al. 2014b). However, the relative contribution of nonnative fish removal via electrofishing, other management actions and environmental factors in driving these changes is unclear. For example, establishing a causal linkage between nonnative fish removal or other management actions (e.g., flow manipulation, habitat restoration) and changes in endangered fish densities is difficult due to the heavily augmented nature of these populations. Conversely, temporal variation (or the lack of) in the densities of nonnative fishes following removal efforts are potentially more directly related, but this variation is also not exempt from other environmental factors (e.g., flow variation and reduced immigration). Given the spatial and temporal inconsistencies of past nonnative fish removal efforts as well as the multiple biotic and abiotic factors contributing to temporal variation in densities of fishes, it is not surprising effects of this management action have been difficult to elucidate.

Based on annual population estimates of Channel Catfish (Duran 2015 and Hines 2015), it is readily apparent the level of nonnative fish removal effort previously put forth will likely not suppress recruitment enough to induce system-wide population decline of this species. Nonetheless, removing individual Channel Catfish from the river by definition lowers their densities, which has the potential to positively impact endangered fishes through reduced competition or predation as well as negatively through deleterious effects of electrofishing on native fishes. Yet, these potential direct (or indirect) effects of the San Juan River's nonnative fish removal program has been difficult to assess due to the complications mentioned above. Therefore, in FY16 we proposed to redesign the nonnative fish removal efforts to evaluate by what factor and for how long Channel Catfish densities were lowered and the responses of native fish densities to electrofishing and nonnative fish removal.

Preliminary data analysis from 2016 showed a general increase in Channel Catfish CPUE over time in the furthest most upstream study reach but decreased CPUE in the lower reaches. Additionally, size structure of Channel Catfish decreased over time in only the three upper removal reaches. Exploitation rates were generally higher in the three upper reaches of the study area. Increased effort in the upper reaches of the study area, much of it focused prior to spring runoff, resulted in a 2.5x increase in hours of electrofishing per river mile compared to previous efforts and a corresponding 2 to 6x increase in juvenile Channel Catfish exploitation rates and a 2 to 3x increase in adult Channel Catfish exploitation rates. In spite of these high exploitation rates, we did not detect riverwide population level declines in Channel Catfish; however, these data were likely confounded by prolonged high spring release flows and higher than average rates of Channel Catfish movement. Continued implementation and evaluation of this more structured nonnative fish removal should provide the San Juan River Basin Recovery and Implementation Program with a clearer scientific evaluation of the effects of the nonnative removal program on native and nonnative fishes in the San Juan River.

To that end, on December 1, 2016 the SJRIP conducted a Nonnative Fish Removal Workshop where results from the 2016 removal efforts were presented and discussed among participants from the Biology Committee and peer reviewers. As a result of these discussions, the Biology Committee developed several options for nonnative removal in 2017 and a ranking system was developed to determine the preferred option. This ranking process resulted in a recommendation by the Biology Committee to move forward with nonnative removal in 2017. Key components to the preferred choice included focusing efforts prior to spring runoff (based on 2016 results), conducting pre and post removal population estimates for Channel Catfish, Razorback Sucker, and Colorado Pikeminnow; and continuing to have both control and treatment reaches. FY18 represents the third year of this revised study design.

### **Objectives**

1. Spatially demarcate removal and control reaches on the San Juan River in order to statistically evaluate responses of fishes to nonnative fish removal via electrofishing.
2. Assess Channel Catfish CPUE and size distributions within removal reaches over time using nonnative fish removal data.
3. Compare Channel Catfish, Razorback Sucker, and Colorado Pikeminnow CPUE between control and treatment reaches using sub-adult and adult fish community monitoring, and nonnative fish removal data.
4. Compare Channel Catfish, Razorback Sucker, and Colorado Pikeminnow population estimates (pre and post removal).
5. Compare Channel Catfish size distributions between control and removal reaches using sub-adult and adult fish community monitoring, and nonnative fish removal data.
6. Quantify movement of tagged Channel Catfish among treatment and control reaches over the summer.

### **Hypotheses**

1. **H<sub>0</sub>:Nonnative fish removal does not alter the CPUE of Channel Catfish over time.**
2. **H<sub>0</sub>:Nonnative fish removal does not change the estimates of population sizes in removal reaches over time.**
3. **H<sub>0</sub>:Nonnative fish removal does not alter the size structure of Channel Catfish over time.**
4. **H<sub>0</sub>:Nonnative fish removal does not alter the CPUE of Channel Catfish in removal reaches compared to control reaches (after controlling for initial CPUE).**
5. **H<sub>0</sub>:Nonnative fish removal does not alter the size structure of Channel Catfish in removal reaches.**
6. **H<sub>0</sub>:Nonnative fish removal does not alter the CPUE of Colorado Pikeminnow and Razorback Sucker Catfish in removal reaches.**
7. **H<sub>0</sub>:Channel Catfish do not move among reaches.**

## **Methods**

### *Study design*

The proposed nonnative fish removal design will be used to address questions about the ability of electrofishing to affect CPUE and size structures of Channel Catfish, and alter the densities of endangered fishes.

The study design for FY18 will follow a protocol similar to FY 2017. The river between Shiprock, NM and Mexican Hat, UT will be stratified by geomorphic reach to help control for natural longitudinal variation in fish densities (Figure 1). Within each geomorphic reach, the river will be further divided into treatment and control reaches (i.e., geomorphic reach 3 will contain two removal and control reaches). Because of the different agencies involved with nonnative removal, reaches in the upper parts of the river will undergo 18 passes (each pass is two electrofishing rafts on each shore) of removal effort and at least eight passes in the lower reach (i.e., NMFWCO upper section and Utah Department of Wildlife Resources (UDWR) lower section; Figure 1) each year. The disparate removal efforts between the upper and lower reaches will necessitate analyzing these reaches separately. Lengths of treatment and control sub-reaches within each geomorphic reach will be demarcated to maximize the sample size of collections used for comparisons to increase statistical power (mean sample size = 13, range = 7-23). No electrofishing will take place in control reaches (except for the two marking and two recapture passes, see below).

### *Removal and tagging protocol*

All nonnative fish removal efforts will occur between March and September before annual sub-adult and adult fish community monitoring (i.e., fall monitoring) and efforts will be made to limit the amount of electrofishing during spawning periods of Colorado Pikeminnow (Table 1). To generate a pre and post removal population estimate, the first and last passes of the year between Shiprock Bridge, NM and Mexican Hat, UT will be used to tag Channel Catfish and quantify relative abundance (CPUE; fish/hr of electrofishing), and sizes of Channel Catfish, Colorado Pikeminnow, and Razorback Sucker in each river mile. The tagging trip in the spring will take place one week prior to all removal events. The tagging trip will consist of two electrofishing rafts collecting all nonnative fishes, as well as Colorado Pikeminnow and Razorback Sucker at one river mile intervals throughout the entire section of river, both treatment and control sections. All Channel Catfish  $\geq 200$ mm total length will be tagged with individually numbered floy tags and released back to the river. To generate a pre-removal population estimate, the first removal event post tagging in the spring will sample the entire section of river from Shiprock Bridge, NM to Mexican Hat, UT., including control reaches. All nonnative fishes collected in control reaches during this trip will be released back to the river. All other subsequent trips will collect and remove Channel Catfish in only the treatment reaches at every three river miles and quantify size structure of Channel Catfish in each reach (all fish will be measured from samples until at least 150 individuals are measured in each reach). All endangered fishes will be collected, measured and PIT tagged if untagged. To generate a post-removal population estimate, the last pass of the study period that would take place in September a week prior to fall monitoring will be substituted to a tagging trip with the same tagging protocol as the spring tagging event. The fall monitoring trip, which samples the entire section of river, will serve as the recapture event post-tagging.

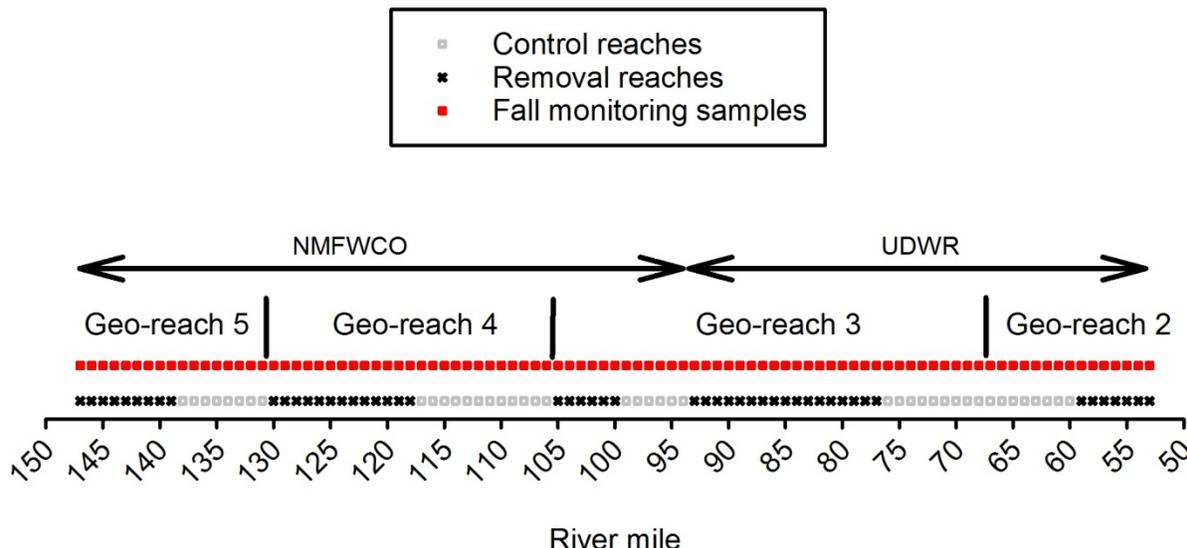


Figure 1. Proposed study area from Shiprock Bridge, NM (RM 147.9) to Mexican Hat, UT (RM 52), detailing treatment (black) and control (grey) sub-reach river miles by geomorphic reach. The red squares identify river miles that will be sampled by large-bodied monitoring in fall 2017 and used in statistical analyses. The proposed spatial effort extended by each agency is denoted.

Table 1. Example of how the timing of the proposed tagging and removal trips may be scheduled in the upper study reaches (USFWS – NMFWCO). Single removal passes are denoted with an “X”, multiple pass efforts are denoted with an “XX”, and sub-adult and adult fish community monitoring is denoted with an “\*”.

	March	April	May	June	July	August	September
Week							
1		XX	XX				
2	Tagging	XX	XX				Tagging
3	XX	XX					*
4	XX	XX				XX	*

Table 2. Example of how the timing of the proposed tagging and removal trips may be scheduled in the lower study reaches (UDWR Moab). Single removal passes are denoted with an “X”, multiple pass efforts are denoted with an “XX”, and sub-adult and adult fish community monitoring is denoted with an “\*”.

	March	April	May	June	July	August	September
Week							
1		XX				X	
2	Tagging	X					Tagging
3	X						*
4	XX					X	*

Due to the disparate removal efforts between the upper and lower sections of the river (i.e., 18 vs 8 passes respectively), we will analyze the two reaches separately. Below we include the primary questions we will address, data sets needed for analyses, and the general structure of statistical analyses that will be applied to the upper and lower reaches. Other potential covariates that may affect sampling efficiency can be included if deemed necessary (e.g., secchi depth, stream discharge at sampling, etc.).

*Data Analysis and Hypothesis Testing***1) Does the CPUE of Channel Catfish vary over time in removal reaches?**

**H<sub>0</sub>: Nonnative fish removal does not alter the CPUE of Channel Catfish over time.**

**Prediction: The CPUE of Channel Catfish will decrease over time in removal reaches.**

-Calculate the mean CPUE of Channel Catfish in each removal reach (using 1 RM as the sample unit from the first and last pass, and 3 RM for each removal pass) from each trip (n = 11 upper reach, n = 9 lower reach).

-Test for temporal variation in CPUE using nonparametric correlations

**2) Do Channel Catfish, Razorback Sucker, and Colorado Pikeminnow population sizes vary over time in removal and control reaches?**

**H<sub>0</sub>: Nonnative fish removal does not change the estimates of population sizes in removal reaches over time.**

**Prediction: The population size of Channel Catfish will decrease over time in removal reaches**

-Assess if 95% CI from Lincoln-Peterson population estimates in each reach overlap between the start and end of the experiment.

**3) Does the size structure of Channel Catfish vary over time in removal reaches?**

**H<sub>0</sub>: Nonnative fish removal does not alter the size structure of Channel Catfish over time.**

**Prediction: Nonnative fish removal will decrease the size structure of Channel Catfish in removal reaches.**

-Calculate the median Total Length (TL) of Channel Catfish in each removal reach during each removal period (n = 11 upper reach, n = 8 lower reach).

-Test for temporal variation in size structure using nonparametric correlations between median TL and trip number.

**4) Does nonnative fish removal alter the density of Channel Catfish in removal reaches relative to control reaches?**

**H<sub>0</sub>: Nonnative fish removal does not alter the CPUE of Channel Catfish in removal reaches compared to control reaches (after controlling for initial CPUE).**

**Prediction: The CPUE of Channel Catfish will be lower in removal reaches compared to control reaches (after controlling for initial CPUE).**

-Subtract the starting CPUE from the ending CPUE in each RM

-Use ANOVAs to test for variation in  $\Delta$  CPUE among all reaches for each size class. Significant effects will be assessed with post hoc tests (independent t-tests) between each paired treatment and control reach.

**5) Does nonnative fish removal alter the size structure of Channel Catfish in removal reaches relative to control reaches?**

**H<sub>0</sub>: Nonnative fish removal does not alter the size structure of Channel Catfish in removal reaches.**

**Prediction: The mean length of Channel Catfish will be smaller in removal reaches compared to control reaches.**

-Use a nonparametric Kruskal-Wallis test to compare TL from the first pass in each removal reach to the last pass in the removal reach, as well as the first and last passes in the control reaches.

**6) Does nonnative fish removal affect the density of endangered fishes (i.e., Colorado Pikeminnow and Razorback Sucker) in removal reaches compared to control reaches?**

**H<sub>0</sub>: Nonnative fish removal does not alter the CPUE of Colorado Pikeminnow and Razorback Sucker Catfish in removal reaches.**

**Prediction: The CPUE of Colorado Pikeminnow and Razorback Sucker will be higher in removal reaches compared to control reaches (after controlling for initial CPUE).**

-Subtract the starting CPUE from the ending CPUE in each RM

-Use ANOVAs to test for variation in  $\Delta$  CPUE among all reaches for each species (and size class). Significant effects will be assessed with post hoc tests (independent t-tests) between each paired treatment and control reach.

**7) What is the rate of Channel Catfish migration into treatment reaches?**

**H<sub>0</sub>: Channel Catfish do not move among reaches.**

**Prediction: Channel Catfish will move among reaches with more movement upstream compared to downstream.**

-Calculate the rate of Channel Catfish movement from recaptured individuals over time.

-Test the calculated rate of movement against a predicted rate of zero using a Wilcoxon sign-rank test.

**Summary**

Management decisions regarding the nonnative fish removal program on the San Juan River have been hindered by the lack of a rigorous study design that impedes our ability to assess the usefulness of the program. A more structured removal design will allow for a thorough assessment of the level the program can reduce densities of Channel Catfish as well as the potential subsequent response of endangered fishes. While having control reaches may seem counterproductive to reducing densities of nonnative fishes, we think it is necessary to provide a scientifically sound test of the efficacy of the program and provide useful

information on the effects of electrofishing on endangered fishes. However, effort will be increased in removal sub-reaches, the overall numbers of Channel Catfish removed will likely remain similar or be increased relative to previous annual removal efforts.

Although this study design is substantially altered compared to previous nonnative fish removal protocols (i.e., prior to FY16), similar data analyses that have been conducted in previous years will still be available with this design (e.g., Channel Catfish population estimates, exploitation rates).

### Deliverables

Data will be entered, analyzed, and presented to the SJRIP Biology Committee at a workshop following the 2018 field season. A draft report will be submitted to the Program Office by 31 March 2019 and a final report will be completed by 1 June 2019. All data will be submitted to the Program Office by 31 December 2018.

### Outyear Budgets:

**FY 18 \$549,520.64 \*\* Funding included for nonnative removal across all Agencies and Agreement Numbers**

#### **Appendix 1. Shiprock to Montezuma Creek (18 passes; two tagging trips)**

USFWS – NMFWCO	\$179,305.97
USFWS – GJFWCO	\$91,419.05
ASIR – Albuquerque	\$49,368.00
UDWR – Moab	\$15,271.00
NMDGF	\$12,814.00
NNDFW	\$6,643.03
<b>Sub-Total for Upper Section</b>	<b>\$354,821.05</b>

#### **Appendix 2. Montezuma Creek to Mexican Hat (8 passes, 2 tagging trips)**

UDWR – Moab	\$159,718.00
USFWS- GJFWCO	\$18,894.48
NMDGF	\$6,604.00
NNDFW	\$9,480.10
<b>Sub-Total for Lower Section</b>	<b>\$194,699.59</b>

**\*\* The following budget reflects the cost associated with all FY 2018 tagging and nonnative fish removal efforts from Shiprock, New Mexico downstream to Mexican Hat, Utah. Two budgets submitted by Utah Department of Wildlife Resources include 1) assisting FWS-NMFWCO with removal from Shiprock, NM to Montezuma Creek, UT (Appendix 1) and 2) UDWR-Moab's led efforts from Montezuma Creek to Mexican Hat, UT (Appendix 2). Disbursement of funds will be under agency specific agreements with the Bureau of Reclamation – Salt Lake City, UT.**

### Literature Cited

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## APPENDIX 1

# PARTICIPATING AGENCIES BUDGETS FOR FY 18 NONNATIVE SPECIES MONITORING AND CONTROL FROM SHIPROCK, NM TO MONTEZUMA CREEK, UT

<b>U.S. Fish and Wildlife Service - New Mexico Fish and Wildlife Conservation Office</b>							
<b>FY 2018</b>							
<b>Endangered Fish Monitoring and Nonnative Fish Removal and Control</b>							
<b>Labor Cost - Removal</b>							
<b>Position</b>	<b>Grade/Step</b>	<b>Hourly Rate</b>	<b>Fringe</b>	<b>Salary w/ Benefits</b>	<b>Hours/Day</b>	<b>Total Days</b>	<b>Sub-total</b>
Fish Biologist	GS 9/7	\$29.41	26.41%	\$37.17	9	80	\$26,765.07
Fish Biologist	GS 7/1	\$19.89	28.00%	\$25.45	9	24	\$5,497.80
Fish Biologist	GS 11/7	\$35.58	25.54%	\$44.66	9	30	\$12,059.36
Supervisory Fish Biologist	GS 13/6	\$49.30	28.28%	\$63.24	9	30	\$17,075.35
Bio. Science Techs (2 people)**	GS 5/1	\$16.17	20.00%	\$19.41	9	160	\$27,949.54
<b>Labor Cost - Tagging</b>							
Fish Biologist	GS 9/7	\$29.41	26.41%	\$37.17	9	8	\$2,676.51
Supervisory Fish Biologist	GS 14/9	\$63.25	26.93%	\$80.29	9	6	\$4,335.48
Fish Biologist	GS 11/7	\$35.58	25.54%	\$44.66	9	6	\$2,411.87
Bio. Science Techs (2 people)**	GS 5/1	\$16.17	20.00%	\$19.41	9	16	\$2,794.95
<b>Administrative and Reporting</b>							
Fish Biologist	GS 9/7	\$29.41	26.41%	\$37.17	9	55	\$18,400.98
Bio. Science Techs (2 people)**	GS 5/1	\$16.17	20.00%	\$19.41	9	40	\$6,987.38
Supervisory Fish Biologist	GS 13/6	\$49.30	28.28%	\$63.24	9	5	\$2,845.89
Administrative Officer	GS 9/8	\$30.23	26.12%	\$38.12	9	5	\$1,715.52
						<b>Total Labor</b>	<b>\$131,515.71</b>
<b>Travel and Per Diem</b>							
	<b>Days</b>	<b>Rate</b>					<b>Sub-total</b>
Hotel Costs	45	\$91.00					\$4,095.00
Per Diem (Hotel Rate/Travel Day)	95	\$38.25					\$3,633.75
Per Diem (Camping Rate)	200	\$29.00					\$5,800.00
						<b>Total Travel/Per Diem</b>	<b>\$13,528.75</b>
<b>Equipment</b>							
	<b>Miles/Qty</b>	<b>Total Miles</b>	<b>Rate</b>				<b>Sub-total</b>
Shuttle Costs	55		\$200.00				\$11,000
5 trucks x 11 trips							
<b>Vehicle Fuel</b>							
3 trucks x 8 trips - ABQ to Montezuma Creek, UT - 545mi RT	545	13,080	\$0.54				\$7,063.20
2 trucks x 3 trips - ABQ to Montezuma Creek, UT - 545mi RT	545	3,270	\$0.54				\$1,765.80
<b>Generator Fuel</b>							
60 gallons x 11 trips - based on ave. price for premium fuel 2/8/17	660		\$2.50				\$1,650.00
<b>Maintenance, repair, replace</b>							
(i.e. life jackets, waders, generator repair/replacement, dip nets, etc.)							\$5,000.00
<b>Tagging Equipment</b>							
3,000 Floy t-Bar Anchor Tags (FD)	3000		\$0.74				\$2,220.00
Ten (10) Replacement Needles	10		\$10.00				\$100.00
Pistol Grip Tagging Gun	4		\$60.00				\$240.00
						<b>Equipment</b>	<b>\$29,039.00</b>
						<b>Sub-total for Nonnative Fish Removal - NMFWCO only</b>	<b>\$174,083.46</b>
						<b>Administrative Overhead (3%)</b>	<b>\$5,222.50</b>
						<b>Total of FWS - NMFWCO</b>	<b>\$179,305.97</b>

**U.S. Fish Wildlife Service, Colorado River Fishery Project (USFWS-CRFP)**  
**Budget for Participation in**  
**Non-native Species Control in the *Upper* San Juan River**  
**Fiscal Year 2018 Project Proposal**  
**(Shiprock, NM to Montezuma Creek, UT)**

Personnel/Labor Costs (Federal Salary + Benefits)										
Description	Rate/HR	PEOPLE	DAYS	Trips	HRS	OT HRS	SUB TOTAL	OT SUB TOTAL	TOTAL	
Principal Biologist (GS-11/7) – 144 hours (1 person X 6 days/trip X 3 camping trips)	\$53.24	1	6	3	144		\$7,666.09		\$7,666.09	
Bio. Tech. Crew Leader (GS-7/4) – 144 hours (1 person X 6 days/trip X 3 camping trips (+ 20 hours overtime/trip X 3 trips)	\$35.91 \$53.87	1	6	3	144 20	60	\$5,171.14	\$3,231.96	\$8,403.10	
Bio. Tech. Crew Leader (GS-6/3) – 144 hours (1 person X 6 days/trip X 3 camping trips (+ 20 hours overtime/trip X 3 trips)	\$28.45 \$42.68	1	6	3	144 20	60	\$4,096.86	\$2,560.85	\$6,657.71	
Biological Technicians (GS-5/1) – 960 hours @ \$23.02/hr (2 people X 6 days/trip X 3 camping trips (2 people X 6 days/trip X 7 camping trips (+ 20 hours OT/trip X 10 trips X 2 people)	\$23.37 \$23.37 \$35.05	2	6	3	288 672 20	400	\$6,729.21 \$15,701.48	\$14,019.18	\$36,449.87	
<b>Personnel and Labor</b>									<b>\$59,176.77</b>	
Administrative Support (Federal Salary + Benefits)										
Description	Rate/HR	PEOPLE	DAYS	HRS						TOTAL
Administrative Officer (GS-9/8) – 60 hours @ \$42.14/hr	\$42.77	1		60						\$2,566.33
Project Leader (GS-14/6) – 60 hours @ \$80.95/hr	\$82.16	1		60						\$4,929.86
<b>Admin Support Total</b>									<b>\$7,496.18</b>	
Travel and Per Diem (Based on Published FY-2017 Federal Per Diem Rates)										
Description	RATE	PEOPLE	NIGHTS	Trips	Sub Total					TOTAL
Hotel – 1 night in Cortez, CO @ 4 people/trip X 3 trips	\$114.00	4	1	3	\$1,368.00					\$1,368.00
Hotel – 1 night in Cortez, CO @ 2 people/trip X 7 trips	\$114.00	2	1	7	\$1,596.00					\$1,596.00
Per Diem (Hotel Rate) – 1 day in Cortez, CO X 4 people	\$59.00	4	1	3	\$708.00					\$708.00
Per Diem (Hotel Rate) – 1 day in Cortez, CO X 2 people	\$59.00	2	1	7	\$826.00					\$826.00
Per Diem (Camp Rate) – 5 days X 4 people/trip X 3 trips	\$59.00	4	5	3	\$3,540.00					\$3,540.00
Per Diem (Camp Rate) – 5 days X 2 people/trip X 7 trips	\$59.00	2	5	7	\$4,130.00					\$4,130.00
<b>Travel &amp; Per Diem Total</b>									<b>\$12,168.00</b>	
Equipment & Supplies										
Vehicle Maintenance & Gasoline (@ \$365/month lease = \$12.17 per day based on 30 days in an "average" month + \$0.42/mile)										
Vehicle Mileage	TRUCKS	DAYS	Trips	MILEAGE	GAS/MILE					TOTAL
GJ to Cortez to Shiprock to Montezuma Creek, to GJ	2		3	600	\$0.43					\$1,534.68
GJ to Cortez to Shiprock to Montezuma Creek, to GJ	1		7	600	\$0.43					\$1,790.46
Vehicle Lease										
GJ to Cortez to Shiprock to Montezuma Creek, to GJ	2	6	3		\$12.35					\$444.69
GJ to Cortez to Shiprock to Montezuma Creek, to GJ	1	6	7		\$12.35					\$518.81
Generator Gas	BOATS	DAYS	Gal/day	Trips	GAS \$/GAL					
San Juan River Shiprock to Montezuma Creek	1	5	5	10	\$2.51					\$626.76
<b>Vehicle Maint. &amp; Gas Total</b>									<b>\$4,915.40</b>	
Equipment Maintenance, Repair, & Replacement										
Equipment Maintenance, Repair, & Replacement	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									



**Under the heading "Funding for participation of other agencies." Cost for participation of American Southwest Ichthyological Researchers, LLC – Albuquerque, NM in FY-2018 nonnative removal activities**

**2018 BUDGET: SAN JUAN RIVER NON-NATIVE FISH REMOVAL**  
Based on eight sampling trips per year: Shiprock to Mexican Hat

**Personnel**

Field Data Collection

*Shiprock to Mexican Hat - RM 148.0 - 53.3*

Fisheries Biologist I (2 staff x 8 trips x 5 days x 8 hrs/day at \$ 57.18/hr):..... \$ 36,595

Project Oversight

Senior Fisheries Biologist (1 staff x 4 days x 8 hrs/day at \$ 96.77/hr):..... \$ 3,097

Tasks: Project coordination and management.

**Personnel: ..... Total \$ 39,692**

**Materials and Supplies**

Rafts and associated sampling gear supplied by USFWS

Personal camping gear (*In kind contribution*)

**Materials and Supplies: ..... Total \$ 0**

**Travel and Per Diem**

Travel

Travel - (1 vehicle x 8 trips x 625 miles x \$ 0.54/mile): ..... \$ 2,700  
(roundtrip Albuquerque to Montezuma Creek, shuttle to Mexican Hat and return) <sup>1</sup>

Travel - (1 vehicle x 8 commercial shuttles x 180/per shuttle): ..... \$ 1,440

Per Diem

Per Diem - 1 hotel day per trip x 8 trips x 2 staff (\$ 91/night GSA lodging rate): ..... \$ 1,456

Per Diem - 5 field days per trip x 8 trips x 2 staff (\$ 51/day GSA M&IE rate): ..... \$ 4,080

**Travel and Per Diem: ..... Total \$ 9,676**

**2018 Project Totals**

**Personnel: ..... Total \$ 39,692**

**Materials and Supplies: ..... Total \$ 0**

**Travel and Per Diem: ..... Total \$ 9,676**

**2018 Scope of Work: ..... GRAND TOTAL \$ 49,368**

**FY 2018 Costs for UDWR- Moab**
**Participation in Middle San Juan River (Shiprock to Montezuma Creek) Nonnative Control (6 people X 5 days)**
Labor: salary + benefits + applicable overtime (personnel services)

	Rate	Hours	Cost
Project Leader	\$35.31	20	\$706
Biologist	\$32.57	80	\$2,606
Technician	\$17.11	340	\$5,817
		<b>subtotal</b>	<b>\$9,129</b>

Food and Transport (current expense)

	Rate	Quantity	Cost
Fleet Costs (2 trucks for 5% of total fleet costs)	\$40,800.00	0.050	\$2,040
In-state per-diem (6 people X 5 days)	\$41.00	30	\$1,230
Hotel in Bluff, UT	\$100.00	3	\$300
		<b>subtotal</b>	<b>\$3,570</b>

Equipment (current expense)

	Rate	Quantity	Cost
Camping gear repair/replacement:			\$300
Sampling gear repair/replacement:			\$300
Boating gear repair/replacement:			\$300
Fuel for generators	\$4.00	30	\$120
		<b>subtotal</b>	<b>\$1,020</b>

**Total Expenses** **\$13,719**

**Administrative Overhead (17% on all personnel services)** **\$1,552**

**UDWR-Moab Total FY 2018** **\$15,271**

<sup>a</sup> The State of Utah motorpool vehicles cost approximately \$6,800/year/vehicle (includes fleet rental, mileage, and gas), which is based on the average annual cost for all trucks used in our program.

<sup>b</sup> Includes, but is not limited to, tents, sleeping pads, toilet system, cookware, stoves, propane, charcoal, satellite phone and service, drybags, coolers, first aid supplies.

<sup>c</sup> Includes, but is not limited to dip nets, tags, tagging equipment, electrofishing units, electrofishing wiring, anodes, cathodes, generators, data loggers, etc...

<sup>d</sup> Includes, but is not limited to, raft repair/replacement, oars, oar hardware, raft frame repair, dry boxes, straps, etc...

Under the heading "Funding for participation of other agencies." Cost for participation of New Mexico Department of Game and Fish in FY-2018 Endangered Fish Monitoring and Nonnative Fish Control activities (Shiprock, NM to Montezuma Creek, UT).

### Sampling

#### Personnel

*Tasks* - Assist USFWS New Mexico Fish and Wildlife Conservation Office with Endangered Fish Monitoring and Nonnative Fish Control from Shiprock, NM to Montezuma Creek, UT; 1 project biologist for 4 trips at 5 days per trip (20 total days), field days projected at 10 hours of work per day = 160 regular hours and 40 overtime hours (200 hours total).

#### Project Biologist (1)

160 hrs regular @ \$37.13/hr (\$26.99/hr (base salary) + \$10.14 (benefits))	\$ 5,941
40 hrs overtime @ \$55.69/hr (\$37.13/hr * 1.5 (time-and-a-half))	\$ 2,228

<b>Sub-total</b>	<b>\$ 8,169</b>
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#### Per Diem

12 days @ \$85/day (standard NM in-state rate)	\$ 1,020
8 days @ 115/day (standard NM out-of-state rate)	\$ 920

<b>Sub-total</b>	<b>\$ 1,940</b>
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#### Vehicles

Round-trip Farmington/Shiprock, NM – 700 miles @ \$0.55/mile x 4 trips	\$ 1,540
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<b>Sub-total</b>	<b>\$ 1,540</b>
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### FY 2018 Total

NMDGF - Santa Fe	\$ 11,649
Administrative Overhead (10%)	\$ 1,165

<b>Total</b>	<b>\$ 12,814</b>
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Under the heading "Funding for participation of other agencies." Cost for participation of the Navajo Nation Department of Fish and Wildlife in FY-2018 nonnative removal activities (Shiprock, NM to Montezuma Creek, UT).

Personnel/Labor Costs (Salary + Benefits)	
Fish Biologist – 10 days @ \$169.44/day (1 person x 5 days x 2 trips)	\$ 1,694.40
Biological Technician – 10 days @ \$92.80/day (1 person x 5 days x 2 trips)	\$ 928.00
	Sub-Total <u>\$2,622.40</u>
Fringe Benefits X 48.7%	\$ 1,277.11
<u>Total Personnel/Labor \$ 3,899.51</u>	
	Sub-total with 3% added for inflation \$4,016.49
Travel (Vehicle shuttling)	
Vehicle Lease/Maintenance & Gasoline \$15.33/day X 12 days = \$183.96 + 2 X 36miles X .28/mile=\$20.16 (36 miles round trip from Fruitland, NM to Shiprock x 6 trips)	\$ 204.12
Per Diem Meals 10 days X \$51.00/day	\$ 510.00
	<u>Total Travel \$ 714.12</u>
	Sub-total with 3% added for inflation \$ 735.54
Equipment	
Equipment Maintenance, Repair, & Replacement (e.g., life jackets, hip boots, generator repair, rubber gloves, dip nets, aluminum welding, raft repair, etc.)	\$ 1,000
	<u>Total Equipment \$ 1,000</u>
	Sub-total with 3% added for inflation \$ 1,030
Navajo Nation Fish and Wildlife Total	\$5,782.03
Navajo Fish and Wildlife Administrative Overhead (17.5%)	\$ 861.00
Navajo Nation Total	\$6,643.03

## APPENDIX 2

# PARTICIPATING AGENCIES BUDGETS FOR FY 18 NONNATIVE MONITORING AND CONTROL FROM MONTEZUMA CREEK TO MEXICAN HAT, UT

<b>FY 2018 Costs for UDWR- Moab</b>			
<b>San Juan River Nonnative Removal (Montezuma Creek to Mexican Hat: 9 passes)</b>			
<u>Labor: salary + benefits + applicable overtime (personnel services)</u>			
	<b>Rate</b>	<b>Hours</b>	<b>Cost</b>
Project Leader	\$35.31	225	\$7,945
Biologist	\$32.57	1400	\$45,604
Technician	\$17.11	2800	\$47,903
		<b>subtotal</b>	<b>\$101,452</b>
<u>Food and Transport (current expense)</u>			
	<b>Rate</b>	<b>Quantity</b>	<b>Cost</b>
Fleet Costs <sup>a</sup> (3 trucks for 25% of total fleet costs)	\$40,800.00	0.25	\$10,200
Food (6 people, 5 days, 9 passes)	\$30.00	270	\$8,100
Shuttle (3 trucks, 9 passes plus 4 others)	\$105.00	31	\$3,255
Out-of-state per diem (Biologist and Project Leader)	\$46.00	12	\$552
Hotel- Durango (Biologist and Project Leader)	\$95.00	8	\$760
		<b>subtotal</b>	<b>\$22,867</b>
<u>Equipment (current expense)</u>			
	<b>Rate</b>	<b>Quantity</b>	<b>Cost</b>
Camping gear repair/replacement <sup>b</sup> :			\$5,625
Sampling gear repair/replacement <sup>c</sup> :			\$4,557
Boating gear repair/replacement <sup>d</sup> :			\$3,950
Fuel for generators (20 gallons/pass)	\$4.00	180	\$720
		<b>subtotal</b>	<b>\$14,852</b>
<u>Other</u>			
	<b>Rate</b>	<b>Quantity</b>	<b>Cost</b>
Swiftwater Rescue Training	\$350.00	2	\$700
Juniper System Data Logger	\$2,600.00	1	\$2,600
		<b>subtotal</b>	<b>\$3,300</b>
<b>Total Expenses</b>			<b>\$142,471</b>
<b>Administrative Overhead (17% on all personnel services)</b>			<b>\$17,247</b>
<b>UDWR-Moab Total</b>			<b>\$159,718</b>



<b>Raft trailer maintenance</b>								
	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						
<b>Generator maintenance</b>								
	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						
<b>Sampling gear (needs to be regularly replaced)</b>								
	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 + freight	\$630.00						
<b>Raft frame &amp;/or boat hull repair</b>								
	Aluminum welding – 7 hours @ \$95/hr	\$665.00						
<b>Raft repair kits</b>								
	Raft glue (urethane/hypalon) – Four 4-oz. cans @ \$24.95/can	\$100.00						
	NRS raft patch material – 5 feet @ \$37/ft	\$185.00						
	Toluene – 1 qt @ \$17.95/qt	\$18.00						
<b>Equipment tie-downs - NRS HD-brand tie-down straps, each boat needs:</b>								
	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						
<b>Raft rigging materials, each boat needs:</b>								
	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 \$375.00	\$375.00						
	Cans for 1st aid & tool kits, raft repair kits, etc. - 20 @ \$19 ea.	\$380.00						
<b>Rafting oars, oar blades, and oar rowing sleeves</b>								
	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						
<b>Camping Gear</b>								
	NRS Canyon Dry Box (kitchen cook kit storage) - 1 at \$165.00	\$165.00						
	NRS campsite counter (18"W X 68" L X 40" H) - 1 at \$299.95	\$299.95						
	Roll-A-Table (32" X 32" table, 27" legs) - 2 at \$99.95 each	\$199.90						
	2-man tent (1/person), ~ 1 year life-span - 6 at \$99.99 each	\$599.94						
	Partner Steel 16" 4-burner camp stove - 1 at \$359.00	\$359.00						
<b>River bags</b>								
	NRS 3.8 heavy-duty Bill's Bag 110L – 1 @ \$160 each	\$160.00						
	NRS Tuff Sacks 25L - 5 @ \$35 each	\$175.00						
<b>Pesola brand spring scales</b>								
	# 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						
<b>Equipment Maintenance, Repair, &amp; Replacement Subtotal</b>		\$15,483.43						
							Requested 2017 Equipment	
							Costs for Task 3	\$1,100.00
							<b>USFWS-GJFWCO Total</b>	<b>\$18,344.16</b>
							<b>USFWS R6 Admin Overhead (3.00%)</b>	<b>\$550.32</b>
							<b>USFWS Region 6 Total</b>	<b>\$18,894.48</b>

**Under the heading "Funding for participation of other agencies." Cost for participation of New Mexico Department of Game and Fish in FY-2018 Endangered Fish Monitoring and Nonnative Fish Control activities (Montezuma Creek, UT to Mexican Hat, UT).**

### **Sampling**

#### **Personnel**

*Tasks* - Assist Utah Department of Wildlife Resources with Endangered Fish Monitoring and Nonnative Fish Control from Montezuma Creek, UT to Mexican Hat, UT; 1 project biologist for 2 trips at 5 days per trip (10 total days), field days projected at 10 hours of work per day = 80 regular hours and 20 overtime hours (100 hours total).

#### Project Biologist (1)

80 hrs regular @ \$37.13/hr (\$26.99/hr (base salary) + \$10.14 (benefits))	\$ 2,970
20 hrs overtime @ \$55.69/hr (\$37.13/hr * 1.5 (time-and-a-half))	\$ 1,114

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**Sub-total \$ 4,084**

#### **Per Diem**

10 days @ 115/day (standard NM out-of-state rate)	\$ 1,150
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**Sub-total \$ 1,150**

#### **Vehicles**

Round-trip Bluff, UT – 700 miles @ \$0.55/mile x 2 trips	\$ 770
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**Sub-total \$ 770**

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### **FY 2018 Total**

NMDGF - Santa Fe	\$ 6,004
Administrative Overhead (10%)	\$ 600

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**Total \$ 6,604**

**Under the heading “Funding for Participating Agencies.” Estimated costs for participation of the Navajo Nation Department of Fish and Wildlife, in FY-2018 (Montezuma Creek to Mexican Hat, UT). BOR Cooperative Agreement Number with Navajo Nation: R11AP40089**

<b>FY 2017 Costs for Navajo Nation</b>			
<u>Personnel/Labor Costs (Salary+Benefits)</u>	Rate	Quantity	
Fish Biologist	\$169.44	14	\$2,372.16
Bio Tech	\$92.80	14	\$1,299.20
Fringe Benefits (Labor Costs* 48.70%)	\$127.71		\$1,787.94
Subtotal			\$5,459.30
<u>Travel and Per Diem</u>			
Per Diem Meals	\$51.00	14	\$714.00
Vehicle Lease/Maintenance	\$460.00	1	\$460.00
Mileage	\$0.28	260	\$72.80
Subtotal			\$1,246.80
<u>Equipment</u>			
Maintenance, Repair, Replacement	\$1,545.00	1	\$1,545
Subtotal			\$1,545
Total Expenses			\$8,251.10
Navajo Nation Administration Fees (17.5%)			\$1,229.00
<b>Navajo Nation FY16 Total</b>			<b>\$9,480.10</b>

**RECOVERY PROGRAM  
FY 2018-2019 SCOPE OF WORK for:**

Recovery Program Project Number: 170

***Development and Maintenance of a Centralized PIT tag Database for the San Juan and Upper Basin Recovery Programs***

Reclamation Agreement number: R14AC00084  
Reclamation Agreement term: Oct 1, 2014 – June. 30, 2019

Note: Recovery Program FY18-19 scopes of work are drafted in May 2017. They often are revised before final Program approval and may subsequently be revised again in response to changing Program needs. Program participants also recognize the need and allow for some flexibility in scopes of work to accommodate new information (especially in nonnative fish management projects) and changing hydrological conditions.

Lead agency: Colorado Natural Heritage Program  
Submitted by: Amy Lavender Greenwell & Dave Anderson  
Colorado Natural Heritage Program  
Colorado State University  
1475 Campus Delivery  
254 General Services Building  
Fort Collins, CO 80523-1474

Date Last Modified: 5/24/2017 10:56:00 AM *[This field is set to update automatically.]*

<u>Category:</u>	<u>Expected Funding Source:</u>
<input checked="" type="checkbox"/> Ongoing project	<input checked="" type="checkbox"/> Annual funds
<input type="checkbox"/> Ongoing-revised project	<input type="checkbox"/> Capital funds
<input type="checkbox"/> Requested new project	<input type="checkbox"/> Other <i>[explain]</i>
<input type="checkbox"/> Unsolicited proposal	

- I. Title of Proposal: *Development and Maintenance of a Centralized PIT tag Database for the San Juan and Upper Basin Recovery Programs*
- II. Relationship to RIPRAP: V.A.1. Conduct interagency data management program to compile, manage, and maintain all research and monitoring data collected by the Recovery Program.
- III. Study Background/Rationale and Hypotheses: STReAMS, the master database of the Upper Colorado and San Juan River endangered fish recovery programs (recovery programs), creates a consolidated system to assist researchers and stakeholders with uploading, managing, editing and accessing data. Data support the recovery of endangered species and removal of non-native fishes, assessment of effects of non-native fish removal, effects of new flow and temperature regimes based on the fish community response, and effects of continued water development.
- IV. Study Goals, Objectives, End Product(s):

Investigators of the Upper Colorado River Endangered Fish Recovery Program and the San Juan River Endangered Fish Recovery Program have been collecting large quantities of data on stocked and wild endangered fishes. These data are stored in the STReAMS database which

makes it easy to identify individual fish and capture histories and integrate data from various active capture projects as well as Passive Interrogation Arrays (PIAs). The sharing of data between investigators and stakeholders is streamlined to improve efficiency of data entry and retrieval, and to prevent duplication of records and efforts between and among the various investigations. The master database standardizes content and provides convenient, easy access to all available data.

- V. Study Area: STReaMS will house data from the entire Upper Colorado and San Juan River Basins, including Lake Powell.
- VI. Study Methods/Approach: *CNHP and the data managers use standard data management and assessment techniques to ensure data are accurate and as complete as possible.*
- VII. Task Description and Schedule:

**CNHP will continue to develop and maintain the STReaMS database during the Federal FY18 (October 1, 2017 - September 30, 2018). Tasks are broken out below.**

#### **Server Maintenance**

- Maintain the server, server security, and perform regular database backups
- Maintain the test server and development environment
- Perform necessary software upgrades including Windows Updates, SQL Server updates, and PHP Updates. Ensure all code performs as expected following updates.
- Assess overall performance and optimize resources as needed
- Maintain Database Manager credentials to access SQL Server

#### **Website Maintenance and New Features**

- Develop advanced SQL Query Builder and Query Builder User Guide
- Create a collaborative resources page to share SQL queries and other helpful information
- Develop QC Tools
  - Change relationships (merge/split records)
  - QC Encounter attributes
  - Recalculate spatial attributes
- Create calculated fields
  - Known distance travelled (based on Encounter history)
  - Days in river
- Batch Upload enhancements
- Bug fixes
- Internal testing and stress tests
- Update online help, data dictionary, user manuals, and system documentation
- Train Recovery Program participants on new features and enhancements
- Other priorities identified by Recovery Program Database Managers

#### **Project Management**

- Prepare annual reports
- Perform project management and CSU compliance
- Maintain regular communication with Database Managers

**CNHP will continue to maintain the STReaMS database and troubleshoot as necessary in Federal FY19-23. Tasks are broken out below.**

#### **Server Maintenance**

- Maintain the server, server security, and perform regular database backups
- Maintain the test server and development environment
- Perform necessary software upgrades including Windows Updates, SQL Server updates, and PHP Updates. Ensure all code performs as expected following updates.
- Assess overall performance and optimize resources as needed
- Maintain Database Manager credentials to access SQL Server

#### **Website Maintenance and New Features**

- Bug fixes
- Internal testing and stress tests
- Update online help, data dictionary, user manuals, and system documentation
- Other priorities identified by Recovery Program Database Managers

#### **Project Management**

- Prepare annual reports
- Perform project management and CSU compliance
- Maintain regular communication with Database Managers

VIII. Deliverables, Due Dates, and Budget by Fiscal Year:

FY18 Deliverables: Annual Report in November. Fully functional database.

<b>FY18-19 BUDGET ITEM</b>	<b>\$/Unit</b>	<b>Quantity</b>	<b>TOTAL COST</b>
<b>PROFESSIONAL SERVICES</b>	\$/mo		
Amy Greenwell	\$7,798.90	2.0	\$16,341.31
David Anderson	\$10,101.72	0.35	\$3,707.10
Puja Gurung	\$6,668.43	3.0	\$20,946.45
Ben Johnke	\$5,237.00	1.0	\$5,237.00
Michael Menefee	\$7,544.83	0.75	\$5,927.66
<b>Subtotal</b>			<b>\$ 52,160</b>
<b>TRAVEL</b>			
2 day trips to Denver, 140 mi/trip @ 50 cents/mi	\$70	2	\$140
<b>Subtotal</b>			<b>\$140</b>
<b>MATERIALS/SUPPLIES</b>			
8TB Hard drive for back-ups, 7200 rpm	\$300	1	\$300
Books (Microsoft SQL Server 2016 Unleashed \$45, PHP Security \$65)	varies	2	\$110
Domain for website	\$20	1	\$20
<b>Subtotal</b>			<b>\$430</b>
<b>OTHER</b>			
Long Distance Phone Calls	\$50	1	\$50
<b>Subtotal</b>			<b>\$50</b>
<b>TOTAL DIRECT</b>			<b>\$52,780</b>
INDIRECT COSTS (@31.3%)			\$16,520
<b>TOTAL PROJECT COSTS</b>			<b>\$69,300</b>
San Juan Contribution			\$15,000
<b>TOTAL UPPER BASIN COST</b>			<b>\$54,300</b>

FY19-FY23 Deliverables: Annual reports due in November. Continued functionality of the database and online interface.

<b>BUDGET ITEM</b>	<b>\$/Unit</b>	<b>Quantity</b>	<b>FY19 COST</b>	<b>FY20 COST</b>	<b>FY21 COST</b>	<b>FY22 COST</b>
<b>PROFESSIONAL SERVICES</b>	\$/mo					
Amy Greenwell	\$7,798.90	1.5	\$11,698	\$8,353	\$8,520	\$8,690
David Anderson	\$10,101.72	0.15	\$1,515	\$1,082	\$1,104	\$1,126
Puja Gurung	\$6,668.43	2	\$13,337	\$9,523	\$9,713	\$9,907
Ben Johnke	\$5,237.00	1	\$5,237	\$3,739	\$3,814	\$3,890
Michael Menefee	\$7,544.83	0.35	\$2,641	\$1,885	\$1,923	\$1,962
<b>Subtotal</b>			<b>\$34,428</b>	<b>\$24,582</b>	<b>\$25,073</b>	<b>\$25,575</b>
<b>TRAVEL</b>						
2 day trips to Denver, 140 mi/trip @ 50 cents/mi	\$70	2	\$140	\$140	\$140	\$140
<b>Subtotal</b>			<b>\$140</b>	<b>\$140</b>	<b>\$140</b>	<b>\$140</b>
<b>MATERIALS/SUPPLIES</b>						
8TB Hard drive for back-ups, 7200 rpm	\$300	1			\$300	\$300
Server	\$6,500	1	\$6,500			
Back-up power supplies	\$650	1		\$650		
Books (Microsoft SQL Server 2016 Unleashed \$45, PHP Security \$65)	varies	2	\$110	\$110	\$110	\$110
Domain for website	\$20	1	\$20	\$20	\$20	\$20
<b>Subtotal</b>			<b>\$6,610</b>	<b>\$760</b>	<b>\$410</b>	<b>\$410</b>
<b>OTHER</b>						
Long Distance Phone Calls	\$50	1	\$50	\$50	\$50	\$50
<b>Subtotal</b>			<b>\$50</b>	<b>\$50</b>	<b>\$50</b>	<b>\$50</b>
<b>TOTAL DIRECT</b>			<b>\$41,228</b>	<b>\$25,532</b>	<b>\$25,673</b>	<b>\$26,175</b>
INDIRECT COSTS (@31.3%)			\$12,904	\$7,991	\$8,036	\$8,193
<b>TOTAL PROJECT COSTS</b>			<b>\$54,133</b>	<b>\$33,523</b>	<b>\$33,709</b>	<b>\$34,368</b>
San Juan Contribution			\$10,000	\$10,000	\$10,000	\$10,000
<b>TOTAL UPPER BASIN COST</b>			<b>\$44,300</b>	<b>\$23,523</b>	<b>\$23,709</b>	<b>\$24,368</b>

IX. Budget Summary:

Total budget to CNHP by Fiscal Year:

FY2018: \$69,300

FY2019: \$54,133

FY2020: \$33,523

FY2021: \$33,709

FY2020: \$34,368

X. Reviewers:

Dave Speas

Fish Biologist

U.S. Bureau of Reclamation

Upper Colorado Regional Office

C/O Western Colorado Area Office

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Data Coordinator

Upper Colorado River Endangered Fish Recovery Program

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XI. References:

**Sub-Adult and Adult Large-Bodied  
Fish Community Monitoring  
Fiscal Year 2018 Project Proposal  
4 May 2017**

Principal Investigator:

Ben Schleicher and Dale Ryden  
U. S. Fish and Wildlife Service  
Colorado River Fishery Project  
445 West Gunnison Ave, Suite 140  
Grand Junction, Colorado 81501  
(970) 628-7205

benjamin\_schleicher@fws.gov dale\_ryden@fws.gov

Contract or Agreement number(s):

R13PG40052 for USFWS – Grand Junction, CO  
R13PG40051 for USFWS – Albuquerque, NM  
R13AC40007 for UDWR – Moab, UT

Reporting Dates: 10/1/2017 through 9/30/2018

**Sub-Adult & Adult Large-Bodied Fish Community Monitoring  
(a.k.a. Adult Monitoring)  
Fiscal Year 2018 Project Proposal  
1 March 2017**

Principal Investigator:  
Benjamin Schleicher and Dale Ryden  
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  
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**Background:**

Studies performed before 1991 documented a native San Juan River fish fauna of eight species, including Colorado Pikeminnow *ptychocheilus lucius*, Razorback Sucker *xyrauchen texanus*, and Roundtail Chub *gila robusta* and provided baseline information on distribution and abundance of native and introduced fish species in the San Juan River. These studies indicated that at least one of the two endangered fish species (i.e., Colorado Pikeminnow) was still a viable member of the San Juan River fish community.

Between 1991 and 1998, the Main Channel Fish Community Monitoring study (called “Adult Monitoring” for short), greatly refined our understanding of the San Juan River fish community. The main sampling technique employed during the 1991-1998 Adult Monitoring study was raft-borne electrofishing, although radio telemetry was also heavily employed. Data collected during the 1991-1998 Adult Monitoring study provided information on specific habitat usage by rare fish species. In addition, data gathered during the 1991-1998 Adult Monitoring study aided in the selection of specific sites for detailed hydrologic measurements and larval drift sampling. Integration of 1991-1998 Adult Monitoring data along with data from Colorado Pikeminnow macrohabitat studies, Razorback Sucker experimental stocking studies, tributary and secondary channel studies, fish health studies, contaminants studies, habitat mapping studies, and non-native species interaction studies, helped provide a logical framework upon which to make flow recommendations for the reoperation of Navajo Reservoir that would benefit the San Juan River’s endangered fishes (as well as other members of the native fish community).

The Sub-Adult & Adult Large-Bodied Fish Community Monitoring study (also referred to as Adult Monitoring), which began in 1999, is a direct offshoot of the 1991-1998 Adult Monitoring study. This study is one of a suite of long-term monitoring efforts detailed in the San Juan River Basin Recovery Implementation Program’s (SJRBRIP) Monitoring Plan and Protocols (SJRBRIP 2012) that are designed to help evaluate progress of the two endangered fish species towards recovery under the SJRBRIP’s Long Range Plan (SJRBRIP 2014). The current Adult Monitoring study incorporates essentially the same monitoring protocols as did its 1991-1998 precursor study (e.g., sampling via raft-borne electrofishing). This allows for data collected during the current Adult Monitoring study to be validly combined with and compared to the older 1991-1998 Adult Monitoring data. The combination of these two data sets provides statistically-powerful, long-term trend data through which the SJRBRIP’s Biology Committee can view changes in the San Juan River’s large-bodied fish community over time. This long-term trend data allows the

SJRBRIP Biology Committee to evaluate whether various management actions being implemented are having the desired effects on the San Juan River fish community. In addition, Adult Monitoring has proven to be an effective tool for monitoring populations of both stocked Razorback Sucker and Colorado Pikeminnow.

### **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 (SJRBRIP 2016): 1.2.1.1, 1.2.1.2, 2.3.1.5, 2.3.1.6, 2.3.1.7, 2.3.2.1, 2.3.2.2, 2.3.2.3, 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, 3.2.3.3, 3.2.3.4, 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, 4.1.4.3, 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, 4.5.2.3, 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 SJRBRIP Monitoring Plan and Protocols (SJRBRIP 2012).

### **Description of Study Area:**

The study area for Adult Monitoring extends from river mile (RM) 180.0 (just downstream of the Animas River confluence in Farmington, NM), downstream to RM 53.0 (just upstream of the Mexican Hat boat launch in Mexican Hat, UT). The river section from RM 53.0 downstream to RM 2.9 (Clay Hills boat launch, just upstream of Lake Powell in UT) is scheduled to be sampled every fifth year. The last such sampling occurring in 2015, so that section of river should be sampled again in 2020.

In addition to sampling from the Animas River confluence to Mexican Hat boat launch, two additional river sections in NM will be sampled (5 total days of sampling). These two river sections would include: 1) the San Juan River from the Bloomfield Riverside Landing (RM 196.0) downstream to the Animas River confluence (RM 180.6) – three days of sampling; and, 2) the Animas River from Riverside Park in Aztec, NM downstream to the San Juan River confluence – two days of sampling. Because extremely low water levels in the Animas River preclude sampling this river section in the fall, Animas River sampling will be done in the spring (March/April) of each year.

### **Objectives:**

- 1) Annually, during autumn, document aspects of the fish community structure such as species abundance (presented as catch/hour, 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 (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 SJRBRIP. These may include the following:

- a. Remove nonnative fish species which prey upon and may compete with native fish species in the San Juan River.
- b. Collect location (river miles) of habitats where endangered Colorado Pikeminnow and Razorback Sucker are collected.
- c. Collect tissue samples from various fish species for stable isotope, genetics, and contaminants studies.

Through the handling of large numbers of fish for other study objectives and because of its long-term dataset, Adult Monitoring provides chances to opportunistically observe and monitor other information on the San Juan River's large-bodied fish community. This includes, but is not limited to: 1) the incidence of disease and abnormalities among fish populations; 2) the distribution and abundance of nonnative white sucker and the rate of hybridization between this species and native sucker species; 3) hybridization rates among native sucker species, specifically the endangered Razorback Sucker and Flannelmouth Sucker; 4) negative interactions between Channel Catfish and native fish species, specifically endangered Colorado Pikeminnow and Razorback Sucker; and, 5) documenting episodic events, such as the invasion of the San Juan River by fish species from Lake Powell or collecting rare, but potentially important fish species, such as Grass Carp.

### **Hypotheses:**

Hypotheses for Adult Monitoring from the SJRBRIP Monitoring Plan and Protocols are listed as the following:

1. Mimicry of a natural hydrograph increases reproductive success among native fishes, resulting in increased abundance of wild sub-adult and adult fishes over time.
2. Mimicry of a natural hydrograph decreases reproductive success among nonnative fishes, resulting in decreased abundance of wild sub-adult and adult fishes over time.
3. Mechanical removal of nonnative fishes leads to an increase in abundance and/or distribution among native fishes.
4. Mechanical removal of nonnative fishes leads to a decrease in their abundance and/or distribution.
5. Modification or removal of instream dispersal impediments results in an increase in distribution (i.e., wider range) among endangered fishes (stocked or wild).
6. Modification or removal of instream dispersal impediments results in an increase in distribution (i.e., wider range) among common fishes.
7. Augmentation of endangered fishes results in the establishment of a multiple year-class population that is self-sustaining.
8. Augmentation of endangered fishes results in significant changes among common native and nonnative fishes (i.e., abundance or distribution) over time.

### **Methods:**

Objectives 1-3: Two Adult Monitoring trips will take place in the fall of 2018 and one in the spring. The first will sample the lower Animas River from Riverside Park in Aztec, NM downstream to the Animas-San Juan River confluence. These two days of sampling will occur sometime between late March and late April. The second sampling trip will sample from RM 196.0 (Bloomfield Riverside Landing) downstream to Shiprock bridge near Shiprock, NM RM 148.0. Sampling will take place in one of the first to second week of September. The third trip

will take place the week following the second and will begin at Shiprock bridge and proceed downstream to Mexican Hat boat launch, RM 53.0, and will be concluded by end of September. Raft-borne electrofishing will be the primary sampling technique for all three sampling efforts.

Electrofishing will follow the methods set forth above and in the SJRBRIP Monitoring Plan and Protocols (SJRBRIP 2012). Two oar-powered rafts, with one netter each, will electrofish in a continuous downstream fashion, with one raft on each shoreline. Depending upon water levels in the lower Animas River in the spring, only one electrofishing raft may be used in the lower Animas River (instead of two) at the Principal Investigator's discretion. Netters will net all stunned fish that can possibly be collected, regardless of species or body size. Trailing or "chase" rafts will not be used to collect fish. No outboard motors will be used. Sampling crews will consist of approximately 2-4 people for spring and the first fall sampling trips (2 per electrofishing raft) and 6 people for the final fall sampling (4 for electrofishing rafts and 2 for baggage rafts). Electrofishing will be used to sample two out of every three miles when sampling above Shiprock bridge, every mile will be sampled below Shiprock bridge. All fish collected will be enumerated by species and life stage at the end of every sampled mile. Every fourth sampled mile (known as a "designated mile" or DM), all fish collected will be weighed and measured. All native fish collected will be returned alive to the river. All nonnative fish collected will be removed from the river. All nonnative predatory fishes (e.g. - Walleye, Striped Bass, Largemouth Bass, Smallmouth Bass) collected will be weighed and measured, and may have stomach samples taken, before being removed from the river. Tag numbers, total length, and weight will be recorded on all recaptured, FLOY-tagged fish (both native and nonnative), as well as any rare fish collected. Colorado Pikeminnow, Razorback Sucker, and Roundtail Chub greater than 150 mm TL will be implanted with 134 kHz PIT (Passive Integrated Transponder) tags. Notes will be kept on any parasites and/or abnormalities observed on collected fishes.

The U.S. Fish and Wildlife Service (USFWS) will assume the lead responsibility for Adult Monitoring trips and other cooperating agencies will provide personnel and equipment as needed. Costs for cooperating agencies are included in this budget.

### **Analysis:**

Data collected within a given year will be used to compare catch per unit effort (CPUE) expressed as fish per hour of shocking for each species. This data will be compared to past CPUE of each species in reference to combined life stages, separated life stages, and longitudinally by river mile or river mile increments. Additional analyses such as frequency of occurrence, length frequencies, and percent of total catch will be compared to past years. Adult monitoring sampling has changed spatially in recent years, data will only be compared to similar river miles sampled in past years.

### **Products:**

An interim progress report for Adult Monitoring data collected during 2018 is scheduled to be available by 31 March 2019. The final version of this interim progress report which incorporates comments received is scheduled to be completed by 1 June 2019. Data files containing PIT tag information on the federally-listed endangered fish species (Colorado Pikeminnow and Razorback Sucker) collected during this Adult Monitoring trip will be submitted for inclusion in the STReAMS integrated database by 31 December 2018. Data files containing the remainder of the information (e.g., data on common fish species) collected during this Adult Monitoring trip will be submitted for inclusion in the STReAMS integrated database by 31 March 2019.

**Projected Duration Of Project:**

The Adult Monitoring study began in 1991 (see Introduction for details). It has continued, annually, with a consistent sampling regime every year since that time. This has allowed for the compilation of one of the longest-running and most statistically powerful fisheries databases available to the SJRBRIP. The Adult Monitoring study was modified with just very slight changes (e.g., a reduction in sampling frequency from every RM to two out of every three RM's) when it was incorporated as an integral part of the long-term San Juan River Monitoring Plan and Protocols (Propst et al. 2000) and a second time (to sample only RM 180.0-77.0) with the development of the SJRBRIP's Monitoring Plan and Protocols (SJRBRIP 2012). The suite of long-term monitoring studies are scheduled to run through the termination of the San Juan River Recovery Implementation Program.

**Literature Cited:**

San Juan River Basin Recovery Implementation Program. 2012. San Juan River Basin Recovery Implementation Program Monitoring Plan and Protocols. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

San Juan River Basin Recovery Implementation Program. 2016. Long-Range Plan. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

## **Fiscal Year 2018 Estimated Budget:**

### **Costs for participation of the U.S. Fish Wildlife Service, Grand Junction Fish and Wildlife Conservation Office (USFWS-GJFWCO), Grand Junction, CO.**

(Based on an anticipated 3% increase from the FY-2017 budget)

#### **Personnel/Labor Costs (Federal Salary + Benefits)**

Principal Biologist (GS-11) – 224 hours @ \$52.37/hr (1 person X 10 days planning & organization) <u>Animas River sampling - spring:</u> (1 person X 3 days/trip X 1 trip – work from hotel) <u>San Juan River sampling - fall:</u> (1 person X 5 days/trip X 1 trip – work from hotel) (1 person X 10 days/trip X 1 trip – camping)	\$ 11,731.00
Bio. Tech. Crew Leader (GS-7) - 120 hours @ \$35.75/hr <u>San Juan River sampling - fall:</u> (1 person X 5 days/trip X 1 trip – work from hotel) (1 person X 10 days/trip X 1 trip – camping) (+ 50 hours overtime at \$53.62/hr = \$2,681.00)	\$ 6,971.00
Bio. Tech. Crew Leader (GS-6) - 120 hours @ \$34.76/hr <u>San Juan River sampling - fall:</u> (1 person X 5 days/trip X 1 trip – work from hotel) (1 person X 10 days/trip X 1 trip – camping) (+ 50 hours overtime at \$52.13/hr = \$2,607.00)	\$ 6,778.00
Biological Technicians (GS-5) – 312 hours @ \$25.71/hr <u>Animas River sampling - spring:</u> (3 person X 3 days/trip X 1 trip – work from hotel) (+ 9 hours overtime each at \$39.72/hr = \$1,072.00) <u>San Juan River sampling – fall:</u> (2 person X 5 days/trip X 1 trip – work from hotel) (2 person X 10 days/trip X 1 trip – camping) (+ 52 hours overtime each at \$39.72/hr = \$4,131.00)	\$ 13,225.00
<b>Sub Total</b>	\$ 38,705.00

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

Administrative Officer (GS-9) – 200 hours @ \$47.44/hr	\$ 9,488.00
Principal Biologist (GS-11) – 400 hours @ \$52.37/hr	\$ 20,948.00
Project Leader (GS-14) – 320 hours @ \$88.50/hr	<u>\$ 28,320.00</u>
<b>Sub Total</b>	\$ 58,756.00

#### **Travel and Per Diem (Based on Published FY-2016 Federal Per Diem Rates)**

\*\*\* see FY-2017 budget for line item breakdowns

<b>FY-2017 Budget Cost</b>	<u>\$ 6,730.00</u>
<b>Sub Total with 3% added for inflation</b>	\$ 6,932.00

#### **Equipment and Supplies**

\*\*\* see FY-2017 budget for line item breakdowns

<b>FY-2017 Budget Cost</b>	<u>\$ 7,584.00</u>
<b>Sub Total with 3% added for inflation</b>	\$ 7,812.00

**USFWS-CRFP (Grand Junction, CO) Total** \$112,205.00

<b>USFWS Region 6 Administrative Overhead (3.00%)</b>	<u>\$ 3,366.00</u>
<b>USFWS Region 6 Total</b>	\$115,571.00

**Funding for Participation by Other Agencies: (These figures are submitted to USFWS-CRFP by the listed cooperating agencies)**

USFWS-NMFWCO - Albuquerque, NM (Region 2)	
See Attached Budget for Line Item Breakdowns	\$ 14,035.00
Utah Division of Wildlife Resources - Moab, UT	
See Attached Budget for Line Item Breakdowns	<u>\$ 5,973.00</u>
	\$ 20,008.00

<b>FY-2018 ESTIMATED WORKPLAN TOTAL</b>	<b>\$135,579.00</b>
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**Under the heading “Funding for participation of other agencies.” Cost for participation of the U.S. Fish and Wildlife Service, New Mexico Fish and Wildlife Conservation Office, NM in FY-2018.**

**Labor Cost**

<b>Position</b>	<b>Grade/Step</b>	<b>Hourly Rate</b>	<b>Fringe</b>	<b>Salary w/ Benefits</b>	<b>Hours/Day</b>	<b>Total Days</b>	<b>Sub-total</b>
Fish Biologist Supervisory	GS 9/7	\$29.41	26.41%	\$37.18	9	17	\$5,688.11
Fish Biologist Bio. Science Technician**	GS 13/6	\$49.30	28.28%	\$63.24	9	2	\$1,138.36
Administrative Officer	GS 5/1	\$16.17	20.00%	\$19.40	9	17	\$2,968.81
	GS 9/8	\$30.23	26.12%	\$38.13	9	2	\$686.27
<b>Total Labor</b>							<b>\$10,481.55</b>

**Travel and Per Diem**

	<b>Days</b>	<b>Rate</b>	<b>Sub-total</b>
Hotel Costs Per Diem	12	\$91.00	\$1,092.00
(Travel Day) Per Diem (Full Day)	10	\$38.25	\$382.50
	10	\$51.00	\$510.00
<b>Total Travel/Per Diem</b>			<b>\$1,984.50</b>

**Equipment**

	<b>Miles/Qty</b>	<b>Total Miles</b>	<b>Rate</b>	<b>Sub-total</b>
Vehicle Fuel 1 truck x 4 trips - 1 trip ABQ to Bluff, UT - 574mi RT and 3 trips from ABQ to Farmington, NM - 366mi RT + 150mi/trip local commute		2,122	\$0.54	\$1,145.88
<b>Equipment</b>				<b>\$1,145.88</b>

<b>Sub-total for Adult Monitoring - NMFWCO only</b>	<b>\$13,611.93</b>
<b>Administrative Overhead (3%)</b>	<b>\$408.36</b>
<b>Total - USFWS - NMFWCO</b>	<b>\$14,020.29</b>

<b>FY 2018 Costs for UDWR- Moab</b>
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<b>Participation in San Juan River Large-Bodied Fish Community Monitoring ( 1person X 10 days)</b>
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Labor: salary + benefits + applicable overtime (personnel services)

	<b>Rate</b>	<b>Hours</b>	<b>Cost</b>
Project Leader	\$35.31	0	\$0
Biologist	\$32.57	70	\$2,280
Technician	\$17.11	80	\$1,369
		<b>subtotal</b>	<b>\$3,649</b>

Food and Transport (current expense)

	<b>Rate</b>	<b>Quantity</b>	<b>Cost</b>
Fleet Costs (2 trucks for 1% of total fleet costs)	\$40,800.00	0.015	\$612
In-state per diem (1 person, 10 days, 1 pass)	\$41.00	10	\$410
Out-of-state Per Diem (travel day)	\$46.00	1	\$46
Hotel (Cortez, CO)	\$89.00	1	\$89
		<b>subtotal</b>	<b>\$1,157</b>

Equipment (current expense)

	<b>Rate</b>	<b>Quantity</b>	<b>Cost</b>
Camping gear repair/replacement:			\$100
Sampling gear repair/replacement:			\$130
Boating gear repair/replacement:			\$130
Fuel for generator	\$4.00	25	\$100
		<b>subtotal</b>	<b>\$460</b>

<b>Total Expenses</b>	<b>\$5,266</b>
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<b>Administrative Overhead (17% on all personnel services)</b>	<b>\$620</b>
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<b>UDWR-Moab Total FY 2018</b>	<b>\$5,886</b>
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<sup>a</sup> The State of Utah motorpool vehicles cost approximately \$6,800/year/vehicle (includes fleet rental, mileage, and gas), which is based on the average annual cost for all trucks used in our program.

<sup>b</sup> Includes, but is not limited to, tents, sleeping pads, toilet system, cookware, stoves, propane, charcoal, satellite phone and service, drybags, coolers, first aid supplies.

<sup>c</sup> Includes, but is not limited to dip nets, tags, tagging equipment, electrofishing units, electrofishing wiring, anodes, cathodes, generators, data loggers, etc...

<sup>d</sup> Includes, but is not limited to, raft repair/replacement, oars, oar hardware, raft frame repair, dry boxes, straps, etc...

<sup>b,c,d</sup> Estimated costs are based on actual costs from previous years plus an estimated 1.5% increase each year following.

**FY 2018 SCOPE OF WORK**

**TO**

**BUREAU OF RECLAMATION**

**FROM**

New Mexico Department of Game and Fish  
Matthew P. Zeigler and Michael E. Ruhl  
One Wildlife Way, P.O. Box 25112  
Santa Fe, New Mexico 87504  
505-476-8104  
matthew.zeigler@state.nm.us  
michael.ruhl@state.nm.us

**FOR**

Title of Agreement: Small-bodied Fishes Monitoring on the San Juan River  
Agreement Number: SJ2631

**REPORTING DATES:**

10/01/2017 through 9/30/2018

## GOAL

The goal of small-bodied fishes monitoring is to quantitatively assess the effects of management actions on survival of post-larval early life stages of native and nonnative fishes and their recruitment into subsequent life stages and use this information to recommend appropriate modifications to recovery strategies for Colorado Pikeminnow *Ptychocheilus lucius* and Razorback Sucker *Xyrauchen texanus* in the San Juan River (SJRIP 2012).

## BACKGROUND

In 1991, a 7-year research period was initiated to gather baseline information on federally endangered Colorado Pikeminnow and Razorback Sucker after both species were re-discovered and documented spawning in the San Juan River. In 1992, a Cooperative Agreement between the U.S. Fish and Wildlife Service, States of Colorado and New Mexico, the Jicarilla Apache Indian Tribe, the Southern Ute Indian Tribe, and the Ute Mountain Ute Indian Tribe was signed to form the San Juan River Basin Recovery Implementation Program (SJRIP). The Navajo Nation later signed the Cooperative Agreement and joined the SJRIP in 1996. The purpose of the SJRIP is to conserve populations of Colorado Pikeminnow and Razorback Sucker in the San Juan River Basin while water development proceeds in the basin in compliance with all federal, state, and tribal laws (SJRIP 2015). The research program was incorporated into the SJRIP when it was formed in 1992.

After the 7-year research period ended, the SJRIP initiated several management actions to aid in endangered species recovery including mechanical control of nonnative species, habitat restoration, population augmentation, and the implementation of flow recommendations. To assess the effects of these management actions on endangered fish recovery and the native fish community as a whole, a long-term monitoring program was initiated in 1998. The goals of this monitoring program were to: (1) track the status and trends of endangered and other fish populations in the San Juan River, (2) track changes in abiotic parameters important to the fish community, and (3) utilize collected data to help assess progress towards recovery of endangered fish species (Propst et al. 2006). The SJRIP Long-Range Plan specifies that monitoring and evaluation of fish in the San Juan River is a necessary element for assessing the progress of the recovery program for Colorado Pikeminnow and Razorback Sucker (Element 4; SJRIP 2015).

Task 4.1.2.2 of the SJRIP's Long-Range Plan specifies the need for juvenile and small-bodied fish monitoring to locate areas and habitats used for rearing and to determine if young fish are surviving and recruiting into adult populations (SJRIP 2015). Data collected during annual small-bodied fish monitoring can be used to assess recovery of Colorado Pikeminnow and Razorback Sucker. In addition to assessing recovery of both endangered fish species, small-bodied monitoring data have also been used to evaluate the influences of SJRIP management actions on the river's fish community as a whole. These assessments have included evaluating the effects of flow regime management on small-bodied fishes in secondary channels (Propst and Gido 2004; Franssen et al. 2007; Gido and Propst 2012; Gido et al. 2012), assessing the influences of habitat stability on the spatial and temporal trends in small-bodied fish communities in secondary channels (Gido et al. 1997), and determining the effects of habitat heterogeneity on the community structure of small-bodied fishes (Franssen et al. 2015).

## MONITORING OBJECTIVES

The specific objectives for small-bodied fishes monitoring include:

1. Annually document occurrence and density of native and nonnative age-0/small-bodied fishes in the

San Juan River.

2. Document mesohabitat use by age-0 Colorado Pikeminnow, Razorback Sucker, and Roundtail Chub, as well as other native and nonnative fishes in the primary channel, secondary channels, and backwaters.
3. Obtain data that will aid in the evaluation of the responses of native and nonnative fishes to different flow regimes and other management actions.
4. Track trends in native and nonnative species populations.
5. Characterize patterns of mesohabitat use by native and nonnative small-bodied fishes.

## Hypotheses

The specific hypotheses for small-bodied fishes monitoring from the Monitoring Plan and Protocols (SJ RIP 2012) include:

1.  $H_0$ : There is no influence of spring discharge volume, duration, or magnitude on autumn density of age-0 native fishes.
2.  $H_0$ : There is no influence of spring discharge volume, duration, or magnitude on autumn density of age-0 nonnative fishes.
3.  $H_0$ : Volume of summer baseflow has no effect on survival of age-0 native fishes, as determined by autumn densities of age-0 specimens.
4.  $H_0$ : Volume of summer baseflow has no effect on reproductive success/survival of age-0 nonnative fishes, as determined by autumn densities of age-0 specimens.
5.  $H_0$ : Mechanical removal of nonnative predators has no effect on the density of small-bodied native fishes.

## STUDY AREA

The study area for annual small-bodied fishes monitoring extends from River Mile (RM) 196.1 at Bloomfield, NM downstream to RM 2.9 at Clay Hills, UT (Figure 1). These 193.2 miles are split into three separate sections for small-bodied fishes monitoring; Section 1 is from Bloomfield, NM (RM 196.1) to Shiprock, NM (RM 147.8), Section 2 occurs from Shiprock, NM (RM 147.8) to Sand Island, UT (RM 76.4), and Section 3 is from Sand Island, UT (RM 76.4) to Clay Hills, UT (RM 2.9). Section 3 (RM 76.4 – 2.9) is regularly sampled every fifth year as part of the regular sampling protocol for annual small-bodied fishes monitoring. This section of river was last sampled in 2015 and will be sampled again in 2020, unless the conditions below are met.

Sampling during FY 2018 will be based on a flexible schematic dependent upon the presence of wild age-0 Colorado Pikeminnow (CPM) and Razorback Sucker (RBS) (Figure 2). This flexibility will allow for increased ability to document river-wide occurrence of both endangered species and increase knowledge on their distribution and mesohabitat use. Captures of wild age-0 CPM and/or RBS during sampling in Section 2 (RM 147.8 – 76.4) will determine whether Section 1 (RM 196.1 – 147.8) and/or Section 3 (RM 76.4 – 2.9) will subsequently be sampled. Section 1 will be sampled if  $< 25$  wild age-0 CPM or RBS are captured throughout Section 2 during regular monitoring. If  $\geq 25$  wild age-0 CPM or RBS are captured in Section 2 from RM 119.1 (Four Corners, CO Bridge) to RM 76.4 (Sand Island, UT), Section 3 will be sampled and Section 1 will not. Capture of  $\geq 25$  wild age-0 CPM or RBS above RM 119.1 and  $\geq 25$  below RM 119.1 will result in the sampling of both Section 1 and Section 3. The Animas River, Aztec, NM downstream to the San Juan-Animas rivers confluence, may also be sampled in the spring (March/April) depending on flows and access.

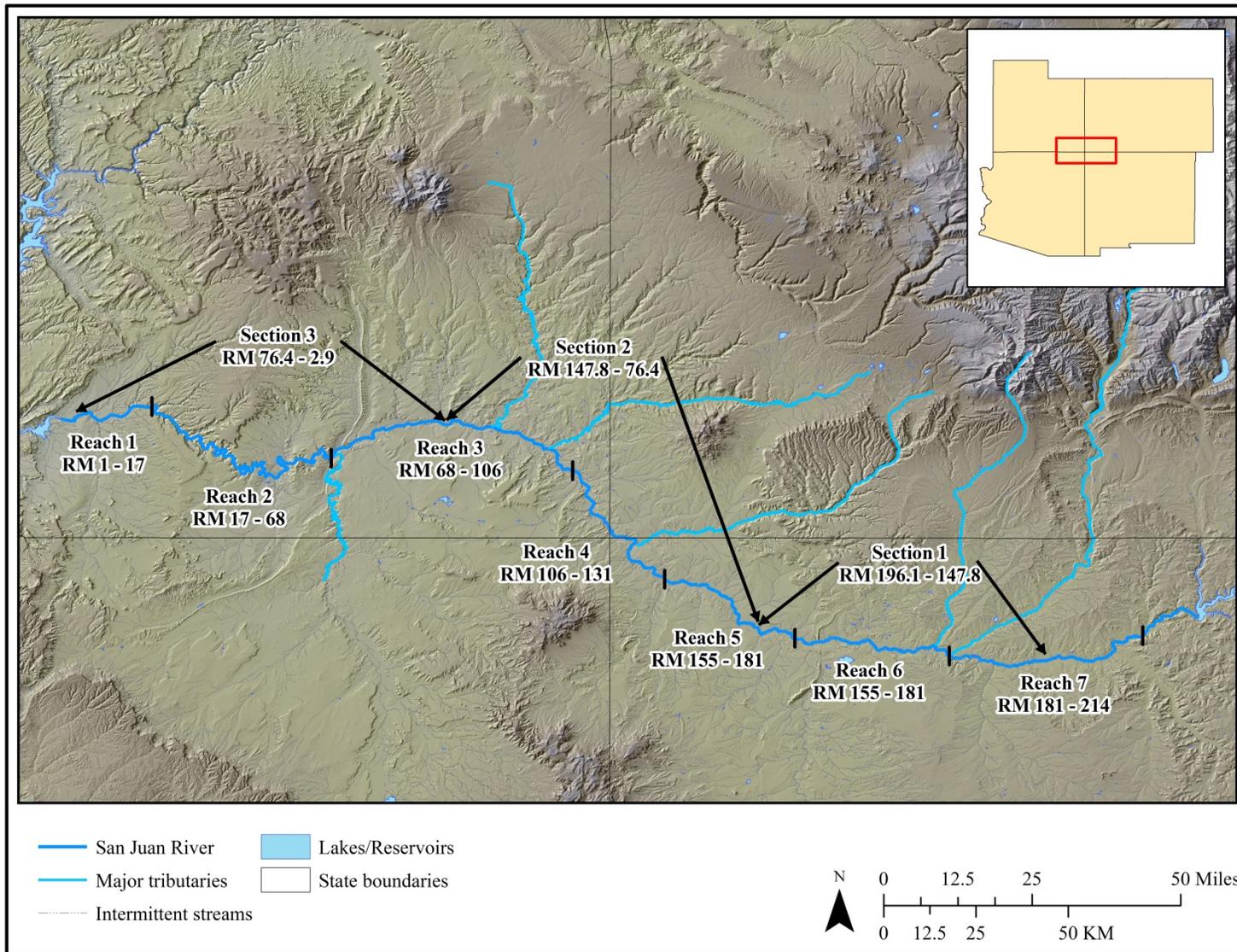


Figure 1. Sampling area for small-bodied fishes monitoring with RM (River Miles) for each Section and Geomorphic Reach. Inset indicates location of San Juan River in Colorado, New Mexico, and Utah.

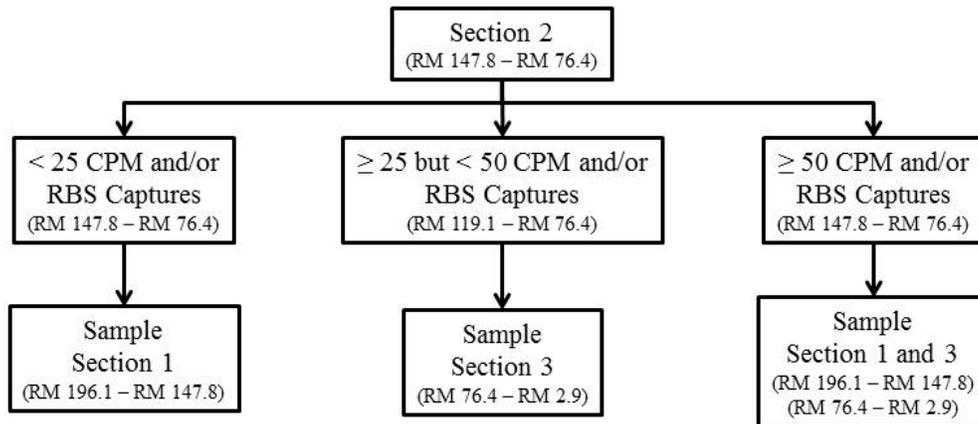


Figure 2. Flexible sampling schematic which will be used during small-bodied fishes monitoring in FY 2018.

## METHODS

Small-bodied fishes monitoring is designed to efficiently and effectively sample those habitats which have the greatest likelihood of supporting age-0 individuals of large-bodied species and all age classes of small-bodied species. Sampling will occur in September before annual sub-adult and adult monitoring. The current sub-adult/adult monitoring protocol requires that every RM be sampled to assess the efficiency of nonnative removal and sampling before sub-adult/adult monitoring will prevent any deleterious effects of electroshocking at primary channel sample sites. Sampling will occur at designated 3-mile intervals in the primary channel, and at all secondary channels (less than 20% of total flow) and zero velocity channels (i.e., backwaters and embayments;  $> 30 \text{ m}^2$ ) when encountered (SJRIP 2012). Note that previous small-bodied fishes monitoring in zero velocity channels occurred in only those  $> 50 \text{ m}^2$  (SJRIP 2012). The decrease from  $50 \text{ m}^2$  to  $30 \text{ m}^2$  will increase the number of zero velocity channels sampled and also make the small-bodied fishes sampling protocol on the San Juan River more similar to the ISMP used in the upper Colorado River Basin (USFWS 1987). Sample reaches will be approximately 200 m long (measured along the shoreline) at primary channel sample sites and, depending upon the extent of surface water, 100 – 200 m long at secondary channel and zero velocity channel sample sites.

In the fall of 2012, six secondary channels were modified during the Phase I River Ecosystem Restoration Initiative (RERI) habitat restoration efforts through excavation of sediment and removal of nonnative plants. These channels are located at RM 132.2, 132.0, 130.7A, 130.7B, 128.6, and 127.2. An additional channel located at RM 136.5 was restored during Phase II habitat restoration efforts in 2014. These restoration sites will be visited during annual small-bodied fishes monitoring and sampled if flowing following the protocols described below.

River mile, geographic coordinates (UTM NAD83), and water quality parameters (dissolved oxygen, conductivity, and temperature) will be recorded at each sampling site. All mesohabitats (e.g., riffle, run, pool) present within a site (except large zero velocity channels) will be sampled in rough proportion to their availability using a 3.0 x 1.8 m (3.0 mm heavy duty Delta untreated mesh) drag seine. Uncommon mesohabitats (e.g., debris pools and backwaters) are sampled in greater proportion to their availability than common mesohabitats. Seine hauls will be made in at least eight different mesohabitats at each site; however, if habitat is homogeneous, as few as five seine hauls will be made. At least two seine hauls, one across the mouth and one parallel to its long axis will be made at each large zero velocity

channel unless the mouth is too narrow, in which case at least one seine haul, parallel to its long axis, will be made.

Additional seine hauls in mesohabitats (i.e., debris pools, backwaters, pools, slackwaters) where wild age-0 CPM and RBS are more likely to occur will be made in an attempt to increase catches of these endangered species and expand knowledge on their distribution and mesohabitat use in the San Juan River. These additional samples will be made at normal sampling sites but will be kept separate from the overall analyses to allow for continued annual comparisons.

All captured fishes will be identified to species and up to 25 in a single seine haul measured for total length (mm TL). Any captured endangered species (i.e., Colorado Pikeminnow and Razorback Sucker) will also be weighed (g) and, if  $\geq 150$  mm, injected with a 12 mm PIT tag. All Colorado Pikeminnow will also be checked for a calcein mark. All native fishes will be released and nonnative fishes removed from the river. Fishes too small to easily identify in the field will be fixed in 10% formalin and returned to the laboratory. After collection of fish, the sampled width and length of each mesohabitat is measured to the nearest 0.1 m and recorded. The depth and dominant substrate at five generalized locations, and any cover (e.g., boulders, debris piles, large woody debris) associated with the mesohabitat will also be recorded. Retained specimens will be identified and measured (TL and SL) in the laboratory to the nearest 0.1 mm and accessioned to the UNM-MSB, Division of Fishes.

After data collection, all original field notes will be checked for errors and missing data. Data will be entered into Excel spreadsheets with a similar template as the small-bodied fishes database. All entered data will be cross-checked with the original field notes by a different biologist. Data from the Excel spreadsheets will be imported into the small-bodied fishes database. Specific conditions for each data field in the database prevent the entry of incorrect data and typographical errors. Database queries will be used to identify and rectify any additional errors.

## **DATA ANALYSIS AND REPORTING**

Analyses will be based on density (i.e., catch-per-unit-effort, CPUE) of individual species, calculated by seine haul, as the number of fish captured per square meter sampled (width x length). To account for the significant number of zeros and highly skewed data, density for each species will be analyzed using a Delta-GLM approach which combines two separate components: (1) a logistic model estimating the probability of presence ( $CPUE_{0/1}$ ) fitted using a GLM with a binomial distribution and logit link, and (2) a model for CPUE only when the species is present ( $CPUE^+$ ) fitted using a GLM with a lognormal distribution (Stefánsson 1996; Fletcher et al. 2005; Acou et al. 2011; Vasconcelos et al. 2013). The predicted density,  $E(CPUE)$ , is then obtained by (3) multiplying the response variables predicted by the binomial and lognormal models for each individual seine haul. This approach models the two aspects of the data (i.e., presence/absence and positive density) separately, allowing for evaluation of how covariates influence the two separate processes. Furthermore, the approach is much simpler and easier to interpret than other methods such as mixture models (Fletcher et al. 2005). Calculation of density will be limited to those species which have greater than 3% of all seine hauls (2003 – 2018) with at least one capture.

Several models using a combination of covariates will be used in both the logistic and positive lognormal model. Both abiotic and biotic covariates will be investigated for their use in each model (Table 1). The negative loglikelihood from both models will be combined to calculate Akaike's Information Criterion with a correction for finite sample sizes ( $AIC_c$ ). The combined model with the lowest  $AIC_c$  will then be used to model the final binomial and lognormal models for each species.

Residual plots will be examined to ensure that the final positive lognormal model meets the assumptions of normally distributed and equal variance residuals.

Table 1. Name and description of abiotic and biotic covariates which may be used in both the logistic and lognormal models to predicted expected density (E(CPUE)).

Covariate Name	Description
sampYear	Year in which the sample was taken.
Reach	Geomorphic reach in which the sampled was taken.
RiverMile	The river mile where the sample was taken.
ChannelType	The channel type in which the sampled was taken.
Mesohabitat	The mesohabitat in which the sample was taken.
sampDis	Discharge at time the sample was taken.
AvgDepth	The average depth of the mesohabitat where the sample was taken.
NNC_1_Den	The density of nonnative competitors in the Reach where the sample was taken. Calculated as the total density of Fathead Minnows, Red Shiners, and Western Mosquitofish captured during annual small-bodied fishes monitoring.
NNC_2_Den	The density of nonnative competitors in the Reach where the sample was taken. Calculated as the total density of Channel Catfish, Fathead Minnows, Red Shiners, and Western Mosquitofish captured during annual small-bodied fishes monitoring.
NNC_3_Den	The density of nonnative competitors in the Reach where the sample was taken. Calculated as the total density of Channel Catfish captured during annual small-bodied fishes monitoring.
NNP_Den	The CPUE (fish/hr) of nonnative predators in the Reach where the sample was taken. Calculated as the number of adult Channel Catfish captured during annual sub-adult/adult monitoring.

Final binomial, lognormal, and Delta-GLM models will be assessed for goodness-of-fit and predictive capability. The predictive accuracy for the binomial model will be tested using the Area Under the Curve (AUC) of the Receiver Operating Characteristic (ROC). The ROC analysis involves plotting the proportion of known presences predicted against the proportion of known absences predicted (Peterson et al. 2008). The values of the AUC of the ROC curve range from 0.5 to 1.0 with 0.5 indicating no fit and a 1.0 a perfect fit (Fielding and Bell 1997). For the positive lognormal and Delta-GLM models, a linear regression between observed (x-axis) and predicted (y-axis) CPUE will be used to test predictive ability. The coefficient of determination ( $R^2$ ) of this relationship shows the proportion of the linear variation in y (predicted values) explained by the variation in x (observed values), the intercept of this linear regression model describes bias, and the slope describes consistency. Differences in annual density for each species, as calculated from the Delta-GLM model, will be assessed only for Reaches 3-6 and Reach 7 using a Kruskal-Wallis analysis of ranks. Statistically significant differences ( $P < 0.10$ ) will be further analyzed using a post-hoc Dunn's test to determine if the density in 2018 is significantly different from the previous 15 years of data.

Differences in annual discharge ( $H_0$  1 – 4) and nonnative competitors and predators ( $H_0$  5) are assumed to influence the E(CPUE) of small-bodied and juvenile native and nonnative species in the San Juan River (Franssen et al. 2007; Gido and Propst 2012; Propst and Gido 2004). To investigate the possible influences of discharge on annual variation of E(CPUE), several discharge metrics will be calculated using daily discharge data at Four Corners, CO (USGS gage 09371010) (Table 2). The Four Corners gage will be used to calculate flow metrics for Reaches 3 – 6 because all of these Reaches are located below the confluence of the Animas River and also because this gage is used to determine if flow recommendations are met each year. Several flow metrics for both the spring (March 1<sup>st</sup> to June 30<sup>th</sup>) and summer (July 1<sup>st</sup> to September 30<sup>th</sup>) will be calculated. To assess the possible influences of nonnatives on the density of native species, the density of nonnative competitors and nonnative predators will be calculated for each year and Geomorphic Reach. Nonnative competitors will be calculated as the total combined density (total fish/total area sampled x 100; fish/100 m<sup>2</sup>) of Red Shiner, Fathead Minnow, and Western Mosquitofish. Nonnative predators will be calculated as the CPUE (fish/hour) of Channel Catfish > 300 mm from annual September adult fall monitoring data. Linear regression will be used to relate E(CPUE) to each discharge metric to assess any potential influences. Linear regression will also be used to relate E(CPUE) of native species to the nonnative metrics to assess influence of nonnative competitors and predators on the density of native species. Although linear regression will initially be attempted, more complex analyses (e.g., GAMs, CART, or RF) may be used to further elucidate the influences of these metrics on E(CPUE) if potential non-linear relationships are observed during initial data exploration. Comparisons between species density and discharge and nonnative metrics will only be conducted for Reaches 3 – 6.

Table 2. Annual discharge metrics for the spring (1 April to 30 June) and summer (1 July to 30 September) calculated from daily discharge at Four Corners, CO (USGS gage 0937101) which will be used to investigate the influence of discharge on the density of native and nonnative fishes.

Covariate Name	Description
Mean April	Mean daily discharge during April
Mean May	Mean daily discharge during May
Mean June	Mean daily discharge during June
Mean Spring	Mean daily discharge during the spring
Days > 10,000 cfs	Number of days greater than 10,000 cfs during the spring
Days > 8,000 cfs	Number of days greater than 8,000 cfs during the spring
Days > 5,000 cfs	Number of days greater than 5,000 cfs during the spring
Mean July	Mean daily discharge during July
Mean August	Mean daily discharge during August
Mean September	Mean daily discharge during September
Mean Summer	Mean daily discharge during the summer
Days > 1,000 cfs	Number of days greater than 1,000 cfs during the summer
Days < 1,000 cfs	Number of days less than 1,000 cfs during the summer
Days < 500 cfs	Number of days less than 500 cfs during the summer

Data collected from the six RERI and the Phase II secondary channels will be reported for each year since these channels were restored. Information for the RERI and Phase II secondary channels will include if the channel was sampled, reasoning for why it was not sampled, and number of endangered, native, and nonnative species captured.

The annual report will provide a summation of data obtained in FY 2018, a synthesis of data across years to document/assess species populations' trends, and a summary of mesohabitat associations. Separate data summaries and analyses will also be conducted for any wild age-0 CPM and RBS (if needed) and any sampling conducted in the Animas River. All data collected will be recorded on electronic spreadsheets and provided to USFWS Program Office by the principal investigator, along with the annual final report, by 30 June 2019.

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#### **FUNDING HISTORY:**

Fiscal Year 2000	\$57,200	Fiscal Year 2010	\$89,479
Fiscal Year 2001	51,700	Fiscal Year 2011	82,929
Fiscal Year 2002	51,700	Fiscal Year 2012	83,417
Fiscal Year 2003	49,775	Fiscal Year 2013	92,353
Fiscal Year 2004	63,545	Fiscal Year 2014	84,307
Fiscal Year 2005	72,645	Fiscal Year 2015	95,054
Fiscal Year 2006	72,885	Fiscal Year 2016	89,345
Fiscal Year 2007	81,246	Fiscal Year 2017	89,842
Fiscal Year 2008	91,882		
Fiscal Year 2009	89,479		

**FY 2018 Budget****Sampling - Section 2**Personnel

*Tasks* - Annual monitoring primary channel, secondary channel, and backwater habitats, San Juan River Section 2, Shiprock, NM to Sand Island, UT; The Nature Conservancy RERI Phase I and Phase II sites; 7 field days projected at 12 hours of work per day = 84 hours (56 hrs regular and 28 hrs

## Project Leader (1)

56 hrs regular @ \$46.34/hr (\$33.69/hr (base salary) + \$12.66/hr (benefits))	\$ 2,595
28 hrs overtime @ \$69.52/hr (\$46.34/hr * 1.5 (time-and-a-half))	\$ 1,947

## Project Biologist (3)

56 hrs regular @ \$37.13/hr (\$26.99/hr (base salary) + \$10.14 (benefits)) * 3	\$ 6,238
28 hrs overtime @ \$55.69/hr (\$37.13/hr * 1.5 (time-and-a-half)) * 3	\$ 4,678

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**Sub-total \$ 15,458**

Per Diem

4 days @ \$85/day (standard NM in-state rate) * 4 biologists	\$ 1,360
3 days @ 115/day (standard NM out-of-state rate) * 4 biologist	\$ 1,380

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**Sub-total \$ 2,740**

Vehicles

Round-trip to Mexican Hat, Utah – 800 miles @ \$0.55/mile	\$ 440
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**Sub-total \$ 440**

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**Section 2 Sampling Sub-total \$ 18,638**

**Sampling - Section 1**Personnel

*Tasks* - Annual monitoring primary channel, secondary channel, and backwater habitats, San Juan River Section 1, Bloomfield, NM to Shiprock, NM; 6 field days projected at 12 hours of work per day = 72 hours (48 hrs regular and 24 hrs overtime).

## Project Leader (1)

48 hrs regular @ \$46.34/hr (\$33.69/hr (base salary) + \$12.66/hr (benefits))	\$ 2,224
24 hrs overtime @ \$69.52/hr (\$46.34/hr * 1.5 (time-and-a-half))	\$ 1,668

## Project Biologist (3)

48 hrs regular @ \$37.13/hr (\$26.99/hr (base salary) + \$10.14 (benefits)) * 3	\$ 5,347
24 hrs overtime @ \$55.69/hr (\$37.13/hr * 1.5 (time-and-a-half)) * 3	\$ 4,010

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**Sub-total \$ 13,249**

Per Diem

6 days @ \$85/day (standard NM in-state rate) * 4 biologists	\$ 2,040
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**Sub-total \$ 2,040**

Vehicles

Round-trip to Farmington, NM – 500 miles @ \$0.55/mile	\$ 275
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**Sub-total \$ 275**

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**Section 1 Sampling Sub-total \$ 15,564**

**Sampling - Section 3****Personnel**

*Tasks* - Annual monitoring primary channel, secondary channel, and backwater habitats, San Juan River Section 3, Sand Island, UT to Clay Hills, UT; 8 field days projected at 12 hours of work per day = 96 hours (64 hrs regular and 32 hrs overtime).

## Project Leader (1)

64 hrs regular @ \$46.34/hr (\$33.69/hr (base salary) + \$12.66/hr (benefits))	\$ 2,966
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32 hrs overtime @ \$69.52/hr (\$46.34/hr * 1.5 (time-and-a-half))	\$ 2,225
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## Project Biologist (3)

64 hrs regular @ \$37.13/hr (\$26.99/hr (base salary) + \$10.14 (benefits)) * 3	\$ 7,129
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32 hrs overtime @ \$55.69/hr (\$37.13/hr * 1.5 (time-and-a-half)) * 3	\$ 5,346
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<b>Sub-total</b>	<b>\$ 17,666</b>
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**Per Diem**

8 days @ \$115/day (standard NM out-of-state rate) * 4 biologists	\$ 3,680
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<b>Sub-total</b>	<b>\$ 3,680</b>
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**Vehicles**

Round-trip to Clay Hills, UT – 950 miles @ \$0.55/mile	\$ 523
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<b>Sub-total</b>	<b>\$ 523</b>
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<b>Section 3 Sampling Sub-total</b>	<b>\$ 21,869</b>
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**Field Equipment & Supplies**

Water quality instrument maintenance 2 @ \$400	\$ 800
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Life Jackets 5 @ \$40	\$ 200
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Raft maintenance	\$ 500
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Whirlpacks (500) @ \$50.00/per 500	\$ 50
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Formalin (6 gal) @ \$25/gal	\$ 150
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<b>Sub-total</b>	<b>\$ 1,700</b>
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<b>Sampling Sub-total</b>	<b>\$ 57,771</b>
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**Specimen Management****Personnel**

*Tasks* - Processing (sorting, identification, and data-entry); 15 days of in the laboratory at 8 hours of work per day = 120 hours.

Project Biologist

120 hrs regular @ \$37.13/hr (\$26.99/hr (base salary) + \$10.14 (benefits)) \$ 4,456

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**Specimen Management Sub-total \$ 4,456**

**Data Management/Analysis and Report Preparation****Personnel**

*Tasks* – Data management and QA/QC, data analysis and synthesis, table and graph preparation, report drafting and revision; Project Leader (120 hrs) and one Project Biologist (200 hrs each).

Project Leader (1)

120 hrs regular @ \$46.34/hr (\$33.69/hr (base salary) + \$12.66/hr (benefits)) \$ 5,561

Project Biologist (1)

200 hrs regular @ \$37.13/hr (\$26.99/hr (base salary) + \$10.14 (benefits)) \$ 7,426

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**Data Management/Analysis & Report Preparation Sub-total \$ 12,987**

**FY 2018 Total**

Sampling Sub-total \$ 57,771

Specimen Management Sub-total \$ 4,456

Data Management/Analysis & Report Preparation Sub-total \$ 12,987

**Sub-Total \$ 75,214**

IDC at 28.0% \$ 21,060

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**Total \$ 96,274**

**SAN JUAN RIVER LARVAL RAZORBACK SUCKER AND COLORADO PIKEMINNOW MONITORING  
FISCAL YEAR 2018 SCOPE OF WORK**

**SUBMITTED TO THE U.S. BUREAU OF RECLAMATION**

**FROM**

**AMERICAN SOUTHWEST ICHTHYOLOGICAL RESEARCHERS, L.L.C. (ASIR)  
800 ENCINO PLACE NE  
ALBUQUERQUE, NEW MEXICO 87102-2606  
505.247.9337 (VOICE) 505.247.2522 (FACSIMILE)**

**CONTRACT No. GS10F0249X**

**1 OCTOBER 2017- 30 SEPTEMBER 2018**

**SAN JUAN RIVER LARVAL RAZORBACK SUCKER AND COLORADO PIKEMINNOW MONITORING  
FISCAL YEAR 2018 PROJECT PROPOSAL**

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**Razorback Sucker project history:**

The apparent absence of Razorback Sucker, *Xyrauchen texanus*, in the San Juan River drainage necessitated experimental stocking of adults (n=672) of this species in 1994 between Hogback, New Mexico, and Bluff, Utah. In their 1995 report of activities, Ryden and Pfeifer (1996) suggested that the majority of the 1994 experimentally stocked Razorback Sucker would achieve sexual maturity in 1996 and spawning by those individuals might begin a few years afterwards.

At the November 1996 San Juan River Basin Biology Committee integration meeting, it was suggested that the Colorado Pikeminnow, *Ptychocheilus lucius*, larval fish drift study (= Passive Drift Netting Study; RM 127.5 and RM 53.3; July-August) be expanded in an attempt to document spawning of the stocked Razorback Sucker (presumed to be during April-May). In addition to temporal differences in spawning between Colorado Pikeminnow and catostomids (suckers), researchers were attempting to document reproduction by hatchery reared Razorback Sucker whose spawning potential was unknown. Sampling for larval Razorback Sucker was to be conducted to determine if the stocked population of adult Razorback Sucker would spawn in this system. Conversely, data from the passive drift-netting study continued to document Colorado Pikeminnow reproduction in the San Juan River and, because of this certainty, larval fish sampling efforts for this fish would (initially) be different than those for Razorback Sucker.

Numerous Upper Colorado River Basin researchers reported light-traps as one of the best means of collecting larval Razorback Sucker. Most of their light trapping efforts was concentrated in floodplain habitats during high spring flows. Light-trap sampling was employed during the first year (calendar year 1997) of the San Juan River larval Razorback Sucker survey. The lack of inundated floodplain habitats in the San Juan River, in comparison to the Upper Colorado River Basin, meant that the light-traps would have to be set in low velocity riverine habitats. The only previous San Juan River fish investigations that had employed light-traps were in 1994 and 1995 (conducted by the National Park Service) near the San Juan River-Lake Powell confluence. That sampling effort produced an extremely large number of larval fish (ca. 25,000) from a modest number of samples (n=20), of which over 99% were Red Shiner. Similar sampling in 1995 yielded 25,455 specimens in 47 light-traps samples and as in 1994, Red Shiner numerically dominated the catch. Both sampling efforts were conducted during July-August but neither Colorado Pikeminnow nor Razorback Sucker was present in the 1994-1995 light-trap samples.

During the 1997 Razorback Sucker larval fish survey, light-traps were set nightly in low-velocity habitats between Aneth and Mexican Hat, Utah, from late March through mid-June. The traps were distributed at dusk and retrieved about four hours later. Fish taken in those samples were preserved in the field. Sampling success during the 1997 Razorback Sucker larval fish study was poor. While there were over 200 light-trap sets, those sampling efforts produced only 297 fish. Of those, about 200 (66%) were larval catostomids (either Flannelmouth Sucker or Bluehead

Sucker). Larval Razorback Sucker was not present in the 1997 sampling survey. While there were probably several factors to account for the poor light-trap catch rate, a principal factor was the limited access to suitable habitats. We determined that being limited to specific collecting sites was not the most efficient means of collecting large numbers of individuals; a prerequisite for this study.

In 1998 a new study design was developed to allow for the sampling of a greater portion of the San Juan River and the collection of a significantly larger number of larval fish throughout several river reaches. An inflatable raft was used to traverse the San Juan River and allowed us the opportunity to sample habitats that were either not formerly accessible or observable under the constraints of the previous sampling protocol. Six sampling forays were conducted at approximately bi-weekly intervals from 17 April to 6 June 1998 between the Four Corners drift station (RM 127.5) and Mexican Hat, Utah (RM 53.3). Both active (seining) and passive (light-traps) sampling techniques were used to collect larval fish. The primary sampling method was a fine mesh larval seine (1 m x 1 m x 0.8mm). If appropriate aquatic mesohabitats could be located, light-traps would be set adjacent to nightly campsites of the sampling crew.

The 1998 sampling protocol resulted in 183 collections containing over 13,000 specimens between river miles 127.5 and 53.3 with the majority of these individuals (n=9,960) being larval catostomids. This 43-fold increase in number of specimens, as compared with 1997, provided substantially better resolution of spawning periodicity of the catostomid community. In addition, the 1998 samples produced enough individuals for us to determine, with a high degree of confidence, if Razorback Sucker reproduction occurred in the San Juan River during that period. None of the aforementioned information was obtainable from 1997 light-trap samples. In 1998, two larval Razorback Sucker were collected providing verification of spawning by the hatchery reared stocked population.

The use of active sampling to determine the reproductive success of Razorback Sucker has proven to be effective. To date, the results of this investigation have provided 19 consecutive years of unequivocal documentation of reproduction in the San Juan River by Razorback Sucker that have been stocked as part of the San Juan River Basin Recovery Implementation Program (Table 1). The data collected during the larval Razorback Sucker survey provide not only valuable data concerning the distribution (spatial and temporal), duration, and magnitude of Razorback Sucker reproduction but also equally informative data on the reproductive efforts of other native fishes in the San Juan River.

Table 1. Collection information of Razorback Sucker (*Xyrtex*) collected during the larval Razorback Sucker survey, 1998 – 2016.

<i>Year</i>	<i>Sampling method</i>	<i>Study Area (River Miles)</i>	<i>River Miles sampled</i>	<i>RM Percent change</i>	<i>Specimens collected</i>	<i>Xyrtex n=</i>
1998	Larval seine Light traps	127.5 – 53.3	74.2	na	13,608	2
1999	Larval seine Light traps	127.5 – 2.9	124.6	+ 67.4%	20,711	7
2000	Larval seine Light traps	127.5 – 2.9	124.6	na	13,549	129
2001	Larval seine Light traps	141.5 – 2.9	138.6	+ 11.2%	95,629	50
2002	Larval seine Light traps	141.5 – 2.9	138.6	na	138,602	813
2003	Larval seine Light traps	141.5 – 2.9	138.6	na	112,842	472
2004	Larval seine	141.5 – 2.9	138.6	na	160,292	41
2005	Larval seine	141.5 – 2.9	138.6	na	109,368	19
2006	Larval seine	141.5 – 2.9	138.6	na	50,616	202
2007	Larval seine	141.5 – 2.9	138.6	na	53,084	200
2008	Larval seine	141.5 – 2.9	138.6	na	40,855	126
2009	Larval seine	141.5 – 2.9	138.6	na	72,404	272
2010	Larval seine	141.5 – 2.9	138.6	na	70,610	1,251
2011	Larval seine	141.5 – 2.9	138.6	na	28,258	1,065
2012	Larval seine	147.9 – 2.9	145.0	+ 4.6%	29,384	1,778
2013	Larval seine	147.9 – 2.9	145.0	na	25,842	979
2014	Larval seine	147.9 – 2.9	145.0	na	20,508	612
2015	Larval seine	147.9 – 2.9	145.0	na	17,787	1,205
2016	Larval seine	147.9 – 2.9	145.0	na	12,973	824

**Colorado Pikeminnow project history:**

Beginning in spring 1995, personnel from the Division of Fishes, Museum of Southwestern Biology (MSB), at the University of New Mexico assumed responsibility for the San Juan River larval fish passive drift-netting study. This project, formerly conducted by the Utah Division of Wildlife Resources, continued through 2001 with only minor changes in sampling protocol. Between 1995 and 2001, a total of four larval Colorado Pikeminnow were collected using this sampling method at two different collecting locations (Table 2).

The limited number of wild adult Colorado Pikeminnow (versus stocked individuals) in the San Juan River was reflected in the extremely low catch rate of larval Colorado Pikeminnow. Numerous adult and sub-adult Colorado Pikeminnow have now been stocked into the San Juan River in an effort to augment the diminished wild population. The Colorado Pikeminnow augmentation plan (phase II) calls for continued stocking efforts in the San Juan River through 2020. The San Juan River Basin Biology Committee expects, as was documented with stocked Razorback Sucker, that reproduction among stocked Colorado Pikeminnow will occur and can be documented through the sampling of larval fish.

As the number of adult (reproductively mature) Colorado Pikeminnow in the San Juan River increases (due to both stocking and recruitment), so does the probability of elevated levels of spawning by this species. The San Juan River Basin Biology Committee began exploring the possibility of expanding the sampling effort for larval Colorado Pikeminnow in fiscal year 2003. One means of accomplishing this task was to include an additional sampling site (increasing from two to three sites) for the passive drift-netting study. Another suggestion was to perform targeted sampling for Colorado Pikeminnow similar to that performed for larval Razorback Sucker. In the case of the latter sampling effort, discussion regarding sampling that would target larval Colorado Pikeminnow centered around expanding the duration of the current larval Razorback Sucker survey (April-June) or development of a discrete (new) project. These and other items were considered and evaluated during the February 2002 San Juan River Basin Biology Committee meeting. The Committee recommended the immediate expansion of the larval Razorback Sucker survey (April-June) to include the months of July, August, and September with seining efforts to target larval Colorado Pikeminnow.

Beginning in July of 2002, using funds from FY 2002 that had been appropriated for use at the two larval drift-netting stations, Museum of Southwestern Biology (MSB) personnel began an active sampling regime that mirrored the sampling protocol successfully used in the larval Razorback Sucker survey. The results from the temporal expansion of the larval surveys have produced 936 wild larval Colorado Pikeminnow to date. The majority of those larvae were collected in 2014 (n= 312) and 2016 (n= 548). Larval Colorado Pikeminnow were collected in surveys during 2004, 2007, 2009, 2010, 2011, 2013, 2014, 2015 and 2016 at 97 discrete sites, within the study area. Between 1995 and 2016 the combined sampling methodologies (passive and active) resulted in the collection of 940 larval Colorado Pikeminnow. Back-calculated spawning dates, based on those 940 individual larvae, range from 23 May to 18 July (Table 2) and are generally associated with the descending limb of spring run-off and mean river temperatures >18°C.

Over 1,000,000 fish have been collected between 1995 and 2016 under the larval Colorado Pikeminnow survey. Of those, over 900,000 fish were collected after 2001 when the sampling protocol switched from passive to active sampling (2002).

Table 2. Summary of larval and YOY Colorado Pikeminnow collected in the San Juan River during larval drift-netting/larval seining (1995-2016) and back-calculated dates of spawning.

<i>Year</i>	<i>Sample Method</i>	<i>Study Area (River Miles)</i>	<i>N=</i>	<i>Length mm TL.</i>	<i>Collection Date</i>	<i>Spawning Date</i>
1995	Drift Netting	127.5, 53.3	2	9.0, 9.2	02, 03 Aug	15, 17 Jul
1996	Drift Netting	127.5, 53.3	1	8.6	02 Aug	18 Jul
2001	Drift Netting	127.5, 53.3	1	8.5	01 Aug	17 Jul
2004	Larval Seine	141.5 – 2.9	2	14.2, 18.1	22, 26 Jul	24, 25 Jun
2007	Larval Seine	141.5 – 2.9	3	14.9-17.5	25 Jul	27 Jun
2009	Larval Seine	141.5 – 2.9	1	25.2	27 Jul	10 Jun
2010	Larval Seine	141.5 – 2.9	5	12.6–21.4	20-23 Jul	15–27 Jun
2011	Larval Seine	141.5 – 2.9	29	10.0–21.3	20, 21 Jul, 10,11 Aug	23 Jun–6 Jul
2013	Larval Seine	147.9 – 2.9	12	14.1–28.7	17–30 Jul	23 May–3 Jul
2014	Larval Seine	147.9 – 2.9	312	8.5–20.8	13–28 Jul	15 Jun–2 Jul
2015	Larval Seine	147.9 – 2.9	24	8.6–9.7	28–30 Jul	10–14 Jul
2016	Larval Seine	147.9 – 2.9	548	8.8–14.7	24–28 Jul	29 Jun–12 Jul

### **Project Modifications:**

There have been numerous modifications to the field methodology of the larval fish survey over time as well as changes in reporting priorities, protocol, and format. The extent of the study area and aspects of the longitudinal sampling have been modified to improve spatial comparisons. The study area was expanded in 1999, 2001, and 2012 by a total of 70.8 river miles (nearly double the length of the original study area) to include most of Reach 5 (Shiprock, New Mexico) through Reach 1 (Clay Hills Crossing, Utah; a total of 145.0 miles of critical habitat sampled). Beginning in 2003, the entire study area was sampled in single uninterrupted trips (10–12 field days per trip) rather than in two temporally discrete sections as done in previous years (1998 – 2002). Because of the increasing numbers of larval Razorback Sucker collected (as well as detailed information regarding the native fish community), the SJRBRIP Biology Committee voted to elevate the larval fish surveys from an “experimental” project to a monitoring program. This change allowed for comparisons of catch per unit effort (CPUE) data with the programs monitoring activities (i.e., small bodied fish, sub-adult and adult, habitat, etc.).

Conducting the larval Razorback Sucker and Colorado Pikeminnow surveys under this new protocol not only provided discrete reach information but also provided greater temporal resolution in respect to the longitudinal distribution of Razorback Sucker larvae and the ability to correlate potential environmental cues required by Razorback Sucker for spawning. These same advantages also apply to Colorado Pikeminnow. Disadvantages to this top to bottom approach were that the duration of the monthly sampling trips (10–12 field days) made them more subject to abiotic fluctuations (floods, flow spikes). Large flood events reduce sampling efficiency as many low velocity habitats become flooded by rising water levels thereby transporting larval and early juvenile fish downstream. In addition, large flood events have necessitated premature termination of some survey runs, reducing the temporal resolution of the single-continuous pass effort. Annually, at least one trip (an average) had to be cut short due to large flood events or low water events in the lower canyon. The abbreviated trips were subsequently resumed once conditions improved (usually 1–2 weeks later). Additional costs were incurred because of the need to return to the field to complete the sampling effort for that month.

To reduce the variability of abiotic conditions as well as gain even greater temporal resolution of the longitudinal distribution of Razorback Sucker larvae, the protocol was modified to survey the upper and lower halves of the study area simultaneously. This effort began in 2007 and utilized two fully equipped and autonomous crews (Table 3). In 2008, additional participation of our staff with other SJRBRIP projects made the new simultaneous sampling effort a necessity so that our staff could meet obligations to assist the other researchers with their work. Beginning in 2011, the September sampling trip was discontinued. The Biology Committee felt that the September survey did not provide enough data with respect to endangered fishes to warrant continuation.

The study area expanded 6.4 miles upstream in 2012. The expansion of the study area was a result of captures of larval Razorback Sucker at the top of the previous study area (river mile 141.5). Collections in 2012, 2013, 2014, and 2015 documented larval Razorback Sucker in this newly expanded area.

Beginning in 2017, larval fish sampling was expanded to include the San Juan River between Farmington and Shiprock, NM (river miles 180 – 148). This expanded effort targets the collection of Razorback Sucker only, and is considered to be independent of the work proposed in this SOW.

In 2013 a new analysis of Colorado Pikeminnow and Razorback Sucker trend data was developed using mixture models (White, 1978; Welsh et al., 1996; Fletcher et al., 2005; Martin et al., 2005.). Mixture models can be particularly effective at modeling ecological data with multiple zeros to estimate occurrence and abundance separately (e.g., combining a binomial distribution with a lognormal distribution). Data collection for this new approach meant each seine haul was preserved independently along with physical descriptors of each haul. Beginning in 2014, the mixture model analysis was expanded to include annual trends for many of the common species collected.

Table 3. Summary of annual projects and project modifications of the larval fish surveys from 1997 to 2016.

<i>Year</i>	<i>Sampling method</i>	<i>Study area (River Miles)</i>	<i>Specimens collected</i>	<i>Field modification</i>	<i>Laboratory modification</i>
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1997	Light Trap Drift-nets	99 – 75	297		
1998	Larval Seine Light Trap Drift-nets	127.5 – 53.3	13,608	study area expanded; active sampling	
1999	Larval Seine Light Trap Drift-nets	127.5 – 2.9	20,711	study area expanded; upper-lower reaches sampled separately; nonsynchronous	
2000	Larval Seine Light Trap Drift-nets	127.5 – 2.9	13,549		
2001	Larval Seine Light Trap Drift-nets	141.5 – 2.9	95,629	study area expanded; upper-lower reaches sampled separately; nonsynchronous	
2002	Larval Seine Light Trap	141.5 – 2.9	138,602	study period expanded to September. Drift-nets no longer used.	
2003	Larval Seine Light Trap	141.5 – 2.9	112,842	upper-lower reaches sampled monthly in one uninterrupted trip (11-12 day runs)	CPUE data used for integration in reporting
2004	Larval Seine	141.5 – 2.9	160,292		Reports merged, trend data reported
2005	Larval Seine	141.5 – 2.9	109,368		
2006	Larval Seine	141.5 – 2.9	50,616		
2007	Larval Seine	141.5 – 2.9	53,084	Two rafts-two crews; upper-lower reaches samples synchronous	Analyzed catch with habitat data
2008	Larval Seine	141.5 – 2.9	40,855		
2009	Larval Seine	141.5 – 2.9	72,404	Specimens preserved in 95% ethanol	
2010	Larval Seine	141.5 – 2.9	70,610		
2011	Larval Seine	141.5 – 2.9	28,258	September survey dropped from the monitoring	
2012	Larval Seine	147.9 – 2.9	29,384	Study area expanded	
2013	Larval Seine	147.9 – 2.9	25,842	Individual seine hauls preserved independently	Mixture Model analysis used for trend data

2014	Larval Seine	147.9 – 2.9	20,508		Mixture Model analysis used for several common species
2015	Larval Seine	147.9 – 2.9	17,787		Multiple covariates used in all mixture models
2016	Larval Seine	147.9 – 2.9	12,973		Additional covariates used in CPM mixture models

### Objectives:

This work is being conducted as required by the San Juan River Basin Recovery Implementation Program Monitoring Plan and Protocol (2012). The objectives of this specific monitoring effort are identified and listed below. Where applicable, these objectives are related to the specific tasks listed in the 2016 Long Range Plan set forth by the San Juan River Basin Recovery Implementation Program (SJRBRIP).

- 1) Conduct larval fish sampling to determine if (Colorado Pikeminnow and Razorback Sucker) reproduction is occurring, locate spawning and nursery areas, and gauge the extent of annual reproduction. (Task 4.1.2.1)
- 2) Determine the spawning periodicity of Colorado Pikeminnow and Razorback Sucker (utilizing back-calculated spawning and hatching formulas) between mid-April and August and examine potential correlations with temperature and discharge.
- 3) Document and quantify reproduction, survival, and recruitment. (Task 4.4.1.1).
- 4) Document and track trends in the use of specific mesohabitat types by larval Colorado Pikeminnow and Razorback Sucker. (Task 4.2.3.2).
- 5) Analyze and evaluate monitoring data and produce Annual Fish Monitoring Reports to ensure that the best sampling design and strategies are employed. (Task 4.1.1.2)
- 6) Provide detailed analysis of data collected to determine progress towards endangered species recovery in the San Juan River. (Task 5.1.1.3)
- 7) Identify principal river reaches and habitats used by various life stages of endangered fish. (Task 4.2.4.1)
- 8) Deposit, process, and secure San Juan River fish specimens, field notes, and associated data at an organized permanent repository. (Task 4.1.2.5)
- 9) Provide annual updates on the rate of opercular deformities found in Razorback Sucker. (Task 4.1.7.2)

- 10) Monitor TNC's restoration sites for the presence of endangered species, and compare species composition and relative abundance of fishes captured in restoration sites to nearby control sites. (Task 4.3.2.1)

### **Hypotheses:**

When possible, the following hypotheses from the 2012 SJRRIP Monitoring Plan and Protocol will be annually evaluated. Exceptions are noted below in italics.

- 1) Densities of larval fishes will be influenced by specific mesohabitat types.
- 2) Relative abundance of larval fishes will be highest in mesohabitat types that contain cover, inundated vegetation and submerged debris which provides protection from aquatic and avian predators.

*Previous attempts to evaluate the effect of cover type on larval fish density have proven problematic. Even at the small scale (ca. 5–15 m<sup>2</sup>) of the individual mesohabitats being sampled, cover type is rarely distributed throughout site. Therefore it is not possible to say with certainty that cover type is resulting in increased abundance of fish.*

- 3) Elevated spring discharge increases relative reproduction of native fishes, as determined by annual relative abundance and distribution of native larval fishes.
- 4) Elevated spring discharge decreases reproductive success of non-native fishes, as determined by annual relative abundance and distribution of non-native larval fishes.
- 5) Modification of physical attributes of San Juan River by natural flow regime mimicry, mechanical creation of nursery habitats and decreased entrainment of adults into irrigation canals will result in increased relative abundance, expanded distribution, and multiple ontogenetic life stages of larval Colorado Pikeminnow and Razorback Sucker.

*Attributing an increase in abundance, distribution, or presence of multiple ontogenetic stages to any one of the factors listed in Hypothesis 5 is difficult or not possible. A variety of management actions preclude the ability to specifically attribute a response in the fish community to any of the factors listed in Hypothesis 5. For example, the stocking of thousands of adult Razorback Sucker, and hundreds of thousands of juvenile Pikeminnow annually could result in increases in abundance, distribution, or the presence of multiple ontogenetic stages. Monitoring of mechanically created habitats is ongoing, and details pertaining to that effort are listed within the methods section of this document.*

- 6) Modification of biological attributes of San Juan River fish community (non-native removal and native fish stocking) will result in increased relative abundance, expanded distribution, and multiple ontogenetic life stages of larval Colorado Pikeminnow and Razorback Sucker.

*See comments regarding Hypothesis 5.*

### **Study Area:**

The study area encompasses the San Juan River between Shiprock, New Mexico (RM 147.9) and the Clay Hills Crossing boat landing (RM 2.9) just above Lake Powell in Utah (145.0 river

miles). As in all post 1999 sampling efforts, the study will include making collections in reaches of the San Juan River under the jurisdiction of the National Park Service.

## **Methods:**

### *Field Work:*

Sampling for Colorado Pikeminnow and Razorback Sucker larvae will be conducted in the San Juan River between RM 147.9 and RM 2.9 from mid-April through early August using sampling techniques that will provide sufficient numbers of fish necessary to meet study objectives 1–7, 9 and 10. Access to the river will be gained through the use of inflatable rafts equipped with all of the necessary equipment and provisions needed for trips of up to seven days. A day and a half is added before and after each field survey for field preparation, gear maintenance, and clean up. The study area will be divided into an “upper” section (Shiprock, NM, to Sand Island, UT) and a “lower” section (Sand Island, UT, to Clay Hills crossing, UT). Separate field crews will launch simultaneously in each of the two sections and proceed through their designated study area. The vehicle and raft trailer used by the field crew working in the upper section will be left at the Shiprock launch site and subsequently be shuttled to the Sand Island BLM ranger station, UT. The vehicle shuttle (with trailer) for the upper reach sampling effort was typically performed en gratis by personnel from the Farmington Office of the Bureau of Indian Affairs Office. Between 2008 and 2010, personnel from the N.M. Fishery Resources Office stationed in Farmington performed this service. Beginning in 2011, ASIR personnel shuttled vehicles for the upper end crew. At this time, there is no charge for this service.

The sampling crew for the lower reach will launch from, and store their vehicle and raft trailer at Sand Island, UT, where a commercial shuttle will take the vehicle to Clay Hills crossing, UT. The cost for this service is included under the travel and per diem section of our budget.

Because crews sampling the lower section of the study area will be in a high use recreational area, advance reservations are required. All trips for 2018 must be scheduled by late January 2018 and submitted to the Bureau of Land Management (BLM) Office at Monticello, Utah. Designated camping permits for our lower reach sampling crews will be obtained and must be strictly adhered to in addition to other BLM- San Juan River Recreation Area regulations (i.e., low impact and pack-out policies). Low flow conditions often prevalent during the study period make several sections of the river more difficult to navigate (especially in the lower reach). Our field crews are required to render assistance to boaters stuck in rapids or otherwise in distress and report all such encounters to the appropriate BLM personnel.

Sampling efforts for larval fish will be concentrated in low velocity habitats and employ small mesh seines (1 m x 1 m x 0.8mm) to collect fish. Individual seine hauls will be preserved independently at each site. Habitat designations will also be recorded by seine haul. Retained specimens will be placed in Whirl-paks containing 10% formalin and a tag inscribed with unique alphanumeric code that is also recorded on the field data sheet. For each sample site, the lengths (to 0.1 m) of each seine haul and total number of hauls will be measured and recorded. Capture densities for seine samples will be reported as the number of fish per 100 m<sup>2</sup>.

Native species large enough to be positively identified will be measured (standard length) and returned to the river. Post-larval endangered fish species collected during this study will be photographed, a small portion of tissue from the caudal fin clipped and retained in 95% ethanol (in the case of potential Razorback Sucker hybrids) and scanned with a FS2001 PIT tag reader

for the presence of a PIT tag. Specimens of sufficient size but lacking a PIT tag will be injected with a tag following the protocols established by the program (Davis 2010). All PIT tag information will be recorded in the field data sheet and subsequently forwarded to the SJRBRIP for integration in the program's PIT tag database.

For each sampling locality, river mile will be determined to the nearest tenth of a mile using the SJRBRIP 2009 Standardized Map Set. Universal Transverse Mercator (UTM) coordinates and zone will be determined with a Garmin Navigation Geographic Positioning System Instrument for each sampling locality. Mesohabitat type, length, maximum and minimum depths, water clarity (determined with a Secchi disc), and substrata will be recorded for each sampling locality. A minimum of one digital photo will also be taken of each specific habitat sampled.

Each of the six River Ecosystem Restoration Initiative (RERI) sites located between river miles 132.2 and 127.2 will be the subject of repeated monthly monitoring. The goal of these collections is to detect the presence of endangered species, and compare species composition and relative abundance of fishes captured in restoration sites to nearby control sites. If a site cannot be effectively sampled (e.g. too deep or swift), photos will be taken, habitat conditions noted, and no collection made.

All collections that contain Razorback Sucker will be examined for frequency and severity of opercular deformities. The opercula are not fully developed until at least the post-flexion mesolarval stage of development. Because of this, only Razorback Sucker greater than 15 mm TL (the size at which the opercula should be fully developed) will be examined for opercular deformities. Individuals will be examined on both the left and right sides. Severity of shortening will be assessed and rated as level 0 (no opercular deformity), level 1 (slight shortening), or level 2 (severe shortening). Annual rates of opercular deformities will be plotted and compared to the long-term data set (1999-present).

#### *Field Work, Safety:*

Personnel participating in fieldwork are required to successfully complete an International Rescue Instructors Association (IRIA) level 2 swiftwater rescue class and American Red Cross CPR/AED training. Type III personal flotation devices (PFD's) will be worn by sampling personnel at all times while working. As PFD's lose flotation capacity due to UV exposure, compression of material, and oil and grit impregnation, and since each crewmember's PFD will be used for approximately 45 days per season, the PFD's will be annually replaced. Simms Guideweight Gore-Tex waders and boots will be issued to all personnel along with 3 mm neoprene gloves (necessary in April and May). In addition to personal camping gear and rain suits, all personnel will be required to provide and use wide brimmed hats, sunscreen, and sunglasses (provided at no cost to the program).

All rafts used for this project will carry an extensively stocked first aid kit replete with items necessary for most minor medical situation. Additionally, the first aid kit will contain a suite of items (i.e., splints, neck braces, butterfly stitches, snakebite kits) needed to address more serious medical conditions. Because ethanol is used in the preservation of specimens, several vials of eyewash solution will be incorporated into each first aid kit. First aid kits will be inventoried after each sampling trip and used and/or expired items replaced. In the upper reach of the study area, personal cell phones and PDA's will be used (at no cost to the program) to contact outside parties should a medical situation arise. In the lower study area reach (canyon bound; where cell phones do not have service) a Iridium 9505-satellite phone will be provided for sampling crews.

Both sampling crews will be equipped with SPOT Satellite GPS Messenger units to be used in case of an emergency.

All preservation fluids will be transported in heavy-duty LPDE carboys. Extensive exposure to UV light makes the carboys susceptible to decomposition and cracking and requires that they be inspected monthly and not used for more than two years. Safety rope throw bags will be similarly inspected and retired from use accordingly. Rafts will be equipped with raft recovery (Z-line) kits, and repair kits, extra oars and oar blades, and two spare hand pumps to help ensure that crews do not become stranded due to raft damage. BLM regulations also mandate that an extra PFD and emergency whistle be carried by all boaters.

#### *Laboratory Work:*

Samples will be returned to the lab immediately after each field trip is completed and processed following a multi-step procedure. To maintain the larval fish in good condition (necessary to ensure accurate identification) the samples must be transferred from whirl-packs to glass jars and the field fluids replaced with new preservation fluids. Cyprinid and catostomid larvae are extremely small and transparent especially at early developmental stages. To minimize the potential loss of fish in individual seine hauls, it is best to retain the entire contents of each seine haul. A negative result of this technique is that, in addition to larval fish, whirl-pack samples usually contain considerable debris, detritus, and silt. Another important step in processing of individual samples is to separate fish from the detritus. This necessary portion of the process is labor intensive and can be quite tedious. During this process initial sorting of fish based on age class (age 0 [larvae] and age 1+) occurs. Samples that contain a large number of larval fish, especially proto or mesolarvae, often must be sorted twice to ensure all larvae are located within a sample.

After the fish are separated from the debris, personnel with San Juan River Basin larval fish identification expertise will identify individual specimens to species. Stereomicroscopes equipped with transmitted light bases (light and dark field) and polarized filters (that enhance the delineation of myomeres, pterygiophores, and fin rays) will be used to assist with the identifications. Larval fish keys are referenced to assist in species specific determinations (e.g., Contributions to a guide to the cypriniform fish larvae of the Upper Colorado River System [Snyder 1981], Catostomid fish larvae and early juveniles of the Upper Colorado River basin, Morphological descriptions, comparisons, and computer interactive key [Snyder and Muth 2004], and Identifications of larval fishes of the Great Lakes Basin [Auer 1982]). Age-0 specimens will be separated from age-1+ specimens using published literature on growth and development (Snyder 1981, Snyder and Muth 2004).

Age classes will be enumerated, measured (minimum and maximum size [mm standard length] for each species at each site), and catalogued in the Division of Fishes of the Museum of Southwestern Biology (MSB) at the University of New Mexico (UNM). Both total length (TL) and standard length (SL) of Colorado Pikeminnow and Razorback Sucker will be obtained using electronic calipers and stereomicroscope mounted micrometers. The ontogenetic stage of Colorado Pikeminnow and Razorback Sucker obtained in this study shall be determined based on the definitions provided by Snyder (1981).

#### *Quality Assurance and Quality Control:*

The qualifications of the investigators include extensive experience working on large data sets from multiple river systems over several decades. This experience has resulted in the implementation of numerous protocols that assure the quality of the finished data files. The field sampling crew has been kept constant, which ensures that the collection of the raw data is standardized between trips and that errors are minimized. Field notes and raw data sheets will be checked for any errors prior to being entered into spreadsheet data files. Any errors will be corrected by crossing out the original data and writing the correct data on the sheet in pencil (all corrections will include the initials of the person making them). All data will be entered into spreadsheet templates designed for the particular type of data being entered (i.e., site locality and physical conditions data, sample size and habitat data, fish species and age-class data). These template files are customized using drop-down lists to facilitate more efficient data entry while also assuring that the correct values are entered (i.e., eliminates typographical errors) within each field. After all data is imported into the main database, all data values will be checked. Data checking will include cross-referencing the field notes and raw data sheets with the values entered into the main database. Upon completion of the quality assurance and quality control steps listed above, the data will then be analyzed and tabulated. All the computed results will be examined and cross-checked with the original data files. Outlying values will be identified by using advanced sorting features on multiple data fields. Missing or incorrect data will be identified by using advanced sorting features and by running multiple queries written for this purpose. Checking the cross-tabulation of data will ensure that the sum of values is in agreement with the individual values (e.g., total number is equal to the sum of the total number of each age-class). Any corrections to the data will be made directly to individual tables within the main database.

#### *Analysis:*

Modeling ecological data with multiple zeros can be particularly effective when using mixture models (e.g., combining a binomial distribution with a lognormal distribution) to estimate occurrence and abundance separately (White, 1978; Welsh et al., 1996; Fletcher et al., 2005; Martin et al., 2005). Long-term Razorback Sucker (1999–2016) and Colorado Pikeminnow (2003–2016) sampling-site density data will be analyzed using PROC NL MIXED (SAS, 2015), a numerical optimization procedure, by fitting a mixture model using the methods outlined in White (1978). Covariates specific to Razorback Sucker and Colorado Pikeminnow mixture models are listed in Tables 4 and 5 of this proposal. Logistic regression will be used to model the probability a site was occupied, and the lognormal model will be used to model the distribution of abundance given that the site is occupied. Models provide four parameter estimates for each year ( $\delta$  = probability of occurrence,  $\mu$  = mean of the lognormal distribution,  $\sigma$  = standard deviation of the lognormal distribution, and  $E(x)$  = estimated density). Model parameter estimates will be annual plotted and compared to the long-term data set to address Objectives 1 and 3–7 of this proposal.

Additional samples (i.e. each seine haul preserved individually) were taken between 2013 and 2016 to increase the overall sample size and provide supplemental information on habitats (i.e., habitat type, habitat location, and cover type) in order to address Objective 4 and 7 of this proposal. Field sampling efforts occurred in nine habitat types (backwater [BW], cobble shoal [CS], eddy [ED], embayment [EM], pool [PO], pocketwater [PW], run [RU], sand shoal [SS], and slackwater [SW]). These habitat designations follow those used by the SJRBRIP as defined in Bliesner et al. (2008). Additionally, four categories were assigned to habitat depending on where the sample was taken. Shoreline (SH) indicates all samples taken along the land-water

interface, open-water (OP) indicates samples taken away from the shoreline, and mouth (MO) or terminus (TR) indicates samples taken from those locations within a backwater or embayment.

Habitat-specific density data (i.e., providing information on habitat type, habitat location, and cover type) have only been available since 2013. These data provide information on the specific habitat features used by Razorback Sucker and Colorado Pikeminnow. Habitat-specific density data are also analyzed using PROC NLMIXED (SAS, 2015), using the same methods outlined previously, to assess differences among models. A simplified list of five habitats (BW, EM, RU, LV [combining CS, PW, SS, and SW], and NZV [combining ED and PO]) is used for the purpose of statistical analysis since several habitats shared nearly identical low velocity (LV) or near zero velocity (NZV) conditions. General linear models will be used to incorporate covariates to model  $\delta$ ,  $\mu$ , and  $\sigma$ . Covariates considered to model habitat-specific density data are year, reach, habitat type, and habitat location. Random effects models are used with the joint binomial and lognormal likelihood to provide random errors for the Site\*Year combinations. Bivariate normal errors with mean zero and covariance are assumed for each Site\*Year combination. A random error will be added to the logit of the binomial parameter  $\delta$ , and a second random error was added to the log of the  $\mu$  lognormal parameter. Adaptive Gaussian quadrature as described in Pinheiro and Bates (1995) is used to integrate out these random effects in fitting the model using the SAS NLMIXED procedure. Goodness-of-fit statistics (logLike and AIC<sub>C</sub>) are generated to assess the relative fit of data to various models. The approach used to analyze habitat data between 2013 and 2016 and scheduled for use in 2017, will be used in 2018 in order to further elucidate fish and habitat relationships and fulfill Objectives 4, 6 and 7 of this proposal.

The results in the annual report will pertain almost exclusively to age-0 fish (i.e., age-1+ are not “larval fish” and are not the focus of this effort, they are not included in analysis). The exception to this will be age-1+ augmented Colorado Pikeminnow. Capture data for all Colorado Pikeminnow is analyzed and trend data reported. The number of all other fish age-1+ collected during the study will be presented as an Appendix.

Hatching dates of Razorback Sucker larvae will be calculated by subtracting the average length of larvae at hatching (8.0 mm TL) from the total length at capture (for proto- and mesolarvae) divided by 0.3 mm (Bestgen et al. 2002), which is the average daily growth rate of wild larvae observed by Muth et al. (1998). Spawning dates for Razorback Sucker will then be calculated once hatching dates have been established using the negative exponential equation  $y=1440.3e^{-0.109x}$  (Bestgen et al. 2011) where  $y$  is the temperature dependent incubation time (in hours),  $e$  is the base of the natural logarithm, and  $x$  is the mean daily temperature on the hatching date.

Hatching dates for larval Colorado Pikeminnow will be calculated using the formula:  $A=-76.7105+17.4949(L)-1.0555(L)^2+0.0221(L)^3$  for larvae <22 mm, where  $A$ = post-hatch age in days, and  $L$ = length (mm TL). For larvae 22-47 mm TL the formula  $A=-26.6421+2.7798L$  will be used. Both hatching date formulas are taken from Nesler et al. (1998).

Spawning dates for larval Colorado Pikeminnow will be estimated by adding five days to the post-hatch ages to account for incubation time at 20 – 22 °C (Nesler et al. 1988). Hatching and spawning dates for both endangered species will then be compared with the discharge and temperature data during that period within the study area in order to fulfill Objective 2 of this proposal.

This study will be initiated prior to spring runoff and completed during mid-summer (late July or early August). Daily mean discharge and temperature (mean, maximum, and minimum) during the study period is acquired from U.S. Geological Survey Gauge (# 09379500) near Bluff, Utah and Four Corners Bridge (#09371010).

Table 4. Covariates used in mixture models for Razorback Sucker.

<b>Covariate</b>	<b>Description</b>
Year	The calendar year in which the larval survey took place.
Reach	Each of the 5 geomorphic reaches (5–1) within the study area.
Mean March, April and May temperature.	Daily mean temperature data was taken from USGS gage #09379500 near Bluff, Utah.
Mean March, April and May discharge.	Daily mean discharge data (cfs) was taken from USGS gage #09379500 near Bluff, Utah.
Annual # stocked.	The number of Razorback Sucker stocked within a calendar year. Fish stocked in a given year were used as a covariate for larval captures during the following larval survey year (i.e. 1+ overwinter periods).
Cumulative # stocked	The number of Razorback Sucker stocked during the time period between 1998 and the year prior to the larval survey year. (e.g. 5,000 fish stocked between 1998–2000 would be used as a covariate for 2001 larval capture data).
Fall monitoring captures.	All fall monitoring captures of adult Razorback Sucker. Fish collected during a given year were used as a covariate for larval captures during the following larval survey year (i.e. 1+ overwinter periods).

Table 5. Covariates used in mixture models for Colorado Pikeminnow.

<b>Covariate</b>	<b>Description</b>
Year	The calendar year in which the larval survey took place.
Reach	Each of the 5 geomorphic reaches (5–1) within the study area.
Mean June and July temperature.	Daily mean temperature data was taken from USGS gage #09379500 near Bluff, Utah.
Mean June and July discharge.	Daily mean discharge data (cfs) was taken from USGS gage #09379500 near Bluff, Utah.
Cumulative # stocked	The number of age-0 Colorado Pikeminnow stocked during the time period between 1998 and five years prior to the larval survey year. (e.g. 100,000 fish stocked in 2000 would be used as a covariate for 2005 larval capture data).
Fall monitoring captures 400+ mm TL.	All fall monitoring captures of Colorado Pikeminnow greater than 400 mm TL. Fish collected during a given year were used as a covariate for larval captures during the following larval survey year (i.e. 1+ overwinter periods).

*Reporting and Permitting:*

Beginning in 2004, data from the two San Juan River larval fish surveys (Razorback Sucker and Colorado Pikeminnow) were analyzed collectively and presented in a single report. This created a whole picture of the reproductive activities of the entire ichthyofaunal community in the San Juan River using the same criterion used as the other monitoring programs. The report will be disseminated as outlined by the program office.

In addition to the annual report of the study provided to the SJRBRIP, reports summarizing fish collecting activities and specimens captured are also required annually under scientific collection permits provided by the U.S. Fish and Wildlife Service, New Mexico Department of Game and Fish, Navajo Nation, and state of Utah. The aforementioned reports include (at a minimum) site localities, GPS coordinates, and fish collected. An annual report of activities is a BLM (Monticello Field Office) requirement under our access permit to the San Juan River below San Island (Bluff, UT) and designated camps in the lower reaches of the river. Annual Mussel-free permits will also be acquired by all trip leaders for use in Utah and Glen Canyon National Park.

*Meetings:*

Researchers are required to attend four meetings annually and report on annual monitoring projects. The two pre-set annual meetings (February and May) require researchers present PowerPoint presentations outlining the results and that years findings. Each meeting lasts about three days (which includes travel time).

*Products:*

A draft report of the 2018 larval Razorback Sucker and Colorado Pikeminnow sampling activities will be prepared and distributed to the San Juan River Basin Biology Committee for review by 31 March 2019. Upon receipt of written comments, that report will be finalized and disseminated to members of the San Juan River Basin Biology Committee by 30 June 2019 in order to meet Objective 5 of this proposal. Electronic copies of the 2018 collection data will be transferred to the San Juan River database manager. Fish collected from this study will be curated in the Division of Fishes, Museum of Southwestern Biology (MSB), Department of Biology, at the University of New Mexico under a MSB contract with the SJRBRIP in order to fulfill Objective 8 of this proposal. Original field notes will be retained in the Division of Fishes and collection information electronically stored in a permanent MSB database program. These data and any maps generated from them will be available to the San Juan River Basin Biology Committee via hard-copy reports and electronically.

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**2018 BUDGET: SAN JUAN RIVER LARVAL ENDANGERED FISH MONITORING**  
Based on five sampling trips per year

**Personnel**

**Field Data Collection**

*Upper Reach (two staff, one raft) Shiprock to Sand Island - RM 148.0 - 76.0*

Fisheries Biologist I (1 staff x 5 trips x 10 days x 8 hrs/day): .....\$ 22,872

Fisheries Technician (1 staff x 5 trips x 10 days x 8 hrs/day): .....\$ 14,076

*Lower Reach (two staff, one raft) Sand Island to Clay Hills - RM 76.0 - 2.9*

Fisheries Biologist I (1 staff x 5 trips x 10 days x 8 hrs/day): .....\$ 22,872

Fisheries Technician (1 staff x 5 trips x 10 days x 8 hrs/day): .....\$ 14,076

Lab Work*Upper and Lower Reach Samples Combined*

Fisheries Biologist I (120 staff days/sampling year): .....\$ 54,893  
 Tasks: Laboratory identification, developmental staging,  
 specialized endangered fish processing, data entry, data query  
 and review, database development

Fisheries Technician (120 staff days/sampling year): .....\$ 33,782  
 Tasks: Post-trip sample processing, juvenile identification,  
 excise, mount and examine sub-sample of otoliths,  
 post-identification – processing, measures, review of counts

Office Work (Report Development)

Fisheries Biologist I (70 staff days year): .....\$ 32,021  
 Tasks: Data analysis, draft report preparation, post-review redraft and  
 submission, development and submission of formal responses to reviewer  
 comments, development of presentation of study for annual meetings,  
 annual reporting related to state and tribal permitting of sampling activities

Senior Biostatistician (10 staff days year): .....\$ 14,075  
 Tasks: Mixture model development and analysis.

Project Oversight

Senior Fisheries Biologist (10 staff days year): .....\$ 7,742  
 Tasks: Project coordination, project and data review, data  
 management, report review

**Personnel (Field, Lab, Office, Oversight): ..... Subtotal \$ 216,409**  
SJRBRIP Meetings

*Four meetings/year required; 2 days/meeting*

Fisheries Biologist I (8 staff days/year): .....\$ 3,660

Senior Fisheries Biologist (8 staff days/year): .....\$ 6,193

**Personnel (Meetings): ..... Subtotal \$ 9,853**

**Personnel: ..... Total \$ 226,262**

**Materials and Supplies**

Safety dedicated first aid gear (open market items): .....	\$ 1,893
Raft and rafting associated gear (open market items):.....	\$ 1,534
Fish Sampling and associated electronic recording gear (open market items):.....	\$ 1,335

**Materials and Supplies: ..... Total \$ 4,762**

**Travel and Per Diem****Field Data Collection**

*Shiprock to Clay Hills (five trips) - RM 148.0 - 2.9 (Using two rafts & two crews)*

Travel - 4 x 4 pickup truck and raft trailer (1,380 miles x \$ 0.54/mile x 5 trips): .....	\$ 3,726
Per Diem - 6 field days per trip x 4 staff (\$51/day GSA M&IE rate) x 5 trips: .....	\$ 6,120
Per Diem - 1 hotel day per trip x 4 staff (\$91/night GSA lodging rate) x 5 trips: .....	\$ 1,820
Truck and Trailer Shuttle from Sand Island to Clay Hills x 5: .....	\$ 1,800

**Travel and Per Diem (Field): ..... Subtotal \$ 13,466**

**SJRBRIP Meetings**

Travel (one vehicle at 430 miles r.t. x 4 trips x \$ 0.54/mile): .....	\$ 929
Per Diem (2 GSA lodging + 3 M&IE per diem days/meeting x 4 meetings x 2 staff): .....	\$ 2,680

**Travel and Per Diem (Meetings): ..... Subtotal \$ 3,609**

**Travel and Per Diem: ..... Total \$ 17,075**

**2018 Project Totals**

<b>Personnel: .....</b>	<b>Total \$ 226,262</b>
<b>Materials and Supplies: .....</b>	<b>Total \$ 4,762</b>
<b>Travel and Per Diem .....</b>	<b>Total \$ 17,075</b>

**2018 Scope of Work: ..... GRAND TOTAL \$ 248,099**

**Projected Out-year funding (Adjusted by 3% annually)**

<b>FY 2019 .....</b>	<b>\$ 255,542</b>
<b>FY 2020 .....</b>	<b>\$ 263,208</b>
<b>FY 2021 .....</b>	<b>\$ 271,104</b>

**ADDENDUM TO SOW 18 21, SAN JUAN RIVER LARVAL RAZORBACK SUCKER AND COLORADO PIKEMINNOW MONITORING**

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**Background:**

During the February 2016 SJRBRIP Biology Committee meeting in Durango Colorado, the option of expanding the study area upstream of Shiprock, NM for the larval fish monitoring program was discussed. Researchers hypothesized that as more Razorback Sucker adults are established in the San Juan River through augmentation efforts, and potentially through natural recruitment, larval Razorback Sucker should be present upstream of the current larval fish monitoring study area.

This expansion was approved and included in the SJRBRIP fiscal year 2017 Annual Work Plan. This addendum addresses the field logistics, data integration with the current larval fish monitoring program, and budget associated with increased upstream monitoring.

**Project Justification:**

Between 1998 and 2012, the increasing upstream distribution of larval Razorback Sucker has necessitated the upstream expansion of the existing larval fish monitoring study area. In 2001, the upper boundary of the study area was moved from river mile (RM) 127.5 to 141.5 (Cudei, NM). The study area was expanded again in 2012 from RM 141.5 to 147.9 (Shiprock, NM). These expansions were accompanied by increasing the length of existing larval fish survey sampling trips. Those trips (accessing suitable habitats via a raft) were able to be expanded with minimal increases in budget and time; a feasible boat launch farther upstream was all that was required. Immediately after each of these expansions, larval Razorback Sucker was documented in the newly expanded study area.

This type of expansion is no longer possible. The area upstream of Shiprock, NM has restricted access in areas that fall within the Navajo Nation, or is otherwise private property with little or no access to the San Juan River. Additionally, the presence of the PNM weir and Hogback diversion structures that are impassible to watercraft necessitated a new approach to study area expansion.

This approach closely followed the successful protocols of other SJRBRIP research projects currently being conducted between Farmington and Shiprock, NM; notably non-native removal, small-bodied, and sub-adult and adult monitoring. Rather than a continuous sampling effort, the area between Farmington and Shiprock, NM is divided into three discrete sections of river. These sections are as follows:

- RM 180.6 – 168.4 (Animas River confluence to Hatch Brother's trading post)
- RM 166.6 – 159.4 (Directly below PNM weir to landowner Buck Wheeler's property)
- RM 158.6 – 147.9 (Directly below Hogback diversion to Shiprock, NM)

These proposed sampling reaches allowed for a 32.7 mile upstream expansion of the current larval fish monitoring project while only foregoing sampling of 2.6 miles of river. The 1.8 mile gap between RM 168.4 and 166.6 as well as the 0.8 mile gap between RM 159.4 and 158.6 are required to bypass the impassable structures of the PNM weir and Hogback diversion. These proposed reaches rely on annually securing private property access through Mr. Buck Wheeler and the Hatch Brother's trading post. Both of these landowners have allowed access to SJRBRIP researchers in the past.

Currently, these reaches are only sampled during the presumed spawning and hatching period of Razorback Sucker (May and June) and target the collection of Razorback Sucker larvae. This sampling effort is independent of ongoing larval fish monitoring taking place below Shiprock, NM, but data can be integrating into the existing long-term larval fish monitoring database. Integration with the long-term larval fish monitoring data will be done in instances (e.g. back-calculated spawning dates) where integration does not affect analysis and interpretation of long-term trends associated with the current larval fish monitoring. Mixture model estimates, frequency of occurrence, and other metrics associated with the expanded study area will be analyzed and presented independently of the long-term larval fish monitoring study.

## **Methods:**

### *Field Work:*

Sampling for Razorback Sucker larvae would be done during the presumed spawning and hatching period of Razorback Sucker (May and June). Access to the river will be gained through the use of inflatable rafts equipped with all of the necessary equipment to successfully sample nursery type habitats. Sample crews will consist of two people and two separate vehicles. The sampling of discrete river reaches requires the use of two vehicles to daily shuttle materials and personnel to the upstream and downstream end of each reach. A proposed schedule for each sampling trip follows:

- Day 1 Fieldwork preparation.
- Day 2 Travel from Albuquerque to Farmington NM, sample RM 166.6 – 159.4.
- Day 3 Sample RM 180.6 – 168.4.
- Day 4 Sample RM 158.6 – 147.9.
- Day 5 Travel from Farmington to Albuquerque NM, clean and maintain field sampling gear, deposit specimens at the Museum of Southwestern Biology, UNM.

The collection and preservation of specimens, magnitude of sampling effort, habitat classification, gathering of physical data, field work safety, laboratory work, species-specific identifications, quality assurance and control, and data analysis will follow the methodology outlined for the San Juan River larval Razorback Sucker and Colorado Pikeminnow Monitoring program. Larval fish monitoring project history, as well as goals and objectives of this project as they relate to the SJRBRIP Long Range Plan, can also be found in the San Juan River larval Razorback Sucker and Colorado Pikeminnow Monitoring scope of work (*SOW 18 21*).

**2018 BUDGET: EXPANDED SAN JUAN RIVER LARVAL ENDANGERED FISH MONITORING**  
Based on three sampling trips per year

**Personnel**

Field Data Collection

*Animas River confluence to Shiprock (two staff, one raft) - RM 180.6 – 147.9*

Fisheries Biologist I (1 staff x 3 trips x 5 days x 8 hrs/day): .....\$ 6,862  
 Fisheries Technician (1 staff x 3 trips x 5 days x 8 hrs/day): .....\$ 4,223

Lab Work

*All Reach Samples Combined*

Fisheries Biologist I (20 staff days/sampling year): .....\$ 9,149  
 Tasks: Laboratory identification, developmental staging, specialized endangered fish processing, data entry, data query and review, database development

Fisheries Technician (20 staff days/sampling year): .....\$ 5,630  
 Tasks: Post-trip sample processing, juvenile identification, Post-identification – processing, measures, review of counts

Office Work (Report Development)

Fisheries Biologist I (5 staff days year): .....\$ 2,287  
 Tasks: Data analysis and integration into long-term larval fish monitoring database, inclusion of data in annual draft report, incorporate data into presentation of study for annual meetings, annual reporting related to state and tribal permitting of sampling activities

Project Oversight

Senior Fisheries Biologist (2 staff days year): .....\$ 1,548  
 Tasks: Project coordination, project and data review, data management, report review

**Personnel (Field, Lab, Office, Oversight): ..... Subtotal \$ 29,699**

SJRBRIP Meetings

*Four meetings/year required; 2 days/meeting. (Costs are covered under SOW 17 21)*

Fisheries Biologist I (8 staff days/year): .....\$ 0  
 Senior Fisheries Biologist (8 staff days/year): .....\$ 0

**Personnel (Meetings): ..... Subtotal \$ 0**

**Personnel: ..... Total \$ 29,699**

**Materials and Supplies**

Safety dedicated first aid gear: *(In kind contribution)* .....\$ 0

Raft and rafting associated gear: *(In kind contribution)* .....\$ 0

Fish Sampling and associated electronic recording gear: *(In kind contribution)* .....\$ 0

**Materials and Supplies: ..... Total \$ 0**

**Travel and Per Diem**

Field Data Collection

*Animas River confluence to Shiprock (three trips) - RM 180.6 – 147.9*

Travel - 4 x 4 pickup trucks (488 miles x \$ 0.54/mile x 3 trips x 2 trucks):.....\$ 1,581

Per Diem - 4 field days per trip x 2 staff (\$51/day GSA M&IE rate) x 3 trips: .....\$ 1,224

Per Diem - 3 hotel days per trip x 2 staff (\$91/night GSA lodging rate) x 3 trips: .....\$ 1,638

**Travel and Per Diem (Field): ..... Subtotal \$ 4,443**

SJRBRIP Meetings (Costs are covered under SOW 17 21)

Travel (one vehicle at 430 miles r.t. x 4 trips x \$ 0.54/mile): .....\$ 0

Per Diem (2 GSA lodging + 3 M&IE per diem days/meeting x 4 meetings x 2 staff): .....\$ 0

**Travel and Per Diem (Meetings):..... Subtotal \$ 0**

**Travel and Per Diem: ..... Total \$ 4,443**

**2018 Project Totals**

**Personnel: ..... Total \$ 29,699**

**Materials and Supplies: ..... Total \$ 0**

**Travel and Per Diem: ..... Total \$ 4,443**

**2018 Scope of Work: ..... **GRAND TOTAL \$ 34,142****

**Projected Out-year funding (Adjusted by 3% annually)**

**FY 2019 .....\$ 35,166**

**FY 2020 .....\$ 36,221**

**FY 2021 .....\$ 37,308**

**Museum of Southwestern Biology**  
**Curation of Lower Colorado River Basin Larval Fish Collections and Digital Files**

**Fiscal Year 2018 Scope of Work**

Principle Investigators: Thomas F. Turner and Alexandra M. Snyder  
University of New Mexico MSC03-2020  
Albuquerque, NM 87131

Contact (505) 277-7541 Thomas F. Turner

**Award R13SS40013**

1 October 2013 to 30 September 2017

**Background**

*Collections Curation and Data Archives* -- Personnel with the Division of Fishes, Museum of Southwestern Biology (MSB), at the University of New Mexico (UNM) are responsible for the curation of collections of fishes taken by principle investigators with the San Juan River Basin Recovery Implementation Program (SJRIP). Since 1991, the MSB Division of Fishes has been the permanent repository for large numbers of voucher specimens and associated data collected by SJRIP researchers. The numbers of specimens and field notes processed each year have varied depending on the availability of specimen/field data after the field season, collecting techniques, and annual variability of sampling conditions. Specimens of San Juan River fishes, taken by the New Mexico Department of Game and Fish during the 1987-2005 secondary channel surveys, were not received by the MSB until 2007; about 85% of these collections have been incorporated into the MSB collections of specimens, field notes, and data. The SJRRIP collections (15,482 cataloged lots and 2,900 data sheets) taken by the Utah Division of Wildlife Resources from 1991 to 2000 were received starting in 1993 have since been fully incorporated.

Given the variability in number of fishes to process, the San Juan River Biology Committee has recommended that the annual budget for the San Juan River specimen curation and larval fish identification reflect an “average” year of sample processing. The SJRIP Biology Committee recognizes that some years would require more effort from MSB staff than budgeted, while other years might not require the same high level of activity. A relatively stable budget would allow for uninterrupted processing of new collections and yet be sufficient to cover the ongoing work of processing backlogged SJRIP collections due to circumstances previously discussed.

To date, 44,255 lots or 1,530,729 fish specimens have been collected (1987-2015) by the San Juan River research group and these specimens have been processed, cataloged, and archived at the Museum of Southwestern Biology, Division of Fishes. A total of 19,540 San Juan River collection sites have been entered into the MSB database and georeferenced; all locality and habitat information has been captured using original field notes and data sheets. Over 25,000 pages of original San Juan River field notes and data sheets have been digitally captured, cleaned, and saved in both tiff and pdf formats for the electronic archives; the original field notes and data sheets are permanently stored in acid-free document boxes for long-term conservation.

Incoming specimen collections are removed from WhirlPaks®, cleaned of debris, placed in known concentrations of fixative (either 5% buffered formalin, 10 % buffered formalin, or 95% ethanol), and organized on the accession shelves by MSB staff. Collections are later sorted and

identified by the principal SJRIP investigators. Specimen collections are assigned an accession number (tracking number) and all associated documentation, like permits and field notes, are filed under that same number. Processing collections of fish specimens (adults and larvae) requires fluid transfers from formalin fixative to ethanol preservative (typically), sending out specimens for species verification as required, counting the number of individuals in each collection, recording the standard lengths for the largest and smallest specimen in each collection, entering all locality and specimen data into an electronic catalog, digital capture of field notes and data sheets, and labeling and filing vials and jars of cataloged San Juan River specimens into the permanent MSB collections. The basic principles for accessioning specimens of fishes in the MSB are standard for most museums of natural history (e.g., Smithsonian Institution, Carnegie Museum, and University of Michigan Museum of Zoology). Species identifications and locality/collection data are verified as necessary prior to incorporation into the MSB catalog. This step is very important for the SJRIP researchers so that any misleading information is not incorporated into subsequent reports on San Juan River fish species, particularly for the larval Colorado pikeminnow (*Ptychocheilus lucius*) and razorback sucker (*Xyrauchen texanus*) studies. For purposes of permitting, the MSB provides with field and species data in museum report format. This information includes species identification, catalog number (MSB number), number of specimens and size range per lot.

### **Study Area**

The objective of this project is to process and organize specimens of fishes, collection data, and field notes taken under the San Juan River Recovery Implementation Program (San Juan River and Upper Colorado River Basin). Capture all field information into an electronic catalog, and incorporate the SJRIP collections into a phylogenetic system within the museum archives for easy access. All of these activities take place in the Division of Fishes, Museum of Southwestern Biology, on the University of New Mexico campus in Albuquerque NM. The work and collaboration to synthesize, analyze, and integrate relevant elements of this large database has moved to the USFWS SJRRIP Program Office in Albuquerque and continues to be presented at researchers' meetings held in the Four Corners area, Colorado or New Mexico.

The MSB Division of Fishes has three offices with a total of six computer workstations for data entry, data management, and data analysis; a fully equipped laboratory for preparation of fish specimens, and approximately 1,858 linear meters of compacted shelving for storage of cataloged collections. On average, five UNM students and staff (three undergraduate, one graduate student, and part-time staff curatorial assistant) process and curate SJRRIP collections. One postdoctoral research associate position is responsible for SJRRIP data synthesis and integration, meeting the research goals of the SJRRIP Program.

### **Curation and Collections Care Objectives**

1. Provide a secure and organized repository for San Juan River fish collections, field notes, and associated data thereby facilitating access to these resources by SJRIP researchers.
2. Insure that all SJRIP species identifications and associated data are verified and correctly represented in the MSB electronic catalog; report discrepancies to SJRIP principal investigators.
3. Georeference collection sites for SJRIP collections; maintain license for ArcView and make collection data available to SJRIP researchers in that format, as required.

## **Curation and Collections Care Methods**

Tasks to be completed under this project are processing and curation of fish specimens and all data from the San Juan River Basin Recovery Implementation Program synthesized and integrated in the form of reports to the Committee and peer review publications. Specimen collections are deposited with the MSB Division of Fishes by SJRIP principal investigators.

Upon receipt of newly collected San Juan River specimens, MSB staff transfer these collections from formalin fixative into stages of 35%, 50%, and 70% concentrations of ethanol. Exceptions to this protocol are made per request of PI, as in the case of using 95% ethanol for genetic or otolith studies. Fish specimens are removed from field containers and cleaned (debris removed) and placed into museum quality jars during the fluid transfers. Principle investigators sort, identify, count and measure each lot (discrete collection) once the collections are transferred to ethanol. MSB staff catalog, label, and file the specimens once the principle investigators have completed their work. SJRIP collections are organized in the permanent archives by drainage (San Juan River) and taxa. These archives are in a room that is controlled for temperature (18° Celsius) and light (complete darkness to low light levels). All data associated with the specimens are entered and organized in the electronic MSB Division of Fishes database (MS Access 2010) and georeferenced (GeoLocate Ver. 3). All original field notes and data sheets are digitally captured and archived in acid-free document boxes for permanent storage.

## **Products**

SJRIP and Upper Colorado River Basin fishes and associated data will be curated in the Division of Fishes, Museum of Southwestern Biology (MSB), at the University of New Mexico. Collection sites will be georeferenced and available in ArcView format. Original field notes and data sheets will be digitized and archived (physical and electronic copies) by the MSB Division of Fishes. Collection data will be electronically stored in a permanent MSB database program. Species verifications and corrections and digital copies (PDF) of their field notes will be made available to SJRIP principle investigators. A draft report of the 2017 San Juan River and upper Colorado River Basin specimen curation, larval fish sampling and identification, and data integration activities will be prepared and distributed by 31 March 2018 to the San Juan River Biology Committee for review. Upon receipt of written comments, that report will be finalized and disseminated to members of the San Juan River Biology Committee by 1 June 2018.

## Budget Fiscal Year 2018      1 October 2017 to 30 September 2018

BUDGET ITEM DESCRIPTION	COMPUTATION		RECIPIENT FUNDING	OTHER FUNDING	RECLAMATION FUNDING	TOTAL COST
	\$/Unit	Quantity				
<b>SALARIES AND WAGES</b> --Position title x hourly wage/salary x est. hours for assisted activity. Describe this information for each position.						
Undergraduate student	\$11.30/HR	2160 HRS			\$24,408.00	\$24,408.00
Undergraduate student	\$12.36/HR	442 HRS			\$5,463.00	\$ 5,463.00
Undergraduate student	\$13.39/HR	912 HRS			\$12,212.00	\$12,212.00
<b>FRINGE BENEFITS</b> – Explain the type of fringe benefits and how applied to various categories of personnel.						
UNM Undergraduate UNM Rate	1% per salary	5 STUDENTS			\$421.00	\$421.00
<b>TRAVEL</b> —dates; location of travel; method of travel x estimated cost; who will travel						
<b>EQUIPMENT</b> —Leased Equipment use rate + hourly wage/salary x est. hours for assisted activity—Describe equipment to be purchased, unit price, # of units for all equipment to be purchased or leased for assisted activity: Do not list contractor supplied equipment here.						
<b>SUPPLIES/MATERIALS</b> --Describe all major types of supplies/materials, unit price, # of units, etc., to be used on this assisted activity.						
Chemical Preservatives-EtOH 95%	\$9.64	25 gallons			\$241.00	\$241.00
Labeling-paper and print film	.91/ft	100 feet			\$91.00	\$91.00
Specimen containers-3 liter jars	7.35/ea	30 jars			\$221.00	\$221.00
Specimen containers-8oz jars	.93/ea	40 jars			\$42.78	\$42.78
Specimen containers-8 dr vials	0.72/ea	1200 vials			\$864.00	\$864.00
Specimen containers-1 dr vials	0.18/ea	300 vials			\$54.00	\$54.00
Closures-cotton plugs	0.008/ea	4000 plugs			\$32.00	\$32.00
Closures-gaskets	3.02/ea	30 gaskets			\$90.60	\$90.60
Closures-caps	0.31/ea	40 caps			\$13.95	\$13.95
<b>CONTRACTUAL/ CONSTRUCTION</b> —Explain any contracts or sub-Agreements that will be awarded, why needed. Explain contractor qualifications and how the contractor will be selected.						
<b>OTHER</b> –List any other cost elements necessary for your project; such as extra reporting, or contingencies in a construction contract.						
<b>TOTAL DIRECT COSTS--</b>						
					\$44,154.00	\$44,154.00
<b>INDIRECT COSTS – 17.5%</b>						
					\$7,727.00	\$7,727.00
<b>TOTAL PROJECT/ACTIVITY COSTS FY18</b>						<b>\$51,881.00</b>

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Walsh, S.J. and M.R. Meador. 1998. Guidelines for quality assurance and quality control of fish taxonomic data collected as part of the national water-quality assessment program. U.S. Geological Survey Water-Resources Investigations Report 98-4239.

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## **SJRRIP Data Integration and Synthesis**

### **Museum of Southwestern Biology**

#### **Fiscal Year 2018 Scope of Work**

Principal Investigator: Thomas F. Turner

Senior Person: Scott R. Clark

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Performance Dates: 1 October 2017 to 30 September 2018

### **Background – San Juan River Data Integration and Synthesis**

Since its inception in 1992, the San Juan River Basin Recovery Implementation Program (SJRRIP) has been instrumental in managing and restoring native fish populations in the San Juan River Basin. During this time, numerous studies have been implemented with the collective goal of characterizing biotic and abiotic components of the environment that are thought to influence endangered fish populations. Information from these studies has been used to identify and implement appropriate management strategies. Most of these long-term projects focused on relationships between habitats and flow, flow mimicry and native/nonnative fish population dynamics, nonnative fish removal, native-nonnative fish interactions, and augmentation of endangered fish populations. While data collected from these projects have helped navigate management decisions over the course of the Program, most data analyses are limited to individual projects. Limited effort has been directed toward integrating and synthesizing information across studies (e.g., larval, small-bodied, and adult fish datasets). Data accumulated over the past two decades are considerable, and are a valuable and an indispensable source of information for determining future management options and opportunities. Consequently, making this information accessible and usable is essential for assessing the current status of native and endangered fish populations, informing and guiding management actions, and evaluating the Program's progress toward achieving recovery and minimizing limiting factors as required by the Program Section 7 Principles.

The U.S. Fish and Wildlife Service's Program Office is the clearinghouse for all Program data. The Program Office is responsible for compiling, integrating, and synthesizing all monitoring data, as necessary, to meet its obligations defined in the Program Document and Long Range Plan. However, the level of integration requested by Program participants exceeds the Program Office Staff's time availability. Therefore, the Program has utilized a dedicated post-doctoral researcher to assist with completion of these tasks. This type of work requires strong quantitative, writing, and research skills, to address questions without other time commitments or demands. Products/results from the research will be presented to both the Program's Biology and Coordination Committees, as well as interested

public, and submitted to scientific journals for peer review and publication. The postdoctoral researcher will collaborate closely with those responsible for directing relevant studies (e.g., adult monitoring, nonnative fish removal, and native fish reproduction) and key researchers associated with the Program, identifying critical questions for integration and analysis (especially early in the process). The overarching goal of data integration and synthesis remains the same in FY 2018 as before: to provide a data-driven and scientifically sound approach to making recommendations regarding flow management, recovery criteria for endangered species, and measurements of Program success.

### **Data Integration Objectives**

Data integration tasks outlined below will be coordinated among UNM, Program PIs and USFWS Program Office Staff. Dr. Clark will be tasked with the following projects to complete during the FY 2018 work plan:

#### **Primary Objective – Evaluation of Remote PIT Tag Arrays**

As the number of temporary and permanent PIT tag arrays increases in the San Juan River and tributaries, a detailed cost-benefit analysis of these systems will provide a better understanding of how these arrays improve our inferential capabilities and understanding of population dynamics of endangered fishes within the San Juan Basin. Refinement of models and interpretation of PIT tag datasets will allow for a means to assess and monitor the status of populations, as focal species move through the downlisting process and beyond. Our approach will relate data collected from the remote arrays to the traditional survey methods using detailed statistical evaluation of both data types, where comparable. In order to realize possibilities associated with these avenues of data collection, serious attention to modeling, analysis, and comparison of PIT tag scan data needs to be undertaken now in order to plan appropriately for adaptive management decisions in the near future. A detailed assessment of the relative improvement (and potential limitations) of data collection using remote PIT tag arrays, in combination with traditional sampling methods (i.e. annual monitoring efforts), will provide the SJRRIP with a valuable baseline to monitor the outcome of future management decisions.

#### **Task 1 – Improvement of biological metrics and inferences from remotely detected PIT tags**

We will extract, collate, and integrate PIT tag data of Colorado Pikeminnow (*Ptychocheilus lucius*) and Razorback Sucker (*Xyrauchen texanus*) obtained from both passive (antenna) detections and active (in-hand) captures from The Species Tagging, Research, and Monitoring System (STRaMS). We will provide a detailed assessment of the relative utility of existing arrays based on a suite of biological metrics, and propose recommendations on the future utility of additional arrays. As of February 2017, greater than 120,000 remote detections, representing over 3,000 individuals, have been logged from endangered fishes (Colorado Pikeminnow and Razorback Sucker) within the San Juan River basin. PIT tag data will be analyzed and summarized to calculate demographic parameters (survivorship and age structure), population estimates, and detection probabilities in the program MARK (White and Burnham 1999). We will examine how these metrics vary through time (seasonal/year effects), by individual covariates (body size, condition, age) and with annual covariates (seasonal/annual discharge, sampling effort). Models will be ranked and assessed using an information theoretic approach to evaluate predictors that best describe observed metrics. Analyses will first utilize only active captures to provide a suite of baseline metrics, and we will subsequently incorporate the remote detections to evaluate relative improvement of metrics and variance estimates. One of our current tasks (FY17) is utilizing similar analyses to gain insight into the age-specific survivorship of Colorado Pikeminnow, and we, in collaboration with Program Office personnel, are qualified to carry

out these analyses and offer recommendations on the value and potential future use of temporary or permanent arrays in the San Juan Basin. Similar studies have documented significant improvement in inferential capabilities when remote antennae are deployed as an alternative to, or in conjunction with, traditional survey methods (e.g. Hewitt et al. 2010, Barbour et al. 2012). We will further investigate the value of these arrays to better understand spatial and temporal movement patterns (Kanno et al 2014) of the endangered fishes in the San Juan. We will utilize methods developed for assessing seasonal and annual movement (Durst and Franssen 2014), and incorporation of remote detections will presumably allow for a finer-scale assessment of these patterns via more robust detection histories for individuals. We will investigate seasonal and annual movement patterns and how these are influenced by seasonal or annual (e.g. discharge, temperature) and individual covariates (e.g., species, body size, condition, age). Furthermore, as annual monitoring efforts generally operate during March – October, remote detections may provide insight into movement patterns in periods outside of these efforts when sampling effort is reduced (November – February). As the SJRRIP moves forward in recovery efforts, a better understanding of the most effective use of resources will be essential to provide the most efficient and comprehensive biological data to base management decisions and recovery efforts.

### **Task 2 – Cost-benefit analysis of remote antennae for future management and data collection**

While assessment of the relative improvement of data inference using biological metrics is imperative to future management decisions, a detailed cost-benefit analysis (monetary) is similarly needed to fully understand the utility of the inclusion of additional arrays (Barbour et al. 2012). If certain biological thresholds associated with San Juan endangered fishes (e.g. number of wild-spawned adult fish) become attainable in the coming years, the relative value of remote arrays needs to be assessed in order to devise the most effective and efficient sampling strategy to inform and motivate future management actions (e.g. increased traditional sampling effort vs. installation of new arrays).

To conduct a comparative cost-benefit analysis of existing arrays, we will compile all detection records associated with remote and active captures within comparable reaches of the San Juan River. For traditional methods (i.e. annual monitoring efforts) we will compile the costs associated with yearly, basin-wide monitoring efforts (e.g. gear, travel, labor, etc.) and compute a number of relative metrics expressed in units of effort (i.e. recaptures per unit effort) and a per dollar basis (recaptures per dollar). Similarly, we will compute comparable metrics for both the temporary and permanent PIT tag antennae (e.g. installation and yearly maintenance costs). These data will provide the SJRRIP insight into the most efficient and effective sampling strategies when confronted with implementing larger-scale or more intensive population and river-wide survey efforts. We will accomplish this by providing a detailed cost-benefit framework to employ in future management actions and decisions.

### **Task 3 – Assess the efficacy of PNM fish passage facility on endangered San Juan fishes**

Maintaining connectivity of riverine habitats is critical to preserving population and community-level processes. Fish passages are often constructed in order to maintain this connectivity among populations or to facilitate life-history processes (e.g. upstream spawning migrations). However, the relative efficiency of such passages, as well as species-specific passage rates, is not well understood. We propose to investigate the efficiency of the PNM fish pass on successful passage endangered fishes and offer recommendations to promote increased success.

Currently, two PIT antennae (perpendicular to stream flow) are in operation in the fish passage at PNM and multiple antennae are on the downstream side of the PNM weir in the channel of San Juan proper. Relatively low passage rates of endangered fishes have been documented at PNM based on logged detections and subsequent capture in the entrapment bays at the upstream terminus of the pass (approximately 2 and 26% for Razorback Sucker and Colorado Pikeminnow, respectively; Cheek

2014). Furthermore, a substantial number of individuals have been detected at the antennae below the weir, but fail to enter the fish passage based on detection histories, and a more thorough analysis of the putative mechanisms driving these inefficiencies is warranted. The configuration of these antennae present the ability to test the effectiveness of this system to pass PIT-tagged fish through this facility, with emphasis on the native endangered fishes, by asking and answering the following questions using the remotely-sensed data and presence of fished temporarily housed in the upstream entrapment bays.

- (1) What proportion of fishes entering the fish passage successfully pass through the facility? What proportion of fishes enter the fish passage (i.e. detected on downstream antenna) but do not pass the upstream antenna?
- (2) What proportion of fishes detected at the weir antennae subsequently enter the passage? Of those detected at the weir and enter the passage, what proportion successfully pass through the facility? Alternatively, after failing to traverse the passage, what proportion of fish are detected at the antennae below the weir?
- (3) Are these patterns related to abiotic conditions (e.g. depth, flow, temperature or season) or species-specific phenotypic traits (e.g. body size, age, condition) of individuals or is the lack of passage random?

Once appropriate dependent and independent variables are identified, we will use a series of multivariate approaches (e.g. multiple logistic regression, classification and regression trees [CART]) to identify the variables most responsible in facilitating successful passage through the PNM fish passage.

While we explicitly propose to investigate the fish passage at the PNM system, we do note that if adequate data becomes available from the recently installed arrays pending conversion to the new series of operational pumps at the Hogback facility, we will provide, at minimum, a preliminary assessment of fish passage there.

### **Products and Updates**

As some of the analytical approaches associated with the proposed tasks are fluid at this stage until available data are compiled and rigorously investigated; we will work closely with the PO personnel to develop these methods to best suit the needs of the SJRRIP. Updates will be subsequently provided (via documents and/or updates at BC meetings) to the BC and other interested parties as these methods and analytical approaches are refined. Summary annual report(s) on data integration activities will be developed and presented to the Program that outline task goals and hypotheses, data sources and integration approaches, analytical methods, and interpretations and conclusions. Preliminary results and project updates will be given during the February Biology Committee meeting and the May annual meeting as well as other meetings when appropriate.

### **References**

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**Budget Fiscal Year 2018      1 October 2017 to 30 September 2018**

BUDGET ITEM DESCRIPTION	COMPUTATION		RECIPIENT FUNDING	OTHER FUNDING	RECLAMATION FUNDING	TOTAL COST
	\$/Unit and Unit	Quantity				
<b>SALARIES AND WAGES</b> --Position title x hourly wage/salary x est. hours for assisted activity. Describe this information for each position.						
UNM Post-Doctoral Associate	\$25.47/HR	1920 HRS			\$48,900.00	\$48,900.00
UNM Faculty Summer Salary	\$90.72/HR	160 HRS			\$14,516.00	\$14,516.00
<b>FRINGE BENEFITS</b> – Explain the type of fringe benefits and how applied to various categories of personnel.						
UNM Post-Doctoral	26.30%	1 EA			\$12,861.00	\$12,861.00
UNM Summer Faculty	22.00%	1 EA			\$3,194.00	\$3,194.00
<b>TRAVEL</b> —dates; location of travel; method of travel x estimated cost; who will travel						
SJRRIP Meetings	\$1,500/traveler	4 EA/YR			\$6,000.00	\$6,000.00
<b>TOTAL DIRECT COSTS--</b>					\$85,471.00	\$85,471.00
<b>INDIRECT COSTS – 17.5%</b>						
					\$14,957.00	\$14,957.00
<b>TOTAL PROJECT/ACTIVITY COSTS FY18</b>					\$100,428.00	<b>\$100,428.00</b>

**FY 2018 Budget Summary**

FY 2018 Grand Total  
Data Synthesis and Integration for SJRRIP Program

**\$100,428.00**

**Incidence and consumption of endangered fishes by channel catfish (*Ictalurus punctatus*) in the San Juan River**

**Scope of Work**

**Submitted to San Juan River Basin Recovery Implementation Program, March 2017**

**Keith B. Gido and Skyler C. Hedden**

**Kansas State University**

**Division of Biology**

**Manhattan, Kansas 66506**

**Contact for KBG:**

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**785-532-5088**

## Background

The channel catfish (*Ictalurus punctatus*) is a highly invasive fish species that has been repeatedly identified as having negative impacts on native fishes (Fuller et al. 1999; Tyus and Saunders 2000). In the Colorado River basin the introduction of channel catfish is thought to threaten native fishes through predation, competition, and as a choking hazard (Tyus and Nikirk 1990; Ryden and Smith 2002; Franssen et al. 2014). Assessing the potential predation impacts on native species by nonnatives requires information on the diet, gut evacuation rates, and daily ration of the predator (Johnson et al. 2008). However, a fish species predation capability will vary spatially and temporally based upon variable demographic rates, prey availability, and abiotic conditions, thus quantifying a predator's ability to diminish native fishes needs to incorporate multiple spatial and temporal scales. Finally, it is necessary to understand prey population size to evaluate if mortality induced by the predator can result in a notable impact on its population. Once the potential predatory impacts on native species are identified for a predator, management strategies can be developed to produce more successful conservation efforts. Previous channel catfish diet work in the San Juan River found no evidence of predation of any endangered fish but argued that their work does not negate the possibility of predation, especially since all samples were only collected during early morning and afternoon hours (Patton 2015). Given the uncertainty and potentially variable importance of channel catfish predatory impacts throughout the San Juan River, this proposal has the overarching goal of identifying the mortality of endangered fish species in the San Juan River basin attributed to consumption by channel catfish.

## Objectives

- 1) Determine the daily ration and gut evacuation rates of channel catfish in two reaches of the San Juan River to understand the potential for predatory impacts on native fishes.
- 2) Determine the incidence of endangered species in the diet of channel catfish throughout the San Juan River at multiple temporal scales (diel and seasonal).
- 3) Obtain estimates for maximum predatory impacts channel catfish can impose on native fishes.

## Methods and sampling design

*Objective 1: Determine the daily ration and gut evacuation rates of channel catfish in two reaches of the San Juan River to understand the potential for predatory impacts on native fishes.*

Surveys at two reaches (an upstream reach – Hogback to Shiprock and a downstream reach – Bluff to Mexican Hat) of the San Juan River will be conducted with raft electrofishing at bimonthly intervals from March through November. Daily ration (Eggers 1979; Boisclair and Leggett 1988) of channel catfish will be measured in each reach during all sampling events. Samples will be collected at 3-hour intervals within a reach to measure how gut volumes fluctuate throughout a day and seasonally (Table 1). The reach lengths will be optimized (using previous studies data to understand variation in channel catfish densities) to allow us to catch enough fish over time to conduct a robust analysis of changes in ration size, but short enough to minimize travel time through the reach. In the event that we are not able to capture enough fish for computing reliable estimates of daily ration, we will follow Boisclair and Leggett (1988), who recommend the Eggers model that allows for variable catch rates in each time period. Sample reaches will also be chosen to minimize hazards of night-time electrofishing. Additionally, rafts will be equipped with flood lights to facilitate night-time capture of fishes. To reduce stress to native fishes only channel catfish will be targeted and netted, and electrofishing will be stopped if endangered species remain in the electric field.

Gut evacuation rates will be measured with field and laboratory experiments. During field gut evacuation experiments, 50 adult channel catfish will be removed from each study reach during the time of day when stomachs are at peak fullness (computed from daily ration sampling) and placed in portable

pools. Stomachs from 10 fish will be removed every 3-4 hours over a 24 hour time period. Stomachs will be weighed and related to the total body mass of the individual to obtain gut fullness and evacuation rates following procedures by Persson (1979) and Grove and Crawford (1980). Laboratory experiments will be conducted to reduce advanced gut evacuation associated with stress in the field (Boisclair and Leggett 1988). After acclimation in the laboratory, channel catfish will be fed a measured amount of food representative of field diets and procedures will then follow those conducted in the field. Laboratory methods will follow those of field gut evacuation experiments. Hatchery raised channel catfish will be used for laboratory trials, with the assumption that gut evacuation rates do not vary from wild San Juan River channel catfish. Water temperatures will be continually monitored during all field and laboratory studies.

Data collected from these experiments will be used to parameterize the following equations, thus allowing us to calculate daily ration:

Gut fullness is calculated as:

$$F_t = G_t/W_t \times 100$$

Where  $F_t$  = gut fullness;  $G_t$  = weight of stomach contents; and  $W_t$  = weight of fish.

Evacuation rate (hours) is calculated as:

$$R = (\ln F_{t+1} - \ln F_t)/T$$

Where  $R$  = evacuation rate;  $F_t$  = gut fullness at  $t$ ;  $F_{t+1}$  = gut fullness at  $t+1$ ; and  $T$  = time between interval.

Daily ration (% body weight) is calculated as:

$$D = F_t * R * 24 + (S_{24} - S_0)$$

$D$  = daily ration;  $F_t$  = mean gut fullness of all fish collected;  $R$  = maximum evacuation rate; and  $S_{24} - S_0$  = final minus initial median gut fullness values.

Table 1: Time matrix of daily ration sampling and field gut evacuation trials. Sampling will occur at two study reaches in the San Juan River and be conducted bimonthly from March to November.

<b>TIME</b>	<b>DAY 1</b>	<b>DAY 2</b>	<b>DAY 3</b>	<b>DAY 4</b>
<b>9A</b>		Daily Ration		Gut Evacuation
<b>12P</b>		Daily Ration		Gut Evacuation
<b>3P</b>	Daily Ration			Gut Evacuation
<b>6P</b>	Daily Ration			Gut Evacuation
<b>9P</b>			Daily Ration	Gut Evacuation
<b>12A</b>			Daily Ration	Gut Evacuation
<b>3A</b>		Daily Ration		Gut Evacuation
<b>6A</b>		Daily Ration		Gut Evacuation

*Objective 2: Determine the incidence of endangered species in the diet of channel catfish throughout the San Juan River basin at multiple temporal scales (diel and seasonal).*

Diet samples will be collected every other month from March through November from large (>300mm) channel catfish, which should encompass the time periods when water temperatures are within the feeding range for ictalurids and for individuals that have the highest diet proportions containing fish (Brooks et al.

2000; Bourret et al. 2008; Tim Patton, unpublished data). Each sampling event will include 4 days of collecting channel catfish stomachs in the two intensively sampled reaches. Stomach contents will be collected in 3-hour blocks over 24 hour time periods to identify the diet of channel catfish during different diel periods. In addition to the two intensively sampled reaches, we will conduct comprehensive diet surveys throughout the river from Hogback Diversion to Bluff, UT. These surveys will occur prior to runoff (May), after runoff (July) and in the autumn (September). The time of day that fish collections will be made in extensive sampling surveys will be based on results from daily ration experiments. Assuming there is diel variation in consumption rates, which has been previously documented with channel catfish (Weisberg and Janicki 1990), we will only sample fish during time periods when channel catfish consumption is the highest. This will allow for higher probabilities of stomachs containing prey items that will be used for diet analysis, identify spatial variation in the diets, and allow for easier identification of prey items. All stomach contents will be identified, measured and weighed. If stomach contents are heavily digested, methods using pharyngeal teeth will be used to identify razorback suckers (unique tooth count of 67-74) and Colorado pikeminnow (ratio of the total length of the arch to the post-tooth section of the arch of 1.8-2.1) following Patton (2015). Sizes of partially digested prey items will be estimated by the lengths of remaining body parts. For example, if we find a neurocranium, we might use reference specimens to establish the length-weight relationships between interorbital width and total mass. After diet analysis is complete and daily ration and gut evacuation is computed, the total potential (maximum number of fish consumed) and actual (number of fish consumed during the study) mortality by channel catfish on native fishes can be calculated. Using the equations in *Objective 1*, the amount of endangered fish consumed by channel catfish can be calculated. As an example, we used mock data in Table 2 to illustrate how we will estimate daily consumption rates. By fitting an equation to the change in daily consumption rates over time (Figure 1) we can extrapolate those rates to estimate the consumption of endangered fish over the entire year. The mock data plotted in Figure 1 yield a total yearly consumption of endangered fish of 60.1 g/catfish. Using this value, the total consumption of endangered fish by channel catfish can be extrapolated with population size and age structure data in the San Juan River (Table 3). We will work with the SJRBRIP scientists that are obtaining population estimates for endangered species and catfish to parameterize these models.

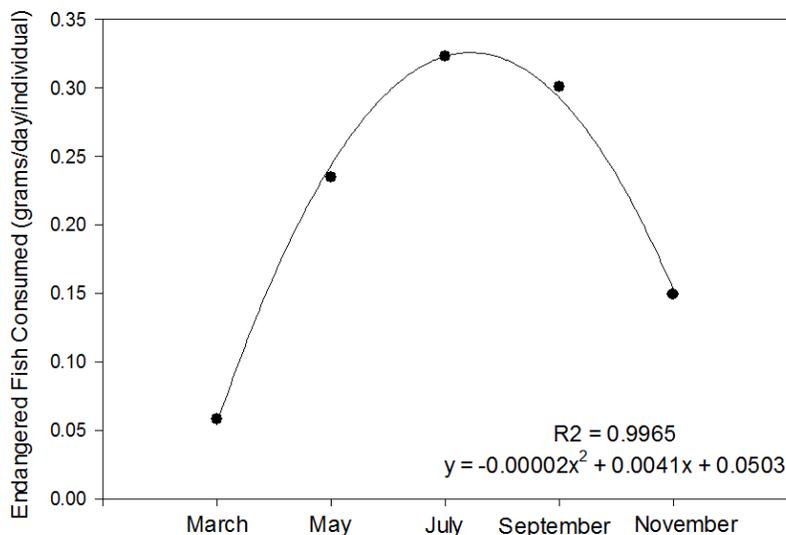


Figure 1: The relationship between sampling event and endangered fish consumption by channel catfish derived from mock data in Table 2.

Table 2: Calculations of gut fullness ( $F_t$ ), evacuation rate ( $R$ ), difference between final and initial gut fullness values ( $S_{24}-S_0$ ), daily ration ( $D$ ), average weight of channel catfish, daily consumption by channel catfish, diet composition of endangered fish, and endangered fish consumed during bimonthly sampling events derived mock data.

Sampling Event	Temp (°C)	$F_t$	$R$	$S_{24}-S_0$	$D$	Weight (g)	Consumption (g/d)	Diet Composition of Endangered Fish (%)	Endangered Fish Consumed (g/d/individual)
March	14	0.00155	0.22	0.00087	0.9054	380	3.44	1.7	0.0584
May	17	0.00255	0.42	0.001	2.6704	400	10.681	2.2	0.2349
July	23	0.0038	0.58	0.0015	5.4396	440	23.934	1.35	0.3231
September	22	0.00335	0.51	0.0012	4.2204	460	19.413	1.55	0.3009
November	15	0.0022	0.33	0.00089	1.8314	480	8.790	1.7	0.1494

Table 3: Individual consumption of endangered fish across a range of possible adult channel catfish (> 300 mm) population sizes in the San Juan River between PNM Diversion and Mexican Hat. Total consumption of endangered fish by channel catfish is based on mock data presented above and the total number of individual endangered fish consumed is based on the assumption that average weight of prey is 10 grams (approximately 100 mm). Note: these numbers are just an illustration of the expected results.

Individual Consumption (g/yr)	Population Size	Total Consumption (g/yr)	Total Individuals Consumed
60.1	10,000	601,000	60,100
	15,000	901,500	90,150
	20,000	1,202,000	120,200
	25,000	1,502,500	150,250
	30,000	1,803,000	180,300
	35,000	2,103,500	210,350
	40,000	2,404,000	240,400
	45,000	2,704,500	270,450
	50,000	3,005,000	300,500

*Objective 3: Obtain estimates for maximum predatory impacts channel catfish can impose on native fishes.*

Growth rates, diet composition, water temperature and activity will be used to develop a bioenergetics model for channel catfish in the San Juan River using Fish Bioenergetics 4.0. Growth rates of channel catfish will be measured using spines or otoliths from male and female channel catfish collected throughout the San Juan River following procedures of Buckmeier et al. (2002). An age-length relationship will be used to calculate yearly growth rates of channel catfish in different reaches of the river. Temperature and activity will be assessed using archival radio tags that are implanted in a fish and continuously record temperature and movement every minute for a 400+ day period (see Hedden et al. 2016 for example with flathead catfish). We propose to tag 10 fish in the lower reach (Bluff to Mexican Hat) and 10 fish in the upper reach (Hogback to Shiprock) in March and recover the implanted transmitters the following year. Internal body temperature for fish will be used to parameterize bioenergetics models and activity sensors will be used to evaluate the temperatures at which the fish are active. Bioenergetics models will be constrained to those times when catfish are active. Combined, these data will allow us to obtain estimates of maximum predatory impacts channel catfish can impose on native fishes (e.g., Hedden et al. 2016).

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**Budget**

Period: January 1, 2018 to December 31, 2019

Task Description	Year 1	Year 2
<b>Task</b>		
<b>Salaries</b>		
Research assistant (9 month)	\$ 32,308	\$ 33,923
Undergraduate field technician (9 month)	\$ 16,000	\$ 16,800
<b>Fringe benefits</b>		
Research assistant (30%)	\$ 9,692	\$ 10,177
Field technician (1%)	\$ 160	\$ 168
<b>Travel</b>		
Per diem (3 - 15 day trips and 2 - 10 day trips per year x \$20/day per person)	\$ 2,600	\$ 2,600
Lodging (3 nights per trip x 5 trips x \$100/night)	\$ 1,500	\$ 1,500
Mileage (2000 miles per trip; 0.50/mile x 10,000 miles)	\$ 5,000	\$ 5,000
<b>Supplies</b>		
Sampling (whirl paks, waders, holding tanks)	\$ 4,500	\$ 4,500
Laptop computer	\$ 2,000	\$ -
Archival radio tags (\$500 each x 20)	\$ 10,000	
<b>Total direct costs</b>	<b>\$ 83,760</b>	<b>\$ 74,668</b>
<b>F&amp;A (17.5% CESU)</b>	<b>\$ 14,658</b>	<b>\$ 13,067</b>
<b>Incl KSU 17.5%</b>	<b>\$ 98,418</b>	<b>\$ 87,735</b>

**Budget Justification**

We are requesting a minimum of two years funding because flow conditions can be highly variable among years and multiple years will allow for a more robust analysis with larger sample size. A full-time research assistant will be paid for 9 months and will oversee the data collection, laboratory work, analysis and report writing. Undergraduate field technician will assist in all aspects of data collection and laboratory work. Travel will cover costs of 5 trips from Manhattan, KS to the San Juan River each year. There will be 2 10-day trips and 3 15-day trips. Lodging will cover 3 hotel rooms per trip; personnel will be camping the rest of the trips. Supplies will cover whirlpaks, formalin, waders and a holding tank (for gut evacuation experiments). A laptop computer is requested for data entry, storage and running bioenergetics models. Overhead rate (F&A) is 17.5% per the cooperative ecosystem studies unit (CESU) agreement with Kansas State University.

**DETERMINING DAILY GROWTH RATES OF LARVAL  
COLORADO PIKEMINNOW AND RAZORBACK SUCKER  
IN THE SAN JUAN RIVER**

**FISCAL YEAR 2018 SCOPE OF WORK**

**SUBMITTED TO THE SAN JUAN RIVER BASIN RECOVERY IMPLEMENTATION PROGRAM**

**FROM**

**AMERICAN SOUTHWEST ICHTHYOLOGICAL RESEARCHERS, L.L.C. (ASIR)  
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**DETERMINING AGE AND GROWTH AND SPAWN DATES OF LARVAL COLORADO PIKEMINNOW AND RAZORBACK SUCKER IN THE SAN JUAN RIVER AND ASSOCIATIONS WITH ABIOTIC FACTORS**

**FISCAL YEAR 2018 PROJECT PROPOSAL**

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**Introduction**

Colorado Pikeminnow *Ptychocheilus lucius* and Razorback Sucker *Xyrauchen texanus* are endemic to the Colorado River Basin including the San Juan River. Both species are federally endangered and are protected under the Endangered Species Act of 1973.

Colorado Pikeminnow is the largest North American member of the family Cyprinidae. Though once prevalent throughout the Colorado River Basin, population declines have been attributed to stream alteration, flow modifications, and competition with, and predation by, nonnative fishes. Colorado Pikeminnow was listed as a federally endangered species in 1967.

Razorback Sucker is one of three members of the family Catostomidae that is endemic to the Colorado River basin. The decline of Razorback Sucker and other native fishes in the Colorado River Basin has been attributed to flow modifications, instream barriers, changes to the thermal regime and channel simplification. In addition, the introduction of non-native fishes may have altered predation dynamics and competition for habitat and resources. Razorback Sucker was listed as an endangered species in 1991.

The San Juan River Basin Recovery Implementation Program (SJRRIP) was established in 1991 with the dual goals of conserving endangered fish in the San Juan River while proceeding with water development. Signatories to the program included the U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, U.S. Bureau of Land Management, U.S. Bureau of Indian Affairs, states of New Mexico and Colorado, Jicarilla-Apache Nation, Ute Mountain Ute, Southern Ute, and Navajo Nation Indian tribes.

The San Juan River is the second largest and downstream-most major tributary in the Upper Colorado River Basin. From its origins in the San Juan Mountains of Colorado, it flows about 30 river miles to the New Mexico border, then 200 river miles through New Mexico to near Four Corners (New Mexico, Colorado, Utah, Arizona) where it exits the state. It flows about 120 river miles through Utah from the Four Corners Bridge (U.S. Highway 160) and empties into Lake Powell. The size, location, and ichthyofaunal community of the San Juan River make it an important component of Upper Colorado River basin fish recovery and conservation efforts.

Spawning of Colorado Pikeminnow occurs 4–6 weeks after spring high flows (Bestgen et al. 2006) when temperatures are 18–23°C. Adults are capable of long migrations to spawning areas. Spawning typically occurs over cobble or gravel bars. In the San Juan River, spawning by Colorado Pikeminnow was first documented in 1995, with very few larvae collected between 1995 and 2013. The majority (92%) of

Colorado Pikeminnow collected in the San Juan River were collected in 2014 (n =312) and 2016 (n = 548).

Spawning of Razorback Sucker has been associated with the ascending limb of the spring hydrograph, peak spring discharge, and warming river temperatures. Adults congregate in riffles with cobble, gravel, and sand substrates. Spawning of Razorback Sucker coincides with spawning of other native catostomids. Hybridization between Flannelmouth Sucker and Razorback Sucker has been documented where these two species co-occur (Tyus and Karp 1990; Douglas and Marsh 1998). In the San Juan River, spawning by Razorback Sucker was first documented in 1998 (Farrington et al. 2013). Successful spawning of this species has occurred in each of the last 19 years (1998 – 2016).

While considerable work has been done correlating temperature to growth rates, and developing basin specific (i.e. Green River) growth rates for both Colorado Pikeminnow (Schaugaard 1997; Bestgen et al. 2006) and Razorback Sucker (Muth et al.1998; Bestgen et al., 2002; Bestgen 2008; Bestgen et al. 2011) this type of analysis has not been performed for the San Juan River Basin. Previous attempts to apply out-of-basin growth rates and back-calculated dates of hatching and spawning have proven to be a poor fit for San Juan River larval Razorback Sucker. For example, back-calculated spawning dates of Razorback Suckers collected in 2013 begin on December 23, 2012. Mean temperatures recorded at Mexican Hat, Utah between 23 and 31 December 2012 range between 0 and 0.5°C, so we assume that Razorback Suckers were not spawning during December 2012 based on these temperatures. This is a pervasive problem (specimens from 2002 also have back-calculated spawning dates in December of the previous year) observed when using the growth curve developed for use in the Green River. This poor fit has necessitated excluding metalarval and juvenile specimens from back-calculating efforts, as these older life stages suggest spawning by adult Razorback Sucker during periods when abiotic conditions (i.e. temperature) are not suitable. Therefore we know that applying a constant linear growth rate, derived from the Green River, results in the poor fit we observe in the San Juan River. We hypothesize that growth rates are likely non-linear and influenced by temperature. Currently, San Juan River growth rates for both larval Razorback Sucker and Colorado Pikeminnow are unknown, as are the back-calculated spawning dates that rely on growth rate data.

### **Objectives:**

The objectives of this proposed effort are captured under the SJRRIP Long-Range Plan (2016). Specific Actions listed are as follows:

- Action 4.4.1 Describe life history parameters of wild CPM and RBS.
- Action 4.5.1 Annually identify potential project/activities/questions/information needs.
- Action 4.5.2 Implement project/activities necessary to obtain needed information.
- Action 5.2.2 Ensure new information is identified and developed, as necessary to achieve Program goals and Assess Progress Towards Recovery.

Specific objectives are to:

1. Determine daily growth rates of Colorado Pikeminnow and Razorback Sucker.
2. Using San Juan specific growth rates, determine spawning dates for Colorado Pikeminnow and Razorback Sucker.
3. Investigate relationship between fish length and daily age.

4. Investigate relationship between spawning dates of larval Colorado Pikeminnow and Razorback Sucker and Growing-Degree Days (GDD).
5. Investigate relationship between spawning dates and water temperature.
6. Investigate relationship between spawning dates and river discharge.

Objectives 5 and 6 encompass a long-standing research question within the SJRRIP Monitoring Program's Larval Colorado Pikeminnow and Razorback Sucker monitoring survey. This study seeks to "*Determine the spawning periodicity of Colorado Pikeminnow and Razorback Sucker and examine potential correlations with temperature and discharge*".

### **Study Area:**

The study area from which the material to be examined was collected is a 145-mile reach of the San Juan River between Shiprock, New Mexico (RM 147.9) and the Clay Hills Crossing boat landing in Utah (RM 2.9), just upstream of Lake Powell. Suitable specimens for analysis were collected between 2009 and 2017 (Table 1).

### **Methods:**

#### *Laboratory Work:*

The proposed study will begin with a null model as follows:

#### Assumptions for larvae:

- a) The first otolith increment forms on the hatch date.
- b) Otolith increments are deposited daily post-hatching date.
- c) For Razorback Suckers only, specimens examined are not hybrids.

Laboratory studies have confirmed that Colorado Pikeminnow (Bestgen and Bundy 1998) and Razorback Sucker (Bundy and Bestgen 2001) form first otolith increment on the hatch date and deposit daily increments post-hatch.

#### Assumption for larval age and growth:

- a) Larval Colorado Pikeminnow average 5.5 mm total length (TL) at hatching (Bestgen and Williams 1994).
- b) Larval Razorback Sucker average 8.0 mm TL at time of hatching (Snyder and Muth 2004).
- c) Growth rates will be positively correlated with increasing river temperatures.

Validity of the assumption that growth rates are positively correlated with increasing river temperature will be tested using Pearson's correlation coefficient. Other assumptions will be tested through a thorough examination of pertinent scientific literature. Potential San Juan River hybrid Razorback Sucker were labeled as such during annual processing of samples (W. Howard Brandenburg, pers. comm.) and will not be used for growth rate analysis.

The results from the proposed study will provide previously unknown information about the early life history of larval Colorado Pikeminnow and Razorback Sucker in the San Juan River including daily growth rates that can be used to back-calculate both hatching and spawning dates specific to the San Juan River. In the future, these data could easily be obtained on an annual basis and used to generate a long-term model that could be correlated with other environmental factors and would be of considerable value to resource managers.

### Age and growth

Otolith removal and examination will follow the procedures outlined by Secor et al. (1991) and Stevenson and Campana (1992). Sagittal and lapillar otoliths will be dissected from the inner ears of selected specimens and mounted on a glass microscope slide labeled with associated field collection information using Crystalbond 509 thermoplastic cement and a cover slip. Otoliths will be viewed under a Zeiss Axioskop 2 MAT 100-1,000X compound microscope using oil immersion lenses. Images of otoliths (including images along the z-axis) will be captured electronically with a digital camera for archival purposes. The age (in days) of each fish will be determined, independently, by two readers counting the number of putative daily rings from the primordium to the outer edge of the rostrum. Disagreements between readers will be reconciled during a joint reading.

Specimens used for this study are those collected as part of San Juan River larval Colorado Pikeminnow and Razorback Sucker monitoring project being conducted for the SJRRIP. A minimum of 500 Razorback Sucker and 500 Colorado Pikeminnow larvae will be examined for the period between 2009 and 2017 (Table 1). Prior to 2009 fish were fixed in a 10% solution of formalin and cannot be used for otolith examination. Razorback Suckers specimens examined will be representative of the temporal and spatial attributes associated with capture of larvae. Equal sample sizes will be selected for each year and specimens will be selected from across the sample area and period. Care will be made to select larvae representative of the different mesohabitats sampled. Because Colorado Pikeminnow were only captured in high numbers in 2014 and 2016, all specimens collected during years without adequate samples will be included in analysis. A subset of specimens from 2014 and 2016 will be selected to provide spatial representation across the river miles sampled and temporal representation of the sampling period each year.

Specimens of both species captured in isolated pool habitats will be excluded from analysis as elevated water temperatures often associated with isolated pools may skew larval growth rates and are not representative riverine and freely accessible habitat growth rates.

Daily growth rates between hatching and date of capture for larval Colorado Pikeminnow and Razorback Sucker will be estimated by subtracting mean TL at hatching (Colorado Pikeminnow: 5.5 mm TL; Bestgen and Williams 1994; Razorback Sucker: 8.0 mm; Snyder and Muth 2004) from TL at capture and dividing by the age of the specimen (in days) as determined by otolith examination.

<b>Year</b>	<b># of Razorback Sucker available</b>	<b>Size range TL mm</b>	<b># of Colorado Pikeminnow available</b>	<b>Size range TL mm</b>
2009	272	10.1 – 30.2	1	25.2
2010	1,251	9.4 – 30.0	5	12.6 – 21.4
2011	1,065	8.6 – 34.2	29	10.0 – 21.3
2012	1,778	8.0 – 31.8	0	NA
2013	979	9.5 – 49.4	12	14.1 – 28.7
2014	612	8.8 – 35.3	312	8.5 – 20.8
2015	1,205	8.8 – 26.0	24	8.6 – 9.7
2016	824	9.3 – 48.4	548	8.8 – 14.7
2017	To be determined			

Table 1. Razorback Sucker and Colorado Pikeminnow larvae available for growth rate analysis.

Degree Day Information

Assessment of Colorado Pikeminnow and Razorback Sucker growth rates in the San Juan River will be made using degree-day metrics. Correlation between rates of growth and environmental temperatures are well established in ectotherms. Degree-days, the thermal integral used to measure the accumulation of thermal units over a given period, are a reliable predictor of growth and development of larval fishes and have been used to predict embryonic developmental rate of White Sucker, *Catostomus commersonii* (Hamel et al. 1997). Degree-days will be calculated using average daily water temperature obtained at the USGS gage near Bluff, UT (#09379500) using the equation:

$$\int GDD = T_{avg} - T_{base}$$

where  $T_{avg}$  is the mean daily water temperature and  $T_{base}$  is the temperature below which spawning is not likely to occur. Colorado Pikeminnow and Razorback Sucker spawn at different temperatures, thus  $T_{base}$  will be species specific. For Colorado Pikeminnow,  $T_{base} = 18^{\circ}\text{C}$  (USFWS 2002a) and for Razorback Sucker,  $T_{base} = 14^{\circ}\text{C}$  (USFWS 2002b).

Statistical analyses

Length-age relationships will be compared using a growth curve analysis. Gompertz, logistic, and von Bertalanffy growth curves will be fitted to the datasets to investigate the relationship between age and length (TL). Model selection will be performed using Akaike information criterion (AIC). The selected models will be used to predict age from length of specimens collected during larval surveys and better refine spawn dates of these species.

A multiple linear regression will be used to evaluate significance of variables such as GDD, month, length, discharge, and reach on growth rates of Colorado Pikeminnow and Razorback Suckers in the San Juan River. Model selection will be performed with AIC. Significant variables can be used to fine-tune growth curves. The newly selected models will be used to post-process existing Razorback Sucker (1999–2016) and Colorado Pikeminnow (2003–2016) data sets to generate San Juan River specific hatching and spawning dates. Newly calculated hatching and spawning dates will be compared to dates previously calculated.

**Management implications**

Current growth rate calculations are performed using growth models calculated from fishes in the Green River. These growth models are a poor fit when used in the San Juan River and produce unfeasible hatch and spawn dates (e.g. spawning in December of previous year). Thus, by using the current Green River growth rate models, key parameters of the life history of San Juan River Colorado Pikeminnow and Razorback Sucker are unknown. Having baseline data regarding larval fish growth, spawning periodicity, and hatching dates for larvae has been used to benefit recovery of endangered species within the Green River Basin, and has helped guide Flaming Gorge dam operations (LaGory et al. 2012, and Bestgen et al. 2011)

This SOW seeks to create a San Juan specific growth model for each species, which will result in accurate determination of hatching and spawning periodicity. This information may be used to guide future management actions related to water temperature, flow recommendations and flow releases from Navajo

Dam. It can be used for timing inundation of restored habitats (i.e. RERI Phase III) to maximize retention, growth and survival of endangered fish larvae. Knowledge of spawning periodicity can be used to minimize the impacts of electrofishing during peak spawning activity by Razorback Sucker and Colorado Pikeminnow. Additionally, this SOW seeks to evaluate the impacts of water temperature and other variables on growth rates of larval fishes. Accurate spawning periodicity and knowledge of factors impacting larval growth will help guide management activities to protect early life stages of these species.

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*2018 BUDGET: DETERMINING DAILY GROWTH RATES OF  
LARVAL COLORADO PIKEMINNOW AND RAZORBACK SUCKER*

Based on examination of 1,000 larval specimens  
(500 larval Colorado Pikeminnow and 500 larval Razorback Sucker)

**Personnel**

Laboratory Work

Fisheries Biologist I (110 staff days x 8 hr/day x \$57.18).....\$ 50,318  
Tasks: Material examination/selection, developmental staging, otolith extraction,  
mounting, aging, photographing, accessioning, data entry, query and review, database development

Office Work (Report Development)

Fisheries Biologist I (40 staff days x 8 hr/day x \$57.18).....\$ 18,298  
Tasks: Data analysis, draft report preparation, post-review redraft and submission,  
development and submission of formal responses to reviewer comments, meeting  
development of study presentation for and attendance at annual meetings (Feb and May)

Project Participation

Senior Fisheries Biologist (5 staff days x 8 hr/day x \$96.77).....\$ 3,871  
Tasks: Project coordination, project and data review, data management, report review

**Personnel (Laboratory, Office, Oversight): Subtotal .....\$ 72,487**

**Materials and Supplies (open market items)**

Microscope maintenance (under-lit bulbs, lens cleaning wipes) .....\$ 85

Otolith extraction and mounting materials  
(insect pins, slides, slide covers, slide storage, Crystalbond™ and solvent) .....\$ 1,570

**Materials and Supplies: Subtotal .....\$ 1,655**

**Travel and Per Diem**

SJRBRIP Meetings

Travel (drive with others).....\$ 0

Per Diem - 3 days per trip x 1 staff (\$51/day GSA M&IE rate) x 2 trips.....\$ 306

Per Diem - 2 hotel days per trip x 1 staff (\$91/night GSA lodging rate) x 2 trips.....\$ 364

**Travel and Per Diem: Subtotal .....\$ 670**

**2018 Project Totals**

**Personnel: .....\$ 72,487**

<b>Materials and Supplies:</b> .....	\$ 1,655
<b>Travel and Per Diem</b> .....	\$ 670
<b>2018 Scope of Work Total:</b> .....	<b>\$ 74,812</b>

**FY 2018 SCOPE OF WORK**

**TO**

**BUREAU OF RECLAMATION**

**FROM**

New Mexico Department of Game and Fish  
Matthew P. Zeigler and Michael E. Ruhl  
One Wildlife Way, P.O. Box 25112  
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**AND**

U.S. Fish and Wildlife Service  
New Mexico Fish and Wildlife Conservation Office  
Jason E. Davis  
3800 Commons N.E.  
Albuquerque, New Mexico 87109  
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[Jason\\_E\\_Davis@fws.gov](mailto:Jason_E_Davis@fws.gov)

**FOR**

Assessment of calcein mark retention and detection in hatchery-reared  
age-0 Colorado Pikeminnow, and their interactions with wild  
age-0 Colorado Pikeminnow in the San Juan River

**REPORTING DATES**

10/01/2017 through 9/30/2018

## INTRODUCTION

The San Juan River Basin Recovery Implementation Program (SJRIP) was formed in 1992 to recover endangered Colorado Pikeminnow *Ptychocheilus lucius* and Razorback Sucker *Xyrauchen texanus* in the San Juan River. The construction of Navajo and Glen Canyon Dams and the introduction of nonnative species caused significant declines of the species in the San Juan River by the time the program was initiated, with the last known wild Colorado Pikeminnow being captured in 2000 (Ryden 2003a). In an effort to increase the abundance of Colorado Pikeminnow in the river, experimental stockings began as early as 1996 with a formal augmentation plan for the species completed in 2003 (Ryden 2003b). Currently the SJRIP is stocking age-0 Colorado Pikeminnow under the Phase II Augmentation Plan (Furr 2010), and since being initiated in 2010 over 2.4 million age-0 fish have been stocked (Furr 2016).

Although monitoring has confirmed the recruitment of these stocked Colorado Pikeminnow to adults (Schleicher 2015), as well as moderate reproduction in some years since 2003 (Farrington et al. 2017), recruitment of wild fish past the larval stage has not been documented. However, 23 wild age-0 Colorado Pikeminnows were captured during standardized small-bodied fishes monitoring in 2016 (Zeigler and Ruhl 2017). It was later estimated that 1,000s to 10,000s wild age-0 Colorado Pikeminnows were present in the river based on expected low capture probabilities and the amount of unsampled habitat available to the species. The significance of documented recruitment of wild fish past the larval stage is unequivocal for the recovery of Colorado Pikeminnow in the San Juan River.

A self-sustaining population of Colorado Pikeminnow in the San Juan River is critical to the delisting of the species; however because of low adult abundances and sporadic reproduction, augmentation is likely to continue. If wild age-0 Colorado Pikeminnow are present in the system, a method to distinguish them from hatchery-reared fish is needed so wild fish can be easily identified and tracked until maturity. Due to the small size (45 – 55 mm total length) and total number ( $\geq 400,000$ ) of age-0 Colorado Pikeminnow stocked every year (Furr 2010), individual identification tags (i.e., PIT tags) are impractical. At the May 2017 SJRIP Biology Committee meeting it was determined that all age-0 Colorado Pikeminnow will be batch marked using calcein before being stocked in the San Juan River to aide in the identification of wild fish.

Calcein, which can be used to mark fish via immersion or feeding, has been successfully used to batch mark Atlantic Salmon *Salmo salar* (Mohler 1997), Rainbow Trout *Oncorhynchus mykiss* (Bart et al. 2001), Walleyes *Sander vitreus* (Brooks et al. 1994), and several other fish species (Leips et al. 2001; Honeyfield et al. 2006). The calcein binds to calcified body parts of an organism and can be detected using ultraviolet light (Elle et al. 2010). Marks are known to fade if fish are not sufficiently exposed to the calcein solution or if fish are exposed to direct sunlight for an extended period (Bashey et al. 2004; Elle et al. 2010; Marsden et al. 2014), but detection of external marks for at least 12 months after marking has been observed in some studies (Mohler 2004; Negus and Tureson 2004). Retention of marks is better on internal structures such as otoliths and vertebrae as opposed to external body structures such as fin rays, but such detections involve lethal sampling (Leips et al. 2001; Elle et al. 2010). Furthermore, calcein marking is not known to affect growth or survival (Bashey 2004), nor increase predation (Mohler et al. 2002).

Currently, the SJRIP Program Office is conducting a 12 month study at Southwestern Native Aquatic Resources and Recovery Center (Southwestern Native ARRC) in Dexter, NM to assess the detection and retention of calcein marks on Colorado Pikeminnow under hatchery conditions (Durst et al. 2016). Calcein marked age-0 Colorado Pikeminnow will be stocked into the San Juan River as part of the SJRIP's augmentation plan in November 2017. Although the mark may be readily identified in laboratory conditions, reliable detection of the mark in the field will be important for assessing contribution of wild and hatchery-reared fish to the population. A previous study using calcein marked Colorado Pikeminnow in the San Juan River found that the mark could not be detected under field conditions approximately one month post-stocking but could be detected under laboratory conditions (Golden and Holden 2005). No information on the marking procedure was provided in the study and faded external marks could have been caused by improper marking techniques. The adoption of calcein marking technique for hatchery-reared age-0 Colorado Pikeminnow created an information need for the SJRIP:

**Information Need 1:** Efficacy of calcein marking for distinguishing hatchery-reared age-0 and age-1 Colorado Pikeminnow in the field.

In addition to the need to readily identify hatchery-reared fish, the presence of wild age-0 Colorado Pikeminnow in 2016 raised questions about potential negative interactions that may occur between hatchery-reared and wild fish in the river. While little information is available on the interactions between wild and hatchery non-game endangered fish species, an abundance of literature is available for other species, in particular, salmonids. Studies have shown hatchery-reared fish to be more aggressive, compete with wild fish for food, and displace wild fish; potentially leading to deleterious effects to wild fish populations (Einum and Fleming 2001; Weber and Fausch 2003).

Hatchery-reared fish can cause significant impacts to populations of wild fish including decreased abundance (Vincent 1987; Flagg et al. 1995), reduced growth and fitness (Dewald and Wilzbach 1992; McMichael et al. 1997; Weiss and Schmutz 1999), and displacement from suitable habitat at local and reach scales (Fenderson et al. 1968; McGinnity et al. 1997; Fleming et al. 2000; Sundt-Hansen et al. 2015). The majority of these negative effects to wild fish are greatly influenced by density-dependent factors (Petrosky and Bjornn 1988; Weber and Fausch 2003), although other factors such as agonistic behaviors can occur even at low densities (Fenderson and Carpenter 1971). However, other studies have failed to produce results which indicated any competition between hatchery-reared and wild fish (Levings et al. 1986; Unwin and Glova 1997; Deverill et al. 1999; Weiss and Schmutz 1999; Skov et al. 2011), potentially due to the reduced likelihood of domesticated fish to survive in the wild (Einum and Fleming 2001). Still, even in the absence of direct competition, hatchery-reared stocks have been shown to replace, rather than enhance wild populations (Hilborn and Eggers 2000; Quinones et al. 2014); this raises the question of their utility for rebuilding depleted fish populations.

The augmentation of Colorado Pikeminnow in the San Juan River differs significantly from most stocking programs, as its initial aim was to reintroduce an essentially extirpated population and not merely enhance a depleted one. Eliminating any potential negative interactions between hatchery-reared and wild age-0 Colorado Pikeminnow will be pertinent not only for increasing the recruitment of these wild fish to adults for delisting, but also critical because wild fish are potentially reproductively superior to hatchery-reared fish (Christie et al. 2014; Clarke et al. 2016) and occupy higher trophic positions (Quinn et al. 2012; Kaeriyama et al. 2014). Continued augmentation of the Colorado Pikeminnow population with hatchery-reared age-0 fish when wild age-0 fish are present creates a second information need for the SJRIP:

**Information Need 2:** Ecological effects of hatchery-reared Colorado Pikeminnow on wild Colorado Pikeminnow when both are present in the system during early life stages (i.e., age-0 and age-1).

This study is designed to specifically address **Information Need 1** as described above. Field verification of the efficacy of using calcein marking to field identify age-1 hatchery-reared Colorado Pikeminnow is vitally important for assessing recovery of the species in the San Juan River while augmentation continues. If field detection of the calcein mark through the first year post-stocking is deemed insufficient to accurately identify hatchery-reared Colorado Pikeminnow in the system, then alternative batch marking techniques must be investigated. In addition to addressing **Information Need 1**, this study will also attempt to address **Information Need 2**. Elucidating any potential negative interactions between hatchery-reared and wild age-0 Colorado Pikeminnow is important for assessing the utility of the current augmentation plan. Ecological interactions between hatchery-reared and wild fish would preferably be assessed using a substitutive, or at least an additive, study design, but the stochastic nature of the San Juan River hydrograph and the improbability of obtaining sufficient replicates precludes these types of experiments. Even in the absence of definitively detecting negative effects of hatchery-reared Colorado Pikeminnow on wild age-0 Colorado Pikeminnow, the second portion of this study will provide information on habitat use, factors affecting condition, and distribution of age-0 Colorado Pikeminnow post-winter in the San Juan River.

## LINKS TO LONG-RANGE PLAN

The SJRIP Long-Range Plan is designed to identify and implement specific actions which will contribute to the recovery of Colorado Pikeminnow and Razorback Sucker in the basin (SJRIP 2016). This project is designed to inform future augmentation plans and protocols for Colorado Pikeminnow (Tasks 1.1.1.1 and 1.1.2.2). Results from this project will also help to increase information on rearing habitat use (Task 4.1.2.2) and early success (Task 4.1.5.1) of stocked and wild age-0 Colorado Pikeminnow.

## STUDY GOALS AND OBJECTIVES

The specific goals and objectives for this project include:

Information Need 1: Efficacy of calcein marking for distinguishing hatchery-reared age-0 and age-1 Colorado Pikeminnow in the field

Objective 1A: Determine the difference in the detectability of the calcein mark on external structures between field and laboratory conditions

Objective 1B: Determine the retention of the calcein mark from pre-runoff to fall sampling

Information Need 2: Ecological effects of hatchery-reared Colorado Pikeminnow on wild Colorado Pikeminnow when both are present in the system during early life stages (i.e., age-0 and age-1)

Objective 2A: Evaluate the effects of density on the condition of age-1 Colorado Pikeminnow in zero velocity habitats

Objective 2B: Determine the effects of the density of hatchery-reared age-1 Colorado Pikeminnow on the condition of wild age-1 Colorado Pikeminnow in zero velocity habitats

## STUDY AREA

The study area for this project includes the San Juan River from Shiprock, NM (River Mile 147.8) downstream to Clay Hills, UT (River Mile 2.9). This section of river includes five different geomorphic reaches, Reach 1 through Reach 5.

## SAMPLING METHODS AND DATA ANALYSIS

### *Calcein Marking and age-0 Colorado Pikeminnow Stocking*

All hatchery-reared age-0 Colorado Pikeminnow will be calcein marked at Southwestern Native ARRC using an osmotic induction procedure developed by Mohler (2003). All fish will be placed in a 3.5% salt bath for 3.5 min and then transferred to a 1% calcein bath for 5 min. All marked fish will then be stocked following the procedures outlined in “Augmentation of Colorado Pikeminnow (*Ptychocheilus lucius*) in the San Juan River: Phase II, 2010-2020” (Furr 2010).

### *Pre-runoff Fish Sampling*

One sampling trip will occur before spring runoff (i.e., late March or early April) in 2018, 2019, and 2020. All zero velocity habitats (i.e., backwaters and embayments) greater than 30 m<sup>2</sup> will be sampled when encountered. Habitats will be closed off using a block net and river mile, geographic coordinates (UTM NAD83), and water quality parameters (e.g., dissolved oxygen, conductivity, and temperature) will be recorded. A 3.0 m x 1.8 m (3.0 mm heavy duty Delta untreated mesh) drag seine will be used to repeatedly sample the backwater until no fish are captured in three consecutive seine hauls. After sampling is completed, the area of the zero velocity habitat will be determined by measuring its length and width at five equally spaced locations. Depth and substrate will be taken at 10 random locations within the habitat to determine mean and maximum depth. The percent cover (i.e., large woody debris, inundated vegetation) available within the zero velocity habitat will be estimated to the nearest 5%.

All captured fish will be held in 5 gal buckets until sampling is complete and then identified to species and enumerated. All native species except age-1 Colorado Pikeminnow will be released and all nonnative species removed from the system. Age-2+ Colorado Pikeminnows and Razorback Suckers will be measured (total length [TL] and standard length [SL]) to the nearest mm, weighed to the nearest g, and scanned for a PIT tag. A 12-mm PIT tag will be implanted in any endangered species  $\geq 150$  mm TL if one is not detected. All age-1 Colorado

Pikeminnow will be examined for a calcein mark on the head and fins using a handheld SE-MARK detector light (Elle et al. 2010), identified as marked or unmarked, and measured for TL and weighed. A tarp will be used to block direct sunlight and assess its usefulness for detecting marks. A subsample of up to 50 fish, but no less than 10 fish, with equal numbers of marked and unmarked fish, will be frozen using dry ice and labeled by sample site and their identified marking group for processing in the laboratory. No more than 400 age-1 Colorado Pikeminnow will be preserved in any year of sampling. We expect the number of age-1 Colorado Pikeminnow preserved in any year to be a very small proportion (about 0.01) of the entire population because capture probabilities for these fish are very low and we are sampling a very small amount of the habitat they occupy (Zeigler et al. 2017).

#### *Fall Sampling*

Age-1 Colorado Pikeminnow will be collected during annual fall small-bodied fishes sampling following the procedures as outlined in San Juan River Basin Recovery Implementation Program Monitoring Plan and Protocols (SJRIP 2012). Fish will be frozen using dry ice after being measured (TL) and weighed in the field. No more than 50 age-1 Colorado Pikeminnow will be preserved in any year of sampling.

#### *Data Q/A and Q/C Procedures*

After data collection, all original field notes will be error checked. Data will be entered into Excel spreadsheets and cross-checked with original field notes by a different biologist. Data queries will be conducted within the Excel spreadsheet to identify and rectify any additional errors.

#### *Objective 1A: Determine the difference in the detectability of the calcein mark on external structures between field and laboratory conditions*

Detectability of the calcein mark on external structures will be tested by comparing the number of field identified marked fish to the number of laboratory identified marked fish. All age-1 Colorado Pikeminnow preserved during pre-spring runoff and fall sampling will be returned to the laboratory and thawed. Each fish will be reexamined for an external calcein mark using the visual reader to confirm field identifications. Any incorrect identifications (i.e., marked or unmarked) will be noted. Fish will be blotted dry, measured (TL) to the nearest 0.1 mm, and weighed to the nearest 0.1 g. Otoliths from each preserved specimen will then be removed and examined for a calcein mark using a visual reader and any incorrect field identifications noted. A Chi-square test will be used to test if the number of fish identified as marked in the field differs from the number of fish identified as marked in the laboratory using otoliths. If the proportion of laboratory identified marked fish significantly differs ( $\alpha = 0.05$ ) from the proportion of field identified marked fish it will be assumed that external mark loss occurred. It is highly probable that field identification will never be 100% and we propose that a mean 90% correct field identification over the three year study would be adequate for continuation of calcein as a marking technique for hatchery-reared age-0 Colorado Pikeminnow.

#### *Objective 1B: Determine if the retention of calcein mark on external structures remains similar between the pre-runoff and fall sampling*

To assess the retention of the external calcein mark, the number of correct mark identifications will be compared for fish captured in the pre-runoff and fall sampling. The mark identifications as described in *Objective 1A* will be used to address *Objective 1B*. The proportion of correct identifications from the fall sampling will be tested to determine if it is less than the proportion of correct identifications in the spring sampling. A statistically significant ( $\alpha = 0.05$ ) difference would indicate that the number of correct external marks decreased from the pre-spring runoff sampling to the fall sampling due to external mark fading or loss.

#### *Objective 2A: Evaluate the effects of density on the condition of age-1 Colorado Pikeminnow in zero velocity habitats*

After the completion of the laboratory procedures to determine incorrectly identified marked or unmarked fish, the condition of each preserved fish will be determined by calculating the relative fat content following the

procedures as outlined by Tobler (2008). The visceral organs of each fish will be removed, the fish weighed, and dried at 60°C for 3 d. Dried fish will be weighed and placed in separate vials. Lipids will be extracted using four 24 hr extractions in petroleum ether (Heulett et al. 1995; Tobler 2008). After extractions, fish will be dried and reweighed using the above procedure. Petroleum ether removes storage lipids and the difference between pre- and post-extraction weight represents relative fat content, a proxy for individual fish body condition (Tobler 2008).

A second condition factor, the relative condition factor ( $K_n$ ), will also be calculated for each individual fish using weights taken before visceral organs are removed. The relative condition factor will be calculated as

$$K_n = (W/W') \times 100$$

where  $W$  is the individual weight and  $W'$  is the predicted length-specific weight based on log10 transformed data (Pope and Kruse 2007). A fish which is considered to be in good condition is expected to have a  $K_n$  of 95 - 105. Weight-length relationships used for the calculation of  $K_n$  will be confined to only age-1 Colorado Pikeminnow captured during the pre-spring runoff sampling during this study. Given the expected small size range (50 – 100 mm TL) of age-1 Colorado Pikeminnow during pre-spring runoff sampling, we expect  $K_n$  to provide a valid measure of an individual fish's condition. Furthermore,  $K_n$  can be compared to the relative fat content of each individual to assess the validity of both condition metrics.

General linear models (GLMs) will be used to assess the influence of density on the condition (i.e.,  $K_n$  and relative fat content) of age-1 Colorado Pikeminnow such that condition is the response variable and density is the explanatory variable. Use of GLMs will allow for the inclusion of other explanatory variables that may describe differences in condition of age-0 Colorado Pikeminnow among zero velocity habitats (e.g., density of natives and nonnatives, average depth of habitat) and between years (e.g., mean winter discharge, winter floods, mean winter water temperature).

*Objective 2B: Determine the effects of the density of hatchery-reared age-1 Colorado Pikeminnow on the condition of wild age-1 Colorado Pikeminnow in zero velocity habitats.*

If wild fish are present, GLMs will be used to assess the effects of the density of hatchery-reared age-1 Colorado Pikeminnow on the condition of wild age-1 Colorado Pikeminnow. It will be assumed that any fish which are not identified as marked in the laboratory are wild. The GLM will be structured such that the condition of age-1 wild fish is the response variable and the density of age-1 hatchery-reared Colorado Pikeminnow is the explanatory variable. Additional explanatory variables that may describe differences in condition of wild age-0 Colorado Pikeminnow between zero velocity habitats (e.g., density of natives and nonnatives, average depth of habitat) and between years (e.g., mean winter discharge, winter floods, mean winter water temperature) may also be included in the models.

## REPORTING

Short draft annual reports with information on sampling locations and number of fish captured will be provided by 31 March 2019 and 2020 with final annual reports provided by 30 June of both years. A draft final report with information on sampling locations and number of fish captured across all years and final analyses of the data will be provided by 31 March 2021 and the completed final report by 30 June 2021. Short update presentations may be given at Biology Committee meetings in February of 2019 and 2020 and a presentation on the projects final results given at the February 2021 Biology Committee meeting and the SJRIP annual meeting in May 2021. All PIT tag data for endangered species will be provided to the SJRIP Program Office (PO) by 31 December of each year. All data collected by this SOW will be provided to the PO by 30 June 2021.

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**NMDGF FY 2018 Budget****Sampling****Personnel**

*Tasks* - Sample all zero velocity habitats on the San Juan River from Shiprock, NM (RM 147.8) to Clay Hills, UT (RM 2.9); 11 field days projected at 12 hours of work per day = 132 hours (88 hrs regular and 44 hrs overtime).

## Project Leader (1)

88 hrs regular @ \$46.34/hr (\$33.69/hr (base salary) + \$12.66/hr (benefits))	\$ 4,078
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44 hrs overtime @ \$69.52/hr (\$46.34/hr * 1.5 (time-and-a-half))	\$ 3,059
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## Project Biologist (1)

88 hrs regular @ \$37.13/hr (\$26.99/hr (base salary) + \$10.14 (benefits))	\$ 3,267
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44 hrs overtime @ \$55.69/hr (\$37.13/hr * 1.5 (time-and-a-half))	\$ 2,450
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<b>Sub-total</b>	<b>\$ 12,854</b>
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**Per Diem**

4 days @ \$85/day (standard NM in-state rate) * 2 biologists	\$ 680
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7 days @ 115/day (standard NM out-of-state rate) * 2 biologist	\$ 1,610
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<b>Sub-total</b>	<b>\$ 2,290</b>
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**Vehicles**

Round-trip to Clay Hills, UT – 950 miles @ \$0.55/mile	\$ 523
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<b>Sub-total</b>	<b>\$ 523</b>
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<b>Sampling Sub-total</b>	<b>\$ 15,667</b>
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**Field Equipment & Supplies**

Cooler @ \$350	\$ 350
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Whirlpicks (500) @ \$50.00/per 500	\$ 50
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Blocknets 2 @ \$ 150	\$ 300
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<b>Equipment Sub-total</b>	<b>\$ 700</b>
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<b>Sampling Sub-total</b>	<b>\$ 16,367</b>
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**Specimen Management****Personnel**

*Tasks* - Processing (sorting, identification, and data-entry) of preserved Colorado Pikeminnow samples lipid extraction; 25 days of in the laboratory at 8 hours of work per day = 200 hours.

Project Leader (1)

200 hrs regular @ \$46.34/hr (\$33.69/hr (base salary) + \$12.66/hr (benefits)) \$ 9,268

Project Biologist (1)

200 hrs regular @ \$37.13/hr (\$26.99/hr (base salary) + \$10.14 (benefits)) 7,426

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**Sub-total \$ 16,694**

**Equipment & Supplies**

20 L Petroeum Ether @ \$60 per L \$ 1,200

1 Laboratory grade oven \$ 1,300

Miscellaneous lab supplies \$ 1,000

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**Sub-total \$ 3,500**

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**Specimen Management Sub-total \$ 20,194**

**Data Management/Analysis and Report Preparation****Personnel**

*Tasks* – Data management and QA/QC, data analysis and synthesis, table and graph preparation, report drafting and revision; Project Leader (15 hrs) and one Project Biologist (80 hrs each).

Project Leader (1)

15 hrs regular @ \$46.34/hr (\$33.69/hr (base salary) + \$12.66/hr (benefits)) \$ 695

Project Biologist (1)

80 hrs regular @ \$37.13/hr (\$26.99/hr (base salary) + \$10.14 (benefits)) \$ 2,970

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**Data Management/Analysis & Report Preparation Sub-total \$ 3,665**

**FY 2018 Total**

Sampling Sub-total \$ 16,367

Specimen Management Sub-total \$ 20,194

Data Management/Analysis & Report Preparation Sub-total \$ 3,665

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**Total \$ 40,226**

**NMFWCO FY 2018 Budget****Sampling****Personnel**

*Tasks* - Sample all zero velocity habitats on the San Juan River from Shiprock, NM (RM 147.8) to Clay

Fish Biologist (GS 11-7)

88 hrs regular @ \$43.57/hr (\$34.71/hr (base salary) + \$8.86 hr (benefits)) \$ 3,834

44 hrs overtime @ \$65.36/hr (\$43.57hr \* 1.5 (time-and-a-half)) \$ 2,876

Fish Biologist (GS 9-7)

88 hrs regular @ \$36.26/hr (\$28.69/hr (base salary) + \$7.57 (benefits)) \$ 3,191

44 hrs overtime @ \$54.39/hr (\$36.26/hr \* 1.5 (time-and-a-half)) \$ 2,393

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**Sub-total \$ 12,294**

**Vehicles**

Round-trip to Clay Hills, UT – 950 miles @ \$0.55/mile \$ 523

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**Sub-total \$ 523**

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**Sampling Sub-total \$ 12,817**

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**Sampling Sub-total \$ 12,817**

**Data Management/Analysis and Report Preparation****Personnel**

*Tasks* – report drafting and revision

Fish Biologist (GS 11-7)

40 hrs regular @ \$43.57/hr (\$34.71/hr (base salary) + \$18.86/hr (benefits)) \$ 1,743

Supervisory Fish Biologist (GS 13-6)

8 hrs regular @ \$61.70/hr (\$48.10/hr (base salary) + \$13.60 (benefits)) \$ 494

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**Data Management/Analysis & Report Preparation Sub-total \$ 2,237**

**FY 2018 Total**

Sampling Sub-total \$ 12,817

Data Management/Analysis & Report Preparation Sub-total \$ 2,237

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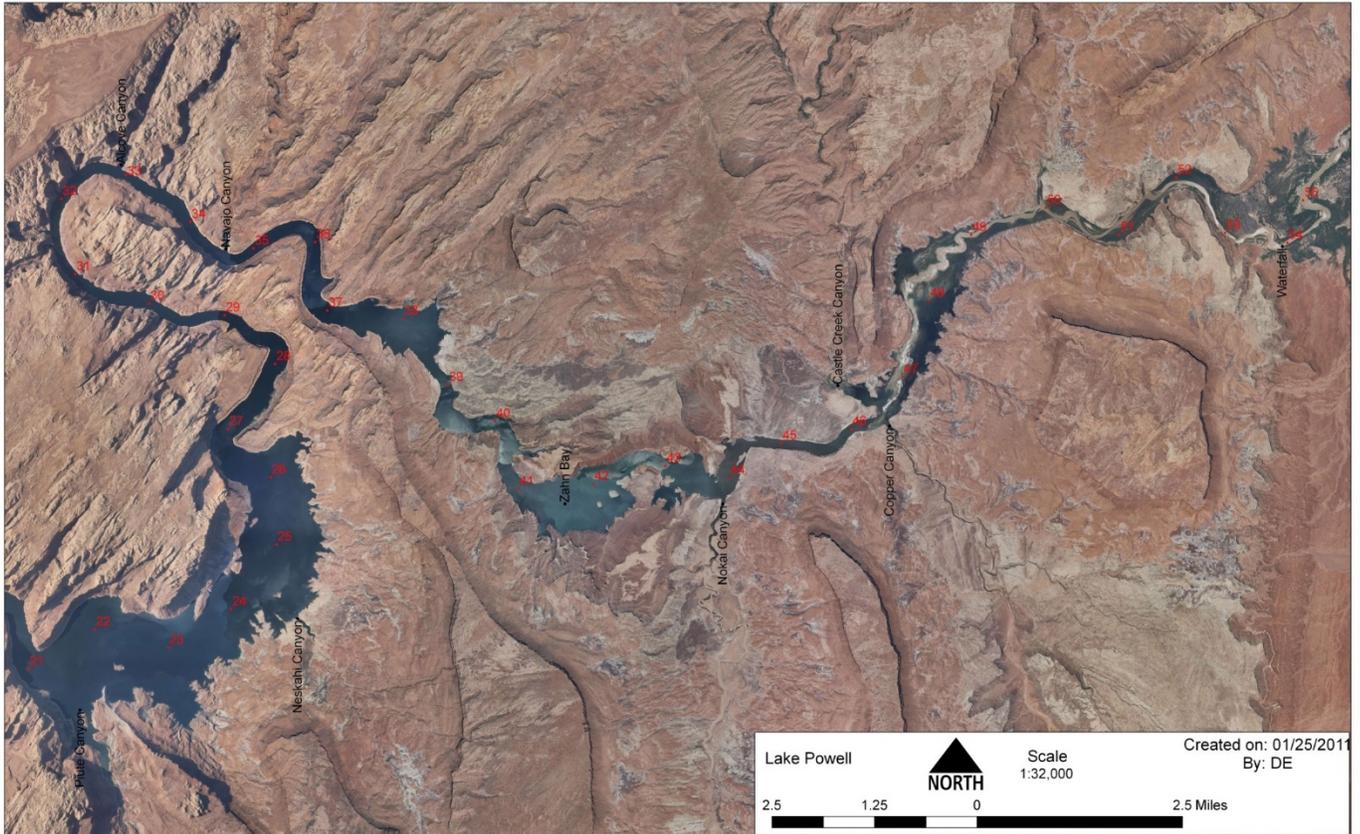
**Total \$ 15,054**

**FY 2018 Total Budget**

NMDGF	\$ 40,226
USFWS NMFWCO	\$ 15,054
<hr/>	
<b>FY 2018 Project Total</b>	<b>\$ 55,280</b>

# Scope of Work (FY 2018): Population size, mobility, and early life history of Razorback Suckers in the San Juan River – Lake Powell complex

April 18, 2017



## Principal Investigators

Keith B. Gido, Casey A. Pennock, and Skyler C. Hedden

Division of Biology

Kansas State University, Manhattan, KS 66506

Collaborator:

Mark McKinstry

## Background

Sampling efforts dating back to the 1980s in the San Juan River arm of Lake Powell have documented the occurrence of Razorback Sucker (*Xyrauchen texanus*). Between the 1980s and 2010, regular captures of Razorback Suckers have been made by different investigators and different sampling gears. In 2011 and 2012, Francis et al. (2015) conducted intensive surveys on the San Juan River arm of Lake Powell and captured 147 adult Razorback Suckers. Population estimations from samples in 2012 suggested a population size of 527 (239 – 1312) in the reservoir, but due to poor recapture rates and limited sampling of a large geographical area, these estimates are likely biased low and inaccurate. Furthermore, additional sampling in the Colorado River arm of Lake Powell has identified even greater numbers of Razorback Suckers, including many fish that use areas outside of the inflow area, suggesting that the lake may provide suitable habitat for adult Razorback Suckers. Indeed, Cathcart et al. (in prep) used a combination of remote PIT antennas and sampling to document the occurrence of over 499 Razorback Suckers below the San Juan River waterfall near Piute Farms in spring 2015 (hereafter termed Piute Farms Waterfall, Figure 1). The detection of these fish at the waterfall during 4 months in 2015 suggests a much larger number of fish are using this area, especially if 20-40% of Razorback Sucker are untagged (C. N. Cathcart and M. M. McKinstry, unpublished). Preliminary detection data from 2017 (February 11<sup>th</sup>-March 26<sup>th</sup>) show that 503 unique Razorback Suckers have been detected. Fish caught in the 1980s and 1990s were clearly wild fish, however, more recent captures of PIT tagged fish, indicate at least some of the Razorback Suckers in the river-reservoir habitat complex were stocked in the upper San Juan River and have dispersed downstream. However, a relatively large percentage of fish (i.e., 20 – 40%) captured in Lake Powell and in the river below the waterfall were not PIT tagged. Although this might be due to tag loss or fish that were never tagged prior to stocking, there is the potential for natural recruitment in the river-reservoir habitat complex.

Given the uncertainty in the size of the population of Razorback Sucker in the river-reservoir habitat complex, potential for natural recruitment, and the seemingly high abundance of fish



below the Piute Farms Waterfall,

Figure 1. Piute Farms Waterfall, Utah.

the

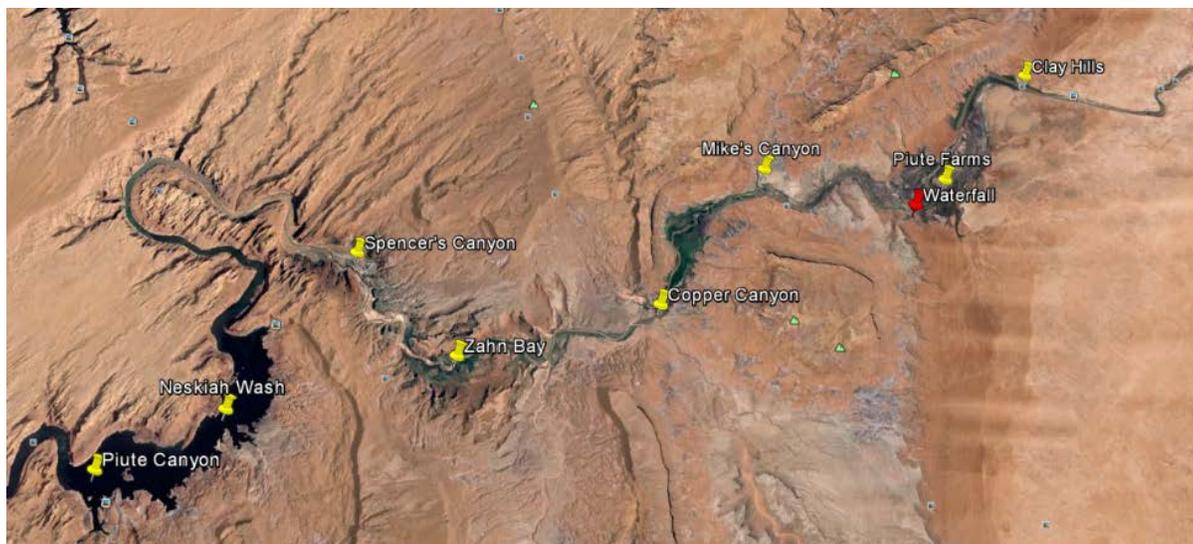
overarching goals of this proposal are centered on hypothesized life history strategies of Razorback Sucker. Specifically, we hypothesize three potential life history strategies of Razorback Sucker in this river-reservoir complex. First, some Razorback Sucker are river-residents that spawn in the San Juan River and offspring remain in the river and recruit to mature adults. Some are reservoir-resident that spawn in Lake Powell and offspring remain in the reservoir and recruit to mature adults. Finally, some are transient that would move between the river and reservoir if not impeded by the waterfall.

## Specific objectives

- 1) Estimate adult population size of Razorback Sucker in the San Juan River – Lake Powell habitat complex.
  - a. This population might include transient and reservoir resident fish.
- 2) Determine the number of Razorback Suckers stocked in the San Juan River that move to Lake Powell and the San Juan River below the waterfall.
  - a. This would provide an estimate of the transient fish that are stocked.
- 3) Identify if spawning and recruitment of Razorback Sucker occurs in the San Juan River – Lake Powell habitat complex.
  - a. This would identify the ability of reservoir resident or transient fish to reproduce and recruit in this habitat complex.
- 4) Characterize movement behaviors of Razorback Sucker within the San Juan River – Lake Powell habitat complex and fish transplanted above the Piute Farms Waterfall.
  - a. By tracking the movement of tagged adults, we can classify them into one of the three different life history strategies.

## Study Area, Access and Personnel Needs

Previous research has focused on the area between Piute Canyon and the Piute Farms Waterfall (Figure 2). A similar study area is proposed here. Because this area is extremely remote, the logistics of access will potentially limit sampling effort. However, recent efforts by USFWS, Utah DWR, BOR, and Kansas State University have provided evidence on the feasibility of working in this area. The Piute Farms Waterfall is accessed by dirt road and can serve as a base camp and/or boat launching site. Additionally, it may be possible to use the Clay Hills access to launch a boat that can be portaged over the waterfall. For sampling in Lake Powell and its confluence with the San Juan River it is possible to launch a boat at Hall's Crossing and motor to the study area (~60 miles to Piute Canyon) or use an inflatable boat (e.g., Zodiac) to access the lake from the waterfall. It is likely that a combination of boat types and access will be necessary. Boats and motors necessary for field work are available through the Bureau of Reclamation,



Salt Lake City office and are not requested here. Additionally, USFWS and Utah DWR are funded to assist in collection

Figure 2. Google Earth image (downloaded 22 March 2016) of study area including key landmarks.

s in the San Juan River arm of Lake Powell, and this effort will be tightly linked to the objectives of the proposed research.

One or two people funded on this project will help assist USFWS and Utah DWR with the lake sampling. A minimum crew of 3 people also will be present for sampling the river portion of the study reach. To ensure the safety of the field crews, they will be outfitted with satellite phones and we will develop contingency plans for exiting the study reach in the case of boat or motor failure. Two people (one graduate student and one research technician) that have extensive experience with boats and river sampling on the San Juan River and elsewhere have been identified for the project (Note, in response to feedback from the SJRBRIP).

## Methods

### *Objective 1: Estimate adult population size of Razorback Sucker in the San Juan River – Lake Powell habitat complex*

Surveys of the San Juan River arm of Lake Powell will be conducted by USFWS and Utah DWR with a combination of boat electrofishing and trammel nets (Francis et al. 2015) who are funded to continue their sampling efforts for Razorback Sucker in the San Juan River arm of Lake Powell. Crews from KSU will assist the USFWS and UDWR. The proposed sampling effort will coordinate sampling to maximize the number of fish marked and recaptured, leading to greater accuracy and precision in population estimates as well as tracking dispersal of marked individuals. To maximize efficiency, locations where large numbers of Razorback Suckers were previously located will be targeted (e.g., Spencer's Camp and Neskehi Wash). In addition, acoustic- and radio-tagged fish (see below) will be used to identify aggregations and spawning locations. Additional sampling at randomly-selected locations throughout the reservoir-inflow area will be used to identify other potential locations within this habitat complex. These random sampling locations will also help evaluate sampling location bias in Mark-Recapture population models (see below).

Surveys of the San Juan River between the Piute Farms Waterfall and the confluence with Lake Powell will be conducted with boat mounted electrofishing, seines, cast netting, trammel nets, and trap nets. We know from recent pilot efforts in 2015 and 2016 that we are able to launch boats below the waterfall and the crew can be picked up in the reservoir with a large boat launched at Bullfrog Marina or Hall's Crossing. We estimate sampling this reach will take 2 days and we would be able to electrofish the entire reach.

Population estimates of Razorback Sucker between the waterfall and Piute Canyon in Lake Powell will be made using multiple mark and recapture models (i.e., multiple recapture events will occur within and across years; White and Burnham 1999). We will work closely with population modelers to identify the appropriate model structures to account for potential bias in our sampling. Anticipated bias might include open population, random distribution of sampling effort, and sex biased capture probabilities. Given the previous success at recapturing large numbers of individuals, it is likely we will be able to obtain robust population estimates.

### *Objective 2: Determine the number of Razorback Suckers stocked in the San Juan River that move to Lake Powell and the San Juan River below the waterfall.*

Through active capture methods (netting and electrofishing) and detections at PIT tag antennas, the number, composition (age, sex, size), and encounter history (stocked, captured and tagged) of both PIT-tagged and non-PIT tagged fish will be determined. To detect PIT tagged individuals, a remote PIT tag antenna (submersible type) was placed (February 2017) and will be maintained in the river-right eddy immediately downstream of the waterfall across seasons to assess seasonal detection patterns. Raft

electrofishing will take place in early spring to capture adults used in telemetry and translocation experiments. We will also work closely with USFWS and UDWR crews sampling in the lake (described in Objective 1) to identify PIT tagged fish stocked upstream of the waterfall.

*Objective 3: Identify if spawning and recruitment of Razorback Sucker occurs in the San Juan River – Lake Powell habitat complex*

To identify if spawning and recruitment of Razorback Sucker occurs downstream of the Piute Farms Waterfall, sampling will be conducted in the riverine area downstream of the waterfall to Lake Powell. Similar to larval fish sampling efforts upstream of the waterfall (Farrington et al. 2015), low-velocity habitats will be opportunistically seined (3 m x 1.5 m x 0.8 mm) as they are available. Larval seines will be used to quantify density (number per unit area) of fishes in these habitats. We will measure the length of each seine haul, as well as the area and maximum depth of each habitat sampled (e.g., backwater). Light traps will also be used to passively capture larvae and identify potential spawning areas. All larval fishes will be preserved in 10% formalin for identification in laboratory conditions. Any identifiable native fishes will be measured for total length (TL, mm) and returned to their place of capture. Larval sampling will be conducted monthly from March to July as flows allow.

Concurrent with larval fish sampling, small-bodied fish sampling will take place at 3-mile intervals (Zeigler and Ruhl 2015) from downstream of the waterfall to upstream of the inflow area of Lake Powell. An additional sampling trip will be made in September or October to match the surveys in the river above the waterfall. Multiple pre-sampling scouting trips indicated that only low-velocity and primary channel, but no secondary channel, habitats occurred between the Piute Farms Waterfall and Lake Powell. Wadeable habitats will be sampled with a combination of seines (3 m x 1.5 m x 0.8 mm; 4.6 m x 1.8 m x 3.2 mm) depending on substrate. Pilot sampling suggests that smaller seines are more efficient when the substrate type is dominated by silt (C. Pennock, personal observation). As above, we will measure the length of each seine haul and record mesohabitats types sampled at each site. Additionally, five depth and substrate measurements will be taken at three representative transects along a site. Fishes will be identified to species, measured to TL and returned to their place of capture. Voucher specimens of juvenile suckers, non-natives, and any unidentifiable fishes will be preserved in 10% formalin for identification in the laboratory. We will classify endangered individuals captured into recruitment classes defined as larvae, age-0 juveniles and age-1+ juveniles.

*Objective 4: Characterize movement behaviors of Razorback Sucker within the San Juan River – Lake Powell habitat complex and fish transplanted above the Piute Farms Waterfall*

In spring 2016, 15 Razorback Suckers captured below the Piute Farms Waterfall were implanted with 4-year acoustic tags and released near the Hogback Diversion. An additional 5 Razorback Suckers were captured near the Hogback Diversion and implanted with acoustic tags and released in the river. Finally, 10 Razorback Suckers were captured below the Piute Farms Waterfall, implanted with acoustic tags, and released ~ 2 miles upstream. Movement of those 30 fish is being tracked passively using SURs placed at the Hogback Diversion, Four Corners, Sand Island (Bluff, UT), Mexican Hat, Piute Farms Waterfall, and the river-lake inflow. In 2017, 61 Razorback Suckers were captured downstream of the Piute Farms Waterfall and implanted with dual acoustic-radio transmitters. Of those implanted, 30 fish (15 females, 15 males; 4 previously unmarked) were released in an eddy ~ 1 mile downstream of the waterfall so as not to continuously expose fish to continued electrofishing efforts at the waterfall, 31 fish (16 females, 15 males; 5 previously unmarked) were translocated ~2 miles upstream and released. An additional 118 (25

previously unmarked) Razorback Suckers that were captured downstream of the waterfall were checked for the presence of a PIT tag, implanted if unmarked, and translocated ~ 2 miles upstream and released.

To characterize movement of tagged Razorback Sucker, similar methods will be used in 2017 – 2019. Additional SURs will be maintained through coordination with USFWS and UDWR at the lower end of the study area (Piute Canyon, Lake Powell) and at least one other location in the reservoir (e.g., Neskahi Wash and the Great Bend area). SURs, PIT antennas, and active tracking of acoustic- and radio-tagged fish will be used to identify locations and movements of fish during various times of the year. Razorback Sucker will be located with a radio receiver followed by a combination of SURs and a directional hydrophone to identify unique tag codes. Active tracking trips will be conducted throughout the spring on a monthly basis as river flows allow. Data from 2017 movements will help inform tracking efforts in 2018-2019. Habitat use of fish in the reservoir and river as well as the number of fish that attempt to move upstream but are impeded by the Piute Farms Waterfall will help identify the percentage of fish that are lake residents, river residents, and fish that use both habitats (i.e., transient).

### **Deliverables**

An annual report will be provided each year of the study using the same timeline as reports required for the SJRBRIP and Reclamation. Likewise, an annual oral report will be given at both the SJRBRIP Annual Meeting in May. At the completion of the project a final report will be delivered to both the SJRBRIP and Reclamation. Scientific publications of the work will be prepared as the work progresses and at the completion of the project.

### **Data management**

All field notes will be scanned and electronic files will be archived on a server at Kansas State University that has daily backups. All data will be entered in database format in spreadsheets and files stored on the KSU server. Every year we will provide PIT data to the SJRBRIP program office.

### **Literature**

Cathcart, C.N., C.A. Cheek, M.C. McKinstry, P.D. MacKinnon and K.B. Gido. In prep. Endangered fish conservation implications of a newly formed waterfall at a river-reservoir interface.

Farrington, M.A., R.K. Dudley, J.L. Kennedy, S.P. Platania, and G.C. White. 2015. Colorado Pikeminnow and Razorback Sucker larval fish survey in the San Juan River during 2014. Final Report. San Juan River Basin Recovery Implementation Program.

Francis, T.A., B.J. Schleicher, D.W. Ryden and B. Gerig. 2015. San Juan River Arm of Lake Powell Razorback Sucker (*Xyrauchen texanus*) Survey: 2012. Interim Progress Report (Draft Final), 10<sup>th</sup> February, 2015

White, G. C., and K. P. Burnham. 1999. [Program MARK](#): survival estimation from populations of marked animals. Bird Study 46 Supplement:120-138.

Zeigler, M.P. and M. Ruhl. 2015. Annual report small-bodied fishes monitoring San Juan River. San Juan River Basin Recovery Implementation Program.

**Budget (FY 2018)**

Period: Year 2 October 1, 2017 to September 30, 2018

<b>Task 1 Razorback Sucker use of the San Juan River below the Piute Farms Waterfall and San Juan Arm of Lake Powell</b>		
<b>Task Description</b>		<b>Total</b>
<b>Task</b>	<b>Item</b>	
<b>Salaries</b>		
Project PI: Advise student and coordinate graduate project	0.5 months	\$ 10,500
Graduate Student	1 year	\$ 28,665
Research Assistant	6 months	\$ 21,000
<b>Fringe benefits</b>		
Project PI	30.00%	\$ 3,150
Graduate Student	6.00%	\$ 1,720
Research Assistant	30.00%	\$ 6,300
<b>Travel</b>		
Field and meeting travel expenses	Per diem	\$ 2,284
	Lodging-Bluff, UT	\$ 1,750
	Vehicle mileage (mile; 2000 miles round trip Manhattan, KS to Bluff, UT and travel to field sites)	\$ 4,000
	Airfare (Manhattan, KS to Durango, CO)	\$ 1,000
<b>Supplies</b>		
Field Sampling Gear	Trammel net (Memphis Net and Twine)	\$ 3,312
	Sonic tags	\$ 0
<b>Tuition (no overhead)</b>		
Graduate Student Tuition and Fees-Spring	KSU Tuition and Fees for Graduate student course work (no overhead)	\$ 8,137
	<b>Total direct costs - Task 1</b>	<b>\$ 91,818</b>
	<b>17.5% MTDC F&amp;A</b>	<b>\$ 14,644</b>
	<b>Total costs - Task 1</b>	<b>\$ 106,462</b>

**Budget Justification**

Personnel – Each year, funds are requested to support one month of the lead PI (Gido) summer salary and a graduate research assistant. For years 1 – 3, funds are requested to support an experienced field assistant for 6 months to assist with field work and laboratory and data analysis when not in the field. Both the graduate research assistant and the field assistant will be skilled in boating and sampling large rivers.

Travel – Funds are requested to support lodging and per diem associated with field work. Airfare is

included for travel to one meeting per year.

Supplies – Includes mileage for travel to field sites from Manhattan, Kansas and other supplies necessary for sampling and telemetry research.

Indirect Costs – This grant would go through the Cooperative Ecosystems Study Unit (CESU) agreement in place with Kansas State University which allows a 17.5% overhead rate.

**SJRIP O&M of Existing PIT Tag Antennas  
2018 Project Proposal**

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**BACKGROUND:**

PIT tags are implanted in various fish species captured through various projects directly supported by the SJRIP, or funded through other agencies and projects (CDP&W, BOR, BLM, NMG&FD, and UDWR). Stationary PIT Tag antennas have been installed at various locations in the San Juan River Basin to passively detect fish as they swim above, through, or underneath the antennas. These antennas require periodic maintenance and support to keep them running and operational. Additionally cell and satellite service is required to access the antennas and download data and perform diagnostics. Locations and numbers of antennas at various sites are listed below:

- 1) PNM Weir and Fish Passage
  - a. Four pass-over antennas, modified with concrete bases are located below the weir
  - b. Two pass through antennas are located in the fish passage.
  - c. All six antennas are served by a single master controller located in a protected shed at the fish passage facility. The master controller is accessed using a Verizon cell data modem.
- 2) Hogback Irrigation Canal and Fish Weir, ~ 20 miles upstream of Shiprock, NM
  - a. Seven pass-through antennas are installed at various locations in the Hogback Fish Weir facility.
  - b. Five antennas are served by a master controller and bank of batteries in a protected shed at the Hogback Irrigation Site that controls the various gates connected to the fish weir. The master controller is accessed using a Verizon cell data modem.
  - c. Two antennas are located approximately 0.5 mi upstream of the fish weir near the canal headgate. These antennas are served by a master controller and bank of batteries (connected to 110 AC power source) located at the antennas. This site is accessed using a Verizon cell data modem.
  - d. Six antennas are located in the bypass and raft launch channel that is south of the canal. These antennas are served by the same Master Controller and power source used to operate the antennas at the head of the headgates.
- 3) TNC Restoration Site ~ 20 miles west of Shiprock
  - a. Four pass-over antennas are installed in a secondary channel created by restoration activities conducted by TNC.
  - b. The four antennas are served by a single master controller and solar-energy supplied battery bank on an island created by the restoration activities. The site is accessed using a satellite data modem.
- 4) McElmo Creek, ~ 25 miles upstream of Bluff, UT
  - a. Five pass-over antennas were installed in McElmo Creek approximately 200m upstream of the confluence with the San Juan River.
  - b. The antennas are served with a multiplexing antenna controller and the controller is accessed using a Verizon cell data modem.
  - c. Four more antennas, along with a master controller and solar panel, were installed at the bridge crossing on McElmo Creek.
- 5) Submersible antennas located near the waterfall on the San Juan River near Gouldings, AZ.
  - a. Submersible antennas are installed at various locations including the waterfall near Gouldings, AZ, and Colorado pikeminnow spawning bar near 4-Corners Bridge, CO, UT, AZ, NM.

- b. Additional submersible antennas and batteries are being purchased in 2016 to augment detections at additional sites.
- 6) Floating PIT tag antenna system
  - a. A floating PIT Tag antenna system has been constructed and used in the San Juan in several locations including below the waterfall in the San Juan River and in the river between Hogback diversion and Bluff, UT. The system will also be deployed in the upstream portions of the San Juan Drainage including the Animas and upper San Juan rivers.

#### **METHODS:**

- 1) Stationary PIT tag antennas will be contacted periodically (bi-weekly) to check the settings, download the data, and perform diagnostics of the systems. Sometimes problems arise (batteries drain down due to lack of sun, antennas are washed away, wires are cut) that cannot be solved remotely. In these cases a site visit must be conducted by a technician to repair the system. The SOW and budget include the replacement of one antenna during the work period. If an antenna is not replaced the funding will be used to purchase additional PIT tags or submersible antennas to be used by other biologists.
- 2) Submersible antennas will be deployed at the waterfall for a continuous period from late February 2018 till August 2018 in an attempt to document fish movements and usage of the river immediately downstream of the waterfall.

#### **TASKS – 2018**

1. Maintain and operate stationary and portable PIT tag antennas
2. Replace one PIT tag antenna (likely at McElmo or TNC Restoration site)

#### **FY 2018 BUDGET**

#### **O&M of Existing Antenna Systems, Replacement of one Antenna, and Data Management**

##### **A) Labor**

Position	Salary total/hr	No. persons	Total Hours	Total cost
BOR Technical Representation for Contracts and Agreements	\$80.00	1	100	\$8,000.00
BioMark or USU Staff (contract)	\$80.00	1-2	200	\$16,000.00
Contract Employee Data Management	\$50.00	1	200	\$10,000.00
<b>Total</b>				<b>\$34,000.00</b>

**B) Travel**

Position	Destination	Purpose	Days	Lodging per day/total	Per diem per day/total	Other*	Total
Reclamation Technical representative	Farmington, Shiprock	Project evaluation or field trips	4 trips @ 5 days/trip	\$100/\$500	\$40/\$800	\$2750	\$3,300.00
BioMark/USU representative	Boise, ID; Kennewick, WA; various	Field trips O&M Antennas	3 trips @ 5 days/trip	\$100/\$1000	\$40/\$600	\$2500	\$2000.00 \$1,500.00 \$655.00
<b>Total</b>				\$1,500.00	\$1,400.00	\$5,250.00	\$11,255.00

\*mileage of 5,000 mi at \$0.55/mile

**C) Equipment**

Item	Unit Cost	Number	Total cost
Antenna system	\$10,000	1	\$10,000
<b>Total</b>			\$10,000.00

**FY-2018 Budget Summary**

Category	Total
Labor	\$34,000.00
Travel	\$5,250.00
Equipment	\$10,000.00
<b>Total FY2018 Budget</b>	<b>\$49,250.00</b>

**Projected funding:**

**FY-2019** \$50,000.00

**FY-2020** \$50,000.00

**Fiscal Year 2018**  
**Draft Scope of Work to Conduct**  
**2017 San Juan River Nonnative Fish Control Program**  
**Data and Results Assessment Workshop**

**Background**

Since implementation of annual intensive nonnative fish removal in 2000, the structure of the fish community in the San Juan River has changed substantially (Franssen et al. 2014a). On an annual basis, Colorado Pikeminnow and Razorback Sucker densities (i.e., CPUE) have increased over time, nonnative Common Carp densities have decreased, and Channel Catfish densities have decreased but only in upper reaches of the river (Franssen et al. 2014a, Franssen et al. 2014b). However, the relative contribution of nonnative fish removal via electrofishing, other management actions and environmental factors in driving these changes is unclear. For example, establishing a causal linkage between nonnative fish removal or other management actions (e.g., flow manipulation, habitat restoration) and changes in endangered fish densities is difficult due to the heavily augmented nature of these populations. Conversely, temporal variation (or the lack of) in the densities of nonnative fishes following removal efforts are potentially more directly related, but this variation is also not exempt from other environmental factors (e.g., flow variation and reduced immigration). Given the spatial and temporal inconsistencies of the previous nonnative fish removal program as well as the multiple biotic and abiotic factors contributing to temporal variation in densities of fishes, it is not surprising effects of this management action have been difficult to elucidate.

Based on annual population estimates of Channel Catfish (Duran 2015 and Hines 2015), it is readily apparent the level of nonnative fish removal effort previously put forth will likely not suppress recruitment enough to induce system-wide population decline of this species. Nonetheless, removing individual Channel Catfish from the river by definition lowers their densities, which has the potential to directly impact endangered fishes through reduced competition or predation as well as indirectly through deleterious effects of electrofishing on native fishes. Yet, these potential direct (or indirect) effects of the San Juan River's nonnative fish removal program has been difficult to assess due to the complications mentioned above. Therefore, the nonnative fish removal efforts was redesigned to evaluate by what factor and for how long Channel Catfish densities were lowered and the responses of native fish densities to electrofishing and nonnative fish removal. Continued implementation and evaluation of a more structured nonnative fish removal design should provide the San Juan River Basin Recovery and Implementation Program with a clearer scientific evaluation of the effects of the nonnative removal program on native and nonnative fishes in the San Juan River.

**Relevant Long Range Plan Tasks**

Task 3.1.1.5 Organize and conduct workshops, as necessary, to develop a comprehensive non-native species management plan, including measurable river wide objective to determine effects of removal effort on native and nonnative fishes.

**Study Area**

The experimental design will be conducted in geomorphic reaches 5, 4, 3, and 2, from Shiprock Bridge, NM (RM 147.9) to Mexican Hat, UT (RM 52).

**Objectives**

1. Spatially demarcate removal and control reaches on the San Juan River in order to statistically evaluate responses of fishes to nonnative fish removal via electrofishing.

2. Assess Channel Catfish CPUE and size distributions within removal reaches over time using nonnative fish removal data.
3. Compare Channel Catfish, Razorback Sucker, and Colorado Pikeminnow CPUE between control and treatment reaches using sub-adult and adult fish community monitoring, and nonnative fish removal data.
4. Compare Channel Catfish, Razorback Sucker, and Colorado Pikeminnow population estimates (pre and post removal).
5. Compare Channel Catfish size distributions between control and removal reaches using sub-adult and adult fish community monitoring, and nonnative fish removal data.
6. Quantify movement of tagged Channel Catfish among treatment and control reaches over the summer.
7. BC recommendations to the CC for alterations to the nonnative removal program.

### **Methods**

The PIs and Program Office will collect and analyze the data to answer the specific objectives described above.

### **Products**

Prior to the workshop the results of analyses will be summarized and distributed to workshop participants. Workshop discussion and deliberations will be summarized and distributed to SJRIP participants.

### **Estimated FY-18 Budget**

There will be no specific cost associated with conducting a nonnative fish workshop in December 2017. Any data analyses for the workshop will be carried out under the Program Office and nonnative fish removal SOWs.

### **Literature Cited**

- Duran, B.R. 2015. Endangered fish monitoring and nonnative species monitoring and control in the upper/middle San Juan River: 2014. Final report to the San Juan River Basin Recovery Implementation Program. Albuquerque, New Mexico.
- Franssen, N.R., S.L. Durst, K.B. Gido, D.W. Ryden, V. Lamarra, and D.L. Propst. 2014a. Long-term dynamics of large-bodied fishes assessed from spatially intensive monitoring of a managed desert river. *River Research and Applications* doi: 10.1002/rra.2855
- Franssen, N.R., J.E. Davis, D. Ryden and K.B. Gido. 2014b. Fish community responses to mechanical removal of nonnative fishes in a large southwestern river. *Fisheries* 39:352–363.
- Hines, B. 2015. Endangered fish monitoring and nonnative fish control in the lower San Juan River 2014. Final report to the San Juan River Basin Recovery Implementation Program. Albuquerque, New Mexico.

## **FY 2018 Reclamation Program Management**

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**Relationship to SJRIP:** Supports Program goals and management by supporting approved activities

**Study Goals, Objectives, and End Product:** Program Management funds support Reclamation staff involved in program management. Funds are used for the administration of funding agreements, including issuing requisitions for program supplies, and the preparation and oversight of work conducted under interagency agreements, cooperative agreements, contracts, and grants. The funds are also used for formation and participation of the technical and peer-review committees, implementation of committee assignments not specifically identified in a scope of work, reporting, and coordination of water operations. Management support for Capital fund projects, including technical oversight, budgeting, preparation of bids and funding agreements is covered in a separate scope of work. Participation in Hydrology and Biology Committee meetings and business is paid for separately by Reclamation with funds unrelated to the SJRIP.

### **Task Description and Schedule**

**Task 1: Manage and administer funding for Recovery Program projects related to the Biology Committee activities.** Funding Recovery Program projects requires establishment or modification of approximately 20—30 Reclamation funding agreements or contracts each year. Each financial agreement requires multiple steps and activities, including: submission of requests for Federal assistance for Recovery Program-approved projects; working with Recovery Program's office on funding issues; reviewing and approving (if warranted) project budgets; writing SOWs for RFPs, requesting obligations to cover funding agreement or contract awards; awarding agreements or contract funding to recipients; maintaining agreement and contract filing system including agreement instruments, invoices, and accruals; reviewing and tracking budgets; participating in audits; reviewing and approving invoices; performing periodic site visits to monitor project performance and progress; filing advanced procurement reports; organizing and participating on TPECs; drafting requests for proposals (RFPs); evaluating proposals and awarding contracts; performing agreement closeouts; answering agreement inquiries from auditors, assistance recipients, and the Recovery Program; recording project performance and status of deliverables; and filing recipient performance reports.

**Deliverables/Due Dates:** Requests from the Recovery Program for funding are processed as they are received. Other deadlines for committee activities are set by the Recovery Program participants during the development of the annual workplan.

**Budget Summary  
FY-2018**

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Total labor	\$212,000.00
Total travel	\$11,255.00\$11,255.00
<b>Grand total</b>	<b>\$223,255.00<sup>1</sup></b>

<sup>1</sup> This total budget represents a 0% increase over the FY2017 Budget.

**Budget FY18**

**Task 1: Biology Committee Annual Funding Administration**

**A) Labor**

Position	Salary total/hr	No. persons	Total Hours	Total cost
Reclamation Contract Manager	\$120.00	1	20	\$2,400.00
Biology Committee Technical Representation for Contracts and Agreements*	\$90.00	1	700	\$63,000.00
Lead Contract Officer	\$120.00	1	80	\$9,600.00
Contract Specialist	\$70.00	1	1000	\$70,000.00
Contract and agreement Auditor	\$120.00	1	100	\$12,000.00
Agreement specialist	\$55.00	2	1000	\$55,000.00
<b>Total</b>				<b>\$212,000.00</b>

\* Funding for Reclamation to participate in the Biology Committee is funded by Reclamation and not the SJRIP.

**B) Travel**

Position	Destination	Purpose	Days	Lodging per day/total	Per diem per day/total	Other*	Airfare total	Total
Reclamation Technical representative	Farmington, Durango, or Albuquerque	Contract support for CC meetings, program funding meetings	3 trips @ 2 days/trip	\$100/\$600	\$50/\$300	\$400	\$2,500	\$3,800.00
Reclamation Technical representative	Farmington	Project evaluation or field trips	2 trips @ 6 days/trip	\$100/600	\$50/\$300	\$400	\$2,000	\$3,300.00
Reclamation Technical representative	Boise, ID; Kennewick, WA; various	Contract administration with suppliers	2 trips @ 3 days/trip	\$100/\$300	\$50/\$300	\$400	\$1,000	\$2000.00
Lead agreement officer	Farmington, Durango	CC/BC mtg., or contract admin	1 trips @ 2 days	\$100/\$200	\$50/\$200	\$100	\$2,000	\$1,500.00
Lead contract officer	Various locations	Contract Admin	1 trip @ 2 days	\$125	\$65/\$130	\$100	\$300	\$655.00
<b>Total</b>								<b>\$11,255.00</b>

\*Taxi \$20; Parking \$10; Rental car \$100/trip

**Peer Review for 2018  
Fiscal Year 2018 Project Proposal**

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**Background:**

A Peer Review Panel was established in 1997 to assist the SJRIP with planning studies, analytical designs, data interpretation, and aiding the Program's use of science towards recovery. The members of the Panel have participated in meetings and reviewed draft and final scopes of work (SOW), work plans, draft reports, integration analyses, and other Program documents. However, the responsibilities of individual peer reviewers were generally unclear, leading to some unsatisfied individuals in the Program as well as peer reviewers themselves. This SOW aims to improve the Program's peer review process by clearly outlining the responsibilities of the Peer Review Panel to maximize the benefits to the Program while decreasing the ambiguity in expectations of Panel members.

**Goals:**

The main goal of peer review in the SJRIP is to use the professional expertise of Panel members to improve the Program's scientific operations, particularly on technical and biological issues. Indeed, peer reviewers are invited to join the Program based on their reputations in their respective fields of study. Therefore, this SOW was developed to capitalize on the use of peer review to aid in guiding and evaluating management decisions made by the Program.

This Peer Review SOW requires independent reviews for annual SOWs and reports, but allows for consolidated reviews on the Annual Program Review (see below) or other documents as directed by the Program Office (PO). A diversity of opinions and even disagreement among peer reviewers is anticipated, and individual review efforts will increase the transparency of contributions of peer reviewers to the PO. Conversely, consolidated reviews on particular documents will have the potential to be enhanced from brainstorming among Panel members. The type of review solicited (individual or consolidated) for each document will be explicitly stated when the PO requests reviews. However, all Panel members will always have the option to provide their reviews independently if desired. All correspondence between the PO and Panel members, but not correspondence among Panel members, will occur through one point of contact within and designated by the PO.

The peer reviewers will contribute to four major components of the Program detailed below. We have noted expectations and responsibilities for each:

**1) Review annual SOWs and reports**

Both annual SOWs and draft annual reports will be independently reviewed by the Peer Review Panel members. Annual SOWs and draft annual reports by Program PIs are due to the PO by 1 March and 31 March, respectively, of each year. After the PO receives these documents, a portion of the documents will be assigned to each peer reviewer by the PO such that the assigned topic aligns with each reviewer's expertise (as much as possible), and all reviewed documents will receive at least two reviews by peer reviewers. For the SOWs, the peer reviewers will assess if there are clearly identified hypotheses to be tested and if there is sufficient information regarding methods of data analysis. Reviews of draft annual reports will focus on experimental design, data analysis, interpretation of results, and relevance of the project in achieving or assessing progress toward recovery. However, an ongoing problem in evaluating

the science of some of the draft reports has been the lack of clarity in the writing and the need for major editing. Therefore, all reports should receive at least one review within the agency or organization of the primary PI prior to being submitted to the PO. Completed reviews of SOWs and draft annual reports will then be returned to the point of contact within the PO via email by 30 April of each year. Reviewer comments will then be compiled by the PO and disseminated to the BC, PIs, and peer reviewers verbatim. In the compilation, reviewers will be identified by name. The PIs will be required to respond to all comments on their SOW and draft report. Responses, including rebuttals, to comments on SOWs will be appended to revised SOWs prior to the SOW being considered in the annual work plan. Responses, including rebuttals, to comments on draft reports will be appended to final reports prior to being accepted by the Program. All reviews and responses to reviewers' comments will be distributed to the entire Program.

Biology Committee members should review all draft SOWs and draft annual reports as part of their commitment to the Program. Issues with editorial comments and interpretation of data can be provided during this review. In the past, it appeared that some in the BC relied on the peer reviewers' review of annual reports rather than conducting their own assessment of annual reports.

## **2) Attend and review presentations during the February meeting**

Each peer reviewer will attend the February BC meeting and have the opportunity to make oral comments and suggestions during the meeting. The February BC meeting consists largely of presentations of the previous year's activities conducted by the PIs. This is an opportunity for the whole group to catch up on the progress on individual projects in a relatively short period. Moreover, these presentations should reflect comments supplied by peer reviewers on the original SOWs. Peer reviewer comments should focus on hypotheses tested, data analysis, clarity of presentation, and interpretation, but other general comments will be welcomed. The comments could also provide constructive suggestions that should be considered for incorporation into the draft annual reports. For the Peer Review Panel to provide in-depth comments on the ongoing research and monitoring efforts both listening to the presentations and seeing the draft annual reports are required, with the latter having sufficient detail to allow a clear understanding of the analyses and interpretations of the data.

## **3) Meeting with BOR, PO, and Annual Program Review**

An additional meeting (half day) will occur at the end of the February BC meeting among the PO, BOR staff, and peer reviewers to discuss 'big picture' issues in the Program, especially progress toward recovery, but other concerns with individual projects or the peer review process will be open for discussion. After this meeting, the Panel members will draft an Annual Program Review of their consolidated assessment of the Program's progress towards recovery, suggestions for improvement, and other critiques of the Program and send them to the PO by 31 March. This Annual Program Review by Panel members will then be distributed to the entire Program (i.e., PO, BC, and CC).

## **4) Attend workshops and review special documents (upon invitation)**

Workshops are occasionally held to address specific issues that arise during Program operations. These meetings usually occur over 2-3 day periods in Albuquerque, Farmington, or Durango. Some or all peer reviewers may be invited to attend workshops to provide professional and technical guidance. If a peer reviewer is invited, the reviewer will be required to provide a review of the workshop and a general opinion on discussions within one month after the workshop completion. Because of the challenge of assessing information "on the fly" during an oral presentation and the complexity of analyses in some reports, a consolidated response from peer reviewers will be accepted. Additional guidance and details regarding reporting will be provided by the PO for any workshops or special documents the PO asks to be reviewed depending on the nature of the workshop or document.

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Dr. Wayne A. Hubert  
 Professor Emeritus, University of Wyoming  
 Retired USGS Cooperative Fish & Wildlife  
 Research Unit  
 Hubert Fisheries Consulting, LLC  
 1063 Colina Drive, Laramie, WY 82072  
 307-760-8723  
 Email: [Hubertfisheries@gmail.com](mailto:Hubertfisheries@gmail.com)

**Budget FY-18:**

Payment for serving on the Peer Review Panel includes expenses for travel to and from the meeting, and an hourly rate for services. It is anticipated that Panel Members will spend approximately 15-20 days each in 2018 (includes travel, meetings, and document review).

The total budget is distributed among the five peer reviewers through individual Services Contracts with Reclamation.

Salaries:	\$50,000
Travel:	\$10,000
<b>Total</b>	<b>\$60,000</b>

**San Juan River Recovery Implementation Program  
Program Coordinator's Office  
Fiscal Year 2018 Draft Proposal**

U.S. Fish and Wildlife Service  
2105 Osuna NE Albuquerque, New Mexico 87113  
[sharon\\_whitmore@fws.gov](mailto:sharon_whitmore@fws.gov) (505) 761-4753  
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[eliza\\_gilbert@fws.gov](mailto:eliza_gilbert@fws.gov) (505-761-4746)

**Cooperative Agreement #:** R10PG40064 (08-AA-40-2713) and R10PG40086 (07-AA-40-2629)  
**Period of Performance:** 10/01/2017 to 9/30/2018

### **Background**

The San Juan River Recovery Implementation Program (Program) is designed to simultaneously address endangered fish species recovery and development of water resources within the Basin. The Program includes representatives from not only Federal agencies, but also the States of Colorado and New Mexico, the Jicarilla Apache Nation, the Southern Ute Indian Tribe, the Ute Mountain Ute Tribe, the Navajo Nation, conservation interests, and water development interests, most of which have legally mandated responsibilities to the endangered fish and/or the water resources.

Region 2 of the U.S. Fish and Wildlife Service (Service) is responsible for directing and coordinating the Program. As stated in the Program Document, the Service will appoint a Program Coordinator who will be responsible for overall Program coordination and dissemination of information about Program activities. Element 5, *Program Coordination and Assessment of Progress toward Recovery*, of the Program's Long Range Plan (LRP) identifies Program coordination goals, actions, and tasks that the Program Office will undertake to administer the Program. Numerous additional Program Office tasks are included in the LRP under other Recovery Elements. The Service's Program Office is located in the New Mexico Ecological Services Office (NMESFO) in Albuquerque, NM. Program staff includes a Program Coordinator, Assistant Program Coordinator, Science Coordinator, Program Biologist, and a part-time Program Assistant.<sup>1</sup>

### **Program Coordination**

The Service is responsible for coordinating the Program. To accomplish this responsibility, the Service will appoint a Program Coordinator for the Program. The Program Coordinator is responsible for overall Program coordination and the dissemination of information about Program activities. Specific Service responsibilities for Program coordination are described in the May 17, 2012 Program Document. An overview of these responsibilities includes:

- Coordinating all activities of the Program, its Coordination Committee and technical committees.
- Developing annual work plans consistent with Service-approved Recovery Plans and the Program's Long Range Plan.
- Conducting section 7 consultations and ensuring recovery actions identified in biological opinions are implemented to benefit Colorado Pikeminnow and Razorback Sucker.
- Maintaining the Program's data, providing technical assistance as requested and conducting analyses to inform science-based decision-making within the Program.
- Coordination with Upper Colorado River Endangered Fish Recovery Program on range-wide recovery issues.

It is recognized in the Program Document that some of these responsibilities will be carried out with the assistance from Program committees as more specifically defined in the Program Document sections entitled, "Biology

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<sup>1</sup> The Program Office includes an additional Program Biologist who is funded through the Four Corners Power Plant and Navajo Mine Energy Project Mitigation Account ([nathan\\_franssen@fws.gov](mailto:nathan_franssen@fws.gov); 505-761-4722).

Committee,” “Long Range Plan Development and Annual Revision Process,” and “Annual Work Plan Development Process” of the Program Document.

### **Education and Outreach**

Element 6 of the Program’s LRP identifies the goals, actions, and tasks the Program Office will undertake to accomplish Program Education and Outreach. The Program works jointly with the Upper Colorado River Recovery Program to conduct outreach activities for both Recovery Programs. Both programs operate under similar recovery elements with management actions that are consistent with the recovery goals for humpback chub, bonytail, Colorado pikeminnow, and razorback sucker. Because the Program Office does not have dedicated Information and Education staff, the Upper Colorado River Recovery Program’s full-time, dedicated Information and Education Coordinator will be used to assist with certain education and outreach activities. An estimate of funds and activities to be provided to the Upper Colorado River Recovery Program in 2018 includes:

\$ 5,820 Congressional Briefing Document (Program Highlights) printing  
 \$ 2,227 Newsletter (Swimming Upstream) printing  
 \$ 4,150 Exhibit fees  
 \$ 2,500 Exhibit repairs/replacement  
 \$ 2,400 Educational materials  
 \$17,100 Total

The Recovery Programs’ continued success depends on coordinated efforts. Communication and outreach are areas where it makes sense to coordinate efforts. Using a shared approach helps to ensure that common audiences receive accurate, consistent information about the endangered fish species and efforts to recover them. Both programs reach out to the general public, elected officials, American Indian tribes, landowners, anglers, river rafter and guides, environmental organizations, water and power developers, teachers, students and Recovery Program participants. The geographic reach of some of these audiences differ by Recovery Program. The full Upper Colorado River Recovery Program’s 2018 Public Involvement SOW is SOW 18-38 in this AWP.

### **Education and Outreach Mission**

To support the San Juan Program’s success in recovering the endangered fishes by assuring that the public understands what is being done and why, and has confidence that the process is honest, open, sensitive, clear, and understandable. Education and Outreach efforts will be coordinated with the Upper Colorado River Recovery Program.

### **Goals**

- To develop public involvement strategies at the beginning of any and all projects.
- To educate target audiences about endangered fish and to increase their understanding of, and support for, the recovery of these fish species at local, state, and national levels.
- To provide opportunities for the public to actively participate in activities that support recovery.
- To improve communication within the Recovery Program.
- To maintain an effective Program website

### **Target Audiences**

- General public
- Elected Officials
- Land and pond owners
- Anglers
- River rafters and guides
- Environmental organizations
- Water users
- Power user interests
- Educators
- Recovery program participants (includes local, state and federal agencies)

<b>Fiscal Year 2018 Program Management Budget</b>	<b>USFWS Funding</b>	<b>Program Base Funding</b>
<b>Personnel/Labor Costs (Federal Salary + Benefits):</b>		
Program Coordinator (GS-13) 1480/520 hours@ \$71.99/hr	\$106,545	\$37,435
Asst. Program Coordinator (GS-12) 1040/1040 hours@ \$52.59/hr	\$54,694	\$54,694
Recovery Science Biologist (GS-12) 520/1560 @ \$50.22/hr	\$26,114	\$78,343
Program Biologist (GS-9/11) 2080 hours @ 38.76/hr	\$0	\$80,621
Program Assistant (GS-7) 416/416 hours @ 31.42/hr	\$13,071	\$13,071
<b>Personnel Sub-total</b>	<b>\$200,424</b>	<b>\$264,164</b>
<b>Travel/Lodging &amp; Per Diem (based on published FY-2017 Federal Per Diem Rates):</b>		
30 days in Farmington, NM (\$91/night lodging; \$51/day MI&E; ave 3 staff)		\$4,184
36 days in Durango, CO (\$120/night lodging; \$64/day MI&E; ave 3 staff)		\$6,528
10 days in Denver, CO (\$178/night lodging; \$69/day MI&E; ave 2 staff)		\$2,881
3 days in St. George, UT (\$91/night lodging; \$51/day MI&E; ave 1 staff)		\$521
8 days in Las Vegas, NV (102/night lodging; \$64/day MI&E; ave 2 staff)		\$1,624
30 days camping (\$29/day MI&E adjusted for full MI&E on travel days; ave 2 staff)		\$870
Airfare to Denver, CO - \$250 trip/6 tickets		\$1,500
Airfare to Las Vegas, NV - \$300 trip/2 tickets		\$600
Airfare to St. George, UT - \$800/1 tickets		\$800
Rental Car @ \$60/day*8 days		\$480
<b>Travel/Lodging &amp; Pier Diem Subtotal</b>	<b>\$0</b>	<b>\$19,988</b>
<b>Materials, Supplies, and Services:</b>		
Vehicle Fuel - Mileage to Farmington - 20 rd. trips@254 mi/trip; 18 mpg; \$3.00/gal		\$846
Vehicle Fuel - Mileage to Durango - 10 rd trips@418 mi/trip, 18 mpg; \$3.00/gal		\$837
Vehicle Fuel - Misc trips in the SJR Basin - 10 rd trips@500 mi/trip; 18 mpg; \$3.00/gal		\$500
Office Telephone support (1/4 of total office costs)		\$4,000
Public Notices in Local Newspapers; \$40-150/meeting@ 22 meeting days (average \$95)		\$2,090
Office Printing/Copier Support (1/4 of total office costs)		\$1,420
Printer Ink (1/4 of total office costs)		\$329
Registration Fee – UT Water Users Workshop, St. George, UT		\$300
Registration Fee CRWUA, Las Vegas \$250 *2		\$500
Publication in Scientific Journals		\$1,000
Outreach Materials for Educational Purposes		\$1,500
Sigma Plot Modeling Software License Fee (\$900/5 years)		\$120
FAMS - Fisheries Analysis & Modeling Simulator \$300/5 years)		\$60
JMP Statistical Software from SAS (total \$1,700/5 years)		\$340
Facilities Rental Costs for Meetings: Farmington@ \$100/10 days		\$1,000
Facilities Rental Costs for Meetings: Durango @\$300/15 days		\$4,500
<b>Materials, Supplies, and Services Sub-Total</b>	<b>\$0</b>	<b>\$19,342</b>

<b>Equipment:</b>		
Field Equipment (waders, cots, rain gear, dry bags, tent, seines, etc.)		\$2,225
Blue Star Light Plus VG3 Glasses - Calcein mark reader		\$430
SPOT GPS Monitor		\$192
Computer Monitors		\$400
Portable Hard Drives		\$200
Misc Computer Equipment (mouse, keyboard, wrist support, video cam, etc.)		\$400
<b>Equipment Sub-Total</b>	<b>\$0</b>	<b>\$3,847</b>
<b>2018 Budget Subtotal</b>	<b>\$200,424</b>	<b>\$307,341</b>
<b>Administrative charge (3%)</b>		<b>\$9,220</b>
<b>FY2018 Total</b>	<b>\$200,424</b>	<b>\$316,561</b>

## Remote Biologist for San Juan River Basin Recovery Implementation Program

Principal Investigators:  
 Jason E. Davis and Thomas B. Sinclair, Jr.  
 U.S. Fish and Wildlife Service  
 New Mexico Fish and Wildlife Conservation Office  
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 Albuquerque, NM 87105  
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### Background

The San Juan River Basin Recovery Implementation Program's (SJRIP) mission is to recover the Colorado Pikeminnow and Razorback Sucker while allowing water development and management activities to continue in the San Juan River Basin. In pursuit of this mission, the SJRIP funds projects under six major program elements. These elements include: management and augmentation of populations and protection of genetic integrity; protection, management, and augmentation of habitat; management of nonnative aquatic species; monitoring and evaluation of fish and habitat in support of recovery actions; program coordination and assessment of progress toward recovery; and, information and outreach. Principal investigators representing various federal and state agencies, tribal governments, and non-governmental organizations are contracted to perform tasks associated with the SJRIP's mission. Most of these entities reside outside of the basin and, as a consequence, extensive travel costs are incurred to complete this work.

Beginning in 2008, the U.S. Fish and Wildlife Service's (USFWS) New Mexico Fish and Wildlife Conservation Office (NMFWCO) was able to fill a position that was stationed in the Farmington/Shiprock, New Mexico Area. This position focused primarily on endangered fish monitoring, nonnative fish control, and rare fish augmentation. Additionally, assistance was provided to the Navajo Nation Department of Fish and Wildlife (NNDFW) with daily operations at a selective fish passage near Fruitland, New Mexico and with daily operation/maintenance at the Navajo Agricultural Products Industry (NAPI) Razorback Sucker grow-out ponds. Since this position was located in the Four Corners Area, the incumbent was extremely knowledgeable of various access points on both the San Juan and Animas Rivers, he was available to provide reconnaissance prior to the initiation of sampling trips, and he assisted with other research projects including the shuttling of support vehicles and equipment. In addition, his location allowed for quick response times to all program participants in cases of emergency (i.e., equipment issues/loss, injury, Gold King mine spill, etc.). In January 2016 the individual filling this position retired from federal service and that position has remained vacant ever since.

As the SJRIP moves forward with on-the-ground projects, having a highly-qualified individual that is knowledgeable of the issues and surrounding area would greatly benefit the SJRIP. This individual could participate on the following projects and activities:

- Nonnative fish removal
- Rare fish augmentation
- Daily operation of selective fish passage
- NAPI pond management and maintenance
- Maintenance of remote passive integrated transponder (PIT) tag antennas including data input
- Assistance on other program projects including: larval, small and large-bodied fish community monitoring, habitat restoration projects
- Assist researchers with shuttling of vehicles and equipment
- Operation of future larval entrainment wetland/impoundment
- Other activities yet to be identified

To that end, we propose that the SJRIP Coordination Committee consider approving funding for a USFWS employee to be locally stationed in the Four Corners Area to assist with the entire suite of SJRIP-related projects. If approved, the NMFWCO would recruit an individual with experience in the fields of endangered fish management, fish culture, specialized sampling techniques (i.e., raft-mounted electrofishing, seining, hoop-netting, river rafting, etc.), PIT tag antenna maintenance, and water control structure/impoundment management. Knowledge of the surrounding area and river system will be afforded additional consideration.

### **Schedule:**

#### Annually

Nonnative fish removal	March-September
Rare fish augmentation	September-October
Fish Passage	March-October
NAPI ponds	March-December
Remote PIT tag antennas	year-round
Other Program activities	year-round
Larval entrainment wetland	seasonally
SJRIP Meetings	February, May, November, one workshop annually

During the May 2017 Coordination Committee Meeting we were asked to modify the scope of work to include potential budget changes resulting from approval of a remote biologist position and a more detailed list of potential position responsibilities. Represented below are those responsibilities and their associated budget adjustments for those projects led by or involving the NMFWCO. This list does not include participation on other yet to be determined projects that are led by other entities:

#### Endangered Fish Monitoring and Nonnative Fish Control

704 hours = (\$17,600) Savings

- The incumbent would be expected to participate on all field activities associated with this project including two tagging trips and nine nonnative fish removal trips. Each of these trips consists of five days in the field and three days for trip preparation and gear cleanup (8 days/trip x 8 hours/day x 11 trips = 704 hours). As needed, the incumbent would be responsible for routine maintenance and upkeep of sampling gear and would be asked to provide shuttling services when available.

#### Augmentation

120 hours = (\$3,000) savings

- The incumbent would be responsible for assisting the lead biologist with annual augmentation activities associated with Razorback Sucker and Colorado Pikeminnow. This task includes assisting in the placement and removal of block nets used for soft releases and assisting hatchery personnel with the tempering and release of all fish. Since this position will be located in the Farmington area, the incumbent would be tasked with identifying and assessing potential stocking locations to expand range and reduce potential for catastrophic loss of an entire year class at a single stocking location.

#### NAPI Ponds

.25 FTE = \$13,000 increase

- The NMFWCO's currently-approved budget associated with the NAPI Razorback Sucker grow-out ponds focuses primarily on the provision of assistance during active harvest and with periodic assistance during the grow-out season as requested by the NNDFW. If approved, the incumbent would be expected to provide

daily assistance to NNDFW including assisting in the collection of daily water quality data, fish feeding, monthly inventories, active and passive harvest and problem resolution. The incumbent would also be able to provide assistance, as needed, with the operation of the selective fish passage near Fruitland, New Mexico.

Operation of Larval Fish Entrainment Wetland/Impoundment

- Once constructed, the incumbent would be responsible for operating the water control structures associated with this wetland/impoundment to maximize native larval fish entrainment. Other duties would include assistance with monitoring of larval fish within the impoundment, aquatic vegetation control, and light maintenance of all water control structures and levees. Associated costs would be shared with the NAPI Ponds project.

*Sub-adult and Adult Fish Community Monitoring*

153 hours = (\$3,825)

- The incumbent would assist the USFWS' Grand Junction Fish and Wildlife Conservation Office (GJFWCO) with annual monitoring of sub-adult and adult fishes in the San Juan River from Bloomfield, New Mexico downstream to Mexican Hat, Utah (RM 196.0-53.0). This would consist of 17 days of work (17 days @ 9 hours/day – 153 hours).

**Budget at full funding level:**

<b>FY 18</b>	<b>\$63,818</b>
<b>FY 19</b>	<b>\$75,641</b>
<b>FY20</b>	<b>\$77,754</b>
<b>FY21</b>	<b>\$79,868</b>

Budget if FY18 is the first year of funding for a GS-482-7/9 position

<b>U.S. Fish and Wildlife Service - New Mexico Fish and Wildlife Conservation Office</b>							
<b>FY 2018</b>							
<b>SJRIP - Remote Biologist</b>							
<b>Labor Cost</b>							
<u>Position</u>	<u>Grade/Step</u>	<u>1/2 Year Salary</u>	<u>Fringe</u>	<u>Salary w/ Benefits</u>	<u>Hours/Day</u>	<u>No. of Days</u>	<u>Sub-total</u>
Fish Biologist (1/2 FTE)	GS 7/1	\$40,790.00	27.06%	\$51,827.77			\$51,827.77
Administrative Officer	GS 9/8	\$29.49	26.12%	\$37.19	9	5	\$1,673.68
					Total Labor		\$53,501.45
<b>Travel and Per Diem</b>							
<u>Travel and Per Diem</u>	<u>Days</u>	<u>Rate</u>					<u>Sub-total</u>
Hotel Costs (four two-day meetings; Durango, CO)	8	\$102.00					\$816.00
Per Diem (Travel Day)	4	\$48.00					\$192.00
Per Diem (Full Day)	4	\$64.00					\$256.00
Per Diem (Camping Rate)	6	\$29.00					\$174.00
					Total Travel/Per Diem		\$1,438.00
<b>Equipment</b>							
<u>Equipment</u>	<u>Miles/Qty</u>	<u>Total Miles</u>	<u>Rate</u>				<u>Sub-total</u>
Vehicle Fuel							
1 truck used throughout year	50	13,000	\$0.54				\$7,020.00
est. 50 miles/day 5 days/week							
52 weeks/year					Equipment		\$7,020
		Sub-total for Program Biologist - NMFWCO only					\$61,959.45
		Administrative Overhead (3%)					\$1,858.78
		Subtotal for Remote Biologist					\$63,818.23
		Savings from other NMFWCO-funded projects					(\$37,425.00)
		Total additional funding needed					\$26,393.23

Budget if FY18 is the second year of funding a GS-482-7/9 position with the associated step increase to a GS 9-1

<b>FY 2018</b>							
<b>SJRIP - Remote Biologist</b>							
<b>Labor Cost</b>							
<u>Position</u>	<u>Grade/Step</u>	<u>Yearly Rate</u>	<u>Fringe</u>	<u>Salary w/ Benefits</u>	<u>Hours/Day</u>	<u>No. of Days</u>	<u>Sub-total</u>
Fish Biologist (1 FTE)	GS 9/1	\$49,894.00	27.06%	\$63,395.32			\$63,395.32
Administrative Officer	GS 9/8	\$30.23	26.12%	\$38.13	9	5	\$1,715.67
					Total Labor		\$65,110.99
<b>Travel and Per Diem</b>							
<u>Travel and Per Diem</u>	<u>Days</u>	<u>Rate</u>					<u>Sub-total</u>
Hotel Costs (four two-day meetings)	8	\$102.00					\$816.00
Per Diem (Travel Day)	4	\$48.00					\$192.00
Per Diem (Full Day)	4	\$64.00					\$256.00
Per Diem (Camping Rate)	6	\$29.00					\$174.00
					Total Travel/Per Diem		\$1,438.00
<b>Equipment</b>							
<u>Equipment</u>	<u>Miles/Qty</u>	<u>Total Miles</u>	<u>Rate</u>				<u>Sub-total</u>
Vehicle Fuel							
1 truck used throughout year	50	13,000	\$0.54				\$7,020.00
est. 50 miles/day 5 days/week							
52 weeks/year					Equipment		\$7,020
		Sub-total for Remote Biologist - NMFWCO only					\$73,568.99
		Administrative Overhead (3%)					\$2,207.07
		Subtotal for Remote Biologist					\$75,776.06
		Savings from other NMFWCO-funded projects					(\$37,425.00)
		Total additional funding needed					\$38,351.06

**COLORADO RIVER RECOVERY PROGRAM**  
**FY 2018-2019 PROPOSED SCOPE OF WORK for:**

**Project No.: PIP 12**

Public Involvement – Upper Colorado River Endangered Fish Recovery Programs

Reclamation Agreement number: R13PG400019

Reclamation Agreement term: Oct. 1, 2013 – Sep. 30, 2017 (new agreement # pending)

**Lead Agency:** U.S. Fish and Wildlife Service (Program Director's Office)

**Submitted By:** Melanie Fischer, UCREFRP  
P.O. Box 25486, DFC, Lakewood, CO 80225  
303-236-9881, melanie\_fischer@fws.gov

**Date:** June 19, 2017

**Category:**

**Source:**

- Ongoing project  
 Ongoing-revised project  
 Requested new project  
 Unsolicited proposal

**Expected Funding**

- Annual funds  
 Capital funds  
 Other

(some funds from San Juan Program)

**I. Title of Proposal:** Upper Colorado River Endangered Fish Recovery Program  
Communications/Public Involvement Plan

**II. Background**

**Situation**

The Upper Colorado River Endangered Fish Recovery Program is a cooperative partnership established to recover the humpback chub, bonytail, Colorado pikeminnow, and razorback sucker in the Colorado River and its tributaries in Colorado, Utah, and Wyoming while water development proceeds in accordance with State and Federal laws. The Recovery Program was initiated in 1988 with a cooperative agreement signed by the Governors of Colorado, Utah, and Wyoming; the Secretary of the Interior; and the Administrator of Western Area Power Administration. In 2009, the agreement was extended through September 30, 2023.

The San Juan River Basin Recovery Implementation Program is working to recover the Colorado pikeminnow and razorback sucker in the San Juan River and its tributaries in Colorado, New Mexico, and Utah, also while water development proceeds. The San Juan Program was established in 1992 with the signing of a cooperative agreement by the Governors of Colorado and New Mexico; the Secretary of the Interior; the Southern Ute Indian Tribe; the Ute Mountain

**Situation (continued)**

Ute Tribe; and the Jicarilla Apache Nation. The Navajo Nation joined the program in 1996. The parties extended the cooperative agreement through September 30, 2023.

Both recovery programs have a multi-stakeholder structure in which Federal and State agencies work with public and private entities to recover the endangered fishes in a manner consistent with Federal,

State, and tribal laws. Although their structure and goals are similar, the recovery programs each continue to operate independently, working with their own program partners and governing committees to fulfill requirements detailed in their respective cooperative agreements. (*See pages 3-4 for partner lists.*)

Both recovery programs operate under similar recovery elements with management actions that are consistent with U.S. Fish and Wildlife Service recovery goals for humpback chub, bonytail, Colorado pikeminnow, and razorback sucker.

Funding for capital construction projects and ongoing operation and maintenance is authorized in Federal legislation through enactment of public laws. Non-Federal Recovery Program partners meet annually with members of Congress and their staffs and key Department of Interior leaders to update them about the recovery programs' progress. The recovery programs' success depends, in part, to their ability to work cost-effectively and efficiently and to document and report measurable outcomes.

The recovery programs coordinate efforts in many ways such as sharing research findings and technical expertise in common pursuits including: nonnative fish management, endangered fish propagation and stocking, habitat restoration, and population monitoring.

Communication and outreach are also coordinated. Using a shared approach helps ensure that common audiences (*see page 3*) receive accurate, consistent information about the endangered fishes and efforts to recover them. The I&E Committee developed and approved general key messages in 2009 (*see page 8*) and is currently discussing updating those messages. The Information and Education (I&E) Coordinator in the Upper Colorado Recovery Program Director's office staffs the I&E Committee, which has representatives from most of the Recovery Program partners and the San Juan Recovery Program.

Beginning in fiscal years 2006 and 2007, the recovery programs began to cost-share several outreach projects. This scope of work outlines those projects and associated cost estimates.

In addition to the shared projects, this scope of work identifies projects and costs for the Upper Colorado River Program only.

### **III. Study Schedule:**

Initial Year: 1988

Final year: Ongoing

### **IV. Relationship to RIPRAP:**

VI. INCREASE PUBLIC AWARENESS AND SUPPORT FOR THE ENDANGERED FISHES AND THE RECOVERY PROGRAM.

### **Mission**

- To support the Recovery Program's success in recovering the endangered fishes by assuring that the public understands what is being done and why, and has confidence that the process is honest, open, sensitive, clear, and understandable.

## **Goals**

- Develop public involvement strategies at the beginning of any and all projects.
- Educate target audiences about endangered fish, the threats to their survival, and Recovery Program efforts to recover them.
- Promote Recovery Program accomplishments.
- Improve communication within the Recovery Program and its partner organizations.
- Integrate outreach efforts with the San Juan River Basin Program when appropriate.

## **Target Audiences**

- News Media
- General Public
- Elected Officials at All Levels
- Land and pond owners
- Anglers
- River rafters and guides
- Educators
- Recovery Program Partners

## **Program Partners -- Upper Colorado River Endangered Fish Recovery Program**

State of Colorado  
State of Utah  
State of Wyoming  
Bureau of Reclamation  
Colorado River Energy Distributors Assoc. Colorado Water Congress  
National Park Service  
The Nature Conservancy  
U.S. Fish and Wildlife Service  
Utah Water Users Association  
Western Area Power Administration  
Western Resource Advocates  
Wyoming Water Association

## **Program Partners -- San Juan River Basin Recovery Implementation Program**

State of Colorado  
State of New Mexico  
Jicarilla Apache Nation  
Navajo Nation  
Southern Ute Indian Tribe  
Ute Mountain Ute Tribe  
Bureau of Indian Affairs

Bureau of Land Management  
 Bureau of Reclamation  
 The Nature Conservancy  
 U.S. Fish and Wildlife Service  
 Water Development Interests

### III. Strategies/Dates

This communication plan addresses Recovery Program strategies in general for the overall program. Separate communication plans are prepared for specific projects as appropriate. The intent of this plan is to revise it as needed to seize opportunities to partner with others to achieve the stated goals.

1. **NEWS MEDIA.** Actively work to identify issues that would generate the interest of the news media. Prepare and distribute advance and follow-up news releases to media, members of Congress and Recovery Program partners. Identify and seek support of partner and other organizations to issue news releases and/or provide supportive statements. Invite reporters to accompany biologists as they conduct their work.  
**RESPONSIBILITY:** I&E Coordinator/I&E Committee  
**COMPLETION DATE:** Ongoing
2. **PUBLICATIONS AND OTHER EDUCATIONAL MATERIALS.** Produce and distribute publications and other educational materials to provide current information to target audiences, ensuring consistent identity and content (such as brochures, newsletter, Program Highlights document, fact sheets, magnets, rulers, etc.)  
**RESPONSIBILITY:** I&E Coordinator/I&E Committee  
**COMPLETION DATE:** Varies depending upon the publication and target audience
3. **SPECIAL EVENTS AND PUBLIC MEETINGS.** Strategically identify opportunities to reach target audiences through participation in special events and public meetings.  
**RESPONSIBILITY:** I&E Coordinator/I&E Committee/Recovery Program partners  
**COMPLETION DATE:** Ongoing
4. **INTERPRETIVE EXHIBITS/SIGNAGE.** Interpretive signs and exhibits at museums and visitor centers are key tools used to educate the general public. Coordinate production and installation of interpretive signs/exhibits at public facilities with high visitation in target communities. Place program exhibit in highly visible public locations.  
**RESPONSIBILITY:** I&E Coordinator/I&E Committee/Recovery Program partners  
**COMPLETION DATE:** Ongoing
5. **SOCIAL MEDIA and WEBSITE.** Maintain and promote updated Facebook page and public website (ColoradoRiverRecovery.org)  
**RESPONSIBILITY:** I&E Coordinator/Recovery Program staff  
**COMPLETION DATE:** Ongoing
6. **AGENCY PUBLICATIONS/WEBSITES.** Publish articles in Recovery Program partners' publications and websites.  
**RESPONSIBILITY:** I&E Coordinator/I&E Committee

**COMPLETION DATE:** Ongoing

7. **INTEGRATE CERTAIN OUTREACH PROJECTS WITH THE SAN JUAN RIVER BASIN RECOVERY IMPLEMENTATION PROGRAM.** These include the newsletter, Program Highlights document, brochure, exhibit, educational materials such as a ruler, and other items as appropriate.

**RESPONSIBILITY:** I&E Coordinator/I&E Committee/Program Directors

**COMPLETION DATE:** Ongoing

8. **COORDINATE MESSAGES WITH ALL AGENCIES INVOLVED WITH RECOVERY OF THE ENDANGERED FISHES.** Coordinate I&E efforts among agencies outside of the Recovery Program to assure consistent and clear messages to target audiences.

**RESPONSIBILITY:** I&E Coordinator/I&E Committee

**COMPLETION DATE:** Ongoing

## Evaluation

- Document print and broadcast news media placements.
- Document the number of special events/public meetings held and presentations made, including attendance numbers.
- Track visitation numbers at sites where interpretive exhibits are in place where feasible.
- Document the number of articles published in agency/partner publications.
- Prepare an annual report to Recovery Program committees.

**IV. Budget**

<b><u>PROJECT</u></b>	<b><u>UNIT COST</u></b>	<b><u>FY 18 CRRP</u></b>	<b><u>FY 18 - SJRRIP</u></b>	<b><u>FY 19- CRRP</u></b>	<b><u>FY 19- SJRRIP</u></b>
Congressional Briefing Document ( <i>Program Highlights</i> )	Printing: 24 pp 8.5 x 11, saddle-stitched into 9 x 12 pocket folder QTY: 1,500 = <b>\$11,340</b> (printed through GPO and costs based on previous years); Design/layout = <b>\$0</b> (in house);Shipping costs for bulk quantities; <b>\$300</b> <b>TOTAL: \$11,640</b>	\$5,820 <sup>1</sup>	\$5,820	\$5936 <sup>1</sup>	\$5936 <sup>1</sup>
Field Report ( <i>Swimming Upstream</i> )	GPO Printing: 16 pp Self CVR. 4/4 8.5 x 11 Saddle- Stitched; QTY: 4,500 = <b>\$2,907</b> Design/layout = <b>\$0</b> (in house); Mailing Services: 2,420@.08 each = <b>\$204</b> Postage: 2,420 = <b>\$1,042</b> Shipping for bulk quantities: <b>\$300</b> <b>TOTAL: \$4,453</b>	\$2,227 <sup>1</sup>	\$2,227 <sup>1</sup>	\$2,272 <sup>1</sup>	\$2,272 <sup>1</sup>
Aquarium Supplies	50/50 cost share with CPW to support classroom program (Aquarium costs determined based on previous years' costs. These are annual supply and equipment costs to maintain aquariums in schools to help local children learn about the endangered fish.)	\$2,800	-0-	\$2,856	-0-
Exhibit Fees	Vendor fee plus noted expenses: CO Water Congress, Denver - <b>\$1,500</b> CO Water Workshop, Gunnison - <b>\$500</b> CO River Water Users, Las Vegas - <b>\$3,350</b> (includes electricity/shipping) UT Water Users, St.George - <b>\$2,500</b> (includes electricity & shipping) WY Water Assoc., Casper - <b>\$150</b> CO Rocky Mountain Coal Institute Annual Meeting - <b>\$300</b> <b>TOTAL: \$8,300</b>	\$4,150 <sup>1</sup>	\$4,150 <sup>1</sup>	\$4,233 <sup>1</sup>	\$4,233 <sup>1</sup>

<sup>1</sup> \*50/50 cost-share for these integrated projects. The San Juan Program has its own budget for outreach expenses incurred only for that program.

Repairs/replacement	Cost varies depending on need. Estimate based on replacing banner stands and repairs/replacements to large exhibit.	\$2,500 <sup>1</sup>	\$2,500 <sup>1</sup>	\$2,575 <sup>1</sup>	\$2,575 <sup>1</sup>
Ute Water Festival 2 days each May Grand Junction, Colo.	2 people @ 45 hrs x \$41/hr = \$3,690 3 people @ 16 hrs x \$46/hr = \$2,208 Miscellaneous supplies = \$242	\$6,140	-0-	\$6,324	-0-
Miscellaneous Supplies/Equipment	Specialty paper (for photos and briefing book inserts) \$300; replacement water-resistant cameras (e.g., Go-Pro) for field staff (4 @ \$200) \$800.	\$1,100	-0-	\$1,133	-0-
Educational Materials <u>FY 18</u> New or replacement item (TBD)	<b>Endangered Fish Tattoos:</b> 20,000 = \$3,200	\$3,200	0	\$3,329	0
<u>FY 19</u> New or replacement item (TBD)	<b>Lil Suckers:</b> 1,000 = \$2,225	\$2,225	0	\$2,315	0
	<b>Endangered Fish Lapel pins:</b>				
	Colorado pikeminnow (Shared) QTY:1050 = \$1628	\$814	\$814	\$847	\$847
	Razorback sucker (Shared) 1050 = \$1628	\$814	\$814	\$847	\$847
	Humpback chub 525 = \$866	\$866	0	\$901	0
	Bonytail 525 = \$866	\$866	0	\$901	0
	<b>Paper Stickers:</b> 25 rolls/2.5x4", 1000 per roll 4-color = \$2,225	\$2,225	0	\$2,315	0
	<b>Magnets:</b> 4 versions; 3 ½ x 2", 4-color, QTY of 6,000 ea. = \$3,495	\$3,495	0	\$3,636	0
	<b>Rulers:</b> 12" 4/4 inches/metric 10,500 = \$3,485	\$3,485	0	\$3,626	0
	<b>Can Koosies:</b> 500 ea of 4 / 2000 = \$3,100	\$2,325	775	\$2,472	\$807
	<b>Vinyl Fish Stickers:</b> 2750 ea of 4 = \$3,300	\$3,300	0	\$3,433	0
	<b>Trading Cards:</b> 2.5x3.5 4/1 12pt C1S 25,000 ea of 4 = \$2,486	\$2,486	0	\$2,587	0
Signs/Exhibits/ Interpretive Signs	<b>Design/Produce/Install:</b> signs/exhibits/interpretive signs at locations with high visitation in target communities.	\$5,000		\$5,000	
<b>TOTAL</b>		<b>\$55,838</b>	<b>\$17,100</b>	<b>\$57,538</b>	<b>\$17,517</b>