FISCAL YEAR 2020 ANNUAL BUDGET AND WORK PLAN

San Juan River Basin Recovery Implementation Program

August 30, 2019

DRAFT SJRRIP FY2020 AWP Budget Actual

SOW	Title	Agency	2020 BOR Appropriated Funds	BOR Capital/NFWF Funding	Partner In-Kind Funding	FCPP Funded Projects	2020 Grand Totals
	Element 1 - Management and Augmentation of Populations and Protection of Genetic Integrity						
7	Horsethief Canyon Ponds O&M at Ouray NFH	FWS, GJ	$39,128				**$39,128**
8	Stocking & Acclimation of Age-0 CPM & Age-1+ RBS	FWS, ABQ	$33,795				**$33,795**
9	Colorado Pikeminnow Fingerling Production (combined with 10)	FWS, SNARRC	$117,970				**$117,970**
10	Rearing Razorback Suckers (combined with 9)	FWS, SNARRC	$94,774				**$94,774**
11	RBS Augmentation/NAPI Pond Management	NN, FWS	$157,927				**$157,972**
12	SJRIP PIT Tags (purchase)	BR				$20,000	**$20,000**
	Subtotal		**$443,639**	**$0**	**$0**	**$20,000**	**$463,639**
	Element 2 - Protection, Management, and Augmentation of Habitat						
13	Maintenance and Operation of SJR Hydrology Model	BR, SLC	$70,400				**$70,400**
14	Stream Gaging and Flow Measurements	BR, USGS	$9,000				**$9,000**
15	Operation of PNM Fish Passage Structure	NN	$120,717				**$120,717**
16	San Juan and Animas Rivers Temp Gauges	BR	$24,000				**$24,000**
C-1	Capital Projects Management	BR	$0	$50,000			**$50,000**
C-2	Repair of Capital Projects (e.g., fish passage, fish weir)[1]	PNM	$0			$50,000	**$50,000**
C-3	SJR Habitat Restoration Phase III[2]	TNC/NN	$0	$500,000			**$500,000**
	Subtotal		**$224,117**	**$550,000**	**$0**	**$50,000**	**$824,117**
	Element 3 - Management of Non-Native Aquatic Species						
17	SJR Nonnative Species Monitoring and Control	FWS	$25,346			$50,361	**$75,707**
	Subtotal		**$25,346**	**$0**	**$0**	**$50,361**	**$75,707**
	Element 4 - Monitoring and Evaluation of Fish and Habitat in Support of Recovery Actions						
18	UCR and SJR Centralized PIT tag database	CSU CNHP	$10,000				**$10,000**
19a	Demographic Monitoring for CPM and RBS	FWS, GJ, UT	$216,436				**$216,436**
19b	Spring Age-1 Razorback Sucker Study	GJ	$63,246				**$63,246**
20	YOY/Small-Bodied Fish Monitoring	NMDGF	$75,699				**$75,699**
21	RBS/CPM Larval Surveys (Combined SOW)	ASIR	$263,069				**$263,069**
21a	RBS/CPM Larval Surveys - Upstream Expansion of Study Area	ASIR	$21,090				**$21,090**
22	Specimen Curation/Identification	UNM	$53,973				**$53,973**
25	Habitat Assessment	ERI	116,329			$25,183	**$141,512**
30	Razorback suckers in SJR-Lake Powell complex (4 of 4-yr project)	KSU	$129,406				**$129,406**

DRAFT SJRRIP FY2020 AWP Budget Actual

SOW	Title	Agency	2020 BOR Appropriated Funds	BOR Capital/NFWF Funding	Partner In-Kind Funding	FCPP Funded Projects	2020 Grand Totals
1	Backwater productivity assessment (2 of 3-yr project)	Pitt State	$90,041				**$90,041**
2	Nb and genetic diversity	SNARRC	$44,664				**$44,664**
32	PIT Tag Antennas O&M & Evaluation of Data	BR, FWS	$24,400				**$24,400**
32a	Hogback PIT Tag Antenna Install	BR		$70,051			**$70,051**
41	Facilitated fish passage in San Juan River (1 of 2-yr project)	KSU, NMDGF, SNARRC, UDWR, GJ	$321,980				**$321,980**
42	Enhancing channel complexity and low-velocity habitat	NN, NMDGF	$72,756				**$72,756**
43	San Juan fish passage investigation	BOR		$301,989			**$301,989**
	Subtotal		**$1,503,089**	**$372,040**	**$0**	**$25,183**	**$1,900,312**
	Element 5 - Program Coordination and Assessment of Progress Toward Recovery						
35	Base Funds and Contract Management BOR	BR, SLC	$223,255				**$223,255**
36	Peer Review[3]	BR, FWS	$45,000				**$45,000**
37	Program Management FWS	FWS, ABQ	$321,980		$199,085		**$521,065**
38	Remote Biologist	FWS, NMFWCO	$61,784				**$61,784**
FCPP	SJRRIP Biologist (FCPP/NMEP)	FWS	$0			$126,000	**$126,000**
	Subtotal		**$652,019**	**$0**	**$199,085**	**$126,000**	**$976,410**
	Element 6 - Information and Education						
39	Education and Outreach (funds transfer to UCRRIP)	FWS, ABQ	$26,639				**$26,639**
	Subtotal		**$26,639**	**$0**	**$0**	**$0**	**$26,639**
	SJRRIP Total		**$2,874,849**	**$922,040**	**$199,085**	**$271,544**	**$4,267,518**
	FY20 BOR Appropriations Requested Amount (Base-$2.88M)		**$2,880,000**				
	FY20 Proposed AWP Request		**$2,874,849**				
	Estimated available 2018 funds to expenditures		**$5,151**				
	Notes						
	[1]Placeholder; [2] Approved (initial amount 04/24/2019; additional costs 08/30/2019) capital funds or state capital NFWF funds; [3]Cost estimate						

Rearing Endangered Fish at the Horsethief Canyon Native Fish Facility Ponds for Stocking into the San Juan River
Draft Fiscal Year FY 2020 Project Proposal
Updated: 27 March 2019

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Current Contract or Agreement number(s):
R17PG00084 for USFWS – Grand Junction, CO

Reporting Dates: 10/1/2019 through 9/30/2020

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Introduction

Along with the workplan entitled, "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 (usually in late January or early February). 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 at least 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 and scanned for a PIT tag (a subset are also weighed). 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 knuckle 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 (O&M) 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 (AIS) 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 transport and stocking. Following QA/QC of the data, this file is submitted to the SJRBRIP and the NMFWCO by December 31, 2019. The SJRBRIP has eliminated stocking any Razorback Sucker that are < 300 mm TL. However, the SJRBRIP is actually getting age-1 fish (i.e., after 2 full growing seasons) from HCNFF that are meeting the Upper Colorado River Basin's minimum size requirements of $\geq$ 350 mm TL. The stocking size of most Razorback Sucker sent to the San Juan River from HCNFF is considerably larger than the minimum 300 mm TL target.

It is anticipated that 2,000-4,000 Razorback Sucker (all $\geq$ 300 mm TL) can be reared annually 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. In addition, stocking numbers will be provide to the NMFWCO for inclusion of augmentation annual report.

In fall 2018, a total of 4,812 Razorback Sucker from the HCNFF were stocked into the San Juan River. Their mean total length at stocking was 337 mm. There have now been six years (representing the fall 2013-2018 stockings) during which Razorback Sucker stocked from the HCNFF have been available for recapture during the annual fall Sub-Adult and Adult Large-Bodied Fish Community Monitoring ("Adult Monitoring") study. During the fall 2017 Adult Monitoring study, Razorback Sucker from HCNFF accounted for 47% of all Razorback Sucker collected (the Adult Monitoring study was not performed in fall 2018).

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 obtaining 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 ½ year that the HCNFF ponds operate) = $50
- $50 (the ½ 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-2020 Budget:

(Based on an anticipated FY-2020 costs)

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

Personnel/Labor Costs (Federal Salary + Benefits)

	UCREFRP Project 29a	SJRBRIP Cost
Principal Biologists (GS-11) – 1,960 hours @ $53.84/hr X 2 people (approx. 130 total hours covered by SJRBRIP or approx. 65 hr/person)	211,053	7,049
Biological Technician (GS-7) – 1,960 hours @ $32.46/hr (approx. 65 total hours covered by SJRBRIP)	63,622	2,125
Biological Technicians (GS-5) – 1,960 hours @ $23.40/hr (approx. 65 total hours covered by SJRBRIP)	45,864	1,531
Overtime:		
Biological Technician (GS-7) – 120 hours overtime @ $48.69/hr (approx. 4 total hours of overtime hours covered by SJRBRIP)	5,843	195
Biological Technician (GS-5) – 120 hours @ $35.10/hr (approx. 4 total hours of overtime covered by SJRBRIP)	4,212	140
Subtotal	330,594	11,040

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

Project Leader (GS-14) – 320 hours @ $82.57/hr (approx. 10.7 total hours covered by SJRBRIP)	26,422	882
Administrative Officer (GS-9) – 320 hours @ $42.98/hr (approx. 10.7 total hours covered by SJRBRIP)	13,754	459
Subtotal	40,176	1,341

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

Fish Food (based on a quote from Rangen, Inc., dated 8 March 2018)

Actual costs = 4 orders of fish food per year (1 order per fiscal quarter) at $19,620 each = $78,480. The line items below represent four total orders to be placed in 2020. 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.

Rangen # 0 Starter:	1,000 lbs @ $1.28 per lb =	$ 1,280	
Rangen # 1 Starter:	2,000 lbs @ $1.28 per lb =	$ 2,560	
Rangen # 2 Starter:	3,000 lbs @ $1.28 per lb =	$ 3,840	
Razorback Diet (1.2 mm):	8,000 lbs @ $1.11 per lb =	$ 8,880	
Razorback Diet (2.0 mm):	16,000 lbs @ $1.02 per lb =	$16,320	
Razorback Diet (3.0 mm):	48,000 lbs @ $0.95 per lb =	$45,600	
	Fish Food Subtotal	$78,480	2,621

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 (dechloniater) = $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 needs in a particular year. Funds for a "typical" field season for one study would likely include the following:

Egg hatching jars – Model J30 = $425

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

Hatchery Supplies Subtotal	31,735	1,060

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 & repair) and fuel		
Vehicles: GSA-lease rate (based on FY-2018 4X4 category 56R @ $365/month lease = $12.17 per day based on 30 days in an “average” month + $0.42/mile)		
Hatchery pickup truck = $11,279		
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	12,429	415
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	159,749	5,335
Subtotal for All Shared Costs	530,519	17,716

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 @ $53.84/hr	4,307
(2 days X 2 people/day for fish harvest)	
(6 days X 1 person/day for PIT-tagging)	
Biological Technician (GS-7) – 136 hours @ $32.46/hr	4,415
(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 @ $23.40/hr	7,488
(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	16,210
Lodging and Per Diem (Based on Published FY-2019 GSA Per Diem Rates)	
Lodging	
5 nights lodging in Cortez, CO X 2 people at $115.00/night =	1,150
Per Diem	
10 days hotel rate (Cortez, CO X 2 people at $59/day =	1,180
Subtotal	2,330
Fuel	
Stocking truck (gets ~8 miles per gallon) from Grand Junction, CO to Farmington, NM (660 miles round trip X 5 trips = 3,300 total miles) = 413 gallons of gas at $4.00/gallon	1,652
Water pump for tempering fish (4 gallons X 5 trips) = 20 gallons gas at $4.00/gallon	80
Subtotal	1,732
Subtotal for Costs Unique to SJRBRIP	20,272

Total of All Costs Incurred by SJRBRIP:

USFWS-CRFP (Grand Junction, CO) Total	37,988
USFWS Region 6 Administrative Overhead (3.00%)	1,140
USFWS Region 6 Total	39,128

Cost/Fish Comparison:

Workplan total cost in FY-2020 = $39,128

Estimated production in FY-2020 = 2,000-4,000 fish

For 2,000 Razorback Sucker produced, the cost/fish = $19.56

For 3,000 Razorback Sucker produced, the cost/fish = $13.04

For 4,000 Razorback Sucker produced, the cost/fish = $ 9.78

Augmentation of
Age-0 Colorado Pikeminnow and
Age-1+ Razorback Sucker
in the San Juan River Basin:
Fiscal Year 2020 Project Proposal

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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 (SJRIP) was initiated in 1992 to protect and recover populations of both species in the San Juan River Basin (Basin) while water development proceeds in compliance with all applicable federal, state, and tribal laws (SJRIP 2014). Delisting of Colorado Pikeminnow, as described 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 either exceeds 1,000 adults in the Upper Colorado River subbasin or a self-sustaining population of at least 700 adults in the Upper Colorado River subbasin and one of at least 800 adults 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 (SJRIP 2014).

Fish community monitoring during the SJRIP's seven-year research period, 1991-1997, identified few wild Colorado Pikeminnows inhabiting the San Juan River. This prompted investigations into the feasibility of augmenting the population with hatchery-reared fish. Based on results from these investigations, an experimental stocking of Colorado Pikeminnows was conducted by the Utah Department of Wildlife Resources in 1996 with the purposes of evaluating dispersal and retention of stocked Colorado Pikeminnows and determining the availability, use, and selection of habitats by their early life stages (Ryden 2008). This experimental stocking, along with subsequent stockings of larval, sub-adult, and adult fish, resulted in the subsequent recapture of hatchery-reared fish suggesting that Colorado Pikeminnows 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 ≥ 300,000 age-0 and ≥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 developed to direct the continuation of stockings through 2020. The Phase II augmentation plan reflected changes requested by the SJRIP Biology Committee that discontinued the stocking of Passive Integrated Transponder (PIT) tagged age-1+ Colorado Pikeminnows in exchange for stocking increased numbers of age-0 fish (n≥ 400,000).

Similarly, after the failure to collect any wild Razorback Suckers in the San Juan River during three years of intensive studies (1991-1993), the SJRIP 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 into the recovery potential and habitat suitability for Razorback Suckers between river mile (RM) 158.6 at the Hogback Diversion structure near Waterflow, NM and RM 3.0 in Lake Powell near Clay Hills, UT (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 at four stocking sites (RMs 158.6, 136.6, 117.5, and 79.6). Data gathered on these fish identified habitat types being used year-round by Razorback Suckers, 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 was initiated in 1997 following the *Five-Year augmentation plan for razorback sucker in the San Juan River* (Ryden 1997). In February 2003, the SJRIP Biology Committee 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, initiation of the eight-year addendum to the original plan was delayed until 2009. That augmentation plan, in effect from 2009-2016, called for the stocking of 91,200 Razorback Suckers over an eight-year period, or ≥11,400 fish per year, from a combination of sources including the Ouray National Fish Hatchery – Grand Valley Unit (Ouray NFH-GVU), the Southwestern Native Aquatic Resources and Recovery Center (Southwestern Native ARRC) and grow-out ponds on Navajo Agricultural Products Industry (NAPI) land stocked with fish from Southwestern Native ARRC. A revised *Augmentation Plan for Razorback Sucker in the San Juan River Basin* (Furr 2016, *draft*) was submitted to the SJRIP Biology Committee in February 2016 for review and is being finalized. It has been recommended that the Program continue to stock all available Razorback Suckers into the San Juan River and its tributaries with a goal of stocking ≥4,800 fish (≥300mm TL) annually. [This is based on the current best Apparent Survival rates (.41 first over-winter post-stocking period, .83 subsequent year-to-year survival) to maintain current predicted in-river population. An absolute minimum number of 2,450 is required to maintain a 5,800 Pop. Est. size]

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

Element 1. Management and Augmentation of Populations of Colorado Pikeminnow and Razorback Sucker

- **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 CPM and RBS.
        - **Task 1.1.1.1** Review and update augmentation plan for CPM and adjust stocking goals as needed.
        - **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 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 1.1.3.2** Produce RBS in three Navajo Nation Agricultural Products (NAPI) grow-out ponds (3,000-3,500 fish per pond, > 200 mm TL) and stock into the San Juan River.

- **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 described above.

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 the *Service's 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 *Strategic Plan for the U.S. Fish and Wildlife Service Fish and Aquatic Conservation Program: FY2016-2020*. The Service's Fish and Wildlife Conservation Offices are the primary conduit for satisfying Policy requirements and ensuring 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, acclimating to water quality and flow), and applicable environmental compliance. The New Mexico Fish and Wildlife Conservation Office (NMFWCO) is now the lead field office for processing SJRIP stocking requests under this policy.

<u>Objectives for Fiscal Year 2019</u>

1. Annually stock ~400,000* age-0 Colorado Pikeminnows, and investigate methods for batch-marking hatchery released fish for verifiable in-field identification.
2. Stock all available Razorback Suckers (≥ 300 mm TL), with the intent to stock ≥4,800* fish per year until the population becomes self-sustaining. (No RBS <300 mm TL will be stocked to help identify wild recruiting juvenile fish)
3. Collect and analyze data to facilitate modifying/updating plans for both Razorback Sucker and Colorado Pikeminnow as needed.

*The target number of Colorado Pikeminnows and Razorback Suckers to be stocked will 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.

<u>Methods and Approach</u>

- Objective 1. Coordinate with Southwestern Native ARRC, 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 Southwestern Native ARRC and delivered via standard distribution unit to the San Juan River. Fish will typically be stocked in the fall of each year, post irrigation season, to reduce the risk of fish entrainment in irrigation canals. A proportion of stocked age-0 Colorado Pikeminnow may be acclimatized to a variety of conditions (i.e., flow, temperature, physical/environmental characteristic, etc.) and monitored for stocking related stress-induced mortality within an *in situ* enclosure (aka, soft release) for up to 72 hours prior to release into the San Juan River Basin. The San Juan Program has been trying to identify an effective way to distinguish hatchery reared fish from wild recruiting Colorado Pikeminnow. The NMFWCO is interesting in pursuing the investigation of cryo-marking (freeze branding) as a suitable way to mark and identify hatchery fish collected during sampling efforts. If this method proves feasible, then future stockings will incorporate this technology to assist in detecting and verifying, wild-produced and recruiting fish. Any opportunistically-acquired Colorado Pikeminnow available to the SJRIP will be stocked on a case-by-case basis.

- Objective 2. Coordinate with Southwestern Native ARRC, 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).

  - Southwestern Native ARRC will stock approximately 10,500 Razorback Suckers (150-250 mm TL) 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. Razorback Suckers reared at Southwestern Native ARRC that have already reached >250 mm TL prior to the NAPI stockings will continue to be reared at that facility until they achieve ≥300 mm TL. Those fish will then be stocked into the San Juan River by Service personnel, or used for other purposes. The Ouray NFH-GVU will provide the SJRIP Augmentation Program with ~2,000-4,000 Razorback Suckers (≥300 mm TL) annually. Razorback Suckers will be stocked at specified sites to eliminate the risk of fish entrainment in irrigation canals. Stocking sites may be adjusted under an adaptive management approach to maximize apparent survival (e.g., retention) or to more equally distribute the population longitudinally. It is anticipated that, beginning in 2019, passively harvested fish from the NAPI ponds will be acclimated to flow in an on-site recirculating holding tank prior to stocking into the San Juan River. The details of this treatment are still being finalized. Furthermore, actively-harvested NAPI fish ≤299 mm TL may also be held in this holding tank until they reach ≥300 mm TL, and then stocked into the San Juan River, or used for other purposes. Therefore, only ≥300 mm TL PIT tagged Razorback Suckers will be stocked into the San Juan River. This will help distinguish wild recruiting Razorback Suckers as any untagged fish captured that is <300 mm TL will be considered as a wild produced fish. Any opportunistically-acquired Razorback Suckers available to the SJRIP will be stocked on a case-by-case basis.

- Objective 3. The New Mexico FWCO, in conjunction with the SJRIP 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 stockings will continue following the *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 2020. A draft summary report detailing findings will be submitted to the SJRIP Biology Committee, by 31 March 2021. Revisions will be completed and a final annual report will be submitted by 1 June 2021.

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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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FY 2020 - Estimated from 2019 GSA pay scale and PL and APL step 1 GS level							
Razorback Sucker and Colorado Pikeminnow Augmentation							
Labor Cost							
Position	Grade/Step	Hourly Rate	Fringe	Salary w/ Benefits	Hours/Day	Total Days	Sub-total
Fish Biologist	GS 9/2	$25.59	$0.26	$32.35	9	10	$2,911.35
Fish Biologist	GS 9/7	$29.71	$0.26	$37.56	9	6	$2,028.05
Fish Biologist	GS 11/7	$35.95	$0.26	$45.13	9	40	$16,247.39
Supervisory Fish Biologist	GS 13/1	$42.70	$0.28	$54.78	9	5	$2,464.90
Supervisory Fish Biologist	GS 14/1	$50.46	$0.27	$64.05	9	4	$2,305.76
Adminstrative Officer	GS 9/8	$30.54	$0.26	$38.52	9	5	$1,733.27
					Total Labor		**$27,690.71**
Travel and Per Diem	Days	Rate					Sub-total
Hotel Costs	20	$94.00					$1,880.00
Per Diem (Travel Day)	18	$38.25					$688.50
Per Diem (Full Day)	16	$55.00					$880.00
					Total Travel/Per Diem		**$3,448.50**
Equipment	Miles/Qty	Total Miles	Rate				Sub-total
Vehicle Fuel							
1 truck x 6 trips - ABQ to Farmington, NM - 366mi RT + 150mi/trip local commute	516	3096	$0.54				$1,671.84
					Equipment		**$1,671.84**
		Sub-total for Augmentation - NMFWCO only					**$32,811.05**
		USFWS Administrative Overhead (3%)					$984.33
		Total for Augmentation - NMFWCO					**$33,795.38**

COLORADO PIKEMINNOW PRODUCTION and RAZORBACK SUCKER REARING at SOUTHWESTERN ARRC, Dexter, NM
San Juan River
FY 2020
(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.

Colorado pikeminnow (*Ptychocheilus lucius*) and razorback sucker (*Xyrauchen texanus*), once common throughout the Colorado River Basin, 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 species 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.

The following scope of work identifies the facilities and methodologies that will be used to continue producing 400,000 age-0 Colorado pikeminnow (CPM); 1,000 300+mm and 11,000, 200mm 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 of this work being the culture and distribution of CPM to the San Juan River and RBS to the Navajo Agricultural Products Industry (NAPI) grow-out ponds located on the, Navajo Nation. 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.

Relationship to Recovery Program Actions, Tasks and Goals

The main objective for the production and augmentation of CPM and RBS is to facilitate the establishment of self-sustaining populations of both species within the San Juan River, with the eventual goal of contributing to the recovery of the species (Ryden 1997, SJRIP 2016). The SJRIP Long-Range Plan (LRP) (SJRIP 2016) identifies the need to implement and assess the augmentation of Colorado Pikeminnow and Razorback Sucker populations in the San Juan River Basin (Basin). Several documents provide the necessary guidance for the production and augmentation requirements for each specie. 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 ≥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.

The proposed work helps address specific actions, tasks and goal requirements of the augmentation program for the Basin's Colorado pikeminnow and razorback sucker populations as identified in the 2016 LRP:

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

- **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 1.1.3.2** Rear and stock hatchery-reared RBS into three NAPI grow-out ponds (3,000-3,500 fish per pond, > 200 mm TL).
  - **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 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.

- **Goal 1.3 - Support Operations and Maintenance of Facilities to Support RBS and CPM Stocking Programs.**
  - **Action 1.3.1.** Support production and grow-out facilities.
    - **Task 1.3.1.1** Support operation and maintenance of hatchery facilities at SNARRC for CPM and RBS production.
    - **Task 1.3.1.3** Support operation and maintenance of Navajo Agricultural Products Industry (NAPI) grow-out ponds for RBS production.

Facility Description:

The U.S. Fish and Wildlife Service (USFWS) has developed extensive infrastructure and expertise at Southwestern ARRC to successfully contribute to recovery programs. 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 64^0 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. Rearing Colorado Pikeminnow at Southwestern ARRC

Southwestern ARRC has been the leader in propagating and culturing CPM 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 and 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) Mark , transport and distribute 400,000 age-0 Colorado pikeminnow from Dexter, NM to the San Juan River.

(1) 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 1991broodstock.

In 2020 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.

<u>Spawning</u>

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 2B-	.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 < = 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/1). 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 > = 80 ^{o}F feed 3 % BW per day, Mon, Wed and Fri.
- Water temp 61-78 ^{o}F feed 2 % BW per day, Mon thru Fri.
- Water temp < 60 ^{o}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.

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

Schedule

Broodfish will be spawned in May 2020 and age-0 fish reared in rubber and plastic lined ponds from June - October 2020.

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 ≥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

Razorback sucker (RASU) have been maintained and cultured at 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 sucker diet. 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.

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 Nation.

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 < = 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.

<u>Pond Vegetation Control and Fertilization</u>
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 CUSo4 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 > = 80 ^{o}F feed 3 % BW per day, Mon, Wed and Fri.
- Water temp 61-78 ^{o}F feed 2 % BW per day, Mon thru Fri.
- Water temp < 60 ^{o}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.

Fish Size	Particle Size
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 2020. Target sized fish are available for distribution in spring and fall of each year.

Projected Harvest Dates and Delivery Date

Year 2020 marks the fifteenth 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 98,442 razorback's averaging 225mm in length into East and West Avocet and Hidden ponds and in 2012, 2016, 2017 and 2018 stocked an additional 1,000+ target sized RBS into the San Juan River annually. An additional 11,000 fish will be stocked into the NAPI ponds in April 2019. 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 2º F or (1ºC) 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, 2020.

Budget

RE: Colorado Pikeminnow Fingerling Production and Razorback Sucker 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 2020. Identified costs also include maintaining CPM and RBS broodstock for recovery efforts.

Budget -Detailed Spending Plan 2020

I. Colorado Pikeminnow Fingerling Production

O&M Labor Costs

The labor costs identified for 2020 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 @ $36.38/hr. * Supervision, spawning, fish health and water quality monitoring, feeding, harvest and prep for distribution.	= $46,566
	(1) Admin. Officer (240 hours- 3pay periods) - GS 341-9 @ $35.59/hr. * Budget tracking, purchasing, data base management & reporting.	=$ 8,542
	Subtotal =	**$55,108**

Equipment and Supplies:

Liquid oxygen and compressed oxygen 12 cylinders @ $91.60 Airgas	$ 1,099
Spawning Supplies Hormones (CCP 5 vials @ $220.18 per 10ml/vial)	$ 1,101
Fish health sampling prior to stocking Lab supplies for bacti, viral and parasite testing.	$ 2,375
Culture equipment (nets, seines, screens, etc.) Eager, Memphis Net & Twine	$ 2,422
Pond management supplies, Barrier $307.43/50# bag (20 bags) Van Diest	$ 6,149
Fish feed, 1.85/lb., 6,000 lbs. SKRETTING	$11,100
Cyclical Maintenance costs for:	$ 1,738

Tractors, mowers, gators, sweepers
used in pond maintenance

Subtotal	**$ 25,984**

Utilities:

Pumping costs	
Electrical 200,257 kwh @ .10568	$21,163
Heating water for hatching eggs to swim-up	
Natural gas 1,525 ccf @ 1.112	$ 1,696
Subtotal	**$22,859**

Reintroduction Costs:

Salaries	
GS-9 Fish Biologist	
24 hrs. @ $36.38	$ 873
GS-7 Fish Biologist	
24 hrs. @ $27.04	$ 649
WG-7 Maintenance Worker	
24 hrs. @ $24.64	$ 591
WG-5 Bio Science technician	
24 hrs. @ $18.44	$ 443
Lodging &Per Diem $126/day (Dexter to Farmington, NM and return)	
$126.00/trip x 2 trips x 4 employees =	$1,008
Fuel costs and truck maintenance 1200 miles @ $6.130	$7,357
Subtotal	**$10,921**

Annual subtotal (CPM)
(O & M Direct Costs) **$ 114,872**

II. Rearing Razorback Sucker at the Southwestern ARRC

O&M Labor Costs

The labor costs identified in the 2020 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 @$36.38/hr. = $ 37,835
* Supervision, spawning, fish health and water quality monitoring, feeding, harvest and distribution.

(1) Administrative Officer (160 hours- 2pay periods) - GS 341-9@$35.59/hr. = $ 5,694
* Budget tracking, purchasing, data base management & reporting.

Subtotal = $43,529

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.	$ 1,371

Fish Culture Supplies

Nets, seines, tubs, screens.	$ 2,318
Wet lab supplies (pipets, petri dishes, slides, probes, markers)	$ 308
Theriputents- salt, Oxytetracycline, formalin, MS-222, stress coat	$ 737
Liquid and compressed oxygen for fish distribution	$ 246

Feed

Production diet RBS0301 (2.0 tons) 4,000 lbs. $ 1.85 per lb.	$ 7,400

Spawning Supplies

Hormones (HCG 10 vials @ $ 61.41 per 10ml/vial)	$ 614

Fertilizer

	FY 2020 - SOW 9 and 10
Alfalfa pellets (1,000 lbs.) .314/lb.	$ 314
Inorganic - Super Phosphate (10 bags) 9.18/bag	$ 92
Chemicals- Aquatic Vegetation Control	
Barrier- (6 bags) $307.43/bag	$ 1,845
Diuron - (2 bags) $ 93.98/bag	$ 188
Subtotal =	**$15,433**
Services	
Utilities & Equipment Maintenance	
* Electrical, fuel and phone	$ 5,464
* Boiler system, heat exchanger maintenance	$ 1,229
*#1 well and water tower and pumping station maintenance	$15,162
Subtotal =	**$ 21,855**
Travel	
- Fish stocking/distribution.	
Dexter to Farmington (NAPI) & return- (1640 miles @ 6.314 per mile DX truck) =	$10,355
Fuel and routine vehicle maintenance.	
Perdiem- $126per day X 2 trips X 2 individuals. =	$ 504
Subtotal =	**$10,859**
Annual subtotal (RBS)	
O&M DIRECT COSTS	**$91,676**
I. Colorado Pikeminnow Fingerling Production	$114,872
II. Rearing Razorback Sucker Subadults at the Southwestern ARRC	$91,676
Annual total:	**$206,548**
3 % Administrative Overhead	**$ 6,196**
TOTAL REQUESTED FOR 2019	**$ 212,744**

Projected out year funding request:

FY 2021 - $219,126

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Razorback Sucker Augmentation at NAPI Grow-Out Ponds

Fiscal Year 2020 Project Proposal

Principal Investigators: Jeffrey Cole, Jerrod Bowman and T. 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*[17], (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 2019.

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[14] 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.

<u>Objectives</u>

(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[20]. 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[21].

2) Annually stock 3,500 (≥ 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[1].
    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[2].
    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[22].

4) Experimentally acclimatize, as guided by SRRIP – Biology Committee, razorback sucker from the NAPI ponds[3]. Current method of acclimatization is performing a Hard and Soft release techniques. This technique is conducted during passive fall harvest of NAPI fish[19].

<u>Location</u>

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[4] 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.[10]. 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][15] 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 2020, 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 2020, 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 2020, 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 2020 and finalized by 1 June 2020.

Budget

Fiscal Year - 2020 NNDFW Razorback Sucker Augmentation at NAPI Grow-Out- Ponds

Personnel/Labor Costs (salary + benefits)	
Daily Pond Management	
1 FTE NNDFW - Fisheries Biologist x $44,720.00	$46,956.00
Fringe Benefits $44,720.00 X 43.85%	$20,590.21
Temporary Wildlife Technician x $8,560.80	$8,988.84
Fringe Benefits Temp. $8,560.80 X 9.95%	$894.39
Personnel Subtotal	**$77,429.44**
Travel	
1 GSA Vehicle	$14,338.80
1 x Per Diem Lodging and Meals	$1,157.63
Travel Subtotal	**$15,496.43**
Equipment	
Aerators - Powerhpuse F750	
Powerhouse Model F750 Single Prop 100 ft ($1288 ea) x 2	$2,704.80
Feed Cost (1.30/lb - 5000)	
Feed 3.0/4.0 mm 40 - 50lbs. bags ($1.25 x 1000lbs)	$1,447.03
Medicated Feed 3.0/4.0 - 20 bags ($1.25 x 500lbs)	$723.52
Fyke Net 3 ft x 4 ft hand net x 4 ($756.0 ea)	$3,588.64
Super Wide Dip Net ($340.70) x 2	$787.19
Equipment Maintnance, Repair, & Replacement	$347.29
Hip boots ($150 each) x 2	$347.29
Waders ($155.00 each) x 2	$358.86
Muck Boots($100 ea) x 2	$231.53
Rain Gear ($100 ea) x 2	$231.53
Uniforms	$231.53
General Operating Supplies (includes fish transport costs, i.e. oxygen, salt, stress coat, etc.)	$347.29
Field Supplies and Repairs	
Write in rain books, pencils, gloves, welding repair for boat, quick connect fitting replacement, PVC cement and primer, trailer bearing and frame welding, Electrical breakers, GFCI outlets and covers, HD Extension cords, Pad locks, Fence repair and replacement of sections at gate.	$1,967.16
Support Subtotal	**$13,313.66**
Navajo Natio Fish & Wildlife Total	**$123,733.64**
NNDFW Administrative charge (15.65%)@ $123,733.6/1.1565 x.1565 =	**$16,743.89**
	$140,477.53

USFWS - NMFWCO - Assistance at the NAPI ponds	**$17,494.11**
NN Total	**$157,971.6**

SJRIP PIT TAGS
2020 Project Proposal

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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 – 2020

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

In FY2020, $20,000.00 is allocated in the workplan to purchase 5,000 PIT tags and associated equipment (readers, antennas, implanters, etc.).

FY 2019 BUDGET

Funding source		**Projected expenditure in FY19**
FY2020 Annual funding		$20,000.0
Total		**$20,000.00**

Projected funding:
FY-2021 $30,000.00
FY-2022 $30,000.00

Response to comments

Scope #	Project	PI(s)
12	**SOW-20-12-SJRIP PIT TAGS**	McKinstry

Wayne Hubert, Peer Reviewer

How can the technical aspects of this SOW be improved?

There is insufficient information in the SOW to provide a science based review.

A concern regarding the overall SJR PIT tagging effort is the opportunistic manner in which it has evolved and the lack of a systematic design. This concern addresses SOWs 12 and 32. The SOWs would benefit from a thorough assessment and description of the current status of the PIT-tagging work in the SJR. A huge amount of work has been done in PIT-tagging fish, developing and installing antennas for PIT-tag detection, and assimilating Pit-tag detection data into databases. The overall structure of the PIT-tagging work is in need of review. Because of the opportunistic way in which PIT-tagging efforts, there is not a "project" with defined goals and quantitative objectives, an experimental design, or mechanism for assessing project success or future needs. The SOWs regarding PIT tagging would greatly benefit from a formal review of PIT-tagging work and development of a formal PIT-tagging project to direct and assess these efforts into the future.

What is this SOW's contribution to recovery?

PIT tagging of the endangered species has become an integral part of recovery efforts and is yielding substantial amounts of information on movements of the species.

Response: Unfortunately the analysis of the data collected by this SOW is disconnected from the SOW to buy PIT tags and install the antennas. I agree that more effort could/should be put into analyzing the data collected from these sites, but we don't have specific plans at this point. The criticism on the lack of experimental design for the sites is valid, but other than the restoration site, we have an experimental design in place, which was explained in the SOW and are more detailed below:

PNM—several antennas have been positioned in the fish passage to show movements of fish up through the passage, indicating sequential movement through the passage and ultimately the success or failure of passage. Antennas have also been installed at the weir to identify fish that hit the weir and either find the passage or not. Lastly, antennas have been installed at the outlet for the passage to quantify success of fish navigating the structure. While formal reporting on these results has not been done, the data have been used to modify *operation of the passage in a flow-through mode during March- May in an effort to increase passage rates. A more formal analysis of the data is planned once we have several years to report on the operation of the facility.*

Hogback—Hogback antennas were planned/designed in an effort to show passage through this weir structure. To date, we have used the antennas to show that few stocked fish actually go over the weir and no wild fish go over the weir. The antennas in the bypass and those planned for the fish passage are useful for showing fish that are not using the passage and give detections that are useful in survival analyses. We have the data for this site and we are planning to publish it shortly.

Piute Farms Waterfall—antennas at this location were installed to quantify the number of fish stacking up at this site and have demonstrated that more than 1900 endangered fish have hit this barrier in the lower river. This information is being used to formulate passage options and the data have been used in several publications that are either completed or in press.

This SOW has never been a formal "project" with annual reporting but rather the results have been discussed at meetings where we use the data to formulate management changes (like opening the passage) and discuss what can be done to improve the data collection. Efforts are in place to publish many of the data.

FY 2020 Project Proposal
San Juan River Basin Hydrology Model
Operation and Maintenance

Susan Behery
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Durango, CO 81303
Phone 970-385-6560
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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 FY2020 scope of work includes updates to data as available, annual operation and maintenance of the model and data management. FY2020 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 adjusting model configurations or operating rules to incorporate new data and/or scenarios when requested, and evolving the data set forward through time. The FY2020 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 by August 31st. A review and comment deliverable will be sent out within one week of the Annual Hydrology Meeting, with a final report provided to the coordination committee within one month of the meeting. In addition, data, documentation and reports from model runs will be provided throughout the model run process. Any model runs requested by the SJRIP will be accompanied by a report within one month of the run completion. The modified model(s) and supporting data and scripts will also be delivered / made available. Climate change modeling and analyses will be completed by the end of FY2020, and a special presentation or report on the climate change runs and analyses will be

provided. The latest version of the models and live documentation will be provided at the end of every fiscal year.

<u>Task Descriptions</u>:

Task 1: Model Modifications In collaboration with the SJRIP Program Office, implement and document any changes made to the model operations.

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 modeling runs and analysis associated with the maintenance release concept and its potential incorporation into the decision tree. Provide ongoing modeling support in the collaborative effort between Reclamation and Sandia National Laboratory to complete climate change modeling runs and analyses. 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. Provide updates to appropriate documentation appendices as new model runs are completed, and update main documentation text with the incorporation of the maintenance release if recommended by the Program.

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 FY2020 budget and track FY2019 expenditures.

Budget Summary FY 2020

Model Modifications	$18,000
Model Maintenance	$18,400
Model Runs	$12,000
Program Management	$22,000
Grand Total	**$70,400**

FY-2020	**$72,500**	†
FY-2021	**$74,700**	†
FY-2022	**$76,900**	†

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

Task 1 Model Development

A) Labor

	Task	Salary total/hr	Total Days	Total cost
1	Model changes or updates	$100	10	$8,000
2	Continued Tech Transfer	$100	5	$4,000

B) Travel

	Purpose	Dest.	Trips	Days/ Trip	Airfare/ Trip	Lodging, expenses/day	Total Cost
1	Reclamation meeting with SJRIP	ABQ	1	2	$500	$250	$1,000

C) Other Costs

	Task	Total Cost
1	Riverware Technical Support	$5,000

Task 1 Total ***$18,000***

Task 2 Model Maintenance

A) Labor

	Task	Salary total/hr	Total Days	Total cost
1	Data Updates as Available	$100	10	$8,000
2	Software Updates	$100	3	$2,400
3	Methodology updates as needed	$100	10	$8,000

Task 2 Total ***$18,400***

Task 3 Model Runs

A) Labor

	Task	Salary total/hr	Total Days	Total cost
1	Model Runs and Analyses	$100	15	$12,000

Task 3 Total ***$12,000***

Task 4 Program Management Coordination

A) Labor

	Task	Salary total/hr	Total Days	Total cost
1	Meetings and Coordination	$100	20	$16,000
2	Budget	$100	5	$4,000

B) Travel

	Purpose	Dest.	Trips	Days/ Trip	Airfare/ Trip	Lodging, expenses/day	Total Cost
1	Reclamation to Workgroup Meetings	ABQ	2	2	$500	$250	$2,000

Task 4 Total ***$22,000***

TOTAL **$70,400**

Improve Stream Gaging and Flow Measurements
San Juan River Basin Recovery Implementation Program
Fiscal Year 2020 Project Proposal

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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-2020:

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	7,200		
Travel			1,800	
Equipment and supplies				0
Total				$9,000

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

Fiscal Year 2021	$9,270
Fiscal Year 2022	$9,550
Fiscal Year 2023	$9,840

Operation of Public Service Company of New Mexico Fish Passage Structure

Fiscal Year 2020 Project Proposal

and

Principal Investigators: Jeffrey Cole, Jerrod Bowman and T. Kim Yazzie
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Operation of Public Service Company of New Mexico Fish Passage Structure

Fiscal Year 2020 Project Proposal

Principal Investigators: Jeffrey Cole, Jerrod Bowman and T. Kim Yazzie
Navajo Nation Department of Fish and Wildlife
Box 1480 Window Rock, AZ 86515
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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 March 1 to May 31, 2020 as a flow through system. This was decided by the biology committee during the February 2018 BC meeting. Pressure sensors at the south channel, entry point and last boulder before passage were installed to keep record of flow during this pass thru system. A new PIT tag antenna was installed at the inlet attached to the trash beam to gather more data for fish passing thru the passage. Installation of a game camera was also installed to give a time elapse image of the passage in operation. The only screen left would be the inlet screen. Preparation for this setup was to remove the automatic brush system and lift up the screens to provide no restrictions for the passage. North passage of the fish passage is closed only leaving the south channel as the flow thru channel.

The Fish Passage facility will resume normal operation from June 1 to October 31, 2019. 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’ 2019. 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[5] 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 March 1 to October 31, 2020. 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[1].

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[2]. 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[6].

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.

Budget

Fiscal Year - 2020 NNDFW PNM Fish Passage

Personnel/Labor Costs (salary + benefits)	
Daily Passage Management	
1 FTE NNDFW - Fisheries Biologist x $44,720.00	$46,956.00
Fringe Benefits $44,720.00 X 43.85%	$20,590.21
Temporary Wildlife Technician x $8,560.80	$8,988.84
Fringe Benefits Temp. $8,560.80 X 9.95%	$894.39
Personnel Subtotal	**$77,429.44**
Travel	
1 GSA Vehicle	$14,338.80
1 x Per Diem Lodging and Meals	$1,157.63
Travel Subtotal	**$15,496.43**
Equipment	
Food Grade Silicone - 16 0z Aersol Multipurpose 12/year	$138.92
Super Wide Dip Net ($340.70) x 2	$787.19
Equipment Maintnance, Repair, & Replacement	$463.05
PFD - Astral PFD ($100 ea) x 2	$231.53
Hip boots ($150 each) x 2	$347.29
Waders ($155.00 each) x 2	$358.86
Muck Boots($100 ea) x 2	$231.53
Rain Gear ($100 ea) x 2	$231.53
Uniforms	$231.53
General Operating Supplies (includes fish transport costs, i.e. oxygen, salt, stress coat, etc.)	$463.05

Office Supplies and Equipment	
Paper, Ink. Toner, Pens, Shipping & shipping material & suppiles	$347.29
Fish Ladder Screen Cleaner Maintenance (i.e. motors, batteries, limiting switches, contractor assistance, Stainless Steel welding, SS Connecting links, SS Chain)	$8,181.60
Maintenance, Landscape, Hardware tools, propane, supplies, wrenches, sockets, nuts bolts, blades, paints, pvc, lumber, tapes, etc…	$1,389.15
Support Subtotal	**$13,402.52**
Navajo Nation Fish & Wildlife Total	**$106,328.39**
NNDFW Administrative charge (15.65%)@ $106,328.39/1.1565 x.1565 =	**$14,388.58**
NN Total	**$120,716.97**

SJRIP San Juan and Animas Rivers Temperature Gauges
2020 Project Proposal

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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
web: http://nm.water.usgs.gov

TASKS – 2020

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

FY 2020 BUDGET

Task	Expenditure in FY2020
Temperature probes @ $5500/ea	$24,000
Total	**$24,000**

[1] **This total budget represents a 1% increase over the FY2019 Budget.**

Projected funding:
FY-2021 $23,000.00
FY-2022 $24,500.00

Phase III Habitat Restoration: A Constructed Floodplain Wetland Refugium Fiscal Year 2020 Scope of Work

Can wild-spawned San Juan River Razorback Sucker larvae recruit to juvenile life-stages in a relatively large, stable, zero-velocity habitat?

Prepared By:
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With assistance from:
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Justification

In the San Juan River, collection of larval Razorback Sucker has occurred every year for the past 18 years but juveniles are rarely detected in fall sampling, indicating a potential recruitment bottleneck between the larval and juvenile life-stage. Within the last seven years, the number of larval Razorback Sucker captured annually was approximately 30 percent that of Flannelmouth Sucker or Bluehead Sucker, two common species that are consistently collected as juvenile and age-1 fishes (Farrington et al. 2017 [larval fishes]; Zeigler and Ruhl 2017 [small-bodied fishes]). Therefore, the apparent lack of recruitment to the juvenile life-stage is unlikely a simple function of the number of larval Razorback Sucker produced. Additionally, the limited collection of metalarval Razorback Sucker, the most mature phase of larvae, and reduction in collection of this larval phase as early as July (Farrington et al. 2017) suggests relatively high mortality rates within the larval phases and is likely a factor contributing to the lack of recruitment to the juvenile life-stage over the spring-summer months.

The source of this apparent recruitment bottleneck in the San Juan River is presently unknown but large, stable, low-velocity habitats are relatively scarce (Lamarra and Lamarra 2017) and may be needed for recruitment of larval Razorback Sucker. Prior to the San Juan River's regulation, this habitat was likely available in higher quantities and stable low-velocity habitat has long been thought to be important nursery and rearing habitat for larval Razorback Sucker. Such habitat could be highly productive within the riverine ecosystem exhibiting higher temperatures, nutrient concentrations, and levels of primary productivity than the main channel environment, qualities which may be required for larval Razorback Sucker to recruit into the juvenile life-stage (Bestgen et al. 2011).

Since 2008, two major habitat restoration projects were implemented in the San Juan River to restore flow in abandoned secondary channels with the overall goal of increasing the quantity of low-velocity habitat (Phase I and II). These projects were successful as they resulted in increased low-velocity habitat and were used by larval Razorback Sucker and age-1+ Colorado Pikeminnow (Farrington et al. 2017 [larval fishes]; Lamarra et al. 2017 [habitat]; Zeigler and Ruhl 2017 [age-1+]). However, there is no evidence that the increased low-velocity habitat resulting from the channel restoration efforts has increased the survival of larval Razorback Sucker to the juvenile life-stage in the San Juan River. Determining whether this type of habitat supports larval fish recruitment is confounded by variation in mainstem river flows which causes these habitats to be ephemeral (Table 1).

The current proposal asks whether Razorback Sucker larvae produced in the San Juan River can recruit into juveniles when provided large, stable, low-velocity habitat that is free of large-bodied nonnative predators. The project design (site selection and operations) builds on the recognition that it is difficult to assess the contribution of constructed secondary channels to larval Razorback Sucker recruitment and builds on efforts in the Upper Colorado River Endangered Fish Recovery Program to construct managed flooded wetlands. Data gleaned from this project will provide the San Juan River Basin Recovery Implementation Program (SJRRIP) scientifically objective and quantifiable outcomes which can be used to prioritize and proceed with management actions.

Table 1. Phase I secondary channels by river mile (RM) and flow conditions (cfs) coded by potential availability of low velocity habitat (Farrington et al. 2017). Phase I restoration was completed in late 2011 and larval fish monitoring was conducted annually after this; 2013 and 2016 bracket the monitoring period. In both years, no channel consistently provided low velocity habitat for early life stages between April and July. Results were similar in 2014 and 2015.

2013	April 22 472 cfs	May 21 1,300 cfs	June 10 610 cfs	July 16 1,040 cfs	July 30 730 cfs
RM 132.2	Channel not flowing	Low velocity habitat present	Low velocity habitat present	Low velocity habitat present	Channel not flowing
RM 132.0	Low velocity habitat present	No low velocity habitat available	No low velocity habitat available	No low velocity habitat available	Low velocity habitat present
RM 130.7 A	Channel not flowing	No low velocity habitat available	Low velocity habitat present	Low velocity habitat present	Channel not flowing
RM 130.7 B	Low velocity habitat present	Low velocity habitat present	No low velocity habitat available	No low velocity habitat available	Channel not flowing
RM 128.6	Channel not flowing	Low velocity habitat present	Channel not flowing	Low velocity habitat present	Channel not flowing
RM 127.2	Channel not flowing	Low velocity habitat present	Low velocity habitat present	Low velocity habitat present	Channel not flowing

2016	April 18 1,140 cfs	May 17 2,830 cfs	June 16 7,380 cfs	July 11 1,340 cfs	July 25 690 cfs
RM 132.2	Channel not flowing	Low velocity habitat present	No low velocity habitat available	Channel not flowing	Channel not flowing
RM 132.0	Low velocity habitat present	No low velocity habitat available	No low velocity habitat available	Low velocity habitat present	Low velocity habitat present
RM 130.7 A	Low velocity habitat present	No low velocity habitat available	No low velocity habitat available	No low velocity habitat available	Low velocity habitat present
RM 130.7 B	No low velocity habitat available	No low velocity habitat available	No low velocity habitat available	No low velocity habitat available	Low velocity habitat present
RM 128.6	Low velocity habitat present	No low velocity habitat available	Low velocity habitat present	Low velocity habitat present	Low velocity habitat present
RM 127.2	Low velocity habitat present	No low velocity habitat available	No low velocity habitat available	No low velocity habitat available	No low velocity habitat available

Key	
(white)	Low velocity habitat present
(grey)	No low velocity habitat available
(black)	Channel not flowing

Project Objective
Use a constructed wetland to assess the ability of large, stable, low-velocity habitat in the San Juan River to increase recruitment of larval Razorback Sucker to the juvenile life-stage.

Methods
Site Selection, Wetland Design, and Construction
Figure 1 summarizes the process for selecting two priority sites for the constructed wetland along the San Juan River (see Appendix 1 report). The first step in this process was to identify wetland design criteria. These were determined by the SJRRIP Biology Committee and partners at the November 2016 Biology Committee Meeting. As background for the discussion, Speas et al. (2016) was distributed prior to the meeting; this report summarizes the lessons-learned over twenty years from managed and unmanaged wetlands on the middle Green River and updates floodplain wetland priorities for the recovery of endangered fish in the Upper Colorado River Basin (also, see Valdez and Nelson 2004; Bestgen et al. 2011; Birchell and Christopherson 2004; Brunson and Christopherson 2005; Christopherson et al. 2004; Modde and Haines 2005; Webber 2010). Based on review of this information the following wetland design criteria were identified during the Biology Committee discussion – the wetland pond must:

- Have sufficient depth to provide vegetation cover on the wetland perimeter and open water in the middle of the pond, i.e. maximum depth $\geq$ 3 feet, with a goal of 3.5 feet;
- Have sufficient slope to facilitate harvest of small-bodied fish in the fall;
- Be drainable so that native fish can be released back to the San Juan River and nonnative fish removed. To accomplish this, the wetland will have a control gate at the inlet and outlet which will isolate the wetland from the river (and reduce sedimentation) and maintain water levels in summer;
- Have a screened outlet gate and fish kettle to facilitate collection of fish at the end of the growing season;
- Have a low-velocity area (i.e. forebay) at the wetland inlet gate to provide an attraction area for larvae to move into the wetland; and
- Have an open inlet channel, rather than a pipe, to enhance attraction of larvae into the wetland.

From these design criteria, four site-selection criteria were subsequently identified. They included:

1) For the pond to be drainable, there must be $\geq$ 3.5 elevation difference between the wetland inlet and outlet;
2) The inlet to the wetland pond must be located on a secondary channel with outflow into the San Juan River or back into the secondary channel;
3) The secondary channel must be stable, i.e. have flowed over a long-time period, and must flow at 500 cfs. Summer flow in the secondary channel is critical as the wetland needs a water supply to overcome seepage and evaporative losses and to maintain water quality during the growing season (Speas et al. 2017); and
4) The site must be accessible by road for construction, operation, monitoring and maintenance.

As a second step, the San Juan River was screened for potential sites (Appendix I). To do this, Bliesner (Appendix I) inspected and compared the 1997 aerial photography and habitat mapping results to the 2015 LiDAR imagery to identify secondary channels that flowed in 1997 and flowed at 500 cfs in 2015. Applying the other criteria resulted in 16 potential sites between RM 135 and RM 70. Seven sites were eliminated due to insufficient elevation difference and access problems. Preliminary designs and cost estimates were developed for the remaining nine sites, assuming a 2-acre pond and a 3.25-feet average wetland depth; the cost estimates included the costs of vegetation clearing, excavation, inlet-outlet structures and remedial work on the secondary channel, if needed. Following this preliminary design step, two sites were eliminated due to significant permitting issues, high construction costs, and remote location.

The remaining seven sites were visited on April 12-13, 2017, and evaluated based on six factors: (1) site access and road conditions; (2) position of the secondary channel inlet relative to the San Juan River's thalweg; (3) site location (RM) and density of Razorback Sucker larvae captured upstream; (4) the condition of the secondary channel inlet (i.e. status of flow, sedimentation); (5) construction costs including the length of the wetland inlet and outlet canals; and (6) site security. Two priority sites were selected by the Reconnaissance Team—RM 107 and RM 135, with a clear preference for RM 107. Conceptual engineering designs and estimates for construction and annual maintenance costs were developed for the two sites, assuming a wetland pond size of 2 acres (Appendix 1, Table 4 in report). Site RM 107 had the lower estimated construction cost and annual maintenance cost.

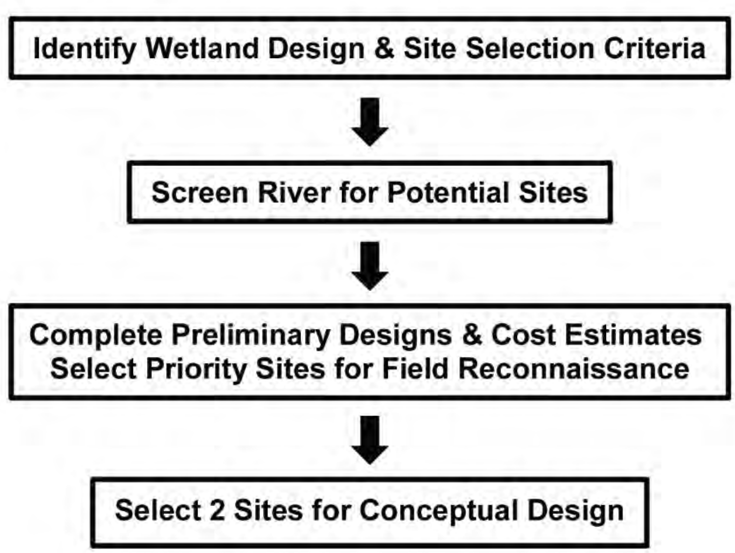

Figure 1. Process for selecting two priority sites for the wetland refugium along the San Juan River. See text for details.

The preferred site is located on Navajo Nation land (in Utah) on an island between a flowing secondary channel and the main channel of the San Juan River. The inlet channel to the wetland is 275 m downstream of the secondary channel entrance and the length of the inlet channel from the inlet gate to the main body of the wetland is approximately 400 m (Appendix 1). In addition, the RM 107 site is downstream of known Razorback Sucker spawning areas and densities of larval sucker captures immediately upstream are relatively high compared to other areas (M.

Farrington, pers. comm.). Thus, the number of Razorback Sucker larvae naturally entrained into the wetland should be high and, when young-of-the-year Razorback Sucker are released from the wetland in fall, there is a sufficient distance above the canyon-bound reach for fish to be retained in suitable habitat before being lost over the waterfall to Lake Powell. In addition, flow into the secondary channel from the San Juan River and site security are both good. On the negative side, the condition of the access road to the site, particularly, the last 2.0 km is poor and, because of its location in the basin, increased sediment loads are likely.

Wetland Adaptive Management

Wetland Operations, Monitoring, and Adaptive Management

The inlet gate will be opened the last week of April for a period of four weeks to entrain Razorback Sucker larvae from the San Juan River into the wetland. In general, Razorback Sucker spawning in the San Juan River occurs early to mid-April with incubation and swim-up lasting approximately three weeks. Thus, larval Razorback Sucker should be in the system in the last week of April with peak abundance during the first few weeks of May (Farrington et al. 2017). During this period, the density of Flannelmouth Sucker and Bluehead Sucker larvae is high in the San Juan River while the density of non-native fish larvae is low and will reduce the likelihood of entraining non-native larval fish (Table 2). While the wetland is being filled, gate(s) will be checked daily by the USFWS Remote Biologist to ensure they are operating properly and to remove debris from the trash rack and screen (which are in place to prevent entrainment of Channel Catfish).

After the gates are closed, the site will be visited weekly to measure water depth and dissolved oxygen concentrations from the staff gauge and electronic water quality sensors, respectively. If pond depth is less than 3 feet in the deepest portion of the pond, the inlet gate will be opened to increase water to depths > 3 feet. It is difficult to determine the dissolved oxygen level that should result in "recharging" the wetland by opening up the inlet gates. At Stewart Lake, another wetland operated to entrain and rear larval Razorback Sucker, dissolved oxygen remained relatively constant with daily average readings of ~3 mg/L from July through mid-September 2017 (Staffeldt et al. 2017). However, daily minimum dissolved oxygen was near zero during the night from late June through mid-August with no apparent detrimental effect on Razorback Sucker. In contrast, when dissolved oxygen concentrations drop to 4-5 mg/L in the Navajo Agricultural Products Industry (NAPI) ponds, staff operate aerators fitted with underwater diffusers to increase O_2 concentrations and alleviate water quality problems. Therefore for this wetland, if dissolved oxygen concentrations are 4-5 mg/L and trending downward and/or an algal bloom is occurring, the USFWS Remote Biologist will operate a solar power aerator (or alternatively, a generator-driven one) that has two attached diffusers for under water aeration, for a minimum of 24 hours. This monitoring and responsive management will continue until the pond is drained in October.

A staff gauge will be installed in the wetland so that water depth can be measured visually and an electronic water level (pressure)-temperature sensor and logger (HOBO U20L-001) will be installed to collect hourly water levels in the pond. The sensor will be installed in an L-shaped stilling basin with the bottom of the "L" underwater; basins will be cleared, if needed, and the data from loggers downloaded during each visit by the USFWS Remote Biologist to the site. A relationship between staff gauge measurements and the pressure sensor will be established so that the sensor provides a continuous record of water levels in the wetland. Dissolved oxygen will be measured using a wireless HOBO sensor. This sensor will enable the Remote Biologist to track changes in water quality including temperature from off-site locations.

In October, the outlet gate will be opened and the wetland drained for the winter to avoid creating poor water-quality and the build-up (and persistence) of nonnative fish populations, two problems that limited production of juvenile Razorback Sucker at Stewart Lake and other managed and unmanaged floodplain wetlands on the Green River (Speas et al. 2017). Small-bodied fish, including juvenile suckers, will be collected in the fish kettle located near the outlet gate and processed as described in following section. Once the wetland is drained, inspection and repair of the control structures will take place as well as removal of sediment that may have accumulated in the inlet forebay or inlet and outlet channels will be removed annually. Sediment removal from the wetland pond itself is not anticipated to be an annual but may be necessary over a longer time period (every 10+ years).

Larval Entrainment Monitoring and Adaptive Management

Larval and small-bodied fishes will be sampled periodically using size-appropriate seines and following the SJRRIP monitoring protocols for larval and small-bodied fish (Farrington et al. 2017, Zeigler et al. 2017)[1]. As a target, 1% of the wetland habitat, and the inlet canal, will be sampled, corresponding to at least ten 10-m (in distance) seine hauls. In addition, the forebay in front of the inlet gate will be sampled in May to determine if larval fish are present. Fish sampling will occur as described in the following bullets:

- May, first and second week of the month: larval fish will be collected using fine-mesh larval fish seines (1 m x 1 m x 0.8 mm; n = 2 trips). Fish collected in a seine haul will be preserved as a single sample; the length (in meters) of each seine haul will be determined and recorded. If entrainment of Razorback Sucker larvae is low in the first year, these two collections will be used in the second year to determine if the larval trigger metrics have been met. If not, a contingency plan of stocking wild larvae will be implemented. Sampling locations will be distributed throughout the inlet channel and wetland in appropriate habitats and marked with bamboo stakes; these locations will be re-sampled in subsequent months to ensure that different crews sample at approximately the same level of effort and in the same locations.
- June, third week of the month: to confirm survival of fish entrained in May, larval fish will be sampled in the inlet channel and wetland at the permanent monitoring stations using seining gear; collected fish will be preserved and identified to species in the laboratory.
- July, third week of the month: larval fish will be sampled in the inlet channel and wetland as in June;
- September during fall Small-Bodied Fish Monitoring: to confirm survival of larval fish to the juvenile life-stage, small-bodied fish will be collected with a 2.2 m x 1.9 m x 3.0 mm mesh drag seine. Total length (TL) and standard length (SL) will be measured on all Razorback Sucker to be consistent with information gathered by the SJRRIP and Upper Colorado River Basin Program. Once measured, the fish will be released back to the

[1] A separate statement of work will be submitted for approval within the appropriate fiscal year given that a timeline for funding, construction, and permitting has not yet been determined.

wetland. Other native species will also be measured and released. If native fishes are too small to identify, they will be preserved and returned to the laboratory for identification. Nonnative fishes will be removed from the wetland after measurements are taken and recorded. If nonnative fishes are found in such abundance that it is not feasible to measure them in the field, they will be preserved and returned to the laboratory. For each sampling location within the inlet channel and wetland, the length (in meters) of each seine haul will be measured.

- October, when pond is drained, small-bodied fish will be collected, identified to species, and appropriately processed (i.e. measured, weighed, implanted with a pit-tag) and released or removed depending on the species[1]. The crew will include staff from the SJRRIP Program Office and NAPI Ponds. It will likely take 3 days to drain the pond and concentrate the fish and approximately 6 hours to process them (K. Yazzie and J. Bowman, pers. comm.). During this time, the aeration system will be operating continuously in the pond and in a foldable holding tank where processed native fish will be held prior to release into the San Juan River.

The above trips will be timed to correspond with ongoing larval and small-bodied fish monitoring efforts to make use of existing crews, thereby increasing efficiency and reducing costs. It is expected that larvae will be entrained larvae at a density similar to that present in nearby low-velocity habitats (i.e., backwaters) in the San Juan River (Table 2).

Table 2. Capture densities (m^2) of larval native and nonnative* fishes from River Mile 116.9–100.5 (2012–2016, Farrington et al. 2017). Species abbreviations composed of first three letters of genus and species (e.g. Xyrauchen texanus = Xyrtex). Extrapolated number (Number) is the predicted number of larvae entrained in the 8,500 m^2 wetland given the median density for that month and species.

		Catdis	Catlat	Xyrtex	Ptyluc	Rhiosc	Cypcar*	Cyplut*	Ictpun*	Pimpro*
Apr	Median	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.00	0.75	0.04	0.00	0.00	0.00	0.00	0.00	0.00
	Number	0	0	0	0	0	0	0	0	0
May	Median	0.33	0.94	0.11	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	1.33	2.85	1.05	0.00	0.06	0.00	0.00	0.00	0.00
	Number	2833	7969	944	0	0	0	0	0	0
June	Median	0.39	0.16	0.00	0.00	0.03	0.00	0.00	0.00	0.00
	Mean	0.92	0.72	0.07	0.00	0.21	0.00	0.08	0.00	0.16
	Number	3351	1365	0	0	278	0	0	0	0
Jul/Aug	Median	0.11	0.01	0.00	0.00	0.45	0.00	0.24	0.00	0.07
	Mean	0.64	0.12	0.00	0.42	1.92	0.02	3.50	0.09	1.17
	Number	923	63	0	0	3840	0	2004	0	564

A benefit of the proposed project is flexibility of water operations to entrain Razorback Sucker larvae should changes need to be made after the first year's operation. If it is found that densities of entrained larvae are lower than the May median density of larval Razorback Sucker captured in nearby San Juan River backwater habitat (Table 2) during the second year of operations, an attraction flow will be created by installing flashboards to the outlet box upstream of the gate and the outlet gate opened to allow water to flow out of the pond while still maintaining the pond elevation. Should the entrainment of larvae continue to be lower than expected, a contingency plan consisting of stocking the wetland with wild-spawned larvae will be implemented. Since the species of larval fish cannot be identified during collection and stocking, area seined would be used as a surrogate and calculated as the quantity necessary to increase the wetland density to the desired density (i.e., 0.111/m^2).

Evaluation of Project Success

Having quantifiable goals of success is critical to any management activity. Prior to 2018 when only a single wild juvenile Razorback Sucker had ever been captured in small-bodied monitoring (Zeigler and Ruhl 2017), we presumed an estimated collection of a single juvenile Razorback Sucker from the Phase III wetland in October would indicate relatively large and stable backwater habitats that may increase Razorback Sucker recruitment rates. However, in 2018, six wild young-of-year (YOY) Razorback Sucker were collected across primary and secondary channel and backwater habitats during a spatially truncated small-bodied monitoring effort (Zeigler and Wick 2019). Extrapolating the estimated catch per unit effort (CPUE) of wild YOY Razorback Sucker in 2018 (0.011 fish/10m^2; Zeigler and Wick 2019) to the size of the Phase III wetland (8,500 m^2) would result in approximately 9 fish being present at those densities. The proposed Phase III wetland represents almost 2/3 of the mean area of backwater habitat associated with secondary channels (13,684 m^2, SD = 7,719 m^2; Lamarra and Lamarra 2017).

Based on the above calculations, the ultimate measure of success for this wetland would be production of 1-9 wild juvenile Razorback Sucker in the fall. This would objectively and quantifiably demonstrating that large, stable, low-velocity habitat increases Razorback Sucker larvae survival through the spring and summer to the juvenile life-stage in the fall. The lower end of the range of success represents more wild juvenile Razorback Sucker than have been documented across all sampled habitats in all but two year of small-bodied monitoring and the upper end assumes the estimated CPUE of wild YOY Razorback Sucker documented in across all habitats in 2018 could be replicated in the constructed wetland. Additionally, success of Phase III project would more importantly indicate larger and more stable backwater habitats may increase the recruitment success of wild-spawned Razorback Sucker in the San Juan River (see Management Implications). A proximate, measurable goal of success would be that the wetland entrains the larvae of the common suckers. Median densities of the larval Bluehead Sucker and Flannelmouth Sucker in May, when Razorback Sucker densities should be at their highest, are 0.33/m2 and 0.94/m2, respectively (Table 2). Entrainment of 10% of these densities would indicate mechanisms to entrain native larval suckers are working, in the event that Razorback Sucker larvae are not documented.

Management Implications

Should providing larval Razorback Sucker with large, stable, low-velocity habitat increase their recruitment to juvenile life stages, this would suggest the rarity of this habitat may be contributing to the recruitment bottleneck in the San Juan River. To address this bottleneck, management would be directed at ways to increase the size and stability of low-velocity habitat. To achieve this, management options such as the following could be prioritized: (1) manage flows to increase the size and stability of backwater low-velocity habitats river-wide; (2)

physically increase the size of backwater habitat at secondary channels outlets; (3) open additional secondary channel inlets to produce outlet backwaters; (4) maintain or develop additional wetland features; and (5) other ideas not yet conceived. Prioritizing or pursuing these management options during the construction and operation of the wetland or once this project is completed are not “either-or” choices and can be pursued simultaneously. The strength of the proposed project is its ability to produce sound quantitative evidence indicating that such actions may or may not result in recruitment of larval Razorback Sucker to juveniles prior to the over-winter period in the San Juan River.

If, after three years of rearing larvae in an environment free of large-bodied nonnative predators, the results indicate Flannelmouth Sucker and Bluehead Sucker recruit to the juvenile stage in the constructed wetland but Razorback Sucker do not, other management actions would need to be identified and pursued. The lack of recruitment by Razorback Sucker would suggest that other intrinsic biological or physical constraints are precluding larval recruitment in the San Juan River which are not related to the availability of large, stable, low-velocity habitats. These may be factors related to genetics and/or differential responses to water quality parameters (e.g. temperature or contaminants), food resource availability (e.g. type and timing), discharge (e.g. drifting behavior), or predation (e.g. Red Shiner, a potential larval predator which cannot be prevented from entering the wetland during filling operations). Although failure of Razorback Sucker larvae to recruit to juveniles within the proposed wetland would be discouraging given the success observed in the Upper Colorado River Endangered Fish Recovery Program, the information would be invaluable in directing SJRRIP resources and management actions.

Acknowledgements
Vince Lamarra first suggested the idea of a restored floodplain wetland; many thanks to him and Dan Lamarra for early discussions on the concept. I would also like to thank Eliza Gilbert, Nate Franssen and Scott Durst (SJRRIP Program Office) for their ideas and discussions that contributed significantly to the development of this Scope. Thanks also to Tom Wesche, Bill Miller and Matt Zeigler for their comments on the engineering report (Appendix 1) and to the SJRRIP Program Office and Jason Davis who reviewed an earlier draft; their comments greatly improved the engineering report and this Scope of Work. Finally, thanks to Michael Farrington (ASIR), Matthew Breen (Utah Division of Wildlife Resources), and Kim Yazzie and Jerrod Bowman (NNDFW) for their contributions to the monitoring and wetland operations sections.

Budget: Cost Estimate for RM 107

Phase III Item Description Cost Total					
1	Mobilization and Demobilization	1	LS	$25,000	$25,000
2	Clearing and Grubbing	3.5	Acres	$9,000	$31,500
3	Excavate Inlet Embayment	1020	Yds³	$5	$5,100
4	Excavate Inlet Channel	3940	Yds³	$5	$19,700
5	Excavate Pond and Outlet Channel	11200	Yds³	$5	$56,000
6	Place and Compact Embankments	14050	Yds³	$6	$84,300
7	Rip Rap	90	Yds³	$50	$4,500
8	Precast Concrete Inlet Structure	1	ea	$16,000	$16,000
9	Precast Concrete Outlet Structure	1	ea	$3,000	$3,000
10	4ft x 4ft Rectangular Inlet Control Gate	1	ea	$10,000	$10,000
11	24" Circular Canal Gate - Outlet	1	ea	$2,500	$2,500
12	24" Corrugated HDPE Pipe - Outlet	30	ft	$30	$900
13	4ft x 10 ft Stainless Steel Outlet Bar Screen w ith 1/2" Openings	1	ea	$5,000	$5,000
14	Revegetation & Site Restoration	1	LS	$43,000	$43,000
15	Aspen Core Matting	4000	LF	$5	$19,000
16	Build Road Across Secondary Channel	1	ea	$7,000	$7,000
17	Temporary Dams on Secondary Channel	2	ea	$1,500	$3,000
18	Cultural Resources Survey of the Razorback Sucker Refugia (SWCA)	1	ea	$5,339	$5,339
18	Project Per-Diem	1	LS	$15,360	$15,360
19	Work SubTotal				$356,199
20	Permitting (COE, Navajo Nation)				$15,000
21	Navajo Nation Tax	6%			$21,372
22	Grand SubTotal				$392,571
23	Navajo Nation IDC (17.5%)	17.50%			$68,699.91
	Total Grant Cost				$461,271
	CC Requesting Amount*				$500,000

(Items in blue are items which were either changed or added form the cost estimate provided in the San Juan River Larval Razorback Sucker Refugia Enhancement Conceptual Design dates September 13, 2019. *CC Requesting Amount is rounded to $500,000 to account for unknown incidentals for this project.)

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Appendix 1

San Juan River Larval Razorback Sucker Refugia Enhancement Conceptual Design Final Report

Prepared for

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EXECUTIVE SUMMARY

The reintroduction of razorback sucker has been successful in establishing a spawning population of razorback sucker in the San Juan River. Despite 18 years of documented spawning, recruitment has not yet been documented. One of the reasons for the lack of recruitment may be the lack of features such as permanent backwaters or flooded bottom lands in the San Juan River necessary for retention and survival of larval razorback sucker.

The goal of this study was to identify potential sites and complete conceptual designs for a facility that could act as a proof of concept for a larger recovery action to aid recruitment of razorback sucker. To accomplish this, the study examined the potential to construct managed larval refugia facilities that would operate similar to Stewart Lake on the Green River but on a smaller scale. This was a four-step process:

1. Identify criteria.
2. Screen the river for potential sites using habitat mapping, aerial photography and LiDAR.
3. Complete preliminary designs and cost estimates for sites that met the initial screening criteria and select the highest priority sites for field inspection.
4. Select the top two sites for conceptual design based on field inspection.

Sixteen sites between RM 70 and RM 135 were initially identified in the screening process. The preliminary design process eliminated seven, leaving nine. Seven of these were inspected in the field. One of the nine, one was much more expensive than the others and one was located in Bears Ears National Monument. Neither were visited in the field but remain candidates for future sites. During field inspection one of the nine potential sites was eliminated because of multiple limitations discovered during field inspection.

Eight sites were finally identified where managed ponds could be constructed with gravity inlets and outlets to provide refugia for larval razorback sucker. The sites could accommodate ponds of at least 2-acres in extend with minimum depths of 3.0 ft. Each of these sites could maintain water supply to the ponds at flows as low as 500 cfs, although some of the sites may require periodic sediment removal in the secondary channel inlet to maintain flow at 500 cfs.

All but one of the sites (RM 135) are located between secondary channels and the main San Juan River, providing at least 3.5 ft of elevation difference between the inlet and outlet to the ponds for adequate pond depth for summer survival. RM 135 is located on the outside of a restored secondary channel and returns to the secondary channel.

RM 107 and RM 135 were selected for completion of conceptual designs. RM 107 is expected to cost about $355,000 to construct with an average annual maintenance cost of about $9,800. RM 135 is more expensive because of the need for a security fence. Its construction cost is estimated at $506,000 with an average annual maintenance cost of $12,000. The operation cost of the facilities will depend on the level of monitoring implemented and would be in addition to the maintenance costs listed.

Because RM 107 is lower cost and is better positioned on the river to capture drifting larval razorback sucker, we recommend that RM 107 be selected for construction as a proof-of-concept facility to improve retention of larval razorback sucker and aid in recruitment of adult

fish to the population. Environmental permitting will be required during final design. Water rights may also be required for the evaporation losses.

BACKGROUND

The proposed refugia site seeks to provide the San Juan River Recovery Implementation Program (SJRIP) with the ability to address a fundamental question as to whether Razorback Sucker larvae produced in the San Juan River will recruit into juveniles when provided large, stable, low-velocity habitat. The project design (site selection and operations) builds on the recognition that it is difficult to assess the contribution of constructed secondary channels to larval Razorback Sucker recruitment and builds on efforts in the Upper Colorado River Endangered Fish Recovery Program[Error! Bookmark not defined.] to construct managed flooded wetlands. Data obtained from this project will provide the San Juan River Recovery Implementation Program (SJRRIP) with scientifically objective and quantifiable outcomes which can be used to prioritize and proceed with future management actions.

APPROACH

Design Criteria

Facilities intended to retain larval razorback sucker through the summer until they can reach a size to survive in the river must have certain conditions. The design criteria set for ponds along the San Juan River were developed with input from SJRIP biology committee members and include features that are based on what has been learned from the performance of upper-basin retention facilities. These are the criteria used to design the facilities:

- Ponds must have sufficient depth to provide cover on the perimeters but maintain open water in the middle. The minimum depth was set at 3.0 ft, with a goal to obtain 3.5 ft at the deepest part of the pond, with slope to facilitate harvest.
- The facilities must be fully drainable to allow harvesting and assessing the number and condition of the larval razorback sucker and to remove non-native fish from the facility before the next season. The following conditions must be met:
    - The bottom must be sloped to avoid stranding when drained.
    - A control gate is required at the top and bottom to isolate the pond from the river. This allows water levels to be maintained during the summer and the pond to be drained in the winter for control of non-native species.
    - There must be sufficient elevation between the inlet and outlet to allow for gravity draining and provide a minimum depth of 3.0 to 3.5 ft.
    - There must be an outlet screen with 1/4-inch open spaces to retain fish for evaluation. The screen is to be sloped at 45 degrees and be 4 ft wide.
    - There must be a kettle at the outlet to facilitate harvest.
- There should be a portion of open water and a portion of vegetative cover to provide protection for the larval fish. To provide adequate cover, a vegetated shelf around the perimeter of the pond is included in the design, with cattails planted for cover (Figure 1). The minimum depth is meant to control encroachment of vegetation in the open water portion of the pond.
- All internal side slopes are to be 3 horizontal to 1 vertical.
- There must be a low velocity area at the inlet to the pond to provide an attraction area for fish to move into the pond.

- The inlet gate is to be 4 ft wide.
- An open channel is used rather than a piped inlet to enhance attraction.
- A course bar screen (2-inch open space) is to be employed to prevent large debris from jamming the gate and limit entrance of adult fish.
- A 2-ft diameter head gate and pipe outlet will be employed to facilitate draining.
- The banks around the pond are to allow 1.5 ft of freeboard above maximum expected water surface during spring runoff to allow containing greater depths than the minimum design depth and to protect against over-topping during flood stage.
- Target surface area was set at 2.0 acres, with some flexibility allowed based on local site conditions.

Site Selection Criteria

Potential sites that could provide the conditions necessary to meet the pond design criteria were identified between River Mile (RM) 135 and RM 70. The sites were to meet the following criteria:

- To be drainable, there must be adequate elevation difference between the inlet and outlet of the pond. This required the inlet to be on a secondary channel with the return flow back to the main river downstream, or to the lower end of the secondary, depending on the site conditions.
- The secondary channel must be stable over an extended period of time to assure that the ponds will not be abandoned soon after construction.
- To qualify as a potential heading, the secondary channel must flow at river flows of 500 cfs and higher and be historically stable.
- There must be at least 3.5 ft of elevation difference between the inlet and outlet of the pond. More elevation difference provides more flexibility in pond design and placement.
- Because the supply is from a secondary channel and the return usually to the main channel, the ponds will nearly always be located on an island. The site must be protected from flood damage at high flow.
- Summer flow in the secondary channel is critical as the ponds need a water supply to overcome seepage and evaporation losses and maintain water depth.
- The site must be accessible for construction, monitoring and maintenance.

Site Identification and Screening Process

Potential sites were identified using the 1997 aerial photography and habitat mapping and the 2015 LiDAR photography. Comparing the two sets allowed identification of secondary channels that had been stable for that period of time and assure that the channels would still flow at 500 cfs, a condition necessary to maintain a water supply to the ponds during summer months.

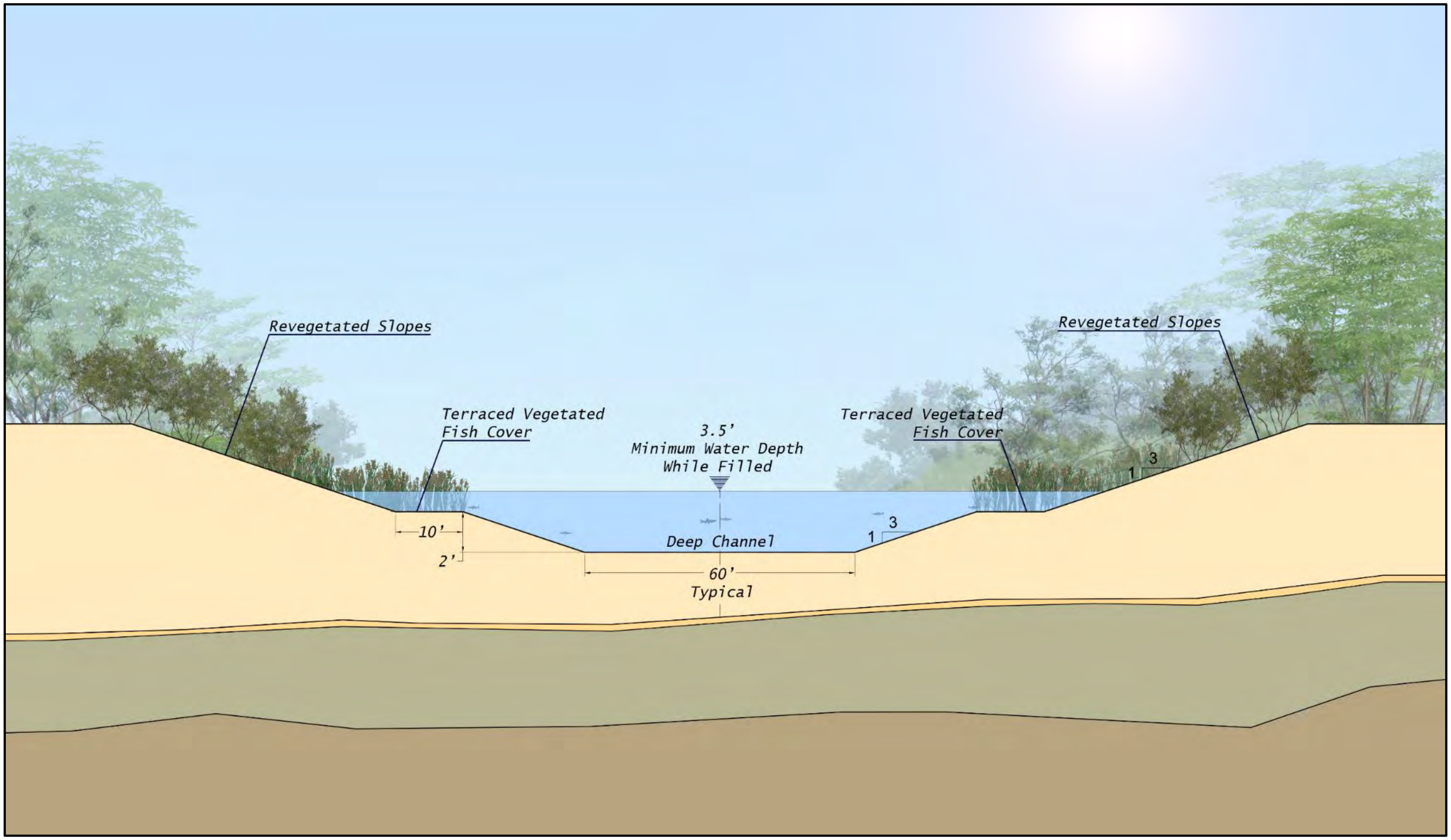

Figure 1. Typical Pond Cross-Section

Using the two sets of photography and the 1997 mapping data, potential sites were preliminarily selected when the main channel between the inlet and the return of the secondary channel contained riffles. This indicated the potential for adequate elevation difference to meet the design criteria. The island condition was also examined in terms of flood protection and potential pond area.

If a secondary channel met the initial selection criteria based on these visual indicators, it was added to the potential site list. Its location was marked on a map and a brief description recorded.

Once the potential sites were identified, the next step was to screen them based on available elevation using the 2015 LiDAR data. LiDAR data were added to the GIS coverage and the inlet, outlet and pond elevations were noted. Sites with less than 3.5 ft of elevation were eliminated from the list of potential sites.

The remaining sites were further evaluated for development by completing a rough system layout and cost estimate. They were then ranked in priority based on access, development cost, secondary channel stability and other site-specific limiting factors. The highest priority sites were further investigated in the field to verify conditions observed in aerial photography and gather information needed for concept design.

During the field visits, the site priorities were updated and additional sites eliminated or moved to a lower priority based on conditions observed in the field. On-site aerial photography was taken with a drone for the highest priority sites.

The final screening to select the two sites for which concept designs would be completed was based on the input of those on the field trip.

SITE SELECTION

The potential site selection process identified 16 sites between RM 135 and RM70 that met the site selection criteria (Table 1). LiDAR screening was completed for these 16 sights and 7 sites were eliminated because of inadequate available elevation difference or extreme access challenges. The remaining nine sites (identified as “proceed” in Table 1) were identified for preliminary layout and cost analysis.

Preliminary Designs

Preliminary designs were completed for the sites shown in Table 2. Table 2 also summarizes the results of the preliminary design analysis. Even though the preliminary pond sizes are not all the same, the cost estimate is based on the excavation required for a 2.0-acre pond for all sites. The excavated volume is based on the average elevation of the ground surface in the pond area less the computed bottom elevation to provide an average depth of 3.25 ft (ranging from 3.0 to 3.5 ft to maintain bottom slope). Cost for structures is the same for all sites in this analysis. Additional excavation cost is included for sites that require remedial work on the secondary channel to maintain flow through the summer.

Following is a discussion of the nine sites in order of occurrence from downstream to upstream:

Table 1. Potential Sites Selected for Screening

River Mile	Description	Access	Upstream Water Surface	Downstream Water Surface	Difference	Status	Notes
71	River Right flowing	Yes	4249.75	4242.75	4.25	Proceed	return to secondary
78	River Right not flowing	TBD	4293.40	4291.40	2.00	Reject	Insufficient elevation
80.7	River Right - Recapture lodge	yes	4311.20	4304.00	4.50	Proceed	Long inlet and discharge
82	River Right restore channel	TBD	4330.00	4327.00	3.00	Reject	Insufficient Elevation
107	River Right flowing	yes	4513.00	4507.50	3.70	Proceed	
109	River right flowing	yes	4533.50	4528.50	5.00	Proceed	
110	River left, restore channel	15 mi dirt road	4543.00	4535.50	5.00	Reject	3000 ft channel cleaning from 0 to 3 ft, poor access
113	River left flowing	12 mi dirt road	4563.80	4561.00	2.50	Reject	Insufficient elevation
114.2	River left restore channel	12 mi dirt road	4571.50	4567.00	2.00	Reject	Removed 200 ft plug in entrance Insufficient elevation
116	River left flowing	poor dirt track	4592.30	4583.70	3.60	Reject	poor access, marginal elevation
122	River left, not flowing	3 mi dirt from 4C	4641.30	4637.50	4.00	Proceed	Short channels, next to abandoned farm field, sediment in secondary
123	River left flowing	4 mi dirt from 4C	4652.30	4645.50	3.70	Proceed	Pond site not as good as 122, longer dirt road
127.2	River Right RERI site	yes	4676.70	4671.30	5.20	Proceed	Sand bar building in inlet
128.6	River Right RERI site, flowing	yes	4688.40	4684.50	2.60	Reject	Insufficient elevation
134.3	River Right flowing	yes	4742.30	4736.50	5.00	Proceed	
135	River Right (Phase II site)	yes	4755.20	4751.20	4.00	Proceed	

Table 2. Preliminary Design Summary for Sites Selected for Further Analysis

Site	Design depth ft.	Maximum depth possible	pond size acres	Inlet/ outlet channel length ft	Total Excavation Volume cu. yds.	Estimated cost for 2-acre pond*
RM 71	3.25	4.25	2.00	589	18,200	$319,000
RM 79 (Recapture)	3.25	4.50	2.40	3197	15,623	$329,000
RM 107	3.25	3.70	2.10	1442	19,100	$328,000
RM 109	3.25	5.00	2.10	1232	21,261	$349,000
RM 122	3.25	4.00	2.20	1545	16,000	$326,000
RM 123	3.25	3.70	2.00	1000	29,000	$426,000
RM 127.2	3.25	5.20	2.10	2750	20,000	$338,000
RM 134.3	3.25	5.00	2.20	1823	20,000	$331,000
RM 135 (Phase II Site)	3.25	4.00	2.50	661	21,000	$343,000

*2-acre pond size used for all sites to compute comparative costs for the same size feature

RM 71

The preliminary design layout for RM 71 appears in Figure 2. This site has excellent potential except for two conditions: 1) It is located in Bears Ears National monument, 2) the access is down combs wash and then back up river, making construction difficult. Its location in a national monument makes permitting very difficult, if not impossible. It was dropped from consideration because of this limitation.

Figure 2. Preliminary Design Layout RM 71

RM 79 (Recapture Lodge)

The preliminary design layout for RM 79 appears in Figure 3. An existing out-of-service irrigation canal served by gravity diversion passes through Recapture Lodge property as well as BLM property. The pond site shown in Figure 3 is on Recapture Lodge property and would be served by this canal. The owner, Jim Hook, has been very interested in and supportive of SJRIP activity is interested in having this facility on his property.

The pond site would be secure as access is tightly controlled by Recapture Lodge. However, there are several challenges for this site:

- Almost 3,200 ft of the existing canal would require excavation as the diversion elevation is lower than the existing channel bottom.
- Sediment load in the river is sufficiently high that annual maintenance would be required to remove the sediment from the channel.
- The diversion headworks would require reconstruction.
- The diversion is on a wide, straight stretch of river with no embayment, so larval entrainment potential is low.
- There is an existing pumped diversion supplying a large pond from which irrigation water is pumped to adjacent fields that could possibly also supply the pond, but it would require an operating agreement with the owner and significant annual electrical power and maintenance costs.

This site was removed from further consideration because of these limitations.

Figure 3. Preliminary Design Layout RM 79 (Recapture Lodge)

RM 107

The preliminary design layout for RM 107 appears in Figure 4. The best location for attachment of the inlet channel is about 900 ft downstream of the secondary channel inlet. The secondary channel is stable, with good inlet control. The pond would be located close to the main channel with an inlet channel about ¼ mile in length. A small embayment would be constructed at the head of the inlet channel.

The site is well located, being low enough in the river to be below razorback spawning areas and sufficiently upstream to allow some downstream movement of fish released in the fall before entering the canyon reaches and potential loss to Lake Powell.

Access is through Navajo grazing lease property, requiring permission for entrance, but the lease owners were cooperative. Access is from Utah State Highway 162 via a 2.67-mile dirt road. The road is reasonably well maintained for the first 2.5 miles. Some Russian Olive tree removal and grading in the last 0.17 miles would be required to gain access to the site. The road has a locked gate and site security is expected to be good.

Constructability of the sight is reasonably good, assuming pre-cast concrete structures are used. Concrete truck assess is not good.

This site was selected for conceptual design and has the highest priority of all the sites.

RM 109

The preliminary design layout for RM 109 appears in Figure 5. The layout of this site is similar to RM 107, except that the pond outlet would return to the secondary channel rather than the main channel to provide the maximum elevation difference.

Access to this site is also through a grazing lease from Highway 162 along a dirt road of similar length. The road has a steep cut as it descends to the river bottom that has eroded. Some grading would be required in this location.

The secondary channel entrance requires some sediment removal to provide dependable flow during the summer months and may require periodic maintenance.

This site could be considered as a future potential site if more locations are needed, but it is not recommended for conceptual design in this study.

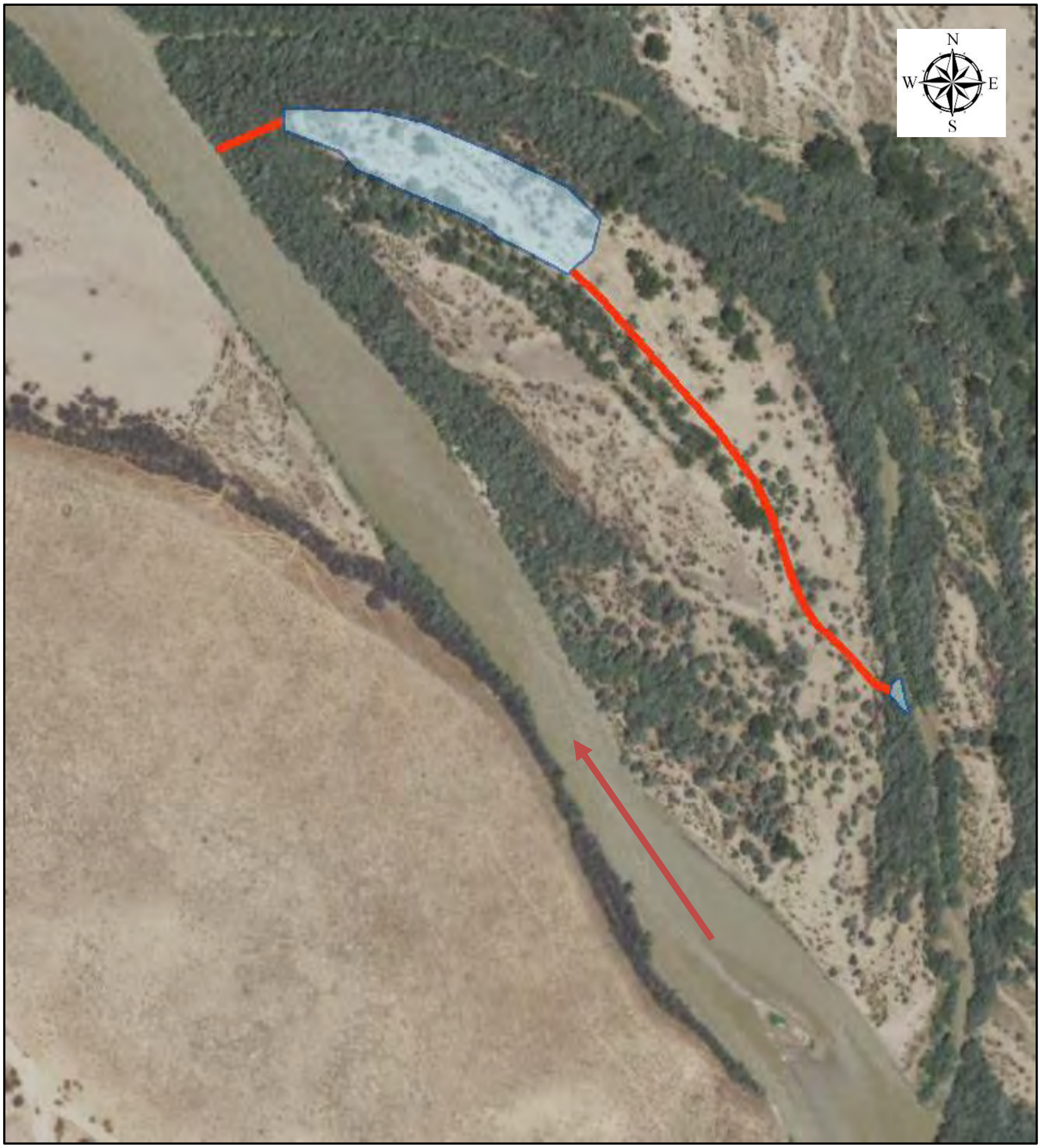

Figure 4. Preliminary Design Layout RM 107

Figure 5. Preliminary Design Layout RM 109

RM 122

The preliminary design layout for RM 122 appears in Figure 6. It is located on a secondary channel on river left that has historically provided irrigation water to a 10-acre field. The secondary channel has historically flowed at or below 500 cfs but recent sediment deposits prevent it flowing at river flows below about 1,200 cfs. The inlet to the secondary channel is well-positioned on an outside bend to attract drifting larval fish, the elevation difference is good and there is a good site for a pond. Access is from U.S. Highway 160 via 3 miles of well-maintained dirt road.

There is a good pond site, but the site would require continued sediment removal to maintain flow to the pond. There is evidence of sediment removal in this channel in the past to maintain flow to the irrigated field on the north, but there is no evidence of irrigation past about 2013.

Except for the sedimentation issue in the secondary channel, this would be a good site. It is recommended for consideration if additional sites are needed in the future.

RM 123

The preliminary design layout for RM 123 appears in Figure 7. It is located on a secondary channel on river left, about 1 mile upstream of RM 122. Secondary channel inlet conditions are good, being on an outside bend. Elevation difference is marginal and the island elevation is high relative to the secondary channel bottom elevation. With long inlet and outlet channels and high island elevation requiring excess excavation, this is the most expensive site investigated (Table 2).

Access is the same as for RM 122, except there is another mile of dirt road. Because this site was so much more expensive than the other sites and was further from the pavement than RM 122, it was not visited and not considered for conceptual design. It does still have potential as an additional future site, if needed.

Figure 6. Preliminary Design Layout RM 122

Figure 7. Preliminary Design Layout RM 123

RM 127.2

The preliminary design layout for RM 127.2 appears in Figure 8. It is located on a secondary channel on river right that was part of the Phase I channel restoration project. Secondary channel inlet conditions are good for larval drift, being on an outside bend. Elevation difference is adequate, but a ½-mile long inlet channel is required.

Access is from U.S. Highway 491 via a BIA road through the Hogback irrigation project. The road is paved for 7.5 miles. The remaining 13 miles are dirt road, with the last 2 miles being unmaintained dirt track.

The biggest limitation to this site is the sedimentation of the inlet to the secondary channel. Within 2 years of the initial restoration, a sand bar was building in the inlet and restricting capacity at base flow. This site is not recommended for conceptual design at this time, but could be considered as a future potential site if additional sites are needed. Regular maintenance of the inlet channel would be required.

RM 134.3

The preliminary design layout for RM 134.2 appears in Figure 9. It is located on a secondary channel on river right just downstream of the Phase II channel restoration site. Secondary channel inlet conditions are good for larval drift, being on an outside bend. Elevation difference is good, and excavation requirements moderate. There is some woody debris blocking the inlet to the secondary channel that has caused some sediment buildup in the inlet. The debris requires removal and some excavation would be required to establish good flow in the secondary channel at base flow.

Access is the same as RM 127.2, except there are only about 5 miles of dirt road beyond the pavement. There is moderate traffic on the road close to this site. The site is hidden from the road, but sufficiently close to it that there may be a vandalism risk. Although it is high in the river, larval captures are regularly achieved upstream of this site.

This site is not recommended for conceptual design at this time, but is considered a high priority site in the future if additional sites are needed. Some secondary channel inlet maintenance may be required.

RM 135

The preliminary design layout for RM 135 appears in Figure 10. It is located on the secondary channel that was restored as a part of the Phase II channel restoration project. The site has excellent properties and is readily accessible by the same road described for RM 134.3. The main limitation to this site is that it is immediately adjacent to the BIA road in an area that has historically been a dumping ground. The possibility of vandalism is high and additional security precautions will be required.

Even with the security limitations RM 135 was selected for conceptual design, the results of which are presented in this report.

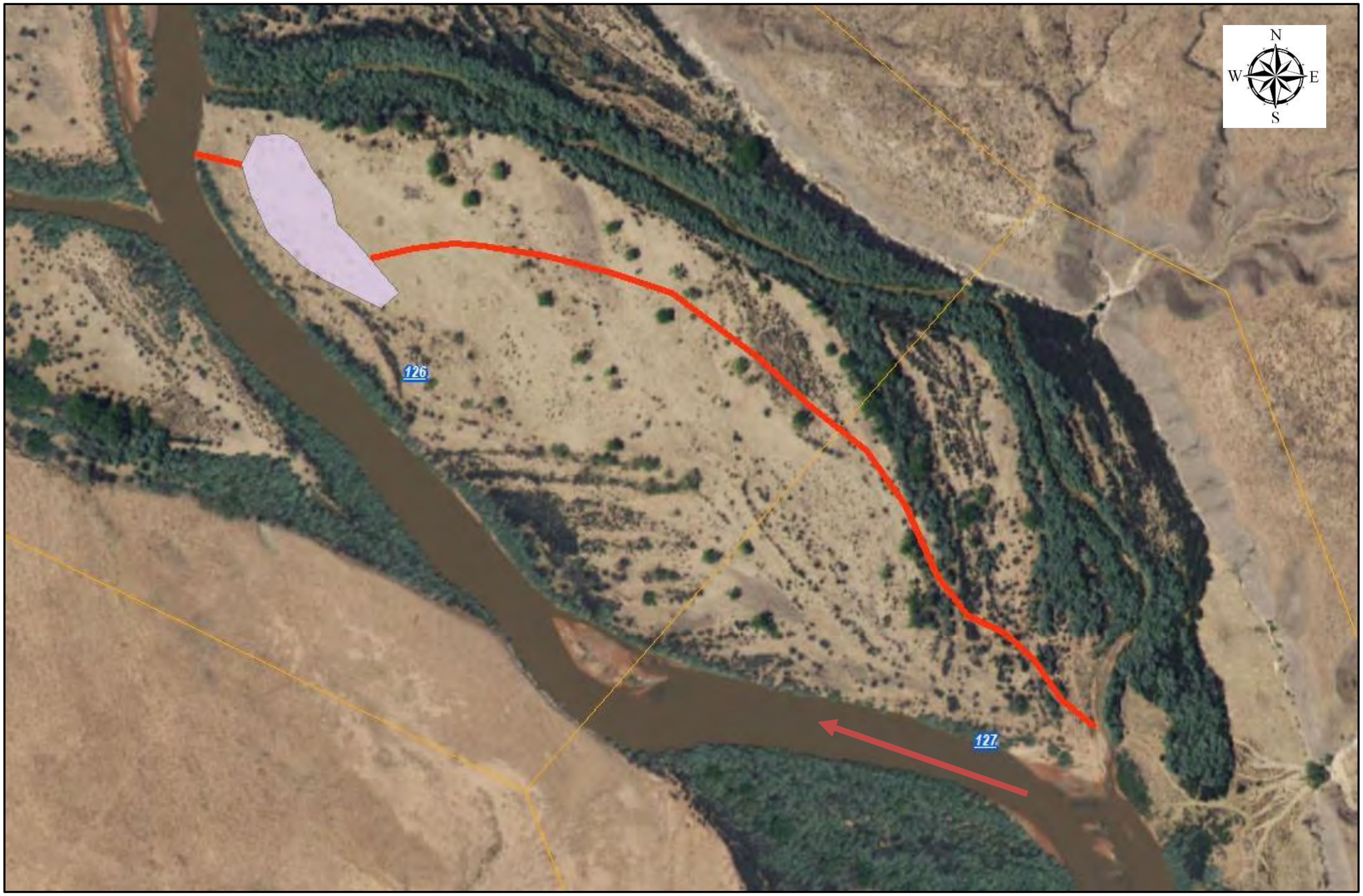

Figure 8. Preliminary Design Layout RM 127.2

Figure 9. Preliminary Design Layout RM 134.3

Figure 10. Preliminary Design Layout RM 135 (Phase II Site)

Site Visits

Seven of the nine sites listed in Table 2 were inspected in the field on April 12-13, 2017. RM 71 was not inspected as it was eliminated from the list once its location in Bears Ears National Monument was established. RM 123 was also eliminated from inspection based on its high cost and more remote location.

The inspection team consisted of the following individuals:

- Robert Findling – The Nature Conservancy
- David Gori – The Nature Conservancy
- Ron Bliesner – Keller-Bliesner Engineering
- Aaron Bliesner – Keller-Bliesner Engineering
- Scott Durst – SJRIP
- Nate Franssen – SJRIP
- Craig Townsend – BLM
- Vince Lamarra[1] – Ecosystems Research Institute, Inc.
- Dan Lamarra[2] – Ecosystems Research Institute, Inc.

During the site visits, the design conditions and relative merits of the sites were discussed among the field inspection team. Inlet and outlet conditions and potential pond areas were inspected. Access and site challenges were also noted. Drone photographs were taken at each site.

Site Selection for Conceptual Design

As a result of the field inspections, the sites were prioritized (Table 3) and the top two priority sites were selected for conceptual design. Sites RM 107 and RM 135 were the highest priority sites identified and were selected for conceptual design. RM 80.7 at Recapture Lodge was rejected for further consideration in the future because of its multiple limitations. Even though sites RM 123 and RM 71 were not visited, they could be considered for future sites if needed.

CONCEPTUAL DESIGNS

The sites at RM 107 and RM 135 were selected for further analysis and conceptual designs were completed for both sites.

To control sediment inflow and contain the larval fish during the growout period, each pond contains an inlet and outlet control gate. The inlet control gate is a 4 ft x 4 ft rectangular slide gate mounted on a pre-cast concrete box. There is a bar screen with 2-inch bar spacing of the front of the box to prevent large debris and adult fish from entering the inlet channel. On each side of the inlet gate is a pre-cast concrete wingwall to contain the bank material around the gate. Riprap is placed on either side of the gate wingwalls to prevent erosion at high flow. A conceptual drawing of a typical inlet gate and box is shown in Figure 11. The inlet profile is in Figure 12. The outlet gate configuration is shown in Figure 13. It consists of a 4-ft wide concrete box with a wedge-wire fish screen with 0.25-inch open space between bars and a 2-ft diameter gate. The outlet box includes slots for flash boards to allow controlled flow-through operation if desired for improved entrainment.

[1] First day only

Table 3. Prioritized List of Potential Sites

Priority	RM	Description	Est. Cost	Land Ownership	Pros	Cons	Visit
			Sites Selected for Conceptual Design				
1	107	River Right, Island between flowing secondary and main channel	$355,000	Navajo	good inlet conditions, good position, lowest cost, good security	access, increased sediment load being further downstream	13-Apr
2	135	River Right (Phase II site)	$506,000[2]	Navajo	good access, good inlet condition, best configuration	position (high in river), Security (dumping area)	12-Apr
			Other Sites Visited				
3	134.3	River Right flowing	$331,000	Navajo	access, good inlet position	high position, inlet maintenance	12-Apr
4	109	River right flowing	$349,000	Navajo	Good position along river, good inlet condition	poor access, long inlet channel, inlet maintenance	13-Apr
5	127.2	River Right RERI site	$338,000	Navajo	good pond location with adequate elevation	inlet sedimentation requiring maintenance, higher cost, access, long inlet channel	12-Apr
6	122	River left, not flowing	$326,000	Navajo	Good inlet condition, stable secondary, shorter inlet channel	Position higher than optimum, channel sedimentation due to low gradient	13-Apr
7	80.7	River Right - Recapture lodge[3]	$329,000	Private / BLM	Good position, good access, good security	Long inlet channel, inlet culvert, no inlet embayment, private canal, BLM/private land, sediment	13-Apr
			Sites Not Visited but With Future Potential				
8	123	River left, flowing	$427,000	Navajo	good pond site	Poor access, high cost	none
9	71	River Right	$319,000	Bears Ears Nat. Mon.	Good position, good inlet	Poor access, located in Bears Ears National Monument	none

[2] High cost due to required security fence
[3] This site is not recommended for future consideration do to the numerous limitations.

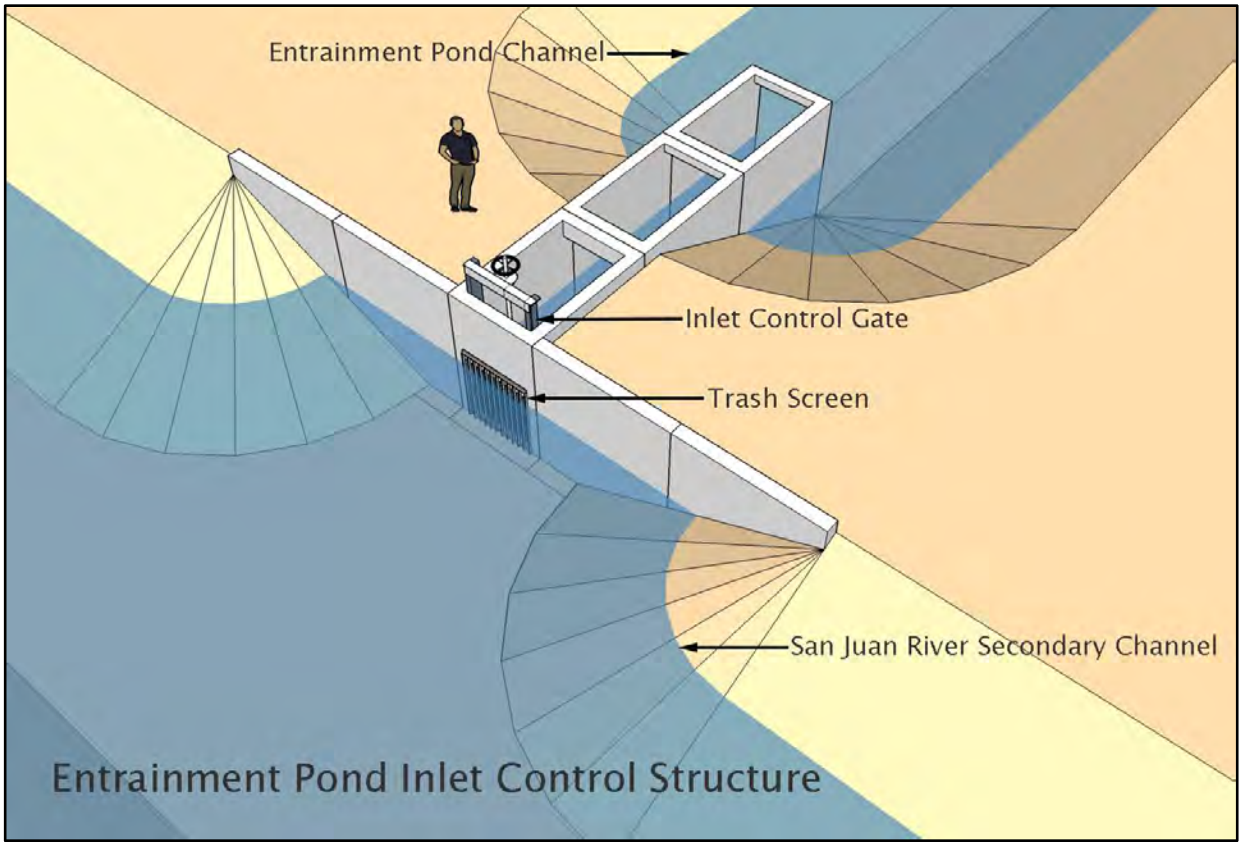

Figure 11. Conceptual Inlet Control Structure

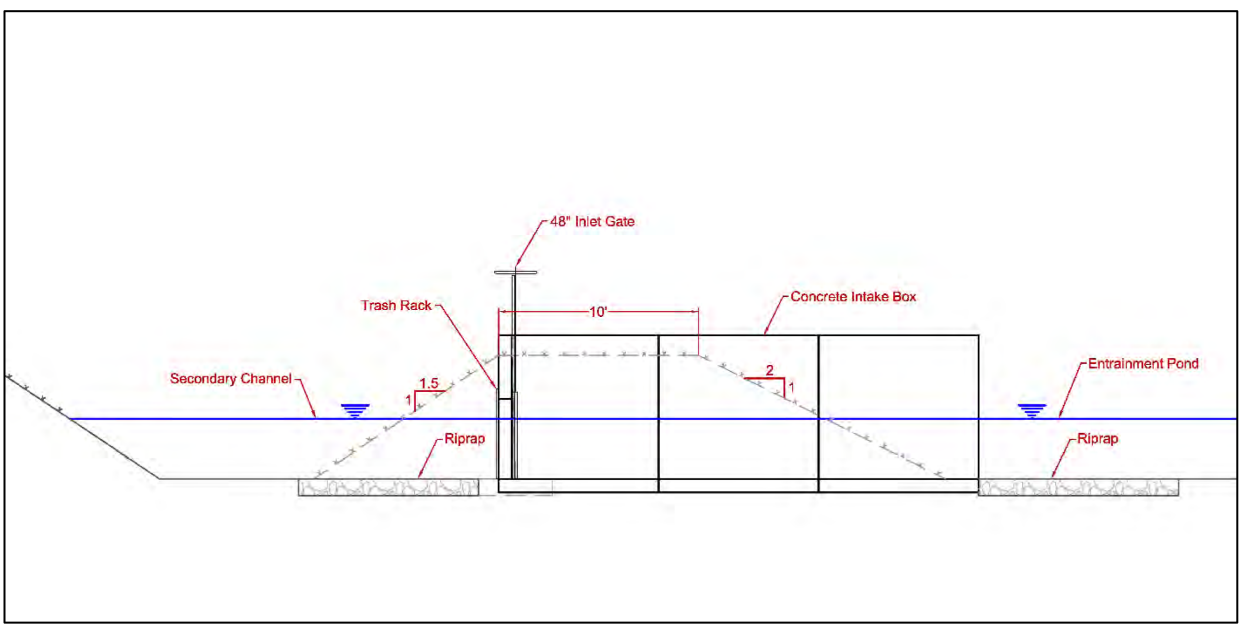

Figure 12. Profile Through Inlet Structure

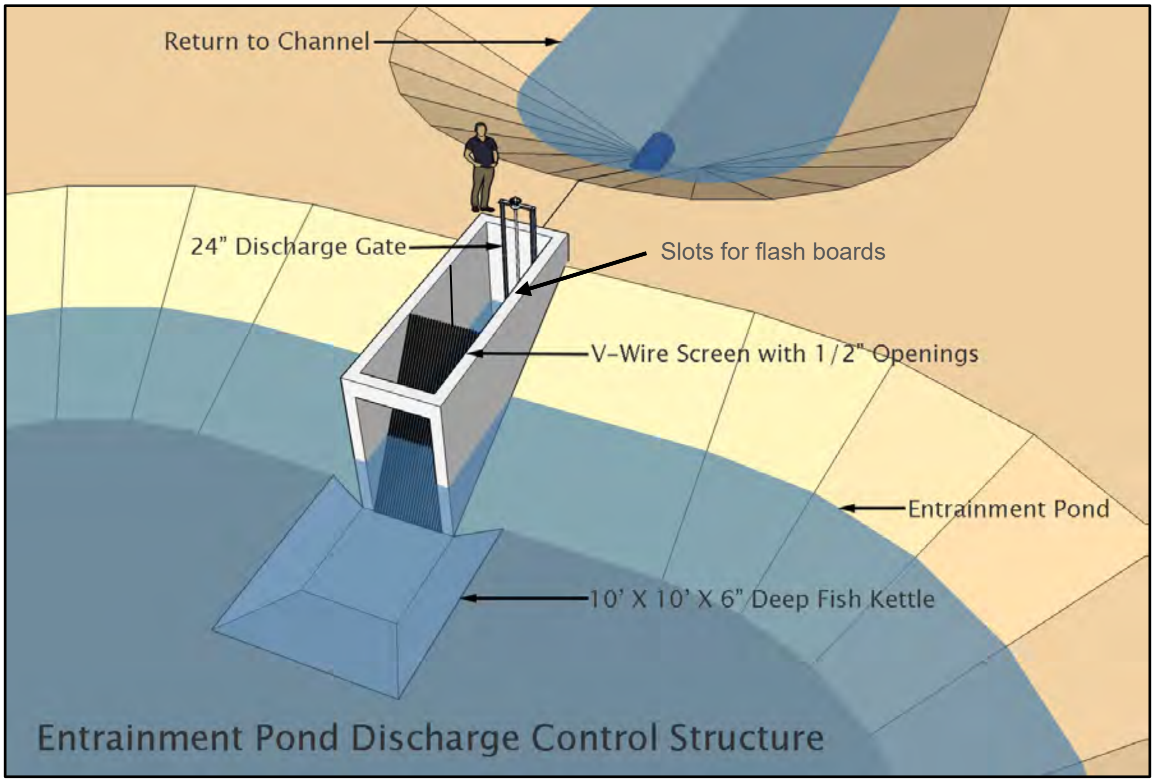

Figure 13. Conceptual Outlet Control Structure

There is a 10 ft x 10 ft kettle in front of the screen to facilitate fish harvest and sorting as water is drained from the pond. The kettle will have a gravel bottom with the pond bottom sloping 3:1 toward the kettle. The profile through the outlet works is shown in Figure 14.

It is anticipated that the excavation at both sites will be below the water table, although the water table will be higher at the RM 135 site. Final excavation will likely require a hydraulic excavator rather than bull dozer or earth mover. Water levels will be determined in final design.

RM107 Conceptual Design

RM 107 is ideally positioned along the river. Its position is below much of the razorback spawning area as evidenced by larval captures above its location and is sufficiently up-river from the canyon reaches to allow released yoy razorback sucker to acclimate to river conditions before being lost to Lake Powell.

The conceptual layout for RM 107 is shown in Figure 15. A forebay would be constructed in the secondary channel upstream of the inlet gates to provide an attraction area for larval fish. The inlet is located about 900 ft downstream of the secondary channel inlet that supplies flow to the facility (Figure 4).

The components of the facility and the estimated cost are shown in Table 4. Estimated annual maintenance costs are also shown in the table. The total estimated cost is $355,000 with an estimated average annual maintenance cost of $9,800.

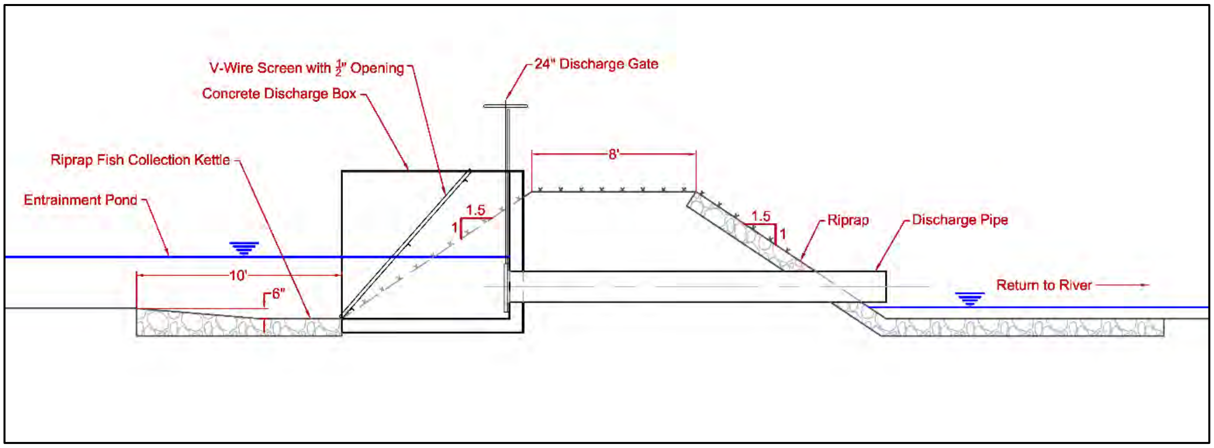

Figure 14. Cross-Section of Outlet Works

RM135 Conceptual Design

RM135 is less ideally positioned along the river, being 28 miles further upstream than RM 107, but is still below a number of sites where larval razorback sucker are regularly captured. This further upstream site will experience less suspended sediment and has better access than RM 107. It is located on one of the secondary channels that was restored during the phase II restoration project and the pond location is well suited to development.

The major drawback is its location adjacent to a well-travelled gravel road and near an area that is an active dump site. To control access to the pond in this location, a 6-ft high chain-link security fence is proposed, which substantially increases the cost at this location. The conceptual layout is shown in Figure 15.

The inlet is on an outside bend of the restored secondary channel. To provide a low velocity area to attract larval razorback sucker, an embayment will be excavated at the bend as shown on Figure 15. The outlet will return to the secondary channel downstream of the pond at a location that provides the needed elevation difference to drain the pond.

The components of the facility and the estimated cost are shown in Table 5. Estimated annual maintenance costs are also shown in the table. The total estimated cost is $506,000 with an estimated average annual maintenance cost of $12,000.

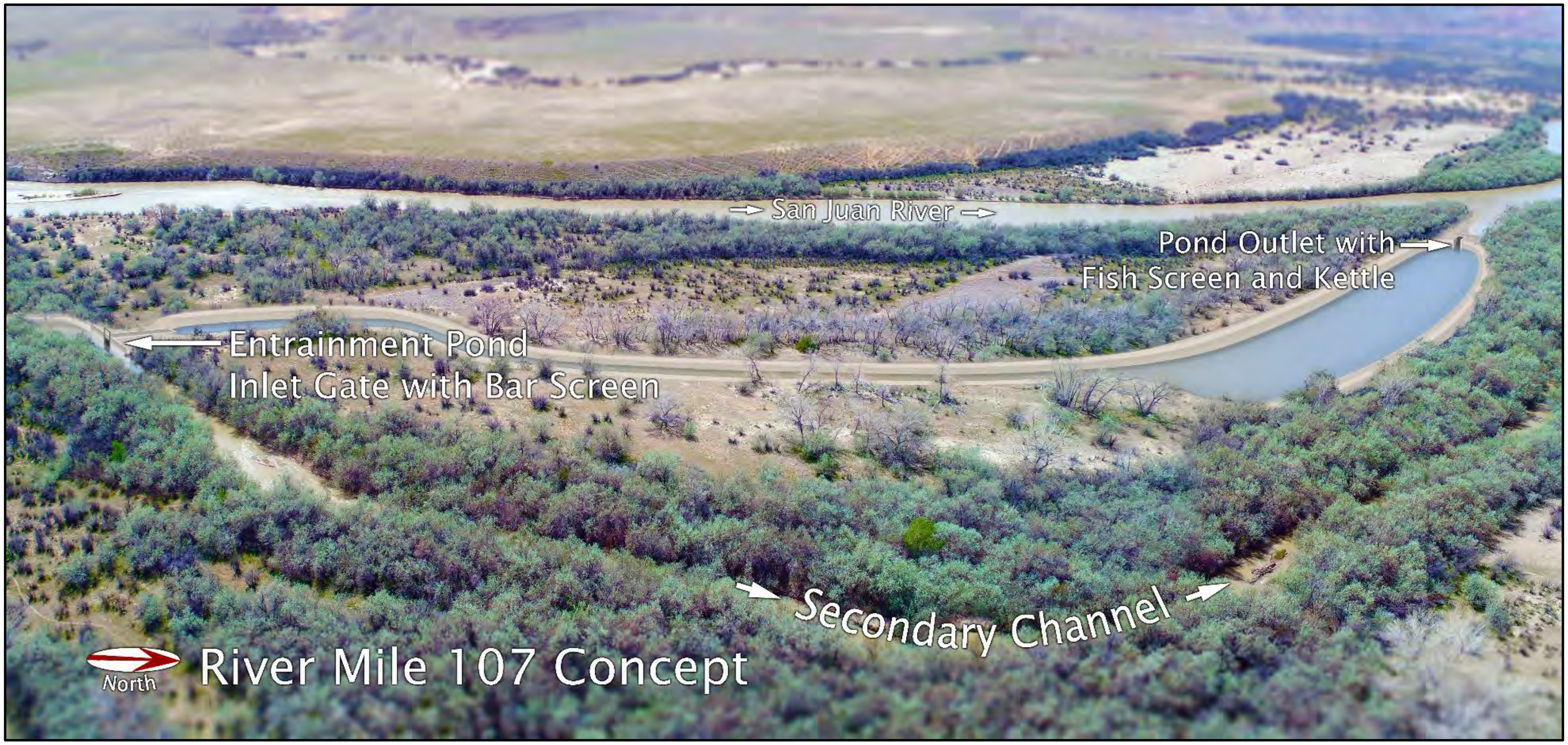

Figure 15. Conceptual Layout for RM 107

Figure 16. Conceptual Layout for RM 135

Table 4. Cost Estimate for RM 107

Item	Description	Quantity	Units	Unit Cost	Total	Annual Maintenance
1	Mobilization and demobilization	1	LS	$25,000	$25,000	
2	Clearing and Grubbing	3.5	acres	$9,000	$31,500	
3	Excavate Inlet embayment	1,020	yds^3	$3	$3,100	$3,000
4	Excavate inlet channel	3,940	yds^3	$3	$11,800	
5	Excavate pond and outlet channel	11,200	yds^3	$3	$33,600	
6	place and compact embankments	14,050	yds^3	$4	$56,200	
7	Rip rap	90	yds^3	$50	$4,500	
8	Precast concrete inlet structure	1	ea	$16,000	$16,000	
9	precast concrete outlet structure	1	ea	$3,000	$3,000	
10	4 ft x 4 ft rectangular inlet control gate	1	ea	$10,000	$10,000	$500
11	24" circular canal gate - outlet	1	ea	$2,500	$2,500	$100
12	24" Corrugated HDPE pipe - outlet	30	ft	$30	$900	
13	4 ft x 10 ft stainless steel outlet bar screen with 1/2" openings	1	ea	$5,000	$5,000	$100
14	Revegetation & site restoration	1	ls	$30,000	$30,000	$3,000
					-	
15	Subtotal				$233,100	$6,700
16	Contingency	15%			$35,000	$1,000
17	Permitting (COE, Navajo Nation)				$15,000	
18	Engineering and Construction oversight	25%			$58,300	$1,700
19	Navajo Nation Tax	6%			$14,000	$400
	Total Preliminary Cost Estimate				**$355,400**	**$9,800**

Table 5. Cost Estimate for RM135

Item	Description	Quantity	Units	Unit Cost	Total	Annual Maintenance
1	Mobilization and demobilization	1	LS	$25,000	$25,000	
2	Clearing and Grubbing	3.3	acres	$9,000	$29,700	
3	Excavate inlet embayment and pond	14,530	yds^3	$3	$43,600	$2,000
4	Excavate outlet channel	2,740	yds^3	$3	$8,200	
5	place and compact embankments	15,020	yds^3	$4	$60,100	
6	Rip rap	90	yds^3	$50	$4,500	
7	Precast concrete inlet structure	1	ea	$16,000	$16,000	
8	precast concrete outlet structure	1	ea	$3,000	$3,000	
9	4 ft x 4 ft rectangular inlet control gate	1	ea	$10,000	$10,000	$500
10	24" circular canal gate - outlet	1	ea	$2,500	$2,500	$100
11	24" Corrugated HDPE pipe - outlet	30	ft	$30	$900	
12	4 ft x 10 ft stainles steel outlet bar screen with 1/2" openings	1	ea	$5,000	$5,000	$100
13	Security Fence	2,900	ft	$30	$87,000	$2,200
14	Revegetation & site restoration	1	ls	$30,000	$30,000	$3,000
					-	
15	Subtotal				$325,500	$7,900
16	Contingency	15%			$48,800	$1,200
17	Permitting (COE, Navajo Nation)				$15,000	
18	Engineering and Construction oversight	25%			$81,400	$2,000
19	Navajo Nation and New Mexico Tax	11%			$35,800	$900
	Total Preliminary Cost Estimate				**$506,500**	**$12,000**

CONCEPTUAL OPERATION PLAN

The refugia facilities at both sites are designed to retain larval fish between larval drift during peak runoff and October of each year. The design is sufficiently flexible to allow options in the way they the facilities operated. Two potential operation plans are presented. Others are possible. The first is preferred to limit sediment intake if sufficient larval fish move into the pond. If not, it may be necessary to make minor modifications to all inflow throughout the peak drift, described in the second operating plan.

Under either plan the inlet gate would be opened on the ascending limb of the hydrograph when larval razorback sucker are most likely to be moving down river (see next section for timing) and remain open until drift diminishes. The sooner the gates are closed after peak runoff, the greater the initial depth in the pond, the less the opportunity for entraining non-native predators and the less the volume of sediment entrainment. Operation would begin with an empty reservoir and with the outlet gate closed to retain any larval fish that enter the pond.

Preferred Operation for Limiting Sediment Intake

To limit the amount of sediment taken into the pond, the outlet gate would remain closed during the entire time the inlet gate is open. When initially opened, any larval in the forebay upstream of the inlet gate would be drawn into the reservoir. Since the capacity is small, this initial filling would last less than 24 hours, after which larvae would primarily have to enter the inlet actively, seeking low velocity habitat. Since the 4-ft wide gate would be fully open, they could easily move into the pond, but there would be very little current (primarily current during diurnal change in river flow allowing the pond to “breath”) to draw them in. After the bulk of the larval drift has occurred and river flows are still high (usually late May or early June), the intake gate would be closed to retain as much water as possible in the pond and to limit intake of additional sediment and non-native fish. Seepage and evaporation will reduce the level of water in the pond after closing. If the pond drops to a preset elevation that is less than 3.0 feet above the deepest portion of the pond, the inlet gate would be opened to add water. It is anticipated that this would be required 3 to 5 times before draining in October. The inlet gate should not be opened during storm events when sediment loads are high.

At a time selected by the SJRIP biologists (anticipated to be in October), the outlet gate would be open and the pond drained to a depth that would allow harvest of the contained fish. The outlet screen would prevent escapement of any fish larger than 1/4-inch in width. The outlet gate can be used to lower the water level in stages to facilitate harvest. It is intended that the pond would then remain empty until being filled in the spring. Any required maintenance could be accomplished during this empty period. It could be refilled during winter months if needed to prevent encroachment of the cattails established as cover and then drained in March prior to larval drift.

Alternate Operation

If it is found that attraction flow is needed during the drift period to encourage larval razorback sucker to enter the pond, flashboards can be added to the outlet box upstream of the gate and the outlet gate opened to allow water to flow out of the pond while still maintaining the pond elevation. The discharge should be kept low (1 – 2 ft^3/sec) to limit the amount of sediment drawn into the pond. All other operation would remain the same.

Sediment Accumulation

The sediment concentration of the San Juan River during runoff typically ranges from 1,000 to 3,000 ppm. The annual sediment accumulation in the pond with the preferred operating plan would range from 170 to 500 cubic yards per year. Most of this will settle out in the inlet channel, which is easily cleaned at an annual cost of about $2,500.00-$3,500.00. If the sediment load is uniformly distributed in the pond, the accumulation would range from 0.07 to 0.20 inches per year, suggesting a service life of the pond of more than 20 years.

With 30 days of flow-through operation at 2.0 cfs, the sediment accumulation would double, but most would still accumulate in the inlet channel where it could more easily be removed.

As long as the gates are not opened during storm events when the sediment concentration typically exceeds 10,000 ppm, the facility should operate for more than 20 years with annual maintenance to remove sediment from the forebay and inlet channel.

MONITORING OPTIONS

To effectively manage the facility and assess its effectiveness, some monitoring will be necessary. We have divided the monitoring discussion into operational and performance monitoring categories. Performance monitoring is covered in a separate document.

Operational Monitoring

Monitoring the sites annually for sediment accumulation will be required. We recommend inspecting the ponds following draining in the fall and removing any sediment accumulation in the inlet forebay or inlet and outlet channels that may restrict the operation of the facility. At this same time the control structures would be monitored for condition and any repairs would be made. Budget was included in the O&M cost estimate for these activities.

We also recommend monitoring dissolved oxygen (DO) and temperature within the pond. A monitor with logger is recommended, such as Hobo by Onset or MiniDOT by PME. The data would be periodically downloaded through the season when the site was visited to add water to the pond. During the site visit it may be advisable to use a portable probe to check DO in locations other than the logger location to check DO distribution in the pond. If DO levels fall below a pre-determined level, fresh water could be added. If this is inadequate to maintain DO, it may be necessary to harvest the fish or install an aerator in the pond.

CONCLUSIONS AND RECOMMENDATIONS

Eight potential sites were identified where managed ponds could be constructed with gravity inlets and outlets to provide refugia for larval razorback sucker in the San Juan River between RM 71 and RM 135. The sites could accommodate ponds of at least 2-acres in extend with minimum depths of 3.0 ft. Each of these sites could maintain water supply to the ponds at flows as low as 500 cfs, although some of the sites may require periodic sediment removal in the secondary channel inlet to maintain flow at 500 cfs.

All but one of the sites (RM 135) are located between secondary channels and the main San Juan River, providing at least 3.5 ft of elevation difference between the inlet and outlet to the ponds for adequate pond depth for summer survival. RM 135 is located on the outside of a restored secondary channel and returns to the secondary channel.

RM 107 and RM 135 had the highest priority based on the selection criteria and were selected for completion of conceptual designs. RM 107 is expected to cost about $355,000 to construct with an average annual maintenance cost of about $9,800. RM 135 is more expensive because of the need for a security fence. Its construction cost is estimated at $506,000 with an average annual maintenance cost of $12,000. The operation cost of the facilities will depend on the level of monitoring implemented and would be in addition to the maintenance costs listed.

Because RM 107 is lower cost and is better positioned on the river to capture drifting larval razorback sucker, we recommend that RM 107 be selected for construction as a proof-of-concept facility to improve retention of larval razorback sucker and aid in recruitment of adult fish to the population.

Construction of either of these sites will require permitting, including NEPA compliance and clean water act permits. Since they are storage facilities and will increase evaporation in the San Juan River, they may also require water rights. RM 107 is located in Utah and RM 135 in New Mexico. They are both on Navajo land. The Navajo Nation has a water rights settlement with New Mexico and the water right for the operation of the pond may be obtainable on a lease basis from the Navajo Nation. The water rights settlement in Utah is still under negotiation, but since the facility is on Navajo land, working with the Navajo Nation on water rights will be necessary. We recommend that the Navajo Nation be contacted concerning water rights and it may be advisable to have the water right issue reviewed by the Department of Interior Solicitor.

These are actively managed facilities and will not continue to operate without being managed. Some on the SJRIP biology committee have expressed a desire to use a more passive approach. This was examined but rejected because of the difficulty of maintaining such a facility. Facilities that flood and fill with water to be flushed during the next season also capture a great deal of sediment and would likely last only one or two seasons. Increasing the abundance of backwaters may be possible by excavating larger backwaters at the lower ends of secondary channels and altering the secondary channels to provide adequate flushing flows. Some success has been seen with the secondary channel restoration work in this regard, although that was not the main focus of the restoration work.

We believe that the best way to test the effectiveness of pond-type refugia for razorback sucker larvae to enhance recruitment is with a managed facility that can more easily be monitored and controlled. What is learned from the operation of this proof-of-concept facility may also be used to design more passive facilities to augment the production of managed ponds.

Channel Catfish Management on the San Juan River

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Overview

The establishment of nonnative fishes including Channel Catfish (*Ictalurus punctatus*) and Common Carp (*Cyprinus carpio*) has been identified as a detriment to the recovery of Colorado Pikeminnow (*Ptychocheilus lucius*) and Razorback Sucker (*Xyrauchen* texanus) (USFWS 2002a, b). Reducing the impacts of nonnative fishes has specifically been identified as a management element in the San Juan River Basin Recovery Implementation Program's Long Range Plan (SJRBRIP 2015). However, the level of threat that Channel Catfish pose on endangered fishes remains unknown. In the absence of rigorous evaluation, Channel Catfish are thought to pose a threat to native fishes in multiple forms such as: predation, competition for resources, and as a choking hazard to the piscivorous Colorado Pikeminnow. In an effort to quantify the threat nonnative fish pose to recovery, an ongoing two-year study assessing the predatory effect of Channel Catfish on endangered fishes was initiated in 2018.

On November 30, 2017, the San Juan River Basin Recovery Implementation Program (SJRBRIP) convened a nonnative fish workshop to discuss results from the modified management during 2016-2017 and to plot a course for future nonnative fish management efforts on the San Juan River. It was determined that work in 2018 and 2019 by the New Mexico Fish and Wildlife Conservation Office (NMFWCO) and Utah Division of Wildlife Resources (UDWR) would support efforts, as identified in Kansas State University's (KSU) SOW 18-26 *Incidence and consumption of endangered fishes by Channel Catfish (Ictalurus punctatus) in the San Juan River,* to quantify the predatory effects Channel Catfish have on the two endangered fishes in the San Juan River. Additionally, it was determined that mark-recapture would be initiated for Channel Catfish to generate more precise population estimates, detection probabilities, and annual survival rates. Data from both stomach content analysis (i.e., percent predation) and abundance/survival estimates (number of predatory fish), when used in concert, will aid the SJRBRIP in the development of a future nonnative fish management program commensurate with the level of threat.

Preliminary results after the 2018 sampling by the NMFWCO and UDWR, estimated the adult Channel Catfish population in the sampling area at 19,177 (15,279 – 24,218) individuals. In 2018, 3,438 adult Channel Catfish stomachs were evaluated for contents by KSU, of which 7.6% contained identifiable fish (Hedden et al. 2019). Of those fish identified in Channel Catfish stomachs, 51.88% were native fish, with two being Colorado Pikeminnow. Even with the low occurrence of Colorado Pikeminnow found in Channel Catfish stomachs, a high adult Channel Catfish population could still have a detrimental effect on juvenile Colorado Pikeminnow survival. Piscivory rates ranged from 5% to 25% in the summer months with the highest occurring in mid-July. KSU also estimated Channel Catfish biomass in the San Juan River using the 2018 population estimate, Channel Catfish size structure, and length-weight relationship. In addition, the biomass of each prey species was estimated. Sky Hedden of KSU estimated the biomass of fish consumed = 16.73 grams (g) wet fish weight per 100 g catfish x San Juan River Channel Catfish biomass. He estimated that 12,040 grams of Colorado Pikeminnow were consumed in 2018 by Channel Catfish, which would equate to an average of 611 (0 – 1,783) Colorado Pikeminnow individuals. He also estimated that removing 25% of the Channel Catfish population annually would potentially result in 3,114 g of Colorado Pikeminnow biomass from being not being consumed by Channel Catfish, which would result in an estimated additional 158 (0 – 461) Colorado Pikeminnow surviving annually due to mechanical removal of adult Channel Catfish.

Until a detailed review of the data from the two-year diet study is completed to aid the SJRBRIP in the development of a future nonnative fish management program, we are proposing a concentrated effort of nonnative removal focusing on removing large adult Channel Catfish from the San Juan River during winter months when flows and turbidity are low, maximizing efficiency and sampling conditions. Previous years data has shown that raft-mounted electrofishing in the San Juan River is negatively impacted by turbid water, usually caused by rain events causing sand washes to flood in to the river increasing turbidity and resulting in lower catch rates for Channel Catfish due to limited visibility in the water. Higher flows make it harder for netters to effectively capture Channel Catfish due to the raft moving too fast downstream as Channel Catfish are in full electrotaxis and take longer to float to the surface of the water. Sampling during winter months should result in more desirable sampling conditions as flows and turbidity should be low and more predictable.

Objectives

1.) Conduct a marking pass to tag fish in order to quantify annual exploitation rates and population estimates of adult Channel Catfish.

2.) Mechanically remove adult Channel Catfish during winter to maximize sampling efficacy.

Methods

Study Area

Sampling will take place from Four Corners Bridge (River Mile 119) to Sand Island, Utah (River Mile 76). One marking pass and three sampling trips will be conducted during the winter months (November – March) when sampling conditions are optimal to maximize sampling efficacy of collecting adult Channel Catfish. Trips will only be conducted when flows are less than 1,000 CFS and turbidity is low (>250mm Secchi disk).

Tagging Protocol

Channel Catfish ≥300 mm total length (TL) captured during the marking pass will be fitted with an individual numerical T-bar anchor tag and implanted with a Passive Implant Transponder (PIT) tag and released back to the river. Tag data, length (mm) and mass (grams) will be recorded for every tagged fish. Tagging of Channel Catfish will allow us to generate exploitation rates during the sampling period as well as generate Lincoln-Peterson population estimates.

All Channel Catfish ≥300 mm TL captured on the subsequent three sampling trips after the marking pass will be removed the river. All fish will be measured to the nearest millimeter for total length, weighed to the nearest gram, and examined for a tag before being removed from the river. As the main focus of this project is removing large predatory adult Channel Catfish from the San Juan River, due to the timing of the trips and the geomorphic reach, we do not expect to see large numbers of juvenile Channel Catfish during these sampling trips, however if juvenile Channel Catfish or any other nonnative fish is observed, they will be collected and removed from the river.

Rare Fishes Captures

Due to the demographic monitoring of Colorado Pikeminnow and Razorback Sucker already taking place in the fall on the San Juan River, rare fishes will not be collected during nonnative removal efforts.

Deliverables

Data will be entered, analyzed, and presented to the SJRIP Biology Committee at a workshop following the field season. A draft report will be submitted to the Program Office by 31 March 2020 and a final report will be completed by 1 June 2020. All data will be submitted to the Program Office by 31 December 2020.

Budget

FY 2020 Budget

Nonnative fish removal - 4 trips, Four Corners Bridge, UT to Sand Island, UT. NMFWCO supplying 5 people per trip

Position	Grade/Step	Hourly Rate	Fringe	Salary w/benefits	Hours/Day	Total Days	Sub-Total
Labor Cost - Field Work (4 trips x 5 days/trip)							
Supervisory Fish Biologist	GS 12/7	$43.09	29.51%	$59.48	9	20	$10,706.40
Fish Biologist	GS 11/7	$35.95	25.57%	$47.75	9	20	$8,595.00
Fish Biologist	GS 9/7	$29.71	26.46%	$39.92	9	20	$7,185.60
Remote Biologist	GS 9/2	$25.59	25.16%	$33.74	9	20	$6,073.20
Biological Tech	GS 5/1	$16.34	7.11%	$17.55	9	20	$3,159.00
Overtime Hours (weekend or >9 hour work days)							
Fish Biologist	GS 9/7	$40.91	26.46%	$51.73	3	12	$1,862.28
Remote Biologist	GS 9/2	$37.14	25.16%	$46.48	3	12	$1,673.28
Biological Tech	GS 5/1	$24.51	7.11%	$26.25	3	12	$945.00
Administrative, Reporting, Planning							
Fish Biologist	GS 9/7	$29.71	26.46%	$39.92	9	20	$7,185.60
Remote Biologist	GS 9/2	$25.59	25.16%	$33.74	9	20	$6,073.20
Supervisory Fish Biologist	GS 12/7	$43.09	29.51%	$59.48	9	5	$2,676.60
Adminstrative Officer	GS 9/9	$31.36	26.18%	$42.22	9	2	$759.96
					Total Labor		**$56,895.12**
					FY20 3% increase		**$1,706.85**
					Total FY20 Labor		**$58,601.97**

Travel and Per Diem	Days	Rate		
Hotel Costs	16	$94.00		$1,504.00
Per Diem (Travel Day)	40	$41.25		$1,650.00
Per Diem (Full Day)	60	$55.00		$3,300.00
			Total Travel/Per Diem	**$6,454.00**

Equipment	Miles/Qty	Total Miles	Rate		
Floy Tags	2000		$0.70		$1,400.00
Vehicle Fuel 3 trucks X 4 trips - ABQ to Sand Island, UT 574 mi RT	574	6,888	$0.58		$3,995.04
Generator Fuel 30 gallons/trip x 4 trips	120		$2.85		$342.00
Maintenance, repair, replace (i.e. life jackets, waders, generator repair, dip nets, etc.)					$3,000.00
				Equipment Total	**$8,737.04**
				Sub-total for 3 trip pop est. - NMFWCO	**$73,793.01**
				USFWS Administrative Overhead (3%)	**$1,913.92**
				Total for 3 trip pop est. - NMFWCO	**$75,706.94**

Literature Cited

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U.S. Fish and Wildlife Service. 2002b. Razorback sucker *Xyrauchen texanus* Recovery Goals: amendment and supplement to the Razorback Sucker Recovery Plan. U.S. Fish and Wildlife Service, Mountain-Prairie Region (6), Denver, Colorado.

Response to Comments

Scope #	Project	PI(s)
17	SOW-17-Channel Catfish management on the San Juan River	Duran, NMFWCO

Harry Crockett, Colorado DNR, BC member

How can the technical aspects of this SOW be improved?

No recommendations.

What is this SOW's contribution to recovery?

Remains a subject of debate within the BC, but the *preliminary* diet study data presented last year suggests that removing catfish, especially larger sizes, could at minimum give the endangered fish a short-term leg up. Support continuing until the KSU diet study is finalized & then reevaluate.

Vince Lamarra, Navajo Nation, BC member

How can the technical aspects of this SOW be improved?

Winter catfish removal seems valid given the environmental conditions (low and stable flows and increased water clarity.

What is this SOW's contribution to recovery?

I support the project in that we need some level of adult catfish removal given that it is one cause of rare fish declines in the San Juan River.

Jacob Mazzone, Jicarilla Apache Nation, BC member

How can the technical aspects of this SOW be improved?

I am not in favor of just netting one target species and size, it leads to complacency. If the target fish is 300mm or greater Channel Catfish than those should be top priority, but if the netter is not saturated, all fish should be netted, and all catfish/non-natives regardless of size should be euthanized. Especially as the PI stated juvenile target species numbers should be at low density at the time of sampling. All nonnative fish will be netted and removed. Collections of Common Carp and other nonnatives are relatively low and should not affect netter from effectively netting Channel Catfish.

What if a weather event hits half way through the trip? There is no easy way to conduct multiday trips in optimal conditions, if turbidity rises during a trip, the majority of the costs have already been incurred, do you continue in bad conditions or take out asap? It seems, shorter, less logistically intensive trips might be easier to maneuver around inclement weather/turbidity/flows/etc. Since the trips will be three days long, I feel that using eyes on the ground (remote biologist) and weather predictions should allow us to complete a trip in optimal sampling conditions. If a flash occurs that increases turbidity, we will cease sampling until the river returns to favorable sampling conditions.

What is this SOW's contribution to recovery?

By removing large-bodied Channel Catfish, one could presumably create a recruitment "window" for stocked Colorado Pikeminnow. By removing larger bodied fish the reproductive capacity, and size structure of the population might be impacted in the short term. This scopes contribution to recovery is unknown, and often debated. Maybe this is an annual, or triennial "maintenance" type activity? That will be for discussion by the BC once the diet study is complete. This SOW could help guide future nonnative management actions if the shift to winter sampling results in higher exploitation rates.

Mark McKinstry, BOR, BC member

How can the technical aspects of this SOW be improved?

The SOW states that "Channel Catfish biomass in the San Juan River was estimated using the 2018 population estimate, Channel Catfish size structure, and length-weight relationship. In addition, the biomass of each prey species was estimated. It is estimated that 12,040 grams of Colorado Pikeminnow were consumed in 2018 by Channel Catfish, which would equate to an average of 611 Colorado Pikeminnow individuals." Are these figures correct? Seems like what Sky presented at BC meeting the number was in 500's??? The number I got from Sky's presentation was 611(0 - 1,783) individuals.

I think all catfish released as part of marking trip should get both floy and PIT tag. Marking catfish is cheap and we may get more information about movements when we either recapture them or detect them on antennas. The more PIT tagged fish the better in my mind. Great suggestion. I will make the change in the SOW and we will floy and PIT tag catfish during the marking pass.

What is this SOW's contribution to recovery?

Removal of CCF during periods of low flow and low turbidity COULD increase efficiency and exploitation rates. If we decided to continue NNF removal this would be very useful for effective use of time and money. Agree

Bill Miller, Southern Ute Indian Tribe, BC member

How can the technical aspects of this SOW be improved?

The SOW is clear that the objective is to remove adult Channel Catfish and provide data needed for estimating populations. The sampling is proposed to occur from November through March. The impact of cold water temperatures on electrofishing efficiency is not stated in the SOW. Has electrofishing been conducted after November and before March (e.g December, January) that would show whether the effort during those months would be successful. It may be more productive to concentrate the trips during the warmer times of the proposed time frame in November and March. Based on my observations during February 2018 sampling in freezing temperatures and the large number of adult Channel Catfish collected I feel sampling during winter months will be successful.

What is this SOW's contribution to recovery?

The SOW continues a management action that addresses a stated threat to recovery.

David Mueller, BLM, BC member

How can the technical aspects of this SOW be improved?

If Common Carp are also found to be a detriment to recovery, are they being removed as well? The data presented at the end of Nov suggested that Channel Catfish were opportunistic, with piscivory focused on prey slightly smaller than the individual, mainly other Channel Catfish. The data also suggested that removal did not alter abundance, but instead altered the age class structure. My concern is that targeted removal of large Channel Catfish will result in more small individuals that would in turn, target smaller individuals, possibly native species. I agree with effort being targeted towards the time/location where the most success will occur of removing all detriments to recovery and further informing the degree of threat and if removal is actual having a significant impact. Yes, Common Carp are removed as well, however collections of Common Carp have become infrequent. While Channel Catfish did prey upon other catfish, 32% of the fish consumed were native fishes with an average total length of 110 mm.

What is this SOW's contribution to recovery?

This will further inform the degree of threat from nonnative fishes and somewhat mitigate that threat from removal of individuals

Ben Schleicher, USFWS R6, BC member

How can the technical aspects of this SOW be improved?

Does existing data show that there are large fish in the section from Shiprock Bridge to Sand Island in the spring or winter? In past years when NNR was starting early, catfish were hard to find the first 24 miles. There are known "hot spots" for catfish that exist below Sand Island was well. Based on sampling trips by KSU in Febuary 2018 and the adult monitoring sampling that took place from Shiprock Bridge, NM to Clay Hills, UT in March 2019, adult Channel Catfish were observed in higher densities from Four Corners Bridge to Sand Island.

What is this SOW's contribution to recovery?

If large catfish are a threat to small bodied native fish then removal of this threat would be the most direct way to aid in recovery.

Tom Wesche, Water Development Interests, BC member

How can the technical aspects of this SOW be improved?

Based on past experience, the PI should be able to propose sampling on a set number of river miles where success may be likely. Also, some additional discussion of the efficacy of winter sampling would be helpful. While it true that low flow and clear water conditions should be helpful, the inactivity of the fish at this time of year may affect their catchability. Has the Program made past winter fish collections that would substantiate the benefits of winter collection? Sampling will take place from Four Corners Bridge (RM 119) to Sand Island, UT. (RM 76). Based on recent sampling by KSU in Febuary 2018 and the adult monitoring sampling that took place from Shiprock Bridge, NM to Clay Hills, UT in March 2019, fish inactivity did not seem to affect catch rates of Channel Catfish in the areas proposed for sampling in this SOW. This SOW would help answer some of the unknowns about winter sampling efficacy and help guide future nonnative fish management actions.

What is this SOW's contribution to recovery?

Until the KSU Diet Study is completed and reviewed, the contribution of this SOW to recovery is a lower priority when compared to other SOW's being reviewed. I recommend it be held back until more is known about channel catfish effects on the endangered fish. When the KSU diet study is completed, it will be two years of not doing any nonnative removal in the San Juan River. While the second year of data will help the Program decide on future nonnative fish management, nonnative removal at some level should be completed in FY20. Removing adult Channel Catfish in the winter of 2019 could potentially aid in the survival of juvenile Colorado Pikeminnow and Razorback Sucker overwinter.

Brian Westfall, BIA, BC member

How can the technical aspects of this SOW be improved?

What is this SOW's contribution to recovery?

With all the question on the need and effectiveness of NN removal to the recovery of CPM and RBS this should be at the bottom of the list.

Matt Zeigler, NMDGF, BC member

How can the technical aspects of this SOW be improved?

This SOW lacks measurable objectives. What is the target exploitation rate? How will the population level effect of nonnative removal on both endangered species be measured? How will efficiency of winter mechanical removal be measured? 25% or greater would be a desired exploitation rate. While population level effects on rare fish would be difficult to measure, we will use the demographic monitoring data to determine survivorship of age-1 Colorado Pikeminnow. Using the 2018-2019 diet study Channel Catfish population estimate, Channel Catfish size structure, and length-weight relationship we can estimate the amount of Channel Catfish biomass removed and the potential estimate of the number of Colorado Pikeminnow that would be “saved” by removing these Channel Catfish. Catch per unit effort will be used to compare winter removal to previous year’s data during other seasons to determine if catch rates are higher during winter months and sampling conditions.

The SOW states that the section of river sampled and the timing of trips will be determined using previous data collected during the winter. What data is the PI referring to? Does this data support the shift to winter sampling? Second, why is the analysis of data to identify the proposed section to be sampled not included in this SOW? This information should be presented in the SOW so it can be reviewed. Although this section of river has not been intensively sampled during winter months, following discussions with other biologists, researchers and using some anecdotal data would suggest we concentrate our efforts between Four Corners Bridge and Sand Island, UT. Data has shown that turbidity effects catch rates when electrofishing for Channel Catfish in the San Juan River. Most times sudden increases in turbidity can be caused by rain events, sand washes flooding in to the river, increased flows and irrigation returns. By sampling during winter months, these factors increasing turbidity should greatly be reduced. This is why I proposed to try sampling in the winter to reduce the effectiveness of higher turbidity on catch rates.

What does the author define as “low” turbidity? A comparison of available turbidity data from the Four Corners, CO USGS gage (gage # 09371010) indicates that turbidity during the proposed winter sampling months (November – March) is not any different than summer months (April – August), except for 2018 (Figure 1). Given the planning required for these trips, it also seems unlikely that they can be flexible enough to sample only when certain conditions are present (i.e., flow less than 1,000 cfs and low turbidity). I would define low turbidity as anything 250mm or greater on a secchi disk reading. Figure one does show summer and winter months can have no significant differences in turbidity, however, when looking at the turbidity data for those same winter months that you’re saying are no different than summer months, there are definitely gaps where lower turbidity exists and a trip can be completed. These trips will be three days long and consists of four personnel from the NMFWCO office, making these trips less extensive to plan and increases the flexibility of getting trips completed during optimal sampling conditions and rescheduling if conditions are not favorable.

What are the expected effects of low water temperature on capture rates of Channel Catfish? Capture rates of Colorado Pikeminnow are much lower in the winter compared to summer and fall, is there any data to suggest that it is opposite for Channel Catfish? I expect the lower water temps to help increase catch rates of Channel Catfish. Observations I made in February 2018 during sampling with KSU near Montezuma Creek, Utah in freezing temperatures we found large numbers of adult Channel Catfish in shallow areas of the river.

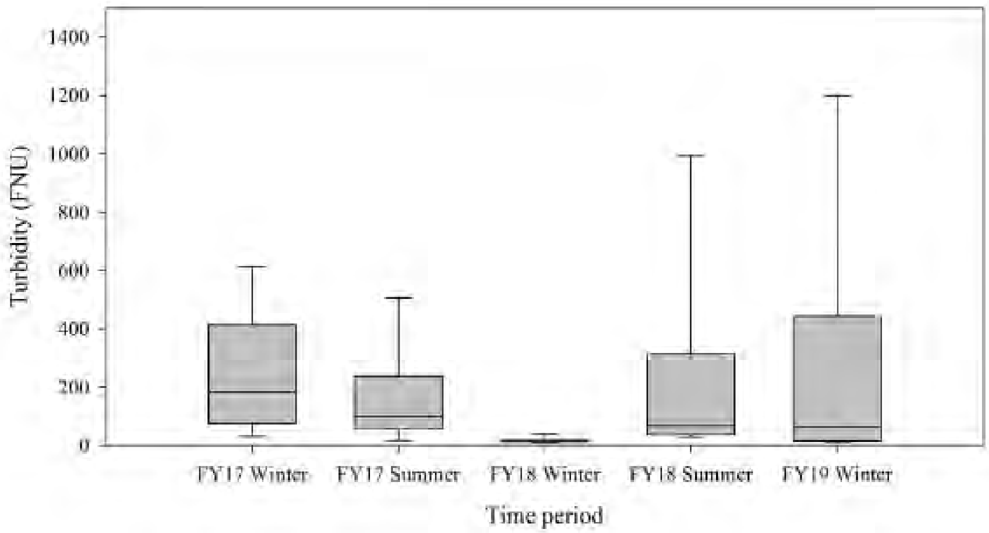

Figure 1. Box whisker plots of daily mean turbidity readings of the San Juan River in the winter (November to March) and summer (April to August) at Four Corners, CO in fiscal year (FY) 2017, 2018, and 2019. The boundary of the box closest to zero indicates the 25th percentile, the middle line the median, and the boundary of the box farthest from zero indicates the 75th percentile. The whiskers indicate the 10th and 90th percentiles.

What is this SOW's contribution to recovery?

A significant amount of Program effort has been expended the past several years to determine the effect of Channel Catfish removal. However, both the experimental design and the first year's results from the predation study have shown no significant population level effects of Channel Catfish on either endangered species. Given the results of these studies (and prior ones) I cannot see how this project has any meaningful contribution to recovery. The SOW also provides no evidence that shifting removal to winter will be more effective. It appears that nonnative removal is reverting to previous methods that have shown no contribution to recovery. Previous methods of nonnative removal were focused on trying to crash the Channel Catfish population riverwide. This SOW is focused on removing adult Channel Catfish in a smaller reach during a time we feel will optimize sampling conditions. During the 2016 spring sampling using the experimental treatment/control design, we showed that with desirable sampling conditions (low flow, low turbidity) and smaller reaches, we were able to reach an exploitation rate of 48.6% for adult Channel Catfish. Although there is not a lot of data to suggest shifting efforts to winter will be more effective, we feel that sampling conditions will be more consistent and favorable and this SOW will help answer that question and help guide future nonnative fish management actions.

Brian Bledsoe, Peer Reviewer

How can the technical aspects of this SOW be improved?

Not my expertise.

What is this SOW's contribution to recovery?

Wayne Hubert, Peer Reviewer

How can the technical aspects of this SOW be improved?

It is recognized that the author of the SOW is presenting the findings of other researchers in the summary of 2018 results. The sources of the information in the paragraph should be clearly explained. More detail would be worthwhile in the paragraph beginning at line 56.

Heddon et al. (2018) is referenced on line 59, but the citation is not included in the Literature Cited. Not only should the citation be included, but a description of the research team and what they are doing should be presented in the SOW.

The expanded information should identify who conducted the population estimates and include details of the population estimate including the estimator used, the precise estimate, and (most importantly) the 95% confidence interval for the estimate.

On line 58 it is stated that 3,438 channel catfish stomachs were sampled and two Colorado pikeminnows were found. The source of these data should be clearly identified and the fact that these are preliminary data should be acknowledged. In order to justify the focus on adult fish removal in 2020, the occurrence of fish in stomachs as a function of length could be described. All of the above comments have been corrected in the SOW.

Beginning on line 67, data used in the bioenergetics modeling exercise are presented (i.e., it was estimate that 12,040 g of Colorado pikeminnow were consumed). The source of these data should be identified and it should be noted that they are preliminary. The modeling exercise is key to justifying continued removal of channel catfish; consequently, it should be fully explained. It should be identified that USFWS staff conducted the bioenergetics modeling. Further, what was the model that was used and what parameter estimates were needed to run the model? The accuracy and precision of parameter estimates used in the model computations should be divulged and the assumptions made in the computations should be described. It was concluded that 611 Colorado pikeminnows were likely to have been consumed in 2018 without acknowledgment of the potential for proliferation of error in the estimate or the precision of the estimate. This should be addressed. Corrected in the SOW

A change in removal methods is proposed for 2020 with a focus on removal during winter (line 70). The rationale for this change in strategy needs full explanation. It is stated on line 98 that “sampling conditions are optimum” during winter. Explanation is needed as channel catfish are generally less susceptible to boat electrofishing during winter. Are modifications of the electrofishing gear or capture techniques planned? Modifications of gear or capture techniques are not planned for winter sampling, other than changing settings to meet conductivity of water requirements. Rational for sampling during winter is to target fish during low turbidity/low flow conditions.

How will the estimates of channel catfish abundance and length frequency be altered by winter sampling? Potential biases when comparing to previous years of data should be considered. It is noted (line 100) that a Lincoln-Peterson Index will continue to be applied. Is there a better estimator? It would be good to consult with experts in population estimation methods to determine if this is the best approach. A marking pass at the beginning of the sampling period will allow us to generate exploitation rates and population estimate. I will look in to other methods for estimating population size. I will note the bias to comparing this to previous years, however that is not the goal of this SOW and exploitation rates of winter sampling can show how effective we are at mechanically removing fish in the winter.

What is this SOW’s contribution to recovery?

It is not known if the removal of channel catfish is an effective strategy in the recovery efforts.

There is indication from the bioenergetics modeling that channel catfish predation may be affecting recovery. However, the outcome of the bioenergetics modeling to date is rudimentary. As mentioned above, more focus is needed on the quality of the parameter estimates, proliferation of error in the model computations, and the accuracy and precision of subsequent consumption estimates. The outcome of the research by the team from Kansas State University is needed to inform future decision regarding channel catfish removal.

The focus on the 2020 removal efforts will be on large channel catfish. Understandably, this is the segment of the population that is most likely to prey on Colorado pikeminnow or naturally spawned razorback sucker. However, juvenile channel catfish recruit to adults rather quickly in the San Juan River. Is a focus on adult removal an effective strategy for channel catfish population control? Assessment of this question is needed to better understand the potential contribution of channel catfish removal efforts to recovery of the endangered fishes. Although it is unknown of removal of Channel Catfish is having a positive effect on recovery efforts and will always be hard to tease apart from other environmental factors, one cannot argue that currently there are positive responses by both species of rare fish happening in the San Juan river to management actions of the Program. We have had record numbers of wild juveniles for both species in the last few years, while this could be a result of flows, habitat or many unknowns, it could be argued that intensive nonnative removal gives juvenile Colorado Pikeminnow and Razorback Sucker a better chance at survival. It can also be argued that Channel Catfish predation doesn't impact rare fish populations. The KSU study is designed to give us a predation rate for Channel Catfish and right now it's more than zero. The program is at a milestone for recovery of these fishes and with record numbers of juvenile Razorback Sucker and Colorado Pikeminnow in the system, any effort to reduce predation or competition for these fishes and aid in their survival shouldn't be taken lightly.

Steve Ross, Peer Reviewer

How can the technical aspects of this SOW be improved?

My main concern is that the rationale for the study does not reflect the current understanding of the impact of Channel Catfish on native fishes. The rationale for this SOW is to concentrate on a smaller reach of river where Channel Catfish abundance is higher and during a time when sampling conditions are not effected by turbidity or high flows. We believe in doing so, we will be more effective at removing larger numbers of fish with less effort (i.e. number of trips). While the impact of Channel Catfish on rare fish survival continues to be studied and quantified, we still feel that Channel Catfish need to be managed in some effort.

What is this SOW's contribution to recovery?

I was surprised, as apparently was Bobby, that the Program Office wanted a nonnative removal proposal given the initial findings of the diet study on Channel Catfish being conducted by Heddon and others. The diet study showed only minimal predation on the listed fishes (from my notes, only two Colorado Pikeminnow consumed out of 832 stomachs examined and no Razorback Suckers consumed). Unless the second year of the study provides very different information, the hypothesis that predation is a major threat of Channel Catfish on the listed fishes is not supported. If the predation hypothesis is not supported by scientific evidence, this SOW would have no contribution to recovery and, in fact, could have a negative impact from the intensive electrofishing and consequent frequent disturbance of the aquatic ecosystem of the San Juan River resulting from this SOW. I understand that some may prefer to wait until the final report of the predation study next year before making a decision on the role of nonnative removal- if the nonnative target is Channel Catfish. However, the existing evidence provided by Heddon et al., along with the fact that Channel Catfish are not targeted for removal in the upper basin, makes it seem unlikely that continuing with removal of Channel Catfish in the San Juan River is a wise use of Program funds.

However, I think it is important to recognize that nonnative fishes could have impacts on native fishes other than through predation. For instance, the hypothesis that Channel Catfish have a negative competitive impact on the native fishes has not been tested, in part because of the challenges of doing so. Competitive impacts of Channel Catfish on Colorado Pikeminnow could occur directly through the common use and depletion of shared resources (e.g., food or habitat), termed exploitation competition. Note that the common use of resources by itself does not indicate competition- the resource must be limiting. In this scenario, the removal of large Channel Catfish, which is a major focus on the proposed SOW, could shift the size structure to smaller Channel Catfish leading to an increase in the possibility of competition with juvenile Colorado Pikeminnow. Conversely, removal of large Channel Catfish could potentially reduce exploitation competition by curtailing the overall population growth through the removal of the highly fecund large fish, given that fecundity in fishes generally is positively correlated with body size. Of the two possible outcomes of removal on exploitation competition, I consider the first much more likely than the second.

A second form of competition is interference, whereby one species excludes another species from access to resources. This form of competition could occur between Channel Catfish and both Razorback Sucker and Colorado Pikeminnow at various life stages.

As it now stands, there is strong evidence, albeit with another year of study still to happen, that Channel Catfish do not pose a significant predation threat to the listed fishes. In addition, no hypotheses involving types of competition have been tested. Consequently, at this point in time there is no rigorous scientific evidence to support the removal of Channel Catfish. Even with the low occurrence of Colorado Pikeminnow found in Channel Catfish stomachs in 2018, a high adult Channel Catfish population could still have a detrimental effect on juvenile Colorado Pikeminnow survival. There is a year left of the diet study (2019) to add to the 2018 results to help get a better understanding on the impact Channel Catfish have on native and rare fishes.

Mel Warren, Peer Reviewer

How can the technical aspects of this SOW be improved?

It is not clear if this is being done to supplement information in the diet study or not. If it's not critical to interpretation or extrapolation of the diet study, I see no clear reason to conduct the work. If it's a critical aspect of the diet study then that should be clearly spelled out in the introduction. The introduction does indicate this SOW and the diet study will be "used in concert", but it does not detail what that means. Perhaps that is explained in SOW 18-26, but the reader should at least be given some idea of how this data is essential to the diet study. This

SOW is not designed or being done to supplement the diet study in any way. This SOW is meant to be a management action of conducting nonnative removal in some form in the San Juan River. Past studies and removal efforts have shown us how environmental factors such as turbidity and high flows can reduce our catch rates for Channel Catfish, that is why we are proposing to sample during winter months when these factors should be reduced.

Since part of the rationale is to increase efficiency (clear water, low flows), how will you measure an increase in efficiency? We will be using exploitation rates to measure if our efficiency increases during winter sampling. We can also compute catch per unit effort and compare to previous years seasonal differences.

It is stated that 12,040 g of CPM were estimated to have been consumed and this equates to an average of 611 CPM. How can 611 be an average? Also 611 CPM of what size? Colorado Pikeminnow size was average 19.7 grams per individual.

It's not clear what the study area encompasses? What is a "determined section"? Does this mean you will only shock a portion of the area from Shiprock to Sand Island? Not clear. If you have the data on past catch rates and conditions can't you select the section now and tell us where it will be? The reach has now been deteremined to take place from Four Corners Bridge to Sand Island, Utah. At the time that this SOW was submitted there was still a trip being completed sampling from Shiprock Bridge to Clay Hills, UT in March. I wanted to use this trip as a measure of Channel Catfish distribution to help aid in the decision of what section to sample to maximize our efforts.

How will a population estimate on a small portion of the river inform the diet study on predation of catfish riverwide? Are the fish being used in the diet study from the same section of river that you will be sampling? The section sampled in this SOW is within the same section of river that was used for the diet study. However, this SOW is aimed towards increasing effectiveness of removing adult Channel Catfish from the river.

What is this SOW's contribution to recovery?

Given past results on Catfish removal (e.g., minimal effects, MSY limits, capture efficiency, removal rates, population relatively stable, low predation) it is not clear how this will contribute to recovery. This SOW could help the Program in future management actions towards nonnative fish control. Until the diet study is completed and reviewed by the Program, the data collected during these winter trips will help researchers make decisions on sampling during the most effective conditions and time of the year. This SOW could contribute to recovery by being a management action that by removing any number of Channel Catfish could potentially result in increased survival of the record numbers of wild Razorback Sucker and Colorado Pikeminnow juveniles that have been observed the last few years.

Program Office

How can the technical aspects of this SOW be improved?

Lines 89-92: It would be beneficial to identify areas of high adult Channel Catfish concentrations based on data that have previously been collected. Corrected on the revised SOW. Sampling will take place from Four Corners Bridge to Sand Island, Utah.

Hedden et al. 2019 presented Catfish population sizes, probability of prey consumed versus catfish-prey TL relationships. Given there are data on exploitation rates of adult Catfish, could you estimate how many you will likely be able to remove and how many CPM that might result in “saving”? I will work on estimating the number of Channel Catfish we can potentially remove and its potential impact to “save” CPM.

What is this SOW’s contribution to recovery?

While evidence to date does not suggest substantial Channel Catfish predation on endangered fishes in the San Juan River, a second year of that study is yet to be completed and this SOW allows the SJRIP to move forward in a conservative approach to managing the threat of Channel Catfish. Additionally, an unknown level of competition is likely present between Channel Catfish and the endangered fishes in the San Juan River. At this time it is not clear what level of nonnative fish management the SJRIP should conduct that is commensurate with the threat nonnative fish pose. Nonetheless, this proposal is an effort to increase exploitation rates by focusing efforts both temporally and spatially to maximize the removal of Channel Catfish. Further discussion at upcoming BC meetings and the results of the KSU predation study will further elucidate this proposal’s contribution to recovery.

RECOVERY PROGRAM
FY 2020-2021 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: New 5 year agreement in progress (existing agreement through FY19 is R14AC00084)
Reclamation Agreement term: Anticipated term Oct 1, 2019 – Sept 30, 2024

Note: Recovery Program FY20-21 scopes of work are drafted in May 2019. 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
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Date Last Modified: 9/5/2019 9:19:00 AM

Category:
_X_ Ongoing project
__ Ongoing-revised project
__ Requested new project
__ Unsolicited proposal

Expected Funding Source:
_X_ Annual funds
__ Capital funds
__ Other *[explain]*

I. Title of Proposal: Development and Maintenance of a Centralized PIT tag Database for the San Juan and Upper Basin Recovery Programs (Recovery Programs)

II. Relationship to RIPRAP: Conduct interagency data management program to compile, manage, and maintain all research and monitoring data collected by the Recovery Programs.

III. Study Background/Rationale and Hypotheses: STReaMS, the central database of the 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 nonnative 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 Recovery Programs 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 maintain the STReaMS database and add feature enhancements during the Federal FY20-21. Tasks are broken out below.

Task 1: Server Maintenance

- Maintain the server, server security, and perform regular database backups
- Maintain the test server and development environment
- Perform necessary software installs and upgrades including Windows operating system, Windows updates, MS SQL Server, MS TFS, and PHP. Ensure all code performs as expected following updates.
- Assess overall performance and optimize resources
- Maintain Database Manager credentials to access SQL Server
- Replace hardware (e.g. server, hard drives, RAM, etc.) as needed and configure new hardware

Task 2: Website Maintenance and Feature Enhancements

- Enhancements to existing tools
    - Batch uploads
    - QC tools
    - Movement tool
    - Calculated fields
- Work with Peter Mackinnon and Julie Stahli to ensure complete PIA data in STReaMS
    - Shift units from Loggernet process to new FTPS upload process as they are upgraded
    - Needs assessment and training with Peter and Julie
    - Add and remove PIAs to the automatic upload system as needed
- Work with Database Managers to develop any necessary custom queries, including non-tagged fish queries
- Bug fixes
- Internal testing and stress tests
- Update online help, data dictionary, user manuals, Data Managers user guide, and system documentation
- Train Recovery Program participants on features and enhancements
- Other priorities identified by Recovery Program Database Managers

Task 3: 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:

Name of Servicing Agency:	Colorado Natural Heritage Program - Colorado State University
Project Name:	Development and Maintenance of a Centralized PIT tag Database for the San Juan and Upper Basin Recovery Programs

		YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5		TOTAL
Enter the BEGINNING dates for each year ------>		**10/1/2019**		**9/30/2020**		**10/1/2021**		**10/1/2022**		**10/1/2023**		
		Through		Through		Through		Through		Through		
Enter the ENDING dates for each year ------->		**9/29/2020**		**9/30/2021**		**9/30/2022**		**9/30/2023**		**9/29/2024**		
DIRECT LABOR AND FRINGE BENEFIT COSTS:		**YEAR 1**		**YEAR 2**		**YEAR 3**		**YEAR 4**		**YEAR 5**		**TOTAL**
Direct Labor - Hourly		$ 16,860.17		$ 18,600.89		$ 15,614.95		$ 15,927.25		$ 16,245.79		$ 83,249.05
Fringe Benefits - Hourly		$ 11,616.01		$ 12,808.48		$ 10,760.02		$ 10,975.22		$ 11,194.72		$ 57,354.45
Subtotal of Direct Labor & Fringe Benefits:		**$ 28,476.18**		**$ 31,409.37**		**$ 26,374.97**		**$ 26,902.47**		**$ 27,440.52**		**$ 140,603.50**

OTHER DIRECT COSTS:		**YEAR 1**		**YEAR 2**		**YEAR 3**		**YEAR 4**		**YEAR 5**		**TOTAL**	**Percentage of dollars contracted for:**
Materials and Supplies		$ 291.00		$ 2,422.94		$ 1,585.45		$ 1,615.78		$ 2,638.52		$ 8,553.69	4.93%
Travel Costs		$ -		$ -		$ -		$ -		$ -		$ -	
Equipment		$ -		$ 6,925.00		$ -		$ -		$ -		$ 6,925.00	3.95%

Contractors		$ -		$ -		$ -		$ -		$ -		$ -	0.00%
Subtotal of Other Direct Costs:		**$ 291.00**		**$ 9,347.94**		**$ 1,585.45**		**$ 1,615.78**		**$ 2,638.52**		**$ 15,478.69**	**8.88%**
INDIRECT/OVERHEAD COSTS:		**YEAR 1**		**YEAR 2**		**YEAR 3**		**YEAR 4**		**YEAR 5**		**TOTAL**	
Subtotal of Labor and Other Direct Costs:		**$ 28,767.18**		**$ 40,757.31**		**$ 27,960.42**		**$ 28,518.25**		**$ 30,079.04**			
Total dollars exempt from indirect/overhead base:				$ 6,925.00									
CSU CESU Rate	**17.50%**	$ 5,034.26	**17.50%**	$ 5,920.65	**17.50%**	$ 4,893.07	**17.50%**	$ 4,990.69	**17.50%**	$ 5,263.83		$ 26,102.51	
Total dollars exempt from indirect/overhead base:		$ -		$ -		$ -		$ -		$ -			
<Enter Description of Indirect/OH Cost #2>		$ -	**0.00%**	$ -	**0.00%**	$ -	**0.00%**	$ -	**0.00%**	$ -		$ -	
Subtotal of Indirect/Overhead Costs:		**$ 5,034.26**		**$ 5,920.65**		**$ 4,893.07**		**$ 4,990.69**		**$ 5,263.83**		**$ 26,102.51**	

		YEAR 1		**YEAR 2**		**YEAR 3**		**YEAR 4**		**YEAR 5**		**TOTAL**
GRAND TOTAL:		**$ 33,801.43**		**$ 46,677.96**		**$ 32,853.49**		**$ 33,508.94**		**$ 35,342.87**		**$ 182,184.69**

Year 2 includes a new server with the latest operating system and software. New software and operating system have a different pricing model based on annual fees. Annual fees for software and operating system are included in Years 3-5.

IX. Budget Summary:

FY2020: $33,801.43	San Juan: $10,000	Upper Basin: $23801.43
FY2021: $46,677.96	San Juan: $10,000	Upper Basin: $36677.96
FY2022: $32,853.49	San Juan: $10,000	Upper Basin: $22853.49
FY2023: $33,508.94	San Juan: $10,000	Upper Basin: $23508.94
FY2024: $35,342.87	San Juan: $10,000	Upper Basin: $25342.87

X. Reviewers:

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FY2020 – Demographic Monitoring of Colorado Pikeminnow and Razorback Sucker

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This SOW proposes a second year of a three-year effort to generate age-specific demographic parameters for Colorado Pikeminnow and Razorback Sucker in the San Juan River. This proposal is aimed at satisfying several data and recovery needs of the San Juan River Basin Recovery Implementation Program (SJRIP): 1) age-specific capture and survival probabilities of endangered fishes, 2) age-specific abundance estimates of endangered fishes, 3) effects of limited handling on the endangered fishes, and 4) development of a new post-2023 endangered fish monitoring program. Specifically, the proposed work will focus strictly on the two endangered fishes but with increased effort in order to track demographic parameters of both endangered fishes. Similar to the Upper Colorado River Endangered Fish Recovery Program, we propose this demographic-based sampling occur in a 3-year on, 2-year off fashion in order to allow periods of limited handling stress to the recovering populations. Conducting this work in 2020 would represent the second year of the 3-year "on" cycle. Annual sub-adult/adult monitoring could occur during the "off" cycle to maintain long-term monitoring dataset established during previous sampling.

Following the Recruitment Bottleneck Workshop on 22 February 2018, the SJRIP decided to limit the capture of Colorado Pikeminnow and Razorback Sucker during summer sampling in order to minimize the apparent detrimental effects of the capture event on juvenile Colorado Pikeminnow survival (Clark et al. 2018). At this point the mechanisms contributing to these capture effects are unknown, but stress-related factors such as electrofishing, handling, tagging, live well housing, and other environmental conditions could be negatively affecting survival. Thus, the SJRIP would likely be unable to evaluate the effects of reduced handling of juvenile Colorado Pikeminnow in the summer without conducting this proposed work.

The negative effect of capture on juvenile Colorado Pikeminnow was documented via analysis of annual survival (Clark et al. 2018). Thus, continued use of the same parameter to measure the response of changing management appears most appropriate (i.e., not capturing juvenile Colorado Pikeminnow during summertime sampling). Clark et al. (2018) reported relatively high capture probabilities for juvenile Colorado Pikeminnow based on the entirety of the SJRIP's sampling efforts (annual mean range: 0.31-0.42). However, single-pass Fall Monitoring capture probabilities of juvenile Colorado Pikeminnow are typically lower (annual mean range: 0.0173-0.0483 from 2011-2015; SJRIP 2017), limiting recaptures needed for precise annual survival estimates. In an effort to increase capture probability for reliable annual survival estimates, we propose conducting three passes in this Demographic Monitoring SOW of four rafts each from Shiprock, NM to Sand Island, Utah in fall 2020 (RM 147.9-77.7). Only endangered fish would be captured during this Demographic Monitoring effort and additional care would be carried out to minimize fish stress (e.g., salting live wells and using aerators). We propose conducting Demographic Monitoring for three of five years (on 2019-2021, off 2022-2023). Three years of Demographic Monitoring will allow for annual, age-specific survival estimates and capture probabilities for both endangered species (and in the future, estimates of wild-spawned versus hatchery-reared fish). Additionally, multiple in-year passes over three years allows for the use of Pollock's robust design (Kendall et al. 1997) and estimation of age and species-specific annual abundance. The Demographic Monitoring proposal increases sampling effort during the fall; however, because temperatures are cooler in fall compared to summer (when catch rates of endangered fishes were previously highest), physiological stress and mortality should be reduced.

The following is an outline for the proposed work:

- Three passes (4 rafts each pass) separated by one week
- Each river mile will be a sample unit
- Sampled reach is between Shiprock and Sand Island (RM 147.9-77.7)
- Start mid-September, end early October
- Capture only endangered fishes
- All previous PIT tagging protocols will be in place
  - All captured fish will be checked for a PIT tag
  - All fish lacking a PIT tag and >130mm will be implanted with a new PIT tag
- Analysis will be mark-recapture robust design (same analysis used by Upper Basin)
  - Estimate age-specific capture probability (per pass)
  - Estimate age-specific survival (annual)
  - Estimate age-specific abundance (annual)

Data Analysis

Data collected during the proposed Demographic Monitoring effort in 2020 would complete the second year (of three years) of this monitoring effort. Interim reports will be based on data in-hand at the time of analysis but these results will be provisional until the completion of analyses in a final report following the three years of data collection.

Following data collection in 2020 and 2021, we will use Pollock's robust design (Kendall et al. 1997) implemented in Program MARK (White and Burnham 1999) to estimate demographic parameters of interest. The use of this model is particularly advantageous because it integrates both closed and open population models to estimate several demographic parameters. For example, within year sampling occasions will take place at closely spaced temporal intervals (3 passes over 6 weeks) to estimate *within year age-specific abundance* with closed models. This level of within-year sampling across consecutive years will then allow for the estimation of *between year age-specific survival* using open population models. Additionally, the robust design allows for the estimation of *capture/recapture probability by pass*. A suite of competing models including the effects of variation in factors such as fish size (TL), year, pass-specific capture/recapture probability, temporary emigration, and reach will be evaluated with AIC_C (Burnham and Anderson 1998).

Because 2019 will complete only the first year of this monitoring effort (multiple passes within year), data analysis for the first year will be limited to closed capture models described by Otis et al (1978) implemented in Program MARK (White and Burnham 1999). The 2019 data analysis will evaluate models with constant pass-specific detection probability, varying pass-specific detection probability, and variation in capture and recapture probability to estimate age-specific abundance and detection probability for Colorado Pikeminnow and Razorback Sucker.

Deliverables

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

References

Burnham, K.P., and D.R. Anderson. 1998. Model selection and inference: a practical information-theoretic approach. Springer-Verlag, New York.

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Otis, D.L., K.P. Burnham, G.C. White, and D.R. Anderson. 1978. Statistical inference from capture data on closed animal populations. Wildlife Monographs 62.

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White, G.C., and K.P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. Bird Study 46 (supplement):120-138.

Budgets

GJFWCO Budget

Task 1: Demographic Monitoring

Personnel/Labor Costs (Federal Salary + Benefits)

Objectives 1-3: Logistics, Electrofishing, Removal of Nonnative Fish

Description	Rate/HR	PEOPLE	DAYS	HRS	OT HRS	SUB TOTAL	OT SUB TOTAL	TOTAL
Principal Biologist (GS-11/7) – 320 hours								$4,307.20
(1 person X 10 days planning & organization)	$53.84	1	10	80		$4,307.20		
San Juan River sampling - fall:								
(1 person X 8 days/trip X 1 trip – camping)	$53.84	1	8	0		$0.00		
(+ 16 extra hours)	$53.84							
1	16	0		$0.00		Bio. Tech. Crew		
Leader (GS-7/4) - 120 hours								
	$0.00							
San Juan River sampling - fall:								
(1 person X 10 days/trip X 1 trip – camping)	$32.46	1	5	0		$0.00		
(+ 40 hours overtime)	$48.69	1			0		$0.00	
Bio. Tech. Crew Leader (GS-6/3) - 120 hours								$16,646.40
San Juan River sampling - fall:								
(1 person X 10 days/trip X 1 trip – camping)	$27.74	2	5	120		$6,657.60		
(+ 40 hours overtime)	$41.62	2			120		$9,988.80	
Biological Technicians (GS-5/1) – 312 hours @ $23.02/hr								$0.00

	Rate/HR	PEOPLE	DAYS	HRS	OT HRS	SUB TOTAL	OT SUB TOTAL	TOTAL
San Juan River sampling – fall:								
(2 person X 10 days/trip X 1 trip – camping)	$23.40	0	5	0		$0.00		
(+ 40 hours overtime)	$35.10	0			40		$0.00	

PERSONNEL/LABOR TOTAL **$20,953.60**

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

	Rate/HR	PEOPLE	DAYS	HRS	OT HRS	SUB TOTAL	OT SUB TOTAL	TOTAL
Administrative Officer (GS-9/8) – 360 hours	$42.98	1		360				$15,472.80
Principal Biologist (GS-11/7) – 480 hours	$53.84	1		480				$25,843.20
Project Leader (GS-14/6) – 320 hours	$82.57	1		320				$26,422.40

PERMITTING, DATA INPUT, E **$67,738.40**

Travel and Per Diem (Based on Published FY-2017 Federal Per Diem Rates) 1

Hotel Costs	RATE	PEOPLE	NIGHTS	TRIPS	TOTAL
5 nights (in Cortez, CO)	$118.00	4	1	3	$1,416.00
Per Diem (Hotel Rate)					
1 days X 5 people (in Cortez, CO)	$61.00	4	1	3	
	$732.00 Per Diem (Camping Rate)				
10 days X 4 people	$36.00	4	7	3	
	$3,024.00				

TRAVEL/PER DIEM TOTAL **$5,172.00**

Equipment and Supplies 1.015

Vehicle Maintenance & Gasoline (@ $365/month lease = $12.17 per day based on 30 days in an "average" month + $0.42/mile)

TOTAL

Vehicle Mileage	TRUCKS	DAYS	MILEAGE	Mileage Rate	TOTAL
San Juan fall sampling					
Grand Jct. to Cortez to Hogback to Sand Island to Grand	3	1	525	$0.43	$671.42
VEHICLE LEASE	**TRUCKS**	**DAYS**	**Lease/day**		
San Juan fa Grand Jct. to Cortez to Hogback to Sand Island to Grand	3	8	$12.35		$296.46
Shuttle Service	8		$253.75		$2,030.00
Generator Gasoline	**BOATS**	**DAYS**	**GAS $/GAL**		
San Juan River sampling - fall camping trip 2	4	7	$2.51		$350.99

Vehicle Maint. & Gasoline **$3,399.10**

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 these funds for a "typical" field season for one study **COULD** include the following: Raft trailer maintenance

Annual trailer maintenance & safety inspection trailer jack stand, wheel bearings	$788.20	Replace/repair trailer suspension, trailer lights, winch handle/straps/gears,
Replace trailer tires – 2 per year @ $77 each	$154.00	
Signal light pigtail adapters – 2 @ $15 each	$30.00	Generator maintenace
Spark plugs for generators – 5 at $2.20 each	$11.00	Synthetic oil for generators - 5 quarts at $6.30 each
	$31.50	Generator repair/tune-up - 9 hrs @ $70/hr = parts $703.79
Sampling gear (needs to be regularly replaced)		
Hip boots – 2 pair at $75/pair	$150.00	
Breathable chest waders - 2 pair @ $120/pair	$240.00	
NRS Type IV life jackets – 2 @ $130 each	$260.00	
Electrical Gloves - 3 pairs @ $75/pair	$225.00	
Dura-Frame electrofishing dip nets – 1 @ $630 each + fr	$630.00	
Raft frame &/or boat hull repair		
Aluminum welding – 7 hours @ $95/hr	$665.00	
Raft repair kits		
Raft glue (urethane/hypalon) – Four 4-oz. cans @ $24.95	$100.00	
NRS raft patch material – 5 feet @ $37/ft	$185.00	
Toluene – 1 qt @ $17.95/qt	$18.00	
Equipment tie-downs - NRS HD-brand tie-down straps, each boat needs:		
Ten 2-ft straps - 10 @ $4.20 each	$42.00	
Five 3-ft straps - 5 @ $4.30 each	$21.50	
Ten 4-ft straps - 10 @ $4.70 each	$47.00	

Five 6-ft straps 5 @ $5.05 each	$25.25		
Five 9-ft straps 5 @ $5.70 each	$28.50		
Five 12-ft straps 5 @ $6.15 each	$30.75		
Raft rigging materials, each boat needs:			
D-style carabiners - 10 @ $8.25 each	$82.50		
Mesh rig bag – 1 @ $50 each	$50.00		
Yeti 125-quart coolers – 1 @ $500 each	$550.00		
5-gallon plastic gasoline jerry cans – 5 @ $40 each	$200.00		
20 lb. propane tanks – 1 @ $55 each	$55.00		
Eddy Out Aluminum Dry Box (36L x 16H x 16D) - 1 at $3	$375.00		
Cans for 1st aid & tool kits, raft repair kits, etc. - 20 @ $1	$380.00		
Rafting oars, oar blades, and oar rowing sleeves			
Carlisle 10-foot oar shafts – 2 @ $100 each	$200.00		
Carlisle Oars blades – 4 @ $65 each	$260.00		
Oar sleeves – 4 @ $18 each	$72.00		
Camping Gear			
NRS Canyon Dry Box (kitchen cook kit storage) - 1 at $16	$165.00		
NRS campsite counter (18"W X 68" L X 40" H) - 1 at $299	$299.95		
Roll-A-Table (32" X 32" table, 27" legs) - 2 at $99.95 each	$199.90		
2-man tent (1/person), ~ 1 year life-span - 6 at $99.99 ea	$599.94		
Partner Steel 16" 4-burner camp stove - 1 at $359.00	$359.00		
River bags			
NRS 3.8 heavy-duty Bill's Bag 110L – 1 @ $160 each	$160.00		
NRS Tuff Sacks 25L - 5 @ $ 35 each	$175.00		
Pesola brand spring scales			
# 20010 Micro-Line 10 gram – 1 @ $68.75	$68.75		
# 20030 Micro-Line 30 gram – 1 $61.60	$61.60		
# 20100 Micro-Line 100 gram – 1 @ $61.60	$61.60		
# 40300 Medio-Line 300 gram – 1 @ $73.15	$73.15		
# 40600 Medio-Line 600 gram – 1 @ $73.15	$73.15		
# 42500 Medio-Line 2,500 gram – 1 @ $71.45	$71.45		
# 41002 Medio-Line 1,000 gram – 1 @ $73.15	$73.15		
# 80005 Macro-Line 5 kg – 1 @ $150.15	$150.15		
# 80010 Macro-Line 10 kg – 1 @ $155.65	$155.65		
NRS E-160 Self-Bailing Raft - 1 at $6,125.00	$6,125.00		
		Requested 2017 Equipment	
Equipment Maintenance, Repair, & Replacement Subtotal	$15,483.43	**Costs for Task 1**	**$6,546.75**
Requested funding divided between Tasks 1-3			

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

USFWS-GJFWCO Total	**$103,809.85**
USFWS R6 Admin Overhead (3.00%)	**$3,114.30**
USFWS Region 6 Total	**$106,924.15**

NMFWCO Budget

FY 2020

Pop. estimate - 3 trips, two passes per trip, Hogback Diversion to Sand Island, UT. NMFWCO supplying 5

people per trip **Labor Cost - Field Work (3 trips x 8 days/trip)**

Position	Grade/Step	Hourly Rate	Fringe	Salary w/benefits	Hours/Day	Total Days	Sub-Total
Supervisory Fish Biologist	GS 12/7	$43.09	29.51%	$59.48	9	24	$12,847.68
Fish Biologist	GS 11/7	$35.95	25.57%	$47.75	9	24	$10,314.00
Fish Biologist	GS 9/7	$29.71	26.46%	$39.92	9	24	$8,622.72
Remote Biologist	GS 9/2	$25.59	25.16%	$33.74	9	24	$7,287.84
Biological Tech	GS 5/1	$16.34	7.11%	$17.55	9	24	$3,790.80
Overtime Hours (weekend work)							
Fish Biologist	GS 9/7	$40.91	26.46%	$51.73	9	6	$2,793.42
Remote Biologist	GS 9/1	$37.14	25.16%	$46.48	9	6	$2,509.92
Biological Tech	GS 5/1	$24.51	7.11%	$26.25	9	6	$1,417.50
Administrative, Reporting, Planning							
Fish Biologist	GS 9/7	$29.71	26.46%	$39.92	9	30	$10,778.40
Remote Biologist	GS 9/2	$25.59	25.16%	$33.74	9	15	$4,554.90
Supervisory Fish Biologist	GS 12/7	$43.09	29.51%	$59.48	9	5	$2,676.60
Adminstrative Officer	GS 9/9	$31.36	26.18%	$42.22	9	2	$759.96

Total Labor

$68,353.74

FY20 3% increase

$2,050.61

Total FY20 Labor

$70,404.35

Travel and Per Diem	Days	Rate		
Hotel Costs	12	$94.00		$1,128.00
Per Diem (Travel Day)	30	$41.25		$1,237.50
Per Diem (Full Day)	90	$29.00		$2,610.00
			Total Travel/Per Diem	**$4,975.50**

Equipment	Miles/Qty	Total Miles	Rate	
Shuttle Costs x 3 trips	9		$200.00	$1,800.00 3 trucks
Vehicle Fuel 3 trucks X 3 trips - ABQ to Sand Island, UT 574 mi RT	574	5,166	$0.58	$2,996.28
Generator Fuel 40 gallons/trip x 3 trips	120		$2.85	$342.00
Maintenance, repair, replace (i.e. life jackets, waders, generator repair, dip nets, etc.)				$3,000.00

Equipment Total **$8,138.28**

Sub-total for 3 trip pop est. - NMFWCO	**$83,518.13**
USFWS Administrative Overhead (3%)	**$1,913.92**
Total for 3 trip pop est. - NMFWCO	**$85,432.05**

FY 2020 Draft Budget

San Juan River Endangered Fish Demographic Monitoring

Utah Division of Wildlife Resources

Submitted by Katie Creighton and Brian Hines

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435.259.3780, 435.259.3782

FY 2020 Costs for UDWR- Moab

San Juan River Endangered Fish Demographic Monitoring

Task 1. Endanagerd Fish Monitoring: Shiprock to Sand Island (4 people X 8 days X 2 trips)

Labor: salary + benefits + applicable overtime (personnel services)			
	Rate	**Hours**	**Cost**
Project Leader	$36.22	20	$724
Biologist	$33.29	280	$9,323
Technician	$17.08	280	$4,782
		subtotal	**$14,829**
Food and Transport (current expense)			
	Rate	**Quantity**	**Cost**
Truck Rental (2 trucks)	$199.37	4	$797
Mileage Costs (2 trucks X 350 miles X 2 trips)	$0.40	1500	$600
In-state per diem (during trip)	$43.00	32	$1,376
Out-of-State per diem (before trip)	$46.00	4	$184
Hotel (before trip)	$105.00	4	$420
Shuttle (2 trucks X 2 trips)	$150.00	4	$600
		subtotal	**$3,977**
Equipment (current expense)			
	Rate	**Quantity**	**Cost**
Camping gear repair/replacement:			$500
Sampling gear repair/replacement:			$1,000
Boating gear repair/replacement:			$1,000
Fuel for generators (50 gallons/pass)	$4.00	100	$400
		subtotal	**$2,900**
Total Expenses			**$21,707**
Administrative Overhead (16% on all personnel services)			**$2,373**
FY 2020 Total			**$24,080**

Response to comments

19a	SOW-19a-Demographic monitoring of Colorado Pikeminnow and Razorback Sucker	Schleicher and Ryden, GJFWCO; Duran, NMWCO; Hines UDWR

Harry Crockett, Colorado DNR, BC member

How can the technical aspects of this SOW be improved?

No recommendations; as the continuation of a 3-year demographic study, methods seemingly need to be kept the same. Assume detailed analysis will come at the end of the three years; in this SOW description of analysis is cursory at best

The SOW has been adjusted to include additional details on data analysis.

What is this SOW's contribution to recovery?

Improved estimates of demographic parameters; possibly assessment of handling effects. Contributes more to ability to assess recovery, rather than effecting recovery directly.

Vince Lamarra, Navajo Nation, BC member

How can the technical aspects of this SOW be improved?

I like the concept of trying to get a quantitative estimate of the population size of the AGE 1 + CPM. Mainstream electrofishing, with 4 boats seems inadequate and may end up with the same results as adult monitoring, (low capture rates of AGE-2 to AGE-7 CPM). Will medium sized secondary channels be sampled? In that reach of the river (RM 147 to 68), there are almost continuous channel breaks. Also, I doubt that you will capture RBS's that are AGE-1 and AGE-2 using this gear type. How does this study fill in the age structure gaps of this species over the captures in the Adult Monitoring Program?

All main channel and any secondary channels that can be sampled with an electrofishing raft will be sampled. Summer 2018 and Spring 2019 sampling indicates that raft electrofishing of shoreline habitats captures AGE 1 Razorback Sucker.

What is this SOW's contribution to recovery?

Important information on CPM population structure (quantifying the rate of recruitment of 50mm stocked fish).

Jacob Mazzone, Jicarilla Apache Nation, BC member

How can the technical aspects of this SOW be improved?

No comment.

What is this SOW's contribution to recovery?

The estimates proposed to be generated by the scope of work are of interest to recovery, especially capture probability and survival estimates. If it is determined that survival estimates remain low, capture inducted myopathy and/or mortality is high, this work could lead to shifts in sampling regime to benefit fish health and therefore aid in their recovery. Data on survival, capture probability, and abundance also help refine and improve data integration and modeling efforts of other Program projects.

Mark McKinstry, BOR, BC member

How can the technical aspects of this SOW be improved?

I think this approach is relatively simple and seems sufficient for the data that is required. I would caution that "trip" becomes the metric, and that what we really want is a bunch of CPM and RBS captured. I realize this is difficult, but trips should not be launched if you think flows are going to be > 800-100 cfs and it is going to be raining. If that is the case the trips should be cancelled and rescheduled. I realize this is difficult with this many people and planning the effort, but the criticism from some members has been that if a contractor was doing it that they would be held to those conditions.

Sampling during high flow and high turbidity conditions will likely preclude the capture of large numbers of CPM and RBS. However, point estimates of population abundance, capture probability, and survival can still be obtained during these conditions. The caveat for estimating these parameters during poor sampling conditions is that the estimated bounds of uncertainty will likely be large. Additionally, capturing and tagging large numbers of CPM and RBS during good sampling conditions will provide a greater contribution to other SJRIP activities (i.e. detecting movement using PIT tag antennas). Given this benefit, river conditions will be monitored prior to launching for trips. Schedule changes will be considered if river conditions merit a change in float dates.

What is this SOW's contribution to recovery?

Providing reliable numbers of the endangered fish would lead to better management actions and provide us with better information on numbers of fish in the river.

Bill Miller, Southern Ute Indian Tribe, BC member

How can the technical aspects of this SOW be improved?

No comments

What is this SOW's contribution to recovery?

Provides survival and abundance data for the two endangered species that will assist in guiding management actions for those species and assessment of progress toward recovery.

David Mueller, BLM, BC member

How can the technical aspects of this SOW be improved?

It seems that conducting three passes may offset the lower capture probabilities in the fall but it may increase the probability of recapture in a short amount of time that additional care to limit stress may not offset. An assessment of the utility of the additional passes and the amount of recaptures should be done to inform future sampling efforts.

The study design and data collected will allow us to evaluate these hypotheses and determine appropriate sampling efforts in the future.

What is this SOW's contribution to recovery?

Provides information on the status of native fishes specifically age class survival and abundance that will provide measures of success for management actions

Ben Schleicher, USFWS R6, BC member

How can the technical aspects of this SOW be improved?

What is this SOW's contribution to recovery?

Tom Wesche, Water Development Interests, BC member

How can the technical aspects of this SOW be improved?

As I'm not involved in the Upper Basin Program, additional description of the methods to be applied and the logic behind the application of the recommended approach would be helpful. Also, either we need to expand this effort to the entire extent of critical habitat for the endangered species in the San Juan River or the process that will be followed to expand the results obtained to the entirety of critical habitat needs to be thoroughly described.

The SOW has been adjusted to include additional details on data analysis. Expanded effort is not possible on this project due to logistical constraints. However, in previous sampling within critical habitat the majority of rare fish captures have occurred within the current project area.

What is this SOW's contribution to recovery?

I view this project as one of high priority as we attempt to measure the progress we've made to achieving recovery and for planning for the post-2023 period. We need to know where we're at before we can plan for the future and modify our management actions as needed.

Brian Westfall, BIA, BC member

How can the technical aspects of this SOW be improved?

What is this SOW's contribution to recovery?

Monitoring is important to indicate the status of the species and I support this scope of work

Matt Zeigler, NMDGF, BC member

How can the technical aspects of this SOW be improved?

This SOW has been presented to the BC for review several times. However, the SOW still lacks any significant information on methods, in particular the use of the mark-recapture robust design to estimate capture probabilities, survival, and abundance. This information is needed so that a complete technical review can be completed.

The SOW has been adjusted to include additional details on data analysis.

Additionally:

What concentration of salt will be used in the live wells? How will consistency be maintained? How will any effect be measured?

Salt will be applied to live wells at a concentration of 0.5% (5 g/l. This is a common concentration used during hauling of live fish. Live wells will be dumped and salt solutions replaced for each sample mile. This idea was simply a way to help reduce stress of fish from handling. It will be hard to tease apart the effect of salting the live wells. Other options to reduce stress such as aerators in live wells will also be used.

What are the "previous PIT tagging protocols" that will be in place?

All fish will be checked for a PIT tag and all untagged fish >130mm will be implanted with a new PIT tag. These details will be included in the revised SOW.

Will an update or report be provided after every year? Will a final report be provided after the three years?

Yes, annual and final reports will be provided. Additional details on project reporting have been included in the revised SOW.

What is this SOW's contribution to recovery?

This SOW will provide needed information on age-specific and population level survival and abundance for both endangered species. Information collected from this SOW will be beneficial for determining stocking rates, recruitment rates, and survival. This study should provide the most robust assessment of the current status of both species in the San Juan that the program has ever completed.

Brian Bledsoe, Peer Reviewer

How can the technical aspects of this SOW be improved?

Not my expertise.

What is this SOW's contribution to recovery?

Wayne Hubert, Peer Reviewer

How can the technical aspects of this SOW be improved?

The Clark et al. (2018) is a very powerful paper that is changing the approach to monitoring of Colorado pikeminnow and razorback sucker in the San Juan River. More emphasis should be placed on summarizing the findings from Clark et al. (2018) and how it has provided knowledge leading to this new monitoring protocol.

While sampling protocols are described in relatively sufficient detail, the methods for computation of age-specific capture probability, survival, and abundance are not described. How will Pollock's robust design be used to estimate these parameters? What are the specific computations for estimation of each parameter? Will the computations be made by the team of Schleicher, Ryden, Duran and Hines or a consultant outside of the team?

Additional details on data analysis have been included in the revised SOW

The handling protocols to reduce stress of captured fish include, but are not limited to, salting of live wells. The SOW would benefit from a thorough description of all protocols aimed at reducing stress on captured fish and inclusion of references that support the application of each protocol.

Salt will be applied to live wells at a concentration of 0.5% (5 g/l) for every sample mile. This concentration is within the range of recommended values found in the literature.

A couple of minor modification to consider:

Line 70. It appears that the correct word is entirety not "entirely."

Correction made

Line 82. The statement should be more specific. Change to "for the use of Pollack's robust design."

Correction made

What is this SOW's contribution to recovery?

The intention of the new demographic monitoring protocol is to reduce stress and enhance survival of the target species. The benefits of this innovative monitoring protocol of this are yet to be determined. However, it is intuitive that any effort to reduce stress on individual fish will benefit the populations as a whole.

Steve Ross, Peer Reviewer

How can the technical aspects of this SOW be improved?

A minor correction:
Line 70, entirety, not entirely

Correction made

Overall, the design seems appropriate for determining the survivorship of the listed fishes.

What is this SOW's contribution to recovery?

This SOW should provide survivorship data that would assess whether the reduced handling of listed fishes in the summer results in less mortality of young age classes.

Mel Warren, Peer Reviewer

How can the technical aspects of this SOW be improved?

Are your age-specific estimates really length-at-age estimates or do you know how old a fish is if it's pit tagged?

For the RBS these are age-specific estimates as all stocked fish are either 1) hatchery origin fish that are PIT tagged and known age or 2) Age 1 wild fish with age determined due to distinct length modes. For the CPM the age-specific estimates are determined from length-at-age data presented in "Movement and Growth of Juvenile Colorado Pikeminnows in the San Juan River, Colorado, New Mexico, and Utah" (Durst and Franssen 2014).

Tell the reader your methods to estimate all the listed parameters.

The SOW has been revised to include additional details on data analysis.

What is this SOW's contribution to recovery?

If age-specific demographics (i.e., capture probability, survival, and abundance) can be reliably estimated, the SOW will be of value in evaluating how well or poorly the endangered species are doing in the river and this can be evaluated for year-classes.

Program Office

How can the technical aspects of this SOW be improved?

It may be useful to suggest community sub-adult/adult monitoring occur in the off years of demographic estimations, if an argument can be made as to how community monitoring can be used to better SJRIP management.

SOW has been revised to reflect this suggestion.

What is this SOW's contribution to recovery?

This proposal was initially offered as a three-year project to estimate age-specific demographic parameters for endangered fish in the San Juan River. Conducting this work in FY2020 represents the second year of this effort. This effort is the only means to evaluate the change in Colorado Pikeminnow annual survival following the reduced handling and capture of juvenile fish during summer sampling efforts. Because this sampling effort will inform monitoring efforts as the SJRIP reaches 2023 and beyond, completing the proposal as intended should be a high priority.

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

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Contract or Agreement number:

R13PG40052 for USFWS –Grand Junction, CO

Introduction

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

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

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

While we were confident wild age-1 Razorback Sucker were positively identified during the spring trip in 2019, identification required very close inspection as some of the smaller individuals looked very similar to age-1 Flannelmouth Sucker. Indeed, some field personnel even suggested a few individuals might be Razorback Sucker X Flannelmouth Sucker hybrids due to their intermediate appearance. We propose that a genetic assessment is needed to quantify any putative hybridization as well as a more definitive check on identified Razorback Sucker of this size. We proposed to photograph and fin clip every Razorback Sucker <300 mm for genetic analyses using single nucleotide polymorphisms (SNPs) obtained using next-generation sequencing. These analyses should allow for of the identification of purebred Razorback Sucker and Flannelmouth Sucker as well as any F_1 or F_2 crosses. These samples can be added to the already planned larval Razorback Sucker parental assignment analyses at the Southwestern Native ARRC from the KSU translocation scope of work.

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

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

1. At what level is the Razorback Sucker population in the San Juan River experiencing annual, age-1 recruitment?
    - Assessing incidence of overwinter recruitment, regardless of water year, would inform the potential time-frame to recovery in the San Juan River as well as other management actions.

2. What is the size variation of wild age-1 Razorback Sucker in the spring and what is the likelihood individuals will be >300 mm TL by fall?
    - Our capacity to track the success of wild cohorts will rest on our ability to identify wild fish, especially when they surpass 300 mm TL.
    - If age-1 wild fish will likely be >300 mm TL by late summer or fall, the Program may need to shift sampling temporally to increase the number of tagged ‘known’ wild fish.

3. Does the spatial distribution of wild age-1 Razorback Sucker indicate spatial variation in recruitment success?
    - Gaining insights into reaches of the river that support wild age-1 Razorback Sucker would potentially lend insight into habitat requirements of wild fish.

4. Are putative wild age-1 Razorback Sucker purebred in origin?
    - Assessing levels of any potential hybridization and introgression should be a first step in assuring these recruits will provide for biologically viable and self-sustaining population of Razorback Sucker in the San Juan River.

    - Matching photographs of individuals with their genetic evaluation and assignment will help field crews increase their ability to recognize age-1 Razorback Sucker.

Methods

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

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

Deliverables

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

Budget

Age-1 Razorback Sucker monitoring

Personnel/Labor Costs (Federal Salary + Benefits)

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

PERSONNEL/LABOR TOTAL **$41,662.56**

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

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

PERMITTING, DATA INPUT, ETC **$5,798.40**

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

	RATE	TOTAL
Hotel Costs		
1 night (in Cortez, CO)	$94.00	$470.00
Per Diem (Hotel Rate)		
1 day X 5 people (in Cortez, CO)	$61.00	$305.00
camp rate	$36.00	$2,340.00

TRAVEL/PER DIEM TOTAL **$3,115.00**

Equipment and Supplies

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

Vehicle Mileage	Mileage Rate	TOTAL
San Juan River sampling - spring:		
GJ to Cortez to Shiprock to Clay Hills to GJ	$0.43	$858.14
VEHICLE LEASE	Lease/day	
San Juan River sampling - spring:		
GJ to Cortez to Shiprock to Clay Hills to GJ	$12.35	$518.81
Generator Gasoline	GAS $/GAL	
San Juan River sampling - spring: 2.5 Gallons/day	$3.00	$195.00
	Rate/Truck	
Shuttle Services (Shiprock to Clay Hills)	$400.00	$1,200.00

Vehicle Maint. & Gasoline **$2,771.95**

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

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 these funds for a "typical" field season for one study **<u>COULD</u>** include the following:

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

Pesola brand spring scales	
# 20010 Micro-Line 10 gram – 1 @ $68.75	$68.75
# 20030 Micro-Line 30 gram – 1 $61.60	$61.60
# 20100 Micro-Line 100 gram – 1 @ $61.60	$61.60
# 40300 Medio-Line 300 gram – 1 @ $73.15	$73.15
# 40600 Medio-Line 600 gram – 1 @ $73.15	$73.15
# 42500 Medio-Line 2,500 gram – 1 @ $71.45	$71.45
# 41002 Medio-Line 1,000 gram – 1 @ $73.15	$73.15
# 80005 Macro-Line 5 kg – 1 @ $150.15	$150.15
# 80010 Macro-Line 10 kg – 1 @ $155.65	$155.65
NRS E-160 Self-Bailing Raft - 1 at $6,125.00	$6,125.00
Equipment Maintenance, Repair, & Replacement Subtotal	$15,483.43

Requested 2020 Equipment 6% of Personel, Permitting, Travel, and Vehicle Maint.	**$3,200.87**

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

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

FY 2020 SCOPE OF WORK

TO

BUREAU OF RECLAMATION

FROM

New Mexico Department of Game and Fish
Matthew P. Zeigler and Jill Wick
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FOR

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

REPORTING DATES:

10/01/2019 through 9/30/2020

NEED

The San Juan River Basin Recovery Implementation Program (SJRIP) Long-Range Plan specifies that monitoring and evaluation of fish is a necessary element for assessing the recovery of federally endangered Colorado Pikeminnow *Ptychocheilus lucius* and Razorback Sucker *Xyrauchen texanus* in the San Juan River (Element 4; SJRIP 2016). Task 4.1.2.2 of the SJRIP's Long-Range Plan specifies the need for juvenile and small-bodied fishes (SBF) monitoring to locate areas and habitats used for rearing and to determine if young fish are surviving and recruiting into adult populations (SJRIP 2016). Data collected during annual SBF monitoring is used to assess recovery of Colorado Pikeminnow and Razorback Sucker, as well as evaluate the influences of SJRIP management actions on the river's fish community as a whole (Gido and Propost 2012; Franssen et al. 2015; Zeigler and Ruhl 2017).

GOAL

The goal of SBF 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 and Razorback Sucker in the San Juan River (SJRIP 2012).

MONITORING OBJECTIVES

The specific objectives for SBF 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.

STUDY AREA

The spatial extent of small-bodied fishes monitoring has changed since 2003 (Figure 1). Until 2011, sampling occurred every year from River Mile (RM) 180.6 (Animas River confluence) downstream to RM 2.9 (Clay Hills Crossing, UT). Sampling below RM 76.4 (Sand Island, UT) occurred once every five years after 2010, primarily because the fish fauna in the lower section of the river has shown little change since the initiation of SBF monitoring. Sampling was extended upstream to RM 196.0 (Bloomfield, NM) in 2012. Beginning in 2017, sampling area was determined using a flexible schematic where different sections of the river were sampled based on the number of wild age-0 Colorado Pikeminnow or Razorback Sucker captured during sampling from RM 147.8 (Shiprock, NM) downstream to RM 52.7 (Mexican Hat, UT). Due to the shifts in sampling extent, only Reaches 3 – 6 have been routinely sampled since 2003.

Sampling in 2020 will occur from RM 180.6 (Animas River confluence) downstream to RM 52.7 (Mexican Hat, UT) (Figure 2). Lack of wild age-0 endangered fish captures after the implementation of the flexible sampling schematic indicates that sampling a set section of the San Juan River every year may be more beneficial for the continuality of long-term sampling. Additionally, no endangered fish have ever been captured upstream of RM 180.6 during SBF monitoring. Sampling from RM 180.6 downstream to RM 52.7 will ensure the continuity of the long-term data set for Reaches 3 – 6 and also allow for the backwater at Lime Creek to be sampled on a yearly basis. Lime Creek has continually produced wild age-0 Colorado Pikeminnow and Razorback Sucker when sampled over the previous three years. The proposed section of river to be sampled will also cover the entire reach sampled during the Demographic Monitoring project. The spatial extent of area sampled could be expanded to include other areas on a yearly basis based on new evidence of increased endangered species presence in the areas above or below the sampling area.

METHODS

Small-bodied fishes monitoring is designed to sample habitats which have the greatest likelihood of supporting age-0 large-bodied fishes and all age classes of small-bodied fishes. Sampling will occur at designated 3-mile intervals in the primary channel, and at all secondary (less than 20% of total flow) and zero velocity channels (i.e., backwaters and embayments; > 30 m^2) when encountered (SJRIP 2012). 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 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 SBF monitoring and sampled if flowing following the protocols described below.

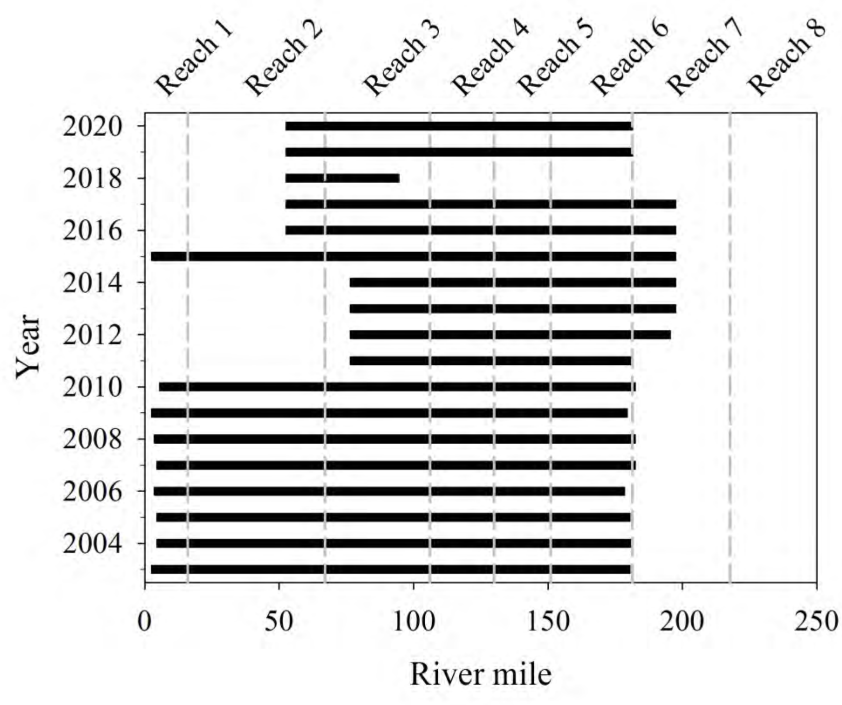

Figure 1. Spatial extent of sampling during small-bodied fishes monitoring on the San Juan River since 2003. The spatial extents of sampling in 2019 and 2020 are proposed. Note that river miles begin at the inflow of Lake Powel in Utah (River Mile 0) and end at Navajo Dam in New Mexico (River Mile 224).

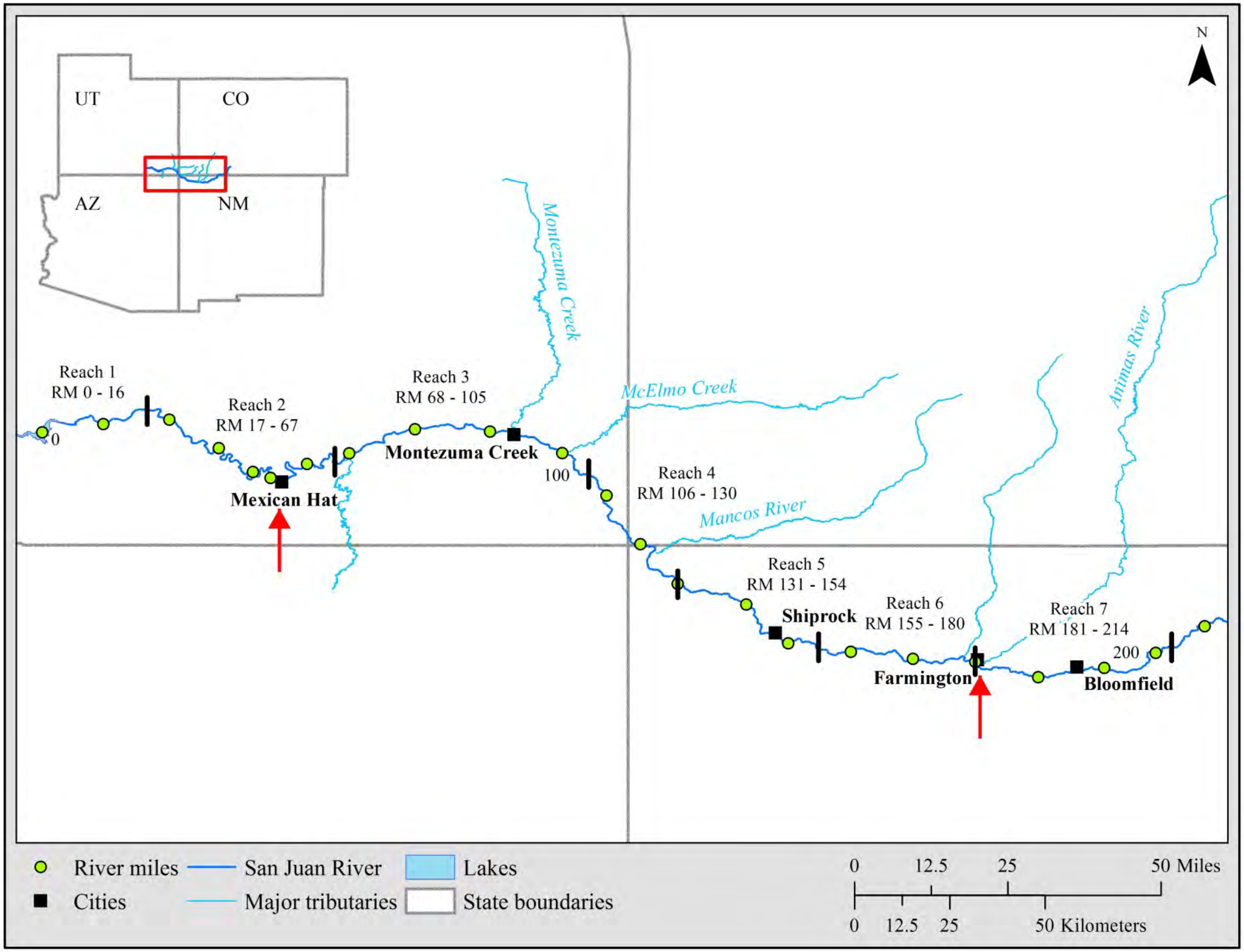

Figure 2. The San Juan River in New Mexico, Colorado, and Utah with river miles and geomorphic reaches indicated. The section between the red arrows will be sampled during 2020 small-bodied fishes monitoring (Animas River confluence downstream to Mexican Hat, UT). Inset indicates location of San Juan River in Colorado, New Mexico, and Utah.

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. Seine hauls will be made in at least eight different mesohabitats at each site; however, if habitat heterogeneity is low at a site, 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 only one seine haul, parallel to its long axis, will be made.

All captured fishes will be identified to species and enumerated. Small-bodied fishes (e.g., Fathead Minnow *Pimephales promelas*, Red Shiner *Cyprinella lutrensis*, and Speckled Dace *Rhinichthys osculus*) will be counted and up to 25 age-0 large-bodied fishes (e.g., Bluehead Sucker *Catostomus discobolus*, Channel Catfish *Ictalurus punctatus*, and Flannelmouth Sucker *Catostomus latipinnis*) in a single seine haul will be measured for total length (mm TL). Any captured endangered or rare species (i.e., Colorado Pikeminnow, Razorback Sucker, and Roundtail Chub *Gila robusta*) will also be weighed (g) and, if ≥ 130 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 University of New Mexico Museum of Southwest Biology, 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 a project specific 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 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 (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 – 2020) 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 logliklihood 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.

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.

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.

An annual report will provide a summation of data obtained in FY2020, 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. 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 2021.

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.
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.

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FY 2020 Budget

Sampling - Animas River to Shiprock, NM

Personnel

Tasks - Annual monitoring of small-bodied fishes in the San Juan River from the Animas River confluence to Shiprock, NM; 1 day trip preperation (8 hrs day) and 4 field days (12 hrs day) = 56 hours (40 hrs regular and 16 hrs overtime).

Project Leader (1)		
40 hrs regular @ $47.73/hr ($34.84/hr (base salary) + $12.89/hr (benefits))	$	1,909
16 hrs overtime @ $71.60/hr ($47.73/hr * 1.5 (time-and-a-half)	$	1,146
Project Biologists (3)		
40 hrs regular @ $38.24/hr ($27.91/hr (base salary) + $10.33 (benefits)) * 3	$	4,589
16 hrs overtime @ $57.36/hr ($38.24/hr * 1.5 (time-and-a-half)) * 3	$	2,753
Sub-total	**$**	**10,397**

Per Diem

4 days @ $85/day (standard NM in-state rate) * 4 biologists	$	1,360
Sub-total	**$**	**1,360**

Vehicles

Round-trip to Shiprock, NM – 500 miles @ $0.55/mile	$	275
Sub-total	**$**	**275**
Animas River to Shiprock Sampling Sub-total	**$**	**12,032**

Sampling - Shiprock, NM to Mexican Hat, UT

Personnel

Tasks - Annual monitoring of small-bodied fishes in the San Juan River from Shiprock, NM to Mexican Hat, UT; The Nature Conservancy RERI Phase I and Phase II sites; 3 days trip preperation (8 hrs day) and 10 field days (12 hrs day) = 144 hours (104 hrs regular and 40 hrs overtime).

Project Leader (1)		
104 hrs regular @ $47.73/hr ($34.84/hr (base salary) + $12.89/hr (benefits))	$	4,964
40 hrs overtime @ $71.60/hr ($47.73/hr * 1.5 (time-and-a-half)	$	2,864
Project Biologist (3)		
104 hrs regular @ $38.24/hr ($27.91/hr (base salary) + $10.33 (benefits)) * 3	$	11,931
40 hrs overtime @ $57.36/hr ($38.24/hr * 1.5 (time-and-a-half)) * 3	$	6,883
Sub-total	**$**	**26,642**

Per Diem		
3 days @ $85/day (standard NM in-state rate) * 4 biologists	$	1,020
7 days @ $115/day (stanadard NM out-of-state rate) * 4 biologists		3,220
Sub-total	**$**	**4,240**
Vehicles		
Round-trip to Mexican Hat, UT – 800 miles @ $0.55/mile	$	440
Sub-total	**$**	**440**
Shiprock to Mexican Hat Sampling Sub-total	**$**	**31,322**
Field Equipment & Supplies		
Water quality instrument maintence 2 @ $400	$	800
Life Jackets 5 @ $60	$	300
Raft maintenance	$	500
Whirlpacks (500) @ $50.00/per 500	$	50
Formalin (6 gal) @ $25/gal	$	150
Sub-total	**$**	**1,800**
Sampling Sub-total	**$**	**45,154**
Specimen Management		
Personnel		
Tasks - Processing (sorting, identification, and data-entry); 10 days of in the laboratory (8 hrs day) = 80 hours.		
Project Biologist (1)		
80 hrs regular @ $38.24/hr ($27.91/hr (base salary) + $10.33 (benefits))	$	3,059
Specimen Management Sub-total	**$**	**3,059**
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 @ $47.73/hr ($34.84/hr (base salary) + $12.89/hr (benefits))	$	5,728
Project Biologist (1)		
200 hrs regular @ $38.24/hr ($27.91/hr (base salary) + $10.33 (benefits))	$	7,648
Data Management/Analysis & Report Preparation Sub-total	**$**	**13,376**

FY 2020 Total

Sampling Sub-total		$	45,154
Specimen Management Sub-total		$	3,059
Data Management/Analysis & Report Preparation Sub-total		$	13,376
	Project Sub-Total	**$**	**61,589**
IDC at 22.91		$	14,110
	Project Total	**$**	**75,699**

San Juan River Larval Razorback Sucker and Colorado Pikeminnow Monitoring

Fiscal Year 2020 Scope of Work

Submitted to the U.S. Bureau of Reclamation

From

American Southwest Ichthyological Researchers, L.L.C. (*ASIR*)
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Contract # GS-10F-0249X

1 October 2019- 30 September 2020

<u>SAN JUAN RIVER LARVAL RAZORBACK SUCKER AND COLORADO PIKEMINNOW MONITORING FISCAL YEAR 2020 PROJECT PROPOSAL</u>

Principal Investigator: Michael A. Farrington
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Project history:

Surveys conducted in late 1980s documented small resident populations of Colorado Pikeminnow and Razorback Sucker in the San Juan River and the San Juan River arm of Lake Powell (Platania et al. 1991). Beginning in the mid-1990s, populations of these two species were augmented with annual hatchery stocking under the auspices of the San Juan River Basin Recovery Implementation Program (SJRRIP). Currently, populations of Colorado Pikeminnow and Razorback Sucker persist in the lowermost 180 river miles of the San Juan River (between the Animas River confluence and the inlet of Lake Powell Reservoir). Annual investigations into the early life history of Colorado Pikeminnow began in 1991 when passive drift-netting for larval and young-of-year (YOY) fish was initiated in the San Juan River. The primary objectives of the passive drift-netting study were to 1) determine the temporal distribution of San Juan River ichthyoplankton in relation to the hydrograph, 2) provide comparative analysis of the reproductive success of San Juan River fishes, 3) attempt to characterize downstream movement of ichthyoplankton, and 4) attempt to validate the presumed spawning period of Colorado Pikeminnow.

Two stationary sites were used for the drift-net surveys. The upstream site was located 4.6 miles upstream of the Mancos River confluence in New Mexico. A second site was established in Mexican Hat, UT. Over 70 river miles separated the two field stations. Results from eleven years of drift-net surveys (1991–2001) resulted in the collection of 11 larval Colorado Pikeminnow (Table 1) as well as information regarding the ichthyofaunal community of the San Juan River during the presumed spawning period of Colorado Pikeminnow (Platania et al. 2000, 2002).

In 1994, personnel from the U.S. Fish and Wildlife Service Colorado River Fishery Project (CRFP; Grand Junction, Colorado) stocked the first series of Razorback Sucker (n=672) in the San Juan River. Those fish, whose mean length and mass at the time of stocking were about 400 mm TL and 710 g, respectively, were released between Hogback, New Mexico and Bluff, Utah. In their 1995 report of activities, Ryden and Pfeifer (1996) suggested that most experimentally stocked 1994 San Juan River Razorback Sucker would achieve sexual maturity by 1996 thereby providing the potential for spawning during 1997–1998. The success of the experimental stocking study resulted in the development of a full-scale augmentation program for Razorback Sucker in the San Juan River.

At the November 1996 SJRRIP Biology Committee integration meeting, it was suggested that the Colorado Pikeminnow, larval fish drift study be expanded to document spawning of Razorback Sucker. However, because reproduction by Razorback Sucker (March-May) occurred considerably earlier than Colorado Pikeminnow (June-July), separate investigations of spawning periodicity and magnitude were deemed necessary. The initial attempt to document reproduction by Razorback Sucker stocked in the San Juan River took place in 1997. Low velocity monitoring sites were established in numerous locations adjacent to U.S. Hwy 163 and Utah State Hwy 262 (which parallels the San Juan River between Aneth and Bluff, UT) that appeared suitable for sampling with light-traps. Light-traps were set nightly in low-velocity habitats between Aneth and Mexican Hat from late March through mid-June 1997. 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 and larval Razorback Sucker was not present. While there were probably several variables that accounted for the poor light-trap catch rate, a principal factor was limited access to suitable habitats. A primary result of the 1997 study was the realization that being bound to specific collecting sites was an inefficient means of collecting the large number of larval fish necessary to document reproduction of a rare species.

In 1998, the Razorback Sucker larval fish sampling technique was modified to allow collections over a larger portion of the San Juan River and capture of a considerably larger number of larval fish. Navigation of the river by use of an inflatable raft provided the opportunity to sample habitats that were formerly either inaccessible or unobservable under the constraints of the 1997 sampling protocol. The primary collecting method was sampling low-velocity habitats with a fine mesh seine (0.8 mm mesh). The seining technique yielded over 13,000 specimens between river miles 127.5 and 53.3 with most these individuals (n=9,960) being larval catostomids. Included in the 1998 larval fish catch were two larval Razorback Suckers (Table 2). The success of this project became evident as documentation of reproduction by Razorback Sucker continued in successive years. Between 1998 and 2018 there have been both spatial and temporal expansions upon this project but sampling methodology has remained relatively consistent.

The most significant change to the larval Razorback Sucker survey was the incorporation of the spawning periodicity of Colorado Pikeminnow using the same methodology. Beginning in July 2002, personnel began an active sampling regime that mirrored the sampling protocol successfully used to document reproduction by Razorback Sucker. This temporal expansion of the larval fish survey resulted in the monitoring of reproduction by the entire ichthyofaunal community.

Following the 2002 expansion of the San Juan River larval fish survey to actively sample for larval Colorado Pikeminnow, 1,164 individuals have been collected. Over 95% (n = 1,112) of all larval Colorado Pikeminnow has been collected since 2014 (Table 1). Back-calculated spawning dates, based on Colorado Pikeminnow larvae, range from 23 May to 16 July and are associated with the descending limb of spring runoff and mean river temperatures typically above 18^{o}C.

The results of the investigation into the early life history of Colorado Pikeminnow and Razorback Sucker is a foundation of work detailing the spawning periodicity of the entire ichthyofaunal community of the San Juan River. For the endangered fishes, catch data elucidates potential spawning areas, distribution, and displacement of propagules in the system and back-calculated spawning and hatching dates. The long-term data set (21 years) can track trends of the entire ichthyofaunal community by year, month, and river reach. The larval survey is also able to detect spawning by the rarest of the San Juan River fishes; Colorado Pikeminnow and Roundtail Chub, *Gila robusta*.

To date larval fish monitoring has collected and identified 12,240 larval or age-0 juvenile Razorback Sucker and documented reproduction by Razorback Sucker for 21 consecutive years

(Table 2). Back-calculated hatching dates derived from individual Razorback Sucker larvae indicates spawning occurs prior to spring run-off often including the ascending limb of the spring hydrograph, and can persist into early summer (Farrington et al. 2017). Mean water temperatures during this period among all years ranged between 7.7–26.5^{o}C. This minimum, maximum and subsequent range of temperatures at which successful spawning by Razorback Sucker has been documented is outside of the temperature range typically reported for this species (Bozek et al. 1990; Tyus and Karp, 1990; Muth et al. 1998; Bestgen et al. 2011).

Table 1. Summary of larval and YOY Colorado Pikeminnow collected in the San Juan River during larval drift-netting/larval seining (1991-2018) and back-calculated dates of spawning.

Year	*Sample Method*	*Study Area (River Miles)*	*N=*	*Length mm TL.*	*Collection Date*	*Spawning Date*
1991-2001	Drift Netting	127.5, 53.3	11	8.5–9.2	26 Jul–03 Aug	15-18 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	14.3-16.2	25, 27 Jul	26–29 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
2017	Larval Seine	180.6 – 2.9	174	9.0–21.5	23 Jul–16 Aug	13 Jun–16 Jul
2018	Larval Seine	180.6 – -17.0*	54	9.3–25.3	7–26 Jul	4–28 Jun

* RM -17.0 is equivalent to Lake Mile 38 in the San Juan arm of Lake Powell.

Table 2. Summary of larval and YOY of Razorback Sucker (Xyrtex) collected in the San Juan River (1998 – 2018) and back-calculated dates of spawning.

Year	*Sample Method*	*Study Area (River Miles)*	*N=*	*Length mm TL.*	*Collection Date*	*Spawning Date*
1998	Larval seine Light traps	127.5 – 53.3	2	12.1, 12.7	21, 22 May	NA
1999	Larval seine Light traps	127.5 – 2.9	7	10.2–18.6	4 May–14 Jun	9 Apr–14 May
2000	Larval seine Light traps	127.5 – 2.9	129	9.3–16.2	9 May–2 Jun	4 Apr–14 May
2001	Larval seine Light traps	141.5 – 2.9	50	10.1–28.8	16 May–14 Jun	7 Apr–8 May
2002	Larval seine Light traps	141.5 – 2.9	813	9.7–62.4	29 Apr–12 Jul	27 Mar–13 May
2003	Larval seine Light traps	141.5 – 2.9	472	9.2–37.3	16 May–18 Jun	18 Mar–12 May
2004	Larval Seine	147.9 – 2.9	41	8.7–25.9	15 May–15 Jun	17 Apr–2 Jun
2005	Larval Seine	147.9 – 2.9	19	10.8–25.3	14 May–3 Aug	16 Apr–26 Jun
2006	Larval Seine	147.9 – 2.9	202	8.9–22.5	23 Apr–30 May	2 Apr–16 May
2007	Larval Seine	147.9 – 2.9	200	6.7–31.9	19 Apr–26 Jul	22 Mar–11 Jun
2008	Larval Seine	147.9 – 2.9	126	8.3–18.7	21 May–21 Jun	15 Apr–31 May
2009	Larval Seine	147.9 – 2.9	272	10.1–30.2	19 May–19 Jun	27 Mar–28 May
2010	Larval Seine	147.9 – 2.9	1,251	9.4–30.0	17 May–20 Jul	13 Apr–4 Jun
2011	Larval Seine	147.9 – 2.9	1,065	8.6–34.2	16 May–19 Jul	21 Mar–27 May
2012	Larval Seine	147.9 – 2.9	1,778	6.1–31.8	14 May–14 Jun	20 Mar–30 May
2013	Larval Seine	147.9 – 2.9	979	9.5–70.0	17 May–18 Jul	23 Mar–2 Jun
2014	Larval Seine	147.9 – 2.9	612	8.8–57.6	22 Apr–17 Jul	19 Mar–30 Jun

Table 2 (cont.). Summary of larval and YOY of Razorback Sucker (Xyrtex) collected in the San Juan River (1998 – 2018) and back-calculated dates of spawning.

Year	*Sample Method*	*Study Area (River Miles)*	*N=*	*Length mm TL.*	*Collection Date*	*Spawning Date*
2015	Larval Seine	141.5 – 2.9	1,205	9.6–22.4	19 Apr–21 May	19 Mar–4 May
2016	Larval Seine	141.5 – 2.9	824	9.3–48.4	21 Apr–25 Jul	19 Mar–30 Jun
2017	Larval Seine	180.6 – 2.9	360	9.2–43.0	20 Apr–26 Jul	23 Mar–9 Jun
2018	Larval Seine	180.6 – -17.0*	1,833	8.2–102.2	23 Apr–26 Jul	3 Mar–22 Jun

* RM -17.0 is equivalent to Lake Mile 38 in the San Juan arm of Lake Powell.

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 (Table 3). 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, 2012 and 2017 by a total of 103.5 river miles (over double the length of the original study area) to include Reach 6 through Reach 1 (Farmington, NM to Clay Hills Crossing, UT). The expansions of the study area were a result of captures of larval Razorback Sucker at the top of the previous study area boundary. Within two years (and often the following year) of each study area expansion, larval Razorback Sucker was documented in the newly expanded study area. The most recent expansion occurred in 2018 when larval fish sampling was expanded downstream of the Paiute Farms waterfall (RM -1.0) to include riverine habitat in the San Juan arm of Lake Powell. Larval Razorback Sucker larvae were collected downstream of the waterfall in 2018. Sampling done downstream of the Paiute Farms waterfall, and within the “Expanded Study Area” (RM 147.9–180.6, Shiprock, NM to Farmington, NM) is considered to be independent of the work proposed in this SOW with discrete sampling dates, SOW’s, and budgets submitted to the SJRRIP each fiscal year.

Beginning in 2003, the entire study area (excluded the aforementioned Expanded Study Area and Paiute Farms waterfall reach) 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 SJRRIP 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 Colorado Pikeminnow and 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 SJRRIP 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.

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 2018.

Year	*Sampling method*	*Study area (River Miles)*	*Specimens collected*	*Field modification*	*Laboratory modification*
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
2017	Larval Seine	180.6 – 2.9	31,587	Study Area expanded	
2018	Larval Seine	180.6 – -17.0*	44,611	Study Area expanded downstream to include riverine habitat below the waterfall.	Fall monitoring covariate changed from raw numbers to CPUE

*RM -17.0 is equivalent to Lake Mile 38 in the San Juan arm of Lake Powell.

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 (SJRRIP).

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^2) 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 to meet the study objectives of this SOW 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 2019 must be scheduled by late January 2019 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 95% ethanol (EtOH) 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 measures and recorded. Capture densities for seine samples will be reported as the number of fish per 100 m^2.

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% EtOH (in the case of potential Razorback Sucker hybrids) and scanned with a 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 most current SJRBRIP 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. Beginning in 2011, ASIR researchers defined 15 monitoring sites located in lateral washes and canyons throughout the study area to assess persistence of backwater habitats. Monitoring sites will be visited in each survey. If suitable nursery habitat exists at the time of visitation they will be sampled. If the sites are dry or contain isolated pools, photographs will be taken and field notes written detailing condition of the habitat. Conditions of all monitoring sites and RERI restoration sites will then be related back to discharge at time of visitation.

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 postflexion 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 60 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) an 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 PDF 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–present) and Colorado Pikeminnow (2003–present) sampling-site density data will be analyzed using PROC NLMIXED (SAS, 2016), 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 (δ = probability of occurrence, μ = mean of the lognormal distribution, σ = 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 2017 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, 2016), 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 δ, μ, and σ. 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 δ, and a second random error was added to the log of the μ 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_C) are generated to assess the relative fit of data to various models. The approach used to analyze habitat data between 2013 and 2018, and scheduled for use in 2019, will be used in 2020 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 were calculated using the formula: age = SL – 7.1058 + 0.0003(Q) + 0.0061(RM) – 0.0408(T)/ 0.2463, where SL is the standard length in millimeters, Q is mean April discharge, RM is river mile and T is the temperature on the collection date (Clark-Barkalow et al. 2019). 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 were calculated for larval Colorado Pikeminnow using the formula: age = $0.0086SL^3 – 0.3781SL^2 –$ 30.7930, where SL is the standard length in millimeters. Spawning dates are calculated by calculating the incubation time using the formula: days = $315.42e^{-0.05(T\ hatch)}$ where T hatch is the temperature on the hatch date and e is the base of the natural logarithm; spawning date is then the age at hatch – the incubation time (Clark-Barkalow et al. 2019). 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.

Covariate	Description
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.
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. 50,000 fish stocked between 1998 and 2019 would be used as a covariate for 2020 larval capture data).
Fall monitoring captures.	# of adult Razorback Sucker collected per hour of electrofishing effort. 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.

Covariate	Description
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 2015 would be used as a covariate for 2020 larval capture data).
Fall monitoring captures 400+ mm TL.	# of Colorado Pikeminnow greater than 400 mm TL collected per hour of electrofishing effort. 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 SJRRIP, 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 Department of Fish and Wildlife, and Utah Division of Wildlife Resources. 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 2020 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 2021. 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 2021 in order to meet Objective 5 of this proposal. Electronic copies of the 2020 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 SJRRIP 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.

2020 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 at $60.67/hr):........................$ 24,268

Fisheries Technician (1 staff x 5 trips x 10 days x 8 hrs/day at $37.33/hr):.......................$ 14,932

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 at $60.67/hr):........................$ 24,268

Fisheries Technician (1 staff x 5 trips x 10 days x 8 hrs/day at $37.33/hr):.......................$ 14,932

Lab Work

Upper and Lower Reach Samples Combined

Fisheries Biologist I (120 staff days/sampling year x 8 hrs/day at $60.67/hr): ....$ 58,243
Tasks: Laboratory identification, developmental staging,
specialized endangered fish processing, data entry, data query
and review, database development

Fisheries Technician (120 staff days/sampling year x 8 hrs/day at $37.33/hr): ....$ 35,837
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 x 8 hrs/day at $60.67/hr):...................................$ 33,975
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 x 8 hrs/day at $186.65/hr): ....$ 14,932
Tasks: Mixture model development and analysis.

Project Oversight

Senior Fisheries Biologist (10 staff days year x 8 hrs/day at $102.66/hr):........................$ 8,213
Tasks: Project coordination, project and data review, data management, report review, permitting review

Personnel (Field, Lab, Office, Oversight): .... Subtotal $ 229,600

SJRBRIP Meetings

Four meetings/year required; 2 days/meeting

Fisheries Biologist I (8 staff days/year x 8 hrs/day at $60.67/hr):....................................$ 3,883

Senior Fisheries Biologist (8 staff days/year x 8 hrs/day at $102.66/hr):..........................$ 6,570

Personnel (Meetings): .... Subtotal $ 10,453

Personnel: .... Total $ 240,053

Materials and Supplies

Safety dedicated first aid gear (open market items): ....$ 2,009
Raft and rafting associated gear (open market items):..$ 1,627
Fish Sampling and associated electronic recording gear (open market items):.................$ 1,416

Materials and Supplies:.. Total $ 5,052

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 $ 0.58/mile x 5 trips):.............$ 4,002
Per Diem - 6 field days per trip x 4 staff ($55/day GSA M&IE rate) x 5 trips: ....$ 6,600
Per Diem - 1 hotel day per trip x 4 staff ($94/night GSA lodging rate) x 5 trips:............$ 1,880
Truck and Trailer Shuttle from Shiprock to Clay Hills x 5 at $220.00 per trip:................$ 1,100

Travel and Per Diem (Field): .... Subtotal $ 13,582

<u>SJRBRIP Meetings</u>

Travel (one vehicle at 430 miles r.t. x 4 trips x $ 0.58/mile): ....$	998
Per Diem (Durango CO.)	
(4 meetings x 2 staff. x GSA lodging $105/night x 2) ....$	1,680
(4 meetings x 2 staff. x M&IE rate $71/day x 3): ....$	1,704
Travel and Per Diem (Meetings): ....Subtotal $	**4,382**
Travel and Per Diem:.. Total $	**<u>17,964</u>**

<u>2020 Project Totals</u>

Personnel: .... Total $	**<u>240,053</u>**
Materials and Supplies: .... Total $	**<u>5,052</u>**
Travel and Per Diem .... Total $	**<u>17,964</u>**
2020 Scope of Work: ....GRAND TOTAL $	**<u>263,069</u>**

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

FY 2021 ....$	**270,961**
FY 2022 ....$	**279,090**
FY 2023 ....$	**287,463**

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Response to reviewers' comments.

Reviewer: Mark McKinstry

Comment: *Is this a for real citation?*
Clark-Barkalow, S. L. and M. J. Chavez. 2018. The joys of examining fish otoliths for months on end. Research report. San Juan River Basin Recovery Implementation Program, USFWS, Albuquerque, NM. XX pp.

Response: This is not a real citation. It was used as a place holder in the Literature Cited while a draft version of the report in question was being written. The Literature Cited has been corrected, and the correct citation included.

San Juan River Larval Endangered Fish Monitoring between RM 180.6 – 168.4
(Animas River confluence to Hatch Brother's trading post)

Fiscal Year 2020 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 # GS-10F-0249X

1 October 2019- 30 September 2020

SAN JUAN RIVER LARVAL ENDANGERED FISH MONITORING BETWEEN RM 180.6 – 168.4 (ANIMAS RIVER CONFLUENCE TO HATCH BROTHER'S TRADING POST) FISCAL YEAR 2020 PROJECT PROPOSAL

Principal Investigator: Michael A. Farrington
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)
mafarrington@gmail.com

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 first included in the SJRBRIP fiscal year 2017 Annual Work Plan.

During a separate 2016 SJRBRIP study "Evaluation of Larval Fish Entrainment in the Hogback Diversion Canal" larval Colorado Pikeminnow and Razorback Sucker were collected in drift-net samples taken in the San Juan River adjacent to the Hogback Diversion Canal. During the May 2017 Biology Committee meeting in Durango Colorado, these collections prompted a discussion regarding moving one survey trip to target the collection of Colorado Pikeminnow. This change in protocol was unanimously approved. During 2017, three sampling trips were conducted between mid-June and early August with the intent of documenting upstream distributional boundaries of both endangered fish. Both larval Colorado Pikeminnow and Razorback Sucker were documented within the expanded study area in 2017. Sampling of the San Juan River between Farmington and Shiprock, NM during 2018 documented larval Razorback Sucker up to river mile (RM) 179.8 near the confluence of the Animas River. There was no larval Colorado Pikeminnow collected in this study area during 2018. At the request of the SJRBRIP, the FY2019 proposal specifically targets the collection of larval Colorado Pikeminnow, with all sampling efforts taking place above the Four Corners Power Plant pumping station located at RM 163.7. This FY2020 proposal will also specifically target the collection of larval Colorado Pikeminnow above RM 163.7.

Project Justification:

Data from this monitoring effort can be used by the SJRBRIP to determine when to implement Reasonable and Prudent Measures (RPM) necessary to avoid adverse impacts to the endangered fish species. Specifically, sampling in the proposed reach (RM 180.6 – 168.4) may trigger RPM #2, as outlined in the Biological Opinion for Four Corners Power Plant (Service, 2015). If larval Colorado Pikeminnow larvae are collected upstream of river mile 163.7 (Four

Corners Power Plant pumping station), a feasible pumping plan that maintains the current operating configuration could be developed to help minimize entrainment risk.

Sampling within this proposed reach relies on annually securing private property access through the Hatch Brother's trading post. These landowners have allowed access to SJRBRIP researchers in the past.

Methods:

Two sampling trips will take place during the presumed spawning and hatching period of Colorado Pikeminnow (July and early August). Results (i.e. raw numbers of larvae captured) from the long-term larval fish survey being conducted immediately downstream of Shiprock will help to inform specific sampling dates within the extended study area. This "adaptive sampling" approach will help ensure the collection of the large number of larval fish necessary to document reproduction of a rare species.

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 a discrete river reach requires the use of two vehicles to daily shuttle materials and personnel to the upstream and downstream end of study area. A proposed schedule for each sampling trip follows:

- Day 1 Fieldwork preparation, travel from Albuquerque to Farmington NM.
- Day 2 Sample RM 180.6 – 168.4.
- Day 3 Travel from Farmington to Albuquerque NM. Clean and store field sampling gear and 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 *(SOW 20 21)*. 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.

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. Density estimates, frequency of occurrence, and other metrics associated with this expanded study area will be analyzed and presented independently of the long-term larval fish monitoring study. Timeline for data submission and reporting follow the same schedule outlined in *SOW 21*.

2020 BUDGET: SAN JUAN RIVER LARVAL ENDANGERED FISH MONITORING BETWEEN RM 180.6 – 168.4 (Animas River confluence to Hatch Brother's trading post)

Personnel

Field Data Collection

Animas River confluence to Hatch Brother's trading post (two staff, one raft)
RM 180.6 – 168.4

Fisheries Biologist I (1 staff x 2 trips x 3 days x 8 hrs/day at $60.67/hr):............................$ 2,912

Fisheries Technician (1 staff x 2 trips x 3 days x 8 hrs/day at $37.33/hr):...........................$ 1,792

Lab Work

All Samples Combined

Fisheries Biologist I (15 staff days/sampling year x 8 hrs/day at $60.67/hr): ....$ 7,280
Tasks: Laboratory identification, developmental staging,
specialized endangered fish processing, data entry, data query
and review, database development

Fisheries Technician (15 staff days/sampling year x 8 hrs/day at $37.33/hr): ....$ 4,480
Tasks**:** Post-trip sample processing, juvenile identification,
Post-identification **–** processing, measures, review of counts

Office Work (Report Development)

Fisheries Biologist I (3 staff days year x 8 hrs/day at $60.67/hr):.......................................$ 1,456
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 (1 staff days year x 8 hrs/day at $102.66/hr):................................$ 821
Tasks: Project coordination, project and data review, data
management, report review, permitting review

Personnel (Field, Lab, Office, Oversight): .... Subtotal $ 18,741

SJRBRIP Meetings

Four meetings/year required; 2 days/meeting. (Costs are covered under SOW 20 21)

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

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

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

Personnel: .... Total $ 18,741

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 Hatch Brother's trading post (two trips) - RM 180.6 – 168.4

Travel - 4 x 4 pickup trucks (404 miles x $ 0.58/mile x 2 trips x 2 trucks):............................$ 937
Per Diem - 3 field days per trip x 2 staff ($55/day GSA M&IE rate) x 2 trips: ....$ 660
Per Diem - 2 hotel days per trip x 2 staff ($94/night GSA lodging rate) x 2 trips: ....$ 752

Travel and Per Diem (Field): .... Subtotal $ 2,349

SJRBRIP Meetings (*Costs are covered under SOW 20 21)*

Travel (one vehicle at 430 miles r.t. x 4 trips x $ 0.58/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 $ 2,349

2020 Project Totals

Personnel: .... Total $ 18,741
Materials and Supplies: .... Total $ 0
Travel and Per Diem: .... Total $ 2,349

2020 Scope of Work: ....GRAND TOTAL $ 21,090

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

FY 2021 ....$ 21,723
FY 2022 ....$ 22,374
FY 2023 ....$ 23,046

Response to reviewers' comments.

There were no comments received on this scope of work.

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

Digital Files Fiscal Year 2020 Scope of Work

Principle Investigator: Thomas
F. Turner University of New
Mexico MSC03-2020
Albuquerque, NM 87131

Contact (505) 277-7541 Thomas F. Turner; Email - turnert@unm.edu

Award R18AC00015, US Bureau of Reclamation
Performance Period: 16 April 2018 to 30 September 2022

Background

Collections Curation and Data Archives -- Since 1991, the MSB Division of Fishes has been the permanent repository for large numbers of voucher specimens and associated data collected by San Juan River Restoration Implementation Program (SJRRIP) 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.

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 SJRRIP 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, 46,055 lots or 1,624,091 fish specimens have been collected (1987-2019) 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 20,402 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 MSB Division of Fishes 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 SJRRIP 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 the Program 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). Field data are captured in an electronic catalog and SJRRIP collections are organized in 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. Synthesis, analysis, and integration of relevant elements of this large database is done in collaboration with 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, four UNM student and one staff postions (three undergraduate, one graduate student, and Collections Manager) 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 SJRRIP species identifications and associated data are verified and correctly represented in the MSB electronic catalog; report discrepancies to SJRRIP principal investigators.
3. Georeference collection sites for SJRRIP 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 SJRRIP 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 and/or otolith studies. Preservation histories for all incoming SJRRIP collections are recorded on accession cover sheets and this information is stored in accession files. Fish specimens are removed from field containers and cleaned (debris removed) and placed into museum quality jars during the fluid transfers. SJRRIP 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. SJRRIP 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 2019

SJRRIP 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 (UNM). Collection sites will be georeferenced and continue to be available in Arctos (https://arctos.database.museum/). Original field notes will be digitized and archived by the MSB Division of Fishes and collection data electronically stored in a permanent MSB database program. San Juan River digital files (data and field notes) are backed up in three different media: two servers- one server in MSB Division of Fishes and the other server located in UNM Department of Biology; the Arctos database, which resides with The Texas Advanced Computing Center (TACC) in Austin TX; and one external hard drive. Species verifications and corrections as well as digital copies (PDF) of field notes will be made available to SJRRIP principle investigators upon request. A draft report of the 2019 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 2020 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 2020.

Budget Fiscal Year 2020 1 October 2019 to 30 September 2020

BUDGET ITEM DESCRIPTION	COMPUTATION		RECIPIENT FUNDING	OTHER FUNDING	RECLAMATION FUNDING	TOTAL COST
	$/Unit	Quantity				
SALARIES AND WAGES --Position title x hourly wage/salary x est. hours for assisted activity. Describe this information for each position.						
UNM Student Assistants(3)	$10.93/HR	2160			$23,609.00	$23,609.00
UNM Student Assistant (1)	$13.11/HR	442			$5,795.00	$5,795.00
UNM Student Assistant (1)	$14.20/HR	912			$12,950.00	$12,950.00
FRINGE BENEFITS – Explain the type of fringe benefits and how applied to various categories of personnel.						
Undergraduate student UNM rate	1% per salary	5			$423.00	$423.00
TRAVEL—dates; location of travel; method of travel x estimated cost; who will travel						
EQUIPMENT—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.						
SUPPLIES/MATERIALS--Describe all major types of supplies/materials, unit price, # of units, etc., to be used on this assisted activity.						
Chemical Preservatives-EtOH 95%	$10.23/gallon	25			$255.75	$255.75
Labeling-paper and print film	$0.97/ea	100			$97.00	$97.00
Specimen containers-3 liter jars	$7.80/ea	30			$234.00	$234.00
Specimen containers-8oz jars	$0.99/ea	50			$49.50	$49.50
Specimen containers-8 dr vials	$0.76/ea	1200			$912.00	$912.00
Specimen containers-1 dr vials	$0.20/ea	300			$60.00	$60.00
Closures-cotton plugs	$0.01/ea	4000			$32.00	$32.00
Closures-gaskets	$3.20/ea	30			$96.00	$96.00
Closures-caps	$0.33/ea	45			$14.85	$14.85
CONTRACTUAL/ CONSTRUCTION—Explain any contracts or sub-Agreements that will be awarded, why needed. Explain contractor qualifications and how the contractor will be selected.						
OTHER –List any other cost elements necessary for your project; such as extra reporting, or contingencies in a construction contract.						
TOTAL DIRECT COSTS--					$44,528.00	$44,528.00
INDIRECT COSTS **– 17.5%**						
					$9,445.00	$9,445.00
TOTAL PROJECT/ACTIVITY COSTS FY20					$53,973.00	**$53,973.00**

FY 2020 Budget Summary

2020 Grand Total
Curation of SJRRIP Specimen, Data, and Field Note Collections

$53,973.00

REFERENCES

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Attachment A

Museum of Southwestern Biology
Curation of Specimens, Data, and Field Notes
San Juan River Restoration Implementation Program

2021-2024

THE FOLLOWING BUDGETS ARE ESTIMATES ONLY (3% INCREASES) AND MAY NOT REPRESENT ACTUAL COSTS

Budget Fiscal Year 2021 1 October 2020 to 30 September 2021

BUDGET ITEM DESCRIPTION	COMPUTATION $/Unit	COMPUTATION Quantity	RECIPIENT FUNDING	OTHER FUNDING	RECLAMATION FUNDING	TOTAL COST
SALARIES AND WAGES --Position title x hourly wage/salary x est. hours for assisted activity. Describe this information for each position.						
UNM Student Assistants(3)	$11.22/HR	2160			$24,235.00	$24,235.00
UNM Student Assistant (1)	$13.50/HR	442			$5,967.00	$5,967.00
UNM Student Assistant (1)	$14.63/HR	912			$13,343.00	$13,343.00
FRINGE BENEFITS – Explain the type of fringe benefits and how applied to various categories of personnel.						
Undergraduate student UNM rate	1% per salary	5			$435.00	$435.00
TRAVEL—dates; location of travel; method of travel x estimated cost; who will travel						
EQUIPMENT—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.						
SUPPLIES/MATERIALS--Describe all major types of supplies/materials, unit price, # of units, etc., to be used on this assisted activity.						
Chemical Preservatives-EtOH 95%	$10.54/gallon	25			$263.00	$263.00
Labeling-paper and print film	$1.00/ea	100			$100.00	$100.00
Specimen containers-3 liter jars	$8.03/ea	40			$321.00	$321.00
Specimen containers-8oz jars	$1.02/ea	51			$52.00	$52.00
Specimen containers-8 dr vials	$0.78/ea	1200			$936.00	$936.00
Specimen containers-1 dr vials	$0.21/ea	300			$63.00	$63.00
Closures-cotton plugs	$0.01/ea	4000			$32.00	$32.00
Closures-gaskets	$3.30/ea	30			$99.00	$99.00
Closures-caps	$0.34/ea	50			$17.00	$17.00
CONTRACTUAL/ CONSTRUCTION—Explain any contracts or sub-Agreements that will be awarded, why needed. Explain contractor qualifications and how the contractor will be selected.						
OTHER –List any other cost elements necessary for your project; such as extra reporting, or contingencies in a construction contract.						
TOTAL DIRECT COSTS--					$45,863.00	$45,863.00
INDIRECT COSTS – **17.5%**						
					$9,729.00	$9,729.00
TOTAL PROJECT/ACTIVITY COSTS FY21						**$55,592.00**

Budget Fiscal Year 2022 1 October 2021 to 30 September 2022

BUDGET ITEM DESCRIPTION	COMPUTATION $/Unit	COMPUTATION Quantity	RECIPIENT FUNDING	OTHER FUNDING	RECLAMATION FUNDING	TOTAL COST
SALARIES AND WAGES --Position title x hourly wage/salary x est. hours for assisted activity. Describe this information for each position.						
UNM Student Assistants(3)	$11.56/HR	2060			$23,814.00	$23,814.00
UNM Student Assistant (1)	$14.32/HR	442			$6,329.44	$6,329.44
UNM Student Assistant (1)	$15.52/HR	950.00			$14,744.00	$14,744.00
FRINGE BENEFITS – Explain the type of fringe benefits and how applied to various categories of personnel.						
Undergraduate student UNM rate	1% per salary	5			$448.00	$448.00
TRAVEL—dates; location of travel; method of travel x estimated cost; who will travel						
EQUIPMENT—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.						
SUPPLIES/MATERIALS--Describe all major types of supplies/materials, unit price, # of units, etc., to be used on this assisted activity.						
Chemical Preservatives-EtOH 95%	$10.86/gallon	25			$271.00	$271.00
Labeling-paper and print film	$1.03/ea	100			$103.00	$103.00
Specimen containers-3 liter jars	$8.27/ea	40			$331.00	$331.00
Specimen containers-8oz jars	$1.05/ea	40			$42.00	$42.00
Specimen containers-8 dr vials	$0.80/ea	1200			$964.00	$964.00
Specimen containers-1 dr vials	$0.22/ea	50			$11.00	$11.00
Closures-cotton plugs	$0.01/ea	4000			$33.00	$33.00
Closures-gaskets	$3.40/ea	40			$136.00	$136.00
Closures-caps	$0.35/ea	40			$14.00	$14.00
CONTRACTUAL/ CONSTRUCTION—Explain any contracts or sub-Agreements that will be awarded, why needed. Explain contractor qualifications and how the contractor will be selected.						
OTHER –List any other cost elements necessary for your project; such as extra reporting, or contingencies in a construction contract.						
TOTAL DIRECT COSTS--					$47,240.00	$47,240.00
INDIRECT COSTS – **17.5%**						
					$10,020.00	$10,020.00
TOTAL PROJECT/ACTIVITY COSTS FY22					$57,260.00	**$57,260.00**

Budget Fiscal Year 2023 1 October 2022 to 30 September 2023

BUDGET DESCRIPTION	COMPUTATION		RECIPIENT FUNDING	OTHER FUNDING	RECLAMATION FUNDING	TOTAL COST
	$/Unit	Quantity				
SALARIES AND WAGES --Position title x hourly wage/salary x est. hours for assisted activity. Describe this information for each position.						
UNM Student Assistants(3)	$11.91/HR	2060			$24,535.00	$24,535.00
UNM Student Assistant (1)	$14.75/HR	442			$6,519.00	$6,519.00
UNM Student Assistant (1)	$15.98/HR	912			$14,574.00	$14,574.00
FRINGE BENEFITS – Explain the type of fringe benefits and how applied to various categories of personnel.						
Undergraduate student UNM rate	1% per salary	5			$456.00	$456.00
TRAVEL—dates; location of travel; method of travel x estimated cost; who will travel						
EQUIPMENT—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.						
SUPPLIES/MATERIALS--Describe all major types of supplies/materials, unit price, # of units, etc., to be used on this assisted activity.						
Chemical Preservatives-EtOH 95%	$11.18/gallon	40			$447.00	$447.00
Labeling-paper and print film	$1.06/ea	101			$107.00	$107.00
Specimen containers-3 liter jars	$8.52/ea	75			$639.00	$639.00
Specimen containers-8oz jars	$1.08/ea	100			$108.00	$108.00
Specimen containers-8 dr vials	$0.83/ea	1000			$830.00	$830.00
Specimen containers-1 dr vials	$0.22/ea	100			$22.00	$22.00
Closures-cotton plugs	$0.01/ea	3400			$34.00	$34.00
Closures-gaskets	$3.50/ea	100			$350.00	$350.00
Closures-caps	$0.36/ea	100			$36.00	$36.00
CONTRACTUAL/ CONSTRUCTION—Explain any contracts or sub-Agreements that will be awarded, why needed. Explain contractor qualifications and how the contractor will be selected.						
OTHER –List any other cost elements necessary for your project; such as extra reporting, or contingencies in a construction contract.						
TOTAL DIRECT COSTS--					$48,657.00	$48,657.00
INDIRECT COSTS – **17.5%**						
					$10,321.00	$10,321.00
TOTAL PROJECT/ACTIVITY COSTS FY23					$58,978.00	**$58,978.00**

Budget Fiscal Year 2024 1 October 2023 to 30 September 2024

BUDGET ITEM DESCRIPTION	COMPUTATION		RECIPIENT FUNDING	OTHER FUNDING	RECLAMATION FUNDING	TOTAL COST
	$/Unit	Quantity				
SALARIES AND WAGES --Position title x hourly wage/salary x est. hours for assisted activity. Describe this information for each position.						
UNM Student Assistants(3)	$12.27/HR	2060			$25,271.00	$25,271.00
UNM Student Assistant (1)	$15.19/HR	442			$6,716.00	$6,716.00
UNM Student Assistant (1)	$16.46/HR	912			$15,011.00	$15,011.00
FRINGE BENEFITS – Explain the type of fringe benefits and how applied to various categories of personnel.						
Undergraduate student UNM rate	1% per salary	5			$456.00	$456.00
TRAVEL—dates; location of travel; method of travel x estimated cost; who will travel						
EQUIPMENT—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.						
SUPPLIES/MATERIALS--Describe all major types of supplies/materials, unit price, # of units, etc., to be used on this assisted activity.						
Chemical Preservatives-EtOH 95%	$11.50/gallon	40			$461.00	$461.00
Labels-paper and print film	$1.10/ea	100			$110.00	$110.00
Specimen containers-3 liter jars	$8.77/ea	70			$614.00	$614.00
Specimen containers-8oz jars	$1.11/ea	100			$111.00	$111.00
Specimen containers-8 dr vials	$0.85/ea	1000			$850.00	$850.00
Specimen containers-1 dr vials	$0.23/ea	50			$11.00	$11.00
Closures-cotton plugs	$0.01/ea	4000			$40.00	$40.00
Closures-gaskets	$3.60/ea	100			$360.00	$360.00
Closures-caps	$0.37/ea	285			$105.00	$105.00
CONTRACTUAL/ CONSTRUCTION—Explain any contracts or sub-Agreements that will be awarded, why needed. Explain contractor qualifications and how the contractor will be selected.						
OTHER –List any other cost elements necessary for your project; such as extra reporting, or contingencies in a construction contract.						
TOTAL DIRECT COSTS--						$50,116.00
INDIRECT COSTS-17.5%						
						$10,631.00
TOTAL PROJECT/ACTIVITY COSTS FY24						**$60,747.00**

Ecosystems Research Institute, Inc.

San Juan River Basin Recovery Implementation Program Habitat Monitoring 2019-20

Technical Proposal

March 2019

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^2 in September 1995 to less than 20,000 m^2, river wide by October 2003. From 2005 to 2015, backwater surface areas have stabilized at approximately 30,000 to 40,000 m^2. However, during 2016, the area of backwaters increased to over 90,000 m^2. 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. These habitats persisted in 2017 with another high spring flow. However, in 2018, there was no spring release from Navajo Reservoir and the San Juan River experienced significant periods with summer baseflows less than 500 cfs. These resultant low flows reduced backwater surface areas to levels near their lows in 2004.

The 2019-20 habitat monitoring will document the impacts of the 2019 hydrograph, which is anticipated to be a better than average flow year. We are hypothesizing that the backwater habitat areas created in 2017 and 2018 will partially return if baseflows can be maintained at flows greater than 500 cfs.

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 Powel) and prepare maps for field verifications. Areal imagery will be obtained from a consultant contracted by ERI. The ortho corrected photography will be acquired for the post run-off summer baseflows as soon as possible given the instability of flows due to the summer monsoonal season.

Task 2) Field habitat mapping will be conducted to verify flowing secondary channel types, backwaters, embayments, islands and total wetted areas under summer baseflow conditions in critical complex areas of the San Juan River that are problematic in interpreting conditions on the aerial images (channels with minimal inflow through cobble at the inflow area)

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 2019 high flow hydrograph on the habitats and secondary channel types found in 2018 and compare them to the habitats created in 2016 and 2017.

The proposal time frame is from July 1, 2019 to September 31, 2020.

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 2019 water hydrograph conditions on habitat planform).* However, in 2019-20, mapping maybe done with a test higher baseflow (1,000-1,500 cfs). The test will depend on available water and the desire and direction of the San Juan River Recovery Implementation Program Biology Committee

Objective 8) Develop relationships between habitat availability and antecedent flow conditions. Use key habitats for this analysis. (*For example*, t*he hydrograph for 2016 and 2017 produced more days above 8,000 and 5,000 cfs since the high flows of 2008 and produced the most backwater area since 1995.Conversely, flows in 2018 were well below those in 2016-17 and backwater habitat was reduced to the second lowest level since 2004). The project will evaluate if the existing* *relationships between habitat densities and antecedent conditions are still valid for the habitat densities that will be found after the 2019 spring runoff).*

Objective 9) Track long-term trends of habitat availability

Task 1. Develop high-resolution Digital Imagery for Rm 3 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.

Task 2 Field Habitat Mapping

If necessary, field-verify selected problematic marginally flowing secondary channels during the summer base-flow period (2019) captured in the aerial images. This will be dependent upon flow at image capture. All secondary channels, main channel splits, island splits and cobble/sand bar splits will be noted on base-maps and compared to the newest images.

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

Once the digital frames 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 2019 high flow hydrograph on the habitats and secondary channel types compared to 2016, 2017 and 2018.

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 hypothesizes to be addressed for the 2019 data depending upon the hydrologic conditions prior mapping.

H_{O1} : If the spring runoff is greater than the average runoff, TWA, Island Count and Backwater Type area will increase compared to the 2018 habitat characteristics (density and area)

H_{O2} : If the spring runoff is equal to the average runoff, TWA, Island Count and Backwater Type area will remain the same compared to the 2018 habitat characteristics (density and area)

H_{O3} : If the spring runoff is less than the average runoff, TWA, Island Count and Backwater Type area will not change compared to the 2018 habitat characteristics (density and area)

H_{O4} : If mapping is done at an elevated baseflow (1,000-1,500 cfs) the added flow over normal baseflow conditions will result in greater TWA, Island counts and flowing secondary channels 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 2019 (flow permitting). Frame capture, rectification, and photo-interpretation will be completed by September 15, 2019. Field mapping will occur as soon as possible following spring runoff and will be done by the end of September, 2019. If water is available, mapping may occur at a higher baseflow as previously noted. Field verification will occur immediately following image capture. ARC GIS data transfer will be completed by December 31, 2019. The draft annual report will be completed by March 31, 2020 with the final report due June 1, 2020.

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 sand 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, 2020
    - A final report submitted by June 1, 2020
    - Attendance at the annual report meeting

APPENDIX A
Qualifications of Investigators

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.

For convenience, ERI will manage the Image acquisition contractor (Blue Sky Consulting) as part of this project.

APPENDIX B
Budget for 2020 Habitat Monitoring

TASK (2020)	Labor	Direct Costs	Total by Task
Contractor Image Capture (Blue Sky Consulting)	**$0**	**$58,500**	**$58,500**
Task 1 Map Preparation			
Image Clipping and Capture	**$2,060**	**$1,267**	**$3,327**
Task 2 Field Verification			
Habitat and Channel determination	**$9,840**	**$1,184**	**$11,024**
Task 3 Post Process			
Image rectification	**$2,060**		**$2,060**
Digitizing Waters Edge	**$16,782**		**$16,782**
Back Water/ Embayment Identification	**$8,672**		**$8,672**
Task 4 Final Report and Presentation			
Data Analysis	**$21,985**	**$984**	**$22,969**
Reporting	**$17,308**	**$870**	**$18,178**
Total Cost Estimate	**$78,707**	**$62,805**	**$141,512**

SUMMARY

TASK	Labor	Direct Costs	Total by Task
Contractor Image Capture	No Charge	No Charge	No Charge
Task 1 Map Preparation			
Image Clipping and Capture	$2,060	$1,267	$3,327
Task 2 Field Verification			
Habitat and Channel determination	$9,840	$1,184	$11,024
Task 3 Post Process			
Image rectification	$2,060		$2,060
Digitizing Waters Edge	$16,782		$16,782
Back Water/ Embayment Identification	$8,672		$8,672
Task 4 Final Report and Presentation			
Data Analysis	$21,985	$984	$22,969
Reporting	$17,308	$870	$18,178
Total Cost Estimate	$66,807	$4,305	$83,012

LABOR (Hours)

Principal $150/hr	Ecologist $150/hr	Sr. Scientist $120/hr	Biologist $62.5/hr	GIS Analyst $103/hr	GIS Specialist $88/hr	Tech Editor $62.5/hr
				20		
		82				
				20		
8		8		130	14	
8		6		16	58	
60		80	9	6	8	24
16		100			16	24
92	0	194	9	172	96	48

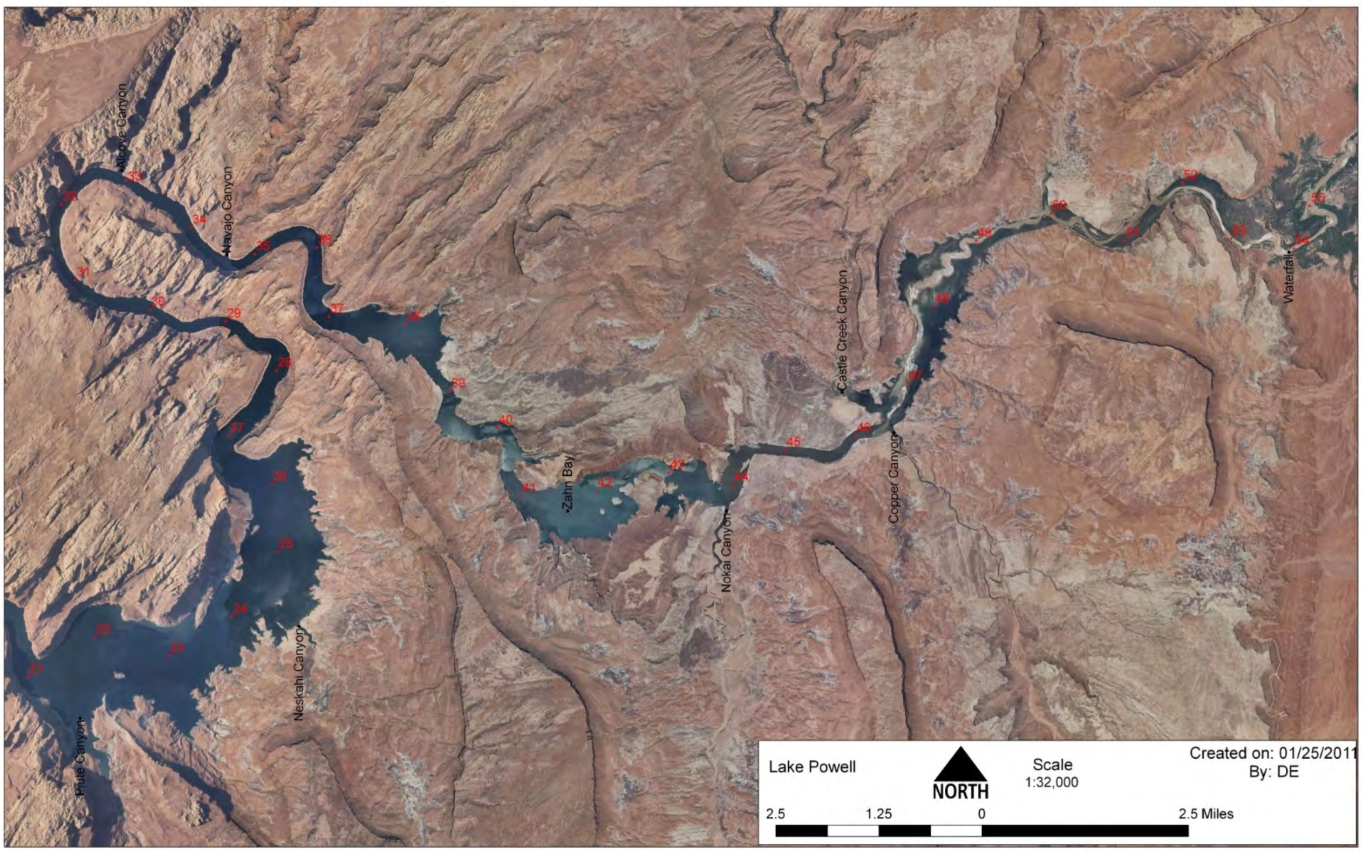
EXPENSES

Direct Costs

Task 1 Image Capture	Unit	QTY	Cost	Totals by Task
Printing	$175	5	$875	
Printing /Sleeving	$392	1	$392	
				$1,267
Task 2 Field Verification				
Travel	0.52	1200	$624	
Per Diem	14	40	$560	
				$1,184
Task 3 Data Analysis				
Travel	0.52	1200	$624	
Per Diem	4	40	$160	
Lodging	100	2	$200	
				$984
Task 4 Final Report and Presentation				
Airfare	$450 /Trip	1	$450	
Lodgin and Meals	$140 /day	3	$420	
				$870

Scope of Work (FY 2020): Population size, mobility, and early life history of Razorback Suckers in the San Juan River – Lake Powell complex (BOR Award #R17AC00039)

August 1, 2019



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 11th-March 26th) 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.

Figure 1. Piute Farms Waterfall, Utah.

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, 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

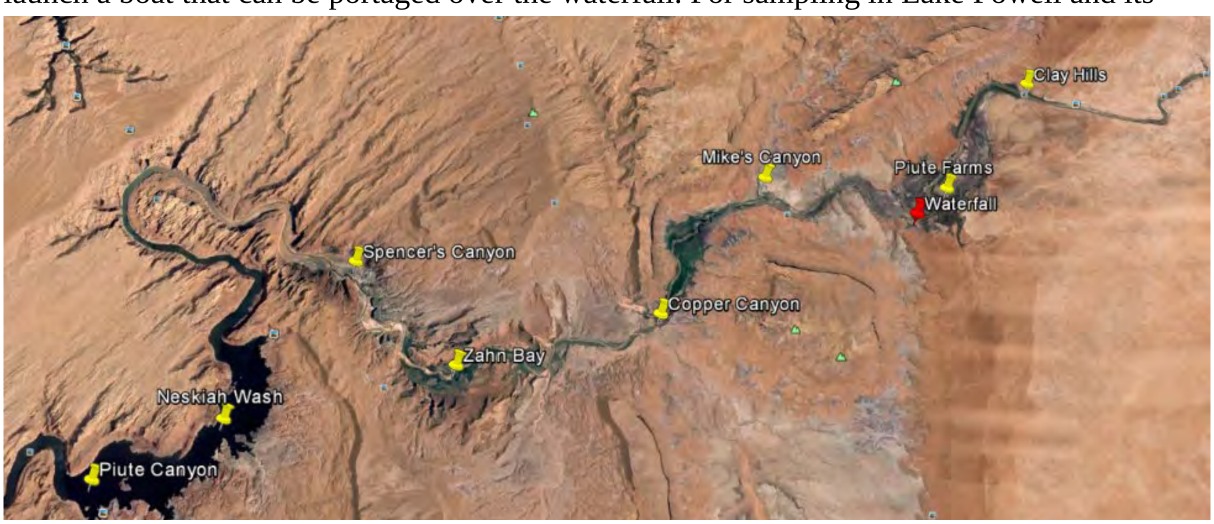


Figure 2. Google Earth image (downloaded 22 March 2016) of study area including key landmarks.

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 collections 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 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 in April/May 2020 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, 2017, 2018, and 2019 Razorback Suckers captured below the Piute Farms Waterfall were implanted with either 4-year acoustic-radio transmitters or PIT tags and released ~ 2 miles upstream of the Piute Farms Waterfall. In 2016, some fish were 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. Movement of tagged fish is being tracked passively using SURs located throughout the San Juan River arm of Lake Powell as well as PIT antennas in the San Juan River between Mexican Hatt and the Hogback Diversion.

To characterize movement of tagged Razorback Sucker, similar methods will be used in 2020. 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 prior tracking efforts (2016 – 2019) will help inform tracking efforts in 2020. 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

A draft final will be submitted to the Program Office by 31 March 2020 and a revision that includes responses to BC member comments submitted by 30 June 2020. All data will be submitted to the Program Office by 31 December 2020. An oral report will be given at the winter SJRIP Biology Committee (BC) meeting.

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 by 31 December.

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), 10th 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 2020)

Period: Year 4 October 1, 2019 to September 30, 2020

Task 1 Razorback Sucker use of the San Juan River below the Piute Farms Waterfall and San Juan Arm of Lake Powell			
-	-		
Task Description			Total
Task	**Item**		
Salaries			
Project PI: Advise student and coordinate graduate project	1 month	$	11,576
Graduate Student	1 year (0.5 FTE, 20 hrs/week)	$	31,603
Research Assistant	6 months	$	23,152
Fringe benefits			
Project PI	30.00%	$	3,473
Graduate Student	6.00%	$	1,896
Research Assistant	30.00%	$	6,946
Travel			
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
Supplies			
Field Sampling Gear	Trammel net (Memphis Net and Twine)	$	2,404
	Sonic tags	$	13000
	Satellite phone subscription	$	123
Tuition (no overhead)			
Graduate Student Tuition and Fees-Spring	KSU Tuition and Fees for Graduate student course work (no overhead)	$	8,137
	Total direct costs - Task 1	**$**	**111,345**
	17.5% MTDC F&A	**$**	**18,061**
	Total costs - Task 1	**$**	**129,406**

Budget Justification

Personnel – Each year, funds are requested to support one month of the lead PI (Gido) one month summer salary and a (0.5 FTE) graduate research assistant. 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 safety, 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.

Habitat Characteristics and Resource Availability in Secondary Channel and Mainstem Backwaters of the San Juan River: Implications for Environmental Flows Management and Imperiled Fish Conservation

August 1, 2019

Principal Investigator
James E. Whitney, PhD, Department of Biology, Pittsburg State University, Pittsburg, KS 66762

Background

Backwaters are the preferred habitat of early life stage (i.e., larvae and juvenile) Razorback Suckers (*Xyrauchen texanus*) (Minckley et al. 1991; Mueller 2006). For example, in the San Juan River larvae were captured at higher densities in backwaters when compared to other mainstem habitats such as low velocity runs (Farrington et al. 2016). Furthermore, the only juvenile Razorback Sucker captured from the San Juan River in the last 18 years during small-bodied fish monitoring was from a large backwater in fall 2015 (Zeigler and Ruhl 2016). Backwaters are important habitat for early life stages of other imperiled fishes as well. Of the juvenile Colorado Pikeminnow (*Ptychocheilus lucius*) captured in 2016, approximately 48% were captured in large backwaters compared to 17% captured in the main channel and 35% in secondary channels (Zeigler and Ruhl 2016). The importance of backwater habitat to early life stages of imperiled fishes has made the restoration of this habitat an important management goal throughout the Colorado River Basin (CRB) (USFWS 2002a; USFWS 2002b). As in other parts of the CRB, backwater formation in the San Juan River has been reduced by flow regulation and concomitant geomorphic changes in the river channel (Holden 1999).

Razorback Sucker can spawn successfully in the San Juan River, as larvae are present in the river and its backwaters during April through June (Farrington et al. 2016). However, these young-of-year (YOY) fishes (i.e., both larvae and juvenile age-0 fishes) are largely absent from the river by August, suggesting some environmental factor or factors are limiting recruitment to the juvenile stage of the population (i.e., a recruitment bottleneck) (Farrington et al. 2016). Several hypotheses may explain this impediment to recovery, including a lack of backwater nursery habitat for development, inadequate physicochemical conditions in backwaters, starvation, and/or predation in backwaters. Identifying the environmental factor(s) responsible for the recruitment bottleneck of Razorback Suckers has important management implications, because once the source of a roadblock is identified, actions can be taken to alleviate that problem.

Although backwaters are important habitat for the early life stages of imperiled fish, there is a high degree of variability among backwaters in terms of habitat characteristics. For instance, Bliesner and Lamarra (2000) demonstrated that geomorphological characteristics and resource availability varied in backwaters along the longitudinal gradient (i.e., upstream to downstream) of the San Juan River. Backwaters positioned more upstream tended to have the highest resource availability, although their upstream location resulted in higher gradient and water velocity in the adjacent mainstem, which presumably prevented larvae from settling in these backwaters (Bliesner and Lamarra 2000). Although Bliesner and Lamarra (2000) examined longitudinal and temporal changes in backwaters generally, they did not investigate differences among different types of backwaters. Long-term habitat mapping in the San Juan River has identified three types of backwaters, including: 1) backwaters associated with secondary channels, 2) island backwaters, and 3) point bar backwaters (Fig. 1; Lamarra et al. In prep). Secondary channels are narrower and receive less flow than the main channel, and when they stop flowing, form secondary channel backwaters that are connected to the main channel at their downstream end, but are disconnected at their upstream end (Fig. 1A; Landers et al. 2002; Yager et al. 2013). Island backwaters are zero-velocity habitats that form in off-channel habitats between an island and the river bank, or at the downstream end of an island (Fig. 1B). Point bars are formed by alluvial deposits on the inside bend of a river (Legleiter et al. 2011). When zero-velocity habitats form on the downstream end of a point bar, a backwater is formed (Fig. 1C). Island and point bar backwaters exhibit high connectivity with the main river channel, whereas secondary channel backwaters are less connected to the main channel (Lamarra et al. In prep). Furthermore, backwaters associated with secondary channels increase in size with increasing base flows, but total backwater area does not change since there is an associated reduction in island and point bar backwaters (from hereon, main channel backwaters) as base flow increases (Lamarra et al. In prep). Thus, changes in base flow result in variation in the size, stability, and type of backwater, meaning the amount and type of backwater habitat in the San Juan River is dependent on flow regulation (Lamarra et al. In prep).

It is currently unclear whether early life stages of imperiled fish exhibit a preference for secondary channel over mainstem backwaters. For instance, age-0 fish may prefer secondary channel backwaters because they function as refugia from flow fluctuations because of their lower connectivity to the mainstem. As such, secondary channel backwaters are less prone to scouring events during the monsoon season in July through September (Adams and Comrie 1997), a time period when nearly all age-0 Razorback Sucker disappear from the river. High-velocity monsoonal flows in main channel backwaters could displace imperiled YOY fish to the main channel where they would experience higher mortality (Robinson et al. 1998; Valdez et al. 2001; Gido and Propst 2012). Further, mainstem backwaters that experience a greater frequency of silt-laden monsoonal flows may have higher turbidity, total suspended solids, and siltation compared to secondary channel backwaters (Bliesner and Lamarra 2000; Heins et al. 2004). High turbidity may hinder YOY feeding because of poorer water clarity (De Robertis et al. 2003; Manning et al. 2014), plus high suspended sediment loads can clog and damage gills, thus interfering with respiration (Sutherland and Meyer 2007; Clark Barkalow and Bonar 2015). In fact, larval Razorback Sucker exhibit a preference for clear water over turbid water (Johnson and Hines 1999). However, nonnative predators feed more effectively on age-0 Razorback Sucker in clear water compared to turbid water, thus, higher turbidity may also benefit YOY fish by reducing predation (Johnson and Hines 1999).

More-frequent and higher magnitude monsoonal flows in mainstem backwaters compared to secondary channel backwaters may cause lower resource availability, which could influence the recruitment success of imperiled fishes (Papoulias and Minckley 1990; Bestgen 1996). For instance, monsoonal floods could scour the substrate and water column of benthic and pelagic invertebrates, respectively, more often in main channel compared to secondary channel backwaters (Speas 2000). Benthic (e.g., chironomids) and pelagic (e.g., cladocerans and copepods) macroinvertebrates are the most frequently occurring prey items in the diets of YOY Razorback Sucker (C. Pennock unpublished data), leaving them potentially more prone to starvation in main channel backwaters. Furthermore, differences among backwaters in water clarity and substrate size may limit basal productivity in main channel versus secondary channel backwaters. More stable secondary channel backwaters would exhibit lower turbidity that allows for greater light penetration that could stimulate photosynthesis of phytoplankton and periphyton, and may also have greater substrate size (e.g., pebble and cobble rather than silt and sand) that provides a stable attachment surface for periphyton (Burkholder 1996; Hillebrand 2002). In turn, greater algal productivity in secondary channel backwaters may exert bottom-up control on the availability of benthic and pelagic macroinvertebrates, as algal productivity is a primary factor influencing invertebrate secondary production (Wotton 1988; Whitney et al. 2014).

Secondary channel backwaters are located nearer the riparian zone and channel margin of the San Juan River, and as such they may receive greater shading from canopy cover and canyon walls. More shading may result in more benign physicochemical conditions in secondary channel backwaters compared to main channel backwaters that receive more direct sunlight. For instance, direct solar radiation in main channel backwaters could cause water temperatures to exceed the upper thermal limit of imperiled age-0 fishes, resulting in hyperthermia, heat stress, and heat-induced mortality (Sweeney 1993; Smale and Rabeni 1995; Poole and Berman 2001; Kappenman et al. 2010; Deslauriers et al. 2016). Further, higher water temperatures may result in hypoxia and anoxia that could suffocate fish (Carlson and Siefert 1974; Fontenot et al. 2001), since the solubility of oxygen decreases as water temperatures increase. Both hyperthermia and hypoxia could results in greater YOY mortality in main channel compared to secondary channel backwaters.

Water temperature may interact with basal resource availability to influence YOY recruitment success. Warmer water temperatures result in greater fish metabolic rates (Fry 1947), meaning fish need more food at warmer temperatures relative to cooler temperatures (Houde 1989). Fish can also attain higher growth rates at warmer temperatures (Houde 1989), but only if enough food is available to sustain their growth (Bestgen 2008). As such, fish in warm water with high rates of resource productivity may exhibit extremely high growth rates, but fishes in warm water with lower productivity may be more prone to starvation (Houde 1989). Investigating resource availability and its relationship with backwater type may inform conservation. For instance, if it is found that low resource availability from frequent monsoonal flooding coupled with high temperatures from direct sunlight occur in main channel backwaters, this unsuitable age-0 habitat could be reduced by increasing base flows (Lamarra et al. In prep). Higher base flows creates more secondary channel backwaters (Lamarra et al. In prep), which may have greater resource availability because of infrequent flooding and cooler temperatures from riparian and canopy shading.

Predation pressure is a final explanation for the variation in recruitment and abundance of YOY Razorback Suckers among backwaters. For instance, several small-bodied nonnative fishes occur in backwater habitat and can prey heavily on native age-0 fishes, including Red Shiner (*Cyprinella lutrensis*), Fathead Minnow (*Pimephales promelas*), and Western Mosquitofish (*Gambusia affinis*) (Tyus and Haines 1991; Ruppert et al. 1993; Brandenburg and Gido 1999; Tyus and Saunders 2000). In fact, Bestgen et al. (2006) concluded that predation by Red Shiners interacting with environmental factors limited the recruitment success of Colorado Pikeminnow in the Green River. These small-bodied nonnative predators are abundant in secondary channel backwaters in the San Juan River, although their densities decreased in between 1999 and 2012 (Franssen et al. 2015).

A lack of large, stable, zero-velocity nursery habitat without large-bodied nonnative predators is one explanation for the recruitment bottleneck of Razorback Suckers in the San Juan River. However, even if this ideal nursery habitat were present in the San Juan River, it is currently unclear whether Razorback Sucker larvae could successfully recruit from the larval to juvenile stage. To test this hypothesis, the Phase III Habitat Restoration Project is proposed to be implemented in 2019 to create more quality nursery habitat via the construction of a ~1 hectare artificial wetland near river mile (RM) 107 (Gori et al. 2018). The Phase III project also aims to measure physicochemical conditions and larval predation pressure (i.e., via small-bodied fish monitoring) in the constructed wetland, but does not plan to measure resource availability. If benthic and/or pelagic algae and macroinvertebrates are scarce in the artificial wetland relative to demand, this lack of food for imperiled larval fishes could hinder the success of this project. Monitoring is needed to assess resource availability in the Phase III wetland.

We have provided several explanations for why secondary channel backwaters may be superior habitat for imperiled YOY fishes relative to main channel backwaters, although high abundances of nonnatives in secondary channel backwaters could reduce their quality. However, it is currently unknown whether stability, habitat quality, resource availability, and/or predation pressure actually differ between backwater types. As such, differences between secondary channel and mainstem backwaters are in need of investigation before environmental flows management can be implemented, as it would be ineffective to increase the area of secondary channel backwaters via elevated base flows if this is not better habitat than main channel backwaters (Lamarra et al. In prep). If secondary channel backwaters do indeed exhibit greater habitat quality and resource availability for imperiled fishes, then environmental flows management (Tharme 2003; Propst and Gido 2004) could be used to increase the coverage of this habitat because of the positive relationship between base flows and amount of secondary channel backwaters (Lamarra et al. In prep).

Objectives and Hypotheses

The objective of the proposed work is to compare stability, physicochemical characteristics, resource availability, and small-bodied predator density between secondary channel and main channel backwaters (i.e., island and point bar) in the San Juan River. To accomplish this objective we will test five hypotheses and their associated predictions (Fig. 2).

Hypothesis and Prediction #1: Stability differs between secondary channel and mainstem backwaters because secondary channel backwaters exhibit lower connectivity with the San Juan River mainstem; secondary channel backwaters will exhibit greater stability compared to main channel backwaters because they experience less frequent, lower magnitude, and shorter duration monsoonal flows.

Hypothesis and Prediction #2: Shading differs between secondary channel and mainstem backwaters because secondary channel backwaters are located nearer the margin of the San Juan River mainstem; secondary channel backwaters will exhibit greater shading compared to main channel backwaters because of greater canopy cover and canyon wall influence.

Hypothesis and Prediction #3: Physicochemical characteristics differ between secondary channel and mainstem backwaters because of differences in stability and shading; secondary channel backwaters will have lower turbidity, larger substrate, cooler water temperatures, and higher dissolved oxygen concentrations because of greater stability and shading.

Hypothesis and Prediction #4: Resource availability differs between secondary channel and mainstem backwaters because of differences in stability and shading; secondary channel backwaters will have greater algal and macroinvertebrate biomass because of greater stability. Also, we will test for differences in resource availability among the Phase III artificial wetland, secondary channel, and mainstem backwaters as part of this hypothesis.

Hypothesis and Prediction #5: The density of small-bodied nonnative predators differs between secondary channel and mainstem backwaters; secondary channel backwaters will have more nonnative predators (Franssen et al. 2015).

Study Area, Site Selection, and Sampling Regime

This study will be conducted in backwaters of the San Juan River located between RM 149 (Shiprock, NM) and RM 93 (Montezuma Creek, UT) (Fig. 3). This stretch of river was chosen because it contains a high density of secondary channel backwaters (Lamarra et al. In Prep). Within this 56-mile stretch we will attempt to sample 10 secondary channel and mainstem backwaters per sample trip (20 total backwaters per sample trip). Potential backwater sites will be scouted using recent habitat maps and surveys in April-May. We will also sample resource availability (i.e., Hypothesis #4) in the Phase III artificial wetland at RM 107, in addition to all of the other study backwaters. Ten backwaters per category per sample trip (i.e., 20 total) was chosen because Lamarra et al. (In Prep) indicated that this is a realistic estimate of the total number of available backwaters in our study reach during late spring, summer, and early fall. However, given the dynamic and ephemeral nature of backwaters and their dependence on flow in the mainstem (Bliesner and Lamarra 2000; Lamarra et al. In Prep), the total number of backwaters sampled per trip may be more or less than 10. Regardless, we will strive to sample as many backwaters as flow conditions will allow to maximize our sample size and inference for statistical analysis. Also, the variable nature of backwaters may result in some backwaters being sampled only once while others get sampled repeatedly. This will be an issue for the testing of Hypothesis #1 since it relies on deployed data loggers (see below), but will not be an issue in testing Hypotheses #2 - #5. So long as we have replication of each backwater type regardless of the identity of any individual backwater, our study design will allow us to test Hypotheses #2 - #5. Sampling will commence when discharge of the San Juan River falls below ~1,500 cubic feet per second (cfs), as most secondary channel backwaters will likely be flowing when discharge is greater than this. As such, sampling will typically start around July 15th, but may be earlier or later depending on flow conditions. Sample trips will then be conducted every 14 days until the end of September, resulting in ~6 sample trips per year in 2019 and 2020. If flows become elevated above 1,500 cfs during our sample period because of monsoonal rainfall or otherwise, a sample trip will be delayed until flows drop back below 1,500 cfs threshold. During each sampling trip we will raft from backwater to backwater collecting data as described below. Each sample trip will take ~5 days to complete.

The length and area of sample sites will depend upon backwater size. A general recommendation in stream sampling is to survey a reach length equal to 40 times the average width to provide a representative sample, with a maximum length of 300 m for a sample reach (Klemm and Lazorchak 1994; Lazorchak et al. 1998). We will follow these guidelines when sampling San Juan River backwaters. Also, we will not sample any backwaters < 30 m^2 in area (Zeigler and Ruhl 2016), as a backwater this small would be too ephemeral to provide meaningful data. In a database containing information on 332 secondary channel and 2,057 main channel backwaters (2,389 total) in the San Juan River, the mean length and width of secondary channel backwaters was 240 m (median = 169 m; range = 13 – 1,442 m) and 3.2 m (2.72 m; 0.22 – 10.10 m), respectively, while that of main channel backwaters was 58 m (29 m; 1 – 1,161 m) and 1.3 m (0.92 m; 0.10 – 8.03 m), respectively (N. Franssen; unpublished data). Therefore, since most of the backwaters in the San Juan River are of a smaller size, our size criteria will result in a large proportion of total backwater area being sampled for most backwaters, allowing us to accurately characterize backwater conditions.

Materials and Methods

Hypotheses #1: Backwater Type and Stability

Upon arrival each backwater will be categorized as a secondary channel or mainstem backwater. In each backwater a HOBO MX2001 data logger (Onset Company, Bourne MA) will be deployed in the deepest part of the backwater and will be set to record water level every 30 minutes. To reduce the influence of the mainstem, the logger will be deployed some distance from the backwater mouth, with that distance dictated by backwater length. The logger will be housed in a PVC casing and will be attached to a t-post to lessen the chance that it will be displaced during high flows. When possible, data loggers will be placed in inconspicuous locations to decrease the probability of being noticed and potentially vandalized. Additionally, we will measure the frequency and duration of flow from the mainstem into backwaters using electrical resistance sensors (Jaeger and Olden 2012). Based on the change in relative conductivity, these sensors (i.e., customized Onset TidbiT Temperature Data loggers) can determine whether the logger is dry (low relative conductivity) versus submersed by water (high relative conductivity) where the sensor is deployed in the substrate (Blasch et al. 2002; Goulsbra et al. 2009). We will deploy a sensor such that it will be able to detect when water is flowing from the mainstem into the backwater. For secondary channels this location will be near the upstream head of the backwater, and in mainstem backwaters the sensor will be located in the backwater mouth. Sensors will be placed in the lowest elevation point in-between the main channel and the backwater to ensure a flow connection is recorded when present. Electrical resistance sensors will be housed in a PVC casing and will be attached to a t-post to prevent them from being displaced during high flows. When possible, resistance sensors will be placed in inconspicuous locations to decrease the probability of being noticed and potentially vandalized. Data from water level loggers and resistance sensors will be downloaded every sample trip. From the continuous measurements collected by electrical resistance sensors we can calculate the frequency and duration of flow into backwaters, and with the water level loggers we can calculate the magnitude and variability of flow events. Finally, we will also deploy an electrical resistance sensor by the water level logger in the deepest part of a backwater located some distance from the backwater mouth (depending on backwater length) to assess whether or not a backwater dries completely in-between sampling events.

Hypotheses #2 and #3: Shading and Physicochemical Variables

Several habitat variables will be quantified along equally-spaced transects in a backwater. The number of transects per backwater will depend upon backwater length. For backwater sites with total site lengths of 150 m – 300 m, the distance between transects will equal 10% of backwater length (i.e., in a 300 m backwater, transects will occur every 30 m), and as such will result in 10 transects per backwater (Klemm and Lazorchak 1994; Lazorchak et al. 1998). For backwaters < 150 m in length, transects will be spaced 10 m apart, resulting in a variable number of transects depending on length. To limit the influence of the mainstem on habitat measurements, transects will not be positioned in the mouth of the backwater where it connects to the mainstem (if applicable). Shading resulting from canopy cover and canyon walls will be quantified at each transect midpoint in a backwater using a spherical concave densiometer, providing an estimate of percent canopy coverage. The wetted surface area (m^2) of a backwater will be calculated by multiplying backwater length (m) by the mean wetted width (m) of a backwater measured at each transect. Also, along each transect five measurements of depth (measured with a Hach topset wading rod) and substrate (e.g., clay, silt, sand, gravel, pebble, cobble, boulder, and bedrock) will be taken. The five locations per transect will be at river right (#1), then 25% (#2), 50% (i.e., transect midpoint; #3), and 75% (#4) of the distance from river right to river left, and then finally at river left (#5) (Klemm and Lazorchak 1994; Lazorchak et al. 1998). The substrate at a transect location will be determined with visual and tactile examination. If there is a mixture of substrates at a location, the location will be assigned the category of whichever substrate is dominant. These measurements will generate an estimate of mean depth, maximum depth, and percent coverage of fine (clay + silt + sand) and coarse substrates (gravel + pebble + cobble + boulder + bedrock) for each backwater. Mean backwater depth (m) will also be multiplied by backwater surface area (m^2) to calculate backwater volume (m^3). Water temperature in a backwater will be measured every two hours using the HOBO MX2001 data logger, which records temperature in addition to water level. Backwater turbidity in nephalometric turbidity units (NTUs) will be measured using an Aquaflor handheld fluorometer (Turner Designs, San Jose, CA), and dissolved oxygen (mg/l and % saturation) will be measured using an Extech heavy duty dissolved oxygen meter (FLIR Commercial Systems, Nashua, NH).

Hypothesis #4: Resource Availability

Algal biomass will be measured by quantifying pelagic and benthic chlorophyll *a* concentrations. Phytoplankton concentrations will be measured by taking a 500 ml water sample from each backwater. The water sample will be collected from various depths in the water column at multiple backwater locations until a 500 ml Nalgene collection jar is filled, thus providing a representative sample. The water sample will then be filtered through a Whatman glass microfibre filter (grade GF/C), with chlorophyll *a* then extracted from the filter by submersing it in 95% ethanol for 12 hours. Chlorophyll *a* concentration (µg/L) will then be measured using an Aquaflor handheld fluorometer followed by correction for sample volume (Wetzel and Likens 2000; Rice et al. 2017). In fine substrates (i.e., silt and sand) benthic chlorophyll *a* samples will be collected using a core sampler (3.2 cm inside diameter), and in coarse substrates (i.e., gravel, pebble, and cobble) whole rocks will be collected. Benthic samples will be collected from six habitat transects per backwater (approximately every other transect); three replicates will be collected along each transect near river right, river left, and the transect midpoint, with either whole rocks or core samples pooled into the same transect Whirl-Pak. The composition of the pooled transect sample (e.g., transect #1 = 2 cores + 1 whole rock; transect #3 = 3 whole rocks) will be recorded in the field notebook. Samples will be kept in the dark in a cooler with dry ice, and then transported back to the lab where they can be frozen. 95% ethanol will be used to extract chlorophyll *a* from benthic samples for 12 hours, with chlorophyll *a* concentration (µg/cm^2) determined with a fluorometer followed by correction for sample surface area (core size or rock size) (Sartory and Grobbelaar 1984; Steinman et al. 2017). This sampling will be performed in backwaters and in the Phase III artificial pond.

The availability of larval prey will be estimated by collecting benthic and pelagic backwater macroinvertebrates. Benthic macroinvertebrates residing in fine-textured benthic substrate (i.e., clay, silt and sand) will be sampled using an Eckman grab, whereas benthic macroinvertebrates residing coarser substrates (i.e., gravel, pebble, cobble, and boulder) will be sampled by scrubbing whole rocks in a bucket (Hauer and Resh 2017). If large woody debris (LWD) is present in a backwater transect, it will be sampled by enclosing a subsection of LWD and then removing macroinvertebrates from it (Whitney et al. 2014; Whitney et al. 2015). Benthic macroinvertebrate samples will be taken from six habitat transects per backwater (approximately every other transect); three replicates will be collected along each transect near river right, river left, and the transect midpoint, with whole rocks, core samples, and LWD samples pooled into the same transect bucket, which will then be sieved and stored in 10% formalin in a Whirl-Pak. The composition of the pooled transect sample (e.g., transect #1 = 2 cores + 1 whole rock; transect #3 = 2 whole rocks + 1 LWD) will be recorded in the field notebook. Pelagic macroinvertebrates (e.g., Copepods and Cladocerans) will be sampled using a Wisconsin plankton sampler equipped with a mechanical flow meter that will measure the volume of water sampled (De Bernardi 1984), with three pelagic macroinvertebrate samples collected per backwater per sample date. Macroinvertebrates will then be identified, enumerated, and measured for total length in the laboratory under a dissecting microscope. Published length-mass relationships (Burgherr and Meyer 1997; Benke et al. 1999; Sabo et al. 2002) will then be used to estimate biomass in grams of dry mass (DM) for each macroinvertebrate taxon, then biomass of macroinvertebrate taxa will be summed separately for benthic and pelagic samples to provide estimates of benthic and pelagic resource availability. This sampling will be performed in backwaters and in the Phase III artificial pond.

Hypothesis #5: Small-Bodied Nonnative Predators

The abundance of potential predators in each backwater will be assessed using a combination of backpack electrofishing with 1-2 dipnetters (Smith-Root LR-20B backpack electrofisher) and seining (4.6m wide X 1.8 m tall; 3.2 mm mesh). To prevent escape of fishes from our sample reach, we will use blocknets to separate our sample reach from the mainstem if necessary, and in longer backwaters, from the section of the backwater not sampled. All potential larval predators will be identified to species, measured for total length, and then returned to the backwater from whence they came. Any native fishes captured by this sampling will also be identified, measured, and released. The density of backwater larval predators for each species and in total will be calculated by dividing the number of individuals caught by backwater area sampled (m^2), giving an estimate in $\#/m^2$.

Our ability to capture fishes may vary among backwaters because of differences in habitat characteristics related to depth, turbidity, and substrate size (Tyre et al. 2003; Gu and Swihart 2004; Falke et al. 2010). As such, differences in sampling efficiency among backwaters could result in different fish density estimates among backwaters independent of the effect of backwater environmental characteristics on fish presence and abundance. To account for differences in sampling efficiency among backwaters, we will perform depletion sampling during one sample trip per month (i.e., every other trip). Depletion sampling will involve sampling each backwater site with multiple repeated passes; after each pass all captured fishes will be retained and won't be released until all passes have been completed. This design will allow for the calculation of absolute population size ($\widehat{N}$), catchability (q; Hayes et al. 2007) and detection probability (p; MacKenzie et al. 2002), which can then be modeled according to habitat characteristics (e.g., depth, turbidity, substrate size). If capture efficiency is found to vary among backwaters, we will use our catchability and detection probabilities to correct our fish density estimates, thus making estimates comparable among backwaters.

Data Analysis

Our interrelated hypotheses operate through several intermediary pathways of cause and effect relationships, and contain multiple predictor and response variables (Fig. 2). As such, covariance structure analysis, otherwise known as structural equations modeling, is conducive to statistically testing our hypotheses (Bollen 1989; Shipley 2000; Infante and Allan 2010). Covariate structure analysis (CSA) is a multivariate technique that allows for the modeling of relationships among sets of direct and indirect predictors and response variables. This technique is similar to multiple regression analysis or canonical ordination, but differs in the fact that it accounts for interrelatedness of predictor variables and indirect effects. In order to model relationships, a priori hypotheses describing the structure among variables and direct and indirect effects must first be completed. These a priori hypotheses (i.e., Fig. 2) are then combined with collected sample data to model relationships via path analysis, which then provides output describing model fit and the strength of relationships. Model fit will be examined using chi-squared analysis, root mean squared error approximation, and the normed fit index, whereas strength and direction of relationships will be evaluated using multiple correlation and slope coefficients (Burcher et al. 2007; Perkin et al. 2014). Covariate structure analysis will be done with the flexible partial least squares approach (PLS; Perkin et al. 2014) using the functions in the plspm package (Sanchez et al. 2017) in program R version 3.3.3 (R Core Team 2017). Results will be displayed using a path diagram.

We will use one-way multivariate analysis of variance (MANOVA) to test for differences in resource availability among secondary channel backwaters, main channel backwaters, and the Phase III wetland. The three categories of wetland or backwater will serve as the predictor variable, and response variables will include phytoplankton biomass (chlorophyll *a* in μg/L), periphyton biomass (chlorophyll *a* $\mu g/cm^2$), benthic macroinvertebrate biomass (g DM/m^2), and zooplankton biomass (g DM/L). The MANOVA assumptions of multivariate normality and equality of variance-covariance matrices will be tested using a Shapiro-Wilk test of multivariate normality and Box's M test, respectively. If assumptions are violated, Box-Cox transformations will be applied to the data. If the MANOVA detects significant differences, we will use separate one-way ANOVAs coupled with Tukey's honest significance difference (HSD) to determine which resource availability variables actually differ among predictor variable categories.

Deliverables

A draft annual report will be submitted to the Program Office by 31 March 2020 and a revision that includes responses to BC member comments submitted by 30 June 2020. A final report will be completed at the end of the three year study period. All data will be submitted to the Program Office by 31 December 2020. An oral report will be given at the winter SJRIP Biology Committee (BC) meeting.

Acknowledgments

I would like to thank my collaborators on this Scope of Work (SOW), including Scott Durst, Nathan Franssen, and Eliza Gilbert with the USFWS SJRIP Program Office. Discussions with them stimulated numerous ideas that form the basis of this SOW. Casey Pennock and Keith Gido of Kansas State University were also helpful in generating this SOW. Lastly, I would like to thank the 10 reviewers whose previous comments greatly benefitted this revised SOW.

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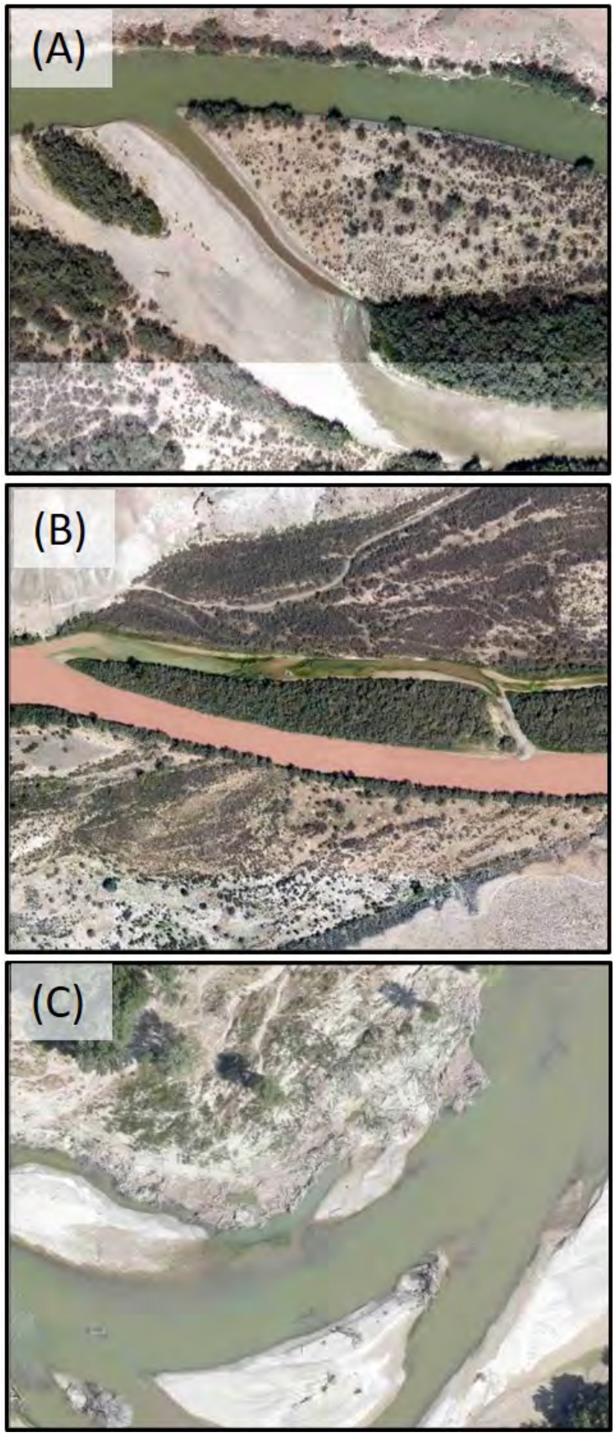

Figure 1. Examples of secondary channel (A), island (B), and point bar (C) backwaters in the San Juan River. Island and point bar backwaters are two types of main channel backwater. (Photos courtesy of Dan and Vince Lamarra).

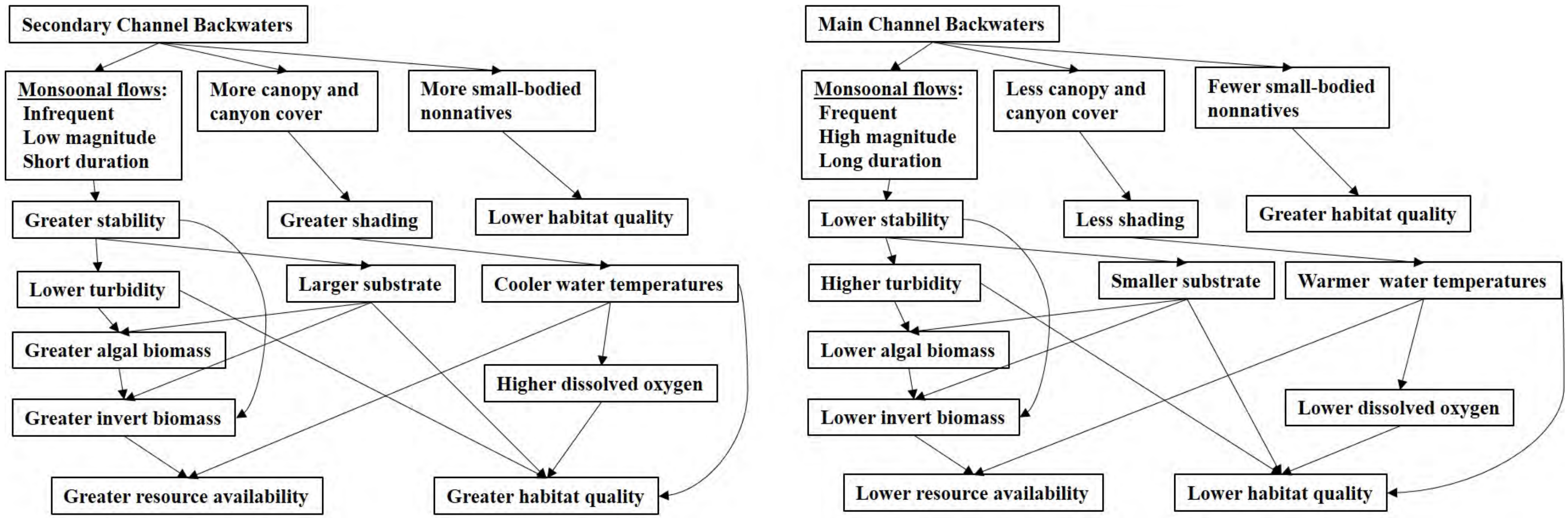

Figure 2. Conceptual model illustrating pathways and hypothesized differences in habitat quality, resource availability, and nonnative (NN) small-bodied predators between secondary channel and main channel backwaters in the San Juan River.

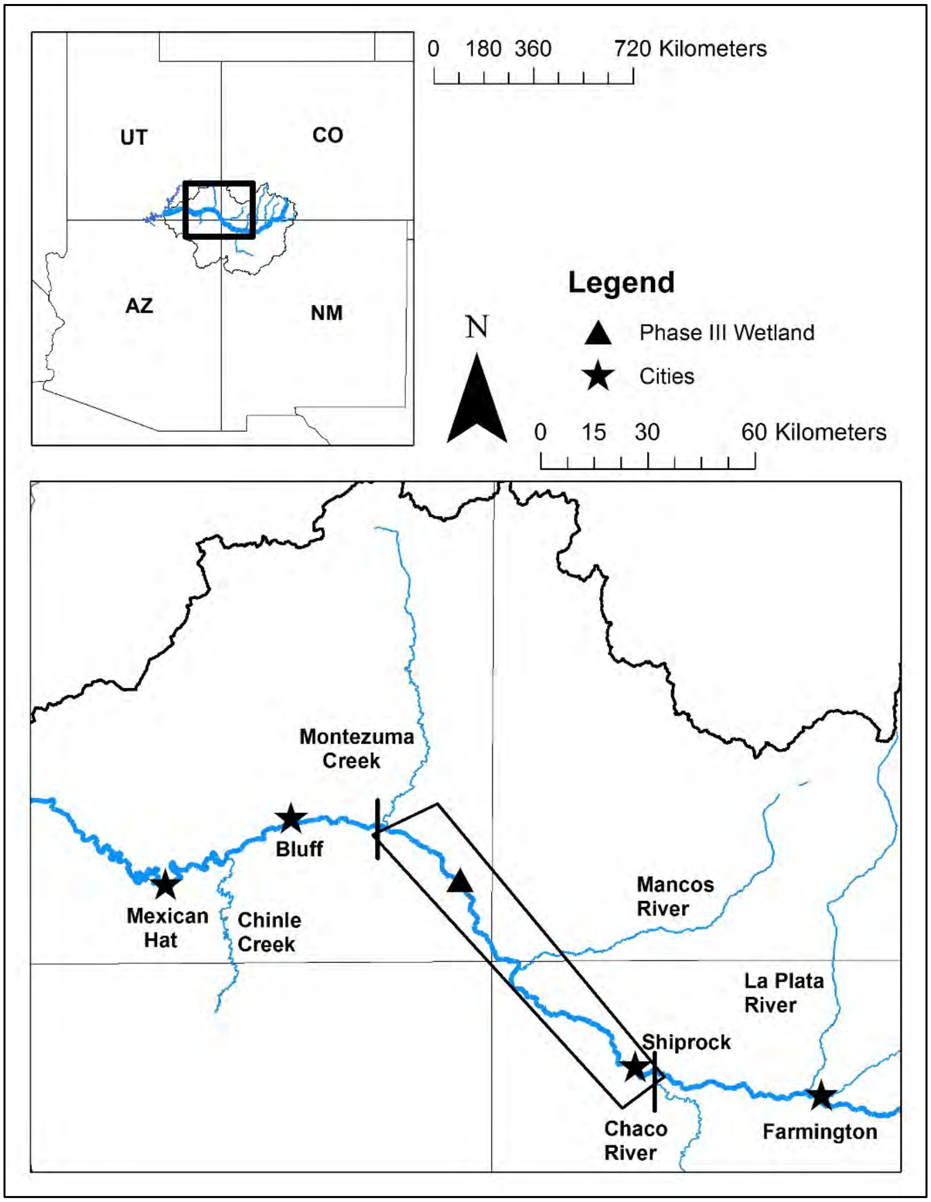

Figure 3. Map of the San Juan River Basin (broad extent) and the section of the San Juan River where backwaters will be studied for this project (fine extent), with Shiprock denoting the upstream end of the study reach and the confluence with Montezuma Creek marking the downstream end of the study reach.

James Whitney Bio Summary

I have been working with imperiled southwestern fishes since 2008 when I began in the Master of Science (M.S.) program at Kansas State University (KSU) in Manhattan, KS under Dr. Keith Gido. The purpose of my Master's thesis was to evaluate factors associated with varying population densities of native and nonnative fishes in the Gila River of southwestern New Mexico (Whitney et al. 2014). I completed this project in May 2010, and then began my PhD project at KSU in August of 2010. The purpose of my PhD dissertation was to evaluate the response of the Gila River ecosystem to multiple catastrophic wildfires that occurred during 2011-2013 (Whitney et al. 2015; 2016), and to assess fish re-colonization following wildfire disturbance using otolith microchemistry (Whitney et al. 2017a). While completing my graduate projects I was also involved in several other projects in the Gila River (Troia et al. 2014; Maine et al. 2014; Troia et al. 2015; Propst et al. 2015; Pilger et al. 2015; Hedden et al. 2016; Pilger et al. 2017), which provided many additional experiences beyond my graduate work. Also, during my time as a graduate student I had several opportunities to help out with research on the San Juan River (Cathcart et al. 2015; 2017; Franssen et al. In Review). After graduating from KSU in 2014 I began work as a postdoctoral research associate at the University of Missouri in Columbia under Dr. Craig Paukert. Part of my postdoctoral research involved compiling existing information for the entire Colorado River Basin to examine how traits were related to species distributions (Whitney et al. 2017b), and to forecast range shifts of CRB fishes in response to climate change (Whitney et al. 2017c). I completed this work in January 2016, and then started as an assistant professor at Pittsburg State University in Pittsburg, KS. I am eager to continue research in the American southwest that informs the conservation of imperiled fishes.

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Table 1. Detailed budget for fiscal year 2020 (year 2) of the project. GS = graduate student; PI = principal investigator (James Whitney). Budget is flexible depending on availability of funds.

Category	Type	Expense	Explanation
Personnel	GS Stipend	$20,000	12-month stipend working 0.5 time (20 hrs/week; $19.23/hr)
	GS Fringe	$867.20	GS stipend *0.04336
	PI Summer Salary	$8,498.52	1.5 months of summer salary
	PI Summer Fringe	$1,571.55	PI summer salary *0.18492
	Technician #1 Salary	$9,990.00	$10.00/hour; 999 hours per year
	Technician #1 Fringe	$125.47	Technician salary * 0.01256
	Technician #2 Salary	$7,200.00	$10.00/hour; 720 hours per year
	Technician #2 Fringe	$90.43	Technician salary * 0.01256
Travel/Per diem	Rental truck	$9,000.00	$100 per day; 90 days per year
	Fuel	$600.00	3,000 miles/trip; 1 trip/year; $3.00/gallon; 15 miles/gallon
	Housing	$3,000.00	$1,000/month; 3 months/year
	Per diem	$7,830.00	$29/person/day; 3 people; 3 months
	SJRIP BC Meeting	$2,000.00	2 people; $1200 airfare; $400 rental car; $400 hotel
Supplies	Rite in the Rain Paper	$27.90	$13.95 per 100 sheets
	Rite in the Rain binders	$13.70	
	Chest Waders	$179.98	$89.99 per pair; 2 pairs
	95% Ethanol	$1,385.00	50 gallons per year; $138.50 per 5 gallons
	37% Formaldehyde	$534.80	20 gallons per year; $133.70 per 5 gallons
	24 oz. Whirl-Paks	$91.10	Box of 500 = $91.10
	20ml scintillation vials	$200.67	Package of 500
Equipment	Polycarbonate Tube	$37.99	
Other	Tuition and fees	$8,322.00	$4,161.00/semester
	Collection Permits	$15.00	
Total Personnel		**$48,343.00**	
Total Overhead		**$8,460.06**	Overhead rate = 17.5% on personnel costs
Total Travel/Per Diem		**$22,430.00**	
Total Supplies		**$2,433.15**	
Total Equipment		**$37.99**	
Total Other		**$8,337.00**	
Grand Total		**$90,041.00**	

Start date = 01 January 2019; End date = 31 May 2021

Table 2. Budget by category for fiscal year 2021 (year 3) of the proposed project. Budget is flexible depending on availability of funds.

Category	Total
Personnel	**$10,433.60**
Overhead	**$1,825.88**
Travel	**$2,000.00**
Supplies	**$0.00**
Equipment	**$0.00**
Other	**$4,161.00**
Total	**$18,420.48**

Budget Justification

Personnel – Funds are requested to support 1.5 months of the lead PI (James Whitney) summer salary, a graduate research assistant, and two undergraduate technicians working full time during the summer (June – August) to help with field work, and two undergraduates working during the school year (September – May) to help with processing the large number of chlorophyll *a* and macroinvertebrate samples from benthic and pelagic habitats collected by this study. For the third year, 6 months of support are requested for the graduate student so that they may finish writing up the results of the project. Both the graduate research assistant and undergraduate research technicians will be skilled in sampling large rivers.

Travel – Funds are requested to support lodging and per diem associated with field work and travel from Pittsburg, KS to the San Juan River. Funds are also requested for the graduate student and PI to travel to the SJRIP Biology Committee (BC) Meeting in May for all three study years.

Supplies and equipment –Includes supplies and equipment necessary for sampling.

Indirect Costs – The overhead rate at Pittsburg State University is 47% on personnel costs, but PSU is willing to charge 17.5% on personnel costs to decrease costs.

United States Department of the Interior
Fish and Wildlife Service
Southwestern Native Aquatic Resources and Recovery Center
P.O. Box 219, 7116 Hatchery Road
Dexter, New Mexico 88230
575-734-5910, 575-734-6130 fax
March 2019

Title: Using Molecular Techniques to Determine Effective Number of Breeders (N_b) for Razorback Sucker and Colorado Pikeminnow in the San Juan River

Principal Investigator: Tracy Diver and Steve Mussmann, Southwestern Native Aquatic Resources and Recovery Center, Dexter, NM

Introduction & Justification

Recent advances in population-level genetic analyses are increasingly helping managers monitor and adaptively manage the recovery of endangered populations (Hartl and Clark 2007). Recovery plans for many endangered fishes include the production and release of hatchery-reared individuals to augment populations with two major objectives: increase population sizes and promote genetic diversity (Miller and Kapuscinski, 2003). In order to meet these recovery criteria, survival, reproduction, and recruitment of wild and augmented individuals must occur at a sustainable scale; however, understanding factors that limit success in achieving a self-sustaining population can be difficult to identify. Long-term datasets can provide insight into population responses that might hinder recovery, and genetic monitoring can be an additional tool for providing insight into complex ecological, demographic, and genetic factors that can impede the establishment of self-sustaining populations.

Augmentation of endangered fish populations in the San Juan River using captive-reared Razorback Sucker (*Xyrauchen texanus*) and Colorado Pikeminnow (*Ptychocheilus lucius*) began in the mid-1990s and continues as a recovery action (USFWS 2005; USFWS 2015). Annual monitoring of survival, reproduction, and recruitment of these populations has been supported through the San Juan River Basin Recovery Implementation Program (SJRRIP). Mark-recapture data on PIT tagged individuals have enabled estimation of survival of both stocked species (Franssen and Durst *unpublished data*; Clark et al. 2018), which in turn has prompted additional research investigating ways to increase survival. Larval fish surveys have documented successful reproduction of both species in the river (Farrington et al. 2015), but recruitment to the adult stage is extremely limited. Successful recovery likely requires a significant portion of the reestablished population to reproduce annually to both increase population sizes and ensure maintenance of genetic diversity. Therefore, quantifying the number of individuals that reproduce annually can provide data to make informed management decisions to aid in the reestablishment of self-sustaining populations.

Population-level spawning success (i.e., number of reproducing adults) is innately difficult to quantify from field studies, especially for highly fecund species where few individuals can produce a large number of offspring. Furthermore, there is substantial evidence that shows reproductive output can depend on environmental conditions and age- or size-related factors (Lauer et al. 2005; Lambert 2008). Both temporal and spatial variation in spawning effort has also been observed for Razorback Sucker with adults vacating a spawning area early in the season and later returning to spawn again that year (Marsh et al. 2015) and with individuals visiting multiple sites during the same spawning period (Modde and Irving 1998). Such reproductive strategies further compound the difficulty in determining individual contribution to cohorts over a reproductive season; however, this question can be addressed by estimating the effective number of breeders (N_b) using genetic analyses. For long-lived, highly fecund, iteroparous species with overlapping generations, such as Colorado Pikeminnow and Razorback Sucker, N_b is an extremely useful metric for understanding population-level spawning success due to its defined seasonal reproductive bouts (Waples et al. 2013; Waples et al. 2014). Single cohort N_b estimates can reliably quantify the number of individuals that contributed to a given cohort (Waples et al 2014). Obtaining annual N_b estimates for the endangered fishes of the San Juan River may provide insight into how management activities (i.e., increasing passage, managing flows) effect population-level reproduction, thus, improving the opportunity to manage the San Juan River to favor spawning success.

Objectives:

1. Continue N_b monitoring for both Razorback Sucker (N = 120) and Colorado Pikeminnow (N = 120) collected in the San Juan River in 2020.
2. Expand upon N_b estimates for Razorback Sucker (N = 120) and Colorado Pikeminnow (N = 120) larvae captured below the waterfall for 2020.

Methods

Larval fish surveys are conducted annually along a 140 mile section of the San Juan River between Shiprock, NM, and Clay Hills, UT. Approximately 240 larval samples representing the spatial and temporal distribution of sampling efforts will be examined for N_b estimates. Tissue subsamples from the posterior portion of each specimen will be collected from 120 Razorback Sucker and Colorado Pikeminnow from 2020. The anterior portion of all specimens will be saved for otolith studies. In order to ensure N_b estimates are not artificially lowered due to limited spatial representation of samples, rare collections were targeted while sites with high larval densities were proportionally reflected in samples. Larval Razorback Sucker are collected during much of the sampling season. Early larval stages (e.g., protolarvae to mesolarvae) will be targeted throughout larval collections under the assumption that these individuals were from recent spawning events; thus, ensuring sampling was representative of the temporal spawning season. Conversely, Colorado Pikeminnow are collected later in the sampling season, making it relatively easy to have those captured individuals reflect the entire seasonal spawning period of adults. Finally, larval sampling downstream of the waterfall located in the San Juan arm of Lake Powell began in 2018. Up to 120 samples for both endangered species will be included to evaluate larval emigration or adult contribution downstream of the waterfall.

Previous N_b estimates have been obtained using multi-locus microsatellite markers; however, the field of population genetics has been shifting to a more recent technology termed “next-generation sequencing” (NGS). This technology has provided a cost-effective means of quantifying massive amounts of genetic data from individuals through the identification of thousands of single nucleotide polymorphism (SNPs). These SNPs are analogous to microsatellite markers, however, SNPs can quantify an order of magnitude more loci compared to microsatellites (i.e., SNP = thousands of loci, microsatellites = 10 – 30 loci), functionally increasing our resolution of genetic variation among individual genomes. This increase in genomic markers not only improves confidence assignments for parental reconstruction (Thrasher et al. 2018), but SNPs also offer benefits over traditional microsatellites methods due to lower error rates and broader genome coverage (Smouse 2010; Hauser et al. 2011). Therefore, N_b estimates for 2020 will be collected using this method along with the methods used in previous years to ensure these results are comparative. The cost of this comparison will include an in-kind contribution for the NGS data collection to: not increase the cost to the Program, ensure 2020 data are comparable to previous years, and provide an avenue to improve data collection while lowering Program costs in the future.

Genomic DNA will be extracted from tissues following standard protocols used at Southwestern ARRC. Microsatellite genotyping will follow the same methods used in previous reports (Diver and Wilson 2018). NGS data will be prepared using double digest Restriction-Site Associated DNA (ddRAD) libraries (Peterson et al. 2012). Restriction digest of 1µg genomic DNA/sample will be performed in 50µl reactions containing 5µl New England BioLabs CutSmart Buffer and 20 units each PstI and MspI. Samples will be digested at 37°C for 18 hours then purified using Agencourt AMPure XP beads (Beckman Coulter, Inc.). Barcoded samples (100 ng DNA each) will be pooled in sets of 48 following Illumina adapter ligation, then size-selected using the Pippin Prep System (Sage Science) to retrieve DNA fragments between 350 and 400 bp in length for Razorback Sucker and 325 to 425 for Colorado Pikeminnow (Bangs et al. 2018; Chafin et al. 2018). Size-selected DNA will be subjected to 10 cycles of PCR amplification using Phusion high-fidelity DNA polymerase (New England Bioscience), according to manufacturer protocols. Four indexed libraries (192 samples) will be pooled per lane for 100bp single-end sequencing on an Illumina HiSeq 4000 (University of Oregon Genomics & Cell Characterization Core Facility). Data will be de-multiplexed and filtered in STACKS (Catchen et al. 2013) to discard reads with uncalled bases or low Phred quality scores (<10), while simultaneously attempting to recover those reads with ambiguous barcodes (=1 mismatched nucleotide). The *de novo* assembly of ddRAD loci will be accomplished in STACKS (Catchen et al. 2013) with clustering parameters being determined by the methods of Rochette & Catchen (2017). Only loci appearing in 95% of individuals will be retained for analysis. SNPs will be filtered to retain one per ddRAD locus. A second researcher will perform a 10% quality assurance/quality control of samples to ensure accuracy.

Both microsatellites and SNPs will be evaluated for linkage disequilibrium and Hardy-Weinberg Equilibrium (Raymond and Rousset 1995; Purcell et al. 2007). For both datasets, N_b will be estimated using the sibship-assignment (SA) method in COLONY version 2.0.4.0 (Jones and Wang 2010). This software uses a maximum likelihood method to estimate relationships among offspring belonging to a single cohort by identifying full and half-sibling families while incorporating genotyping errors (i.e., E_1 and E_2) and allowing for inferences related to the mating strategy of the organism. Analyses will be conducted separately for each year to estimate N_b, the number of adults that contributed at least one offspring, number of sampled offspring produced by each parent, and the number of parental pairs. For both species, male and female polygamy will be assumed and parameter settings (i.e., dioecious, diploid, inbreeding, medium run length, full-likelihood with medium likelihood precision, no sibship prior, and updated allele frequencies) will be maintained across years.

Schedule:

Completion of genetic analysis	March 30, 2021
Final Report	June 30, 2021

Intended Method of Information Dissemination:
Dissemination of the results will include a draft and final report and presentation of project results at the San Juan Researcher's meeting. Data will be submitted per SJRRIP timelines.

FY20 - Detailed Spending Plan

1. PERSONNEL	
A. Laboratory Work	
1 Bio/Geneticist (GS-11; 400 hours -10 pay periods) @ $32.27/hr	$12,908
B. Report Writing	
1 Bio/Geneticist (GS-11; 150 hours -3.75 pay periods) @ $32.27/hr	$4,841
Subtotal Personnel	$17,749
1. MATERIALS/SUPPLIES	
A. Extractions	$1,711
B. PCR Reactions	$12,232
C. Genetic Analyzer	$4,158
D. Other (tubes, tips, etc.)	$6,513
Subtotal Supplies	$24,614
TOTAL	$42,363
Southwestern ARRC Utilities	
-Electrical, (approx. 4,259 KW/h @ 0.34569 per KW/h) =	$1,000
Administrative and Overhead Costs Regional Office @ 3%	$1,301
Project Total FY2020	**$44,664**

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Response to Comments

SOW20-2 - Using molecular techniques to determine effective number of breeders (N_b) for Razorback Sucker and Colorado Pikeminnow in the San Juan River

Responses to reviewer comments are presented in bold text.

Wayne Hubert: "This is a novel approach to determine effective population size that is worthy of continuation. A concern is if the sample size for an individual species (n = 120) in a given year is sufficient and if the sample approximates a random sample of the population of larval fish in the SJR. Can a sample of 120 larvae effectively represent the spatial and temporal variation in the population of larvae in a given year? Estimates of numbers of breeders may be biased by insufficient sampling. It would be wise for the research from the Southwest Resources Aquatic Resources and Recovery Center to collaborate with ASIR (the organization sampling larval fish) and statisticians with expertise in sampling to assess sampling needs to obtain an accurate and relative precise estimates of the number of breeders of a species within a given year."

Thanks to Dr. Hubert for his comments. We hope our responses help alleviate some of his concerns. We agree appropriate sample sizes for these types of assessments will be extremely important for developing accurate estimates. For each year, we randomly selected 120 fish from all of ASIR's annual collections; this was weighted by densities at each site (i.e., backwater at river mile X) while specifically including rare samples. Our genetic sampling is therefore limited to the temporal and spatial sampling of larval fish collections, thus, we are estimating the effective number of breeders that contributed to the larval fish that were collected in the field. While, we agree that there remains the possibility that cohorts of Razorback Sucker and Colorado Pikeminnow that are not sampled in the field (spatially and/or temporally) would lower our estimate, we are unable to factor for that in our genetic sampling if those cohorts are missed in field. Nonetheless, because ASIR's annual sampling is relatively constant, we are intending these estimates to be used as an index of annual reproductive output rather than an estimate of the actual number of all the breeding adults in the San Juan Basin. Furthermore, this estimate factors for variance in reproductive success. Thus, if a few individuals contributed a majority of the larvae sampled in the field, then we would predict that biased contribution would lower our estimate; this is a genetic estimate for quantifying the number of adults that effectively contributed to a single cohort and is not a count of spawning adults.

Although we are taking a random sample from the annual larval fish collections, our data also suggest that in most years, a sample size of 120 is adequate for the endangered fishes we are targeting. Other studies have indicated that a sample size that is close to the true N_b is adequate (England et al. 2006; Wang 2016; Sánchez-Montes et al. 2017; Bacles et al. 2018). Our data also suggest that increasing our sample size from the larvae collected in the field is not necessarily going to change our estimates due to the high level of relatedness among the larval fish sampled. In other words, increasing our sample size generally increases the number of siblings (whose parents have already been included in the estimate), and therefore would not change the overall N_b estimate. However, we are aware that if the number of breeders from our samples start to increase substantially, then our sample sizes will need to be increased. But at this point, we think the minimum sample size of 120 should be adequate to estimate N_b for the larval fish that are collected annually in the field. If the Program would like to test if our samples size is sufficient, we would

recommend both increasing field sampling of larval fishes over space and time and increasing the number of fish included in genetic sampling; however, the cost of this increase must also be considered.

SJRIP O&M Existing PIT Tag Antennas
2020 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. This proposal is to add an another series of PIT Tag antenna at the Hogback Fish Passage to detect fish that either may or may-not use the fish passage. Existing antennas at Hogback currently cover the intake structure, the fish bypass at the weir, and the canal, in addition to the bypass at the canal headgate. Installation of this new set of antennas will provide almost full coverage of the river at Hogback under all but the highest of flows.

1) 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 Hogback 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.

Antennas installed at Hogback Canal are being used in a "design" to give us information on how many, when, where, and how fish use the Hogback canal and fish weir. These antennas have been used under controlled experimental conditions and have given us some good information. If VFD pumps are replaced in the canal we can get good information on how the weir works under more normal operating conditions. Antennas were installed at the canal intake, in the canal downstream of the fish weir, and in the fish bypass that leads back to the river. Under this design, in theory, we can evaluate numbers of fish that enter the intake, numbers of fish that are entrained or bypassed back to the river, direction of fish movement, as well as date and timing of movements.

Antennas installed at Hogback Bypass were installed primarily due to proximity to existing infrastructure and antennas in the Canal portion of the project. These antennas are not part of a design, but are giving us information on recaptures (i.e., survival), timing of fish movements, and potential information about use of the fish passage right next to it. There were two arrays of antennas installed at this site so, theoretically, movement direction as well as date and time can be evaluated at this bypass. Since this site is protected by a radial gate just upstream that regulates the amount of water than can go through this channel the antennas cannot be flushed out during high water.

2) 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.

Antennas installed at TNC Restoration site were incorporated as a component of the evaluation of this habitat restoration and were installed in the secondary channel near the downstream mouth. Antennas were not installed as part of a "design" but can be used to provide information on movements of fish, timing, as well as simply increasing total number of detections river-wide. There are two arrays of antennas at this site so, theoretically, movement direction can be evaluated. For fish that are detected here there is little more that can be said other than they were present at a certain date and time since there is no comparison being made to main channel sites, control sites, or other restoration sites.

3) 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 as part of a rehabilitation project for the bridge conducted by Utah Department of Transportation.

Antennas were initially installed in McElmo Creek near the mouth where it joins the San Juan. These antennas were installed as part of a "design" to look at fish movements (all fish) in and out of McElmo Crk. There are two arrays of antennas at this site so movement direction can theoretically be evaluated. These antennas are continuing to function even though they are past their planned life-span, albeit at a reduced level of effectiveness due to burial by sediment and two of the 5 antennas being flushed away from floods.

McElmo Creek Bridge--These antennas were installed as part of a rework of the bridge abutment and, since the contractor had heavy equipment and was going to be using large rip rap to create a new channel, it was relatively easy and cheap to install a series of antennas. Antennas installed at the McElmo Creek Bridge were not installed as part of a "design", although there are two arrays of antennas, one upstream and the other downstream of the Bridge. Thus movement direction and ability of fish to swim up the channel can be assessed. Additionally, when combined with antennas approximately 300 yards downstream at the mouth of McElmo, the antennas can be used to asses direction, timing, and movements of fish that come in and out of McElmo Creek.

4) Submersible antennas located near the waterfall on the San Juan River near Gouldings, AZ.
    a. Submersible antennas are installed at various locations including the Piute Farms 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.

A single semi-permanent concrete antenna has been installed at the Piute Farms Waterfall downstream of the falls. This antenna was installed as part of a design to determine species, timing, and numbers of fish visiting the Piute Farms Waterfall and which are precluded further movement upstream.

5) Shiprock Bridge Secondary Channel--This site consists of a restored secondary channel that has a concrete inlet at the mouth. We installed a three-array system in October of 2018 as part of the concrete apron, which reduces risk of antennas being destroyed by flooding. Antennas installed here of a three-array system that provides information on species and timing of use, as well as direction of movement in and out of the secondary channel.

Proposed sites:

1) 2) Four-Corners Bridge---The Four-Corners Bridge is being reworked due to erosion of rip rap on the bridge abutment on the upstream side of the north abutment. Antennas could be installed at this site as part of the repair work on the rip rap. River-wide antennas would be ideal, but incorporating the antennas into the rip rap at the foot of the bridge is more likely. These antennas would not be part of a "design" but could provide more detections of fish in this portion of the river as well as information on a potential spawning bar for Colorado pikeminnow that may be located just upstream. Since this would not be a multiple-array system the data would only provide information on species, number, and timing of movements.

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 2020 till August 2020, IF the cement semi-permanent antenna is not working, in an attempt to document fish movements and usage of the river immediately downstream of the waterfall.

TASKS – 2020

1. Maintain and operate stationary and portable PIT tag antennas
2. Replace one PIT tag antenna (location unknown, probably PNM)
3. Data will be remotely or manually entered into SJRIP and STReaMS databases.

FY 2020 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	40	$3,200.00
BioMark or USU Staff (contract)	$80.00	1-2	100	$6,400.00
Total				$9,600.00

B) Travel

Position	Destination	Purpose	Days	Lodging per day/total	Per diem per day/total	Other*
Reclamation Technical representative	Farmington, Shiprock	Project evaluation or field trips	2 trips @ 5 days/trip	$100/$500	$40/$400	$0
BioMark/USU representative	Boise, ID; Kennewick, WA; various	Field trips O&M Antennas	2 trips @ 5 days/trip	$100/$1000	$40/$400	$2500
Total				$1,500.00	$800.00	$2,500.00

*mileage of 5,000 mi at $0.55/mile

C) Equipment

Item	Unit Cost	Number	Total cost
Antenna system	$10,000	1	$10,000
Total			$10,000.00

Budget Summary
FY-2020

Category	Total
Labor	$9,600.00
Travel	$4,800.00
Equipment	$10,000.00
Total FY2020 Budget	**$24,400.00**

Projected funding:
FY-2021 $30,000.00
FY2022 40,000.00

SJRIP PIT ANTENNA INSTALLATION AT HOGBACK FISH PASSAGE
2020 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. This proposal is to add an additional series of PIT Tag antennas (Figure 1) at the Hogback Fish Passage to detect fish that either may or may-not use the fish passage. Existing antennas at Hogback currently cover the intake structure, the fish bypass at the weir, and the canal, in addition to the bypass at the canal headgate. Installation of this new set of antennas (Figures 2 & 3) will provide almost full coverage of the river at Hogback under all but the highest of flows.

The existing antennas include:

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 Hogback 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.

Antennas installed at Hogback Canal are being used in a "design" to give us information on how many, when, where, and how fish use the Hogback canal and fish weir. These antennas have been used under controlled experimental conditions and have given us some good information. If VFD pumps are replaced in the canal we can get good information on how the weir works under more normal operating conditions. Antennas were installed at the canal intake, in the canal downstream of the fish weir, and in the fish bypass that leads back to the river. Under this design, in theory, we can evaluate numbers of fish that enter the intake, numbers of fish that are entrained or bypassed back to the river, direction of fish movement, as well as date and timing of movements.

Antennas installed at Hogback Bypass were installed primarily due to proximity to existing infrastructure and antennas in the Canal portion of the project. These antennas are not part of a design, but are giving us information on recaptures (i.e., survival), timing of fish movements, and potential information about use of the fish passage right next to it. There were two arrays of antennas installed at this site so, theoretically, movement direction as well as date and time can be evaluated at this bypass. Since this site is protected by a radial gate just upstream that regulates the amount of water than can go through this channel the antennas cannot be flushed out during high water.

The additional antennas (Figures 1-3) installed at Hogback would provide information on fish movements at the Fish Passage Structure and would provide information on successful fish passage.

METHODS:

1) Stationary PIT tag antennas will be installed in the fish passage (Figure 3) and at the bottom (Figure 2).
2) Data collected from these antennas will be provided to the SJRIP and STReaMS.

FY 2020 BUDGET—See attached Invoice from Biomark

Hogback Fish Passage

Budget Summary

Biomark
SPECIALISTS IN IDENTIFICATION SOLUTIONS
705 S. 8th St.
Boise, ID 83702
PHONE: (208) 275-0011
FAX: (208) 275-0031

SUMMARY	Subtotal	Grand Total	Cumulative Total
Phase 1: Site Visit	$4,901	$4,901	$4,901
Phase 2: System Test	$53,272	$53,272	$58,173
Phase 3: Installation	$12,878	$12,878	$71,051
Phase 4: O&M	$0	$0	$71,051
TOTAL	$71,051.00		

SUMMARY (all Phases)

Labor	CLIN	Hours	Rate	Subtotal
(1) Project Manager	"00410	10.5	$162.00	$1,701
(2) Computer Scientist	"00450	0	$136.00	$0
(3) Senior Scientist	"00400	0	$124.00	$0
(4) Biometrician	"00420	0	$133.00	$0
(5) Fisheries Specialist	"00390	5	$97.00	$485
(6) Field Technician (Biology)	"00440	0	$62.00	$0
(7) Habitat Biologist	"00430	0	$69.00	$0
(8) Electronic Technician	"00380	100	$111.00	$11,100
(9) Senior Engineer	"00370	0	$151.00	$0
Labor Total		115.5		$13,286.00

Nonlabor	
Travel	$3,048
Equipment	$54,717
Nonlabor Total	$57,765.00
Total	$71,051.00

* QUOTE GOOD FOR 90 DAYS
** IF PROJECT START DATE EXCEEDS 180 DAYS FROM BID DATE, PRICE ESCALATION MAY BE REQUIRED.
***NO RETURNS OR REFUNDS CAN BE ISSUED ON PROJECT RELATED PURCHASES AND SPECIAL ORDERS
****BIOMARK'S STANDARD WARRANTY APPLIES

Figure 1. PIT Tag antenna locations at Hogback Weir and Fish Passage. Proposed antennas are in yellow.

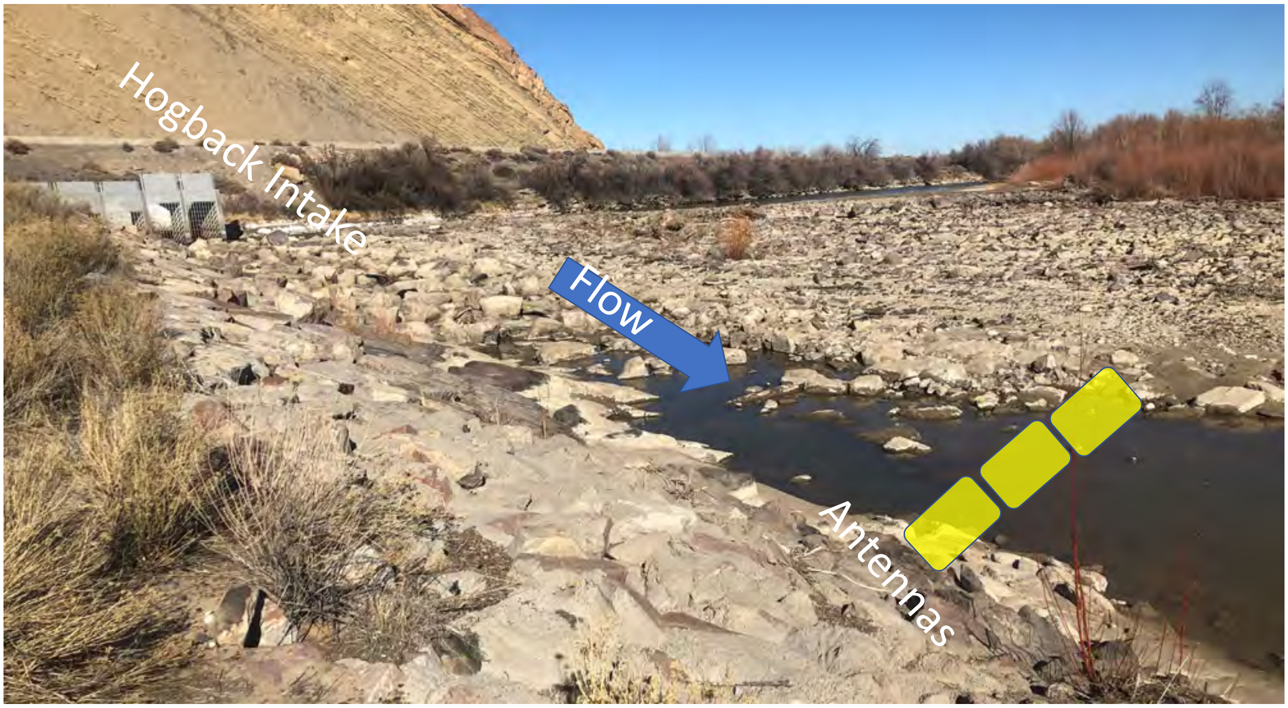

Figure 2. Proposed PIT Tag antennas at the bottom of the fish passage at Hogback Weir and Fish Passage.

Figure 3. Proposed PIT Tag antennas in the fish passage at the Hogback Weir and Fish Passage Facility.

Response to Comments

Scope #	Project	PI(s)
12	***SOW-20-32b-SJRIP PIT TAGS***	**McKinstry**

Wayne Hubert, Peer Reviewer

How can the technical aspects of this SOW be improved?

There is insufficient information in the SOW to provide a science based review.

A concern regarding the overall SJR PIT tagging effort is the opportunistic manner in which it has evolved and the lack of a systematic design. This concern addresses SOWs 12 and 32. The SOWs would benefit from a thorough assessment and description of the current status of the PIT-tagging work in the SJR. A huge amount of work has been done in PIT-tagging fish, developing and installing antennas for PIT-tag detection, and assimilating Pit-tag detection data into databases. The overall structure of the PIT-tagging work is in need of review. Because of the opportunistic way in which PIT-tagging efforts, there is not a "project" with defined goals and quantitative objectives, an experimental design, or mechanism for assessing project success or future needs. The SOWs regarding PIT tagging would greatly benefit from a formal review of PIT-tagging work and development of a formal PIT-tagging project to direct and assess these efforts into the future.

What is this SOW's contribution to recovery?

PIT tagging of the endangered species has become an integral part of recovery efforts and is yielding substantial amounts of information on movements of the species.

Response: Unfortunately the analysis of the data collected by this SOW is disconnected from the SOW to buy PIT tags and install the antennas. I agree that more effort could/should be put into analyzing the data collected from these sites, but we don't have specific plans at this point. The criticism on the lack of experimental design for the sites is valid, but other than the restoration site, we have an experimental design in place, which was explained in the SOW and are more detailed below:

PNM—several antennas have been positioned in the fish passage to show movements of fish up through the passage, indicating sequential movement through the passage and ultimately the success or failure of passage. Antennas have also been installed at the weir to identify fish that hit the weir and either find the passage or not. Lastly, antennas have been installed at the outlet for the passage to quantify success of fish navigating the structure. While formal reporting on these results has not been done, the data have been used to modify operation of the passage in a flow-through mode during March- May in an effort to increase passage rates. A more formal analysis of the data is planned once *we have several years to report on the operation of the facility.*

Hogback—Hogback antennas were planned/designed in an effort to show passage through this weir structure. To date, we have used the antennas to show that few stocked fish actually go over the weir and no wild fish go over the weir. The antennas in the bypass and those planned for the fish passage are useful for showing fish that are not using the passage and give detections that are useful in survival analyses. We have the data for this site and we are planning to publish it shortly.

Piute Farms Waterfall—antennas at this location were installed to quantify the number of fish stacking up at this site and have demonstrated that more than 1900 endangered fish have hit this barrier in the lower river. This information is being used to formulate passage options and the data have been used in several publications that are either completed or in press.

This SOW has never been a formal "project" with annual reporting but rather the results have been discussed at meetings where we use the data to formulate management changes (like opening the passage) and discuss what can be done to improve the data collection. Efforts are in place to publish many of the data.

Facilitated fish passage for enhancing populations of endangered fishes in the San Juan River

Proposed Scope of Work for FY 2020 and 2021

August 1, 2019

 

Principle Investigators
Keith Gido, Casey Pennock, Skyler Hedden
Kansas State University, Manhattan, KS

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U.S. Fish and Wildlife Service, Grand Junction, CO

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Navajo Nation Department of Fish and Wildlife

Steven Mussmann and Tracy Diver
Southwestern Native Aquatic Resources and Recovery Center, Dexter, NM

Background

Migration is integral to the life history of many riverine fishes because it can impact population vital rates. Many fishes require movements among spawning, rearing and feeding habitats (Schlosser and Angermeier 1995). As river systems have become fragmented by dams, water diversions, road crossings, and other human engineered structures, fish populations have declined (Gido et al. 2016). Accordingly, there has been active interest in promoting various forms of fish passage to conserve and manage populations (e.g., Bunt et al. 2012), and translocation, the intentional movement of individuals from one area to another, is a widely applied conservation tool used to increase the viability of threatened populations (IUCN/SSC 2013; Ranke et al. 2017). In the Colorado River system, it is likely that barriers affect reproductive success of razorback sucker, as this species is known to migrate up to 106 km to spawn (Tyus and Karp 1990). Spawning, and associated migrations, occur between March and June during the ascending or peak spring flows when water temperatures are between 9 and 17 °C (Tyus and Karp 1990; Farrington et al. 2014). Given that razorback sucker have evolved in a historically open river network, barriers to movement have likely interrupt critical spawning opportunities and perhaps other aspects of their life cycle.

On the San Juan River, two major obstacles to fish movement are the Piute Farms Waterfall (PFW) and the PNM weir. The PFW formed most recently in 2001 after sediment deposition in the Lake Powell-San Juan River inflow area redirected the river during high water years (Cathcart et al. 2018a). Other than in 2011, when the elevation of Lake Powell last exceeded the elevation of the waterfall, this structure has excluded upstream migration of fishes from the Lake Powell-San Juan River inflow area. In most years, it is typical to have at least 10 river kilometers between the waterfall and the inflow to Lake Powell. One consequence of the PFW is that stocked razorback sucker and Colorado pikeminnow that move downstream of the waterfall cannot return to the mainstem San Juan River. We know a large number of razorback suckers (> 1000 individuals) occur in the San Juan Arm of Lake Powell and many of those fish are found immediately below the waterfall in early spring (Cathcart et al. 2018a). This large aggregation of razorback suckers suggests these individuals are trying to move upstream to spawn. Over the past three years, there have been efforts to translocate fish upstream of the waterfall. In 2016, 152 razorback sucker were moved upstream of the waterfall, 151 in 2017, and in 2018, 202 were moved. However, PIT tag data show that translocated fish do not necessarily reside in the river long, making seasonal returns to Lake Powell (Pennock, unpublished data). In 2016, 80% of translocated fish were subsequently detected below the waterfall, and in 2017 a similar number was observed with 79% of moved fish detected downstream of the waterfall. In contrast, when PIT tagged razorback suckers in the San Juan Arm of Lake Powell had the opportunity to move into the San Juan River in July 2011 (n = 6, Durst and Francis 2016; plus one additional fish , Schleicher 2016), many of these individuals remained in the mainstem for at least 3 years. Thus, the importance of potentially short durational movements above PFW or longer forays in the upper river is unknown. It is possible that allowing movement (open fish passage or facilitated by biologists) above the waterfall might allow access to critical spawning habitats or allow the return of individuals to the river population.

A similar fish barrier occurs at the PNM weir on the San Juan River near Fruitland, NM. This weir was constructed in 1971 and diverts water to the nearby San Juan Generating Station. The PNM weir forms a barrier to fish movement at base flows, but fish passage might be possible at higher discharges (>7,000 cfs, BOR 2001). As such, a fish passage facility was constructed to trap and manually move fish upstream of the barrier. However, recent analyses suggested that relatively of the fish encountered on PIT antennas below the weir were passing through the diversion (Cheek 2014). In 2018, the selective fish passage barrier was opened to allow passive movement in hopes of increasing passage rates. Overall, and as with the PFW, it is important to understand how endangered fish movement above this barrier might influence the population dynamics of razorback sucker (e.g., reproductive success).

It is currently unclear if these major barriers to fish movement are impeding reproductive output and natural recruitment of razorback sucker in the San Juan River. To help answer this question, we propose to use PIT tagging and radio telemetry to track the movement of razorback sucker that are actively transported upstream of PFW and PNM weir. Specific research objectives are:

1) Quantify movement of fish transported above the PFW and PNM weir (**Task 1 – 4**)
2) Identify fish aggregations and potential spawning habitats above both barriers using radio telemetry and PIT antennas (**Task 2 and 3**)
3) Estimate the reproductive contribution of translocated razorback sucker to the San Juan River population (**Task 5**)

Conservation need

Razorback sucker have generally failed to recruit in the San Juan River, despite extensive efforts to stock adults in the river. At this point, it is not clear how important connectivity among habitats (i.e., the river and reservoir or river upstream of PNM weir) is to the ability to maintain sustainable populations of razorback sucker in the San Juan River. Rivers, reservoirs, and tributaries might play different roles relative to spawning, recruitment, foraging, and refugia for this species. Continuing to monitor the movement dynamics and reproductive success of translocated fish will help gauge the importance of linkage across habitats to the success of razorback sucker in the San Juan River. Specifically, this research will assess the efficacy of a potentially important management action (i.e., providing fish passage), while also identifying critical habitat needs of this species.

Task 1: Facilitated migration and telemetry study of razorback sucker through the Piute Farms Waterfall and PNM weir (Kansas State University)

Methods

Piute Farms Waterfall - Raft mounted electrofishing will be used to capture razorback sucker below the PFW and lengths and weights will be taken from each individual. Additionally, fin clips will be taken and preserved in ethanol to identify the contribution of translocated fish to that year's production of larvae (see Task 4). Fish will be scanned for PIT tags and if no tag is present, they will be tagged with BioMark 12 mm tags. Fish will be held in a holding tank with fresh river water (salt added to reduce stress) for a maximum of 3 hours while additional fish are captured. At this time, fish will be hauled upstream of the waterfall to a motor-mounted boat and fish will be transported and released at a location approximately 2 river miles (3.2 km) upstream of the waterfall. This effort will take place for 10 – 14 days during March of each year with the goal of capturing and transporting 200 adult razorback sucker.

Movements of fish transported upstream of the PFW will be assessed using a combination of physical recaptures, detection of PIT tagged individuals below the waterfall, and radio telemetry. Specifically, we know from previous work (Cathcart et al. 2018a) that the detection probability on a PIT antenna located in an eddy below the waterfall is relatively high (64 - 91% over a 15 day period). Thus, by using existing PIT tags or tagging untagged fish, we can estimate the proportion of translocated fish that are retained in the river in each year of the study, assuming that fish not detected are still above the waterfall. This estimate will consider a correction for detection probability of PIT antennas below the waterfall. To better quantify the detection probability of our PIT antennas below the waterfall, we will periodically deploy submersible antennas at several other locations below the waterfall to assess detection probability of the permanent PIT antenna below the waterfall. Submersible antennas will be placed in deep, low velocity habitats that are most likely holding areas for razorback sucker. Additionally, by scanning fish during each sampling effort, we might identify fish that have returned to the river below the waterfall but not detected on the permanent PIT antenna, allowing an additional estimate of detection probability. Additionally, we will monitor upstream movement and retention based on an array of submersible antennas in the lower canyon between Sand Island and Clay Hills (Task 2), standard fall monitoring, and stationary PIT antennas located at McElmo Creek, Restoration Channels, Hogback Diversion, and PNM.

Although PIT tagging will allow us to monitor coarse movement patterns of a large number of fish, we also propose to use radio telemetry on a subset of razorback sucker translocated above the PFW to monitor movement and habitat use. Stationary radio antennas will identify passage at critical periods and locations while monthly tracking by raft (Task 2) and airplane (Task 4) will help identify fine-scaled movements and habitat use by razorback sucker transplanted above the PFW. These efforts will serve to validate data obtained from PIT tagged fishes.

To provide fine-scaled movement of translocated razorback suckers, we propose to implant 40 fish with 300-day, body implant, coil radio transmitters (13g; Advanced Telemetry Systems). A stationary, uni-directional radio antenna and receiver will be place at Sand Island and a stationary, bi-directional antenna and receiver will be placed at the PFW. The receiver at Sand Island will be powered by an outlet at the BLM ranger station and will be used to assess if fish translocated above the PFW successfully migrated through the lower canyon. The receiver at the PFW will be attached to the solar unit powering the existing PIT antenna. A receiver with three antenna channels will have one antenna pointing upstream, one downstream and one uni-directional antenna. The combination of these three signals will allow us to determine when fish move downstream over the PFW. Unless there is a power failure, fish should not be able to pass either location without being detected. Antenna receivers will continuously run for the 300-day period to identify date and specific time fish are detected in these areas. We will only use 300-day tags so they expire before the following year. That will allow us to replicate the design a second year and not risk the chance of having too many active tags in the river, making it difficult to scan frequencies.

PNM weir – Similar methods as described above for translocation of fish above PFW will be applied to river reaches below and above the PNM weir. We will take fin clips for genetic analysis and implant 40 suckers with radio tags and transport them approximately 2 river miles upstream (to match the design at the waterfall). We will also capture and take fin clips from up to 160 additional individuals captured below the weir and transported upstream to the same location as radio tagged fish. Thus, we might be able to identify the contribution of transported fish to larval razorback suckers collected that year.

A stationary radio telemetry receiver will be placed at the PNM weir with directional and unidirectional antennas to capture movements of fish above and below the weir. Additional efforts will focus on detecting PIT and radio tagged fish above the weir with an array of submersible PIT antennas (Task 3) and tracking radio tagged fish river-wide by airplane (Task 4).

Budget Justification

The majority of funds for this project are for personnel, telemetry equipment, field gear, and travel costs. The PI will oversee the entire project with primary responsibilities to mentor the graduate student and technician, assist with data analysis, and edit reports and manuscripts. The graduate student will be responsible for field work that includes translocating fish at the PFW and PNM weir and assisting with river trips to track radio tagged fish and replace batteries on PIT antennas. The student will also be in charge of data organization (including compiling PIT and radio telemetry data), analysis, and report/manuscript writing. A technician is necessary because field work will require a minimum of two people for safety. This person will assist with field work, data entry and general maintenance of equipment. Telemetry receivers (stationary and portable) and tags (148-151.999 MHz range) will be purchased through Advanced Telemetry Systems. Four-wheel drive trucks and rafts are available at Kansas State University and through the BOR and SJRIP Program Office. Due to extensive wear from using outboard motors to run upstream, additional funds are requested for an outboard motor to sample fish below barriers and transport fish upstream of PFW. Funds for field camping gear are included to accommodate extended periods of time in potentially cold conditions while translocating fish.

Task 2: Reproductive ecology of translocated razorback sucker in the lower canyon, Sand Island to Clay Hills (UDWR)

Spawning aggregations of razorback sucker have been observed by Utah Division of Natural Resources in the lower canyon above Slickhorn Wash since 2002 (Jackson 2003). It is possible that translocated razorback suckers will aggregate, and potentially spawn at this location, or in other locations in the lower canyon. To evaluate the potential spawning habitats of razorback sucker transported above the PFW, we propose fine-scaled radio tracking and submersible PIT tag antenna surveys to identify potential spawning habitats. Specifically, we propose to 1) sample around the Slickhorn Wash area using larval drift nets and submersible PIT antennas to verify Razorback Sucker spawning and 2) use radio telemetry to identify potential spawning habitats between Sand Island and Clay Hills. If additional spawning aggregations are identified with radio telemetry then additional sampling will occur at those locations the following season.

Methods

A maximum of four trips will take place in March, April, May and June (depending on flows) following translocation of fish above the PFW each year. Trips will begin at Sand Island and end at Clay Hills. Hand-held radio telemetry receivers will be used to track the location of radio tagged fish within that reach and GPS coordinates of fish will be noted at the location of each fish. Locations will also be marked on aerial photographs of the river. In the first trip, 6 – 12 submersible PIT antennas will be placed at strategic locations around suspected spawning locations. Additionally, a minimum of four submersible antennas will be placed at regular intervals above the waterfall (e.g., 10, 20, 30, 40 river miles) to evaluate upstream movement of fish. Exact locations and habitats where submersibles are placed will be adjusted according to locations of fish with radio transmitters. Not only can we test if detections decline with distance above the waterfall, but this will also provide data on the exact timing of fish moving into these habitats. Batteries in these antennas typically last about 3-4 weeks and efforts will be made to keep antennas operational from March through June.

Larval fish sampling will occur below spawning habitats (most likely Slickhorn Wash) to identify if razorback sucker larvae are being produced at putative spawning aggregations. Because it is possible that larval razorback suckers might be produced upstream and drift down, we also will sample habitat above the suspected spawning habitat. If higher abundances of larval fish are found downstream of the suspected spawning aggregation, that would indicate those larvae are coming from that aggregation. Larval fish will be sampled up-and downstream of spawning sites using standard methods from annual larval fish monitoring (Farrington et al., 2014). However, we will also use drift nets set out at dusk and dawn to increase the probability of capturing larvae around spawning beds. Larval fish will be preserved in 95% ethanol for potential genetic analysis. These data will supplement systematic larval fish surveys conducted by ASIR. All larval fish collections will include geographic coordinates to identify the distribution of samples along the river.

Budget justification

Funds are requested for personnel needed for field crews, travel to survey locations, sampling gear and basic maintenance.

Task 3: Reproductive ecology of translocated razorback sucker above PNM weir (USFWS Grand Junction)

The occurrence of larval razorback sucker as high up as the confluence with the Animas River in 2018 (Farrington et al., 2019 BC annual meeting presentation) indicates there is spawning habitat above PNM weir. We propose a parallel effort to the lower canyon described in Task 2 to 1) use radio telemetry to identify spawning aggregations and habitats in the San Juan River above the PNM weir and 2) strategically place PIT antennas to identify patterns of movement of PIT tagged razorback suckers in or around suspected spawning habitats.

Methods

Because the PNM weir has an existing fish passage facility we will focus our activities around tracking radio and PIT tagged fish that are transported above the barrier. A minimum of four trips (depending on flow) will take place in March, April, May, and June following translocation of fish above the PNM weir. Hand-held radio telemetry receivers will be used to track the location of radio tagged fish within that reach and GPS coordinates of fish will be noted at the location of each fish as will their location on aerial photograph of the river. As with the lower canyon, location of radio tagged fish will be used to identify suspected spawning locations of translocated fishes. Six to 12 submersible PIT antennas will be placed at strategic locations around suspected spawning aggregations and at variable distances upstream of the PNM weir that will help identify movements into suspected spawning habitats. The occurrence of larval razorback suckers below spawning habitat will be sampled and assessed from annual larval fish monitoring by ASIR.

Budget justification

Funds are requested for personnel needed for field crews, travel to survey locations, sampling gear and basic maintenance.

Task 4: Riverwide distribution of razorback sucker tagged with radio transmitters (NMGF budget)

It is possible, and highly likely, that fish tagged with transmitters will move outside of our focal reaches above the two barriers (i.e., downstream of the waterfall and upstream of Sand Island; as well as downstream of PNM weir and upstream of Bloomfield, NM). Thus, we propose that New Mexico Department of Game and Fish will survey the entire San Juan River, including the sections of the San Juan River above the confluence with the Animas for fish with radio transmitters by airplane. Flights will be conducted during months when flows are expected to be high (May and June) as well as in September, when fish are likely to be more dispersed. These flights will not only allow us to examine long-distance movement away from the barriers, but will provide additional data on observed locations of fish during the spawning period. We are assuming detection probability from the aircraft is 100% because radio signals are strongest immediately above the transmitter. However, we can confirm detection probabilities based on opportunistic PIT antenna and physical captures to account for potential bias in detection probabilities associated with altitude, flight direction and depth (Watkins et al. 2019).

Budget justification

The majority of funds for this task will be for personnel (1 biologist) to fly and track fish once per month in May, June, and August. Funding covers the cost of the biologist to fly for two days and two days for trip preparation and data summary for the flight (4 days total). The cost of the pilot and plane will be provided in-kind by the New Mexico Department of Game and Fish.

Task 5: Estimating reproductive contribution of translocated Razorback Sucker (*Xyrauchen texanus*) in the San Juan River

Translocation of animals has been used to repatriate extirpated populations, increase genetic variation and/or population size, move individuals out of the way of human development, and assist migration around unnatural impediments (Dresser et al. 2017; Mulder et al. 2017). Despite the increased, broad-scale use of this management action, effects of translocations are rarely assessed and only a handful of those have been deemed successful (Fischer and Lindenmayer 2000; Tarszisz et al. 2014; Dresser et al. 2017). A successful translocation program may require both the survival of relocated individuals and their reproductive contribution to the next generation; however, contribution of offspring can be difficult to evaluate when translocated animals are placed into a reproducing resident population. Fortunately, genomic analyses may provide managers a way to evaluate the conservation benefits of a translocation program despite difficulties faced within this management activity.

Every living organism has a genetic blueprint (herein, genome) that constitutes a combination of genetic signatures passed on from their parents and previous ancestors; if reproductively successful, a subset of their genome will be passed on to their offspring and future generations. Due to this fact, inheritance of parental genomic DNA provides the opportunity to reconstruct genealogical relationships among parents and their offspring. While the technology to accomplish these assessments has been available over the last few decades, this capacity has been further improved through recent advances in genetic methodologies. Recent technology termed “next-generation sequencing” (NGS) has provided a cost-effective means of quantifying massive amounts of genetic data from individuals through the identification of thousands of single nucleotide polymorphism (SNPs). These SNPs are analogous to microsatellite markers, however, SNPs can quantify an order of magnitude more loci (i.e., specific locations of DNA) compared to microsatellites (i.e., SNP = thousands of loci, microsatellites = 10 – 30 loci), functionally increasing our resolution of genetic variation among individual genomes. This increase in genomic markers not only improves confidence assignments for parental reconstruction (Thrasher et al. 2018), but SNPs also offer other benefits over traditional microsatellite methods due to lower error rates and broader genome coverage (Smouse 2010; Hauser et al 2011). Therefore, SNPs have the potential to evaluate translocation success (i.e., contribution of offspring) within reproducing resident populations by reconstructing relationships using genomic data for both translocated individuals and putative offspring. It is of particular interest to know whether or not these individuals contributed offspring to the San Juan River population. While this currently remains unknown, SNP analysis could inform managers about the effectiveness of fish translocation around significant migration barriers and clarify the importance of these animals to the recovery of the San Juan River razorback sucker population.

Methods

Fin clips will be collected from all razorback sucker translocated above PFW and the PNM weir and stored in 95% ethanol. Any corresponding data (e.g., PIT tag, length) will be recorded with the tissue for potential downstream comparisons (i.e., measures of individual reproductive success). The current goal is to move approximately 200 fish upstream of each barrier (PFW = 200; PNM weir = 200); however any animals moved in excess of this target will be fin clipped and included in all genomic analyses.

Larval fish surveys are conducted annually along a 140 mile section of the San Juan River between Shiprock, NM, and Clay Hills, UT. Larval fish are preserved and maintained in 95% ethanol making them suitable for genomic analyses. The number of larval Razorback Sucker has varied considerably among years with as few as 272 (Brandenburg and Farrington 2009) to as many as 1,834 collected in 2018 (M. Farrington, pers comm.). Therefore, larval collections will include a maximum of 900 individuals; if larval collections exceed this threshold, 900 larvae will be randomly selected from the total collection. Tissue subsamples from the posterior portion of each specimen will be obtained for genomic analyses and heads will be retained for potential future otolith examination. Prior to tissue collection, length and stage data will be recorded for each larvae.

Genomic DNA will be extracted from tissues following standard protocols used at Southwestern ARRC. Preparation of double digest Restriction-Site Associated DNA (ddRAD) libraries will follow Peterson et al. (2012). Restriction digest of 1μg genomic DNA/sample will be performed in 50μl reactions containing 5μl New England BioLabs CutSmart Buffer and 20 units each PstI and MspI. Samples will be digested at 37°C for 18 hours then purified using Agencourt AMPure XP beads (Beckman Coulter, Inc.).

Barcoded samples (100 ng DNA each) will be pooled in sets of 48 following Illumina adapter ligation, then size-selected to retrieve DNA fragments between 350 and 400 bp in length (Bangs et al. 2018; Chafin et al. 2018) using the Pippin Prep System (Sage Science). Size-selected DNA will be subjected to 10 cycles of PCR amplification using Phusion high-fidelity DNA polymerase (New England Bioscience), according to manufacturer protocols.

Four indexed libraries (192 samples) will be pooled per lane for 100bp single-end sequencing on an Illumina HiSeq 4000 (University of Oregon Genomics & Cell Characterization Core Facility). Data will be de-multiplexed and filtered in STACKS (Catchen et al. 2013) to discard reads with uncalled bases or low Phred quality scores (<10), while simultaneously attempting to recover those reads with ambiguous barcodes (=1 mismatched nucleotide). The *de novo* assembly of ddRAD loci will be accomplished in STACKS (Catchen et al. 2013) with clustering parameters being determined by the methods of Rochette & Catchen (2017). Only loci appearing in 95% of individuals will be retained for analysis. SNPs will be filtered to retain one per ddRAD locus.

SNPs will be evaluated for linkage disequilibrium (LD) and Hardy-Weinberg Equilibrium (HWE) using PLINK 1.9 (Purcell et al. 2007). Parentage will be assessed using COLONY (Jones and Wang 2010). This program uses maximum likelihood methods to reconstruct parentage via sibship analysis (i.e., the reconstruction of family groups from genotypic data when no known sibling groups have been identified: Smith et al. 2001). These methods will allow for the identification of putative parents if they are present among the sampled adults.

Larval samples collected in 2020 must first be identified prior to data collection for this project. Larval ID is typically completed in the fall of that sampling year. Given the extent of this scope (i.e., N = 900 larvae) genomic data collection and analysis will require multiple months before the project can be completed. Unfortunately, this will be delayed from the standard deadline for draft and final reports to the San Juan River Basin Recovery Implementation Program.

Budget justification

The majority of funds requested for this task are for laboratory consumables required for library preparation and genome sequencing. Additional funds are requested to cover personnel costs for two biologist to conduct the laboratory work and parentage analysis.

Task 6: Synthesis (Kansas State University)

All data on PIT tagged fish such as length, weight, location (coordinates), and translocation date will be collected and entered in the STReaMS – Endangered Fishes Database. To facilitate coordination among different agencies, personnel from Kansas State University will assist with other tasks as much as possible. Distribution of translocated fish based on PIT tags and radio tracking will be visualized using GIS software. Summary statistics will be used to quantify metrics such as retention time above barriers, timing of migrations up or downstream of barriers and distances traveled. Data from this study will be synthesized in a manuscript that will be submitted to a peer-reviewed journal.

Data analysis

The primary data analysis will involve quantifying five main aspects of razorback sucker ecology. Below we list those aspects and potential approach to quantification:

1) The duration that translocated fish remain in the river after translocation (PFW and PNM) - The average and variance in time translocated fish with PIT tags remain in the river above these barriers will be based on when those fish appear at PIT antennas immediately below the barriers. Although detection probabilities are not 100%, we assume fish detected below the barrier will represent a random distribution of fish moving back downstream. In addition, we can obtain estimates of average time and variance based on radio telemetry fish that will be detected by directional antenna at those structures.

2) Distance moved upstream of the barriers – Tagging studies most often use graphical summaries to represent movement patterns of fish, and can be used to represent average distances and range of distances moved (Pine et al. 2002). Coordinates for observations of tagged fish (radio transmitter detections, PIT antenna detections and physical captures) will be entered in a GIS platform and used to develop summary graphics representing dispersal patterns of tagged fish. We will also consider available software to evaluate animal movements to quantify our results (e.g., Hooge et al. 2001).

3) Location of aggregations or spawning habitats – A combination of airplane and raft telemetry tracking efforts will be used to identify aggregation of fish. These data will be visualized in a GIS platform.

4) Differences in retention above barriers across years (including data collected in 2016 – 2019 for PFW) – Our team will integrate data from previous years translocations at PFW with the current study to evaluate if different water years results in differences in retention. These analysis will only be conducted for fish translocated at PFW to include enough years and

exploratory correlation analysis will test association of retention rates and annual and seasonal flow metrics.

5) Estimate river-wide reproductive contribution of translocated fish to annual razorback sucker larval production – Assuming our collection of larval razorback suckers is a random sample of the population, the genetic analysis will tell us which fish are the result of translocated fish. Thus, we will get an estimate of the proportion of larvae contributed by translocated fish. By analyzing 900 larvae, we expect to test the majority of larval razorback suckers captured in each year. If >900 larvae are collected, we will analysis a subset that will maximize distribution along the river to assure a random sample from the population.

Yearly Timeline (Tasks will be repeated in Year 1 and 2)

Table 1. General time line for activities described above with agency involvement (**bold indicates lead unit**).

Task	March (2020)	April (2020)	May (2020)	June (2020)	July (2020)	Sept (2020)	March (2021)	April (2021)	May (2021)	June (2021)	July (2021)	Sept (2021)	Sept (2021)
Translocate fish; implant radio transmitters (**KSU**, UDWR, USFWS, NNDFW)	X						X						
Track fish above barriers (**UDWR, USFWS**, KSU)	X	X	X	X		X[a]	X	X	X	X		X[a]	
Telemetry flight (**NMGF**)			X	X		X[b]			X	X		X[b]	
Deploy mobile PIT antennas is suspected spawning locations above barriers (**UDWR, USFWS**, KSU)	X	X	X	X			X	X	X	X			
Larval fish sampling below suspected spawning locations (UDWR, ASIR)		X	X	X	X			X	X	X	X		
Maintain remote radio antenna (**KSU**, NNDFW)	X	X	X	X	X	X	X	X	X	X	X	X	
Genetic analysis of tissues and larvae (**SNARRC**)					X	X	X	X	X	X	X	X	X

a River-wide tracking from Farmington to Clay Hills

b Flight will most likely occur in August, but will occur before river-wide float trip.

Deliverables

A draft annual report will be submitted to the Program Office by 31 March 2020 and a revision that includes responses to BC member comments submitted by 30 June 2020. A final report will be completed at the end of the three year study period. All data will be submitted to the Program Office by 31 December 2020. An oral report will be given at the winter SJRIP Biology Committee (BC) meeting.

Budget

KSU FY2020 Budget

Task 1 Razorback Sucker use of the San Juan River below the Piute Farms Waterfall and San Juan Arm of Lake Powell	-	-
-	-	
	Task Description	Total
Task	**Item**	
Salaries		
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
Fringe benefits		
Project PI	30.00%	$ 3,150
Graduate Student	6.00%	$ 1,720
Research Assistant	30.00%	$ 6,300
Travel		
Field work	Per diem (63 days x $20/day x 2 people)	$ 2,520
	Lodging-Bluff, UT and Farmington, NM ($100/night x 22 nights)	$ 2,200
	Vehicle mileage (0.58/mile; 2000 miles round trip Manhattan, KS to Bluff, UT and travel to field sites x 5 trips)	$ 5,800
BC annual meeting	Airfare (Manhattan, KS to Durango, CO)	$ 1,000
	Hotel ($105/night x 3 nights)	$ 315
Supplies		
Field Sampling Gear	Remote logging reciever (ATS R4500S $5800 x 3) (no overhead)	$ 17,400
	Hand-held reciever (ATS $1100 x 2)	$ 2,200
	Radio tags ($175 each X 80)	$ 14,000
	Antennas for R4500S ($160 X 7)	$ 1,120
	Wall tent and stove for waterfall work	$ 1,100
	Laptop computer	$ 1,500
	Outboard motor	$ 4,000

	Waders, life vests, surgery stuff, MS-222, other gear	$ 1,500
Graduate Student Tuition and Fees-Spring	KSU Tuition and Fees for Graduate student course work (no overhead)	$ 8,137
	Total direct costs - Task 1	**$ 134,127**
	17.5% MTDC F&A	**$ 19,003**
	Total costs - Task 1	**$ 153,130**

KSU FY2021 Budget

Task 1 Razorback Sucker use of the San Juan River below the Piute Farms Waterfall and San Juan Arm of Lake Powell		
-	-	
Task Description		Total
Task	**Item**	
Salaries		
Project PI: Advise student and coordinate graduate project	0.5 months	$ 10,815
Graduate Student	1 year	$ 29,525
Research Assistant	6 months	$ 21,630
Fringe benefits		
Project PI	30.00%	$ 3,150
Graduate Student	6.00%	$ 1,720
Research Assistant	30.00%	$ 6,300
Travel		
Field work	Per diem (63 days x $20/day x 2 people)	$ 2,520
	Lodging-Bluff, UT and Farmington, NM ($100/night x 22 nights)	$ 2,200
	Vehicle mileage (0.55/mile; 2000 miles round trip Manhattan, KS to Bluff, UT and travel to field sites x 5 trips)	$ 5,800
BC annual meeting	Airfare (Manhattan, KS to Durango, CO)	$ 1,000
	Hotel ($105/night x 3 nights)	$ 315
Supplies		
Field Sampling Gear	Misc field gear and repairs	$ 1,000
	Radio tags ($175 each X 80)	$ 14,000
Graduate Student Tuition and Fees-Spring	KSU Tuition and Fees for Graduate student course work (no overhead)	$ 8,381
	Total direct costs - Task 1	**$ 108,356**
	17.5% MTDC F&A	**$ 17,496**
	Total costs - Task 1	**$ 125,852**

<u>SNARRC FY 2020 Budget</u>
FY20 - Detailed Spending Plan

1. PERSONNEL	
A. Laboratory Work	
1 Bio/Geneticist (GS-11; 560 hours -14 pay periods) @ $32.27/hr	$18,071
B. Report Writing	
1 Bio/Geneticist (GS-11; 200 hours -5 pay periods) @ $32.27/hr	$6,454
Subtotal Personnel	$24,525
1. MATERIALS/SUPPLIES	
A. Extractions	$4,868
B. Library Prep	$4,637
C. Library Quantification/QAQC	$3,585
D. Other (tubes, tips, etc.)	$5,892
E. Sequencing	$11,288
Subtotal Supplies	$30,270
TOTAL	$54,795
Southwestern ARRC Utilities	
-Electrical, (approx. 4,259 KW/h @ 0.34569 per KW/h) =	$1,000
Administrative and Overhead Costs Regional Office @ 3%	$1,674

Project Total FY2020 $57,469

NMDGF FY 2020 Budget

New Mexico Department of Game and Fish FY 2020 budget for assisting in the "Facilitated fish passage for enhancing populations of endangered fishes in the San Juan River" scope of work.

Sampling - July Trip

Tasks - Monitoring for radio tagged Razorback Sucker in the San Juan River from Bloomfield, NM to Clay Hills, UT and the Animas River in May, June, and August; 2 days of pre-flight planning (8 hrs day), 2 days of flights (12 hrs day), and 1 day post-flight clean-up (8 hrs day) = 48 hrs total (40 hrs regular and 8 hrs overtime) per flight = 144 hrs total for 3 flights

Personnel		
Project Leader (1)		
24 hrs regular @ $47.73/hr ($34.84/hr (base salary) + $12.89/hr (benefits))	$	1,146
Project Biologist (1)		
96 hrs regular @ $38.24/hr ($27.91/hr (base salary) + $10.33 (benefits))	$	3,671
24 hrs overtime @ $57.36/hr ($38.24/hr * 1.5 (time-and-a-half))	$	1,377
Monitoring Sub-total	$	6,194

FY2020 Total

Project Sub-total	$	6,194
IDC @ 22.91%	$	1,419
NMDGF Project Total	**$**	**7,613**

GJFWCO FY2020 Budget

Task 4: Razorback Sucker monitoring

Personnel/Labor Costs (Federal Salary + Benefits)

Description	Rate/HR	TOTAL
Principal Biologist (GS-11/7) – 244 hours		$5,814.72
San Juan sampling - spring:		
(1 person X 3 days/trip X 4 trip – work from hotel)	$53.84	
(+ 3 hours overtime each)	$53.84	
Bio. Tech. Crew Leader (GS-6/3) - 131 hours		$1,581.24
San Juan sampling - spring:		
(1 person X 3 days/trip X 2 trip – work from hotel)	$27.74	
(+ 3 hours overtime each)	$41.62	
Biological Technicians (GS-5/1) – 361 hours @ $23.02/hr		$1,333.80
San Juan sampling - spring:		
(1 person X 3 days/trip X 2 trip – work from hotel)	$23.40	
(+ 3 hours overtime each)	$35.10	
PERSONNEL/LABOR TOTAL		$8,729.76

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

	Rate/HR	TOTAL
Administrative Officer (GS-9/8) – 24 hours	$42.98	$1,031.52
Principal Biologist (GS-11/7) – 24 hours	$53.84	$1,292.16
Project Leader (GS-14/6) – 16 hours	$82.57	$1,321.12
PERMITTING, DATA INPUT, ETC		$3,644.80

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

Hotel Costs	RATE	TOTAL
2 people X 3 nights X 4 trips (in Farmington, NM)	$94.00	$2,256.00
Per Diem (Hotel Rate)		
3 days X 4 people (in Farmington, NM)	$55.00	$1,320.00
TRAVEL/PER DIEM TOTAL		$3,629.64

Equipment and Supplies

Vehicle Maintenance & Gasoline (@ $365/month lease = $12.17 per day based on 30 days in an “average” month + $0.42/mile)

Vehicle Mileage	Mileage Rate	TOTAL
San Juan River sampling - spring:		$1,486.93
Grand Junction to Farmington: 2 Trucks X 4 Trips	$0.43	$102.31
Sampling around Farmington: 2 Trucks X 4 Trips	$0.43	
VEHICLE LEASE	Lease/day	
San Juan River sampling - spring:		$74.12
Sampling around Farmington: 2 Trucks X 4 Trips	$12.35	
Generator Gasoline	GAS $/GAL	$18.80
San Juan River sampling - spring: 2.5 Gallons/day	$2.51	
Vehicle Maint. & Gasoline		$1,682.16
SUBTOTAL		**$17,686.36**

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 these funds for a "typical" field season for one study COULD include the following:

Raft trailer maintenance	
Annual trailer maintenance & safety inspection	$788.20
Replace/repair trailer suspension, trailer lights, winch handle/straps/gears, trailer jack stand, wheel bearings	
Replace trailer tires – 2 per year @ $77 each	$154.00
Signal light pigtail adapters – 2 @ $15 each	$30.00
Generator maintenace	
Spark plugs for generators – 5 at $2.20 each	$11.00
Synthetic oil for generators - 5 quarts at $6.30 each	$31.50
Generator repair/tune-up - 9 hrs @ $70/hr = parts	$703.79
Sampling gear (needs to be regularly replaced)	
Hip boots – 2 pair at $75/pair	$150.00
Breathable chest waders - 2 pair @ $120/pair	$240.00
NRS Type IV life jackets – 2 @ $130 each	$260.00
Electrical Gloves - 3 pairs @ $75/pair	$225.00
Dura-Frame electrofishing dip nets – 1 @ $630 each + freight	$630.00
Raft frame &/or boat hull repair	
Aluminum welding – 7 hours @ $95/hr	$665.00
Raft repair kits	
Raft glue (urethane/hypalon) – Four 4-oz. cans @ $24.95/can	$100.00

NRS raft patch material – 5 feet @ $37/ft	$185.00
Toluene – 1 qt @ $17.95/qt	$18.00
Equipment tie-downs - NRS HD-brand tie-down straps, each boat needs:	
Ten 2-ft straps - 10 @ $4.20 each	$42.00
Five 3-ft straps - 5 @ $4.30 each	$21.50
Ten 4-ft straps - 10 @ $4.70 each	$47.00
Five 6-ft straps 5 @ $5.05 each	$25.25
Five 9-ft straps 5 @ $5.70 each	$28.50
Five 12-ft straps 5 @ $6.15 each	$30.75
Raft rigging materials, each boat needs:	
D-style carabiners - 10 @ $8.25 each	$82.50
Mesh rig bag – 1 @ $50 each	$50.00
Yeti 125-quart coolers – 1 @ $500 each	$550.00
5-gallon plastic gasoline jerry cans – 5 @ $40 each	$200.00
20 lb. propane tanks – 1 @ $55 each	$55.00
Eddy Out Aluminum Dry Box (36L x 16H x 16D) - 1 at $375.00	$375.00
Cans for 1st aid & tool kits, raft repair kits, etc. - 20 @ $19 ea.	$380.00
Rafting oars, oar blades, and oar rowing sleeves	
Carlisle 10-foot oar shafts – 2 @ $100 each	$200.00
Carlisle Oars blades – 4 @ $65 each	$260.00
Oar sleeves – 4 @ $18 each	$72.00
Camping Gear	
NRS Canyon Dry Box (kitchen cook kit storage) - 1 at $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
River bags	
NRS 3.8 heavy-duty Bill’s Bag 110L – 1 @ $160 each	$160.00
NRS Tuff Sacks 25L - 5 @ $ 35 each	$175.00
Pesola brand spring scales	
# 20010 Micro-Line 10 gram – 1 @ $68.75	$68.75
# 20030 Micro-Line 30 gram – 1 $61.60	$61.60
# 20100 Micro-Line 100 gram – 1 @ $61.60	$61.60
# 40300 Medio-Line 300 gram – 1 @ $73.15	$73.15
# 40600 Medio-Line 600 gram – 1 @ $73.15	$73.15
# 42500 Medio-Line 2,500 gram – 1 @ $71.45	$71.45
# 41002 Medio-Line 1,000 gram – 1 @ $73.15	$73.15

# 80005 Macro-Line 5 kg – 1 @ $150.15	$150.15
# 80010 Macro-Line 10 kg – 1 @ $155.65	$155.65
NRS E-160 Self-Bailing Raft - 1 at $6,125.00	$6,125.00
Equipment Maintenance, Repair, & Replacement Subtotal	$15,483.43

Requested 2020 Equipment	
6% of costs of above subtotal	**$1,061.18**

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

USFWS-GJFWCO Total	**$18,747.55**
USFWS R6 Admin Overhead (3.00%)	**$562.43**
USFWS Region 6 Total	**$19,309.97**

2020 Costs for UDWR- Moab

San Juan River Razorback Sucker Translocation. Movement and Reproduction Study

Task 1. Waterfall Translocation (2 people, 7 days, 2 trips; March)

Labor: salary + benefits + applicable overtime

	Rate	Hours		Cost
Project Leader	$36.22		10	$362
Biologist	$33.29		220	$7,325
Technician	$17.08		220	$3,758
		subtotal		**$11,445**

Food and Transport

	Rate	Quantity		Cost
Monthly fleet rental (1 truck)	$199.37		2	$399
Mileage (1 truck x 350 miles x 2 trips)	$0.40		700	$280
Food (2 people x 7 days x 2 trips)	$30.00		28	$840
		subtotal		**$1,519**

Equipment

	Rate	Quantity		Cost
Camping gear repair/replacement:				$250
Sampling gear repair/replacement:				$500
Boating gear repair/replacement:				$500
		subtotal		**$1,250**
		Task 1 Subtotal:		**$14,213**

Task 2. Reproductive Ecology of RZ- Lower Canyon (4 people, 7 days, 4 trips; April-July)

Labor: salary + benefits + applicable overtime

	Rate	Hours		Cost
Project Leader	$36.22		110	$3,985
Biologist	$33.29		530	$17,646
Technician	$17.08		1020	$17,422
		subtotal		**$39,053**

Food and Transport

	Rate	Quantity		Cost
Monthly fleet rental (2 trucks)	$199.37		8	$1,595
Mileage (2 truck x 350 miles x 2 trips, 100 extra)	$0.40		2800	$1,120
Food (4 people x 7 days x 4 trips)	$30.00		112	$3,360
Shuttle (2 trucks x 4 trips)	$180.00		8	$1,440
		subtotal		**$7,515**

Equipment

	Rate	Quantity		Cost
Camping gear repair/replacement:				$1,500
Sampling gear repair/replacement:				$3,000
Boating gear repair/replacement:				$2,000
		subtotal		**$6,500**

		Task 2 Subtotal:		**$53,068**

Task 6. Data Entry, Analysis, Reporting

Labor: salary + benefits + applicable overtime

	Rate	Hours		Cost
Project Leader	$36.22		60	$2,173
Biologist	$33.29		160	$5,327
Technician	$17.08		20	$342
		subtotal		**$7,842**

Food and Transport

	Rate	Quantity		Cost
Mileage	$0.40		0	$0
Out-of-state per diem (meeting attendance)	$46.00		0	$0
Hotel (meeting attendance, Farmington)	$95.00		0	$0
		subtotal		**$0**
		Task 6 Subtotal:		**$7,842**

Total Expenses	**$75,123**
Administrative Overhead (16% on all personnel services)	**$9,334.33**
UDWR-Moab Total	**$84,458**

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Response to comments

Response to comments from BC

Harry Crockett, Colorado DNR, BC member

How can the technical aspects of this SOW be improved?

No recommendations. Looks extensive.

What is this SOW's contribution to recovery?

Inform future recovery actions with regard to the two fish barriers.

Vince Lamarra, Navajo Nation, BC member

How can the technical aspects of this SOW be improved?

N/C

What is this SOW's contribution to recovery?

I am in favor of range expansion no matter what the mechanism. Not sure trans-locating a few hundred RBS from below the PFW will make a difference when you may have thousands of adult RBS in the upper river system now. Current data infers that we have RBS spawning from RM 180 to RM 17. Do we really need to quantify the lower canyon spawning? Seems like we are just checking the box. It might be more important to find potential off channel (or lake) nursery habitats for this species current reproductive products.

This is a good point. There are > 1000 RBS below the PFW that seem to want to get back into the river. Given the limited recruitment in the river, it is of interest to test if restoring connectivity would contribute to recruitment if there is some important link between the lower river/reservoir inflow and the river.

Jacob Mazzone, Jicarilla Apache Nation, BC member

How can the technical aspects of this SOW be improved?

No Comment.

What is this SOW's contribution to recovery?

This scope proposes answering research questions of interest to the Program, as well as, actually conducting a desired management action. Identifying spawning habitats and behavior is of the upmost interest, as is allowing/facilitating movement between and among reaches of the river. There are limited data available on spawning habitats and their locations within the river, this work proposes telemetry which could assist in identifying these critical sites. In conjunction with *Diver et al.* these efforts can be analyzed using genomic techniques for fine resolution parental lineages. These lineage metrics allow for direct evaluation of the proposed management action.

Mark McKinstry, BOR, BC member

How can the technical aspects of this SOW be improved?

Would be nice to tag and move CPM as well as RBS, especially below the PFW. Would be hard to efish much below the waterfall, but it would be useful to move fish above the falls.

What is this SOW's contribution to recovery?

It will be useful to know fate of fish that move past barriers. Spawning contribution will be especially valuable since that is the ultimate goal with stocking fish, i.e., reproduction and recruitment. Opening up river areas above barriers is a potential management action that we can implement.

We are open to including CPM, and an e-mail conversation with the PIs and the program office indicated an interest in this research. However, we the consensus was to focus on Razorback Suckers because 1) they are more frequently encountered below these barriers, 2) handling CPM might cause some mortality if done during high water temperature, 3) it might distract from main objectives described in this proposal, and 4) there is a concern we would have too many tagged fish and managing a lot of frequencies might be difficult (Watkins et al. 2019, now cited in SOW). That said, we'll have all the infrastructure in place and we could radio tag CPM and rely on stationary antennas to detect their movements. Perhaps this could be a separate project?

Bill Miller, Southern Ute Indian Tribe, BC member

How can the technical aspects of this SOW be improved?

The proposal title indicates the work includes both Razorback Sucker and Colorado Pikeminnow, however, the proposed work only includes Razorback Sucker. The SOW should be updated to include Colorado Pikeminnow. Of the two listed species, we know the least about Colorado Pikeminnow. Location and movement of Colorado Pikeminnow, especially the stocked fish, is not currently known.

What is this SOW's contribution to recovery?

With the inclusion of Colorado Pikeminnow it would fill in a data gap to help guide future recovery efforts.

See comment above. We can include CPM.

David Mueller, BLM, BC member

How can the technical aspects of this SOW be improved?

New work is being done with UAV radio telemetry tracking. It is cheaper than flights and may be useful to get more accurate and precise locations and movement of the tagged individuals.

What is this SOW's contribution to recovery?

This will provide information on movement, distribution, and reproduction as well as further assess the impact of barriers. This will also act as a management action to facilitate movement of individuals to spawning locations.

NMDGF has offered to pay for the flights so that cost to the program is minimized. That said, UAV tracking definitely sounds like something to consider. The large spatial extent of our study reach might limit the utility of this approach, assuming that drone flights have a limited range.

Ben Schleicher, USFWS R6, BC member

How can the technical aspects of this SOW be improved?

What is this SOW's contribution to recovery?

Tom Wesche, Water Development Interests, BC member

How can the technical aspects of this SOW be improved?

The proposal is well written, comprehensive, and clearly identifies tasks, methods, schedule and deliverables. The PI's are highly experienced with the sampling and analysis proposed, and their willingness to foster inter-agency collaboration is commendable. As mentioned above under SOW New-1, there may be some overlap between the two projects regarding larval drift sampling. If both are considered for approval, there may be some efficiencies possible by integrating the two efforts to prevent any unnecessary duplication of effort.

What is this SOW's contribution to recovery?

The proposed study should provide important information on which to base decisions regarding fish passage in both the lower and the upper river, as well as increase our understanding of razorback sucker spawning habitat availability and use. The results of this work should help us to 1) identify possible recruitment bottlenecks, 2) move us toward recovery, and 3) plan for future management actions post-2023.

Brian Westfall, BIA, BC member

How can the technical aspects of this SOW be improved?

Can more fish be moved upstream?

What is this SOW's contribution to recovery?

I support this because it is also a management action instead of just a study.

Matt Zeigler, NMDGF, BC member

How can the technical aspects of this SOW be improved?

No Comment.

What is this SOW's contribution to recovery?

No Comment.

Brian Bledsoe, Peer Reviewer

How can the technical aspects of this SOW be improved?

Looks sound as is.

What is this SOW's contribution to recovery?

Determine if translocated fish are retained and assess the potential for a larger effort.

Wayne Hubert, Peer Reviewer

How can the technical aspects of this SOW be improved?

This is a very ambitious project involving collaboration of personnel from KSU and three different agencies. The proponents are to be commended for their collaborative efforts. Overall, the SOW is well written and the methods are appropriate. However, several elements of experimental design and data analysis need further consideration and explanation:

Task 1: The design for detecting PIT tags in the vicinity of the waterfall is somewhat haphazard and opportunistic. The researchers plan to place a PIT antenna in an eddy below the falls, "periodically deploy submersible antennas," and occasionally scan fish during sampling efforts below the falls. Additionally, it is stated that "we will monitor upstream movement and retention based on an array of submersible antennas in the lower canyon between Sand Island and Clay Hills (Task 2), standard fall monitoring, and stationary PIT antennas located at McElmo Creek, Restoration Channels, Hogback Diversion, and PNM." Again, this sampling design is a somewhat haphazard. It is unclear how these data will be analyzed to address movement patterns upstream in the SJR. The SOW would benefit from a more detailed description of the hypotheses to be addressed using PIT data and how the data will be analyzed to address the hypotheses.

We agree that some of these observations are rather opportunistic. However, the main quantitative result of this task is determining the timing of movement and proportion of fish moving downstream of these two barriers based on PIT antennas located below those barriers (adjusted for detection probabilities) and systematic tracking efforts of fish with radio transmitters. We included these "haphazard" detections or capture events because they might provide valuate qualitative information on the behavior of these fish; albeit they might not be useful in a statistical analysis or quantification of dispersal rates. Moreover, these observations might help interpret detection probabilities, if fish are observed outside of the more qualitative experimental design. We clarify the focus of our analysis under Task 6 (see below).

> Tasks 2 and 3: Descriptions of methods to locate translocated fish are similar for both tasks – attempts to locate radio-tagged fish will be made with hand-held antenna and to locate PIT-tagged fish with submersible antennas. No clear sampling/survey design is presented for either task. This should be considered in an expansion of the methods along with some description of how the data will be analyzed. Further, larval fish will be sampled, but there is not description of the gear to be used, how sampling sites will be selected, or a sampling design beyond sampling upstream and downstream of potential spawning sites. Samples will be turned over to ASIR for identification or razorback sucker larvae in samples. What will happen to the data from there? An expansion of the SOW to address sampling designs and data analyses is needed. Additionally, it is recognized that the first year of the project is likely to be a learning process. How will insights from the first year be assessed to modify the experimental designs for the second year of the project?

We have added to the data analysis (Task 6) to include how we will analyze the data. As suggested, it is important to have some flexibility because the exact nature of the data to be collected is unknown. In regards to the larval fish, we will use standard seining methods of larval habitats. Although location and abundance will be recorded, the primary goal of that work is to provide a genetic sample.

> Task 4: Flights over the entire river will be conducted in May, June, and September to survey for radio-tagged fish. No information is provided regarding the antennas and recorders to be used or the survey design. What will be the detection probability of radio-tagged fish during each sampling event? Will detection probability be assessed? How will the survey data be analyzed? Substantially more information of the methods to be use and approach to data analysis in the river-wide distribution surveys is needed in the SOW.

Another good question. We are assuming detection probability from the aircraft is 100% because radio signals are strongest immediately above the transmitter.

We can confirm that with opportunistic PIT antenna locations and hand-held detections. We also can place a “dummy” tag in the river to evaluate detection probability if we are concerned there is a problem. We now cite a recent paper (Watkins et al. 2019) that we can use to help develop a model for detection probability if necessary.

Task 5: The application of genomic analyses to determine the contribution of translocated fish is novel and exciting. A substantial concern is the sample of 900 larvae to be analyzed. How will it be determined to be a random sample of larvae in the SJR given that samples will be taken from several locations? Consideration of how subsamples of larvae collected from various locations will be aggregated into something close to a random sample from the river is needed.

GPS locations will be taken for all larval collections, so we will be able to evaluate the distribution of individuals used in the analysis. However, 900 larvae was an estimate of the total larval fish that might be caught. So, our expectation is to sample all or a large proportion of larval fish caught each year. If we catch more than 900 laval RBS, we can stratify the sampling from what we catch based on sampling location. Note, larval sampling will occur at regular intervals along the river (ASIR sampling), thus we can use the dispersion of sampling locations to obtain a random sample of the population.

Task 6: The KSU research team will have a daunting task of assimilating all of the radio-telemetry and PIT-tagging data and conducting a thorough analysis. The SOW would benefit from a description of the major hypotheses to be assessed and the data analysis methods to be used utilized to address each hypothesis.

We have added more details within each of the major goals of the study to address this concern and some of the other concerns listed above.

What is this SOW’s contribution to recovery?

This project has the potential to define strategies for recovery into the future. It is an extremely valuable research effort.

Steve Ross, Peer Reviewer

How can the technical aspects of this SOW be improved?

Minor corrections:

However, recent analyses suggested that relatively ***few*** of the fish encountered on PIT antennas below the weir~~, very few are~~ ***were*** passing through the diversion (Cheek 2014).

This is a complex proposal requiring close coordination of different entities. However, the design seems appropriate and the timeline is helpful in understanding how the work will be done.

What is this SOW's contribution to recovery?

As also pointed out in the 2019 Peer Review report, an important question is the fate of Razorback Suckers transported above barriers in the San Juan River. Current evidence is suggestive that fish attempting to move upstream are doing so for spawning purposes. However, this has not been documented. This study uses a highly collaborative approach to answer a suite of important questions associated with movements upstream. Although an ambitious proposal, the investigators have track records of completing challenging field projects. This proposal should provide information that is critical in determining whether activities to move Razorback Suckers above barriers is important for recovery.

Mel Warren, Peer Reviewer

How can the technical aspects of this SOW be improved?

This is a very ambitious study. I have no substantive suggestions of improvement and look forward to the results. The SOW was thorough, organized, and well written.

What is this SOW's contribution to recovery?

I believe this study will be of great value in determining movements of RZB and could locate significant spawning areas. Importantly, if translocated RZB are retained in the river moving additional individuals up river might be considered as a recovery strategy.

Program Office

How can the technical aspects of this SOW be improved?

What is this SOW's contribution to recovery?

This proposal seeks to address the apparent Razorback Sucker recruitment bottleneck of the limited number of adults contributing to annual successful larval production. Understanding how and to what extent, the management action of moving Razorback Suckers past two barriers addresses an impediment to recovery. The task within the proposal (genetically evaluating reproductive contribution of translocated fish) to evaluate the management activity is an important component of the proposal because it furthers the SJRIP's ability to assess this management activity in the San Juan River.

Eliminating flow impediments at the interface of main and secondary channels in the San Juan River: enhancing channel complexity and low-velocity habitats for endangered fishes

Proposed Scope of Work for FY 2020 and 2021

June 27, 2019

Principal Investigators

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and

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Background

Dam construction and invasive species have irreversibly transformed the aquatic ecosystem of the Colorado River Basin. Impoundments altered the natural flow regime that simultaneously shaped environmental conditions of stream systems as well as the life history traits of native fishes that interacted with them (Olden et al. 2006). Specific to stream flow magnitude, the reduction of high spring flows have likely reduced the ability of stream channels to migrate and facilitated the encroachment of nonnative vegetation, further reducing channel heterogeneity through bank armoring (Tickner et al. 2001). Understanding and ameliorating the combined deleterious effects of altered flows and nonnative vegetation will be a continued challenge for managers charged with endangered fish recovery in these 'novel' ecosystems (*sensu* Hobbs et al. 2006).

Since 1962, the geomorphology of the San Juan River has been severely affected by the construction of Navajo Dam and the subsequent proliferation of nonnative riparian vegetation has resulted in channel simplification and loss of aquatic habitat. The San Juan River's stream channel is longitudinally and laterally heterogeneous between Navajo Dam and Lake Powell (Bliesner & Lamarra, 2000) and most large-scale stream heterogeneity stems from anastomosing channels that form relatively spatially stable stream braids (or secondary channels; Franssen et al. 2015). In 1998, the San Juan River Basin Recovery Implementation Program (SJRIP) developed flow recommendations for Navajo Dam operations to mimic a more natural hydrograph aimed at improving spawning and rearing conditions for the endangered Colorado Pikeminnow *Ptychocheilus lucius* and Razorback Sucker *Xyrauchen texanus* (Holden et al. 1999). However, since these flow recommendations were enacted, Navajo Dam operations have failed to meet the highest discharge flow targets at the recommended frequency and duration (largely due to the extended drought experienced in the basin during this time; SJRIP 2018). These high flow targets were aimed at creating and maintaining important low-velocity stream habitats. Accordingly, the scarcity of high spring flows over the last two decades also coincided with a reduction in the number of flowing secondary channels and backwater habitats in the system, presumably due to the river's reduced ability to move and rework channel substrates (Lamarra and Lamarra 2016). The reduced availability of these low-velocity habitats could be a key component limiting the recruitment of wild-spawned Razorback Sucker and stocked Colorado Pikeminnow in the San Juan River.

To date, the SJRIP has devoted minimal efforts into creation and maintenance of habitats presumed to be important for larval fish growth and recruitment, likely due to the presumption these habitats would be made available through successful implementation of the 1999 flow recommendations (SJRIP 2018). Nonetheless, since 2011, non-SJRIP funds provided for increased flow persistence in seven degraded secondary channel systems (i.e., Phase I and II) by removing sediment that hindered inflow from the primary channel as well as removal of riparian nonnative vegetation along the secondary channel corridors (Keller-Bliesner Engineering, 2012; Lamarra et al. 2018). These relatively large-scale projects demonstrated secondary channel habitats in the San Juan River could be modified to increase the persistence of flow and that juvenile native fishes would readily occupy these newly formed habitats (Lamarra et al. 2018). Inarguably, the success of these habitat restoration projects could only be diminished by their apparent short-term persistence. Indeed, woody debris in the form of an uprooted tree as well as a continuingly growing cobble bar at the inflow area of Phase II currently threatens its existence.

Overall, these two phases of habitat restoration have provided much needed insight into the likelihood endangered fishes will use these types of restored habitats as well as the potential life-span of these relatively large-scale efforts.

Here, we propose small-scale efforts to create and maintain low-velocity habitats to aid the recovery of endangered fishes in the San Juan River through removal of impediments to flow at the upstream interface of secondary and main channels in the San Juan River. Primarily, our efforts will focus on removal of woody debris in the inflow area of secondary channels prior to spring run-off. This debris traps sediment and reduces the amount of flow entering these channels during elevated discharges. Figures 8 and 12a-12c illustrate the type of small-scale effort that would be needed to alleviate flow impediments through the removal of dead and downed woody debris. The main intent from this activity will be to allow the river to conduct the 'heavy lifting' of sediment removal in the secondary channels during the run-off period. Secondly, high volume gas-powered water pumps will be used to open those secondary channels that have been bermed by sediment following spring run-off (Figure 12c). Additionally, further effort to remove debris will occur at secondary channels where flow impediments occur in preparation for the following spring run-off. We think an approach of spreading our efforts among several secondary channel sites rather than focusing on one or two channels mitigates the risk of the project and provides more immediate responses of habitat enhancement in perpetually degrading secondary channel inflow areas. Moreover, because all work will be accessed by raft, the number of channels that can potentially be maintained will not be limited by road access. The overarching goal of the project will be maintaining flow (or wetted backwater or embayment habitats) in each of 11-15 secondary channels after spring runoff for the duration of the fish growing season each year.

Task 1: Reconnaissance of secondary channels for treatment prior to spring run-off (trip 1)

Methods

To identify potential sites for treatment, we conducted a remote sensing GIS analysis from Shiprock to Sand Island (river miles 148 - 76) and identified secondary channels whose upstream entrances appeared to contain woody debris impeding channel flow. This resulted in identification of 11 channels (Figures 1-11) that have persisted in recent times at variable base flows (Table 1). To "ground-truth" the GIS analysis and determine the type of work required to treat each of these 11 secondary channels, a spring reconnaissance trip will be conducted prior to spring run-off. During this trip an extensive visual record of both the upstream and downstream portions of the secondary channel will be made through photography and flow characteristics will be observed and documented (i.e., entire channel flowing, backwater or embayment present, or no flow). An effort will also be made during this trip to identify other secondary channels, not recognized during the GIS analysis, which would benefit from small-scale removal of woody debris to increase secondary channel flow.

Personnel, equipment, and timeline

This trip would require 2-3 people with personnel from agencies representing the principal investigators participating. Equipment would include water vessels (either a single raft, cataraft, or kayaks) and take 4-5 days.

Task 2: Remove woody debris impeding secondary channel flow prior to spring run-off (trip 2)

Methods

The purpose of this trip will be to remove woody debris at the inlet of the secondary channels to increase the volume of flow going into each channel during spring runoff. Our prediction is that removal of these flow impediments will increase the likelihood that the secondary channel will be wetted at base flows and will help clean the channel's outlet, which in turn increase the likelihood of a backwater forming at base flow. Before work is conducted, the site will be extensively photographed to document levels of change. All woody material that is removed will be placed on the river's bank high enough to keep it from reentering the river during high water. High pressure water pumps mounted on rafts will be used to excavate any buried woody material to aid its removal.

Personnel, equipment, and timeline

This trip would require 4-5 people with personnel from agencies representing the principal investigators will participate in this trip. At a minimum, two 16' rafts, two high pressure pumps and hoses, shovels, and Pulaskis would be used. Depending on the type and extent of woody debris identified during the reconnaissance trip, winches and pruning equipment such as limb saws, battery operated reciprocating saws, tree pruner, chainsaws, etc. will be required. We estimate a day of work at each secondary channel and expect trip 2 to take 10-15 days, dependent on the identification of additional channels during trip 1.

Task 3: Ensure secondary channels are wetted post spring run-off (trip 3)

Methods

This trip will be conducted after spring run-off during base flows (hopefully July). The purpose of the trip will be to ensure secondary channels provide fish habitat by being wetted and connected to the main channel. Each channel would be assessed as flowing, containing a backwater or embayment, or not flowing and extensive photography will be taken. If the channel is not flowing, then the impediment will be identified and eliminated. It is most likely that the impediment would again be woody debris or the deposition of a sediment berm (see Figure 12c for an example). High pressure water pumps will be used to create at least a 0.3 x 1.0 m cross sectional channel between the main stem river in hopes of withstanding up to a ~0.25 m drop in stage.

Personnel, equipment, and timeline

This trip would require the same number of personnel and equipment as trip 2. We would still estimate a day of work at each secondary channel but expect the trip to take less time, approximately 7-10 days.

Task 4: Evaluation and reporting

Methods

After spring runoff, we will assess whether each channel is wetted and note the discharge of the river at the time of visit. We will use the photography from trip 3 and obtain data from the larval/small-bodied fish and habitat monitoring efforts to assess our effectiveness at providing fish habitat. The goal of this project is to have 100% of the channels flowing or contain backwaters or embayments at base flows. To assess whether removal of impediments to flow at these 11 secondary channels (plus any additional channels identified during trip 1) was successful, we will compare the percent of channels with flow to a historical benchmark (described below).

We obtained fall habitat monitoring data (2011-2016 and 2018) for each of the 11 secondary channels identified through the GIS analysis (Table 1). For each channel, we identified whether it was flowing, which was defined as either fully wetted or containing a backwater or embayment. The median discharge at habitat monitoring mapping was 750 cfs. At this flow, for these 11 secondary channels, the highest percentage of flowing channels was in 2016 at 82%. Therefore, we would consider this project successful if >82% of the 11+secondary channels are wetted at base flow during the summer months.

Long-term (5 months to 1 year) success of opening these channels will be assessed using coordinated monitoring by the larval and small-bodied fishes crews. These fish monitoring efforts often stop at all secondary channels to sample. The location of all channels opened during this project will be provided to fish monitoring crews. These sites will be visited during routine monitoring efforts to determine if they are flowing or have an embayment or backwater. The small-bodied fishes crew will take photographs of each channel site in September. The presence/absence of native and native fishes will be determined from these monitoring efforts and be used to help assess channel use when flowing.

Timeline

We propose this project as a two-year effort and will submit annual reports in line with the San Juan River Basin Recovery Implementation Program's guidelines.

Permitting

We have contacted the Navajo Nation Environmental Protection Agency and the Army Corp of Engineers and are currently working through the permitting process. Initial discussions with their personnel indicated our proposed work will be permitted in the time frame needed to conduct the work.

Budget Justification

Our goal was to make this project as efficient as possible. The highest costs the first year will likely be associated with equipment purchases followed by salaries and per diem (see Table 2 for suggested equipment). Most labor will be provided in the form of summer technicians from Navajo Nation.

Further, the second year of the project should see a reduction in cost due to most equipment already being purchased the year prior.

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Table 1. Summary of wetted states of 11 secondary channels between 2011 and 2018 and the river's discharge at each mapping evaluation. The states of each channel were categorized as "Flow" as freely flowing, "None" with no part of the channel wetted, "BW" for a backwater at the downstream end, and "Emb" for an embayment on the upstream end. The percent of channels that were wetted (i.e., Flow, BW, or Emb) was quantified for each year and the percent of years each channel was wetted was also quantified.

			Discharge at mapping (cfs)							
			950	750	1500	750	750	750	500	
			Annual Channel State							
RM	River Side	~Length (m)	2011	2012	2013	2014	2015	2016	2018	Percent Years Wetted
127.2	Right	1200	None	Flow	Flow	Flow	Flow	Flow	None	71%
124.0	Left	1500	Flow	Flow	Flow	Flow	Flow	BW	None	86%
122.8	Left	1700	Flow	Emb	Flow	None	None	None	None	43%
114.2	Left	1000	BW	None	Flow	BW	None	None	None	43%
113.6	Left	650	None	None	Flow	None	None	BW	None	29%
105.9	Left	600	None	None	BW	None	None	BW	None	29%
103.3	Left	900	None	None	Flow	None	None	Flow	None	29%
99.0	Left	650	Flow	BW	Flow	None	BW	BW&Emb	None	71%
97.2	Left	400	None	None	BW	None	None	BW	None	29%
92.1	Right	800	Flow	BW	Flow	None	BW	BW&Emb	None	71%
78.4	Right	850	Flow	Emb	Flow	None	BW	Flow	None	71%
		Percent Channels Wetted	55%	55%	100%	27%	45%	82%	0%	

Table 2. Proposed equipment list needed to eliminate woody debris and sediment from the inflow areas of secondary channels.

Part	QTY	Cost	Distributor
3" Trash pump and Hose kit from Home Depot	1	$897.09	Home Depot
Floating Home Fire Fighting Pump System	1	$2,395.00	www.jjsfiresupply.com
Pulaski w/sheaths	3	$332.40	Forestry Suppliers
Shovel	3	$204.75	Forestry Suppliers
Tree Limb Saw	3	$637.38	Forestry Suppliers
Limb Saw Blades	3	$229.47	Forestry Suppliers
Honda EU2200i Portable Inverter Generator — 2200 Surge Watts, 1800 Rated Watts, CARB-Compliant, Model# EU2200iTA	1	$1,009.00	www.northerntool.com
Dewalt radio/charging station	1	$219.00	www.toolnut.com
Reciprocating Saw Dewalt	2	$344.00	Home Depot
Reciprocating Blades pk10	2	$79.97	Home Depot
Dewalt Battery extra	6	$539.91	Home Depot
HD limb loppers	3	$74.25	Forestry Suppliers
Z-drag Kit	1	$299.95	nrs.com
Camera with tripod	1	$800.00	
Chainsaw Powered Winch	1	$899.00	https://www.westechrigging.com/capstan-cs.html
MS-311 Chainsaw	2	$979.90	Noel's Inc.
Performance zip chaps - 6 layer	2	$219.98	Noel's Inc.
TOTAL		$10,161.05	

Figures.

Figure 1. River mile 127.2 on river right. The top panel shows the entire secondary channel, the bottom shows a closer view of woody debris impeding flow.

Figure 2. River mile 124.0 on river left. The top panel shows the entire secondary channel, the bottom shows a closer view of woody debris impeding flow.

Figure 3. River mile 122.8 on river left. The top panel shows the entire secondary channel, the bottom shows a closer view of woody debris impeding flow.

Figure 4. River mile 114.2 on river left. The top panel shows the entire secondary channel, the bottom shows a closer view of woody debris impeding flow.

Figure 5. River mile 113.6 on river left. The top panel shows the entire secondary channel, the bottom shows a closer view of woody debris and Russian olivs impeding flow.

Figure 6. River mile 105.9 on river left. The top panel shows the entire secondary channel, the bottom shows a closer view of woody debris impeding flow.

Figure 7. River mile 103.3 on river left. The top panel shows the entire secondary channel, the bottom shows a closer view of woody debris impeding flow.

Figure 8. River mile 99.9 on river left. The top panel shows the entire secondary channel, the bottom shows a closer view of woody debris impeding flow, with the right indicating the amount of woody debris that would be the focus of removal.

Figure 9. River mile 97.2 on river left. The top panel shows the entire secondary channel, the bottom shows a closer view of woody debris impeding flow.

Figure 10. River mile 92.1 on river right. The top panel shows the entire secondary channel, the bottom shows a closer view of woody debris impeding flow.

Figure 11. River mile 78.4 on river right. The top panel shows the entire secondary channel, the bottom shows a closer view of woody debris impeding flow.

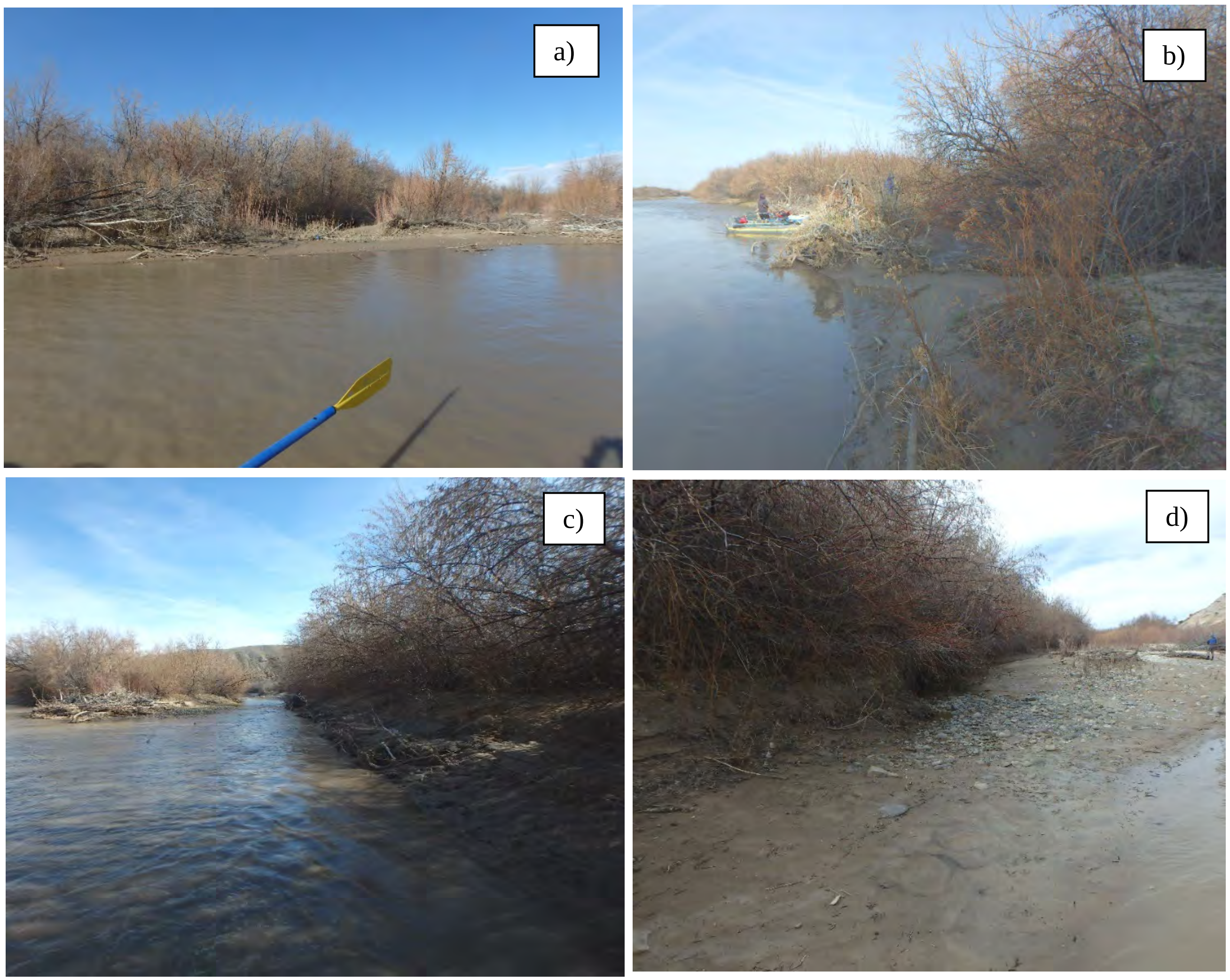

Figure 12. Examples of expected treatment types. Photos a-c provide examples of woody debris that would be removed prior to spring run-off and d) shows an example of a berm that would be removed during the post spring run-off trip.

Appendix A: Response to reviewer comments
Responses in Blue

Harry Crockett, Colorado DNR, BC member
How can the technical aspects of this SOW be improved?
No recommendations as is this is a reconnaissance / proof-of-concept type proposal. My sense, however, is that the effort required to remove woody debris may be more than what can be accomplished on the single trip proposed.

What is this SOW's contribution to recovery?
Again, proof-of-concept. Might provide additional rearing habitat which might in turn enhance recruitment. I do wonder about the longevity of accomplishments. Will this have to be done in perpetuity? Not necessarily a deal-breaker.

The proposed two years of this study will allow us to assess the feasibility and longevity of this type of work. Observations made by the larval and small-bodied fish crews will also be beneficial in assessing the longevity of this work.

Vince Lamarra, Navajo Nation, BC member
How can the technical aspects of this SOW be improved?
This seems like a reasonable effort and a low cost test case. I hope that the effort is successful.

What is this SOW's contribution to recovery?
It has been previously shown that the San Juan River is losing secondary channels and that these channels are important habitats to early life stages to the two rare fish. This is the only new start that directly addresses trying to reverse the trend without spending $++100,000 or more. I hope the effort is successful and support the attempt.

Thank you for the support. If this proposed low effort maintenance works, it will be an additional tool to increase and maintain habitat in the San Juan River.

Jacob Mazzone, Jicarilla Apache Nation, BC member
How can the technical aspects of this SOW be improved?
The PI's might consider the incorporation of mechanical advantage type systems to remove debris piles (z-drags or higher advantage systems) if they have not done so already. As well as the use of controlled fuels management type burns as a technique to clear larger debris piles and small areas of shoreline encroachment of invasive plants.

What is this SOW's contribution to recovery?
This scope provides a low-cost alternative to heavy equipment-based habitat projects, which are cost intensive and limited to areas with road access. The "scalpel" approach is low investment in comparison and creates/maintains high quality habitat during the most critical times. The proposed two-year effort allows the PI's to refine techniques and equipment needs to continue maintaining the proposed channels as well as identify channels for future efforts. Bigger bang for the buck.

We've added a z-drag kit to the proposed equipment list (Table 2). Conducting small burns to remove/control debris piles and invasive plants is a good idea, however we think it best to assess the first two years of this effort before we decide if it would be beneficial/feasible. It is likely that conducting controlled burns would significantly increase the costs associated with this project.

Mark McKinstry, BOR, BC member

How can the technical aspects of this SOW be improved?

I would use set photo/camera points to take the pictures as well as set azimuths for each picture so you get the same picture location. This will give accurate repeat photography.

You mention equipment to take, but I didn't see a chain saw listed. I would bring at least one chain saw for removing trees. Bringing an electric winch that can be anchored easily would be a good addition.

Start doing some investigation on what it takes to become certified to use explosives.

Investigate the use of fire hose nozzles. A 3" pump has a lot more power than you think. Figure out some way to float the intake for the pump or dangle it below the raft.

I think this work might be harder to accomplish than what this proposal shows, but, hey….GOOD LUCK!! I hope it works.

What is this SOW's contribution to recovery?

Finding a CHEAP and reliable method for opeing up secondary channels and other complex habitats would be a huge gain for the Program since currently all of the habitat options we have looked at are very expensive.

A camera with tripod was added to the proposed equipment list (Table 2). A chainsaw was already included with the proposed equipment list. This will likely be a very important piece of equipment though, so we increased the proposed number to purchase to 2, in case one would break while on the river.

After the first year of data collection and assessment, we plan to revise our methods and will take into account some of your proposed ideas.

Bill Miller, Southern Ute Indian Tribe, BC member

How can the technical aspects of this SOW be improved?

Trip 1 is used to identify potential sites. It would be useful to identify secondary channels where the block is to large for small scale treatment but may be a candidate for other mechanical methods to open the channel if a larger scale operation is part of future work.

What is this SOW's contribution to recovery?

Provides a means to maintain complexity in critical habitat for the endangered species.

We agree that identifying all potential restoration sites, even those too big to tackle under this SOW, is important for the Program. We'll work to identify all restorable secondary channels while floating the river during the initial trips. Identification of these sites will provide a suite of potential habitat restoration sites for the Program to consider for restoration in the future.

David Mueller, BLM, BC member

How can the technical aspects of this SOW be improved?

It may be worthwhile to attempt to remove encroaching vegetation as well. If the woody debris as allowed vegetation to establish it may continue to encroach especially will low flows.

What is this SOW's contribution to recovery?
This should help maintain crucial habitat.

It is unlikely that the scale of this project will be able to remove encroaching vegetation at some sites. Identification of these sites will be made to allow for the development of other restoration efforts to remove vegetation and open these secondary channels.

Ben Schleicher, USFWS R6, BC member

How can the technical aspects of this SOW be improved?
The control for this project appears to be the fall work for habitat monitoring 2011 – 2016 and 2018, yet the evaluation for the success (or not) will be conducted during the summer (pre monsoonal flows which take place in the late summer/fall and bring a large amount of sediment into the system). The timing of this evaluation could set up the study for a false positive as it is only based on a percentage of secondary channels with water. I would recommend having several control channels to test if this addition manual labor aids nature in clearing these side channels.

What is this SOW's contribution to recovery?
Any additional complex and or low flow habitat in the San Juan river is a good things as the river has become more channelized over the years from dam releases and nonnative vegetation encroachment.

Habitat monitoring occurs in the summer, when the river is at baseflow conditions. Additional information on the status of restored channels will be gathered during annual small-bodied fishes monitoring in September. Additional monitoring of these sites the following year will also allow us to assess the longevity of this work.

Tom Wesche, Water Development Interests, BC member
How can the technical aspects of this SOW be improved?
The proposal is well written and makes excellent use of historic Program habitat data and photos. The PI's have done their homework in preparing this SOW and are well qualified to conduct this project. Project personnel commitments and schedules appear realistic and workable. One aspect of the project that needs to be discussed is permitting; if it is a concern, and if so, what would it entail? Also, the PI's may want to re-consider their proposed "measure of success". Looking over Table 1, the percent of wetted channels at 750 cfs over the years provided ranges from 27 to 82%. Selecting > 82% leaves little margin for error and indicates at least 10 of 11 channels must be wetted to call the project a success, when in fact as few as three channels were wetted during some years at this flow. In 2018, none of the channels were wetted at 500 cfs. Perhaps having 50% of the channels wetted at 500 cfs might be a better measure of success. Finally, I seem to recall that last year we had a similar proposal submitted by KB Engineering. How does this FY20 proposal relate to that?

What is this SOW's contribution to recovery?
If successful, this SOW could contribute substantially to recovery by aiding recruitment of larval/juvenile endangered fish to older life stages, a significant problem the Program has not yet been able to overcome. While there is no guarantee the work will have long-lasting beneficial effects unless periodically repeated, conducting this work now should provide us with important information regarding its' feasibility for future management actions that may be needed if recovery is to be achieved.

Additional information on the permitting was included in the SOW for reviewers. We agree that the measure of success probably needs to be refined, however we also think that several different measures of success need to be considered. For instance, an opened secondary may not be flowing at the time of monitoring, however cleaning during spring runoff may have caused a backwater to form at its terminus instead of the terminus being dry. We believe this would also be considered as success.

The FY2019 SOW submitted by KB Engineering is not related to this proposal. Their proposal was focused on larger habitat restoration and we encourage the proponents of that SOW to continue pursuing its funding. The type of work proposed in this SOW is on a much smaller scale, but could be beneficial to larger scale projects by ensuring that the mouths of restored secondary channels remain clear of flow impediments.

Brian Westfall, BIA, BC member
How can the technical aspects of this SOW be improved?
There are several problems with this approach.

1. Much of the debris has been deposited at high flows and removing the debris without removing the accumulated sediment is unlikely to have much of an impact on making the channel flow. Envision cleaning brush off the top on an earthen dam. As an example see the screen clip pulled from the SOW. In the image you can see the sediment is piled fairly high around and behind the debris that was circled in red. Removing the debris and leaving the sediment will have limited impact.

2. There will be a permitting requirement which their is no mention of. Any excavation in the channel is subject too permitting.

3. From a permitting standpoint hydraulic exaction is much more detrimental to the river than mechanical excavation and would likely not be permitted to begin with. When we have done exaction allowed under a 404 permit you are required to move the sediment above the high water mark.

Removing these debris piles by hand above the high water mark is really not practical without equipment. In most cases you would have to move though dense thickets of Russian Olive/Tamarisks to get the debris to the high water mark. See the wall of trees in the image. In past rehab jobs we have spent considerable effort just clearing vegetation to get access to the river.

I appreciate the intent of the proposal and the effort that went into it but I don't believe it is practical nor will it have the desired outcome of opening up these secondary channels any more that the water naturally would at high flows.

What is this SOW's contribution to recovery?
Limited impact to increasing habitat and contributing to recovery.

We've provided additional information in the SOW about permitting.

We agree that the proposed project will be difficult and may fail in its intended purpose of opening secondary channels using low effort. However, we proposed this as a proof-of-concept project to assess its usefulness over a two year period. If this type of work is success at even a small scale, it will

provide a cheap tool to keep some secondary channels open. If the project fails, the Program will have to keep looking at conducting mostly large scale restoration efforts to maintain important habitat in the San Juan River for endangered fish.

Brian Bledsoe, Peer Reviewer

How can the technical aspects of this SOW be improved?

It think may be necessary to experiment and iterate with different channel geometries. Tie in with fish monitoring.

What is this SOW's contribution to recovery?

Has the potential to open up substantial amounts of habitat in remote areas at a relatively low cost.

Looking at different channel geometries will probably be important for assessing the success or failure of some of these channels. We do not see a need to tie in this work with fish monitoring though. Simple assessment of fish presence/abundance will be completed by the small-bodied fishes crew in September if the channels are flowing.

Wayne Hubert, Peer Reviewer

How can the technical aspects of this SOW be improved?

The SOW proposes a management activity that could be ongoing. A concern is that the proponents may be initiating an "activity trap," that is an ongoing activity that is believed to be beneficial without evidence that meaningful benefits are obtained.

The strategy that is proposed may be viable, but substantial research will be needed to determine if it may be. This reviewer recommends that the proponents re-write the SOW to include substantial assessment and monitoring of channel dynamics, flows into secondary channels, and responses of fish to enhanced flows into secondary channels at each of the 11 channels or a subset of them.

The first step in such an effort, prior to initiation of a research design, would be to determine if it is feasible (physically possible) for a crew of 4-5 people using hand tools, winches, and pumps to remove sufficient debris to open channels on a routine basis. If feasibility is determined, then a detailed research design to assess flows into secondary channels and channel dynamics from prior to spring flow through early fall could be initiated. Such a research effort would likely involve routine measurements of water depths at multiple channel transects at the upstream end and within secondary channels, as well as monitoring of flows through the secondary channels during that time. If it is determined that it is possible to remove sufficient debris and sediment and that secondary channel habitat for fish is enhanced, than annual activity to open channels may be a reasonable management option.

What is this SOW's contribution to recovery?

Even if the routine removal of debris at the entrance to secondary channels is determined to be an effective method of enhancing secondary-channel habitat, it is questionable if that will result in enough nursery habitat to affect recovery of the two endangered fishes.

We too are worried about the potential of entering an "activity trap" with this project. However, we are proposing only a study to assess the feasibility of this effort. Simply, with a small crew can we remove impediments to some of these secondary channels to return them to a flowing status?

Once this question is answered, a more detailed work plan with hypotheses and additional monitoring to determine its success and benefits to recovery will be developed. An enhanced SOW would also benefit from the development of an adaptive management framework with identified hypotheses and measures of success.

Steve Ross, Peer Reviewer

How can the technical aspects of this SOW be improved?

I like the low-tech approach of using manpower and boats to open up side channels to flow, although I am a bit concerned that the amount of physical effort could be overwhelming. Of course, if this approach is successful, it would offer a relatively inexpensive approach to increasing the area of low- velocity lateral habitats. Even though this project would not involve heavy equipment needing road access to the river, are there permitting issues that would need to be resolved?

I would also like to see some stated collaboration with other monitoring work to determine if the improved access to low-velocity habitats has a positive impact on populations of native fishes. Would larval sampling and small- bodied sampling be able to provide such information?

What is this SOW's contribution to recovery?

This project could contribute to recovery by increasing the area of low velocity habitats, as well as providing a cost-effective means of maintaining such habitats.

We added information about permitting requirements and collaboration with other monitoring efforts to the SOW. However, we are unsure that any larval or small-bodied monitoring of fish would provide any statistically measurable effect of these secondary channel restoration efforts. It's more likely that only the presence of endangered or native fish in restored channels would be identified.

Mel Warren, Peer Reviewer

How can the technical aspects of this SOW be improved?

I really like the idea of small-scale improvement of existing habitats.

Under the post spring runoff evaluation, how do you know a 0.3 deep x 1.0m wide channel is adequate? Is it a guess? Are these suction dredges (as used in gold mining) or pumps? If pumps have you tried to see if they would move the volume of sediment (substrate) you think you will have to move? It would be improved by telling the reader if this is tested or untested. I've worked with floating gold dredges to sample substrate. You might look into those; they will move a lot of substrate and you can direct it to the shore or wherever you want it.

You lost me on how you plan to evaluate "success." It reads as if you are using fall flows through 11 secondaries to evaluate summer flows through the same secondaries. Not clear.

Also are small-bodied and larval crews going to sample these 11 secondaries? I would hope you would coordinate that to see if they are used or not. It will also be interested to see how long they stay open (1 yr, 1yr+).

What is this SOW's contribution to recovery?

If this relatively low-tech approach keeps secondary channels flowing AND fish use them, especially CPM and RZB, then another management tool will be at SJRIPs disposal for larval habitat management. If it is even partially successful then the investment will be worth it. The Program has discussed for years the importance of lateral connectivity as have the Peer Reviewers. I would like to see this go forward.

It is only a guess that a 0.3 m deep x 1.0 m wide channel is adequate. Currently we do not know, but we hope this is something we can determine through this work.

We will coordinate with larval and small-bodied fish crews to sample these sites into the future. This will help us to evaluate short-term (i.e., through one year) and long-term (i.e., through multiple years) success of this effort. These crews will also allow us to assess presence of endangered fish in the restored channels, however determining a statistical effect of these channels may be difficult.

Program Office

How can the technical aspects of this SOW be improved?

We are excited an alternative method for creating and maintaining low- velocity habitats has been proposed. However, we would like to see a little more narrative about the permitting process that may be needed to conduct the work.

It would also be beneficial if the proposal could explicitly state the probability that these treated and control sites would be sampled by larval and small- bodied crews to help assess responses of the endangered fishes.

What is this SOW's contribution to recovery?

This proposal attempts to address the perceived low-velocity habitat limitation impeding recruitment of Razorback Sucker and Colorado Pikeminnow.

Because habitats are accessed via raft and the approach is "low-tech," more numerous sites can be "treated" compared to more intensive habitat restoration methods that have been previously proposed. While it will be difficult to tie the proposed management activity to a biological response of the endangered fish, the proposal includes a straight-forward means to evaluate success based on the observed history at the sites proposed for treatment. If successful, this could be a more cost-effective and longer term solution to habitat degradation in the San Juan River.

We added information to the SOW about the permitting process and larval and small-bodied crews sampling these sites after restoration.

NMDGF FY2020 Budget

New Mexico Department of Game and Fish (NMDGF) FY2020 budget for the "Eliminating flow impediments at the interface of main and secondary channels in the San Juan River: enhancing channel complexity and low-velocity habitats for endangered fishes" scope of work.

Task 2 - Pre-runoff Trip

Tasks - Assist with opening inlets of secondary channels on the San Juan River between Shiprock, NM and Sand Island, UT prior to spring-runoff; 2 days trip preparation (8 hrs day), 15 field days (12 hrs day), 2 days post-trip clean-up (8 hrs day) = 212 hrs (152 hours regular, 60 hours overtime).

Personnel		
Project Leader (1)		
72 hrs regular @ $47.73/hr ($34.84/hr (base salary) + $12.89/hr (benefits))	$	3,437
28 hrs overtime @ $71.60/hr ($47.73/hr * 1.5 (time-and-a-half)	$	2,005
Project Biologist (1)		
80 hrs regular @ $38.24/hr ($27.91/hr (base salary) + $10.33 (benefits))	$	3,059
32 hrs overtime @ $57.36/hr ($37.13/hr * 1.5 (time-and-a-half))	$	1,836
Sub-total	**$**	**10,337**
Per Diem		
5 days @ $85/day (standard NM in-state rate)	$	425
10 days @ 115/day (standard NM out-of-state rate)	$	1,150
Sub-total	**$**	**1,575**
Equipment and Supplies		
Chainsaw and supplies	$	800
Camera with tripod	$	800
Z-drag Kit	$	300
Sub-total	**$**	**1,900**
Vehicles		
Round-trip to Sand Island, UT – 650 miles @ $0.55/mile	$	358
Sub-total	**$**	**358**
Task 2 Sub-total	**$**	**14,170**

Task 3 - Post-runoff Trip

Tasks - Assist with post-runoff re-visiting and re-opening any secondary channels that were opened in the pre-runoff Task 2 trip on the San Juan River between Shiprock, NM and Sand Island, UT ; 2 days trip preparation (8 hrs day), 10 field days (12 hrs day), 2 days post-trip clean-up (8 hrs day) = 152 hrs (112 hours regular, 40 hours overtime).

Personnel		
Project Leader (1)		
56 hrs regular @ $47.73/hr ($34.84/hr (base salary) + $12.89/hr (benefits))	$	2,673
20 hrs overtime @ $71.60/hr ($47.73/hr * 1.5 (time-and-a-half)	$	1,432

Project Biologist (1)		
56 hrs regular @ $38.24/hr ($27.91/hr (base salary) + $10.33 (benefits))	$	2,141
20 hrs overtime @ $57.36/hr ($37.13/hr * 1.5 (time-and-a-half))	$	1,147
Sub-total	**$**	**7,393**
Per Diem		
3 days @ $85/day (standard NM in-state rate)	$	255
7 days @ 115/day (standard NM out-of-state rate)	$	805
Sub-total	**$**	**1,060**
Vehicles		
Round-trip to Sand Island, UT – 650 miles @ $0.55/mile	$	358
Sub-total	**$**	**358**
Task 3 Sub-total	**$**	**8,811**

Administration, Data Management/Analysis, and Report Preparation

Personnel

Tasks – Managing grant, Data management and QA/QC, data analysis and synthesis, table and graph preparation, report drafting and revision; Project Leader (40 hrs) and one Project Biologist (120 hrs).

Project Leader (1)		
40 hrs regular @ $47.73/hr ($34.84/hr (base salary) + $12.89/hr (benefits))	$	1,909
Project Biologist (1)		
120 hrs regular @ $38.24/hr ($27.91/hr (base salary) + $10.33 (benefits))	$	4,589
Data Management/Analysis & Report Preparation Sub-total	**$**	**6,498**

FY 2018 Total

Task 2 - Pre-runoff Trip Sub-total	$	14,170
Task 3 - Post-runoff Trip Sub-total		8,811
Data Management/Analysis & Report Preparation Sub-total	$	6,498
Project Total	$	29,478
IDC @ 22.91%	$	6,753
NMDGF Total	**$**	**36,231**

Navajo Nation Budget

Fiscal Year - 2020 Smallscale channel maintenance along the San Juan from Shiprock, NM to Sand Island, Ut

Personnel/Labor Costs (salary + benefits)

Task 1 - Reconnaissance of potential secondary channels to conduct work	
1 FTE NNDFW - Fisheries Biologist @ $21.50/Hr for 72Hrs	$1,548.00
Fringe Benefits $1,548.00 X 43.85%	$678.80
1 Wildlife Technician @ $11.89/Hr for 72Hrs	$856.08
Fringe Benefits Temp. $856.08 X 9.95%	$85.18
Personnel Subtotal	**$3,168.06**
Travel	
1 GSA Vehicle Round-trip to Sand Island, UT - 242 miles @ $.325/mile	$78.65
Per Diem Lodging for Biologist for 5-days	$470.00
Per Diem Lodging for Technician for 5-days	$470.00
Per Diem Meals for Biologist for 5-days	$275.00
Per Diem Meals for Technician for 5-days	$275.00
Travel Subtotal	**$1,568.65**
Task 2 - Pre-runoff Trip	
1 FTE NNDFW - Fisheries Biologist @ $21.50/Hr for 128Hrs	$2,752.00
Fringe Benefits $1,548.00 X 43.85%	$1,206.75
1 Wildlife Technician @ $11.89/Hr for 128Hrs	$1,521.92
Fringe Benefits Temp. $856.08 X 9.95%	$151.43
Personnel Subtotal	**$5,632.10**
Travel	
1 GSA Vehicle Round-trip to Sand Island, UT - 242 miles @ $.325/mile	$78.65
Per Diem Lodging for Biologist for 12-days	$1,128.00
Per Diem Lodging for Technician for 12-days	$1,128.00
Per Diem Meals for Biologist for 12-days	$660.00
Per Diem Meals for Technician for 12-days	$660.00
Travel Subtotal	**$3,654.65**
Task 3 - Post-runoff Trip	
1 FTE NNDFW - Fisheries Biologist @ $21.50/Hr for 112Hrs	$2,408.00
Fringe Benefits $1,548.00 X 43.85%	$1,055.91
1 Wildlife Technician @ $11.89/Hr for 112Hrs	$1,331.68
Fringe Benefits Temp. $856.08 X 9.95%	$132.50

Personnel Subtotal	**$4,928.09**
Travel	
1 GSA Vehicle Round-trip to Sand Island, UT - 242 miles @ $.325/mile	$78.65
Per Diem Lodging for Biologist for 10-days	$940.00
Per Diem Lodging for Technician for 10-days	$940.00
Per Diem Meals for Biologist for 10-days	$550.00
Per Diem Meals for Technician for 10-days	$550.00
Travel Subtotal	**$3,058.65**
Navajo Nation Fish & Wildlife Total	**$22,010.20**
Equipment Total	**$10,161.05**
NNDFW Administrative charge (15.65%)@ $32,171.25/1.1565 x.1565 =	**$4,353.48**
NN Total	**$36,524.73**
NMDGF Total	**$36,231.00**
NNDFW Total	**$36,524.73**
Total	**$72,722.73**

San Juan Fish Passage Investigation

Rob Hilldale, Tim Randle, Connie Svoboda, Jason Wagner
Bureau of Reclamation, Technical Service Center
4/23/2019

INTRODUCTION

At the request of Mark McKinstry (Bureau of Reclamation, UC-Region Adaptive Management Group) a reconnaissance field trip was organized to several locations along the San Juan River in New Mexico and Utah to allow Technical Service Center (TSC) engineers to become familiar with fish passage concerns for federally endangered Razorback Sucker (*Xyrauchen texanus*) and Colorado Pikeminnow (*Ptychocheilus lucius*) and other native fish (Ryden and Ahlm, 1996). The endangered fish are the focus of recovery efforts within the San Juan River Basin Recovery Implementation Program (SJRIP).

The purpose of the reconnaissance trip was to view two sites where native fish passage either needs to be improved or provided and two sites where fish passage is currently provided with varying degrees of success. The field trip on January 29-30, 2019 included TSC Engineers: Tim Randle and Rob Hilldale (Sedimentation and River Hydraulics Group), Jason Wagner (Civil Structures Group), and Connie Svoboda (Hydraulic Investigations and Laboratory Services Group). Also on the field trip were Mark McKinstry and Dave Speas (Reclamation, UC-Region); Eliza Gilbert, Daniel Kaus, Nate Franssen (U.S. Fish and Wildlife Service (USFWS)), Melissa Trammell (National Park Service); Peter MacKinnon (Biomark); and Casey Pennock (Kansas State University). A subsequent field trip to the same sites was conducted on March 13, 2019 and included William Rice, Eliza Gilbert and Nate Franssen (USFWS). Information from both of these field trips is included in this report.

FIELD TRIP SYNOPSIS

The first day (January 29, 2019) of the first field trip was spent visiting sites on the San Juan River at the Public Service Company of New Mexico (PNM) weir, Arizona Public Service (APS) weir, and the Hogback diversion facility. These locations are 11 to 18 miles west of Farmington, NM. The second day (January 30, 2019), was spent visiting a waterfall where the San Juan River enters the receded area of Lake Powell, 30 miles west-northwest from Mexican Hat, UT.

Fish passage for Razorback Sucker and Colorado Pikeminnow is provided with some success at the Hogback diversion and PNM weir. Although the gated sluiceway at the APS weir may provide upstream passage for some adult native fish, the sluiceway is not suitable for juvenile fish. There is no fish passage at the waterfall site. There is a desire for selective fish passage around the waterwall that would prevent the upstream migration of non-native fish from Lake Powell along the San Juan River. These non-native fish species include Striped Bass, Common Carp, Channel Catfish, Walleye, Smallmouth and Largemouth Bass, Green Sunfish, and Northern Pike.

PNM Weir

The PNM Weir at RM 166.6 (Figure 1) diverts water on river right to the San Juan Generating Station (Cheek, 2014). On river left, a fish passage and sorting facility has been constructed around the weir. The fishway consists of a series of boulder or rock weirs leading to a concrete fish sorting facility. This facility was built with SJRIP funds and is operated by Navajo Nation Department of Fish and Wildlife. The facility is designed to allow upstream passage of juvenile and adult endangered Razorback Sucker and Colorado Pikeminnow around the PNM weir structure. Fish that successfully navigate the nature-like bypass channel are guided to a gated, concrete facility where they are captured and then sorted. Native fish are then provided passage upstream.

FIGURE 1: Aerial photograph (3/15/2015) of the PNM facility. Flow direction is from the bottom of the figure to top left.

The purpose of the visit to this site was to familiarize the team with an existing fish passage facility for sucker and pikeminnow. The following issues with the facility were discussed during the visit:

- Sediment accumulation at the upstream flow inlet to the fish bypass can limit flow and impede fish passage. Water is diverted from the San Juan River into the fish bypass channel at a 55-degree angle. However, a 30-degree angle would minimize the amount of sediment diverted (Vanoni, 1975). Land immediately upstream of the inlet structure protrudes into the San Juan River channel along the left bank and creates a downstream eddy along the bank where water is diverted into the bypass channel. Sediment naturally deposits in eddies and the accumulation at the inlet is exacerbated when the gates are closed. For the first time since construction, water has been allowed to continually flow through the facility during the winter, which has decreased sediment accumulation at the inlet.

- Upstream-migrating fish pass through the fish channel, but congregate at the downstream side of the concrete structure. PIT tag studies indicate that sucker and pikeminnow enter the bypass channel, but may refuse to enter the concrete structure.
    - Sucker were observed by biologists to move through the bypass facility better than pikeminnow.
    - There was a discussion about adding natural roughness to the floor and wall surfaces of the concrete structure. This would provide some diversity and micro edies in the stream flow velocity and better replicate natural conditions. Some cobbles have been added at the downstream portion of the facility with some success. However, any roughness added to the collection chamber (between the gates) must not interfere with the netting of fish.
    - It was suggested that natural sediment particles can be epoxied to plywood and fastened to the concrete bottom. If sediment particles are no larger than 32-45 mm it shouldn't interfere with the netting of fish.
    - During the second field trip, USFWS also suggested that one more rock weir could be added just downstream of the facility. The additional weir could help reduce flow velocity for fish in the concrete structure. A series of 2"x4" wooden boards (extending about 100 mm from the concrete wall) had been added to the downstream part of the concrete structure to add additional roughness in response to TSC's guidance.

Hogback Diversion

The Hogback Diversion Dam at river mile 158.7 (Figure 2) is 8 river miles downstream of the PNM weir and 5 river miles downstream of the APS weir. This facility provides irrigation water to the north side of the San Juan River. The dam was rebuilt in 2001-2002 to provide for more efficient and reliable diversion of water, while allowing for fish passage over a wide range of river flows (Renfro et al., 2006). The team visited this site to see another facility that has had a fishway constructed for passage of native sucker and pikeminnow. The fishway is often dry when the sluice gates are open and irrigation water is not being diverted.

Figure 2: Aerial photograph (3/15/2015) of the Hogback Diversion structure. The canal at the top of the page serves as a sediment sluice.

This facility is effective for upstream passage of adult fish when water is able to flow down the bypass channel. Downstream-moving adult fish that are entrained into the diversion are excluded from the canal with a fish weir that allows water to flow over the top portion of the water column. The downstream drift of larvae may present a problem when they're entrained through the bar rack and into the irrigation canal. Data collected at the site show that larvae are entrained over the weir approximately in proportion to the amount of flow diverted. The section of the canal upstream of the fish weir also serves to collect sediment that can be flushed through an outlet that returns to the river channel.

APS Weir

The APS weir (Figure 3) is 3 river miles downstream of the PNM weir (13 miles west of Farmington, NM). This weir backs up water for the Four Corners Pumping Plant on river left which provides cooling water to Morgan Lake and the power plant. The APS weir spans the channel and is constructed with concrete between two rows of steel sheet-pile walls (Stamp and Golden, 2005) (Figure 4). There is a sluiceway on river left. A single vertical slide gate (Figure 5) controls water surface elevations for two intake pumps, upstream of the weir on river left. When the slide gate is fully open during low-flow periods, all the San Juan River water is forced through the sluiceway and the weir crest is dry. This was the condition during our site visit on January 29th.

Figure 3: Aerial image of the APS weir near Waterflow, NM.

When the gate is lowered or during higher river flows, water spills over the weir crest. Water flowing over the weir crest is the most common condition. Flow velocities over the weir exceed the swimming capabilities of Razorback Sucker and Colorado Pikeminnow. Observation at 7,000 cfs (Stamp and Golden, 2005) indicates the presence of a standing wave over the weir that is not likely passable by native fishes. Presently, adult native fish (Razorback Sucker and Colorado Pikeminnow) can pass upstream through the sluiceway, depending on the setting of the slide gate (Figure 5). However, flow velocities through the sluiceway are generally too high to accommodate upstream passage of juvenile fish. Another problem with the sluiceway is that the fish may have difficulty locating the entrance on river left when most of the San Juan River is flowing over the weir. Therefore, improved upstream fish passage is desired at this location.

Figure 4: Photograph of the APS weir. Flow is from left to right. The intake structure and sluiceway are on the opposite (left) bank.

Figure 5: Sluiceway at the APS weir on river left. The intake for the pumping plant is just upstream of this structure. Velocities through this channel are too high for the passage of juvenile Colorado Pikeminnow and Razorback Sucker.

San Juan Waterfall

The San Juan waterfall (Figure 6 and Figure 7) is in a remote location that exists within the full pool area of Lake Powell at water surface elevation 3700 feet. The water surface elevation of Lake Powell was at or near full in 1980 and 1983 through 1988. During these years, sedimentation formed a wide delta across the reservoir valley. The alignments of stream channels flowing along the delta surface often alternate between the far left or right margins of the delta. The water surface of Lake Powell decreased by about 90 feet over water years 1989 through 1993 (Figure 8). During this reservoir drawdown, the San Juan River incised wherever it was and mostly along the margins of the delta, rather than along the natural channel alignment, and encountered bedrock ledges in places, which resulted in waterfalls. Lake Powell was again at or near the full pool elevation in 1998 and 1997 through 1999 where sedimentation likely refilled in the previously eroded portions of the delta. The Lake Powell water surface decreased 90 feet again during water years 2000 through 2005. During this reservoir drawdown, the San Juan River again incised a channel through the delta and encountered the bedrock ledge at the present-day waterfall. This waterfall is evident in the 2004 Google Earth aerial photographs. The waterfall may have been mostly inundated in 2011 when the reservoir filled to elevation 3660 feet. Lake Powell water storage volume must approach 85-90% for the current waterfall to become inundated. On January 30, 2019, the height of the waterfall was estimated to be approximately 15 feet high. Figure 9 and Figure 10 show the 1993 and 2016 aerial photography with a centerline drawn for the 1993 channel.

When Lake Powell fills again, sedimentation will again fill in eroded portions of the delta and the San Juan River may find a new channel alignment away from the present waterfall location. There is great uncertainty as to when Lake Powell may fill again and the new alignment of the San Juan River channel after the lake recedes. However, the present river channel is locked in place at the waterfall location until the reservoir is near full for at least a year.

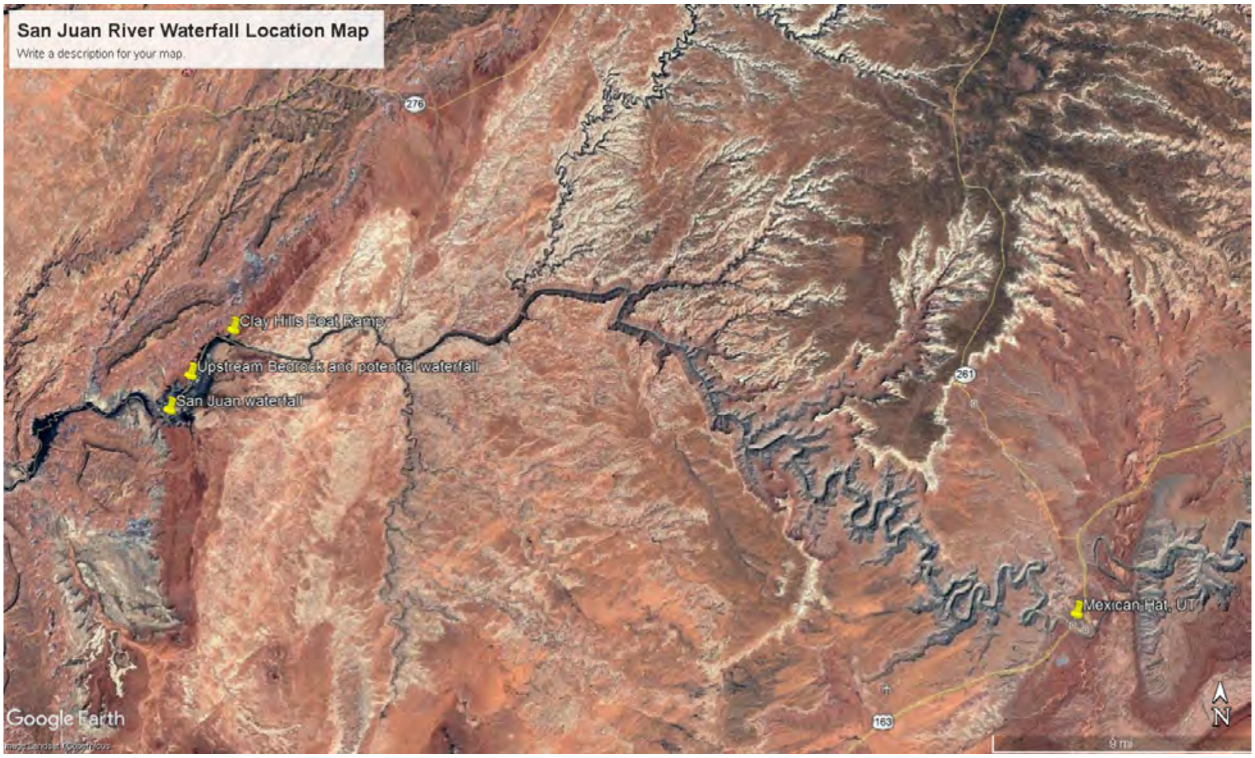

Figure 6. General location map of the waterfall (left) and Mexican Hat, UT (right).


Figure 7: Photograph looking upstream at the San Juan waterfall.

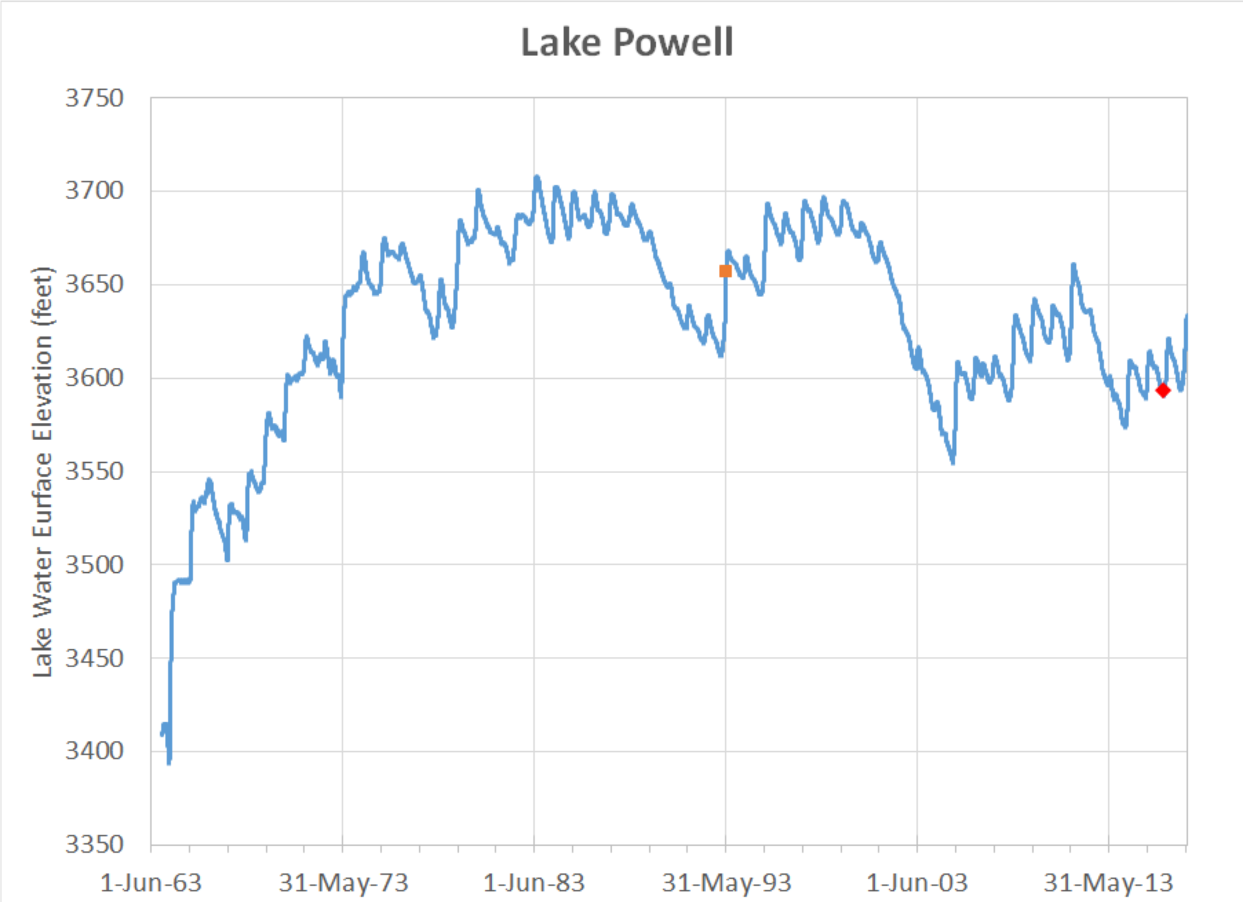

Figure 8. History of Lake Powell water surface since original filling in 1963. According to Google Earth, the top elevation of the San Juan waterfall is 3680 feet (+/- 20 feet).

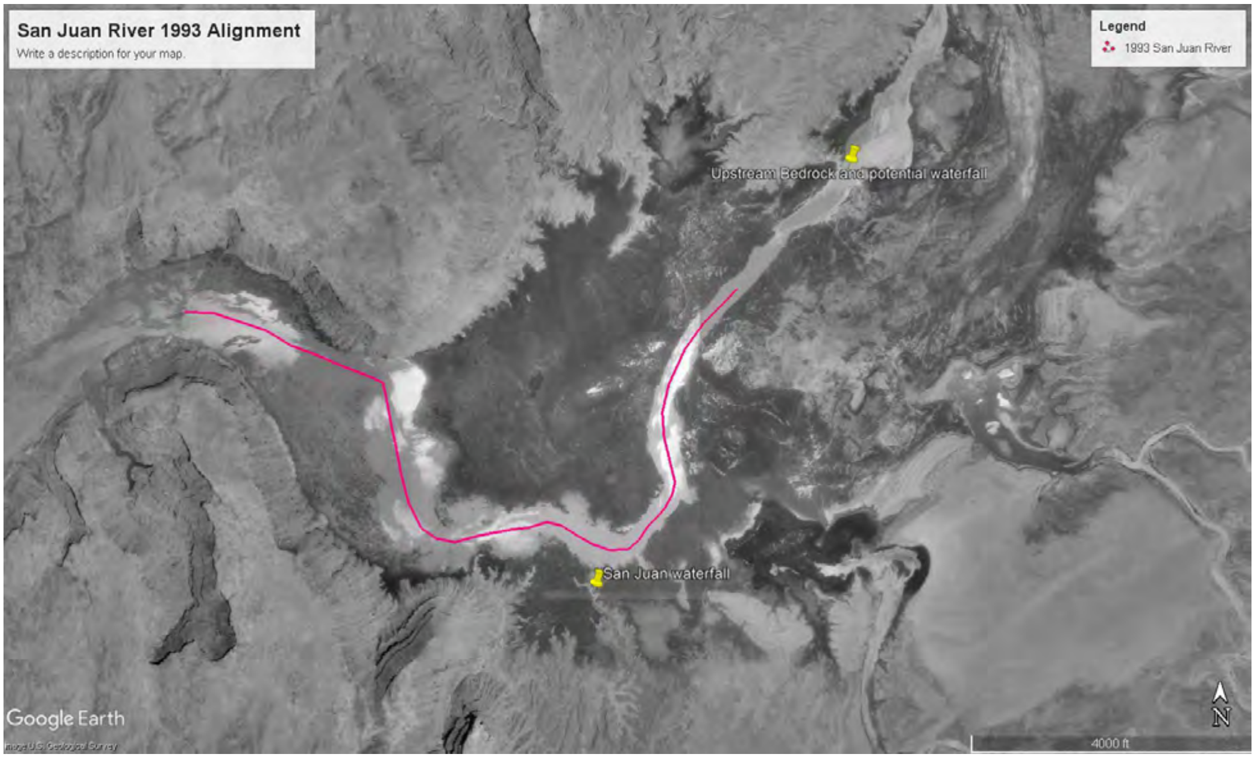

Figure 9. San Juan arm of Lake Powell, 1993 aerial photography with centerline that is north of the waterfall.

Figure 10. San Juan arm of Lake Powell, 2016 aerial photography with 1993 centerline.

PROPOSED SOLUTIONS FOR FISH PASSAGE ON THE SAN JUAN RIVER

Fish passage solutions were proposed for the APS Weir and Lake Powell waterfall.

APS Weir Fish Passage Solutions

At this location, it is not necessary to selectively pass fish. Selective fish passage is provided at the PNM Weir 3 river miles upstream.

A fish bypass channel on river right was discussed. There were several potential issues identified with a bypass channel. During low-river discharge, there will be less flow attraction to the downstream entrance of the bypass-channel than what is presently provided through the sluiceway on the opposite side of the river. Because of the upstream river bend, a bypass channel along the right bank would be subject to sedimentation, impairing fish passage. A bypass channel along the right bank would encroach somewhat on farm property. The previous installation of gabions and concrete/grout along the right bank at the weir indicates past problems with erosion. These erosion problems would pose challenges for a fish bypass channel.

A notch in the weir with an inflatable gate was discussed during the site visit. The gate could be controlled in such a way to allow fish passage during low flow conditions and be raised when pumping requirements demand a higher water surface elevation. The drawbacks of this option include; complicated O&M that would require an agreement with APS, concerns about durability, and difficulty finding an appropriate location for the bladder air compressors and blowers.

Modification of the current sluiceway is another option for improved fish passage at this site. The team discussed the possibility of placing baffles in the sluiceway and perhaps improving the slide gate to provide improved velocity conditions for upstream passage. However, baffles may impede the downstream passage of sediment and wood. Also, the sluiceway may be difficult for fish to locate because most of the river flow goes over the weir crest. Additionally, this option requires modification to a portion of the diversion structure nearest the pumping plant and likely would preclude pumping plant operations during construction.

Concept drawings of proposed fish passage channels imbedded with the weir are included in a document authored by Biotactic (written communication 2018). This passage option was a series of concave, inclined wedge-shaped ramps passable by fish. These ramps have their upstream edge aligned with the weir and extend downstream into the pool. The team discussed a wedge-shaped bypass ramp similar to that proposed by Biotactic, with the major difference being the longitudinal placement of the ramp. We propose aligning the downstream edge of the ramp with the weir, thus providing strong attraction flow at the weir to improve the likelihood of fish locating the passage ramp. This plan would also avoid constructing anything in the deep pool below the weir crest. The fish ramp would extend 15 to 25 feet upstream of the weir, depending on the vertical drop and desired slope. The upstream shape of the ramp would resemble a horseshoe, with its top crest elevation being a few inches below the existing weir crest elevation depending on minimum depth requirement for fish passage. It is likely that only one ramp would be necessary.

Lastly, during the second field trip USFWS proposed the option of a rock ramp downstream of the weir. A rock ramp would have a longitudinal slope of no more than 3 percent and have a low-flow channel to provide fish passage for adults and juveniles over a wide range of flows. The rocky ramp would provide good flow attraction for fish passage as it would span the entire river width, except the bank near the sluice gate. It would also minimize modification of APS infrastructure. Drawbacks of this option may be cost and potential need to add or re-arrange boulders after large flood events if movement occurs. The scour hole immediately downstream of the weir may be 10 to 20 feet deep and require a large volume of rockfill to support the fish ramp.

San Juan River Waterfall Fish Passage Solutions

The San Juan River waterfall currently provides beneficial exclusion of non-native fish species from the San Juan River, however this comes at the expense of preventing native fish, including the endangered Razorback Sucker and Colorado Pikeminnow, access to upstream migration. Selective fish passage at this location is desired.

A solution at this location is made difficult by the very remote location and the fact that this location will be inundated by Lake Powell when the reservoir water surface is above 3655 feet. All considerations for providing fish passage at this location must consider that the land is within Glen Canyon National Recreation Area (managed by the National Park Service) and consultation with the Navajo Nation is needed.

During the past few years, native fishes have been captured through electrofishing downstream of the falls, tagged and loaded into buckets for transport, manually hauled upstream of the falls, and loaded into a waiting boat. The fish are then transported by boat about 2 miles upstream from the falls and released. While this process has been successful, it is labor intensive, costly, and induces an unquantified level of stress on the fish. If this process is continued, it represents a no-action scenario, but it is uncertain how sustainable this operation will be.

An alternative solution is to re-route the San Juan River channel to the alignment that existed prior to the filling of Lake Powell (Figure 11). The channel realignment would be accomplished by the excavation of two separate pilot channels through the reservoir delta and then allowing river flows to create a wider and deeper channel through natural river erosion processes. The downstream pilot channel would realign the San Juan River around the present waterfall. An upstream pilot channel would then be needed to realign the San Juan River around an exposed bedrock outcrop where another waterfall would likely develop. Each pilot channel would be about 50 feet wide, 8 feet deep, and 6,000 to 7,000 feet long. This solution would help restore the natural river channel alignment until Lake Powell refilled to near a full pool level. If the reservoir remained full for a long enough period, sedimentation would refill the excavated and eroded portions of the delta.

Selective fish passage could be accomplished for the channel realignment alternative by installing a weir across the San Juan River near the Clay Hills Boat Ramp (Figure 12) and constructing a fish bypass channel with a trapping and sorting facility along the right bank. The Clay Hills boat ramp is approximately 3.5 miles upstream of the present waterfall and can be accessed by a 12-mile dirt road south from paved Highway 276. Rafters currently recover boats at this location, which is approximately the upstream extent of Lake Powell. Therefore, a facility at this location would not be completely impacted by a full Lake Powell. A weir and fish bypass channel downstream from the boat ramp is not likely to interrupt rafting activities. However, it may be necessary to relocate the boat ramp a few hundred feet upstream.

Alternatively, selective fish passage could also be constructed near Mexican Hat, UT near the highway bridge. This location would have easy road access or construction, operations, and maintenance and it would be completely above the full elevation of Lake Powell. However, a channel spanning structure at Mexican Hat is likely to meet permitting hurdles and opposition from the rafting community.

Figure 11. Possible channel realignment of the San Juan River through the Lake Powell delta.

Figure 12. Location of possible fish weir and selective bypass channel.

The alternative most discussed during the January 29, 2019 field trip was the excavation of a fish bypass channel around the waterfall (along the left or southern terrace) and provide for selective fish passage. The approximate alignment of the proposed fish bypass channel is presented in Figure 13. This channel is approximately 1,500 feet long and would pass over a bedrock ledge near the present waterfall. Assuming the waterfall is 15 feet high, the bypass channel would provide a slope of 1%, which should be sufficient to transport sediment through the channel, allow appropriate depth and velocity for upstream fish passage, and provide options for variable slopes to accommodate a fish trapping and sorting facility. The bedrock ledge would provide a grade control for the bypass channel and could provide a break in slope to prevent unassisted fish passage in the upstream direction. A fish sorting facility could be constructed just downstream of the bedrock ledge.

Steel sheet pile may be necessary to control the upstream flow entrance to the bypass channel. The upstream alignment of the bypass channel would be designed with a 30-degree angle of flow diversion relative to the San Juan River channel alignment. This 30-degree angle would help to minimize the amount of sediment diverted into the bypass channel. Multiple upstream entrances to the bypass channel could be considered to create redundancy, but this may reduce the upstream flow velocities and result in sediment deposition.

Figure 13: Approximate alignment for fish bypass channel discussed during the field trip (Jan 2019). Flow is from the top right of the image toward the bottom left.

During the second field trip on March 13th, USFWS discussed the need to fill and armor a portion of the scour hole downstream from the waterfall, but near the downstream entrance to the bypass channel. Presently, there is a strong re-circulation eddy left of the waterfall that might make it difficult for native fish to find the entrance to the bypass channel. The rock fill in the scour hole would be used to create ramp, with a longitudinal slope of up to 3 percent, for fish entering the bypass channel

For the waterfall itself, USFWS discussed the depth of the existing scour pool and degree of natural undercutting. Widening the low flow section of the waterfall to reduce some of the erosive force of the flow downstream was discussed. A technical fishway such as a vertical slot was briefly entertained but cost, sedimentation issues, geologic structural stability of the bedrock, and questions related to fishway attraction would likely preclude this option.

APPRAISAL-LEVEL STUDY PLAN

The study plan consists of data collection needs, costs, and schedule.

For the APS Weir, three fish passage solutions will be evaluated:

- Construction of a fish bypass channel around the weir along the right bank

- Construction of a fish ramp within the existing weir that extends upstream from the weir
- Construction of a rocky ramp downstream of the face of the existing weir

For the San Juan River Waterfall, two fish passage solutions will be evaluated:
- Realignment of the San Juan River (at two locations) to its location prior to the initial filling of Lake Powell with selective fish passage near the Clay Hills Boat Ramp.
- Construction of a selective fish bypass channel around the waterfall along the left terrace bank

Data Collection Needs

APS Weir
- Water surface elevations required for pump operation
- Pump operation (schedule - frequency, duration) and sluice gate operation
- Thresholds for minimum and maximum velocities and minimum depth for fish passage for all desired species and life stages
- Bathymetry & topography
- Drawings for current weir and sluiceway
- Range of San Juan River discharge for analysis and modeling (hydrologic analysis)

San Juan Waterfall
- Topography
- Fish passage and trapping requirements
- Rock, soil, and sediment conditions
- Range of San Juan River discharge for analysis and modeling (hydrologic analysis)
- Thresholds for minimum and maximum velocities and minimum depth for fish passage for all desired species and life stages

Study Tasks

APS Weir
1. Determine location and obtain LiDAR - 8240
2. Literature review on fish passage requirements and pumping operations - 8150/8560 + Bill Rice
3. Hydrology analysis of San Juan River flows at weir - 8240
4. Collect channel bathymetry and some topographic data collection - 8240
5. Rough concept design of fish bypass channel - 8150/8560
6. Concept design of fish ramp within the weir - 8150/8560
7. Concept design of channel-spanning rock ramp - 8150/8560
8. Hydraulic analysis and modeling of fish bypass channel - 8240
9. Hydraulic analysis and modeling of fish ramp within the weir - 8240
10. Hydraulic analysis and modeling of channel-spanning rock ramp - 8240
11. Construction description of fish bypass channel - 8150/8520

12. Construction description of fish ramp within the weir - 8150/8520
13. Construction description of channel-spanning rock ramp - 8150/8520
14. Appraisal-level cost estimate to construct the fish bypass channel - 8520
15. Appraisal-level cost estimate to construct the fish ramp within the weir - 8520
16. Appraisal-level cost estimate to construct the channel-spanning rock ramp - 8520
17. Draft study report - 8240/8150/8560
18. Peer review report- 8240/8150/8560
19. Complete final report - 8240/8150/8560

San Juan Waterfall

20. Hydrology analysis of San Juan River flows at waterfall - 8240
21. Acquire LiDAR and determine proper projection and format - 8240
22. Concept design of pilot channels to realign the San Juan River around both waterfalls - 8150/8560/8240
23. Concept design of fish bypass channel with selective fish passage - 8240/8150/8560
24. Geomorphic analysis of pilot channels to realign the San Juan River around both waterfalls and upstream selective fish passage - 8240
25. 1D Hydraulic analysis and modeling of fish bypass channel with selective fish passage - 8240
26. Construction description of pilot channels to realign the San Juan River around both waterfalls and upstream selective fish passage - 8150/8520
27. Construction description of fish bypass channel with selective fish passage - 8150/8520
28. Appraisal-level cost estimate to construct the pilot channels to realign the San Juan River around both waterfalls and upstream selective fish passage - 8520
29. Appraisal-level cost estimate to construct the fish bypass channel with selective fish passage - 8520
30. Draft study report - 8240/8150/8560
31. Peer review report - 8240/8150/8560
32. Complete final report - 8240/8150/8560

Study Costs

FY-2020 Technical Service Center Cost Summary 4/11/2019

APS Weir

Task #		Task Description	Staff Days	Labor Total	Trave l	Total
		APS Weir				
1		Determine location and obtain LiDAR	3.0	$3,480	$0	$3,480
2		Literature review on fish passage requirements and pumping operations	3.0	$3,660	$0	$3,660
3		Hydrology analysis of San Juan River flows at weir	2.0	$2,240	$0	$2,240
4		Collect channel bathymetry and some topographic data collection	12.0	$13,440	$1,64 9	$15,089
5		Rough concept design of fish bypass channel	12.0	$14,080	$0	$14,080
6		Concept design of fish ramp within the weir	11.0	$12,960	$0	$12,960
7		Concept design of channel-spanning rock ramp	11.0	$12,960	$0	$12,960
8		Hydraulic analysis and modeling of fish bypass channel	5.0	$5,600	$0	$5,600
9		Hydraulic analysis and modeling of fish ramp within the weir	15.0	$16,800	$0	$16,800
10		Hydraulic analysis and modeling of channel-spanning rock ramp	15.0	$16,800	$0	$16,800
11		Construction description of fish bypass channel	2.5	$2,960	$0	$2,960
12		Construction description of fish ramp within the weir	2.5	$2,960	$0	$2,960
13		Construction description of channel-spanning rock ramp	2.5	$2,960	$0	$2,960

14		Appraisal-level cost estimate to construct the fish bypass channel	6.0	$6,960	$0	$6,960
15		Appraisal-level cost estimate to construct the fish ramp within the weir	6.0	$6,960	$0	$6,960
16		Appraisal-level cost estimate to construct the channel-spanning rock ramp	6.0	$6,960	$0	$6,960
17		Draft study report	19.0	$21,680	$0	$21,680
18		Peer review report	2.0	$2,240	$0	$2,240
19		Complete final report	2.0	$2,240	$0	$2,240
		Project Management	12.0	$14,220	$0	$14,220
		Sub Totals	**149.5**	**$172,160**	**$1,649**	**$173,809**

San Juan Waterfall

		San Juan Waterfall	0.0	$0	$0	$0
20		Hydrology analysis of San Juan River flows at waterfall	2.0	$2,240	$0	$2,240
21		Acquire LiDAR and determine proper projection and format	6.0	$6,920	$0	$6,920
22		Concept design of pilot channels to realign the San Juan River around both waterfalls	14.0	$16,320	$0	$16,320
23		Concept design of fish bypass channel with selective fish passage	12.0	$14,080	$0	$14,080
24		Geomorphic analysis of pilot channels to realign the San Juan River around both waterfalls and upstream selective fish passage	5.0	$5,600	$0	$5,600

25		1D Hydraulic analysis and modeling of fish bypass channel with selective fish passage	10.0	$11,200	$0	$11,200
26		Construction description of pilot channels to realign the San Juan River around both waterfalls and upstream selective fish passage	2.5	$2,960	$0	$2,960
27		Construction description of fish bypass channel with selective fish passage	2.5	$2,960	$0	$2,960
28		Appraisal-level cost estimate to construct the pilot channels to realign the San Juan River around both waterfalls and upstream selective fish passage	11.0	$12,760	$0	$12,760
29		Appraisal-level cost estimate to construct the fish bypass channel with selective fish passage	11.0	$12,760	$0	$12,760
30		Draft study report	19.0	$21,680	$0	$21,680
31		Peer review report	2.0	$2,240	$0	$2,240
32		Complete final report	2.0	$2,240	$0	$2,240
		Project Management	12.0	$14,220	$0	$14,220
		Sub Totals	**111.0**	**$128,180**	**$0**	**$128,180**
		Grand Totals for Both Projects	**260.5**	**$300,340**	**$1,649**	**$301,989**

Schedule

<u>APS Weir</u>

Draft study report – 31 March 2021
Complete final report – 30 June 2021

<u>San Juan Waterfall</u>

Draft study report – 31 March 2021
Complete final report – 30 June 2021

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RESPONSE TO COMMENTS

Scope #	Project	PI(s)
43 (New-4)	43-(New-4)-San Juan fish passage investigation	Hilldale, Randle, Svobada, and Wagner, BR-TSC

Overall response (from McKinstry and Gilbert who developed SOW with PIs): There appears to be a broad spectrum of opinions pertaining to 20% design to help determine feasible fish passage options at the waterfall but little disagreement for development of design options for the APS weir. On one side of the spectrum reviewers think passage at the waterfall would not contribute to recovery, we need more data to provide justification for fish passage, or that fish passage at this site (which is in critical habitat) either won't contribute toward recovery or proof needs to be provided that it would support recovery. It is hard to understand that the need for fish passage at the waterfall, whether it is a structure or a fish-translocation-project, at a place where we have had over 1900 unique detections of endangered fish in the last 3 years would receive less support and more scrutiny than APS where there are little data indicating how many fish are prevented from moving past the structure, which is passable in certain instances. Passage at the waterfall may be trickier than other locations and it is understood that may be some of the reasons for reticence but, both in the SJRIP and throughout the Colorado River Basin, millions of dollars have been spent on fish passage without the level of information we know pertaining to the number of endangered fish at and prohibited from moving upstream of the waterfall. Stocking fish is the one management action we all agree has contributed to recovery with 100% certainty. Given this is the only management action we have this much certainty with, it is difficult to understand what other data reviewers think need to be collected to justify fish passage at the waterfall. If the SJRIP postpones work on this issue much longer, we could lose our ability to alleviate the problem if capital funds expire post-2023.

Harry Crockett, Colorado DNR, BC member

How can the technical aspects of this SOW be improved?

No recommendations.

What is this SOW's contribution to recovery?

May provide solutions directly relevant to a potential bottleneck, if fish passage proves to be an impediment to recovery (e.g., upstream reproduction / recruitment is limited by upstream movement constraints).

Vince Lamarra, Navajo Nation, BC member

How can the technical aspects of this SOW be improved?

N/C

What is this SOW's contribution to recovery?

I support this effort in the expansion of range of the two rare fish in the San Juan River. Data would indicate that expansion is critical for the recovery of these fish.

Response: none

Jacob Mazzone, Jicarilla Apache Nation, BC member

How can the technical aspects of this SOW be improved?

No Comment

What is this SOW's contribution to recovery?

Maintaining and maximizing fish passage and reach connectivity is a hallmark of fisheries conservation and management. Improved passage at the APS weir in my opinion might be the most valuable of the sites proposed for further analysis/design/etc.

Response: none

Mark McKinstry, BOR, BC member

How can the technical aspects of this SOW be improved?

Get it started ASAP! Keep pushing this ball uphill.

What is this SOW's contribution to recovery?

Millions of dollars in fish passage have been built throughout the CO Basin, and none of those sites had as much proof that passage would be used as we have at APS and Piute Farms Waterfall. Providing fish passage at these sites would give us uninterrupted fish passage from the Upper Basin all the way to PNM (which has questionable passage).

Response: none

Bill Miller, Southern Ute Indian Tribe, BC member

How can the technical aspects of this SOW be improved?

What is this SOW's contribution to recovery?

David Mueller, BLM, BC member

How can the technical aspects of this SOW be improved?

No comment, collect the data necessary for the engineers to make a functional design for fish passage tailored to the unique physiological and life histories of the native fishes

What is this SOW's contribution to recovery?

This should help inform future management actions to remove impediments to movement.

Response: none

Ben Schleicher, USFWS R6, BC member

How can the technical aspects of this SOW be improved?

What is this SOW's contribution to recovery?

This SOW appears to have no direct contribution to recovery, rather a more informative review or several passage theories.

Response: We think the feasibility-level study needs to be completed before we can move forward with recommending a project that is on the ground contribution towards recovery. In the SJRIP and Upper Colorado programs we have built fish passages with less information in regards to the number of fish prohibited from moving upstream. At the waterfall over 1800+ RBS and 100+ CPM have been detected at this barrier. We agree this SOW is not providing fish passage but it is a step towards providing the BC and CC the information they need to make a decision to institute a management action that could support recovery.

Tom Wesche, Water Development Interests, BC member

How can the technical aspects of this SOW be improved?

I appreciate the Bureau's Technical Service Center becoming involved in these investigations, and while I have no reason to question their capabilities on this topic, a brief review of PI backgrounds and credentials would be helpful for those of us who don't know these folks. For the waterfall work, having representatives from the Navajo Nation and the National Park Service on the study team might be useful. Likewise, an APS rep on that portion of the study may be useful as well. In its' current form, the draft SOW is incomplete and needs to have tasks fleshed out a bit and a schedule included. Also, I am hopeful the PI's will include maintenance and other costs in their analysis (e.g. improving access into the waterfall).

What is this SOW's contribution to recovery?

A thorough analysis of fish passage options at these two locations is much needed and potentially, the long-term ramifications for recovery could be substantial. Therefore, I consider this draft SOW, once completed, to be a high priority for FY20.

Response: Personnel from both NPS and APS have participated in the field trips to the respective passage locations and been part of discussing what options to consider for feasibility. Both entities were sent the SOW, are aware of the process that is occurring through the SJRIP, and have been attending SJRIP BC meetings. Both entities will also have their own processes to employ once they have decided they are in a position to do so, as passage at APS and the waterfall will ultimately have to be approved by APS and NPS before it can be done. The schedule of tasks was provided by BOR-TSC and we will ask them to provide an updated and better table. However more specifics will be hard to provide at this point since the SOW has been approved by the CC and project is moving forward.

Brian Westfall, BIA, BC member

How can the technical aspects of this SOW be improved?

This study seems premature until the results of NEW-2 and the ASIR study are completed to document we have a problem.

What is this SOW's contribution to recovery?

Suggest not funding this until we are convinced that fish passage is a problem. If the water fall is a problem they why do New-2 and the ASIR study?

Response: It is difficult to understand what additional data would be convincing that the waterfall is a problem. For assessment of other projects, the SJRIP has been relying on fish behavior (i.e. presence in secondary channels or attempts to move through PNM fish *passage) to evaluate project success or need for adaptive management. In this instance 1800+ RBS and 100+CPM have been detected at the waterfall, suggests these fish are attempting to move upstream, and the waterfall is a barrier to that behavior. Delaying this project increases the risk capital project funds will be unavailable to mitigate this fish passage impediment given the post-2023 sunset of the SJRIP and thus future uncertainty. Developing a 20% feasibility design for fish passage options is in line with both BC and CC stated interests (i.e. memos recommending and approving the Phase III habitat project) of moving forward with multiple planning and implementation options for both habitat and fish passage.*

Matt Zeigler, NMDGF, BC member

How can the technical aspects of this SOW be improved?

It's difficult to determine what this SOW is proposing. As currently written it is more of a report from the last trip to assess fish passage options at the waterfall and APS then a proposal. Will this proposal cover just pre-construction plan data collection or will it also fund construction plans? Will plans be developed for each potential bypass design at both APS and the waterfall? Are there plans to assess the efficiency of these passage structures if constructed?

I would also suggest splitting this proposal into two separate SOWs, one for APS and one for the Waterfall.

What is this SOW's contribution to recovery?

Providing fish passage throughout the San Juan River provides endangered fish the ability to move freely and access areas needed for spawning, rearing, and feeding; increasing the chances that recovery for both endangered species is achieved. Better passage needs to be provided at APS, however I am not sure there is significant agreement about the need for passage at the waterfall. Additional data needs to be collected and threat analyses need to be completed before moving forward with any passage at the waterfall.

Response: Detection of 1800+ RBS and 100+ CPM at the waterfall barrier indicate that passage is an issue at this location. These are more data on fish prohibited from moving upstream than what has been provided for any another other fish barrier which *substantiated the need for and resulted in construction of fish passage in the Colorado River Basin. It is agreed that increased passage is needed at APS but it must be acknowledge that there are less data showing the weir is as much of a barrier as is the waterfall. We know fish can get past APS and the intent is to retrofit the weir to increase availability of passage as compared to the waterfall where we know there is no upstream passage. Similar to our response to other reviewers, we are uncertain what other kind of data is thought to be needed to justify fish passage at the waterfall.*

Brian Bledsoe, Peer Reviewer

How can the technical aspects of this SOW be improved?

Good sound as is.

What is this SOW's contribution to recovery?

Provides a needed system level perspective on connectivity and management options that will be valuable in prioritizing interventions.

Response: none

Wayne Hubert, Peer Reviewer

How can the technical aspects of this SOW be improved?

The SOW included a report of findings from two field trips to a discussion of possible solutions to fish passage problems at the APS weir and Waterfall. These elements of the report on insights from field trips in early 2019 were quite informative.

The SOW is for an "Appraisal-level Study Plan" to consider three fish passage option at the APS weir and two fish passage options at the Waterfall. Substantial amounts of on-site data collection would occur followed by numerous "Study Tasks" to engineer fish passage solutions. It is not possible from the SOW to determine the extent of data to be collected or the extent of design work that is proposed, but it is good to see that reasonable alternatives may exist for fish passage at the two sites and that an experienced engineering team from the BOR is addressing innovative alternatives.

What is this SOW's contribution to recovery?

If solutions are identified to enable selective fish passage into the San Juan River at the Waterfall, it would go a long way in reducing or eliminating fragmentation of the populations of endangered fishes and allow for reservoir-river life histories that appear to be very important for recovery. Eliminating additional fragmentation due to the APS weir would further allow reservoir-river life histories and enable more complete use of the San Juan River by the endangered fishes during varying life stages. Together, solutions to fish passage issues at the Waterfall and APS weir would be major moves toward recovery of the endangered fishes in the Colorado River Basin and, particularly, in the San Juan River.

Response: We think the current level of detail is sufficient to develop an appraisal level proposal but Reclamation's Technical Services Center personnel will be asked to provide as much more detail as the currently can.

Steve Ross, Peer Reviewer

How can the technical aspects of this SOW be improved?

No suggestions

What is this SOW's contribution to recovery?

Longitudinal connectivity is extremely important to the recovery of the listed species and is one of the key issues identified by the Peer Review Panel in 2019. The metapopulation structure suggested for Razorback Sucker requires movement of individuals among the local populations. The options being evaluated in this SOW would increase fish passage within the San Juan River and provide selective passage of fishes out of Lake Powell.

Response: none

Mel Warren, Peer Reviewer

How can the technical aspects of this SOW be improved?

The SOW was an interesting, largely non-technical descriptive overview of the various types, locations, and good photographs of fish passage barriers on the San Juan. I support this proposed study to get the ball rolling on improving upstream connectivity in as many places as possible.

What is this SOW's contribution to recovery?

The SOW can help the Program evaluate alternative fish passage designs at known barriers and hopefully begin design and construction of as many of these as possible.

Response: none

Program Office

How can the technical aspects of this SOW be improved?

The fish bypass channel at APS seems like a poor option and to reduce feasibility study costs, PIs might consider removing it from the options?

What is this SOW's contribution to recovery?

Improving and allowing fish passage through critical habitat is a recovery element identified in the Long Range Plan. In fact, mounting evidence at the waterfall and PNM suggest large numbers of endangered fish (especially Razorback Sucker) are stacking up and attempting to move upstream of these barriers. Allowing access to upstream spawning habitat may result in increasing the apparently low number of Razorback Sucker that contribute to successful spawning. Providing for passage at APS and the waterfall are already identified as actions and tasks to be carried out by the SJRIP in the Long Range Plan. Given funding to carry out these activities is earmarked in Capital Funds and 4CPP NFWF, further planning to improve passage at both locations as described in the proposal is warranted.

Response: none

FY 2020 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 FY2020
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
Total				$212,000.00

** 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
Total								$11,255.00

*Taxi $20; Parking $10; Rental car $100/trip

Budget Summary
FY-2020

Total labor	$212,000.00
Total travel	$11,255.00
Grand total	**$223,255.00**[1]

[1] This total budget represents a 0% increase over the FY2019 Budget.

Peer Review for 2020
Fiscal Year 2020 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 the process of recovery. The members of the Panel participated in meetings and reviewed pre-draft, draft, and final scopes of work, work plans, reports, integration analyses and reports, 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 Scope of Work (SOW) aims to improve the Program's peer review process by refining and guiding the responsibilities of the Panel members to maximize the benefits to the Program while decreasing the ambiguity of peer reviewer expectations.

Goals:

The main goal of peer review in the SJRIP should be 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, we developed this SOW to capitalize on the use of peer review to aid in guiding and defending management decisions made by the Program. Furthermore, we have incorporated new aspects of the peer review process that are aimed at encouraging candid reviews without the fear of personal/social reprisals as well as to increase transparency of contributions of individual peer reviewers to the Program Office (Program Office). The peer reviewers will contribute to three major components of the Program detailed below and we have noted expectations and responsibilities for each:

1) Review annual SOWs

Annual SOWs by Program PIs are due to the Program Office by 31 March of each year. After the Program Office receives SOWs, each peer reviewer will review a list of SOWs assigned by the Program Office (n=5-15). SOWs will be assigned such that each scope's topic aligns with each reviewer's expertise (as much as possible) and each SOW will receive at least two independent reviews (as well as comments from the Program Office). Reviews will then be due back to the Program Office by 30 April. If reviewers don't want to remain anonymous, they will need to indicate that on individual reviews sent to the Program Office.

The Program Office would like to see reviews as succinct as possible (i.e., ≤ 1 page reviews will be acceptable) and do not necessarily want to read through track changes on word documents (blind track changes can be delivered to the PIs through the Program Office but will not be required for the review). Blind reviewer comments will then be compiled by the Program Office and disseminated to the BC and PIs. The PIs will then be required to respond to peer reviewer and Program Office comments and append those to their respective SOW before they will be considered in the annual work plan.

2) Attend the November/December meeting and review 2020 work

The November/December BC meeting consists largely of discussions of the previous year's activities conducted by the PIs and proposed future projects. This meeting is for the group to catch up on progress on individual projects in a relatively short period of time. As a result of the discussion of the previous year's work, the group then discusses potential changes in projects and potential projects and studies that could improve recovery actions and progress.

Each peer reviewer will evaluate the presentations and discussion and provide verbal comments on the individual recovery actions and send them to the Program Office by 31 December. These comments should focus on implications of the work toward recovery of the two fish species.

3**) Attend and review presentations during the February meeting**

The February BC meeting consists largely of presentations of the previous year's activities conducted by the PIs. This is a great opportunity for the group as a whole to catch up on progress on individual projects in a relatively short period of time. Moreover, these presentations should reflect comments supplied by peer reviewers in original SOWs and they are often rough drafts of how data will be analyzed and interpreted in the final reports.

Each peer reviewer will make blind comments on individual presentations (a list of presentations will be provided by the Program Office) and send them to the Program Office by 31 March. These comments should focus on data analysis, presentation, and interpretation but other general comments will be welcomed. The Program Office will then compile the reviewer comments and distribute them to the BC and individual PIs. These written comments to the Program Office will not preclude any questions or comments the peer reviewers want to make orally during the meeting.

An additional meeting (half day) will occur at the end of the February BC meeting among the Program Office, BOR staff and peer reviewers to discuss 'big picture' issues in the Program, progress toward recovery, and other concerns with individual projects or the peer review process. The peer reviewers will then draft a summary of their independent reviews of the Program's progress towards recovery as well as general suggestions for improvement and send them to the Program Office by 31 March.

3) Attend workshops/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/all peer reviewers may be invited to attend workshops to provide professional and technical guidance. If a peer reviewer is invited, they will be required to provide a review of the workshop and their general opinion on discussions. The same review requirements as 1) and 2) above will apply to any special documents the Program Office asks to be reviewed. In FY 2020 one workshop is anticipated.

Rotating personnel:

The peer review process should benefit from the diverse experiences and expertise of individual reviewers. In this light, individual peer reviewers will be kept on the panel for 3-5 years and then required to take at least a 3-5 year hiatus to allow for new reviewers to join the panel. The exact timing of rotation of individuals from and onto the peer-review panel will be handled at the discretion of the Program Office and BOR.

Primary Contacts:

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Budget FY-2020:

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 2020 (includes travel, meetings, and document review).

The total budget is distributed among the four peer reviewers through individual Services Contracts with Reclamation.

Salaries:	$40,000
Travel:	$15,000
Total	**$45,000**

Future use of the Peer Review Panel is not known but they likely will be used each year to provide guidance to the Biology Committee.

San Juan River Recovery Implementation Program
Program Coordinator's Office
Fiscal Year 2020 Draft Proposal

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Cooperative Agreement #: R18PG0002
Period of Performance: 10/01/2020 to 9/30/2021

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.[1]

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 July 23, 2018 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.

[1] The Program Office includes an additional Program Biologist who is funded through the Four Corners Power Plant and Navajo Mine Energy Project Mitigation Account although travel for that position is included herein (nathan_franssen@fws.gov; 505-761-4722).

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 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 2020 includes:

$ 5,936 Congressional Briefing Document (Program Highlights) printing
$ 2,272 Newsletter (Swimming Upstream) printing
$ 4,233 Exhibit fees
$ 2,575 Exhibit repairs/replacement
$ 2,501 Educational materials
$17,517 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 2020 Public Involvement SOW is SOW 20-38 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)

Fiscal Year 2020 Program Management Budget	USFWS Funding	Program Base
Personnel/Labor Costs (Federal Salary + Benefits):		
Program Coordinator (GS-13) 0/2080 hours@ $61.41/hr	$0	$127,733
Asst. Program Coordinator (GS-12) 1560/520 hours@ $56.96/hr	$88,858	$29,619
Recovery Science Biologist (GS-12) 0/2080 @ $53.41/hr	$0	$111,093
Program Biologist (GS-9/11) 2080/0 hours @ 42.59/hr	$88,587	
Program Assistant (GS-7) 416/416 hours @ 26.01/hr	$21,640	
Personnel Sub-total	**$199,085**	**$268,445**
Travel/Lodging & Per Diem (based on published FY-2019 Federal Per Diem Rates):		
Hotel – 25 days in Farmington, NM @ $94/night		$2,350
Hotel – 40 days in Durango, CO @ $121/night		$4,840
Hotel – 16 days in Denver, CO @ $181/night		$2,896
Hotel - 3 days in St. George, UT @ $94/night		$282
Hotel – 8 days in Las Vegas, NV @ $108/night		$864
Per Diem – 25 days in Farmington, NM @ $55		$1,375
Per Diem – 40 days in Durango, CO @ $71		$2,840
Per Diem – 16 days in Denver, CO @ $76		$1,216
Per Diem - 3 days in St. George, UT @ $55		$165
Per Diem – 8 days in Las Vegas, NV @ $61		$488
Per Diem – 30 days camping @ $29 night		$870
Airfare to Denver, CO - $250 trip/9 trips		$2,250
Airfare to Las Vegas, NV - $300 trip/2 trips		$600
Airfare to St. George, UT - $800/1 trip		$800
Rental Car @ $60/day*12 days		$720
Travel/Lodging & Pier Diem Subtotal	**$0**	**$22,556**
Materials, Supplies, and Services:		
Registration Fee – UT Water Users Workshop, St. George, UT *1		$300
Registration Fee CRWUA, Las Vegas $250 *2		$500
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		$687
Vehicle Fuel - Misc trips in the SJR Basin - 10 rd trips@500 mi/trip; 18 mpg; $3.00/gal		$833
Materials, Supplies, and Services Sub-Total	**$0**	**$3,166**
Equipment:		
Supplies		$1,761
Public Notices in Local Newspapers; $40-150/meeting@ 5 meetings		$750
Office Telephone support (1/4 of total office costs)		$4,000
Printing/Copier Support		$1,749
Computer Hardware/Software (e.g., upgrades, models, database mgt., license fees)		$2,000
Outreach Materials/Publication Costs		$2,500
Equipment and Supplies Sub-total	**$0**	**$12,760**
Facilities Rental Costs for Meetings:		
Farmington@ $100/5 days		$500
Durango @$300/15 days		$4,500
Facilities Rental Sub-Total	**$0**	**$5,000**
2020 Budget Subtotal	**$199,085**	**$311,927**
Administrative charge (3%)		**$9,358**
FY2020 Total	**$199,085**	**$321,285**

Remote Biologist for San Juan River Basin Recovery Implementation Program

Principal Investigators:
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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. Efforts to hire a qualified individual began in 2017 and a selection was made in March 2018. Since this individual has yet to begin employment we are still uncertain on scope of the projects/tasks they will be asked to participate on. Therefore, similar to the FY 2018 SOW, a list of potential projects and activities this individual could participate on during FY 2020 are listed below:

- 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
- Other activities yet to be identified
- 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

Schedule:

Annually

Support of Diet Study	June-September
Rare fish augmentation	September-October
Adult Fish Monitoring	September
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:

Nonnative fish management – support of diet study in FY 2020

288 hours = ($8,902) 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 9 hours/day x 4 trips = 256 hours). As needed, the incumbent would be responsible for routine maintenance and upkeep of sampling gear and would be asked to provide shuttling service when available.

Augmentation

120 hours = ($3,709) 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.

Operation of Larval Fish Entrainment Wetland/Impoundment

- Once constructed, the incumbent would be responsible for operating the water control 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

198 hours = ($6,120)

- 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) or Clay Hills Landing. This would consist of 22 days of work (17 days @ 9 hours/day – 198 hours).

Budget at full funding level:

FY 19	**$76,939**
FY20	**$78,170**
FY21	**$79,264**

FY 2020

SJRIP - Remote Biologist

Labor Cost							
Position	**Grade/Step**	**Yearly Rate**	**Fringe**	**Salary w/ Benefits**	**Hours/Day**	**No. of Days**	**Sub-total**
Fish Biologist (1 FTE)	GS 9/2	$53,352.84	27.06%	$67,790.12			$67,790.12
Adminstrative Officer	GS 9/9	$31.89	26.12%	$40.22	9	5	$1,809.89
					Total Labor		**$69,600.01**
Travel and Per Diem	**Days**	**Rate**					**Sub-total**
Hotel Costs (4 two-day meetings)	8	$105.00					$840.00
Per Diem (Travel Day)	8	$53.25					$426.00
Per Diem (Full Day)	4	$71.00					$284.00
					Total Travel/Per Diem		**$1,550.00**
Equipment	**Miles/Qty**	**Total Miles**	**Rate**				**Sub-total**
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					**$78,170.01**
		USFWS Administrative Overhead (3%)					**$2,345.10**
		Savings from other NMFWCO-funded projects					**-$18,731.00**
		Total for Remote Biologist					**$61,784.11**

San Juan River Recovery Implementation Program
Communication and Public Involvement Plan
Fiscal Year 2020 Draft Proposal

U.S. Fish and Wildlife Service
Melanie Fischer
P.O. Box 25486, DFC, Lakewood, CO 80225
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Period of Performance: 10/01/2020 to 9/30/2021

Background

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 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.

The Upper Colorado River Endangered Fish Recovery Program and the San Juan River Basin Recovery Implementation Program each have a multi-stakeholder structure in which federal and state agencies work with public and private entities to recover endangered fish species in a manner that is consistent with federal, state, and tribal water laws. Although their structure and goals are similar, these recovery programs operate independently, working with their own program partners and governing committees to fulfill requirements detailed in their respective cooperative agreements. Nevertheless, the similarities in these programs provide for effective communication and public outreach under a coordinated effort. The funding for capital construction and ongoing operation and maintenance (O&M) for the Upper Colorado River and San Juan River Basin Recovery Programs is also tied together in Federal legislation (Public Laws 106-392, 107- 375, 109-183, 111-11 and 112-270).

Using a shared approach, the two recovery programs coordinate their outreach efforts and work with other organizations throughout the Colorado River Basin to ensure common audiences receive consistent, current, and accurate information about the endangered fishes and efforts to recover them. These audiences include the general public, elected officials, Indian Tribes, landowners, anglers, river rafters and guides, environmental organizations, water and power developers, teachers, students, and Program participants. Although the geographic coverage of these recovery programs differs within the Upper Colorado River Basin, the majority of affected parties are interested in the recovery efforts taking place for both programs.

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 receive accurate, consistent information about the endangered fishes and efforts to recover them. The Information and Education (I&E) Committee developed and approved general key messages in 2009 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.

Relationship to Long Range Plan:

Goal 6.1 Increase Public Awareness and Support for the Endangered Fishes and the Recovery Programs

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.

Objective

- 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.

Target Audiences

- News Media
- General Public
- Elected Officials at All Levels
- Land and pond owners
- Anglers
- River rafters and guides
- Educators
- Recovery Program Partners

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.

Budget

PROJECT	**UNIT COST**	**FY 20 CRRP**	**FY 20 SJRRIP**	**FY 21 CRRP**	**FY 21 SJRRIP**
Congressional Briefing Document (*Program Highlights*)	Printing: 24 pp 8.5 x 11, saddle-stitched into 9 x 12 pocket folder QTY: 1,500 = **$12,052.46(**printed through GPO and costs based on previous years); Design/layout = **$0** (in house);Shipping costs for bulk quantities**; $300** **TOTAL: $12,352.46**	$6,176[1]	$6,176[1]	$6,300[1]	$6,300[1]
Field Report (*Swimming Upstream*)	GPO Printing: 16 pp Self CVR. 4/4 8.5 x 11 Saddle-Stitched; QTY: 4,500 = **$2,907** Design/layout = **$0** (in house); Mailing Services: 2,420@.0843 each = **$204** Postage: 2,420 = **$1,042** Shipping for bulk quantities: **$300** TOTAL: **$4,453**	$2,363[1]	$2,363[1]	$2,411[1]	$2,411[1]
Aquarium Supplies UCREFRP Aquarium Supplies SJRRIP	50/50 cost share with CPW to support classroom program (Aquarium costs determined based on previous years' costs.) Aquarium supplies to start RBS in the Classroom	$2,971	$2,971	$3,060	$3,060
Exhibit Fees	Vendor fee plus noted expenses: CO Water Congress, Denver - **$1,600** CO Water Workshop, Gunnison - **$500** CO River Water Users, Las Vegas - **$3,350** (includes electricity/shipping) UT Water Users, St.George - **$2,500** (includes electricity & shipping) WY Water Assoc., Casper - **$150** CO Rocky Mountain Coal Institute Annual Meeting **-$300** Animas River Festival $**300** Navajo Nation Fair **$500** **TOTAL: $9,200.00**	$4,600[1]	$4,600[1]	$4,738[1]	$4,738[1]

[1] *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 exhibit.	$2,653[1]	$2,653[1]	$2,706[1]	$2,706[1]
Ute Water Festival-UCREFRP, 2 days each May, Grand Junction, CO. Children's Water Festival, Durango, CO SJRRIP	2 people @ 45 hrs x $41/hr = $3,690 3 people @ 16 hrs x $46/hr = $2,208 Miscellaneous supplies = $242 **TOTAL: $6,140**	$6,140	$3,070	$6,263	$3,210
Miscellaneous Supplies/Equipment	Specialty paper (for photos and briefing book inserts) and other design materials.	$2,100	-0-	$2,163	-0-
Educational Materials <u>FY 18</u> New or replacement item (TBD) <u>FY 19</u> New or replacement item (TBD)	**Endangered Fish Tattoos**: 23,000 = $3,496 **Lil Suckers**: 1,000 = $2225 **Endangered Fish Charms with half circle-used for key rings, zipper pulls and glass charms**: Colorado pikeminnow (Shared) QTY:1050 = $1,628; Razorback sucker (Shared) 1050 = $1,628; Humpback chub 525 = $866; Bonytail 525 = $866 **Endangered Fish Lapel Pins**: Colorado pikeminnow (Shared) QTY:1050 = $1,628; Razorback sucker (Shared) 1050 = $1,628; Humpback chub 525 = $866; Bonytail 525 = $866 **Paper Stickers:** 5000 each set-2.5x4", 500 per roll 4-color = $2,444 **Magnets:** 4 versions; 3 ½ x 2", 4-color, QTY of 6,000 ea. = $3,495 **Rulers:** 12" 4/4 inches/metric 10,500 = $3,485 **Can Koosies:** 500 ea of 4 / 2000 = $3,100 **Vinyl Fish Stickers:** 2750 ea of 4 = $3,479 **Trading Cards:** 2.5x3.5 4/1 12pt C1S 25,000 ea of 4 = $2,486 **TOTAL:$34,186**	$34,186	$4,806	$35,211	$4,950
Signs/Exhibits/ Interpretive Signs	**Design/Produce/Install**: signs/exhibits/interpretive signs at locations with high visitation in target communities.	$5,000		$5,150	
TOTAL		**$66,189**	**$26,639**	**$68,002**	**$27,375**

IF ADDITIONAL FUNDS BECOME AVAILABLE:

Reprint Historic Doc	60 pp 1/1 8.5 x 11 Perfect Bind QTY: 5000	$12,000		TBD	
Print/Direct Mail 6 x 11 postcard Western Slope	25 Adult Age To: 40 Income $0 - $49,999 Gender Male 3431 pieces: mailing list, printing, address and sort, postage and deliver to USPS Mail quarterly	$8,960		$9,139	
Billboards	Billboard message in Craig CO Junior Bulletin 6’ x 12’ $630.00 per month plus setup of $150.00 (3 months)	$2,040		$2,081	
Radio Spots	Series of radio spots targeting Western Slope	$2,800		$2,856	
Movie	5-10 min, featuring both programs; produced in-house, place on website, distribute through Facebook and other outlets.	$2,000		$2,040	
TOTAL		**$98,989**	**$26,639**	**$84,118**	**$27,375**