FISCAL YEAR 2017 ANNUAL BUDGET AND WORK PLAN

Approved August 15, 2016

SJRRIP FY2017 AWP Budget Estimate (August *2016*)

SOW	Title	Agency	2017 Hydropower Revenue	Capital Funding[1]	Partner In-Kind Funding	FCPP Funded Projects	2017 Grand Totals	FCPP Available Funding and Balance
	Element 1 - Management and Augmentation of Populations and Protection of Genetic Integrity							**$40,600**
5	Determine effective number of RBS & CPM breeders in SJR	SNARRC	$0			$44,111	$44,111	
7	Horsethief Canyon Ponds O&M at Ouray NFH	FWS, GJ	$37,216				$37,216	
8	Stocking & Acclimation of Age-0 CPM & Age-1+ RBS	FWS, ABQ	$29,735				$29,735	
9	Colorado Pikeminnow Fingerling Production (combined with 9)	FWS, SNARRC	$108,659				$108,659	
10	Rearing Razorback Suckers (combined with 8)	FWS, SNARRC	$86,072				$86,072	
11	RBS Augmentation/NAPI Pond Management	NN, FWS	$130,445				$130,445	
12	SJRIP PIT Tags (purchase)	BR	$60,000				$60,000	
	Subtotal		**$452,127**	**$0**	**$0**	**$44,111**	**$496,238**	**-$3,511**
	Element 2 - Protection, Management, and Augmentation of Habitat							**$153,045**
13	Maintenance and Operation of SJR Hydrology Model	BR, SLC	$74,860				$74,860	
14	Stream Gaging and Flow Measurements	BR, USGS	$8,220				$8,220	
15	Operation of PNM Fish Passage Structure	NN	$112,564				$112,564	
16	San Juan and Animas Rivers Temp Gauges	BR	$20,600				$20,600	
C-1	Capital Projects Management	BR		$50,000			$50,000	
C-2	PNM Fish Passage O&M	PNM					$0	
C-3	Hogback Fish Weir O&M	PNM					$0	
C-4	Fruitland Diversion Dam Fish Passage and Screens	NN		$972,000			$972,000	
FCPP	SJR Habitat Restoration Phase III	TNC/NN			$150,000	$153,045	$303,045	
	Subtotal		**$216,244**	**$1,022,000**	**$150,000**	**$153,045**	**$1,541,289**	**$0**
	Element 3 - Management of Non-Native Aquatic Species							**$50,361**
17-18	SJR Nonnative Species Monitoring and Control[2]	FWS, UDWR	$499,902			$50,361	$550,263	
	Subtotal		**$499,902**	**$0**	**$0**	**$50,361**	**$550,263**	**$0**
	Element 4 - Monitoring and Evaluation of Fish and Habitat in Support of Recovery Actions							**$103,463**
19	Sub-Adult/Adult Lg-Bodied Fish Monitoring	FWS, GJ	$131,848				$131,848	
20	YOY/Small-Bodied Fish Monitoring	NMDGF	$89,842		$40,000		$129,842	
21	RBS/CPM Larval Surveys (Combined SOW)	ASIR	$242,142				$242,142	
21a	RBS/CPM Larval Surveys -Upstream Expansion of Study Area	ASIR	$33,367				$33,367	
22	Specimen Curation/Identification	UNM	$49,393				$49,393	
23	Integration of Long-term Monitoring Data (combined w SOW 22)[2]	UNM	$87,469				$87,469	

24	CPM Recruitment limitations and trophic dynamics	Purdue	$67,520				$67,520	
25	Habitat Monitoring Workplan (Task 2A)	ERI, MEC	$79,844				$79,844	
30	Razorback suckers in SJR-Lake Powell complex (4-yr. project)	KSU	$113,382				$113,382	
31	SJR Phase II Channel Restoration Site Monitoring	TNC	$0			$94,134	$94,134	
32	PIT Tag Antennas O&M & Evaluation of Data	BR, FWS	$49,250				$49,250	
33	Post-peak release digital imagery	ERI	$0	$52,500			$52,500	
34	2016 Nonnative Control Program Assessment Workshop[3]	BR, FWS	$20,000				$20,000	
	Subtotal		**$964,057**	**$52,500**	**$40,000**	**$94,134**	**$1,150,691**	**$9,329**
	Element 5 - Program Coordination and Assessment of Progress Toward Recovery							**$126,000**
35	Base Funds and Contract Management BR	BR, SLC	$223,255				$223,255	
36	Peer Review[3]	BR, FWS	$60,000				$60,000	
37	Program Management FWS	FWS, ABQ	$292,706		$200,232		$492,938	
FCPP	SJRRIP Biologist (FCPP/NMEP)	FWS	$0			$126,000	$126,000	
	Subtotal		**$575,961**	**$0**	**$200,232**	**$126,000**	**$902,193**	**$0**
	Element 6 - Information and Education							
	Education and Outreach (funds transfer to UCRRIP; in SOW 37)	FWS, ABQ	$16,000				$16,000	
	Subtotal		**$16,000**	**$0**	**$0**	**$0**	**$16,000**	
	SJRRIP Total		**$2,724,291**	**$1,074,500**	**$390,232**	**$467,651**	**$4,656,674**	**$5,818**
	Estimated Base Funds (2016 Amt. x 0% CPI)		**$2,724,095**			**$473,469**		
	Hydropower Revenue-Funded Projects		**$2,724,291**			**$467,651**		
	Carry over from FY2016							
	Estimated available 2017 funds to expenditures		**-$196**			**$5,818**		
	Notes							
	[1] Reclamation capital funds or state capital funds managed by NFWF; [2] Placeholder; [3] Cost estimate							
	Projects not funded in 2017							
New	Determining daily growth rates of larval Razorback Sucker in the San Juan River (unfunded 2016 project)	ASIR	$52,111					
New	SJR waterfall passage evaluation proposal 2016	BR	$30,000					
New	Analysis for Determining Natal Origin Razorback Sucker in the San Juan River (unfunded 2016 project)	ASIR	$32,918					
New	Population Estimates	FWS-UDWR	$442,529					

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July 2016

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

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Co-Invest./Cooperators: Jennifer Kennedy, American Southwest Ichthyological Researchers, L.L.C. (ASIR), Albuquerque, NM

Introduction & Justification

Recovery plans for many endangered fishes include the production and release of hatchery reared individuals to reestablish or augment wild populations in an effort to restore self-sustaining populations. Propagation programs have been implemented with two major objectives: increase population size and avoid unnatural loss of 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. Understanding factors that limit success in achieving a self-sustaining population can be difficult to identify. Monitoring various aspects of population dynamics allows managers to implement an adaptive management approach, which provides opportunity to maximize the rate and extent of learning from current management actions to better understand how to achieve management goals.

In an effort to mitigate further loss of two federally listed species, Razorback Sucker (*Xyrauchen texanus*) and Colorado Pikeminnow (*Ptychocheilus lucius*), augmentation of captive-reared individuals into the San Juan River commenced in the mid-1990s and has continued through present day (USFWS 2005; USFWS 2015). Annual monitoring of survival, reproduction, and recruitment of augmented populations has been supported through the San Juan River Recovery and Implementation Program (SJRRIP). Survival of augmented individuals is the first component to reestablishment. Mark-recapture data on PIT tagged individuals have provided quantifiable survival estimates of stocked Razorback Sucker, which in turn has prompted additional research investigating ways to increase first-year survival (Franssen, N.R. per. comm.). Reproduction and survival of offspring to a reproductive age (recruitment) is the second step to reestablishing a self-sustaining population. Although recruitment of Colorado Pikeminnow and Razorback Sucker is limited, San Juan River larval fish surveys have documented successful reproduction of both species (Farrington et al. 2015); however, surveys do not quantify the number of individuals in the population that have reproduced each year. A successful augmentation program requires a large portion of the reestablished population to reproduce annually to maintain high levels of genetic diversity. Quantifying the number of individuals that are reproducing annually will provide insight into the augmentation program and additional management actions needed to reestablish a self-sustaining population.

Population-level reproductive success can be difficult to quantify from field studies, especially for highly fecund species where few individuals can produce a large number of offspring. There is substantial evidence that shows reproductive output depends on environmental conditions and age- or size-related differences with older/larger fish producing a greater number of eggs relative to younger fish (Lauer et al. 2005; Lambert 2008). For example, relative fecundity for Razorback Sucker is high and increases with length. In addition, batch spawning has 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). Such reproductive strategies further compound the ability to determine individual contribution over a reproductive season. Consequently, understanding population-level reproductive success for long-lived, highly fecund, iteroparous species such as Razorback Sucker and Colorado Pikeminnow can be difficult to quantify. In an effort to better understand the number of individuals reproducing in the San Juan River each year (effective number of breeders, N_b), tissues from specimens collected from annual larval fish surveys will be used to calculate N_b using molecular methods.

Compared to traditional population monitoring, molecular methods can provide information about the augmentation program that cannot be quantified from field surveys. For iteroparous species with overlapping generations N_b is an ideal metric to monitor because it requires data from a single cohort within a breeding season. In addition, it is a useful metric for understanding eco-evolutionary processes in age structure species due to its defined seasonal reproductive bouts (Waples et al. 2013; Waples et al. 2014). Single cohort, N_b, estimates have been shown to be reflective of the effective number of breeders in a reproductive season (Waples et al 2014). Obtaining N_b estimates for the endangered fishes of the San Juan River can provide information regarding recovery limitations, such as understanding if a bottleneck to recruitment is influenced by limited population-level reproduction.

Annual genetic monitoring of larval Razorback Sucker collected from Lake Mohave between 1997 and 2010 showed a significant increase in N_b over a fourteen year period (e.g. N_b=743 (1998); N_b=49,984 (2005)). Results suggest management actions effectively reduced the variance in population-level reproductive success, thus further reducing effects of non-neutral processes such as hatchery-induced selection, non-random survival or relaxation of selection pressures (Carson et al. 2016). Similar analyses conducted on San Juan River Razorback Sucker and Colorado Pikeminnow can be used to determine if current management actions (e.g. augmentation, habitat restoration, flow regulations) are significantly increasing reproductive success. Understanding whether or not reproduction is limited is necessary to further evaluate if other biological and/or environmental factors (i.e. population numbers, spawning habitat, or resource availability) are limiting recruitment and recovery. N_b results can provide the SJRRIP data that can provide additional insight into current management actions, which can then be incorporated into future management decisions regarding program success.

Objectives

Using wild caught larval fish currently held at the Museum of Southwestern Biology, the specific objectives of this study are to:

1. Quantify the effective number of breeders (N_b) for Razorback Sucker annually from 2009-2015.
    a. Determine if results correlate with augmentation efforts.
2. Quantify the effective number of breeders (N_b) for Colorado Pikeminnow when samples sizes for any given year are greater than 25.

Study Area

San Juan River larval surveys are conducted along a 140 mile section between Shiprock, NM, and Clay Hills, UT. Samples collected for genetic analyses will represent the spatial and temporal distribution of larval fish collections in this section.

Methods

Approximately 1,200 larval samples will be examined. Larval fish collections from 2009-2015 were preserved in 95% ethanol and are currently stored in the Museum of Southwestern Biology. Prior to 2009, samples were preserved in 10% formalin and are not viable for genetic analyses. Tissue subsamples from the posterior portion of each specimen will be collected from 120 Razorback Sucker for each year from 2009-2015. The anterior portion of all specimens will be saved for otolith studies. Spawning dates are back-calculated based on ontogenetic stage (Farrington et al. 2015). Genetic sampling will strive to comprise a minimum of three (N=40) or four (N=30) spawning periods, depending on available data, to ensure samples are not collected from a single spawning bout. In addition, samples collected during each spawning period will cover the relative abundance and distribution of larval collections to reduce the potential bias caused by the collection of siblings at any one site. Collections for Colorado Pikeminnow are far more limited than Razorback Sucker. Three years have reasonable sample sizes to quantify the effective number of breeders. For 2011 and 2015, approximately 30 larval Colorado Pikminnow were collected, and all specimens will be included in the analyses for these two years. In 2014, over 300 larval Colorado Pikeminnow were collected; thus, genetic sampling will follow the same protocol used for Razorback Sucker.

Genomic DNA will be extracted from tissues following standard protocols used at Southwestern ARRC. Fourteen microsatellite loci developed for evaluating the genetic diversity of Razorback Sucker broodstock (Wilson 2012) will be amplified for Razorback Sucker. If necessary, additional loci developed by Dowling and Marsh (2011) will be added to the data set. Twenty polymorphic microsatellite loci developed and screened at Southwestern ARRC will be amplified for Colorado Pikeminnow (Martin et al. 2015). Samples will be processed on an ABI 3130xl Genetic Analyzer and scored using GeneMapper^{TM} 4.0 software (Applied Biosystems). A second researcher will perform a 10% quality assurance/quality control of samples to ensure accuracy. Departures from Hardy-Weinberg Equilibrium (HWE) and linkage disequilibrium (LD) will be tested using Genepop v4.2 (Raymond and Rousset 1995), and alpha (0.05) will be adjusted for multiple comparisons using the Benjamini and Yekutieli (2001) method false discovery rate (Narum 2006). Effective number of breeders will be calculated using NeEstimator v.2 (Do et al. 2014) for each cohort. Although, NeEstimator v.2.01 is more commonly used to calculate effective population size (N_e) per generation of a species, the same linkage disequilibrium method LDNE (Waples and Do 2008) can be applied to calculate N_b which is defined by a cohort within a single breeding season. Results will provide a seven year data set that can be compared annually to estimates of population size, environmental variables, and stocking efforts.

Schedule:

Completion of genetic analysis	June 1, 2017
Final Report	September 30, 2017

Intended Method of Information Dissemination:

Dissemination of the results will include a final report and presentation of project results at the Upper Basin/San Juan Researcher's meeting.

Budget Narrative

The requested project funds are used to purchase replacement items as needed. Example items in each materials/supplies category: Extractions – sample tubes, DNA extraction kits, sample storage plates, ethanol; PCR Reactions – polymerase, oligonucleotides, buffer, magnesium, PCR plates, plate sealing film, primers; Genetic Analyzer Costs – size standard, buffer, polymer, reaction plates, formamide, capillary array; Other – filtered tips, gloves, tubes, solution basins, storage boxes.

Unlike other projects, purchases of supplies are not kept for one project alone. Supplies are kept on hand and used as projects are started. Many of the items have expiration dates, so as a project is started in our work flow we utilize inventory we have on hand. Project funds are used to replace what is used and needed at that point in time. Over the years we have estimated about how much of each item is used per sample and calculated a per sample cost. For example, the array in the genetic analyzer ($1,000/per array) will last for a few thousand samples so we use it for multiple projects until we need to replace it. It does not make sense to replace it after every project. Likewise, we purchase items such as plastics (tips, plates, tubes) and ethanol in bulk to reduce prices, so again these are shared across projects but we have estimated how much is used per sample. If purchased in small quantities for a single project prices would go up. In doing things this way, sharing across projects and purchasing in bulk, money is saved, efficiency is increased, and waste decreased.

Detailed Spending Plan

1. PERSONNEL		
A. Laboratory Work		
1 Bio/Geneticist (GS 9; 240 hours -3.0 pay periods) @$34.05/hr		$8,172
B. Report Writing		
1 Bio/Geneticist (GS13; 130 hours -1.63 pay periods) @$42.15/hr		$5,480
	Subtotal Personnel	$13,652
2. MATERIALS/SUPPLIES		
A. Extractions		$3,061
B. PCR Reactions		$15,465
C. Genetic Analyzer Costs		in kind contribution
D. Other (tubes, tips, etc.)		$8,238
	Subtotal Supplies	$26,764
	Total	**$40,416**
Southwestern ARRC Utilities		
-Electrical, (approx. 4,259 KW/h @ .34569 per KW/h) =		$1,233
Administrative and Overhead Costs Regional Office @ 3%		$2,462
Project Total FY2017		**$44,111**
Project Total FY2018		**$0**

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Rearing Endangered Fish at the Horsethief Canyon Native Fish Facility Ponds for Stocking into the San Juan River
Draft Fiscal Year FY-2017 Project Proposal
31 March 2016

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

Reporting Dates: 10/1/2016 through 9/30/2017

Operation & Maintenance of the Horsethief Canyon Native Fish Facility Ponds Fiscal Year 2017 Project Proposal 31 March 2016

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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 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, and Bonytail.

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 San Juan River Basin Recovery Implementation Program (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.

Currently, the one surface acre of grow-out ponds allotted to the SJRBRIP is being used to rear Razorback Sucker that are progeny of paired matings of appropriate genetic lineage, produced annually from Razorback Sucker broodstock being held at Ouray NFH-GVU. After spawning, fertilized eggs are reared in flow-through egg jars at HCNFF. As these fish approach 200 mm TL, they are stocked back out into grow-out ponds at HCNFF to be reared until they reach their target stocking size ($\geq$ 300 mm TL). It is anticipated that 2,000-4,000 Razorback Sucker ($\geq$ 300 mm TL) can be reared in the one surface acre of ponds allotted to the SJRBRIP. Razorback Sucker of the appropriate target stocking size will be made available to the SJRBRIP in October of each calendar year for stocking (after the annual fall fish community monitoring studies are completed).

The SJRBRIP will have the option to change the management approach and species being reared in their ponds 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 species being reared, etc. Changes in numbers or sizes of fish desired, species being reared, etc. may lead to adjustments in future years' budgets. For instance, if the SJRBRIP decides to rear Colorado Pikeminnow (a species not currently being held on station at Ouray NFH-GVU), appropriate lead time will be needed to arrange attaining young fish from another facility.

Cost Share with Upper Colorado River Endangered Fish Recovery Program

As stated earlier, 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

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-2017 Budget:

(Based on projected FY-2017 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 @ $54.63/hr X 2 people (130 total hours covered by SJRBRIP or 65 hr/person)	214,150	7,153
Biological Technician (GS-7) – 1,960 hours @ $34.71/hr (65 total hours covered by SJRBRIP)	68,032	2,272
Biological Technicians (GS-5) – 600 hours @ $25.70/hr X 2 people (40 total hours covered by SJRBRIP or 20 hr/person)	30,840	1,030
Overtime:		
Biological Technician (GS-7) – 120 hours overtime @ $52.07/hr (4 total hours of overtime hours covered by SJRBRIP)	6,248	209
Biological Technician (GS-5) – 40 hours @ $38.55/hr X 2 people (2.7 total hours covered by SJRBRIP or 1.35 hr/person)	3,084	103
Subtotal	322,354	10,767

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

Project Leader (GS-14) – 320 hours @ $85.92/hr (10.7 total hours covered by SJRBRIP)	27,494	918
Administrative Officer (GS-9) – 320 hours @ $46.06/hr (10.7 total hours covered by SJRBRIP)	14,739	492
Subtotal	42,233	1,410

In-Kind Services

Bozeman Fish Technology Center		
Grind and sift fish food for larval Razorback Suckers	<$2,814>	<94>

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

Fish Food (from Skretting USA)

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

Trout # 1 Crumble: 1,000 lbs @ $1.18 per lb = $1,180		
Trout # 2 Crumble: 1,000 lbs @ $1.17 per lb = $1,170		
1.0 mm RZ Grower 2,000 lbs @ $1.00 per lb = $2,000		
2.0 mm RZ Grower 4,000 lbs @ $1.00 per lb = $4,000		
3.0 mm RZ Grower 8,000 lbs @ $1.00 per lb = $8,000		
4.0 mm RZ Grower 2,000 lbs @ $1.00 per lb = $2,000		
Fish Food Subtotal	73,400	2,452

Chemicals and Fertilizer

Exact use of the money in this line item will vary from year to year depending on specific chemical/fertilizer/herbicide needs in a particular year. It will also depend on if there are outbreaks of pathiogens 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 = $455
5 @ $85/each

24-hr belt feeder = $2,700
Repair/replace 10 annually @ $270 each

Waders = $225
Replace 3 pair annually @ $75 each

Duraframe dip nets = $1,500
Replace 5 annually @ $300 each
Digital scale repair, replace battery, recalibration = $1,500
(3 scales per year @ $500 per service per scale)
YSI brand water chemistry meters = $2,000
(dissolved oxygen, pH, salinity) – repair, replace, recalibrate annually
HVAC service = $1,200
Done annually
Service fish food cooler refrigeration unit = $750
Done annually
Service the backup generator = $700
Done annually
Pump & motor maintenance/service = $5,700
Labor & parts to rebuild:
One portable water pump/year = $1,700
One hatchery motor/pump set/year = $4,000
Fluorescent hatchery lights = $2,200
Replace ½ of all hatchery lights annually
Tank Cleaning Supplies = $235
Scotch-Brite pads, scrubbing handles
Maintenance tool replacement = $400
Screwdrivers, crescent wrenches, monkey wrenches, vise grips, hammers, rubber mallets, ratchets & sockets, drills & drill bits, chop saw blades
Plumbing supplies = $2,000
PVC pipe, couplers, primer & glue
Refill compressed oxygen bottles = $2,500
50 per year @ $50 each
Air stones, tubing couplers, hose clamps = $1,500
0.4" air stones – 20 @ $50 each = $1,000
Tubing, couplers, hose clamps = $500
Screens and pond boards = $3,700
10 screens @ $300/screen
PVC lumber for making screen frames
Metal mesh for making screens
Redwood pond boards
100 boards (2" X 8" X 6') @ $7 each = $700

Koch rings = $500
For aerating water in packed columns
Sand = $2,000
For sand filters - 1 pallet = twenty 80 lb bags

Hatchery Supplies Subtotal	31,765	1,061

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 (@ $365/month lease = $12.17 per

day based on 30 days in an "average" month + $0.33/mile)		
Hatchery pickup truck = $9,803		
24-Road Hatchery Building to Horsethief Canyon Native Fish Facility ponds (45 mile round trip X 1 vehicle X 365 days per year = 16,425 total miles per year)		
Fuel		
Diesel fuel = $350		
For Kubota tractor – one 55-gallon drum of diesel @ $250 (includes fuel, barrel & delivery)		
For back-up generator at hatchery – 25 gallons @ $4.00/gallon		
Repair/replace shocks, struts, brakes = $800		
Vehicles and Fuel Subtotal	10,953	366
Electricity = $6,800		
For pump and spawning shed at the Horsethief State Wildlife Area brood ponds		
8 months operation at $850/month		
Electricity Subtotal	6,800	227
Operations Subtotal	153,223	5,118
Subtotal for All Shared Costs	517,810	17,295

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 @ $54.63/hr	4,370
(2 days X 2 people/day for fish harvest)	
(6 days X 1 person/day for PIT-tagging)	
Biological Technician (GS-7) – 136 hours @ $34.71/hr	4,721
(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 @ $25.70/hr	8,224
(2 days X 3 people/day for fish harvest)	
(6 days X 5 people/day for PIT-tagging)	
(2 stocking trips X 2 days each X 1 person)	
Subtotal	17,315
Lodging and Per Diem (Based on Published FY-2016 GSA Per Diem Rates)	
Lodging	
2 nights lodging in Farmington, NM X 2 people at $89.00/night =	356
Per Diem	
4 days hotel rate (Farmington, NM) X 2 people at $51/day =	408
Subtotal	764
Fuel	
Stocking truck (gets 8 miles per gallon) X 2 trips from Grand Junction, CO to Farmington, NM (660 miles round trip) X 2 trips (= 1,320 total miles)	

= 170 gallons of gas at $4.00/gallon	678
Water pump for tempering fish	
= 20 gallons gas at $4.00/gallon	80
Subtotal	758
Subtotal for Costs Unique to SJRBRIP	18,837

Total of All Costs Incurred by SJRBRIP:	
USFWS-CRFP (Grand Junction, CO) Total	$36,132
USFWS Region 6 Administrative Overhead (3.00%)	$ 1,084
USFWS Region 6 Total	**$37,216**

Cost/Fish Comparison:
Workplan total cost in FY-2017 = $37,216
Estimated production in FY-2017 = 2,000-4,000 fish
For 2,000 Razorback Sucker produced, the cost/fish = $18.61
For 3,000 Razorback Sucker produced, the cost/fish = $12.41
For 4,000 Razorback Sucker produced, the cost/fish = $ 9.30

Augmentation of Age-0 Colorado pikeminnow and Age-1+ razorback sucker in the San Juan River Fiscal Year 2017 Project Proposal

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Cooperative Agreement #'s:
USFWS – NMWFCO R13PG40051

Period of Performance: 9/20/2013 to 9/30/2017

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 Colorado Pikeminnow and Razorback Sucker in the San Juan River Basin (Basin) while water development proceeds in compliance with all applicable federal, state, and tribal laws (SJRIP 2014). Recovery of Colorado Pikeminnow, as listed in the recovery goals, is dependent on the maintenance of a wild population of at least 2,600 adults in the Green River subbasin and at least 700 adults in the Upper Colorado River subbasin, as well as a target of 1,000 age 5+ (>300 mm TL) in the San Juan River subbasin. Delisting criteria include a self-sustaining population that exceeds 800 adults maintained in the San Juan River subbasin. Razorback sucker recovery criteria are dependent on the establishment of four self-sustaining populations of 5,800 adult fish each; two populations in the Upper Colorado River Basin (one population in the Green River subbasin, the other in either the Colorado River or San Juan River subbasins) and two populations in the Lower Colorado River Basin (SJRIP 2014).

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

Similarly, after the failure to collect any wild Razorback Sucker in the San Juan River during three years of intensive studies (1991-1993) the 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 about recovery potential and habitat suitability for the Razorback Sucker in the San Juan River between river mile (RM) 158.6 at the Hogback Diversion structure near Waterflow, NM and Lake Powell near Clay Hills, UT RM 3 (Maddux et al. 1993). Subsequently, Critical Habitat for Razorback Sucker and Colorado Pikeminnow was designated as between the Hogback Diversion structure (RM 158.6) downstream to Neskahai Canyon (RM-35.0) in Lake Powell; approximately 35 river miles below the waterfall which demarcates RM 0.0 on the San Juan River (USFWS 1994). Between March 1994 and October 1996, 942 Razorback Suckers were stocked into the San Juan River at four stocking sites (RM 158.6, 136.6, 117.5, and 79.6). Data gathered on these fish identified habitat types being used year-round by Razorback Sucker in the San Juan River, and provided information on movements, survival, and growth rates. Based on the successes of the experimental stocking study, a full-scale augmentation effort for Razorback Sucker in the San Juan River was initiated with the *Five-Year augmentation plan for razorback sucker in the San Juan River* (Ryden 1997). In February 2003 the SJRIP-BC extended the augmentation effort for Razorback Sucker with *An*

augmentation plan for razorback sucker in the San Juan River: An addendum to the five-year augmentation plan for razorback sucker in the San Juan River (Ryden 2003). However, due to changes in augmentation protocols and difficulties in producing requested numbers of fish the eight-year addendum to the original plan was delayed in initiation until 2009. The current augmentation plan (2009-2016) calls for the stocking of 91,200 Razorback Suckers over an 8-year period, or ≥11,400 fish per year, from a combination of fish reared in a hatchery (currently, Ouray National Fish Hatchery – Grand Valley Unit [Ouray NFH-GVU] or the Southwest Native Aquatic Resources and Recovery Center [SNARRC]) and Razorback Suckers that are grown out in ponds on Navajo Agricultural Products Industry (NAPI) land. A draft, revised, Razorback Sucker Augmentation Plan (Furr 2016) was submitted to the Program's Biology Committee in February 2016 for review. It has been recommended that the Program continue to stock all available Razorback Sucker into the San Juan River and its tributaries with a goal of stocking at least 6,500 fish (≥300mm TL) annually.

The augmentation programs for the Colorado Pikeminnow and Razorback Sucker populations in the San Juan River are related to the 2015 SJRIP Long Range Plan (LRP). These activities are specifically addressed in the following Elements, Goals, Actions, and Tasks:

Element 1. Specific goals, actions, and tasks

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

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

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

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

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

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

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

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

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

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

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

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

Task 1.2.1.2 Identify, describe, and implement strategies for improving survival and retention of stocked razorback sucker and Colorado pikeminnow, including acclimation prior to stocking, size of fish stocked, time and location of stocking, physiological conditioning, and predator avoidance.

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

Objectives for Fiscal Year 2017

1. Coordinate with SNARRC, to procure and stock Colorado Pikeminnows according to guidelines set forth in *Augmentation of Colorado Pikeminnow (*Ptychocheilus lucius*) in the San Juan River: Phase II, 2010-2020* (Furr 2010)
    a. Annually stock ≥400,000 age-0 Colorado pikeminnow.
2. Coordinate with SNARRC, Navajo Nation Department of Fish and Wildlife (NNDFW), and Ouray NFH-GVU to procure and stock Razorback Suckers according to guidelines set forth in *An augmentation plan for razorback sucker in the San Juan River* (Ryden 2003)
    a. Stock at least 91,200 RBS (> 300 mm TL) during eight year stocking period or 11,400 per year.*
3. Identify and use multiple stocking locations to expand range and reduce potential for catastrophic loss of an entire year class at a single stocking location (Furr 2011). Stock Colorado pikeminnow according to guidelines defined in *Stocking plan and protocol for the augmentation of Colorado pikeminnow (*Ptychocheilus lucius*) in the San Juan River* (Furr and Davis 2009). Stock Razorback Suckers according to guidelines defined in *Stocking plan and protocol for the augmentation of razorback sucker (*Xyrauchen texanus*) in the San Juan River* (in preparation)
4. Update and revise the Colorado Pikeminnow Augmentation Plan, as needed.
5. Provide summarization report on timing and location of individual stockings, numbers, and age classes while relating information to fulfillment of recommended stocking numbers as outlined in the augmentation plan.

* current goals, based on availability of Razorback Sucker, are to stock ≥6,500 (>300mm TL) fish

Methods and Approach

Objective 1.a. Age-0 Colorado Pikeminnows will be annually reared and harvested by SNARRC and delivered via standard distribution unit to the San Juan River. Fish will be stocked in the fall of each year, post irrigation season, to eliminate the risk of fish entrainment in irrigation canals. When possible, age-0 Colorado Pikeminnow will be acclimatized to a

variety of conditions (i.e. flow, temperature, physical/environmental characteristic, etc.) for up to 72 hours prior to release into the San Juan River.

Objective 2.a. SNARRC will stock approximately 10,500 Razorback Suckers (≥200 mm total length) into three NAPI ponds (3,500 fish/pond;). Grow-out, harvesting, and stocking via standard distribution unit into the San Juan River will be conducted by NNDFW annually with assistance from NMFWCO. When possible, fish will be stocked in the fall of each year, post irrigation season, to eliminate the risk of fish entrainment in irrigation canals. Ouray NFH-GVU will provide the SJRIP Augmentation Program with 2,000-4,000 Razorback Suckers (≥300 mm TL) annually. All Razorback Suckers from Ouray NFH-GVU will be hard released at four specified locations as part of a stocking Source and Location comparison being conducted by NNDGF, the SJRIP Program Office, and NMFWCO. By comparing differences in subsequent recapture rates, this stocking study will aid the Program in comparing survival and retention of fish stocked from Ouray NFH-GVU vs. NAPI, and determine if fish from either source had better survival and retention rates at a particular stocking location(s).

Objective 3. New Mexico FWCO will continue to identify suitable stocking sites throughout the basin. Site selection for Colorado pikeminnow will continue under in *Stocking plan and protocol for the augmentation of Colorado pikeminnow (*Ptychocheilus lucius*) in the San Juan River* (Furr and Davis 2009).

Objective 4. New Mexico FWCO will collate all pertinent stocking information including, but not limited to, timing, location, environmental conditions, size of fish, and numbers stocked. These data will be entered into a standardized database that will be provided to the Program Coordinators office for deposition. These data and subsequent recapture data will be used to evaluate stocking effectiveness.

Products/Schedule

An electronic data file will be provided for inclusion in the centralized database by 31 December 2017. A draft summary report detailing findings will be submitted to the San Juan River Implementation Program, Biology Committee, by 31 March 2018. Revisions will be completed and a final annual report will be submitted by 1 June 2018.

Literature Cited

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

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

FY 2017 Proposed Budget:

Personnel/Labor Costs (Federal Salary + Benefits)	
Fish Biologist (GS-11-6) – 40 days @ $394/day	$ 15,760.00
Age-0 Colorado pikeminnow stockings (Objective 1.a): (1 person x 2 days/trip x 1 trip)	
Age-1+ razorback sucker stockings (Objective 2.a): (1 person x 4 days/trip x 2 trips)	
Reporting/Data Management (Objective 2) (1 person x 30 days)	
Fish Biologist (GS-9-6) – 10 days @ $325/day	$ 3,250.00
Age-0 stockings (Objective 1.a): (1 person x 2 days/trip x 1 trip)	
Age-1+ razorback sucker stockings (Objective 2.a): (1 person x 4 days/trip x 2 trips)	
Supervisory Fish Biologist (GS-13-6) – 5 days @ $561/day (Project oversight and review)	$ 2,805.00
Project Leader (GS-14-8)- 4 days @$701/day	$ 2,804.00
Sub-total	**$ 24,619.00**
Travel and Per Diem (Based on Published FY-2016 Federal Per Diem Rates)	
Hotel Costs – 20 nights ($89/night – single occupancy)	$ 1,780.00
Per Diem (Hotel Rate) – 20 days @ $51/day	$ 1,020.00
Sub-total	**$ 2,800.00**
Equipment	
Vehicle Maintenance & Gasoline 2,500 miles @ $0.58/mile (includes costs associated with gasoline/diesel fuel, vehicle maintenance)	$ 1,450.00
Sub-total	**$ 1,450.00**
USFWS-NMFWCO Total	$ 28,869.00
USFWS Region 2 Regional Office Administrative Overhead (3%)	$ 866.00
USFWS Region 2 Total	**$ 29,735.00**

Out-year funding

FY 2018 ..... $30,607
FY 2019 ..... $31,519
FY 2020 ..... $32,480
FY 2021 ..... $33,461

COLORADO PIKEMINNOW PRODUCTION and RAZORBACK REARING of SUBADULTS at the SOUTHWESTERN ARRC, Dexter, NM
San Juan River
FY 2017-2021

IA# R13PG0035

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

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

The U.S. Fish and Wildlife Service (USFWS) has developed extensive infrastructure and expertise at Southwestern ARRC to successfully contribute to recovery programs and the facility has been totally devoted to the maintenance, propagation and culture of threatened and endangered fish species for forty years. During that period it has successfully cultured razorback

sucker, bonytail, humpback chub and Colorado pikeminnow of the Colorado River system and currently maintains large genetically diverse broodstocks. Over the years staff have developed successful spawning, culture and distribution methodologies for the species that are still used today. The facility utilizes an abundant water supply to produce over 2.0 million fish annually.

Facilities

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

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

Water

An abundant supply of fish culture water is supplied by five shallow aquifer wells (150 feet in depth) capable of pumping a combined 2,000+ gallons per minute. The well water is a constant 64^0 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. Colorado Pikeminnow Production

Background

Once very common throughout the Colorado River Basin, Colorado pikeminnow have declined from historic levels and are now found primarily in the Upper basin of the Colorado River. Various factors have contributed to the decline of the specie including alteration of natural stream flows and temperature regimes, loss of habitat and habitat fragmentation as a result of water development and the introduction of nonnative fish species.

Colorado pikeminnow are native to the San Juan River. Its historic distribution included the entire mainstem San Juan River up to Rosa, New Mexico, located approximately 25 miles upstream from present day Navajo Dam. Currently the species is considered extremely rare and the small population is estimated at less then 20 adults. This small group of fish has persisted in the San Juan River since the closure of Navajo Dam in 1962. Recent studies being conducted by

the San Juan Recovery Implementation Program (SJRIP) indicate that the Colorado pikeminnow is reproducing and recruiting in the river to at least a limited degree, however the low numbers collected do not satisfy recovery goal requirements for the specie. The Recovery criteria calls for a target of 1,000 subadult fish established by the end of a five year down listing period, and 800 adults maintained during the 7 year delisting period. The Upper Colorado River Endangered Fish Recovery Program has recommended that the wild population be increased by augmenting with hatchery produced fish. The initial **Augmentation Plan For Colorado Pikeminnow In The San Juan River (Phase I)**, (Ryden 2003) called for annual stocking of age-0 fish over an eight year Period (2002-2009). A modified work plan was developed and incorporated into the augmentation program in 2005. Under the amended plan; (Addendum #1 to Augmentation Plan For Colorado Pikeminnow In The San Juan River (Ryden 2005)), age-1 fish were produced at Dexter from 2006-2010 to augment the age-0 stockings in the San Juan River. The augmentation plan (**Phase I**) for age-0 and age-1+ Colorado pikeminnow ended in 2010. Augmentation efforts identified in the **Phase II** (2010 – 2020) **Augmentation Of Colorado Pikeminnow (*Ptychocheilus lucius*) In The San Juan River Plan,** (Furr 2009); focuses primarily on culturing and stocking increased numbers of age-0 fish. Current facility and broodstock capabilities at Southwestern ARRC allow for ≥400,000 age-0 Colorado pikeminnow to be produced and stocked annually. These stocking targets were started in 2016 and will continue in subsequent years unless further production capacity is identified and/or stocking targets are modified by the SJRIP.

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

The funding requested also covers costs associated with proper care of the broodstock necessary to successfully carry out this project for future years and aide in restoration of the species. Stocking will require coordination with New Mexico Fish & Wildlife Conservation Office, Navajo Nation Department of Fish and Wildlife.

Objectives

(1) Produce 400,000 age-0 fingerlings (50 mm) for stocking in the San Juan River in 2017.

(2) Transport and distribute 400,000 age-0 Colorado pikeminnow from Dexter, NM to the San Juan River.

(3) Maintain 400 Colorado pikeminnow broodstock for recovery efforts.

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 2017 a maximum of 50 paired matings (1 female X 1 male) will be spawned from the 1999 YC broodstock. Given the past history of hormonal induced ovulation, 38 females (75%) should produce viable eggs during a given year. All members of the broodstock are PIT tagged and records of spawning pairs are maintained at Southwestern ARRC.

Spawning

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

Rearing Ponds

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

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

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

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

If the dissolved oxygen drops to < = 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 2017 and age-0 fish reared in rubber and plastic lined ponds from June - October 2017.

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 SubAdults at the Southwestern ARRC

Background

Lake Mohave Razorback Sucker Broodfish

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

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

Production Plan

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

Additional objectives of the work include:

(1) Improve, maintain and staff facilities at Southwestern ARRC to rear and distribute the target number of fish.

(2) Maintain razorback sucker captive broodstock for recovery efforts.

(3) Passive Integrated Transponder (PIT) tag all fish prior to stocking into the NAPI ponds. PIT tags will be provided by the SJRIP.

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.

Pond Vegetation Control and Fertilization

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

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

Copper sulfate (CUSo4) will be used to control floating filamentous algae blooms. Treatments will began approximately 45 days after fish are stocked into the ponds and repeated every 30 days. Application rates in ponds are 5 to 8 lbs per acre. A secondary benefit derived from using 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 2017. Target sized fish are available for distribution in spring and fall of each year.

Projected Harvest Dates and Delivery Date

Year 2017 marks the twelfth 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 76,942 razorback's averaging 225mm in length into East and West Avocet and Hidden ponds and in 2012 stocked an additional 1,000 target sized RBS into the San Juan River. An additional 11,000 will be stocked into the NAPI ponds in April 2017. Based on historical growth rates for razorback at Dexter, the production target of 11,000, 200mm fish is achieved in a fifteen month period. 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 into the NAPI ponds are PIT tagged prior to stocking. The fish will be graded and sorted approximately 6 to 8 weeks before the scheduled stocking date. Fish that average 200mm will be PIT tagged and allowed to recover for a minimum of 10 to 14 days after each handling. The PIT tagged fish will be scanned for tag retention and any fish that lost a tag will be retagged prior to shipping.

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

General Fish Husbandry Requirements and Conditions

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

Handling and Transport Protocol
Transport of all fish will follow guidelines described in the USFWS Protocols for Biological Investigations developed by Dr. Gary Carmichael, retired U.S. Fish & Wildlife Service employee. The protocol is as follows:

1. When Colorado pikeminnow and razorback fingerlings, subadults and broodfish are handled they will be placed in a .5% salt bath to help in osmoregulation and reduce the effects of handling stress.

2. Temperature should be 5 degrees Fahrenheit lower in the hauling truck than in the river.

3. Drivers must be informed of and follow a specified route.

4. Transport water will contain 0.5 percent NaCl (18.9 grams per gallon).

5. Oxygen levels will be greater than 6.0 mg/L as determined with an oxygen meter.

6. Nets must be functional. Aeration equipment must be in place and must be used. A fish holding container will be a minimum of 5 gallons in size and fish densities will not exceed 1 lb of fish per gallon of water. Small delta mesh (1/8") will be present to transfer

the fish from one container to another, although it is preferred to have water to water transfer. Oxygenation/aeration equipment will be in place and working.

7. Prior to transfer and after the fish are concentrated, they should be quickly placed in the transport tank. When using nets to place fish in transfer buckets or tanks, nets should not be overloaded. The fish on the bottom will be crushed. Using a wet transfer with buckets is preferable. When emptying the nets and buckets, care will be taken to avoid adding algae and mud to the transport tank. Before loading, dissolved oxygen levels should be at saturation.

8. Immediately after loading, all equipment on the transport vehicle should be re-checked and the vehicle should depart. Oxygen concentrations and temperatures should be monitored at a minimum of every hour.

9. During unloading tempering water should be present and functional, and thermometers should be used to match water temperatures. Hauling water temperatures should be equal to receiving water temperature.

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

Fish Health Monitoring Protocols

All fish should be handled with the best animal husbandry practices available. A feeding schedule will be developed and followed daily. All tanks will be cleaned of uneaten food and feces daily. A daily log recording times of feeding, water temperature and comments on fish health will be maintained. If fish are maintained in a re-circulating system, all filters and pumps will be routinely cleaned and monitored. If fish are held in ponds O2 levels will be closely monitored. At least once a year, a fish health inspection will be conducted to examine fish for bacterial, viral and parasitic infections. Normally 60 fish per lot are sacrificed for an adequate sample. However, in the case of endangered or rare fish of genetic importance, numbers sampled may be less, depending upon availability. Non-lethal methods, if available, will be employed to obtain samples. Condition factors will be calculated on an annual basis and data added to a RBS database. Wet mounts will be examined for parasites and bacteria. Routine condition exams will be conducted and an examination will be conducted on all lots one month prior to delivery to the San Juan River and NAPI ponds on the Navajo Nation. Brood and refuge stock will have health checks annually and only when needed to minimize handling stress.

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

Disposition of Fish

All fish propagated and cultured for this project are made available to the SJRIP for stocking and meeting augmentation requirements identified in the Phase II (2010 – 2020) **Augmentation Of Colorado Pikeminnow (*Ptychocheilus lucius*) In The San Juan River Plan ,** (Furr 2009) and the "draft" (2016-2023) **Augmentation Plan For Razorback Sucker In The San Juan River** (Furr 2016). In the case of catastrophic loss (>25% of the stock) at Southwestern Native ARRC, up to 1,000 individuals will be collected for testing and diagnosis to determine (if possible) reason for loss. A written statement describing the loss will be provided immediately to the US Fish and Wildlife Service (Service) Fisheries Division and the SJRIP Coordinator, Albuquerque, NM; followed by a detailed report of the diagnosis once results are available. Excluded from these reporting requirements are gametes and fish lost to natural attrition, including but not limited to non-viable eggs prior to hatch and incidental predation mortalities. As per the guidelines identified in the 2003 Memorandum of Understanding between the Service and University of New Mexico, Division of Fishes, Museum of Southwestern Biology (MSB), fish carcasses (specimens) will be provided to the MSB who serves as the repository for vouchered specimens of native fishes. Any additional mortalities above the 1,000 mark will be recorded in the annual Threatened and Endangered Species report and disposed of by burial onsite or at a local land fill.

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

Reporting

A draft annual progress report detailing fish culture and distribution activities will be completed and provided to the SJRIP by January 31, 2018.

Budget

RE: Colorado Pikeminnow Fingerling Production and Razorback Rearing of Subadults at the Southwestern ARRC, Dexter, NM. The following costs are associated with producing and stocking 400,000 age-0 fingerlings in the San Juan River and 11,000, 200 mm subadults into the NAPI ponds on the Navajo Nation in 2017. Identified costs also include maintaining Colorado pikeminnow and razorback broodstock for recovery efforts.

Budget -Detailed Spending Plan 2017

I. Colorado Pikeminnow Fingerling Production

O&M Labor Costs

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

Southwestern Native Aquatic Resources and Recovery Center

(1) Fish Biologist (1,280 hours -16pay periods) - GS 482-9 @ $33.30/hr. = $42,623
* Supervision, spawning, fish health and water quality monitoring, feeding, harvest and prep for distribution.

(1) Admin. Officer (240 hours- 3pay periods) - GS 341-9 @ $32.58/hr. =$ 7,820
* Budget tracking, purchasing, data base management & reporting.

Subtotal = $50,443

Equipment and Supplies:

Liquid oxygen and compressed oxygen 12 cylinders @ $83.83 Airgas	$ 1,006
Spawning Supplies Hormones (CCP 5 vials @ $201.50 per 10ml/vial)	$ 1,009
Fish health sampling prior to stocking Lab supplies for bacti, viral and parasite testing.	$ 2,174
Culture equipment (nets, seines, screens, etc.) Eager, Memphis Net & Twine	$ 2,217
Pond management supplies, Barrier $281.35/50# bag (20 bags) Van Diest	$ 5,627
Fish feed,1.70/lb., 6,000 lbs. SKRETTING	$10,197
Cyclical Maintenance costs for: Tractors, mowers, gators, sweepers used in pond maintenance	$ 1,591
Subtotal	**$ 23,821**

Utilities:

Pumping costs Electrical 200,257 kwh @ .0968	$19,389
Heating water for hatching eggs to swim-up Natural gas 1,525 ccf @ 1.019	$ 1,554
Subtotal	**$20,943**

Reintroduction Costs:

Salaries

GS-9 Fish Biologist
24 hrs. @ $33.29 $ 799

GS-7 Fish Biologist
24 hrs. @ $24.75 $ 594

WG-7 Maintenance Worker
24 hrs. @ $22.54 $ 541

WG-5 Bio Science technician
24 hrs. @ $16.87 $ 405

Lodging &Per Diem $123/day (Dexter to Farmington, NM and return)
$126.75/trip x 2 trips x 4 employees = $1,014

Fuel costs and truck maintenance 1200 miles @ $5.778 $6,934
Subtotal **$10,287**

Annual subtotal (CPM)
(O & M Direct Costs) $ 105,494

II. Rearing Razorback Sucker Subadults at the Southwestern ARRC

O&M Labor Costs

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

Southwestern Native Aquatic Resources and Recovery Center

(1) Fish Biologist (1,040 hours -13pay periods) - GS 482-9 @$33.30/hr. = $ 34,632
* Supervision, spawning, fish health and water quality monitoring, feeding, harvest and distribution.

(1) Administrative Officer (160 hours- 2pay periods) - GS 341-9@$32.57/hr. = $ 5,212
* Budget tracking, purchasing, data base management & reporting.

Subtotal = $39,844

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.	$ 1,255

Fish Culture Supplies

Nets, seines, tubs, screens.	$ 2,121
Wet lab supplies (pipets, petri dishes, slides, probes, markers)	$ 282
Theriputents- salt, Oxytetracycline, formalin, MS-222, stress coat	$ 675
Liquid and compressed oxygen for fish distribution	$ 225

Feed

Production diet RBS0301 (2.0 tons) 4,000 lbs. $ 1.596 per lb.	$ 6,386

Spawning Supplies

Hormones (HCG 10 vials @ $ 56.20 per 10ml/vial)	$ 562

Fertilizer

Alfalfa pellets (1,000 lbs.) .288/lb.	$ 288
Inorganic - Super Phosphate (10 bags) 8.40/bag	$ 84

Chemicals- Aquatic Vegetation Control

Barrier- (6 bags) $281.33/bag	$ 1,688
Diuron -(2 bags) $ 86.00/bag	$ 172
Subtotal =	**$13,738**

Services

Utilities & Equipment Maintenance	
* Electrical, fuel and phone	$ 5,000
* Boiler system, heat exchanger maintenance	$ 1,125
*#1 well and water tower and pumping station maintenance	$13,875
Subtotal =	**$ 20,000**

Travel

- Fish stocking/distribution.

Dexter to Farmington (NAPI) & return- (1640 miles @ 5.778 per mile DX truck) =	$ 9,476
Fuel and routine vehicle maintenance.	
Perdiem- $126per day X 2 trips X 2 individuals. =	$ 507
Subtotal =	**$ 9,983**

Annual subtotal (RBS)	
O&M DIRECT COSTS	**$83,565**

I. Colorado Pikeminnow Fingerling Production	$105,494
II. Rearing Razorback Sucker Subadults at the Southwestern ARRC	$83,565
Annual total:	**$189,059**
3 % Administrative Overhead	**$ 5,672**
TOTAL REQUESTED FOR 2017	**$ 194,731**

Projected out year funding request:

FY 2018 - $200,573
FY 2019 - $206,590
FY 2020 - $212,788
FY 2021 - $219,172

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Razorback Sucker Augmentation at NAPI Grow-Out Ponds
Fiscal Year 2012-2016 Project Proposal

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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 (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 2017.

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 Construction 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 resolved since installation of the aerators.

Objectives
(NAPI Ponds Management)

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

1) Manage three grow-out ponds using a single cohort strategy; including passive and active harvest techniques.

2) Annually stock 3,500 (≥ 200mm) razorback sucker per pond.

3) Harvest all ponds on an annual basis.
    a. Implant all razorback sucker with a PIT tag prior to stocking.
    b. Stock all fish regardless of size at harvest.
    c. Stock ~ 4,200 to 6,300 fish based on 40-60% return.
    3c. Investigate and utilize multiple stocking localities.

4) Experimentally acclimatize, as guided by SRRIP – Biology Committee, razorback sucker from both NAPI ponds and Uvalde National Fish Hatchery.

Location

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

Methods/Approach

The NNDFW will be responsible for overall management of the NAPI ponds regarding daily management duties, harvesting, and stocking. The Service, Region 2, will be responsible for coordinating the stocking of the ponds with Dexter NFH 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. In addition, 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, operating the propane cannons to scare away predators, repairing fences, monitoring aquatic vegetation and maintaining a log book and database for management of the ponds.

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 2017, Dexter National Fish Hatchery will deliver 10,500 ≥ 200 mm RBS to two of three NAPI grow-out ponds. In the fall of 2017, 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 SJRIP Program Coordinators Office by 31 March 2018. A draft report will be submitted by 31 March 2018 and finalized by 1 June 2018.

Budget Fiscal Year 2017

BUDGET WORKSHEET – Program Base Funding		
Razorback Sucker Augmentation at NAPI Grow-Out Ponds		
Personnel (salary/benefits)	**USFWS NMFWCO**	**NNDFW**
Daily Pond Management .30 FTE (GS-9-8) USFWS R2 and active/passive harvesting assistance 1 FTE NNDFW X $44,055	$ 9,739	$ 44,055
Temporary Wildlife Technician NNDFW X $6,391		$ 6,391
Fringe Benefits FTE $44,055 X 45.6%		$20,089
Fringe Benefits temp. @ 8.4%		$537
Personnel Subtotal	**$ 28,071**	**$71,072**
Travel		
Per Diem Lodging and Meals	$ 4,900	$ 1,000
Vehicle Mileage and Maintenance	$ 1,160	$ 18,000
Travel Subtotal	**$ 6,060**	**$ 19,000**
Office Supplies and Equipment		$ 500
General Operating Supplies (includes fish transport costs, i.e. oxygen, salt, stress coat, etc.)		$ 2,500
Feed		$ 5,000
Uniforms		$ 500
Printing/Binding/Photocopying		$ 100
Fuel – Propane/Cannon Guns		$ 200
Repairs and Maintenance – Paint, sealant, lubricants, plumbing supplies, water quality probes, etc.		$ 500
Support Subtotal	**$ -0-**	**$ 9,300**
Total	**$ 30,649**	**$99,372**
Administrative charge (17.5%) $99,372/1.175 X .175 = $14,800	$ 474	$14,800
USFWS/NNDFW Totals	**$ 16,273**	**$114,172**
Grand Total		**$130,445**

Razorback Sucker Augmentation at NAPI Grow-Out Ponds
Fiscal Year 2017 Project Proposal

Under the heading "Funding for participation of other agencies." Costs for participation of the U.S. Fish and Wildlife Service, New Mexico Fish and Wildlife Conservation Office, Albuquerque, NM in FY-2017.

Daily pond management activities	
Biological Science Technicians	
2 people x 20 days @ $192.80/day	$ 7,712.00
Active Harvest	
Fish Biologist (GS-11-5) - 5 days @ $405.45/day	$ 2,027.25
Personnel subtotal	$ 9,739.25
Travel and Per Diem (Based on Published FY-2016 Federal Per Diem Rates)	
Hotel Costs – 35 nights	$ 3,115.00
Daily pond management: 2 rooms x 4 nights/trip x 4 trips @ $89/night – single occupancy	
Active Harvest: 1 room X 3 nights @ $80/night – single occupancy	
Per Diem (Hotel Rate) – 35 days @ $51/day	$ 1,785.00
Travel subtotal	$ 4,900.00
Equipment	
Vehicle Maintenance & Gasoline 2,000 miles (400 miles/trip x 5 trips @ $0.58/mile	$ 1,160.00
Equipment subtotal	$ 1,160.00
USFWS – NMFWCO Total	$ 15,799.25
USFWS Region 2 Regional Office Administrative Overhead (3%)	$ 474.00
USFWS – Region 2 Total	**$ 16,273.25**

SJRIP PIT TAGS
2017 Project Proposal

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Bureau of Reclamation
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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
764 Horizon Drive, Building B
Grand Junction, Colorado 81506-3946
Phone: 970-245-9319 (19)

TASKS – 2017

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

In FY2017, $60,000 is allocated in the workplan to purchase 25,000 PIT tags and associated equipment (readers, antennas, implanters, etc.). The purchase of this equipment will be done under a new contract to be awarded in FY2016.

FY 2016 BUDGET

Funding source		**Projected expenditure in FY16**
FY2017 Annual funding		$60,000
Total		**$60,000**

Projected funding:
FY-2017 $60,000.00
FY-2018 $70,000.00

FY 2017 Project Proposal
San Juan River Basin Hydrology Model
Operation and Maintenance

Susan Behery
Bureau of Reclamation
185 Suttle St. Suite 2
Durango, CO 81303
Phone 970-385-6560
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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 FY2017 scope of work includes updates to data as available, annual operation and maintenance of the model and data management. FY2017 activities will also include final incorporation of revised flow recommendations operational tree, as developed by the Biology Committee. The Bureau of Reclamation has the primary responsibility for model development and O&M.

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

Objective:
The objective for this work is to ensure that the San Juan Basin Hydrology Model is available for run requests. This will be accomplished by developing and incorporating a revised hydrologic baseline as well as potential flow recommendation scenarios. Adjusting model configurations or operating rules to incorporate new data and/or scenarios and evolving the data set forward through time is also necessary. The FY2017 request also includes funds to continue coordination and interaction with the Program participants and their technical designees.

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

Task Descriptions:
Task 1: Model Modifications In collaboration with the Biology Committee, begin work implementing revised flow recommendation operational rules. Document all modifications to the

model, communicate changes to Program and interested parties.

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 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. 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 take place as model, data and software updates take place to ensure that several people are trained in the maintenance of the model.

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

Task 4: Program Management and Coordination Attend or provide written reports for Coordination Committee meetings, as needed, to update the committee on the model status and model results. Attend and assist in conducting Hydrologic Baseline Workgroup meetings to provide model status updates, present results, and work on developing the revised hydrologic baseline. Conduct an annual hydrology meeting of Program participants to review and solicit input on accomplishments and activities relating to the model for the previous year, status of the model, and proposed activities for the coming year; and provide a report on the meeting to the Coordination Committee for their review and approval. Develop the FY2018 budget and track FY2017 expenditures.

Budget Summary FY 2017

Model Modifications	$23,900	
Model Maintenance	$9,360	
Model Runs	$18,000	
Program Management	$23,600	
Grand Total	**$74,860**	
FY-2017	**$77,100**	†
FY-2018	**$79,400**	†
FY-2019	**$81,800**	†

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

Task 1 Model Development

A) Labor	Task	Salary total/hr	Total Days	Total cost
	Revision and incorporation of new flow recommendation operations	$90	25	$18,000

B) Travel	Purpose	Dest.	Trips	Days/ Trip	Airfare/ Trip	Lodging, expenses /day	Total Cost
	Reclamation meeting with SJRIP	ABQ	1	2	$400	$250	$900

C) Other Costs	Task	Total Cost
	Riverware Technical Support	$5,000

Task 2 Model Maintenance

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

Task 3 Model Runs

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

Task 4 Program Management Coordination

A) Labor	Task	Salary total/hr	Total Days	Total cost
	Meetings and Coordination	$90	25	$18,000
	Budget	$90	5	$3,600

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

Improve Stream Gaging and Flow Measurements
San Juan River Basin Recovery Implementation Program
Fiscal Year 2017 Project Proposal

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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-2017:

Objective: Provide funding to USGS for 12 additional flow measurements at the four San Juan River Gages in NM.	Staff days	Labor	Travel	Equipment and supplies
Personnel	7.5	6,670		
Travel			1,550	
Equipment and supplies				0
Total				$8,220

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

Fiscal Year 2018	$8,500
Fiscal Year 2019	$8,750
Fiscal Year 2020	$9,000

Operation of Public Service Company of New Mexico Fish Passage Structure
Fiscal Year 2017 Project Proposal

Principal Investigators: Jeffrey Cole, Kim Yazzie
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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 April 1 to October 31, 2017. 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 tray. 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 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' 2017. 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. Maintain the facility in a manner that assures long-term benefit.

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

Products/Schedule

The Fish Passage facility will be operated from April 1 to October 31, 2017. Data will include definitive numbers of species, numbers per species, and seasonal use and distribution by species.

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

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

Fiscal Year – 2017 Budget

Personnel (salary and benefits)	**NNDFW**
1 FTE Fisheries Biologist X $44,055	$44,055
Temporary Wildlife Technician	$6,391
Fringe Benefits $44,055 X 45.6%	$20,089
Fringe Benefits Temp. @8.4%	$537
Personnel Subtotal	**$71,072**
Travel	
1 Tribal Vehicle	$18,000
Per Diem Lodging and Meals	$1,000
Travel Subtotal	**$19,000**
Office Supplies	$ 500
Office Equipment	$1,000
General Operating Supplies Plumbing supplies, Hardware Supplies, Neoprene Waders, rubber boots, wet suit, landscaping supplies	$3,500
Nenahnezad Phone	$ 800
Uniforms	$500
Printing/Binding/Photocopying	$100
Repairs and Maintenance – Paint, sealant, lubricants, water pump repairs	$1,000
Support Subtotal	**$7,400**
Training and Conference Registration	$500
	Base Funding
Total	**$97,972**
Administrative charge (17.5%) $97,972/1.175 X .175	**$14,592**
Grand Total	**$112,564**

SJRIP San Juan and Animas Rivers Temperature Gauges
2017 Project Proposal

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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 (after we configure our database on Monday).
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 – 2017

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

FY 2016 BUDGET

Task	**Expenditure in FY2016**
Temperature probes @ $5150/ea	$20,600
Total	**$20,600**

Projected funding:
FY-2018 $21,000.00
FY-2019 $21,500.00

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

Fiscal Year 2017 Project Proposal

Bobby R. Duran and Jason E. Davis
U.S. Fish and Wildlife Service
New Mexico Fish and Wildlife Conservation Office
3800 Commons N.E.
Albuquerque, New Mexico 87109
505.342.9900
Bobby_Duran@fws.gov Jason_E_Davis@fws.gov

and

Katie Creighton and Brian Hines
Utah Department of Wildlife Resources
Moab Field Station
1165 S. Hwy 191- Suite 4, Moab, Utah 84532
(435) 259-3780
Katherinecreighton@utah.gov Bhines@utah.gov

Cooperative Agreement #'s:

USFWS – NMFWCO	R13PG40051
USFWS – CRFP	R13PG40052
UDWR – Moab	R13AC40007
NMDGF – Santa Fe	
NNDFW	

Period of Performance: 9/20/2013 to 9/30/2017

Goal

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

Overview

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

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

Objectives

1. Spatially demarcate removal and control reaches on the San Juan River in order to statistically evaluate responses of fishes to nonnative fish removal via electrofishing.

2. Assess Channel Catfish CPUE and size distributions within removal reaches over time using nonnative fish removal data.

3. Compare Channel Catfish, Razorback Sucker, and Colorado Pikeminnow CPUE between control and treatment reaches using sub-adult and adult fish community monitoring, and nonnative fish removal data.

4. Compare Channel Catfish size distributions between control and removal reaches using sub-adult and adult fish community monitoring, and nonnative fish removal data.

6. Quantify movement of tagged Channel Catfish among treatment and control reaches over the summer.

Link to Long Rang Plan

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

Goal 3.1—Control Problematic Nonnative Fishes

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

Task 3.1.1.1 Mechanically remove nonnative fish to achieve objectives.

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

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

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

Secondarily, nonnative fish removal crews collect both spatial and temporal data on rare fish encountered during sampling efforts. These data have been used in assessing progress towards recovery and to evaluate the augmentation programs for both Colorado pikeminnow and razorback sucker. Additional Long Range Plan Actions and Tasks associated with this task include, but are not limited, to the following:
Goal—4.1 Monitor Fish Populations of the San Juan River Basin

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

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

Methods

Study design

The study design for FY17 will follow the same protocol as FY 2016. The river between Shiprock, NM and Mexican Hat, UT will be stratified by geomorphic reach to help control for natural longitudinal variation in fish densities (Figure 1). Within each geomorphic reach, the

river will be further divided into treatment and control reaches (i.e., geomorphic reach 3 will contain two removal and control reaches). Because of the different agencies involved with nonnative removal, reaches in the upper parts of the river will undergo 20 passes (each pass is two electrofishing rafts on each shore) of removal effort and at least eight passes in the lower reach (i.e., NMFWCO upper section and Utah Department of Wildlife Resources (UDWR) lower section; Figure 1) each year. The disparate removal efforts between the upper and lower reaches will necessitate analyzing these reaches separately. Lengths of treatment and control sub-reaches within each geomorphic reach will be demarcated to maximize the sample size of collections used for comparisons to increase statistical power (mean sample size = 6.4, range = 4-11). No electrofishing will take place in control reaches (except for the initial marking pass, see below). While not electrofishing control reaches and returning Channel Catfish to the river will confound effects of electrofishing and removal of Channel Catfish in this study design, the exact mechanisms (i.e., electrofishing or removing Channel Catfish) behind the potential effects observed are not particularly important for guiding management actions at this time (i.e., we don't have other feasible mechanisms for removing large numbers of Channel Catfish at the scale proposed). Moreover, we will likely gain more insight into the effects of electrofishing on endangered fishes by not electrofishing control reaches.

Removal and tagging protocol

All nonnative fish removal efforts will occur between March and September before annual sub-adult and adult fish community monitoring (i.e., fall monitoring) and efforts will be made to limit the amount of electrofishing during spawning periods of Colorado Pikeminnow (Table 1). The first pass of the year will occur between Shiprock, NM to Mexican Hat, UT and be used to tag Channel Catfish (≥200mm TL) and quantify densities (CPUE; fish/hr of electrofishing), and sizes of Channel Catfish, Colorado Pikeminnow, and Razorback Sucker in each river mile. The subsequent passes will recapture and remove Channel Catfish at every three river miles and quantify size structure of Channel Catfish in each reach (all fish will be measured from samples until at least 150 individuals are measured in each reach). Other endangered fishes will be collected and PIT tagged if untagged.

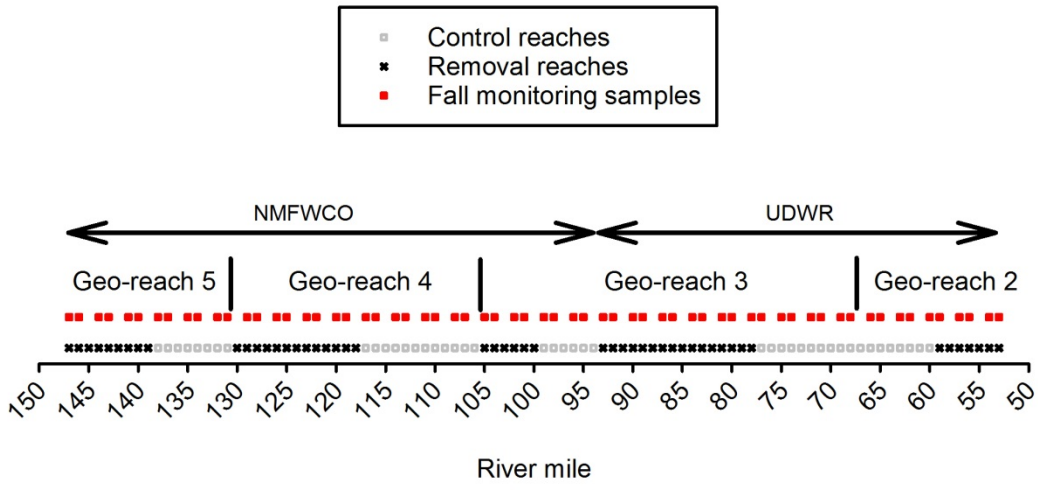

Figure 1. Proposed study area from Shiprock Bridge, NM (RM 147.9) to Mexican Hat, UT (RM 52), detailing treatment (black) and control (grey) sub-reach river miles by geomorphic reach.

The red squares identify river miles that will be sampled by large-bodied monitoring in fall 2017 and used in statistical analyses. The proposed spatial effort extended by each agency is denoted.

Table 1. Timing of the proposed tagging and removal trips. Removal trips are denoted with "X".

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

Data Analysis

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

Due to the disparate removal efforts between the upper and lower sections of the river (i.e., 20 vs 8 passes respectively), we will analyze the two reaches separately. Below we include the primary questions we will address, data sets needed for analyses, and the general structure of statistical analyses that will be applied to the upper and lower reaches. Other potential covariates that may affect sampling efficiency can be included if deemed necessary (e.g., secchi depth, stream discharge at sampling, etc.).

In all models, non-significant (α=0.10) interactions will be sequentially removed until all/any remaining interactions are significant. If any models have significant terms, post hoc tests can be conducted to determine which factor levels differ.

1) Does the CPUE of Channel Catfish vary over time in removal reaches?

H_o:Nonnative fish removal does not alter the CPUE of Channel Catfish over time.

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

-Calculate the mean CPUE of Channel Catfish in each removal reach during each removal period (n = 11 upper reach, n = 9 lower reach).

-Construct a general linear model:

Channel Catfish CPUE = Georeach × Treatment reach × Date

-A significant Date × Treatment reach term would indicate the slope of at least one reach differed from the other reaches.

-A significant Date term would indicate the slope between date and CPUE of Channel Catfish was different than zero.

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

H_o:Nonnative fish removal does not alter the size structure of Channel Catfish over time.

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

-Calculate the median Total Length (TL) of Channel Catfish in each removal reach during each removal period (n = 10 upper reach, n = 8 lower reach).

-Construct a general linear model:

Channel Catfish TL = Georeach × Treatment × Date

-A significant Date × Treatment term would indicate the slope of at least one reach differed from the other reaches.

-A significant Date term would indicate the slope between date and CPUE of Channel Catfish was different than zero.

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

H_o:Nonnative fish removal does not alter the CPUE of Channel Catfish in removal reaches compared to control reaches (after controlling for initial CPUE).

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

-The initial CPUE of Channel Catfish from the first pass of nonnative removal will serve as a covariate.

-CPUE of Channel Catfish from fall monitoring will be the response variable.

-Construct a general linear model (the follow notation indicates all main effects and interaction terms):

Channel Catfish CPUE = Georeach × Treatment × Initial CPUE

-A significant Initial CPUE term would indicate the initial CPUE of Channel Catfish predicted the final Channel Catfish CPUE.

-A significant Treatment term would indicate the CPUE of Channel Catfish differed between control and removal reaches.

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

H_o:Nonnative fish removal does not alter the size structure of Channel Catfish in removal reaches.

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

-The TL of all Channel Catfish in control and removal reaches from fall monitoring will be the response variable.

-Construct a general linear model:

Channel Catfish TL = Georeach × Treatment

-A significant Treatment term would indicate the TL of Channel Catfish differed between control and removal reaches.

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

H_o:Nonnative fish removal does not alter the CPUE of Colorado Pikeminnow and Razorback Sucker Catfish in removal reaches.

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

-The initial CPUE of Colorado Pikeminnow/Razorback Sucker from the first pass of nonnative removal will serve as covariates.

-CPUE of Colorado Pikeminnow/Razorback Sucker from fall monitoring will be the response variable.

-Construct general linear models (the follow notation indicates all main effects and interaction terms):

Colorado Pikeminnow/Razorback Sucker CPUE = Georeach × Treatment × Initial CPUE

-A significant Initial CPUE term would indicate the initial CPUE of Colorado Pikeminnow/Razorback Sucker predicted the final Colorado Pikeminnow/Razorback Sucker CPUE.

-A significant Treatment term would indicate the CPUE of Channel Catfish differed between control and removal reaches.

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

H_o:Channel Catfish do not move among reaches.

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

-Calculate the proportion of resident versus immigrants (i.e., fish tagged in the same reach versus tagged in another reach) in each treatment reach versus control reaches from all sampling events.

-Construct a general linear model:

Proportion of immigrants = Georeach × Treatment reach × Date

-A significant Date × Treatment reach term would indicate the slope of at least one reach differed from the other reaches.

-A significant Date term would indicate the slope between date and proportion of immigrant Channel Catfish was different than zero.

Summary

Management decisions regarding the nonnative fish removal program on the San Juan River have been hindered by the lack of a rigorous study design that impedes our ability to assess the usefulness of the program. A more structured removal design will allow for a thorough assessment of the level the program can reduce densities of Channel Catfish as well as the potential subsequent response of endangered fishes. While having control reaches may seem counterproductive to reducing densities of nonnative fishes, we think it is necessary to provide a scientifically sound test of the efficacy of the program and provide useful information on the effects of electrofishing on endangered fishes. However, effort will be increased in removal sub-reaches, the overall numbers of Channel Catfish removed will likely remain similar or be increased relative to previous annual removal efforts.

Although this study design is substantially altered compared to previous nonnative fish removal protocols (i.e. prior to FY2016), similar data analyses that have been conducted in previous years will still be available with this design (e.g., Channel Catfish population estimates, exploitation rates).

As illustrated in the FY16 scope of work, the effects of nonnative fish removal likely will not manifest after the first year of study (i.e. 2016) and will likely need several years to come forth. The FY17 scope of work, if funded, would be the second year under the revised study design.

Outyear Budgets:

FY 17	**$550,263****	**Funding included for nonnative removal across all Agencies and Agreement Numbers**
	$362,215	**Shiprock to Montezuma Creek (20 passes)**
	$188,509	**Montezuma Creek to Mexican Hat (9 passes)**
FY18	$566,771	(if needed and approved)

FY19 $583,474 (if needed and approved)

**** The following budget reflects the cost associated with all FY 2017 tagging and nonnative fish removal efforts from Shiprock, New Mexico downstream to Mexican Hat, Utah. Two budgets submitted by Utah Department of Wildlife Resources include 1) assisting FWS-NMFWCO with removal from Shiprock, NM to Montezuma Creek, UT (Appendix 1) and 2) UDWR-Moab's leads efforts from Montezuma Creek to Mexican Hat, UT (Appendix 2). Disbursement of funds will be under agency specific agreements with the Bureau of Reclamation – Salt Lake City, UT.**

Literature Cited

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APPENDIX 1

PARTICIPATING AGENCIES BUDGETS FOR FY 17 NONNATIVE SPECIES MONITORING AND CONTROL FROM SHIPROCK, NM TO MONTEZUMA CREEK, UT

Lead Agency:

- **U.S. Fish and Wildlife Service, New Mexico Fish and Wildlife Conservation Office, Albuquerque, NM**

Participating Agencies:

- **U.S. Fish and Wildlife Service, Colorado River Project – Grand Junction, CO**
- **Utah Division of Wildlife Resources, Moab Field Station, UT**
- **American Southwest Ichthyological Researchers, LLC – Albuquerque, NM**
- **New Mexico Department of Game and Fish – Santa Fe. NM**
- **Navajo Nation Department of Fish and Wildlife**

Labor Costs	USFWS-NMFWCO	FY 2017			
Sampling - Removal					
		People Days	**Grade/Step**	**Daily Rate**	
Senior Level Fish Biologist	10 trips @ 8 days/trip	80	GS 9/6	$325.27	$26,021.60
Fish Biologist	4 trips @ 6 days/trip	24	GS 7/1	$229.98	$5,519.52
Fish Biologist	5 trips @ 6 days/trip	30	GS 11/6	$393.58	$11,807.40
Supervisory Fish Biologist	5 trips @ 6 days/trip	30	GS 13/6	$560.85	$16,825.50
Bio Sci. Tech (Seasonals)	10 trips @ 8 days/trip x 2 people	160	GS 5/1	$184.02	$29,443.20
					$89,617.22
Sampling - Tagging					
Senior Level Fish Biologist	1 trip @ 8 days/trip	8	GS 9/6	$325.27	$2,602.16
Fish Biologist	1 trip @ 6 days/trip	6	GS 7/1	$229.98	$1,379.88
Fish Biologist	1 trip @ 6 days/trip	6	GS 11/6	$393.58	$2,361.48
Bio Sci. Tech (Seasonals)	1 trip @ 8 days/trip x 2 people	16	GS 5/1	$184.02	$2,944.32
Supervisory Fish Biologist	1 trip @ 6 days/trip	6	GS 13/6	$560.85	$3,365.10
					$12,652.94
Administrative and Reporting					
Senior Level Fish Biologist		55	GS 9/6	$325.27	$17,889.85
Bio Sci. Tech (Seasonals)		40	GS 5/1	$184.02	$7,360.80
Supervisory Fish Biologist		5	GS 13/6	$560.85	$2,804.25
Adminstrative Officer		2	GS 9/8	$343.81	$687.62
					$28,742.52
				Sub Total	**$131,012.68**
Travel and Per Diem					
	Days	**Rate**			
Hotel Costs	45	$89.00			$4,005.00
Per Diem (Hotel Rate/Travel Day)	95	$38.25			$3,633.75
Per Diem (Camping Rate)	200	$29.00			$5,800.00
				Sub Total	**$13,438.75**
Equipment					
	Miles (round trip)/Quantity	**Total Miles**	**Rate**		
Shuttle Costs					
5 trucks x 10 trips	50		$200		$10,000.00
Vehicle Fuel					
3 trucks x 8 trips	660	15,840	$0.58		$9,187.20
2 trucks x 3 trips	660	3960	$0.58		$2,296.80
Generator fuel					
60 gallons x 11 trips	660		$2.50		$1,650.00
Maintenance, repair, replace					
(i.e. life jackets, waders					
generator repair, dip nets, etc.)					$5,000.00
Tagging Equipment					
3,000 Floy t-Bar Anchor Tags (FD-94)	3000		$610/1,000		$1,830.00
Six (6) Replacement Needles	6		$10.00		$60.00
				Sub Total	**$30,024.00**
USFWS - NMFWCO					**$174,475.43**
USFWS Region 2 Overhead (3%)					**$5,234.26**
USFWS Region 2 Total					**$179,709.69**
Funding for cooperators					
USFWS -CRFP					$87,087.00
UDWR - Moab					$30,455.00
ASIR, LLC					$48,183.00
NNDFW					$4,539.18
NMDGF-Santa Fe					$11,780.00
				Grand Total	**$361,753.87**

Under the heading "Funding for participation of other agencies." Cost for participation of U.S. Fish and Wildlife Service, Colorado River Project – Grand Junction, CO in FY-2017 nonnative removal activities (Shiprock, New Mexico to Mexican Hat, Utah).

Endangered Fish Monitoring and Non-native species Monitoring and Control in the *Upper/Middle* San Juan River Fiscal Year 2017 Project Proposal Updated: 31 March 2016

Budget for Participation by U.S. Fish Wildlife Service,
Colorado River Fishery Project (USFWS-CRFP)

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

Reporting Dates: 10/1/2016 through 9/30/2017

Fiscal Year 2017 Estimated Budget:

Costs for participation of the U.S. Fish Wildlife Service, Colorado River Fishery Project (USFWS-CRFP) office, Grand Junction, CO.

(Based on projected FY-2017 costs)

Note: The FY-17 and outyear costs have been adjusted for the GS-5 Bio Tech line items to reflect new guidance from Office of Personnel Management (OPM) to the USFWS requiring the USFWS to provide health insurance to all federal employees, regardless of grade level or appointment type, if they work for the federal government longer than 60 days (480 total hours).

Personnel/Labor Costs (Federal Salary + Benefits)	
Principal Biologist (GS-11) – 144 hours @ $50.84/hr	$ 7,321.00
(1 person X 6 days/trip X 3 camping trips)	
Bio. Tech. Crew Leader (GS-7) – 144 hours @ $34.71/hr	$ 8,122.00
(1 person X 6 days/trip X 3 camping trips)	
(+ 20 hours overtime/per trip X 3 trips = 60 total hours of overtime at $52.06/hr = $3,124.00)	
Bio. Tech. Crew Leader (GS-6) – 144 hours @ $33.74/hr	$ 7,896.00
(1 person X 6 days/trip X 3 camping trips)	
(+ 20 hours overtime/per trip X 3 trips = 60 total hours of overtime at $50.61/hr = $3,037.00)	
Biological Technicians (GS-5) – 960 hours @ $24.96/hr	$ 39,386.00
(1 people X 6 days/trip X 3 camping trips)	
(2 people X 6 days/trip X 7 camping trips)	
(+ 20 hours overtime/per trip X 10 trips X 2 people = 400 total hrs of overtime at $38.56/hr = $15,424.00)	
Sub Total	$ 62,725.00
Administrative Support (Federal Salary + Benefits)	
Administrative Officer (GS-9) – 60 hours @ $46.06/hr	$ 2,764.00
Project Leader (GS-14) – 60 hours @ $85.92/hr	$ 5,155.00
Sub Total	$ 7,919.00
Travel and Per Diem (Based on Published FY-2016 Federal Per Diem Rates)	
Hotel – 1 night in Cortez, CO @ 4 people/trip X 3 trips	$ 1,368.00
(12 nights @ $114/night – single occupancy = $1,368)	
Hotel – 1 night in Cortez, CO @ 2 people/trip X 7 trips	$ 1,596.00
(14 nights @ $114/night – single occupancy = $1,596)	
Per Diem (Hotel Rate) – 1 day in Cortez, CO X 4 people per trip X 3 trips (12 days @ $59/day)	$ 708.00
Per Diem (Hotel Rate) – 1 day in Cortez, CO X 2 people per trip X 7 trips (14 days @ $59/day)	$ 826.00
Per Diem (Camp Rate) – 5 days X 4 people/trip X 3 trips (60 days @ $28/day)	$ 1,680.00
Per Diem (Camp Rate) – 5 days X 2 people/trip X 7 trips (70 days @ $28/day)	$ 1,960.00
Sub Total	$ 8,138.00

Equipment

Vehicle Maintenance & Gasoline (@ $365/month lease = $12.17

per day based on 30 days in an "average" month + $0.33/mile)

3 trips from Grand Junction, CO to Cortez, CO to Shiprock, NM to Montezuma Creek, UT (park trucks at Bluff, UT) and back to Grand Junction, CO X 2 trucks X 6 days per trip (600 miles/trip X 3 trips X 2 trucks = 3,600 miles X $0.33/mile) = $1,188 — $ 1,626.00

(2 trucks X 6 days/trip X 3 trips = 36 days X $12.17/day) = $438

7 trips from Grand Junction, CO to Cortez, CO to Shiprock, NM to Montezuma Creek, UT (park trucks at Bluff, UT) and back to Grand Junction, CO X 2 trucks X 6 days per trip X 1 truck X 6 days per trip — $ 1,897.00

(600 miles/trip X 7 trips X 1 truck = 4,200 miles X $0.33/mile) = $1,386

(1 truck X 6 days/trip X 7 trips = 42 days X $12.17/day) = $511

Generator Gasoline

(25 gallons/trip X 10 trips @ $4.00/gallon) — $ 1,000.00

5 days @ 5 gallons/day X 1 raft X 10 trips

Equipment Maintenance, Repair, & Replacement — $ 1,245.00

Exact use of the money in this line item 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 would include the following:

Annual trailer maintenance & safety inspection = $175

Replace/repair trailer suspension, trailer lights, winch handle/straps/gears, trailer jack stand wheel bearings

Replace trailer tires – 2 per year @ $100 each = $200

Synthetic oil for generators - 5 quarts at $7 each = $35

Generator repair/tune-up - 5 hrs @ $75/hr = $375

Hip boots – 2 pair at $50/pair = $100

Breathable chest waders - 2 pair @ $125/pair = $250

Stearns Type III life jackets – 3 @ $70 each = $210

Electrical Gloves - 3 pairs @ $65/pair = $195

Repair raft frame

Aluminum welding – 3 hours @ $150/hr = $450

Raft repair kits

Raft glue (urethane/hypalon) – Four 4-oz. cans @ $22.50/can = $90

NRS raft patch material – 5 feet @ $37/ft = $185

Acetone – 1 gallons @ $17.50/gallon = $17.50

Toluene – 1 gallon @ $17.50/gallon = $17.50

Replace any missing NRS HD-brand tie-down straps, each boat needs:

Ten 2-ft straps @ $4.20 each = $42

Five 3-ft straps @ $4.30 each = $21.50

Ten 4-ft straps @ $4.70 each = $47

Five 6-ft straps @ $5.05 each = $25.25

Five 9-ft straps @ $5.7 each = $28.50

Five 12-ft straps @ $6.15 each = $30.75

Replace any missing D-style carabiners, each boat needs:

10 @ $7.50 each = $75

Mesh rig bag – 1 @ $50 each = $50

Rafting oars, oar blades, and oar rowing sleeves
Carlisle 10-foot oar shafts – 2 @ $90 each = $180
Carlisle Oars blades – 4 @ $65 each = $260
Oar sleeves – 4 @ $12 each = $48
5-gallon plastic gasoline jerry cans – 5 @ $20 each = $100
River bags
NRS 3.8 heavy-duty Bill's Bag – 1 @ $100 each = $100
Clavey (green 7 X 17) dry bag – 3 @ $22 each = $66
Clavey (blue 10 X 24) dry bag) – 4 @ $26 each = $104
20 lb. propane tanks – 3 @ $20 each = $60
Pesola brand spring scales
20010 Micro-Line 10 gram – 1 @ $50 = $50
20060 Micro-Line 60 gram – 1 $46 = $46
20100 Micro-Line 100 gram – 1 @ $46 = $46
40300 Medio-Line 300 gram – 1 @ $54 = $54
40600 Medio-Line 600 gram – 1 @ $54 = $54
42500 Medio-Line 2,500 gram – 2 @ $56 = $112
41002 Medio-Line 1,000 gram – 3 @ $54 = $108
80005 Macro-Line 5 kg – 1 @ $107 = $107
80010 Macro-Line 10 kg – 1 @ $109 = $109

Other potential uses for these same funds could 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 (spark plugs, 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), camp stoves, 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 electrofishing "witches brooms," Yeti 125-quart coolers, Dura-Frame electrofishing dip nets, 2-man dome tents, NRS Canyon Box for dry storage, Rite-In-The-Rain data sheets, data books, pencils, repair/replace river maps, etc.

Sub Total	$ 5,768.00
USFWS-CRFP (Grand Junction) Total	$ 84,550.00
USFWS Region 6 Regional Office Administrative Overhead (3.00%)	$ 2,537.00
USFWS Region 6 Total	$ 87,087.00

Under the heading "Funding for participation of other agencies." Cost for participation of Utah Division of Wildlife Resources, Moab Field Station in FY-2017 nonnative removal activities (Shiprock, New Mexico to Mexican Hat, Utah).

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

Fiscal Year 2017 Budget

Prepared by: Katie Creighton
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BOR Agreement #: R13AC40007

FY 2017 Costs for UDWR- Moab

Participation in Middle San Juan River (Shiprock to Montezuma Creek) Nonnative Control (2 people X 5 days X 6 trips)

Labor: salary + benefits + applicable overtime (personnel services)

	Rate	Hours	Cost
Project Leader	$34.79	80	$2,783
Biologist	$33.92	250	$8,480
Technician	$17.13	560	$9,592
		subtotal	**$20,856**

Food and Transport (current expense)

	Rate	Quantity	Cost
Fleet Costs (2 trucks for 3% of total fleet costs)	$40,800.00	0.030	$1,224
In-state per-diem (2 people, 4 days, 6 passes)	$40.00	48	$1,920
Camping reimbursement	$25.00	48	$1,200
		subtotal	**$4,344**

Equipment (current expense)

	Rate	Quantity	Cost
Camping gear repair/replacement:			$450
Sampling gear repair/replacement:			$450
Boating gear repair/replacement:			$450
Fuel for generators	$4.00	90	$360
		subtotal	**$1,710**

Total Expenses	**$26,910**
Administrative Overhead (17% on all personnel services)	**$3,545**
UDWR-Moab Total FY 2017	**$30,455**

[a] The State of Utah motorpool vehicles cost approximately $6,800/year/vehicle (includes fleet rental, mileage, and gas), which is based on the average annual cost for all trucks used in our program.
[b] Includes, but is not limited to, tents, sleeping pads, toilet system, cookware, stoves, propane, charcoal, satellite phone and service, drybags, coolers, first aid supplies.
[c] Includes, but is not limited to dip nets, tags, tagging equipment, electrofishing units, electrofishing wiring, anodes, cathodes, generators, data loggers, etc…
[d] Includes, but is not limited to, raft repair/replacement, oars, oar hardware, raft frame repair, dry boxes, straps, etc…
[b,c,d] Estimated costs are based on actual costs from previous years plus an estimated 3% cost of living increase each year following.

Under the heading "Funding for participation of other agencies." Cost for participation of American Southwest Ichthyological Researchers, LLC – Albuquerque, NM in FY-2017 nonnative removal activities

2017 BUDGET: SAN JUAN RIVER NON-NATIVE FISH REMOVAL
Based on eight sampling trips per year: Shiprock to Mexican Hat

Personnel

Field Data Collection
Shiprock to Mexican Hat - RM 148.0 - 53.3
Fisheries Biologist I (2 staff x 8 trips x 5 days x 8 hrs/day at $ 55.52/hr): ..... $ 35,533

Project Oversight
Senior Fisheries Biologist I (1 staff x 4 days x 8 hrs/day at $ 93.95/hr): ..... $ 3,006
Tasks: Project coordination and management.

Personnel: ..... Total $ 38,539

Materials and Supplies

Rafts and associated sampling gear supplied by USFWS
Personal camping gear (we will use gear from SJR larval fish project)
Materials and Supplies: ..... Total $ 0

Travel and Per Diem

Travel
Travel - (1 vehicle x 8 trips x 625 miles x $ 0.54/mile): ..... $ 2,700
(roundtrip Albuquerque to Montezuma Creek, shuttle to Mexican Hat and return) [1]
Travel - (1 vehicle x 8 commercial shuttles x 180/per shuttle): ..... $ 1,440

Per Diem
Per Diem - 1 hotel day per trip x 8 trips x 2 staff ($ 89/night GSA lodging rate): ..... $ 1,424
Per Diem - 5 field days per trip x 8 trips x 2 staff ($ 51/day GSA M&IE rate): ..... $ 4,080
Travel and Per Diem: ..... Total $ 9,644

2017 Project Totals

Personnel: ..... Total $ 38,539
Materials and Supplies: ..... Total $ 0
Travel and Per Diem: ..... Total $ 9,644

2017 Scope of Work: ..... GRAND TOTAL $ 48,183

Under the heading "Funding for participation of other agencies." Cost for participation of New Mexico Department of Game and Fish in FY-2017 nonnative removal activities (Shiprock, NM to Montezuma Creek, UT).

Personnel/Labor Costs (State Salary + Benefits)		
Biologists – 20 days @ $366/day		
(1 persons x 5 days/trip x 4 trips)		$ 7,320.00
		$ 7,320.00
Travel and Per Diem (State Per Diem Rates)		
Per Diem – 4 trips @ $465/trip		
(3 days in-state @ $85/day + 2 days out-state @ $105/day		
X 4 trips)		$ 1,860.00
		$ 1,860.00
Equipment		
Vehicle Maintenance and Gasoline (@ $0.55/mile)		
(2,780 miles for 4 trips from Santa Fe to Shiprock and		
associated shuttling of vehicles)		$ 1,529.00
		$ 1,529.00
NMDGF – Santa Fe	**Total**	**$ 10,709.00**
Administrative Overhead (10%)		**$ 1,071.00**
NMDGF – Santa Fe – Total Budget		**$ 11,780.00**

Under the heading "Funding for participation of other agencies." Cost for participation of the Navajo Nation Department of Fish and Wildlife in FY-2017 nonnative removal activities (Shiprock, NM to Montezuma Creek, UT).

Personnel/Labor Costs (Salary + Benefits)		
Fish Biologist – 10 days @ $163.54/day		$ 1635.40
(1 person x 5 days x 2 trips)		
Biological Technician – 10 days @ $89.54/day		$ 895.40
(1 person x 5 days x 2 trips)		
	Sub-Total	$1530.80
Fringe Benefits X 42.48%		$ 1075.08
	Total Personnel/Labor	**$ 2,605.88**
Travel (Vehicle shuttling)		
Vehicle Lease/Maintenance & Gasoline		
$15.13/day X 12 days = $181.56 + 2 X 36miles X .30/mile=$21.60		$ 203.16
(36 miles round trip from Fruitland, NM to Shiprock x 6 trips)		
	Total Travel/Per Diem	**$ 203.16**
	Sub-total with 3% added for inflation	$ 209.25
Equipment		
Equipment Maintenance, Repair, & Replacement (e.g., life jackets, hip boots, generator repair, rubber gloves, dip nets, aluminum welding, raft repair, etc.)		$ 1,000
	Total Equipment	**$ 1,000**
	Sub-total with 3% added for inflation	$ 1,030
Navajo Nation Fish and Wildlife Total		**$3,845.13**
Navajo Fish and Wildlife Administrative Overhead (18.05%)		**$ 694.04**
Navajo Nation Total		**$4,539.18**

APPENDIX 2

PARTICIPATING AGENCIES BUDGETS FOR FY 17 NONNATIVE MONITORING AND CONTROL FROM MONTEZUMA CREEK TO MEXICAN HAT, UT

Lead Agency:

- **Utah Division of Wildlife Resources, Moab Field Station, UT**

Participating Agencies:

- **U.S. Fish and Wildlife Service, Colorado River Project – Grand Junction, CO**
- **New Mexico Department of Game and Fish – Santa Fe, NM**
- **Navajo Nation Department of Fish and Wildlife**

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

(Montezuma Creek to Mexican Hat)

Estimated Budget for 2016-2020
BOR Cooperative Agreement #R13AC40007

Principal Investigator: Brian Hines
Prepared by: Katie Creighton and Brian Hines
Utah Division of Wildlife Resources, Moab Field Station
1165 S. Hwy 191- Suite 4, Moab, Utah 84532
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FY 2017 Costs for UDWR- Moab

San Juan River Nonnative Removal and Monitoring (Montezuma Creek-Mexican Hat: 9 passes)

Personnel Costs (salary + fringe costs)

	Rate	Hours	Cost
Project Leader	$33.71	250	$8,427
Biologist	$30.76	1400	$43,063
Technician	$16.77	2800	$46,956
		subtotal	**$98,446**

Food and Travel

	Rate	Quantity	Cost
Fleet Costs[a] (3 trucks for 25% of total fleet costs)	$40,800.00	0.25	$10,200
Food (6 people, 4 days, 9 passes)	$30.00	216	$6,480
Shuttle (3 trucks, 9 passes)	$100.00	27	$2,700
Out-of-state per diem (Biologist and Project Leader)	$47.00	12	$564
Hotel- Durango (Biologist and Project Leader)	$95.00	8	$760
		subtotal	**$20,704**

Equipment

	Rate	Quantity	Cost
Camping gear repair/replacement[b]:			$3,667
Sampling gear repair/replacement[c]:			$4,828
Boating gear repair/replacement[d]:			$2,750
NRS 16' Expedition Raft	$5,000.00	1	$5,000
Fuel for generators (20 gallons/pass)	$4.00	180	$720
		subtotal	**$16,965**

Total Expenses	**$136,115**
Administrative Overhead (17% on all personnel services)	**$16,736**
UDWR Grand Total FY 2017	**$152,851**

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

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

[c] Includes, but is not limited to dip nets, tags, tagging equipment, electrofishing wiring, anodes, cathodes, generator repair, data loggers, etc…

[d] Includes, but is not limited to, raft repair/replacement, oars, oar hardware, raft frame repair, dry boxes, straps, etc…

[b,c,d] Estimated costs are based on actual costs from previous years plus an estimated 3% cost of living increase each year following.

FY 17 Budget Nonnative Monitoring and Control from Montezuma Creek To Mexican Hat, UT	
Funding for lead agency:	
UDWR- Moab	$ 152,851
Funding for cooperators:	
NNDFW	$ 9,398
NMDGF-Santa Fe	$ 6,864
USFWS-CRFP	$ 19,396
Grand Total	**$ 188,509**

Under the heading "Funding for Participating Agencies." Estimated costs for participation of the Navajo Nation Department of Fish and Wildlife, in FY-2017 (Montezuma Creek to Mexican Hat, UT). BOR Cooperative Agreement Number with Navajo Nation: R11AP40089

FY 2017 Costs for Navajo Nation			
Personnel/Labor Costs (Salary+Benefits)	Rate	Quantity	
Fish Biologist	$158.78	14	$2,223
Bio Tech	$86.93	14	$1,217
Fringe Benfits (Labor Costs* 42.48%)	$43.75		$1,461
Subtotal			$4,901
Travel and Per Diem			
Hotel- (4 nights)	$72.10	4	$288
Camping Rate-(20 nights)	$29.87	20	$597
Vehicle Lease/Maintenance	$467.62	1	$468
Gasoline-(260 miles)	$0.62	260	$161
Subtotal			$1,515
Equipment			
Maintenance, Repair, Replacement	$1,545.00	1	$1,545
Subtotal			$1,545
Total Expenses			$7,961
Navajo Nation Administration Fees (18.05%)			$1,437
Navajo Nation FY16 Total			**$9,398**

Under the heading "Funding for Participating Agencies." Costs for participation of the New Mexico Game and Fish in FY 2017 (Montezuma Creek to Mexican Hat, UT). BOR Cooperative Agreement Number with New Mexico Department of Fish and Game: 07FG402630

FY 2017 Costs for New Mexico Game and Fish			
Personnel/Labor Costs (Salary+Benefits)	Rate	Quantity	
Fish Biologist	$412.00	12	$4,944
Subtotal			$4,944
Travel and Per Diem			
Per Diem	$115.00	10	$1,150
Gasoline-(260 miles)	$0.55	1400	$770
Subtotal			$1,920
New Mexico Dept. Game and Fish FY17 Total			**$6,864**

U.S. Fish Wildlife Service, Colorado River Fishery Project (USFWS-CRFP)
Budget for Participation in
Non-native Species Control in the *Lower* San Juan River
Fiscal Year 2017 Project Proposal
(Montezuma Creek to Mexican Hat, UT)
Updated: 31 March 2015 (by Ben Schleicher and Dale Ryden)

Principal Investigator(s):
Brian Hines and Katherine Creighton
Utah Division of Wildlife Resources, Moab Field Station
1165 S. Hwy 191- Suite 4, Moab, Utah 84532
(435) 259-3782

Fiscal Year 2017 Estimated Budget:

Costs for participation of the U.S. Fish Wildlife Service, Colorado River Fishery Project (USFWS-CRFP) office, Grand Junction, CO.
(Based on projected FY-2017 costs)
Note: The FY-16 and outyear costs have been adjusted for the GS-5 Bio Tech line items to reflect new guidance from Office of Personnel Management (OPM) to the USFWS requiring the USFWS to provide health insurance to all federal employees, regardless of grade level or appointment type, if they work for the federal government longer than 60 days (480 total hours).

Personnel/Labor Costs (Federal Salary + Benefits)	
Principal Biologist (GS-11) – 80 hours @ $50.84/hr	$ 4,067.00
(1 person X 5 days/trip X 2 trips)	
Principal Biologist (GS-7) - 80 hours @ $34.71/hr	$ 4,338.00
(1 people X 5 days/trip X 2 trips)	
(+ 30 hours overtime at $52.06/hr = $1,562)	
Biological Technician (GS-5) – 80 hours @ $24.96/hr	$ 3,154.00
(1 people X 5 days/trip X 2 trips)	
(+ 30 hours overtime each at $38.56/hr = $1,157)	
Sub Total	$ 11,559.00
Administrative Support (Federal Salary + Benefits)	
Administrative Officer (GS-9) – 23 hours @ $46.06/hr	$ 1,059.00
Project Leader (GS-14) -- 15 hours @ $85.92/hr	$ 1,289.00
Sub Total	$ 2,348.00
Travel and Per Diem (Based on Published FY-2016 Federal Per Diem Rates)	
Hotel Costs	
2 nights X 3 people X $89/night (standard hotel rate)	$ 534.00
Per Diem (Hotel Rate)	
2 days X 3 people X $51/day (standard hotel rate)	$ 306.00
Per Diem (Camping Rate)	
10 days X 3 people X $28/day	$ 840.00
Sub Total	$ 1,680.00
Equipment	
Vehicle Maintenance & Gasoline (GSA lease @ $365 = $12.17 per day based on 30 days in an "average" month + $0.33/mile)	
2 trips from Grand Junction, CO to Clay Hills boat take-out in Utah X 1 truck X 5 days per trip (camping)	$ 584.00
(350 miles 1-way = 700 miles round trip X	

2 trips) = $462 (1 truck X 5 days/trip X 2 trips X $12.17/day) = $122	
Generator Gasoline for Electrofishing (20 gallons/trip X 2 trips @ $4.00/gallon)	$ 160.00
Equipment Maintenance, Repair, & Replacement	$ 2,500.00

Exact use of the money in this line item will vary from year to year depending on what equipment needs to be maintained, repaired, or replaced, but probable uses for this incurred cost include the following:

- Annual trailer maintenance & safety inspection = $175
  - Replace/repair trailer suspension, trailer lights, winch handle/straps/gears, trailer jack stand, wheel bearings
- Replace trailer tires – 2 per year @ $100 each = $200
- Spark plugs for generators - 5 @ $7.50 each = $37.50
- Synthetic oil for generators - 5 quarts at $7.50 each = $37.50
- Generator repair/tune-up - 3 hrs @ $75/hr = $225
- Hip boots – 3 pair at $50/pair = $150
- Breathable chest waders - 4 pair @ $125/pair = $500
- Dura-Frame electrofishing dip nets – 3 @ $300 each = $900
- Stearns Type II life jackets – 3 @ $70 each = $210
- Electrical Gloves - 3 pairs @ $65/pair = $195
- Repair raft frame
  - Aluminum welding – 3 hours @ $150/hr = $450
- Restock raft repair kits
  - Raft glue (urethane/hypalon) – Two 4-oz. cans @ $22.50/can = $55
- NRS raft patch material – 5 feet @ $37/ft = $185
- Acetone – 1 gallon @ $17/gallon = $17
- Replace any missing NRS HD-brand tie-down straps, each boat needs:
  - Ten 2-ft straps @ $4.20 each = $42
  - Five 3-ft straps @ $4.30 each = $21.50
  - Ten 4-ft straps @ $4.70 each = $47
  - Five 6-ft straps @ $5.05 each = $25.25
  - Five 9-ft straps @ $5.7 each = $28.50
  - Five 12-ft straps @ $6.15 each = $30.75
- Replace any missing D-style carabiners, each boat needs:
  - 10 @ $7.50 each = $75

Sub Total	$ 3,244.00
USFWS-CRFP (Grand Junction, CO) Total	$ 18,831.00
USFWS Region 6 Administrative Overhead (3.00%)	$ 565.00
USFWS Region 6 Total	$ 19,396.00

Sub-Adult and Adult Large-Bodied Fish Community Monitoring Fiscal Year 2017 Project Proposal 31 March 2016

Principal Investigator:
Ben Schleicher and Dale Ryden
U. S. Fish and Wildlife Service
Colorado River Fishery Project
445 West Gunnison Ave, Suite 140
Grand Junction, Colorado 81501
(970) 628-7205
benjamin_schleicher@fws.gov dale_ryden@fws.gov

Contract or Agreement number(s):
R13PG40052 for USFWS – Grand Junction, CO
R13PG40051 for USFWS – Albuquerque, NM
R13AC40007 for UDWR – Moab, UT

Reporting Dates: 10/1/2016 through 9/30/2017

Sub-Adult & Adult Large-Bodied Fish Community Monitoring
(a.k.a. Adult Monitoring)
Fiscal Year 2017 Project Proposal
31 March 2016

Principal Investigator:
Benjamin Schleicher and Dale Ryden
U. S. Fish and Wildlife Service, Colorado River Fishery Project
445 West Gunnison Ave, Suite 140
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(970) 628-7205
benjamin_schleicher@fws.gov dale_ryden@fws.gov

Background:

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

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

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

Relationship to the Recovery Program:

Adult Monitoring provides data for or makes possible (at least in part) the following Tasks under element numbers 1-5 of the Long Range Plan (SJRBRIP 2015): 1.1.1.1, 1.1.1.2, 1.2.1.1, 1.2.1.2, 2.3.1.4, 2.3.1.5, 2.3.1.6, 2.3.1.7, 2.3.2.1, 2.4.2.1, 2.6.1.1, 2.6.1.2, 2.6.1.3, 3.1.1.1, 3.1.1.3, 3.1.1.4, 3.1.1.5, 3.1.1.6, 3.1.1.7, 3.2.3.5, 4.1.1.1, 4.1.1.2, 4.1.1.3, 4.1.2.3, 4.1.2.4, 4.1.2.6, 4.1.3.1, 4.1.4.2, 4.1.5.1, 4.1.6.1, 4.1.6.2, 4.1.6.3, 4.1.7.1, 4.1.7.2, 4.4.1.1, 4.4.2.1, 4.4.2.2, 4.4.2.3, 4.4.3.1, 4.4.3.2, 4.4.3.3, 4.5.2.3, 5.2.2.2, 5.2.2.3, 5.2.2.4, and 5.2.2.5. The monitoring protocols discussed in the Methods section of this report reflect those that are currently included in the latest version of the revised SJRBRIP Monitoring Plan and Protocols (SJRBRIP 2012).

Description of Study Area:

As per the latest version of the SJRBRIP Monitoring Plan and Protocols (SJRBRIP 2012) the study area for Adult Monitoring extends from river mile (RM) 180.0 (just downstream of the Animas River confluence in Farmington, NM), downstream to RM 77.0 (just upstream of the Sand Island boat launch near Bluff, UT). The river section from RM 77.0 downstream to RM 2.9 (Clay Hills boat launch, just upstream of Lake Powell in UT) is scheduled to be sampled every fifth year. The last such sampling occurring in 2015, so that section of river should be sampled again in 2020.

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

Objectives:

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

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

3) Continue to perform activities that support other studies and recovery actions being implemented by the SJRBRIP. These may include the following:
    a. Remove nonnative fish species which prey upon and may compete with native fish species in the San Juan River.
    b. Collect GPS waypoints in habitats where endangered Colorado Pikeminnow and Razorback Sucker are collected.
    c. Collect tissue samples from various fish species for stable isotope, genetics, and contaminants studies.

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

Methods:

Objectives 1-3: Two Adult Monitoring trips will take place in the fall of 2017. The first will sample the lower Animas River from Riverside Park in Aztec, NM downstream to the Animas-San Juan River confluence. These two days of sampling will occur sometime between late March and late April. The second sampling trip will sample from RM 196.0 (Bloomfield Riverside Landing) downstream to RM 77.0 (Sand Island boat landing). Sampling will begin in the first to second week of September and will be concluded by end of September. Raft-borne electrofishing will be the primary sampling technique for both sampling efforts.

Electrofishing will follow the methods set forth above and in the SJRBRIP Monitoring Plan and Protocols (SJRBRIP 2012). Two oar-powered rafts, with one netter each, will electrofish in a continuous downstream fashion, with one raft on each shoreline. Depending upon water levels in the lower Animas River in the spring, only one electrofishing raft may be used in the lower Animas River (instead of two) at the Principal Investigator's discretion. Netters will net all stunned fish that can possibly be collected, regardless of species or body size. Trailing or "chase" rafts will not be used to collect fish. No outboard motors will be used. Sampling crews will consist of approximately 2-4 people for spring sampling (2 per electrofishing raft) and 8-10 people for fall sampling (4 for electrofishing, 2-3 for baggage rafts, and 2-3 for other research elements that are being done simultaneously with our sampling). Electrofishing will sample two out of every three miles (approximately 130 total sampled river miles each fall). All fish collected will be enumerated by species and life stage at the end of every sampled mile. Every fourth sampled mile (known as a "designated mile" or DM), all fish collected will be weighed and measured. All native fish collected will be returned alive to the river. All nonnative fish collected will be removed from the river. All nonnative predatory fishes (e.g. - Walleye, Striped Bass, Largemouth Bass, Smallmouth Bass) collected will be weighed and measured, and may have stomach samples taken, before being removed from the river. Tag numbers, total length, and weight will be recorded on all recaptured, FLOY-tagged fish (both native and nonnative), as well as any rare fish collected. Colorado Pikeminnow, Razorback Sucker, and Roundtail Chub greater than 150 mm TL will be implanted with 134 kHz PIT (Passive Integrated Transponder) tags. Notes will be kept on any parasites and/or abnormalities observed on collected fishes.

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

Products:

An interim progress report for Adult Monitoring data collected during 2017 is scheduled to be available

by 31 March 2018. The final version of this interim progress report which incorporates comments received is scheduled to be completed by 1 June 2018. Data files containing PIT tag information on the federally-listed endangered fish species (Colorado Pikeminnow and Razorback Sucker) collected during this Adult Monitoring trip will be submitted for inclusion in the SJRBRIP's integrated database by 31 December 2017. Data files containing the remainder of the information (e.g., data on common fish species) collected during this Adult Monitoring trip will be submitted for inclusion in the SJRBRIP's integrated database by 31 March 2018.

Qualifications of Personnel Included in the Budget:

Principal Biologist (GS-11) – Benjamin Schleicher, USFWS-CRFP
Ben has seven years with the USFWS-CRFP performing fisheries research and management in the Colorado and San Juan River basins, leading crews on daily and multi-day trips dealing with endangered species population estimates, nonnative fish removal, and riverwide fish community monitoring. He also spent two years with the UDWR-Moab performing the same tasks in the Colorado, Green, and San Juan River basins. In summer 2012, Ben took over as principal fish biologist for Region 6 of the USFWS in charge of performing fisheries research and management associated with the San Juan River Recovery Implementation Program (SJRBRIP). Specific to the San Juan River Basin recovery Implementation Program, Ben has been involved in a number of areas including: 1) long-term augmentation and monitoring of the San Juan River's two endangered fish populations; 2) performing and analyzing the effects of nonnative fish removal operations; and, 3) performing Razorback Sucker surveys in Lake Powell. Ben co-authored the 2012 Sub-Adult and Adult Large-Bodied Fish Community Monitoring Adult Monitoring report and was sole author of this report in 2013. Ben also was a co-author of the 2011 and 2012 San Juan River arm of Lake Powel Razorback Sucker Survey reports. Ben took over as the USFWS's Region 6 representative on the SJRBRIP Biology Committee in May 2013.

Principal Biologist (GS-14) -- Dale Ryden, USFWS-CRFP
Dale has 26 years of experience performing fisheries research and management in the Colorado, Gunnison and San Juan rivers. For over 22 years, Dale was the principal fish biologist for Region 6 of the USFWS in charge of performing fisheries research and management associated with the San Juan River Recovery Implementation Program (SJRBRIP). During his involvement with the SJRBRIP, Dale's responsibilities have ranged across a number of areas including: 1) initial reintroduction efforts for Razorback Sucker in the mainstem San Juan River; 2) long-term augmentation and monitoring of the San Juan River's two endangered fish populations; 3) annually monitoring the riverwide distribution and abundance of the entire large-bodied fish community in the San Juan River; 4) determining habitat use and preference and locating spawning areas of stocked Razorback Sucker and both stocked and wild Colorado Pikeminnow via radio-telemetry; and, 5) performing and analyzing the effects of nonnative fish removal operations. Dale has authored two peer-reviewed journal articles on his work in the San Juan River basin, as well as over 35 agency reports, and numerous augmentation plans and addendums. He co-authored a genetics management plan for the endangered Colorado Pikeminnow and Razorback Sucker in the San Juan River and has been a contributing author to both the flow recommendations report for the reoperation of Navajo Reservoir and the long-term monitoring protocols document currently being used by the SJRBRIP. During the development of the flow recommendations document, Dale acted as the chairman for the Native Fishes Workgroup. He is the Project Leader for the Colorado River Fishery Project office in Grand Junction, CO. From 2011-2013, Dale was the USFWS's Region 6 representative on the SJRBRIP Biology Committee. In May 2013, Dale became the USFWS's Region 6 representative on the SJRBRIP Coordination Committee.

Biological Technician Crew Leader (GS-6) – USFWS-CRFP

Our Crew Leaders have a minimum of three years with the USFWS-CRFP preforming fisheries research and management in the Colorado and San Juan River Basins. They have all led single and multi-day trips conducting sampling for endangered and other native fishes, as well as conducting non-native fish removal efforts. Our Crew Leaders also assist biologists at the Ouray National Fish Hatchery – Grand Valley Unit with day to day operations and fish culture.

Biological Technicians (GS-5) – USFWS-CRFP
All have at least a BS degree in biology. Depending upon the individual, they have up to 3 years of experience performing fisheries research and management in the Colorado River Basin, including the San Juan River.

Projected Duration Of Project:

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

Literature Cited:

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

San Juan River Basin Recovery Implementation Program. 2015. Long-Range Plan. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

Fiscal Year 2017 Estimated Budget:

Costs for participation of the U.S. Fish Wildlife Service, Colorado River Fishery Project (USFWS-CRFP) office, Grand Junction, CO.
(Based on projected FY-2016 costs)

Note 1: The FY-17 and outyear costs have been adjusted for the GS-5 Bio Tech line items to reflect new guidance from Office of Personnel Management (OPM) to the USFWS requiring the USFWS to provide health insurance to all federal employees, regardless of grade level or appointment type, if they work for the federal government longer than 60 days (480 total hours).

Note 2: As per conversations with the San Juan River Biology Committee on the 25 March 2015 conference call, costs have been added to this budget to reflect the separate springtime sampling that will occur in the lower Animas River.

Personnel/Labor Costs (Federal Salary + Benefits)

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

Principal Biologist (GS-11) – 224 hours @ $50.84/hr	$ 11,388.00
(1 person X 10 days planning & organization)	
Animas River sampling - spring:	
(1 person X 3 days/trip X 1 trip – work from hotel)	
San Juan River sampling - fall:	
(1 person X 5 days/trip X 1 trip – work from hotel)	
(1 person X 10 days/trip X 1 trip – camping)	
Bio. Tech. Crew Leader (GS-7) - 120 hours @ $34.71/hr	$ 6,768.00
San Juan River sampling - fall:	
(1 person X 5 days/trip X 1 trip – work from hotel)	
(1 person X 10 days/trip X 1 trip – camping)	
(+ 50 hours overtime at $52.06/hr = $2,603.00)	
Bio. Tech. Crew Leader (GS-6) - 120 hours @ $33.74/hr	$ 6,580.00
San Juan River sampling - fall:	
(1 person X 5 days/trip X 1 trip – work from hotel)	
(1 person X 10 days/trip X 1 trip – camping)	
(+ 50 hours overtime at $50.62/hr = $2,531.00)	
Biological Technicians (GS-5) – 312 hours @ $25.70/hr	$ 13,068.00
Animas River sampling - spring:	
(3 person X 3 days/trip X 1 trip – work from hotel)	
(+ 9 hours overtime each at $38.55/hr = $1,041.00)	
San Juan River sampling – fall:	
(2 person X 5 days/trip X 1 trip – work from hotel)	
(2 person X 10 days/trip X 1 trip – camping)	
(+ 52 hours overtime each at $38.55/hr = $4,009.00)	
Sub Total	$ 37,804.00

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

Administrative Officer (GS-9) – 200 hours @ $46.06/hr	$ 9,212.00
Principal Biologist (GS-11) – 400 hours @ $50.84/hr	$ 20,336.00
Project Leader (GS-14) – 320 hours @ $85.92/hr	$ 27,494.00
Sub Total	$ 57,042.00

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

Hotel Costs	
15 nights @ $89/night (in Farmington, NM)	$ 1,335.00
5 nights @ $114/night (in Cortez, CO)	$ 555.00
12 nights @ $89/night (in Farmington, NM)	$ 1,068.00
Per Diem (Hotel Rate)	
3 days X 5 people X $51/day (in Farmington, NM)	$ 765.00
1 days X 5 people X $59/day (in Cortez, CO)	$ 295.00
3 days X 4 people X $51/day (in Farmington, NM)	$ 612.00
Per Diem (Camping Rate)	
15 days X 5 people X $28/day	$ 2,100.00
Sub Total	$ 6,730.00

Equipment and Supplies

Vehicle Maintenance & Gasoline (@ $365/month lease = $12.17 per day based on 30 days in an "average" month + $0.33/mile)	
Animas River sampling - spring:	
1 trip from Grand Junction, CO to Farmington, NM X 2 trucks X 3 days/trip – work from hotel (296 miles one-way = 592 miles round-trip X 2 trucks = 1,184 total miles) = $390	$ 390.00
3 days sampling on lower Animas River – work from hotel (30 miles/day X 3 days X 2 trucks = 180 miles) = $59 (2 trucks X 3 days/trip X 1 trip X $12.17/day) = $73	$ 132.00
San Juan River sampling - fall:	
1 trip from Grand Junction, CO to Farmington, NM X 1 truck X 6 days/trip, sample from Animas river confluence down-stream to Shiprock, NM – work from hotel (296 miles one-way = 592 miles round-trip) = $195 (+ 70 miles shuttling/day X 5 days = 350 miles) = $116 (1 truck X 6 days/trip X 1 trip X $12.17/day) = $73	$ 384.00
3 additional days sampling on San Juan River upstream of Animas River confluence – work from hotel (30 miles/day X 3 days X 1 trucks = 90 miles) = $30 (1 trucks X 3 days X $12.17/day) = $37	$ 67.00
1 trip from Grand Junction, CO to Cortez, CO to Shiprock, NM to Mexican Hat, UT and back to Grand Junction, CO X 2 trucks X 10 days per trip – camping portion (610 miles/trip X 1 trip X 2 trucks = 1,220 miles) = $403 (2 trucks X 10 days/trip X 1 trip X $12.17/day) = $243	$ 646.00
Generator Gasoline	
Animas River sampling - spring:	
(30 gallons/trip X 1 trip @ $4.00/gallon) – work from hotel: 3 days sampling on lower Animas River	$ 120.00
San Juan River sampling - fall:	
(50 gallons/trip X 1 trip @ $4.00/gallon) – work from hotel 5 days @ 5 gallons/day X 2 raft X 1 trip	$ 200.00
(30 gallons/trip X 1 trip @ $4.00/gallon) – work from hotel:	$ 120.00

3 additional days sampling on San Juan River upstream of Animas River confluence
3 days @ 5 gallons/day X 2 raft X 1 trip
(120 gallons/trip X 1 trips @ $4.00/gallon) – camping portion $ 480.00
4 days @ 5 gallons/day X 1 raft X 1 trip
5 days @ 5 gallons/day X 4 rafts X 1 trip

Equipment Maintenance, Repair, & Replacement $ 5,045.00

Exact use of the money in this line item 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 would include the following:

- Annual trailer maintenance & safety inspection = $175
  - Replace/repair trailer suspension, trailer lights, winch handle/straps/gears, trailer jack stand wheel bearings
- Replace trailer tires – 2 per year @ $100 each = $200
- Spark plugs for generators – 5 at $7 each = $35
- Synthetic oil for generators - 5 quarts at $7 each = $35
- Generator repair/tune-up - 5 hrs @ $75/hr = $375
- Hip boots – 2 pair at $50/pair = $100
- Breathable chest waders - 2 pair @ $125/pair = $250
- Stearns Type III life jackets – 3 @ $70 each = $210
- Electrical Gloves - 3 pairs @ $65/pair = $195
- Dura-Frame electrofishing dip nets – 2 @ $300 each = $600
- Raft trailer maintenance
  - Signal light pigtail adapters – 2 @ $30 each = $60
- Repair raft frame
  - Aluminum welding – 3 hours @ $150/hr = $450
- Raft repair kits
  - Raft glue (urethane/hypalon) – Four 4-oz. cans @ $22.50/can = $90
  - NRS raft patch material – 5 feet @ $37/ft = $185
  - Acetone – 1 gallons @ $17.50/gallon = $17.50
  - Toluene – 1 gallon @ $17.50/gallon = $17.50
- Replace any missing NRS HD-brand tie-down straps, each boat needs:
  - Ten 2-ft straps @ $4.20 each = $42
  - Five 3-ft straps @ $4.30 each = $21.50
  - Ten 4-ft straps @ $4.70 each = $47
  - Five 6-ft straps @ $5.05 each = $25.25
  - Five 9-ft straps @ $5.7 each = $28.50
  - Five 12-ft straps @ $6.15 each = $30.75
- Replace any missing D-style carabiners, each boat needs:
  - 10 @ $7.50 each = $75
- Mesh rig bag – 1 @ $50 each = $50
- Yeti 125-quart coolers – 1 @ $500 each = $500
- Rafting oars, oar blades, and oar rowing sleeves
  - Carlisle 10-foot oar shafts – 2 @ $90 each = $180
  - Carlisle Oars blades – 4 @ $65 each = $260
  - Oar sleeves – 4 @ $12 each = $48
- 5-gallon plastic gasoline jerry cans – 5 @ $20 each = $100

River bags
NRS 3.8 heavy-duty Bill's Bag – 1 @ $100 each = $100
Clavey (green 7 X 17) dry bag – 3 @ $22 each = $66
Clavey (blue 10 X 24) dry bag) – 4 @ $26 each = $104
20 lb. propane tanks – 3 @ $20 each = $60
Pesola brand spring scales
20010 Micro-Line 10 gram – 1 @ $50 = $50
20060 Micro-Line 60 gram – 1 $46 = $46
20100 Micro-Line 100 gram – 1 @ $46 = $46
40300 Medio-Line 300 gram – 1 @ $54 = $54
40600 Medio-Line 600 gram – 1 @ $54 = $54
42500 Medio-Line 2,500 gram – 2 @ $56 = $112
41002 Medio-Line 1,000 gram – 3 @ $54 = $108
80005 Macro-Line 5 kg – 1 @ $107 = $107
80010 Macro-Line 10 kg – 1 @ $109 = $109

Other potential uses for these same funds could 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), camp stoves, 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 electrofishing "witches brooms," 2-man dome tents, NRS Canyon Box for dry storage, camping kitchen gear (roll-up camp tables, anodized dutch ovens, plates, bowls, cups, silverware), data books, Rite-In-The-Rain data sheets, pencils, repair/replace river maps, etc.

Sub Total	$ 7,584.00
USFWS-CRFP (Grand Junction, CO) Total	$109,160.00
USFWS Region 6 Administrative Overhead (3.00%)	$ 3,275.00
USFWS Region 6 Total	$112,435.00

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

USFWS-NMFWCO - Albuquerque, NM (Region 2)	
See Attached Budget for Line Item Breakdowns	$ 13,614.00
Utah Division of Wildlife Resources - Moab, UT	
See Attached Budget for Line Item Breakdowns	$ 5,799.00
	$ 19,413.00

FY-2017 WORKPLAN TOTAL	**$131,848.00**

Under the heading "Funding for participation of other agencies." Cost for participation of the U.S. Fish and Wildlife Service, New Mexico Fish and Wildlife Conservation Office, NM in FY-2017.

Personnel/Labor Costs (Federal Salary + Benefits)	
Fish Biologist (GS-9)– 17 days @ $325/day	$ 5,525
(1 person x 12 days x 1 trip; Shiprock to Mexican Hat)	
(1 person x 5 days x 1 trip; Animas to Shiprock)	
Biological Science Technician – 17 days @ $184/day	$ 3,128
Supervisory Fish Biologist (GS-13) – 2 days @ $561/day	
(Project participation oversight and contract management)	$ 1,122
Administrative Officer (GS-9) – 1 day @ $343/day	$ 343
Sub Total	**$ 10,118**
Travel and Per Diem (Based on Published FY-2016 Federal Per Diem Rates)	
Hotel Costs – 12 nights	$ 1,068
(6 nights x 2 rooms @ $89/night; Farmington, NM)	
Per Diem	
Camping Rate - 20 days @ $29/day	$ 580
(2 people x 10 days x 1 trip)	
Hotel Rate – 10 days @ $51.00/day	$ 510
Sub Total	**$ 2,158**
Equipment	
Vehicle Maintenance & Gasoline (@ $0.58/mile)	
(660 miles round trip from Albuquerque, NM to Mexican Hat, UT + 100 miles shuttling)	$ 441
Equipment Maintenance, Repair, & Replacement	
(e.g., life jackets, hip boots, generator repair, rubber gloves, dip nets, aluminum welding, raft repair, etc.)	$ 500
Sub Total	**$ 941**
USFWS-NMFWCO (Albuquerque) Total	**$ 13,217**
USFWS Region 2 Regional Office Administrative Overhead (3%)	**$ 397**
USFWS Region 2 Total	**$ 13,614**

FY 2017 Costs for UDWR- Moab

Participation in San Juan River Large-Bodied Fish Community Monitoring (1person X 10 days)

Labor: salary + benefits + applicable overtime (personnel services)

	Rate	Hours	Cost
Project Leader	$34.79	0	$0
Biologist	$33.92	70	$2,374
Technician	$17.13	70	$1,199
		subtotal	**$3,574**

Food and Transport (current expense)

	Rate	Quantity	Cost
Fleet Costs (2 trucks for 1% of total fleet costs)	$40,800.00	0.01	$408
In-state per diem (1 person, 10 days, 1 pass)	$40.00	10	$400
Out-of-state Per Diem (travel day)	$46.00	1	$46
Hotel (Cortez, CO)	$89.00	1	$89
Camping reimbursement	$25.00	9	$225
		subtotal	**$1,168**

Equipment (current expense)

	Rate	Quantity	Cost
Camping gear repair/replacement:			$100
Sampling gear repair/replacement:			$125
Boating gear repair/replacement:			$125
Fuel for generator	$4.00	25	$100
		subtotal	**$450**

Total Expenses	**$5,192**
Administrative Overhead (17% on all personnel services)	**$607**
UDWR-Moab Total FY 2017	**$5,799**

[a] The State of Utah motorpool vehicles cost approximately $6,800/year/vehicle (includes fleet rental, mileage, and gas), which is based on the average annual cost for all trucks used in our program.
[b] Includes, but is not limited to, tents, sleeping pads, toilet system, cookware, stoves, propane, charcoal, satellite phone and service, drybags, coolers, first aid supplies.
[c] Includes, but is not limited to dip nets, tags, tagging equipment, electrofishing units, electrofishing wiring, anodes, cathodes, generators, data loggers, etc…
[d] Includes, but is not limited to, raft repair/replacement, oars, oar hardware, raft frame repair, dry boxes, straps, etc…
[b,c,d] Estimated costs are based on actual costs from previous years plus an estimated 3% cost of living increase each year following.

SMALL-BODIED FISHES MONITORING
FISCAL YEAR 2017 STATEMENT OF WORK AND PROJECT BUDGET
AGREEMENT NUMBER: SJ2631

Principal Investigators: Matthew P. Zeigler and Michael E. Ruhl
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GOAL

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

BACKGROUND

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

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

Task 4.1.2.2 of the SJRIP's Long-Range Plan specifies the need for juvenile and small-bodied fish monitoring to locate areas and habitats used for rearing and to determine if young fish are surviving and recruiting into adult populations (SJRIP 2015). Data collected during annual small-bodied fish monitoring can be used to assess recovery of Colorado Pikeminnow and Razorback Sucker. In addition to assessing recovery of both endangered fish species, small-bodied monitoring data have also been used to evaluate the influences of SJRIP management actions on the river's fish community as a whole. These

assessments have included evaluating the effects of flow regime management on small-bodied fishes in secondary channels (Propst and Gido 2004; Franssen et al. 2007; Gido and Propost 2012; Gido et al. 2012), assessing the influences of habitat stability on the spatial and temporal trends in small-bodied fish communities in secondary channels (Gido et al. 1997), and determining the effects of habitat heterogeneity on the community structure of small-bodied fishes (Franssen et al. 2015).

MONITORING OBJECTIVES

The specific objectives for small-bodied fishes monitoring include:

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

Hypotheses

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

1. H_0: There is no influence of spring discharge quantity and duration on autumn density of age-0 native fishes.
2. H_0: There is no influence of spring discharge quantity and duration on autumn density of age-0 nonnative fishes.
3. H_0: Quantity of summer baseflow has no effect on survival of age-0 native fishes, as determined by autumn densities of age-0 specimens.
4. H_0: Quantity of summer baseflow has no effect on reproductive success/survival of age-0 nonnative fishes, as determined by autumn densities of age-0 specimens.
5. H_0: Mimicry of the natural flow regime has no effect on native or nonnative fishes.
6. H_0: Habitat complexity has no influence on densities of native and nonnative fishes.
7. H_0: Densities of age-0 and small-bodied fishes has no influence on the distribution and density of age-0 to age-3 Colorado Pikeminnow.
8. H_0: Mechanical removal of nonnative predators has no effect on the density of small-bodied native fishes.

STUDY AREA

The study area for annual small-bodied fishes monitoring extends from River Mile (RM) 180 near the San Juan-Animas rivers confluence downstream to RM 76.4 at San Island, UT. The section of river from RM 76.4 to 2.9 at Clay Hills, UT is only sampled during regular monitoring every fifth year. This section of river was last sampled in 2015 and will be sampled again in 2020.

In addition to sampling the common area from RM 180 to 76.4, two additional sections of the San Juan River and one section of the Animas River will be sampled in FY 2017. The two additional sections on the San Juan River include (1) RM 196.1 near Bloomfield, NM downstream to the San Juan-Animas rivers confluence at RM 180 and (2) RM 76.4 at Sand Island, UT downstream to RM 52.0 at Mexican Hat, UT. The section of the San Juan River from Sand Island to Mexican Hat will only be sampled if funding for the current nonnative removal study is continued. The Animas River will also be sampled

from Aztec, NM downstream to the San Juan-Animas rivers confluence in the spring (March/April) depending on flows and access.

METHODS

Small-bodied fishes monitoring is designed to efficiently and effectively sample those habitats which have the greatest likelihood of supporting age-0 individuals of large-bodied species and all age classes of small-bodied species. Sampling will occur in September in conjunction with sub-adult and adult monitoring. The primary channel will be sampled at designated 3-mile intervals, skipping the miles sampled by sub-adult and adult monitoring crews (SJRIP 2012). All secondary channels (less than 20% of total flow) and large backwaters (> 50 m^2) will be sampled when encountered, regardless if they occur within a designated 3-mile interval or not. Sample reaches will be approximately 200 m long (measured along the shoreline) at primary channel sample sites and, depending upon the extent of surface water, 100 – 200 m long at secondary channel and large backwater sample sites.

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

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

All captured fishes will be identified to species and measured for total length (mm TL) and standard length (mm SL). 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 recorded. Retained specimens will be identified and measured (TL and SL) in the laboratory to the nearest 0.1 mm and accessioned to the UNM-MSB, Division of Fishes.

DATA ANALYSIS AND REPORTING

Analyses conducted each year will be based on density of individual species, calculated for each individual seine haul as the number of fish captured per square meter (sampled width x sampled length). Annual reports will primarily be a summation of data obtained each year, a synthesis of data across years to document/assess species populations' trends, a summary of mesohabitat associations, and basic characterizations of species demographics. Separate data summaries and analyses will also be conducted for the Phase I RERI secondary channels and any sampling conducted in the Animas River.

All data collected will be recorded on electronic spreadsheets and provided to USFWS Program Office by the principal investigator, along with the annual final report, by June 30 of the year following data collection.

REFERENCES

Franssen, N.R., K.B. Gido, and D.L. Propst. 2007. Flow regime affects availability of native and nonnative prey of an endangered predator. Biological Conservation 138:330-340.

Franssen, N.R., E.I. Gilbert, and D.L. Propst. 2015. Effects of longitudinal and lateral stream channel complexity on native and non-native fishes in an invaded desert stream. Freshwater Biology 60:16-30.

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Propst, D.L., and K.B. Gido. 2004. Responses of native and nonnative fishes to natural flow regime mimicry in the San Juan River. Transactions of the American Fisheries Society 133:922-931.

Propst, D.L., S.P. Platania, D.W. Ryden, and R.L. Bliesner. 2006. San Juan River monitoring plan and protocols (revised). San Juan River Basin Recovery Implementation Program. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

SJRIP (San Juan River Basin Recovery Implementation Program). 2012. San Juan River Basin Recovery Implementation Program monitoring plan and protocols. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

SJRIP (San Juan River Basin Recovery Implementation Program). 2015. Long-range plan. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

FUNDING HISTORY:

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

FY 2017 BUDGET

Sampling Costs

Personnel

Tasks - Annual monitoring primary channel, secondary channel, and backwater habitats, San Juan River, Bloomfield, NM to Mexican Hat, UT; The Nature Conservancy and upstream sites; 16 field days projected at 12 hours of work per day = 192 hours (project leader 7 days).

Project Leader (1)	
56 hrs regular @ $45.66/hr ($33.19/hr (base salary) + $12.47 (benefits))	$ 2,557
28 hrs overtime @ $68.49/hr ($45.66/hr * 1.5 (time-and-a-half)	$ 1,918
Project Biologist (3)	
128 hrs regular @ $36.58/hr ($26.59/hr (base salary) + $9.99 (benefits)) * 3	$ 14,047
64 hrs overtime @ $54.87/hr ($36.58/hr * 1.5 (time-and-a-half) * 3	$ 10,535
Sub-total	**$ 29,057**

Per Diem

9 days @ $85/day (standard NM in-state rate) * 4 biologists	$ 3,060
7 days @ 115/day (standard NM out-of-state rate) * 4 biologist	$ 3,220
Sub-total	**$ 6,280**

Vehicles

Round-trip Farmington/Shiprock, NM – 850 miles @ $0.55/mile	$ 468
Round-trip to Mexican Hat, Utah – 1,400 miles @ $0.55/mile	$ 770
Sub-total	**$ 1,238**

Field Equipment & Supplies

Water quality instrument maintenance 2@$400	$ 800
Life Jackets 5@$40	$ 200
Raft maintenance	$ 500
Whirlpacks (500) @ $50.00/500	$ 50
Formalin (6 gal) @ $25/5gal	$ 150
Sub-total	**$ 1,700**

Sampling Costs Sub-total **$ 38,275**

Specimen Management

Personnel

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

Project Biologists (2)	
120 hrs regular @ $36.58/hr ($26.59/hr (base salary) + $9.99 (benefits)) * 2	$ 8,780

Specimen Management Sub-total **$ 8,780**

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 two Project Biologist (200 hrs each).

Project Leader (1)
120 hrs regular @ 45.66/hr ($33.19/hr (base salary) + $12.47 (benefits)) $ 5,480

Project Biologist (2)
200 hrs regular @ 36.58/hr ($26.59/hr (base salary) + $9.99 (benefits)) * 2 $ 14,632

Data Management/Analysis & Report Preparation Sub-total $ 20,112

Reviews & Meetings

Personnel

Tasks – Project Leader: attend 2 Biology Committee meetings per year (@ 28 hrs each) and review reports (40 hrs); Project Biologist: attend 5 Biology Committee meetings per year (@ 28 hrs each) and review reports (60 hrs).

Project Leader (1)
86 hrs @ $45.66/hr ($33.19/hr (base salary) + $12.47 (benefits)) $ 3,927

Project Biologists (1)
200 hrs @ 36.58/hr ($26.59/hr (base salary) + $9.99 (benefits)) $ 7,316

Sub-total $ 11,243

Per Diem (meetings requiring travel)

Project Leader (1)
6 days @ $115.00/day (standard NM out-of-state rate) $ 690

Project Biologists (1)
3 days @ $85.00/day (standard NM in-state rate) $ 255
9 days @ $115.00/day (standard NM out-of-state rate) $ 1,035

Sub-total $ 1,980

Vehicle

Roundtrip to Farmington, NM (1 meeting) – 400 miles @ $0.55/mile $ 220
Roundtrip to Durango, CO (3 meetings) – 500 miles @ $0.55/mile * 3 $ 825

Sub-total $ 1,045

Reviews & Meetings Sub-total $ 14,268

Administrative

Personnel

Tasks – Project Leader: administration of agreements, tracking budget expenditures (120 hrs); Project Biologist: purchasing equipment, arranging travel (80 hrs)

Project Leader (1)
120 hrs @ $45.66 ($33.19/hr (base salary) + $12.47 (benefits)) $ 5,480

Project Biologist (1) 80 hrs @ $36.58/hr ($26.59/hr (base salary) + $9.99 (benefits))	$ 2,927
Administrative Sub-total	**$ 8,407**

FY 2017 Total

Field Work Sub-total	**$ 38,275**
Specimen Management Sub-total	**$ 8,780**
Data Management/Analysis & Report Preparation	**$ 20,112**
Reviews & Meetings	**$ 14,268**
Administrative	**$ 8,407**
Total	**$ 89,842**

Out-Year Budgets within Current Agreement (Through FY2018)

FY 2018 TOTAL	**$88,936**

Out-Year Budgets Beyond Current Agreement (FY2019 and 2020)

FY 2019 TOTAL	**$91,604**
FY 2020 TOTAL	**$116,337**

SAN JUAN RIVER LARVAL RAZORBACK SUCKER AND COLORADO PIKEMINNOW MONITORING FISCAL YEAR 2017 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 NO. GS10F0249X

1 OCTOBER 2016- 30 SEPTEMBER 2017

SAN JUAN RIVER LARVAL RAZORBACK SUCKER AND COLORADO PIKEMINNOW MONITORING FISCAL YEAR 2017 PROJECT PROPOSAL

Principal Investigator: Michael A. Farrington
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Razorback Sucker project history:

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

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

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

During the 1997 Razorback Sucker larval fish survey, light-traps were set nightly in low-velocity habitats between Aneth and Mexican Hat, Utah, from late March through mid-June. The traps were distributed at dusk and retrieved about four hours later. Fish taken in those samples were preserved in the field. Sampling success during the 1997 Razorback Sucker larval fish study was

poor. While there were over 200 light-trap sets, those sampling efforts produced only 297 fish. Of those, about 200 (66%) were larval catostomids (either Flannelmouth Sucker or Bluehead Sucker). Larval Razorback Sucker was not present in the 1997 sampling survey. While there were probably several factors to account for the poor light-trap catch rate, a principal factor was the limited access to suitable habitats. We determined that being limited to specific collecting sites was not the most efficient means of collecting large numbers of individuals; a prerequisite for this study.

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

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

The use of active sampling to determine the reproductive success of Razorback Sucker has proven to be effective. To date, the results of this investigation have provided 18 consecutive years of unequivocal documentation of reproduction in the San Juan River by Razorback Sucker that have been stocked as part of the San Juan River Basin Recovery Implementation Program (Table 1). The data collected during the larval Razorback Sucker survey provide not only valuable data concerning the distribution (spatial and temporal), duration, and magnitude of Razorback Sucker reproduction but also equally informative data on the reproductive efforts of other native fishes in the San Juan River.

Table 1. Collection information of Razorback Sucker (Xyrtex) collected during the larval Razorback Sucker survey, 1998 – 2015.

Year	*Sampling method*	*Study Area (River Miles)*	*River Miles sampled*	*Percent change*	*Specimens collected*	*Xyrtex n=*
1998	Larval seine Light traps	127.5 – 53.3	74.2	na	13,608	2
1999	Larval seine Light traps	127.5 – 2.9	124.6	+ 40.4%	20,711	7
2000	Larval seine Light traps	127.5 – 2.9	124.6	na	13,549	129
2001	Larval seine Light traps	141.5 – 2.9	138.6	+ 10.1%	95,629	50
2002	Larval seine Light traps	141.5 – 2.9	138.6	na	138,602	813
2003	Larval seine Light traps	141.5 – 2.9	138.6	na	112,842	472
2004	Larval seine	141.5 – 2.9	138.6	na	160,292	41
2005	Larval seine	141.5 – 2.9	138.6	na	109,368	19
2006	Larval seine	141.5 – 2.9	138.6	na	50,616	202
2007	Larval seine	141.5 – 2.9	138.6	na	53,084	200
2008	Larval seine	141.5 – 2.9	138.6	na	40,855	126
2009	Larval seine	141.5 – 2.9	138.6	na	72,404	272
2010	Larval seine	141.5 – 2.9	138.6	na	70,610	1,251
2011	Larval seine	141.5 – 2.9	138.6	na	28,258	1,065
2012	Larval seine	147.9 – 2.9	145.0	+ 4.6%	29,384	1,778
2013	Larval seine	147.9 – 2.9	145.0	na	25,842	979
2014	Larval seine	147.9 – 2.9	145.0	na	20,508	612
2015	Larval seine	147.9 – 2.9	145.0	na	17,787	1,205

Colorado Pikeminnow project history:

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

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

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

Beginning in July of 2002, using funds from FY 2002 that had been appropriated for use at the two larval drift-netting stations, Museum of Southwestern Biology (MSB) personnel began an active sampling regime that mirrored the sampling protocol successfully used in the larval Razorback Sucker survey. The results from the temporal expansion of the larval surveys have produced 388 wild larval Colorado Pikeminnow to date. The majority of those larvae (N=312) were collected in 2014. Larval Colorado Pikeminnow were collected in surveys during 2004, 2007, 2009, 2010, 2011, 2013, 2014 and 2015 at 60 discrete sites, within the study area. Between 1995 and 2015 the combined sampling methodologies (passive and active) resulted in the collection of 392 larval Colorado Pikeminnow. Back-calculated spawning dates, based on those 392 individual larvae, range from 23 May to 18 July (Table 2) and are generally associated with the descending limb of spring run-off and mean river temperatures >18^{o}C.

Over 1,000,000 fish have been collected between 1995 and 2015 under the larval Colorado Pikeminnow survey. Of those, over 900,000 fish were collected after 2001 when the sampling protocol switched from passive to active sampling (2002).

Table 2. Summary of larval and YOY Colorado Pikeminnow collected in the San Juan River during larval drift-netting/larval seining (1995-2015) and back-calculated dates of spawning.

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

Project Modifications:

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

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

To reduce the variability of abiotic conditions as well as gain even greater temporal resolution of the longitudinal distribution of Razorback Sucker larvae, the protocol was modified to survey the upper and lower halves of the study area simultaneously. This effort began in 2007 and utilized two fully equipped and autonomous crews (Table 3). In 2008, additional participation of our staff with other SJRBRIP projects made the new simultaneous sampling effort a necessity so that our staff could meet obligations to assist the other researchers with their work.

Beginning in 2009, larval fish specimens collected in the field were preserved in 95% ethanol (as opposed to 10% buffered formalin). This change in preservation technique assured that specimens could be used for a variety of purposes, (such as genetic analysis and age determination via examination of otoliths) that was not possible under the formalin preservation protocol. Beginning in 2011, the September sampling trip was discontinued. The Biology Committee felt that the September survey did not provide enough data with respect to endangered fishes to warrant continuation.

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

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 2015.

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

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 2015 Long Range Plan set forth by the San Juan River Basin Recovery Implementation Program (SJRBRIP).

1) Conduct larval fish sampling to determine if (Colorado Pikeminnow and Razorback Sucker) reproduction is occurring, locate spawning and nursery areas, and gauge the extent of annual reproduction. (Task 4.1.2.1)

2) Determine the spawning periodicity of Colorado Pikeminnow and Razorback Sucker (utilizing back-calculated spawning and hatching formulas) between mid-April and August and examine potential correlations with temperature and discharge.

3) Document and quantify reproduction, survival, and recruitment. (Task 4.4.1.1).

4) Document and track trends in the use of specific mesohabitat types by larval Colorado Pikeminnow and Razorback Sucker. (Task 4.2.3.2).

5) Develop and revise a Standardized Fish Monitoring Plan to assess presence status and trends of Colorado Pikeminnow, Razorback Sucker and fish community (4.1.1.1).

6) 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)

7) Provide detailed analysis of data collected to determine progress towards endangered species recovery in the San Juan River. (Task 5.1.1.3)

8) Identify principal river reaches and habitats used by various life stages of endangered fish. (Task 4.2.4.1)

9) Deposit, process, and secure San Juan River fish specimens, field notes, and associated data at an organized permanent repository. (Task 4.1.2.5)

10) Provide annual updates on the rate of opercular deformities found in Razorback Sucker. (Task 4.1.7.2)

11) Monitor TNC's restoration sites. (Task 4.3.2.1)

Study Area:

The study area encompasses the San Juan River between Shiprock, New Mexico (RM 147.9) and the Clay Hills Crossing boat landing (RM 2.9) just above Lake Powell in Utah (145.0 river miles). As in all post 1999 sampling efforts, the study will include making collections in reaches of the San Juan River under the jurisdiction of the National Park Service.

Methods:

Field Work:

Sampling for Colorado Pikeminnow and Razorback Sucker larvae will be conducted in the San Juan River between RM 147.9 and RM 2.9 from mid-April through early August using sampling techniques that will provide sufficient numbers of fish necessary to meet study objectives. 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 gratis by personnel from the Farmington Office of the Bureau of Indian Affairs Office. Between 2008 and 2010, this service was performed by personnel from the N.M. Fishery Resources Office stationed in Farmington. 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 2017 must be scheduled by late January 2017 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 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% ethanol (in the case of potential Razorback Sucker hybrids) and scanned with a FS2001 PIT tag reader for the presence of a PIT tag. Specimens of sufficient size but lacking a PIT tag will be injected with a tag following the protocols established by the program (Davis 2010). All PIT tag information will be recorded in the field data sheet and subsequently forwarded to the SJRBRIP for integration in the program's PIT tag database.

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

Field Work, Safety:

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

All rafts used for this project will carry an extensively stocked first aid kit replete with items necessary for most minor medical situation. Additionally, the first aid kit will contain a suite of items (i.e., splints, neck braces, butterfly stitches, snakebite kits) needed to address more serious medical conditions. Because ethanol is used in the preservation of specimens, several vials of eyewash solution will be incorporated into each first aid kit. First aid kits will be inventoried

after each sampling trip and used and/or expired items replaced. In the upper reach of the study area, personal cell phones and PDA's will be used (at no cost to the program) to contact outside parties should a medical situation arise. In the lower study area reach (canyon bound; where cell phones do not have service) a Iridium 9505-satellite phone will be provided for sampling crews. Both sampling crews will be equipped with SPOT Satellite GPS Messenger units to be used in case of an emergency.

All preservation fluids will be transported in heavy-duty LPDE carboys. Extensive exposure to UV light makes the carboys susceptible to decomposition and cracking and requires that they be inspected monthly and not used for more than two years. Safety rope throw bags will be similarly inspected and retired from use accordingly. Rafts will be equipped with raft recovery (Z-line) kits, and repair kits, extra oars and oar blades, and two spare hand pumps to help ensure that crews do not become stranded due to raft damage. BLM regulations also mandate that an extra 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 95% ethanol. 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 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) are 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 are separated from age-1+ specimens using published literature on growth and development (Snyder 1981, Snyder and Muth 2004).

Age classes are 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 are obtained using electronic calipers and stereomicroscope mounted micrometers. The ontogenetic stage of

Colorado Pikeminnow and Razorback Sucker obtained in this study is 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 (1999–2015) and Colorado Pikeminnow (2003–2015) sampling-site density data were analyzed using PROC NLMIXED (SAS, 2014), a numerical optimization procedure, by fitting a mixture model using the methods outlined in White (1978). Logistic regression was used to model the probability a site was occupied, and the lognormal model was used to model the distribution of abundance given that the site was occupied. Models provided 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).

Additional samples (i.e. each seine haul preserved individually) were taken in 2013, 2014 and 2015 to increase the overall sample size and provide supplemental information on habitats (i.e., habitat type, habitat location, and cover type). 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]). Additionally, four categories were assigned to habitat depending on where the sample was taken. Shoreline (SH) indicated all samples taken along the land-water interface, open-water (OP) indicated samples taken away from the shoreline, and mouth (MO) or terminus (TR) indicated samples taken from those locations within a backwater or embayment. Three categories were assigned to habitat depending on the type of cover encountered. Type 1 indicated the presence of inundated vegetation, type 2 indicated the presence of submerged woody debris, and type 3 indicated the presence of overhead cover (i.e., shade).

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 were also analyzed using PROC NLMIXED (SAS, 2014), 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]) was 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 were used to incorporate covariates to model μ, δ, and σ. Covariates considered to model habitat-specific density data were year, reach, habitat type, habitat location and cover type. Random effects models were 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 were assumed for each Site*Year combination. A random error was 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) was used to integrate out these random effects in fitting the model using the SAS NLMIXED procedure. Goodness-of-fit statistics (logLike and AIC_C) were generated to assess the relative fit of data to various models.

The results in the annual report 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 only 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 is presented in an Appendix.

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

Hatching dates for larval Colorado Pikeminnow are calculated using the formula: $-76.7105+17.4949(L)-1.0555(L)^2+0.0221(L)^3$ for larvae <22 mm, where L=length (mm TL). For larvae 22-47 mm TL the formula A=-26.6421+2.7798L will be used.

Spawning dates for larval Colorado Pikeminnow are then estimated by adding five days to the post-hatch ages to account for incubation time at 20 – 22 ^oC (Nesler et al. 1988). Hatching and

spawning dates for both endangered species are then compared with the discharge and temperature data during that period within the study area.

This study is initiated prior to spring runoff and completed during mid-summer (late July or early August). Daily mean discharge during the study period is acquired from U.S. Geological Survey Gauge (# 09379500) near Bluff, Utah and Four Corners Bridge (#09371010). Water temperatures (mean, maximum, and minimum) are acquired from water temperature monitoring conducted by Miller Ecological Consultants, Inc. and data provided by the USGS gauging station at Mexican Hat, Utah (RM 53.3).

Reporting and Permitting:

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

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

Meetings:

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

Products:

A draft report of the 2017 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 2018. 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 2018. Electronic copies of the 2017 collection data will be transferred to the San Juan River database manager. Fish collected from this study will be curated in the Division of Fishes, Museum of Southwestern Biology (MSB), Department of Biology, at the University of New Mexico under a MSB contract with the SJRBRIP. Original field notes will be retained in the Division of Fishes and collection information electronically stored in a permanent MSB database program. These data and any maps generated from them will be available to the San Juan River Basin Biology Committee via hard-copy reports and electronically.

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2017 BUDGET: SAN JUAN RIVER LARVAL ENDANGERED FISH MONITORING
Based on five sampling trips per year

Personnel

Field Data Collection

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

Fisheries Biologist I (1 staff x 5 trips x 10 days x 8 hrs/day): .....$ 22,208

Fisheries Technician (1 staff x 5 trips x 10 days x 8 hrs/day): .....$ 13,664

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

Fisheries Biologist I (1 staff x 5 trips x 10 days x 8 hrs/day): .....$ 22,208

Fisheries Technician (1 staff x 5 trips x 10 days x 8 hrs/day): .....$ 13,664

Lab Work

Upper and Lower Reach Samples Combined

Fisheries Biologist I (120 staff days/sampling year): .....$ 53,299
Tasks: Laboratory identification, developmental staging, specialized endangered fish processing, data entry, data query and review, database development

Fisheries Technician (120 staff days/sampling year): .....$ 32,794
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): .....$ 31,091
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): .....$ 13,666
Tasks: Mixture model development and analysis.

Project Oversight

Senior Fisheries Biologist (10 staff days year): .....$ 7,516
Tasks: Project coordination, project and data review, data

management, report review

Personnel (Field, Lab, Office, Oversight): ..... Subtotal $ 210,110

SJRBRIP Meetings

Four meetings/year required; 2 days/meeting

Fisheries Biologist I (8 staff days/year): ..... $ 3,553

Senior Fisheries Biologist (8 staff days/year): ..... $ 6,013

Personnel (Meetings): ..... Subtotal $ 9,566

Personnel: ..... Total $ 219,676

Materials and Supplies

Safety dedicated first aid gear (open market items): ..... $ 1,838
Raft and rafting associated gear (open market items): ..... $ 1,489
Fish Sampling and associated electronic recording gear (open market items): ..... $ 1,296
Water quality measuring electronic meters ($14/day GSA rate x 60 days): ..... $ 840

Materials and Supplies: ..... Total $ 5,463

Travel and Per Diem

Field Data Collection

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

Travel - 4 x 4 pickup truck and raft trailer (1,380 miles x $ 0.54/mile x 5 trips): ..... $ 3,726
Per Diem - 6 field days per trip x 4 staff ($51/day GSA M&IE rate) x 5 trips: ..... $ 6,120
Per Diem - 1 hotel day per trip x 4 staff ($89/night GSA lodging rate) x 5 trips: ..... $ 1,780
Truck and Trailer Shuttle from Sand Island to Clay Hills x 5: ..... $ 1,800

Travel and Per Diem (Field): ..... Subtotal $ 13,426

SJRBRIP Meetings

Travel (one vehicle at 430 miles r.t. x 4 trips x $ 0.54/mile): ..... $ 929
Per Diem (2 GSA lodging + 3 M&IE per diem days/meeting x 4 meetings x 2 staff): .... $ 2,648

Travel and Per Diem (Meetings): ..... Subtotal $ 3,577

Travel and Per Diem: ..... Total $ 17,003

2017 Project Totals

Personnel:	**Total**	**$ 219,676**
Materials and Supplies:	**Total**	**$ 5,463**
Travel and Per Diem	**Total**	**$ 17,003**
2017 Scope of Work:	**GRAND TOTAL**	**$ 242,142**

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

FY 2018	**$ 249,406**
FY 2019	**$ 256,888**
FY 2020	**$ 264,595**

ADDENDUM TO SOW 17-21, SAN JUAN RIVER LARVAL RAZORBACK SICKER AND COLORADO PIKEMINNOW MONITORING – EXPANSION OF THE STUDY AREA UPSTREAM OF SHIPROCK, NM

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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. This addendum addresses the field logistics, data integration with the current larval fish monitoring program, and potential costs associated with increased upstream monitoring.

Project Justification:

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

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

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

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

These proposed sampling reaches would allow for a 32.7 mile upstream expansion of the current larval fish monitoring project while only restricting sampling access to 2.6 miles of river. The 1.8 mile gap between RM 168.4 and 166.6 as well as the 0.8 mile gap between RM 159.4 and 158.6 are required to bypass the impassable structures of the PNM weir and Hogback diversion. These proposed reaches are contingent on securing private property access through

Mr. Buck Wheeler and at the Hatch Brother's trading post. Both of these landowners have allowed access to SJRBRIP researchers in the past.

Currently, these reaches would only be sampled during the presumed spawning and hatching period of Razorback Sucker (May and June) and would target the collection of Razorback Sucker larvae. This sampling effort would be independent of ongoing larval fish monitoring taking place below Shiprock, NM, but data would be seamlessly integrating into the existing long-term larval fish monitoring database.

Methods:

Field Work:

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

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

The collection and preservation of specimens, gathering of physical data, field work safety, laboratory work, quality assurance and control, and data analysis will follow the methodology outlined for the San Juan River larval Razorback Sucker and Colorado Pikeminnow Monitoring program. Larval fish monitoring project history, as well as goals and objectives of this project as they relate to the SJRBRIP Long Range Plan, can also be found in the San Juan River larval Razorback Sucker and Colorado Pikeminnow Monitoring scope of work *(SOW 17 21).*

2017 BUDGET: EXPANDED SAN JUAN RIVER LARVAL ENDANGERED FISH MONITORING
Based on three sampling trips per year

Personnel

Field Data Collection

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

Fisheries Biologist I (1 staff x 3 trips x 5 days x 8 hrs/day): .....$ 6,662

Fisheries Technician (1 staff x 3 trips x 5 days x 8 hrs/day): .....$ 4,099

Lab Work

All Reach Samples Combined

Fisheries Biologist I (20 staff days/sampling year): .....$ 8,883
Tasks: Laboratory identification, developmental staging, specialized endangered fish processing, data entry, data query and review, database development

Fisheries Technician (20 staff days/sampling year): .....$ 5,466
Tasks**:** Post-trip sample processing, juvenile identification, Post-identification – processing, measures, review of counts

Office Work (Report Development)

Fisheries Biologist I (5 staff days year): .....$ 2,221
Tasks: Data analysis and integration into long-term larval fish monitoring database, inclusion of data in annual draft report, incorporate data into presentation of study for annual meetings, annual reporting related to state and tribal permitting of sampling activities

Project Oversight

Senior Fisheries Biologist (2 staff days year): .....$ 1,503
Tasks: Project coordination, project and data review, data management, report review

Personnel (Field, Lab, Office, Oversight): ..... Subtotal $ 28,834

SJRBRIP Meetings

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

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

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

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

Personnel: ..... Total $ 28,834

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
Water quality measuring electronic meters ($14/day GSA rate x 9 days): .....$ 126

Materials and Supplies: ..... Total $ 126

Travel and Per Diem

Field Data Collection

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

Travel - 4 x 4 pickup trucks (488 miles x $ 0.54/mile x 3 trips x 2 trucks):.....$ 1,581
Per Diem - 4 field days per trip x 2 staff ($51/day GSA M&IE rate) x 3 trips: .....$ 1,224
Per Diem - 3 hotel days per trip x 2 staff ($89/night GSA lodging rate) x 3 trips: .....$ 1,602

Travel and Per Diem (Field): ..... Subtotal $ 4,407

SJRBRIP Meetings (*Costs are covered under SOW 17 21)*

Travel (one vehicle at 430 miles r.t. x 4 trips x $ 0.54/mile): .....$ 0
Per Diem (2 GSA lodging + 3 M&IE per diem days/meeting x 4 meetings x 2 staff): .....$ 0

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

Travel and Per Diem: ..... Total $ 4,407

2017 Project Totals

Personnel: ..... Total $ 28,834
Materials and Supplies: ..... Total $ 126
Travel and Per Diem ..... Total $ 4,407
2017 Scope of Work: ..... GRAND TOTAL $ 33,367

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

FY 2018 .....$ 34,368
FY 2019 .....$ 35,399
FY 2020 .....$ 36,461

San Juan River Specimen Curation, Data Integration, and Synthesis
Museum of Southwestern Biology Fiscal Year 2017 Scope of Work

Principle Investigators: Alexandra M. Snyder and Thomas F. Turner
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Contact (505) 277-6005 amsnyder@unm.edu, turnert@unm.edu
Award R13SS40013

1 October 2016 to 30 September 2017

Background

Collections Curation and Data Archives -- Personnel with the Division of Fishes, Museum of Southwestern Biology (MSB), at the University of New Mexico (UNM) are responsible for the curation of collections of fishes taken by principle investigators with the San Juan River Basin Recovery Implementation Program (SJRIP). Since 1991, the MSB Division of Fishes has been the permanent repository for large numbers of voucher specimens and associated data collected by SJRIP researchers. The numbers of specimen processed each year have fluctuated depending on the availability of these collections after the field season. For example, larval and juvenile San Juan River fishes (approximately 200,000) collected in the early 1990s by the Utah Division of Wildlife Resources were not completely processed by MSB staff until 2001. Specimens of San Juan River fishes, taken by the New Mexico Department of Game and Fish during the 1991-99 secondary channel surveys, were not received by the MSB until 2007 and are still being incorporated into the MSB collections. Other factors such as annual variability of sampling conditions and changes in sampling techniques have affected numbers of specimens processed by MSB staff. For example, between 2001 and 2002 drift net sampling for larval Colorado Pikeminnow and razorback sucker was eliminated in favor of larval seine sampling. Given the variability in number of fishes to process, the San Juan River Biology Committee has recommended that the annual budget for the San Juan River specimen curation and larval fish identification reflect an “average” year of sample processing. The SJRIP Biology Committee recognizes that some years would require more effort from MSB staff than budgeted, while other years might not require the same high level of activity. A relatively stable budget would allow for uninterrupted processing of new collections and yet be sufficient to cover the ongoing work of processing backlogged SJRIP collections due to circumstances previously discussed.

To date, 44,255 lots or 1,530,729 fish specimens have been collected (1987-2015) by the San Juan River research group and these specimens have been processed, cataloged, and archived at the Museum of Southwestern Biology, Division of Fishes. A total of 19,540 San Juan River collection sites have been entered into the MSB database and georeferenced; all locality and habitat information has been captured using original field notes and data sheets. Over 25,000 pages of original San Juan River field notes and data sheets have been digitally captured, cleaned, and saved in both tiff and pdf

formats for the electronic archives; the original field notes and data sheets are permanently stored in acid-free document boxes for long-term conservation.

Incoming specimen collections are removed from WhirlPaks®, cleaned of debris, placed in known concentrations of fixative (either 5% buffered formalin, 10 % buffered formalin, or 95% ethanol), and organized on the accession shelves by MSB staff. Collections are later sorted and identified by the principal SJRIP investigators. Specimen collections are assigned an accession number (tracking number) and all associated documentation, like permits and field notes, are filed under that same number. Processing collections of fish specimens (adults and larvae) requires fluid transfers from formalin fixative to ethanol preservative (typically), sending out specimens for species verification as required, counting the number of individuals in each collection, recording the standard lengths for the largest and smallest specimen in each collection, entering all locality and specimen data into an electronic catalog, digital capture of field notes and data sheets, and labeling and filing vials and jars of cataloged San Juan River specimens into the permanent MSB collections. The basic principles for accessioning specimens of fishes in the MSB are standard for most museums of natural history (e.g., Smithsonian Institution, Carnegie Museum, and University of Michigan Museum of Zoology). Species identifications and locality/collection data are verified as necessary prior to incorporation into the MSB catalog. This step is very important for SJRIP researchers to ensure that any misleading information is not incorporated into subsequent reports on San Juan River fish species, particularly for larval Colorado Pikeminnow (*Ptychocheilus lucius*) and Razorback Sucker (*Xyrauchen texanus*) studies. For purposes of permitting, the MSB provides with field and species data in museum report format. This information includes species identification, catalog number (MSB number), number of specimens and size range per lot.

Data Integration and Synthesis—Since its inception in 1992, the San Juan River Basin Recovery Implementation Program (SJRRIP) has been instrumental in managing and restoring native fish populations in the San Juan River Basin. During this time, numerous studies have been implemented with the collective goal of characterizing biotic and abiotic components of the environment that are thought to influence endangered fish populations. Information from these studies has been used to identify and implement appropriate management strategies. Most of these long-term projects focused on relationships between habitats and flow, flow mimicry and native/nonnative fish population dynamics, nonnative fish removal, native-nonnative fish interactions, and augmentation of endangered fish populations. While data collected from these projects have helped navigate management decisions over the course of the Program, most data analyses are limited to individual projects. Limited effort has been directed toward integrating and synthesizing information across studies (e.g., larval, small-bodied, and adult fish datasets). Data accumulated over the past two decades are considerable and are a valuable and an indispensable source of information for determining future management options and opportunities. Consequently, making this information accessible and usable is essential for assessing the current status of native and endangered fish populations, informing and guiding management actions, and evaluating the Program's progress toward achieving recovery and minimizing limiting factors as required by the Program Section 7 Principles.

The U.S. Fish and Wildlife Service's Program Office is the clearinghouse for all Program data. The Program Office is responsible for compiling, integrating, and synthesizing all monitoring data, as necessary, to meet its obligations defined in the Program Document and Long Range Plan. In 2010,

the Program Office proposed adding a senior Recovery Science Biologist to the Program Office to better accomplish data integration and synthesis to assess progress toward recovery and facilitate adaptive management decision-making. The Coordination Committee approved the proposal but for various reasons, the Service has been unable to hire another staff member and does not anticipate this will occur anytime soon. Existing Program Office staff has taken on some of this work but the need for additional data integration and synthesis still exists. Additionally, the information developed will help inform important relationships for integration into the San Juan Population Model being developed by the Southern Ute Indian Tribe and Miller Ecological Consultants for Programs use.

Previously, Nathan R Franssen, Ph.D., served as postdoctoral research associate to synthesize, analyze, and integrate relevant elements of this immense database in conjunction with the Program Office biologist. The work required strong quantitative, writing, and research skills, addressing questions without other time commitments or demands. Products/results from the research have been presented to both the Program's Biology and Coordination Committees, as well as interested public, and submitted to scientific journals for peer review and publication. Dr. Franssen collaborated closely with those responsible for directing relevant studies (e.g., adult monitoring, nonnative fish removal, and native fish reproduction) and key researchers associated with the Program, identifying critical questions for integration and analysis (especially early in the process). In August of 2015, Dr. Franssen left the University of New Mexico to continue this work with the US Fish and Wildlife Service, Office of Ecological Services' SJRRIP

To replace Dr. Franssen, we have identified an outstanding candidate to take on tasks associated with San Juan River data integration and synthesis outlined below. Dr. Scott Clark received his Ph.D. in May 2016 from Professor Jacob Schafer's Fish Ecology Laboratory at the University of Southern Mississippi. For his Ph.D. dissertation work, Dr. Clark studied fish movement dynamics using PIT-tag methods and other survey techniques, and has considerable experience with statistical modeling and integration of PIT-tag data with other ecological survey data (see attached curriculum vitae). He has five peer-reviewed scientific papers either published or in press, and has demonstrated his ability to produce high-quality scientific reports and publications. Dr. Clark will work especially closely with Franssen and Durst in the USFWS Ecological Services (ES) Office, and be available to collaborate broadly with other researchers in the San Juan River Program to integrate and synthesize key datasets with special attention to broader program goals. With Dr. Clark housed at UNM, he will have access to a broad variety of academic researchers interested in theory and practice of remote sensing data and integration, UNM Library resources, and access to data and archives held in the Museum of Southwestern Biology. He is also located in close proximity to the ES field office to facilitate collaboration. Despite the change in personnel, the overarching goal of data integration and synthesis remains the same: to provide a data-driven and scientifically sound approach to making recommendations regarding flow management, recovery criteria for endangered species, and measurements of Program success.

One graduate student research assistant (RA) will be dedicated to assisting the PI and Research Scientist with data synthesis and integration tasks including management and assistance with experimental, field, and fish data taken from the SJR Program and Upper Colorado River Basin. This effort will help to understand the wider distribution of native fishes in order to support the San Juan River Restoration Implementation Program and associated collections maintained by MSB Division of

Fishes. See note in budget summary. The RA will also work with the Curation team on an as-needed basis to provide specimen identification services.

Study Area

The object of this project is to process and organize specimens of fishes collected for the San Juan River Recovery Implementation Program (San Juan River and Upper Colorado River Basin), capture all field information into an electronic catalog, and incorporate the SJRIP collections into a phylogenetic system within the museum archives for easy access. All of these activities take place in the Division of Fishes, Museum of Southwestern Biology, on the University of New Mexico campus in Albuquerque NM. The work and collaboration to synthesize, analyze, and integrate relevant elements of this large database has moved to the USFWS SJRRIP Program Office in Albuquerque and continues to be presented at researchers' meetings held in the Four Corners area, Colorado or New Mexico.

The MSB Division of Fishes has three offices with a total of six computer workstations for data entry, data management, and data analysis; a fully equipped laboratory for preparation of fish specimens, and approximately 1,858 linear meters of compacted shelving for storage of cataloged collections. On average, five UNM students and staff (three undergraduate, one graduate student, and part-time staff curatorial assistant) process and curate SJRRIP collections. One postdoctoral research associate position is currently open and will be responsible for SJRRIP data synthesis and integration, meeting the research goals of the SJRRIP Program.

Curation and Collections Care Objectives

1. Provide a secure and organized repository for San Juan River fish collections, field notes, and associated data thereby facilitating access to these resources by SJRIP researchers.
2. Insure that all SJRIP species identifications and associated data are verified and correctly represented in the MSB electronic catalog; report discrepancies to SJRIP principal investigators.
3. Georeference collection sites for SJRIP collections; maintain license for ArcView and make collection data available to SJRIP researchers in that format, as required.

Curation and Collections Care Methods

Tasks to be completed under this project are processing and curation of fish specimens and all data from the San Juan River Basin Recovery Implementation Program synthesized and integrated in the form of reports to the Committee and peer review publications. Specimen collections are deposited with the MSB Division of Fishes by SJRIP principal investigators.

Upon receipt of newly collected San Juan River specimens, MSB staff transfer these collections from formalin fixative into stages of 35%, 50%, and 70% concentrations of ethanol. Exceptions to this protocol are made per request of PI, as in the case of using 95% ethanol for genetic or otolith studies.

Fish specimens are removed from field containers and cleaned (debris removed) and placed into museum quality jars during the fluid transfers. Principle investigators sort, identify, count and measure each lot (discrete collection) once the collections are transferred to ethanol. MSB staff catalog, label, and file the specimens once the principle investigators have completed their work. SJRIP collections are organized in the permanent archives by drainage (San Juan River) and taxa. These archives are in a room that is controlled for temperature (18° Celsius) and light (complete darkness to low light levels). All data associated with the specimens are entered and organized in the electronic MSB Division of Fishes database (MS Access 2010) and georeferenced (GeoLocate Ver. 3). All original field notes and data sheets are digitally captured and archived in acid-free document boxes for permanent storage.

Products

SJRIP and Upper Colorado River Basin fishes and associated data will be curated in the Division of Fishes, Museum of Southwestern Biology (MSB), at the University of New Mexico. Collection sites will be georeferenced and available in ArcView format. Original field notes will be digitized and archived by the MSB Division of Fishes and collection data electronically stored in a permanent MSB database program. Species verifications and corrections and digital copies (PDF) of their field notes will be made available to SJRIP principle investigators. A draft report of the 2015 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 2016 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 Coordination Committee by 1 August 2016.

Data Integration Tasks and Objectives

Tasks outlined below will be coordinated with USFWS SJRRIP office, notably Nathan Franssen and Scott Durst. The University of New Mexico will fill a Research Scientist III position with a new PhD-level researcher that will report to coPI Turner. This researcher will be tasked with the following items in the 2016-2017 work plan:

Task 1. PIT tag data collection, synthesis, and integration

Collect and collate PIT tag data from both passive (antenna) and active (capture) sources and upload to The Species Tagging, Research, and Monitoring System, an online database. PIT tag data will be analyzed and summarized to calculate demographic parameters, assess recapture frequencies, investigate movement patterns, and determine habitat use. Additional hypotheses and questions may be identified that can be addressed with PIT tag data. A major focus is to relate PIT-tag data to more traditional survey methods using detailed statistical evaluation of both data types, where comparable. Another component of the work will involve experimental evaluations using remote antennae and other scanners and stationary and boat-mounted wagon wheel receivers deployed during electrofishing surveys and other key survey events.

Refinement of models and interpretation of PIT tag datasets will allow for a means to assess populations, as the target species move through the downlisting process and beyond. It may be

possible to develop remote sensing capabilities using stationary PIT tag arrays to automatically deliver population information to managers in the future, providing invaluable long-term monitoring data. It order to realize these exciting possibilities, serious attention to modeling, analysis, and comparison of PIT-tag scan data needs to be undertaken now.

Task 2. Evaluation of growth, movement and condition of Razorback Sucker (*Xyrauchen texanus*)

Investigate seasonal movement and growth of razorback sucker using methodology developed in Durst & Franssen (2014). Statistically compare growth and movement data to other databases in Upper and Lower Colorado. Evaluate variation in growth rates and possibilities for resources as a limiting factor to razorback sucker recruitment in the San Juan River.

Task 3. Age-specific survival of Colorado Pikeminnow (*Ptychocheilus lucius*)

Investigate age-specific survivorship of Colorado pikeminnow using the program MARK to evaluate potential demographic bottlenecks to recruitment, possible sources of mortality, and age-specific resource limitation.

Task 4. Investigate long-term dynamics of aquatic habitat in response to variation in flow

Determining the effects of flow on aquatic habitat in the San Juan River will inform how future managed releases from Navajo Dam are conducted. Past efforts investigating the effects of flow on habitat have been confounded by variation in habitat by flow at the time of mapping. Assessing the effect of antecedent flow on habitat would shed light on an important management action that has largely been conducted without any evaluation of its effects.

Products

Manuscripts, suitable for peer reviewed publication, will be prepared in collaboration with appropriate Program personnel, the Biology Committee, and researchers for each commonly agreed upon investigation. This model has proven to be very productive, producing six peer-reviewed papers since 2012, and many more in the pipeline.

Budget Fiscal Year 2017 1 October 2016 to 30 September 2017

BUDGET ITEM DESCRIPTION	COMPUTATION		RECIPIENT FUNDING	OTHER FUNDING	RECLAMATION FUNDING	TOTAL COST
	$/Unit and Unit	Quantity				
SALARIES AND WAGES --Position title x hourly wage/salary x est. hours for assisted activity. Describe this information for each position.						
UNM Professional Staff	$13.39/HR	1582 HRS			$21,190.00	$21,190.00
UNM Student Assistants (2)	$12.36/HR	780 HRS			$ 9,641.00	$ 9,641.00
UNM Post-Doctoral Associate	$21.43/HR	2080 HRS			$44,585.00	$44,585.00
UNM Graduate Student RA	$9.93/HR	2080 HRS			$20,658.00	$20,658.00
UNM Faculty Summer Salary	$61.99/HR	161 HRS			$ 9,980.00	$ 9,980.00
FRINGE BENEFITS – Explain the type of fringe benefits and how applied to various categories of personnel.						
UNM Staff and Faculty	35.30%	1 EA			$7,480.00	$7,480.00
UNM Undergraduate	1%	2 EA			$ 96.00	$ 96.00
UNM Post-Doctoral	26.20%	1 EA			$11,681.00	$11,681.00
UNM Graduate Student	1%	1 EA			$ 207.00	$ 207.00
UNM Summer Faculty	22.0%	1 EA			$ 2,196.00	$ 2,196.00
TRAVEL—dates; location of travel; method of travel x estimated cost; who will travel						
Four SJRRIP Meetings	$1,500/traveler	4 EA/YR			$6,000.00	$6,000.00
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	$204.00	12 MOS			$2,448.00	$2,448.00
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.						
UNM Graduate Student Tuition	$666.08	12 MOS			$ 7,933.00	$ 7,933.00
UNM Graduate Student Health	$156.33	12 MOS			$ 1,876.00	$ 1,876.00
TOTAL DIRECT COSTS--					$145,971.00	$145,971.00
INDIRECT COSTS – **17.5%**						
					$25,545.00	$25,545.00
TOTAL POJECT/ACTIVITY COSTS FY17					$171,516.00	**$171,516.00**

FY 2017 Budget Summary

2017 Grand Total Curation of SJRRIP Specimen Collections $49,393

2017 Grand Total Data Synthesis and Integration for SJRRIP Program $87,469

2017 Grand Total Upper Colorado Basin Graduate Student RA $34,654 (This portion is not being funded by the SJRRIP.

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Proposal: Recruitment limitations and trophic dynamics of Colorado Pikeminnow in the Colorado River Basin

Principal Investigator

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Collaborators

Keith Gido

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Background

Altering flow regimes through impoundment and water withdrawal can have a marked impact on trophic structure and ecosystem properties in fluvial systems. Specifically, changes in flow can alter primary production and macroinvertebrate assemblages having a “bottom-up” impact on higher trophic levels (Chester and Norris 2006). The introduction of invasive predators can increase predation pressure on lower trophic levels and create competitive interactions with native predators (Johnson and Agrawal 2003). In addition, invasion of lower trophic levels can alter native prey abundance through competition, change prey availability, or reduce food quality, leading to reduced fitness of native predators (Carlsson et al. 2009). Most often this occurs when an invasive prey is less nutritionally optimal or predation on invasive prey is limited.

The San Juan and Upper Colorado River Basins have undergone invasions of predators and prey species along with alteration of the natural flow regime (Holden and Wick 1982; Tyus et al. 1982). These changes have likely altered trophic linkages which could partly explain the declines of Colorado Pikeminnow (*Ptychocheilus lucius*; CPM). In the San Juan River, extensive augmentation of age-0 CPM has failed to establish natural recruitment and few stocked fish apparently reach adulthood (Durst 2015). Stocked CPM are typically recaptured at age-1 and age-2, but high mortality makes larger size classes less abundant. Other Upper Colorado River Basin drainages have a more equal distribution of size classes with a greater distribution of adult fish compared to the San Juan River (Figure 1; unpublished data).

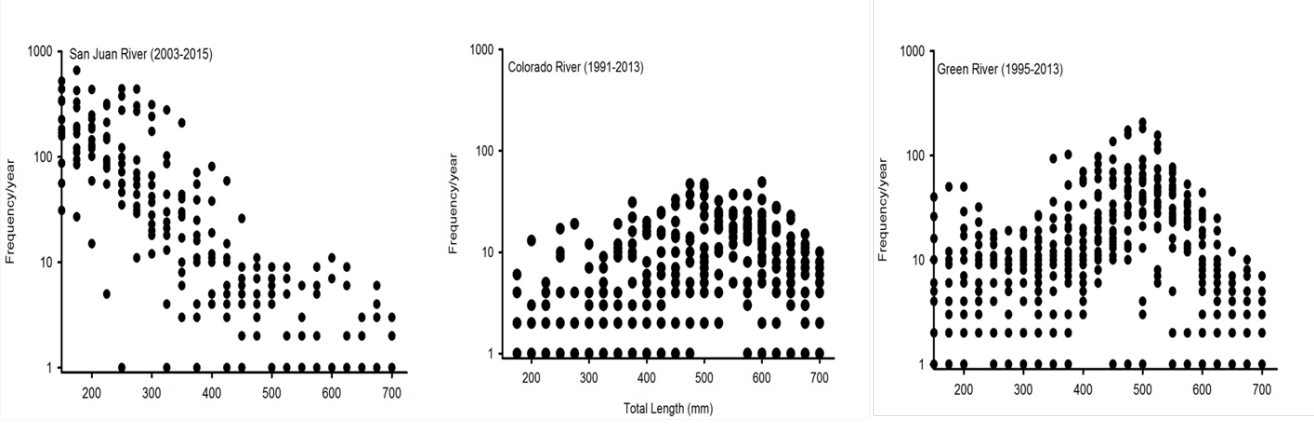

Figure 1. Length-frequency scatter plot showing the size distribution in the San Juan River (2003-2015; Left), Colorado River (1991-2013; center) and Green River (1995-2013). Unpublished data.

The sharp decline in abundance of stocked CPM coincides with a historically observed ontogenetic diet shift from primarily invertebrates to piscivory (Vanicek and Kramer 1969). Additionally, recent stable isotope analyses from the San Juan River failed to document the hypothesized shift in trophic position (Franssen 2014) although there was a gradual increase in trophic position with total length. These results indicate that CPM may be experiencing prey limitations that could be attributed to the extirpation of native prey species (Roundtail Chub, *Gila robusta*) or gape limitations for predation on non-native small bodied fishes (Franssen 2007; Franssen 2014).

Compared to the San Juan River, the Colorado and Green Rivers have natural (unstocked) populations of CPM including fish in larger size classes and potentially have a greater abundance of native prey. In order to attribute lower trophic position and lack of diet shifts to prey limitation, comparisons between the San Juan River, Colorado, and Green River populations would be useful. In addition, to better understand the trophic positon of CPM in the San Juan River, Colorado, and Green Rivers it is necessary to determine the composition of prey items in the diet. As traditional stomach content analysis is not feasible with rare and endangered fish, we will use alternative methods to qualitatively assess difference in diet between the Green, Colorado, and San Juan Rivers. Specifically, this proposal will seek to address two main questions: 1) Do CPM exhibit previously observed ontogenetic diet shift in the Green or mainstem Colorado Rivers that was not observed in the San Juan River? and 2) what fish and non-fish prey are contributing to the diet of CPM? We hypothesize that populations with greater recruitment (Green, Colorado) will exhibit expected diet shift with adults being exclusively piscivorous. In addition, we hypothesize that adult Colorado Pikeminnow in the SJR will have a higher reliance on benthic macroinvertebrates compared to Colorado and Green River populations.

Objectives

1) Compare the trophic position of Colorado Pikeminnow using carbon and nitrogen stable isotope signatures in the San Juan River, Green River, and Upper Colorado River.
2) Measure and compare the composition of fatty acids in CPM tissue lipids as an indicator of nutrient flow pathways, diet, and fish health among these three rivers.
3) Conduct stable isotope and fatty acid analysis on common primary producers, invertebrates, and fishes in order to compare trophic structure and diet.
4) Assess differences in prey availability (density and assemblage) between basins using respective small bodied fish monitoring data.

Methods

Study Site

Sampling will be conducted in the Upper Colorado River, Green River, and the San Juan River. A 128 km sample reach will be selected within each basin where Colorado Pikeminnow are the most abundant based on annual monitoring efforts. Sample reaches in the upper basin will

be upstream of the Green/Colorado River confluence. San Juan samples will be collected from each reach corresponding to Franssen et al. (2014).

Tissue Sampling

Colorado Pikeminnow and other large-bodied fishes will be collected via raft-based electrofishing during monitoring, population estimates, and non-native removal efforts conducted by the San Juan River Recovery Implementation Program (SJRIP) and the Upper Colorado River Endangered Fish Recovery Program (UCRP). Small-bodied and juvenile fishes will be collected via seining. Invertebrates will be sampled in all locations using mesh screens in riffles and backwater habitats and preserved in salt. Algae will be collected from cobble, cleaned, and preserved in the field. Terrestrial vegetation will also be collected to account for carbon sources including cottonwood, willow, grasses, Russian olive (leaves and seeds).

Stable isotopes signatures for carbon and nitrogen ($\delta^{15}N$ and $\delta^{13}C$) will be assessed from fin clips preserved in table salt for large-bodied species and those of conservation concern (*C. latipinnis, C. discobolus, I. punctatus, M. dolomieu, G. robusta, and P. lucius*) (Arrington and Wineminner 2004). Small-bodied fishes (juvenile *C. latipinnis*, juvenile *C. discobolus*, juvenile *M. dolomieu*, *R. osculus*, *C. lutrensis*, and *P. promelas, I. punctatus)* will be preserved whole in table salt. Fatty acid signatures will be accessed via a muscle biopsy from the dorsal surface for large bodied fishes and those of conservation concern (see list above). Small bodied fishes will be preserved whole. All samples for fatty acid analysis will be preserved in a chloroform and antioxidant solution. Samples will be stored on wet ice in the field and placed in a -80 °C freezer for storage.

In order to account for seasonal variation in diet and trophic position all samples will be collected during late summer-fall sampling efforts. Stable isotope data from the Colorado and Green Rivers will be collected in fall and compared to samples collected by Franssen et al. (2014). Fatty acids samples will be collected from all study sites in fall. We will seek to collect at least 15 samples from each river within each category (n=33) of primary producers, prey, and fish species (by size class for large bodied fishes; Table 1).

Laboratory Analyses

Stable isotope analysis methodology will follow those outlined in Franssen et al. (2014). Samples will be washed, dried, and ground prior to analysis at the University of New Mexico's Center for Stable Isotopes to remain consistent with the previous study. Both isotopic values will be reported in the common notation:

$$\delta^{15}N = [(R_{sample}/Rs_{tandard})\text{-}1] \times 10^3$$

$$\delta^{13}C = [(R_{sample}/R_{standard})\text{-}1] \times 10^3$$

Where R is the ratio between heavy and light isotopes ($^{13}C/^{12}C$; $^{15}N/^{14}N$).

Trophic position will be determined by comparing Colorado pikeminnow relative to a secondary consumer (*R. osculus)* and based on fractionation rates established in experimental trials in Franssen et al. (2014). Trophic position will be calculated as:

$$TP = [(\delta^{15}N\ \textit{P. lucius} - \delta^{15}N\ \textit{R. osculus})/\ 2.48] + 3$$

Where the mean fractionation rate for *P. lucius* is 2.48

Fatty acid samples (whole fish and muscle biopsy) will be frozen and homogenized prior to analysis. Fatty acid analyses will follow methods outlined in Budge et al. (2006) and Feiner et al. (2016). Fatty acids will be extracted from samples, transformed into fatty acid methyl esters (FAME) and separated by gas chromatography with Flame Ionization Detection. Fatty acids of interest will be identified and quantified by comparison to known standards and the abundance of each fatty acid will be reported as mass percentage of total identified FAME.

Statistical Analysis

A multivariate analysis of variance (MANOVA) will be used to simultaneously test for differences in $\delta^{15}N$ and $\delta^{13}C$ for Colorado Pikeminnow among rivers and size classes. Univariate analysis of variance will be used to assess individual differences of the stable isotopes. NMDS will be used to visualize the differences in fatty acid profiles among species and among rivers; the robustness of apparent divisions between groups will be tested using ANOSIM. SIMPER analysis will be used to contrast the fatty acids that show the greatest differences between groups.

Table 1. Number of samples per year that will be collected for stable isotope and fatty acid analysis. Stable isotope samples do not include samples previously collected in the SJR.

Taxa	Size Classes	Stable Isotope	Fatty Acid
Primary producers			
Algae	-	30	45
Cottonwood	-	30	45
Grasses	-	30	45
RO seeds	-	30	45
RO leaves	-	30	45
Invertebrates			
Crayfish	-	30	45
Chironomids	-	30	45
Ephemeroptera	-	30	45
Megaloptera	-	30	45
Odonata	-	30	45
Native Fishes			
C. discobolus	2	60	90
C. latipinnis	2	60	90
G. robusta	2	60	90
P. lucius	5	150	225
R. osculus	1	100	150
Non-native Fishes			
C. lutrensis	1	30	45
E. lucius	2	60	90
I. punctatus	2	60	90
M. dolomieu	2	60	90
N. stramineus	1	30	45
P. promelas	1	30	45

Total	31	1000	1500

Small Bodied Fish Availability

In order to understand any observed variation in the trophic position or fatty acid signatures of pikeminnow among the San Juan River and Upper Colorado basins we will assess differences in small bodied prey fish density and assemblage. To do this, we will compile the available small bodied fish data from the monitoring efforts in the San Juan River and Upper Colorado Basin. Differences in prey density and assemblage will help to explain differences between sites. Analysis of Variance will be used to assess differences in small bodied prey densities among basins. Non-metric Multidimensional Scaling and Multi-response Permutation Procedure will be used to test for differences in small bodied fish assemblages between basins.

Schedule for Completion

Inter-basin comparison sampling will begin in September of 2017 and extend into October. Timing of sampling will be determined by monitoring and non-native removal scheduled by US Fish and Wildlife Service. Stable isotope samples will be delivered to University of New Mexico Stable Isotope Lab in November of 2017 and completed by January 2018. Fatty Acid Analyses will also begin in November of 2017 and be completed by January 2018. Fatty Acid analyses will begin in November 2017 and continue until August 2018. Results will be presented to the SJRIP in February of 2019. Final reports and publication drafts will be completed by June 2019.

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Budget Justification

The full cost of the stable isotope analyses will be contracted through the University of New Mexico's Center and samples will be shipped when needed. Fatty Acid analyses will be conducted at the Purdue University Aquatic Ecology Laboratory. A field technician will be hired for four months to assist with preparation and with collecting tissue and environmental samples in the field. An additional technician will be hired to conduct fatty acid analyses. A portion of the lab manager's annual salary is budgeted to oversee the fatty acid analyses and conduct data processing. Both the manager and FA technician will be paid per sample.

Travel will cover mileage, lodging costs, and attendance at two biology committee meetings to provide updates and results. Mileage will include two round trips to Lafayette, IN to sites in the Colorado River Basin. Mileage also covers driving between sample locations. Lodging and per diem will cover trips to meetings as well as between-trip lodging in the field. The majority of lodging will be camping and only per diem will be needed.

The majority of sample equipment will be available from federal and tribal agencies. Sample equipment will also be available from Purdue University. Also requested is the purchase of two dry boxes and two coolers to facilitate the transport of samples. Other material costs include preservatives and sample vials.

In-kind contribution will include one year of a graduate student assistantship which includes salary, tuition, benefits, and administrative costs. In-kind funding will be provided by Purdue University through National Science Foundation's Graduate Research Fellowship Program.

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Recruitment limitations and trophic dynamics of Colorado Pikeminnow in the Colorado River Basin				
Task Description		**Cost/unit**	**Units/hours**	**Total**
Task	**Item**			
Salaries				
Undergraduate Field Technician	Bi-weekly	$1,000.00	$8.00	$8,000.00
Fringe benefits				
Undergraduate Field Technician	1.00%	$10.00	$13.00	$130.00
Travel				
Travel: 2 X 15 day trips on San Juan River for Task 2 field work (2 people each trip)	Per diem (person/day)	$20.00	$90.00	$1,800.00
Hotels, 4 nights on each field trip	Lodging-Bluff, UT (person/day)	$75.00	$8.00	$600.00
	Vehicle mileage (mile: 3000 miles round trip Lafayette, IN to Bluff, UT and to field sites)	$0.50	$6,000.00	$3,000.00
Travel: Durango, CO for San Juan Researchers meeting (2 people)	Per diem (person/day)	$46.00	$4.00	$184.00
	Lodging-Durango, CO	$100.00	$4.00	$400.00
	Airfare (Lafayette, IN to Durango, CO)	$600.00	$2.00	$1,200.00
Supplies				
Field Sampling Gear	Dry boxes	$500.00	$2.00	$1,000.00
	Cooler	$500.00	$2.00	$1,000.00
	Ice	$2.00	$100.00	$200.00
	Stable Isotope sample vials	$150.00	$3.00	$450.00
	Fatty acid sample vials	$90.00	$15.00	$1,350.00
	Preservatives	$250.00	$1.00	$250.00
	Whirlpacks (24 oz, box of	$105.00	$10.00	$1,050.00

	500)			
	Shipping (FedEx samples to processing lab)	$250.00	$1.00	$250.00
Sample processing				
Stable Isotope sample analysis	Processing fee per sample	$12.50	$1,000.00	$12,500.00
Fatty acit sample analysis	Processing fee per sample	$16.00	$1,500.00	$24,000.00
Office	Phone calls, xerox	$100.00	$1.00	$100.00
		Total		**$57,464.00**
		F&A		**$10,056.20**
		Incl KSU 17.5%		**$67,520.20**

Ecosystems Research Institute, Inc.
Miller Ecological Consultants, Inc.

San Juan River Basin Recovery Implementation Program Habitat Monitoring 2016

Technical Proposal

July 2016

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.

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

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

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

The intent of this proposed habitat monitoring plan is to determine if these trends in lost habitat (backwaters, secondary channel types, and total wetted area has been reversed given the high runoff experienced by the San Juan River in the spring of 2016.

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) Develop high resolution digital imagery from Rm 180 to Rm 2 and prepare maps for field verifications

Task 2) Field Habitat Mapping (verification of flowing secondary channel types, backwaters, embayments, islands and total wetted areas under summer baseflow conditions)

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 2016 high flow hydrograph on the habitats and secondary channel types found in 2015.

The proposal time frame is from September 1, 2016 to June 1, 2017.

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 2016 high water hydrograph on habitat planform).*

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

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

Task 1. Develop high-resolution Digital Imagery for Rm 2 to Rm 180.

The San Juan River has been flown and digital images captured at a resolution of 10 centimeters. Images will be printed with a 20% overlap between images and placed in plastic overlays. Field mapping will be on these plastic sheets.

Task 2 Field Habitat Mapping

Field verification of flowing secondary channel types, backwaters, embayments, islands and total wetted areas will occur during the summer base-flow period (2016).

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

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

Once the digital frames with the field mapping have been registered, ArcGIS will be used to digitize the boundaries of the wetted channel, backwaters, embayments and islands. 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 2016 high flow hydrograph on the habitats and secondary channel types compared to 2015

A final report will be written examining 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.

Schedule

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

Deliverables

Annual tasks

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
4) Distribution and abundance (area and density) of backwaters, embayments and total wetted area in response to antecedent runoff conditions and other management actions. Channel complexity (e.g. island count and total wetted area per river mile)
5) Date of mapping
6) Antecedent runoff hydrograph
7) Data summarized by river mile, geomorphic reach and full range
    - An annual draft report prepared and submitted by March 31, 2017
    - A final report submitted by June 1, 2017
    - 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) and Miller Ecological Consultants, Inc (MEC). Both organizations have had extensive experience on the San Juan River and its tributaries. In addition, the principals (Dr. Vincent Lamarra, ERI and Dr. William Miller, MEC) have a long-standing presence on the Biology Committee of the SJRIP. ERI will be responsible for the field and laboratory habitat portion of the work elements while MEC and ERI will analysis and report the data to the Biology Committee.

ERI has had more experience mapping habitat on the San Juan River than any other government or private organization. Since 1992, ERI staff (Dr. Vincent Lamarra, Mr. Daniel Lamarra) have mapped all historical habitat data used by the SJRIP including the last five years, including the RERI Phase I and II channels). That same group of scientists 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.

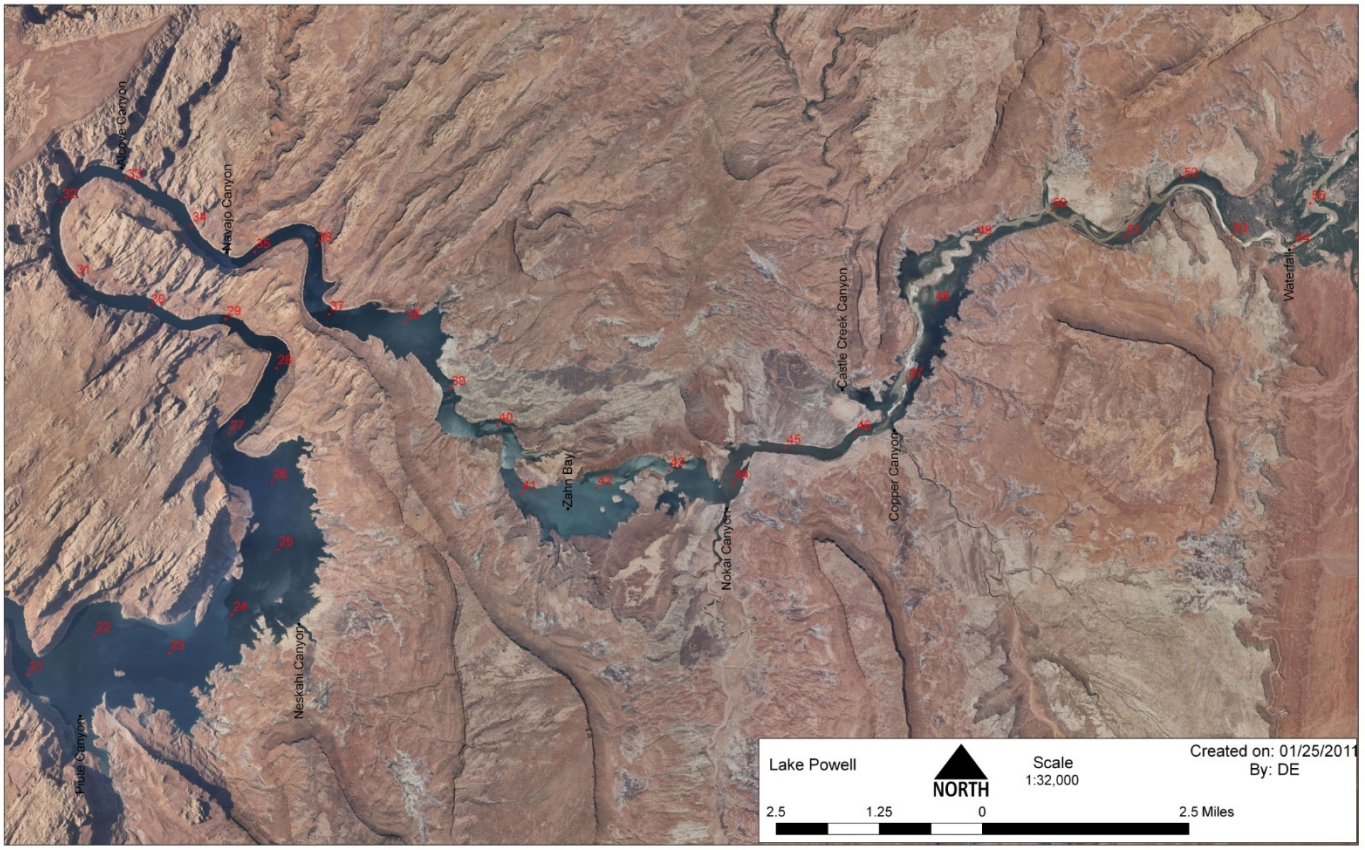
APPENDIX B
Budget for 2016 Habitat Monitoring

Budget: 2016

TASK	Labor	Direct Costs	Total by Task
Contractor Image Capture	By Others	By Others	By Others
Task 1 Map Preparation			
Image Clipping and Capture	$2,060	$1,267	$3,327
Task 2 Field Verification			
Habitat and Channel determination	$9,594	$1,184	$10,778
Task 3 Post Process			
Image rectification	$2,060		$2,060
Digitizing Waters Edge	$16,758		$16,758
Back Water/ Embayment Identification	$8,654		$8,654
Task 4 Final Report and Presentation			
Data Analysis	$19,405	$984	$20,389
Reporting	$17,008	$870	$17,878
Total Cost Estimate	$75,539	$4,305	$79,844

Proposal: Population size, mobility, and early life history of razorback suckers in the San Juan River – Lake Powell complex

July 19, 2016



Principal Investigator

Keith B. Gido, Division of Biology, Kansas State University, Manhattan, KS 66506

Collaborators

Scott Durst, Nathan Franssen and 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 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. Sampling of the Piute Farms Waterfall in spring 2016 resulted in the capture of an additional 50+ razorback suckers. 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, this proposal has the overarching goal of identifying the role, if any, of the reservoir and lower San Juan River below the waterfall in the life cycle and ecology of razorback suckers in the San Juan River Basin.

Specific objectives

1) Determine population size and the prevalence of recruitment in the San Juan River – Lake Powell habitat complex between the Piute Farms Waterfall (Figure 1) and Piute Canyon in Lake Powell (Figure 2) during spring and summer over a three-year period.
2) Determine the contribution of stocked razorback suckers to Lake Powell and the San Juan River below the waterfall.
3) Sample for larvae and young-of-year razorback suckers in habitats throughout the San Juan River–Lake Powell habitat complex with seines to document spawning and recruitment of razorback suckers.
4) Evaluate movements of razorback suckers that are i) captured in the reservoir, ii) captured in the river between the Piute Farms Waterfall and the reservoir, iii) captured below the waterfall and transported upstream of the waterfall, and iv) control fish that are captured upstream of the waterfall and released at point of capture using mobile telemetry and submersible ultrasonic receivers (SURs) to determine how razorback suckers use the inflow, lake, and river habitats.

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, but recent efforts by USFWS, Utah DWR, BOR and others have provided evidence on the feasibility of working in this area. The Piute Farms Waterfall is accessed by dirt road and can serve as a base camp and/or boat launching site. Additionally, it may be possible to use the Clay Hills access to launch a boat that can be portaged over the waterfall. For sampling in Lake Powell and its confluence with the San Juan River it is possible to launch a boat at Hall's Crossing and motor to the study area (~60 miles to Piute Canyon) or use an inflatable boat (e.g., Zodiac) to access the lake from the waterfall. It is likely that a combination of boat types and access will be necessary. Boats and

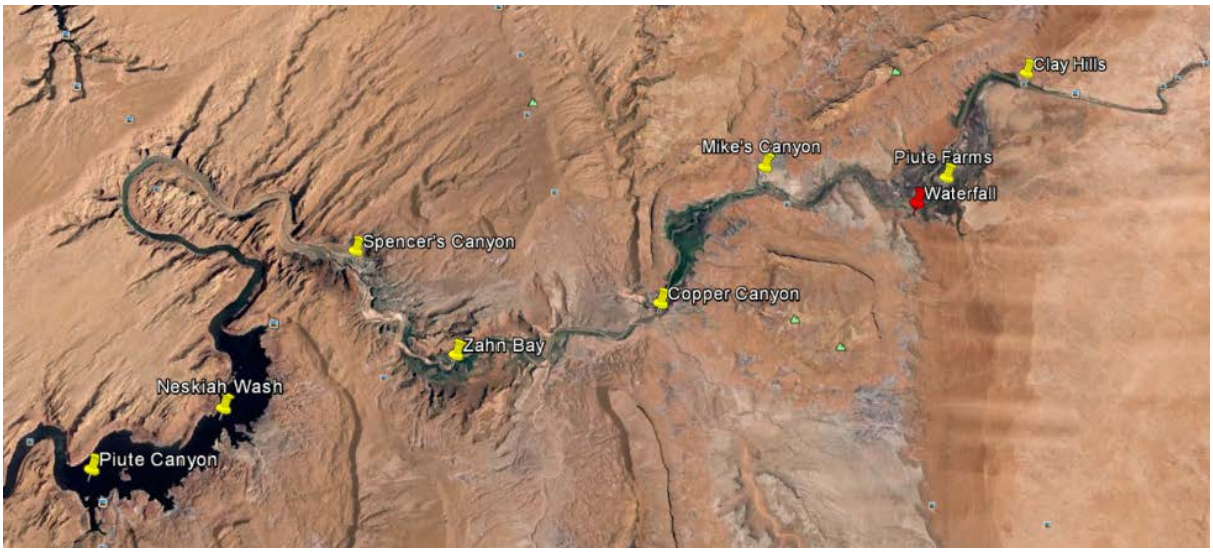


Figure 2. Google Earth image (downloaded 22 March 2016) of study area including key landmarks.

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 radios 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 SJRRIP.

Methods

Objective 1: Estimate population size and the potential of recruitment 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 with a combination of boat electrofishing and trammel nets, following protocols used by Francis et al. (2015). Crews from KSU will assist the USFWS out of Grand Junction, CO, and Utah DWR in Moab, UT who are funded to continue their sampling efforts for razorback sucker in the San Juan River arm of Lake Powell. 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 previously large numbers of razorback suckers were 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 or at equally spaced intervals throughout the study area will be used to identify other potential locations within this habitat complex. These random sampling locations will also help evaluate sampling location bias in Mark-Recapture population models (see below).

Surveys of the San Juan River between the Piute Farms Waterfall and the confluence with Lake Powell will be conducted with boat mounted electrofishing, seines, cast netting, trammel nets, and trap nets. We know from recent pilot efforts is 2015, we gaged the feasibility of these methods within the first river mile below the waterfall. For the proposed work, we expect to conduct monthly forays in the spring to sample the entire reach between the waterfall and the confluence with Lake Powell. As with the reservoir sampling, telemetry will be used to locate aggregations of fish (see Objective 4).

Sampling will be conducted monthly from March through July. This time period has resulted in the most efficient captures of razorback suckers because it coincides with spawning. Each monthly sampling bout will include a minimum of 4 - 5 days sampling in the river and 4 - 5 days in the reservoir. Prior to initial sampling in 2017, a scouting trip will be made to identify potential habitats in the study area to stratify sampling efforts and increase our ability to quantify the population dynamics of the entire river and reservoir between the waterfall and Piute

Canyon. Ideally, the river and reservoir can be partitioned into sampling "reaches" that will allow an objective means of distributing sampling effort throughout the study area.

Population estimates will be made using multiple mark and recapture models (i.e., multiple recapture events will occur within and across years; White and Burnham 1999). We will work closely with population modelers to identify the appropriate model structures to account for potential bias in our sampling. Anticipated bias might include open population, random distribution of sampling effort, and sex biased capture probabilities. Given the previous success at recapturing large numbers of individuals, it is likely we will be able to obtain robust population estimates.

Objective 2: Determine the contribution of stocked razorback suckers 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 and composition (age, sex, size) of both PIT-tagged and non-PIT tagged fish will be determined. Remote PIT tag antennas (submersible type) will be placed at a minimum of two locations following methods of Cathcart et al. (in prep). Over the last two years, these PIT tag antennas have recorded hundreds of razorback suckers below the waterfall. These locations will include one at the base of the waterfall and another at a constriction point in the river upstream of the confluence with Lake Powell. Further, telemetry studies (see Objective 4) will also provide information on movement of fishes downstream of the waterfall.

Objective 3: Identify spawning and recruitment of razorback sucker in the San Juan River – Lake Powell habitat complex

Concurrent with netting and electrofishing surveys, shoreline seining will be conducted at locations where aggregations of suckers are found as well as at random (or equally-spaced) sampling locations as described above. Larval seines will be used to quantify density (number per unit area) of fishes in these habitats, with a focus on slackwater habitats. Light traps will also be used to identify larvae and potential spawning areas. Sampling will be conducted monthly and will occur throughout the study area based on an assessment of habitat available and access.

Objective 4: Characterize movement behaviors of razorback sucker within the San Juan River – Lake Powell habitat complex and fish transplanted above the Piute Farms Waterfall

In spring 2016, 15 razorback suckers captured below the Piute Farms Waterfall were implanted with 4-year acoustic tags and released near the Hogback Diversion. An additional 5 razorback suckers were captured near the Hogback Diversion and implanted with acoustic tags and released in the river. Movement of those fish is being tracked passively using SURs placed at the PNM weir, Hogback Diversion, Shiprock, Four Corners, Mexican Hat and at the Waterfall. Similar methods will be used in 2017 – 2019 but expanded to include fish that are i) captured in the reservoir and released in the reservoir (15 tagged fish), ii) captured in the river between the Piute Farms Waterfall and the reservoir and released at point of capture (15 tagged fish), iii) captured below the waterfall and transported upstream of the waterfall (15 tagged fish), and iv) control fish that are captured upstream of the waterfall and released at point of capture (5 tagged fish).

Additional SURs will be deployed at the lower end of the study area (Piute Canyon) and at least one other location in the reservoir (e.g., Neskahi Wash). SURs as well as monthly active tracking of acoustic- and radio-tagged fish will be used to identify locations and movements of fish during various times of the year. 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.

Deliverables

An annual report will be provided each year of the study using the same timeline as reports required for the SJRIP and Reclamation. Likewise, an annual oral report will be given at both the SJRIP Annual Researcher's Meeting in February and the Annual Public Meeting in May. At the completion of the project a final report will be delivered to both the SJRIP and Reclamation. Scientific publications of the work will be prepared as the work progresses and at the completion of the project.

Literature

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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.

Budget

Start date: 1/1/17 End date: 12/30/20

PI Keith Gido

	Year 1	Year 2	Year 3	Year 4	Total
Salaries and Wages					
PI - Keith B. Gido (1 month summer support @ $10,000/month)	$10,000	$10,000	$10,000	$10,000	$40,000
Graduate Research Assistant ($29,000/yr)	$29,000	$29,000	$29,000	$29,000	$116,000
Research Assistant ($40,000/yr x 0.5 year)	$20,000	$20,000	$20,000	$0	$60,000
Total Personnel Costs	$59,000	$59,000	$59,000	$39,000	$216,000
Fringe Benefits					
Faculty - 34%	$3,400	$3,400	$3,400	$3,400	$13,600
Graduate Research Assistant - 5.5%	$1,595	$1,595	$1,595	$1,595	$6,380
Field assistant – 32.0%	$6,400	$6,400	$6,400	$0	$19,200
Total Fringe Benefits	$11,395	$11,395	$11,395	$4,995	$39,180
Travel					
Lodging (camp site fees and hotel: $2000/yr); Airfare to 1 meeting/yr ($600); Per diem ($1000/yr except year 4)	$3,600	$3,600	$3,600	$1,000	$11,800
Total Travel Costs	$3,600	$3,600	$3,600	$1,000	$11,800
Supplies (include mileage)					
Field supplies: Vehicle (4 trips/ yr from KS to Utah; 8000 miles x $0.50/mile = $4000); Misc equipment (Trammel and seine nets $2500 year 1; expendibles $1000); sonic tags (50 x $300 each; year 1)	$22,500	$5,000	$5,000	$0	$32,500
Total Supply Costs	$22,500	$5,000	$5,000	$0	$32,500
Total Direct Costs	$96,495	$78,995	$78,995	$52,870	$307,355
Indirect Costs - 17.5% MTDC (CESU project)	$16,887	$13,824	$13,824	$9,252	$53,787
Total Project Costs	$113,382	$92,819	$95,819	$62,122	$361,142

Budget Justification

Personnel – Each year, funds are requested to support one month of the lead PI (Gido) summer salary and a graduate research assistant. For years 1 – 3, funds are requested to support an experienced field assistant for 6 months to assist with field work and laboratory and data analysis when not in the field. Both the graduate research assistant and the field assistant will be skilled in boating and sampling large rivers.

Travel – Funds are requested to support lodging and per diem associated with field work. Airfare is included for travel to one meeting per year.

Supplies – Includes mileage for travel to field sites from Manhattan, Kansas and other supplies necessary for sampling and telemetry research.

Indirect Costs – This grant would go through the Cooperative Ecosystems Study Unit (CESU) agreement in place with Kansas State University which allows a 17.5% overhead rate.

Scope of Work: San Juan River Phase II Channel Restoration Site Monitoring

to

Bureau of Reclamation

From

Dave Gori, The Nature Conservancy
212 E. Marcy St., Suite 200, Santa Fe, NM
505-946-2031

BOR Cooperative Agreement No. R09AP0004 (TNC);
Contract No. GS10F0249X-12PD40037 (ASIR);
and Agreement No. SJ2631 (NMDG&F)

Reporting Dates: 10/1/2016 through 6/30/2018

San Juan River Phase II Channel Restoration Site Monitoring
Fiscal Year 2017 Scope of Work

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INTRODUCTION

Since the 1930s, the San Juan River's channel has become narrower, deeper and less complex; expansive sand bars and open portions of the floodplain have become vegetated by nonnative Russian olive and saltcedar, and stream banks have become densely armored by nonnative vegetation (Bliesner and Lamarra 2006; Bassett 2015). In addition, many of the secondary channels that historically supported backwaters and other low-velocity habitats are now disconnected from the main channel (i.e. perched above the river's primary channel) and are choked with nonnative vegetation (Stamp et al. 2006). As a result of these changes, there has been a greater than 50% loss of backwaters and secondary channel habitats between 1998 and 2005 (Miller 2006). Large floods that create and maintain these habitats are virtually nonexistent in the system and flow recommendations implemented since 2000 have not been successful in opening up secondary channels or in maintaining backwaters due to the extensive bank armoring by nonnative vegetation; this armoring reduces the capacity of high flows to scour sediments from secondary channels and reconnect them to main channel (Miller 2006; Michels-Boyce 2013). Backwaters and secondary channels are critical to the survival of young of the year and juvenile native fish, including Colorado pikeminnow and razorback sucker (Propst and Hobbes 1999; Archer et al. 2000). Retention studies after stocking of Colorado pikeminnow and razorback sucker showed that secondary channels are important habitats for stocked endangered fish, especially during the initial months after stocking (Golden and Holden 2005).

In 2009, The Nature Conservancy (TNC) received funds from the New Mexico Environment Department through their River Ecosystem Restoration Initiative to implement a large-scale

restoration experiment—restoring channel complexity at six sites using a variety of methods including: 1) re-establishing the secondary channel inlet (connection with the river) and cleaning out (excavating) the secondary channel; and 2) mechanical clearing and chemical treatment of Russian olive and saltcedar along the secondary channel banks.

The initial channel restoration project, which was completed in the fall of 2012, was monitored using existing resources from the Small Bodied Fish, Larval Fish, and Habitat Monitoring programs. In early 2013, TNC received additional funds for a Phase II restoration effort and in August, a complex site, located between RM 134 and 137, was selected (Figure 1).

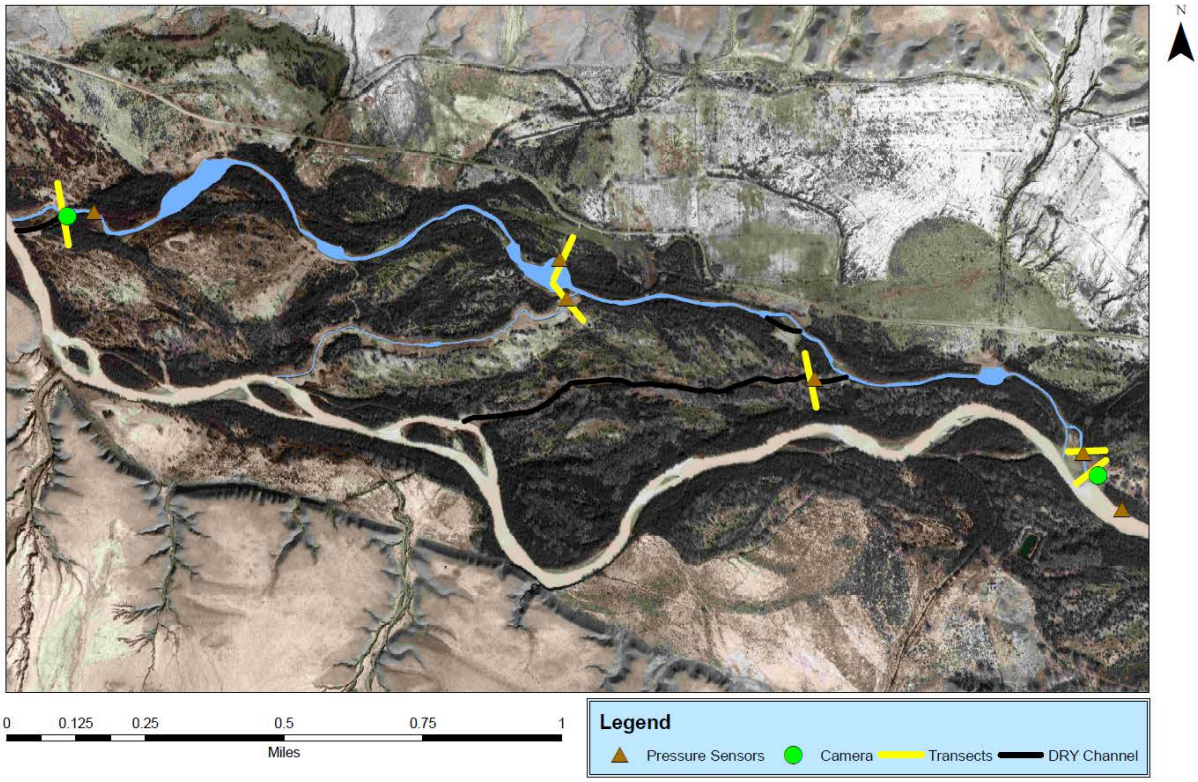

Figure 1. Phase II restoration site with the approximate location of channel cross-sections, pressure sensors, and field cameras.

As part of the site selection process, the historical habitat and the larval and small-bodied fish monitoring databases were queried to determine all available data that had been collected at the site. These data will be used as a baseline prior to construction. In terms of the Small Bodied Monitoring Program, the historical data are summarized in Table 1. There have been a total of 21 observations between 1998 and 2013. Similarly, there have been 36 collections of larval fish made during this time period. In a similar manner, the historical habitat mapping data was queried specifically for the Phase II restoration site. The intent was to determine the status of the channel (flowing or non-flowing) at the time of mapping. In total, there were 31 observations between June 1993 and August 2013. Flows at mapping ranged between 479 cfs and 9,453 cfs. A temporal summary can be seen in Figure 2.

Table 1. Summary of the historical collections from the Small Bodied Monitoring Program between RM 134 and 137.

Query19						
Year	Site (RM)	Channel	UTM Zone	UTM East	UTM North	Coordinate System
1998	135.2	Secondary				
1998	136.5	Secondary				
1999	136.5	Secondary				
2000	134.3	Secondary				
2000	136.6	Secondary				
2001	134.25	Secondary				
2001	136.6	Secondary				
2002	134.4	Secondary				
2002	136.55	Secondary				
2003	135.5	Secondary				
2003	136.8	Secondary				
2004	136.5	Secondary				
2006	134.3	Secondary				
2006	136.5	Secondary	12S	694014	4084091	
2007	134.3	Secondary	12S	108.86046	36.8923	
2010	133.9	Secondary	12S	690100	4085104	NAD83
2010	135.9	Secondary	12S	692934	4084055	NAD83
2011	134.3	Secondary	12S	690635	4085068	NAD83
2012	134.3	Secondary	12S	690646	4085061	NAD 83
2013	135.1	Secondary	12S	691404	4084314	NAD 83
2013	136.4	Secondary	12S	690041	4084140	NAD 83

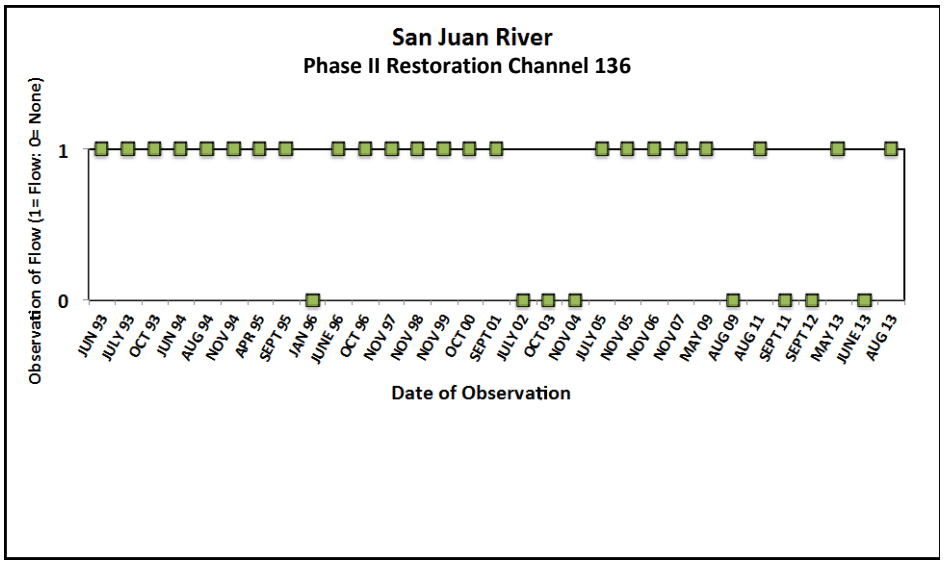

Figure 2. Temporal summary of the status (flowing or non-flowing) of the restored secondary channel located at River Mile 136 prior to its restoration.

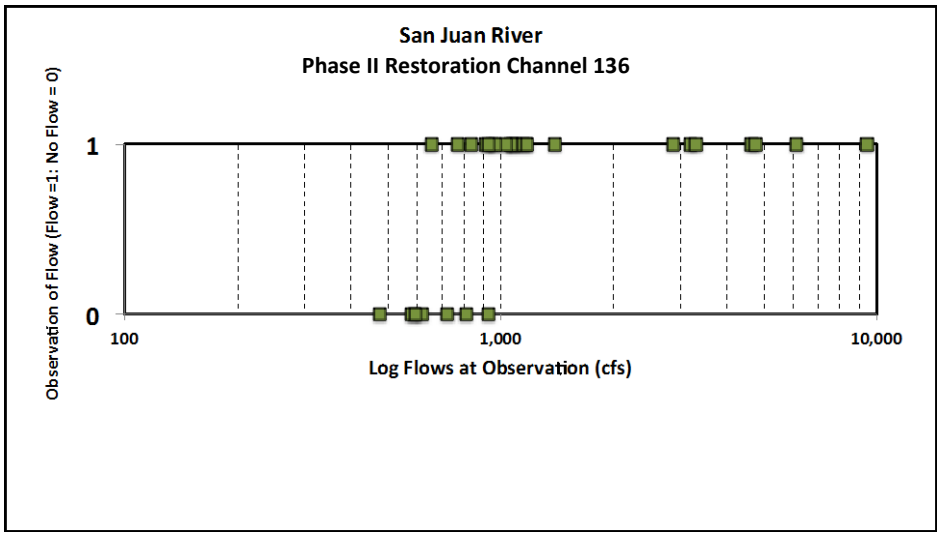

Figure 3. Status (flowing or non-flowing) of the restored secondary channel located at River Mile 136 prior to restoration as a function of flow at the time of observation.

As noted in Figure 2, there were three periods where there were over 5 continuous observations where the main secondary channel was flowing. In a similar manner, the data were plotted as a function of flow at observation time and status (Figure 3). As shown in this figure, the channel historically did not flow at river flows at or below 659 cfs and always flowed at river flows above 930 cfs. Between these two flows the channel was intermittent, flowing in 9 out of 13 observations or 70% of the time.

These three data sets obtained from the historical Larval Fish, Small-Bodied Fish and Habitat Monitoring Programs will be valuable in assessing the success of the restoration process. The restoration work at this site was completed in late fall 2014. Because of the need for better information on the availability and persistence of aquatic meso-habitats at the restored site and the occurrence and relative abundance of larval and small-bodied fish in these habitats over time and as a function of flow conditions, an integrated, stand-alone monitoring program is required. The intent of this proposal is to continue implementation of a monitoring study that addresses the following objectives:

1) To measure changes in habitat features of the restored secondary and tertiary channels, larval fish abundance, and small-bodied fish abundance over three years following completion of restoration treatments at the Phase II site; habitat features include: a) the number and surface area of different aquatic meso-habitats in restored channels, and b) channel cross-sections established in restored secondary and tertiary channels.
2) To measure seasonal changes in habitat features of the restored secondary and tertiary channels, larval fish abundance, and small-bodied fish abundance from prior to spring runoff to late fall during each of the three years following completion of restoration treatments.
3) To compare the relative abundance of small-bodied fish collected in different meso-habitats in the restored site to determine whether preferences for specific meso-habitats exist.

4) To measure changes in habitat features of the restored secondary and tertiary channels associated with environmental flow releases or large floods that may occur over three years following completion of restoration treatments.
5) To compare habitat features, larval fish abundance and small-bodied fish abundance between restored channels and a control secondary channel site.

These objectives were derived from four monitoring questions that were discussed at two Biology Committee meetings in 2014.

To address these objectives, we initiated a monitoring study in 2015 that involves simultaneous collection of habitat, larval fish, and small-bodied fish data so that spatial habitat data can be linked with fish species composition and abundance information. The monitoring activities and measurements include:

Aquatic habitat mapping: 1) hand-mapping of aquatic habitats in restored secondary and tertiary channels using methods developed by Lamarra (Bliesner el al. 2008); 2) surveying of channel cross-sections along permanent transects established along restored channels; and 3) electronic data collection using sensors that simultaneously record water temperature and pressure which will be used to measure water depth in the channel. The sensors were placed strategically in restored secondary channels and the main channel (Figure 1) and the two field cameras were placed in the mouth and near the outlet of the restored secondary channel.

At the same time that habitat mapping and surveying of channel cross-sections occur, a sample of available aquatic habitats in restored secondary and tertiary channels will be sampled for larval and small-bodied fish (see Methods for details). With these data, we can address the first four objectives. Our intent is two-fold: first, to determine the number, surface area, and proportionate abundance of different meso-habitats in the restored channels, and second, to estimate the relative abundance of identified larval and small bodied fish in different meso-habitats. To detect changes in the occurrence and relative abundance of habitats, small-bodied fish and larval fish, comparisons will be made in these parameters between sampling visits (e.g., from before spring runoff to late fall) and across years.

A secondary channel site located at RM 129 that was flowing more frequently than the restored site did prior to restoration (e.g., had water and habitat at almost all times and flows) was selected as a control (Figure 4). A parallel set of measurements will be collected at the control site, however, the site was not instrumented with a field camera and pressure-temperature sensors (see below). The control channel is located just downstream of the restoration site and was used as a control site for the RERI restored channels. There are no tributaries between the two sites and their proximity to each other should insure similar physical conditions. In addition, historic larval and small-bodied fish collections made over multiple years exist for the Phase II site prior to restoration so that a comparison of fish captures (abundance, species composition) for specific meso-habitats can be made before and after treatment. If the restoration effort is successful, we expect that the restored channels will provide aquatic habitat for larval and small-bodied fish when flows are between 500-700 cfs and higher just as the control channel does. Pressure sensor data confirmed this prediction: the restored secondary channel and tertiary B flowed continuously at all flows including those < 700 cfs from late April through early November in 2015. Comparisons of the relative abundance of meso-habitats in

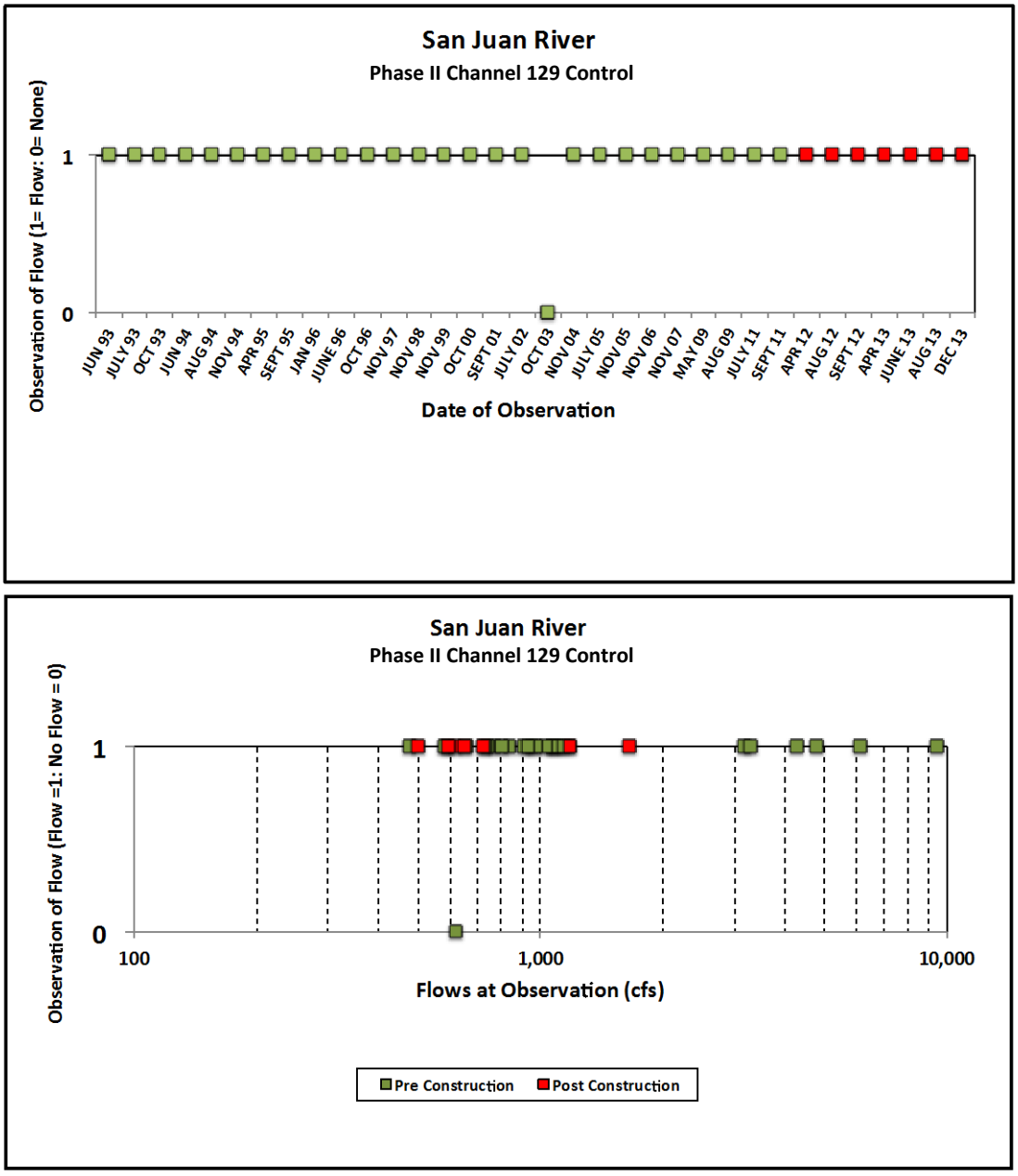

Figure 4. A temporal summary of the status (flowing or non-flowing) of the control secondary channel located at River Mile 129 in the San Juan River (above) and the observations of that same secondary channel as a function of flow at the time of observation (below). This channel was monitored as a control site before and after the Phase I channel restorations activities.

restored and control channels and the relative abundance of identified larval and small-bodied fish collected in these meso-habitats will provide additional information to assess restoration success; the comparisons between restored and control channels will be made seasonally from before spring runoff to late fall within a year and between years. In addition, comparisons of the relative abundance of small bodied fish collected in different meso-habitats will indicate whether fish are distributed randomly with respect to habitat or whether small-bodied fish

disproportionately occur in certain meso-habitats (Table 2); these comparisons can be made seasonally from before spring runoff to late fall and between years.

METHODS

To address the five objectives and measure changes in aquatic habitat in the restored and control sites seasonally, from pre-runoff to late fall, and between years as a function of changing flow conditions, we propose a combination of habitat mapping, measurement of channel cross-sections, and electronic data collection.

Habitat Mapping

Post-construction geo-referenced base photography maps will be used at a scale of approximately 1 inch = 200 feet for the secondary and tertiary channel mapping. Photos will be printed on 11 x 17 inch pages with the river-miles marked and provided in sheet protectors for field mapping. Ten aquatic habitat types and three associated terrestrial types (Table 2) will be delineated on the base photographs by visual inspection in the field. The high resolution photos allow the mapper to have a high degree of confidence as to the visual location of the habitat being mapped and available reference points on the photos (i.e. debris piles, cobble bars, shoreline cover, etc.). Each polygon delineated will be marked with its corresponding code as noted in Table 2. The date of mapping and the mapper's name will be recorded on the first map sheet for each day's mapping. In as much as the mapping process is interpretive, the mappers will initially overlap 10 percent of the area of the channels to be mapped during each mapping effort. Variability in habitat interpretation and surface areas of habitats will be determined based upon the comparison between mapping results.

Table 2. The categories of habitat types on the San Juan River that will be used in this investigation.

(1) Backwater	(10) Inundated Vegetation
(2) Embayments	(11) Rootwad Piles
(3) Riffle	(12) Dry (Sand bar)
(4) Runs	(13) Dry (Channel)
(5) Rapids	(14) Dry (Cobble Bar)
(6) Slackwaters	(15) Islands

(7) Low Velocity Types: (7A) Pools, (7B) Eddies, (7C) Pocketwater

(8) Shoals (Sand and Cobble)

(9) Isolated Pools

Following field mapping, the field sheets will be reviewed and missing codes or non-closed polygons will be corrected prior to processing. Following this review, the habitat polygons will be digitized and coded in ArcGIS to produce shape files. Within each channel, all polygons areas and perimeters for each habitat type will be quantified and summarized by total count and total area in each channel and date mapped.

Channel Cross Sections

Across channel transects were established at the inflow area of the restored secondary and tertiary channels in April 2015 (Figure 1). At each transect location, a field survey will be conducted and referenced to benchmarks established on the initial survey such that the year-to-year variations in the secondary and tertiary channel stream beds can be determined. The overall control benchmark will be outside the floodplain of the river with individual transect benchmarks being established on each side of the individual transects.

The survey will use a metered tape strung across the inflow channel starting at the established benchmark. The bed elevation will be measured every 0.5 m across the channel as well as in major landform topographic breaks (i.e. steep banks, substrate changes, root-wad piles, etc.). In addition, the location and elevation of the water's edge will be surveyed. All elevations will be measured to the nearest 2 cm using a metered stadia rod and a Spectra LL300N Self Leveling Laser. Surveys will occur at the time of field mapping. The main secondary channel entrance will have two transects, spaced approximately 8 m apart, due to the size of the existing cobble/sand bar at its mouth. If sand or cobble shoals are mapped at the mouth of the restored secondary and tertiary channels, water and sediment depth will be measured. A transect and benchmarks, including an overall control benchmark outside of the floodplain, have already been established at the channel entrance of the control site; the cross-section has been surveyed annually from 2012-2015.

Electronic Surveillance

Electronic water level (pressure) and temperature sensors and loggers (HOBO U20L-001) will be used to collect hourly water levels at three locations in the secondary channel and one location in each tertiary channel immediately downstream of each channel split. Sensors were installed in an "L" shaped stilling basin adjacent to the channels. The bottom of the "L" is underwater and facing downstream; basins will be cleaned, if necessary, during each trip. The relative elevations of the sensors have been surveyed. In addition, a sensor was placed in the main stream of the San Juan River upstream of the reclaimed secondary channel. A relationship between gaged flows (USGS 0936800, San Juan River at Shiprock) and the pressure sensor in the main channel (Figure 1) and the entrance to the secondary channel will be established. It is anticipated that these initial relationships will change with time as the channels become altered. The sensors will, however, provide a continuous record of when the secondary and tertiary channels have water.

A Moultrie M-1100i mini game field camera was placed at both the entrance and outlet of the reclaimed secondary channel, pointing down- and upstream respectively. Cameras are programmed to take hourly photographs from 8 am-5 pm, providing a near-continuous record of the flow conditions at the channel complex entrance and outlet and field verification of the water level (pressure) sensor readings (e.g., sensors recording water and not sediment depth). No sensors or cameras were placed at the control site since the site has been flowing in 98% of the observations since 1993. Sensor readings and visual confirmation of the entrance and outlet

conditions from the cameras will provide information on: 1) the persistence of aquatic habitats in restored channels between field visits; and 2) the effect of high flows on flow conditions in restored channels (e.g. flowing or not flowing). Habitat mapping and channel cross-sections will provide additional data to address the five study objectives, as well as periodic field calibration of the electronic data.

Larval and Small Bodied Fish

To measure changes in species composition and relative abundance (catch per unit effort) seasonally, from pre-runoff through late fall, and between years, small bodied fishes will be collected with a 2.2 m x 1.9 m x 3.0 mm mesh drag seine. During the first sampling period (April 2015), habitats were mapped in restored secondary and tertiary channels and at the control site and, using the map, six study reaches were identified at the restored site and one reach at the control site (i.e. the entire length of the control secondary channel). These reaches will be sampled throughout the study. Within each of the reaches, 6 to 8 samples (seine hauls) will be taken following the small-bodied fish protocol where habitats are sampled roughly in proportion to their occurrence within the reach (Gilbert 2014). This gives a total of 42-56 small-bodied fish samples at the restoration site and 6-8 samples at the control site each field visit (Table 3). Each catch will be inspected to determine presence of protected species. Total length (TL) and standard length (SL) will be measured on all Colorado pikeminnow and razorback sucker to be consistent with information gathered by the San Juan River Basin and Upper Colorado River Basin programs. Once measured, the fish will be released. Other native species will also be measured and released. When >50 individuals of a particular species are collected in a seine haul, these individuals will be fixed in formalin and taken back to the laboratory where a subsample of >50 individuals will be selected to approximate the proportion of sizes present and measured; non-selected individuals will be counted. If native fishes are too small to identify they will be fixed in formalin and returned to the laboratory. Nonnative fishes will be removed from the river 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 fixed in formalin and returned to the laboratory. For each meso-habitat sampled within the reach, the length (in meters) of each seine haul will be determined in addition to the number of seine hauls per meso-habitat.

Collection efforts for larval fishes will differ from the small-bodied fish sampling and will be concentrated in low velocity habitats, such as backwaters and embayments, within study reaches using fine-mesh larval fish seines (1 m x 1 m x 0.8 mm). Several seine hauls (between two and seven) will be made through an individual meso-habitat depending on the size of that habitat. Fishes collected in a seine haul will be preserved together as a single sample. For each meso-habitat sampled, the length (in meters) of each seine haul will be determined in addition to the number of seine hauls per meso-habitat. We will target 20 larval fish collections (meso-habitats sampled) per sample period (Table 3) with roughly 70% of collections made at the restored site and the rest at the control. For additional details on the larval fish sampling protocol, see the 2013 larval fish survey report (Farrington et al. 2014).

Habitat designations used in this study will follow the classification given in Table 2. All larval and small-bodied fish sample locations will be referenced on the habitat maps developed during that specific sample period.

Laboratory Processing

All retained larval specimens will be placed in plastic bags (Whirl-Paks) containing a formalin solution and a tag inscribed with a unique alpha-numeric code that was also recorded on the field data sheet and maps. Samples will be returned to the laboratory where they will be sorted and identified to species. Specimens will be identified by personnel with expertise in San Juan River Basin larval fish identification. Stereo-microscopes with transmitted light bases and polarized light filters will be used to aid in identification of larval individuals. Ontogenetic stage will be determined for all razorback sucker and Colorado pikeminnow collected. Age-0 specimens will be separated from age-1+ specimens using published literature to define growth and development rates for individual species (Auer 1982; Snyder 1981; Snyder and Muth 2004). Both age classes will be enumerated, measured (minimum and maximum size [mm standard length] for each species at each site), and cataloged in the Division of Fishes of the Museum of Southwestern Biology at the University of New Mexico.

Monitoring Frequency

The frequency and timing of field visits to measure habitat and fish at the restoration and control sites are summarized in Table 3. These correspond to times before and after spring runoff and monsoonal storm events when changes may occur to the channels and habitats at restored and control sites and when razorback sucker and Colorado pikeminnow larvae are present in the system. The sampling in late fall and early spring pre-runoff will be particularly interesting since the distribution and relative abundance of small-bodied fish in secondary channels is not known with certainty during the overwinter period.

Table 3. Field-sampling schedule for habitat, larval fish (LF), and small-bodied fish (SBF). Habitat measurements include aquatic habitat mapping (M) in secondary and tertiary channels, surveying channel cross-sections (XS) to assess changes in channel morphology after large flow events, and checking and downloading data from camera and sensors (E).

Sampling Date	Measurements
Pre-spring runoff (April)	M, XS, E, LF, SBF
Post-spring runoff; includes environmental flow releases, Navajo Dam; timed with presence of razorback sucker and Colorado pikeminnow larvae (mid- to late July)	M, XS, E, LF, SBF
Post-monsoon (August-September)	XS, E
Late fall (October); after irrigation season	M, XS, E, LF, SBF

Analysis

The focus of our analyses will be to address the five study objectives. Comparisons within and between the Phase II restoration site and the control site will be made for a number of variables to determine how habitat, larval fish and small-bodied fish abundance change over time (across the three sampling periods) at both sites and how changes in the restoration site compare to those in the control (Table 4). The habitat-fish data will also be analyzed to determine whether small-

bodied fish are distributed randomly with respect to aquatic habitats at restored and control sites or whether preferences or avoidance of specific habitats exist; this information will assist in identifying and refining fish-habitat relationships for small-bodied fish. Finally, the sensor and field camera data will provide information on the persistence of aquatic habitat at the restored site and, if they occur, the effect of large flows on channel cross-sections and status (flowing vs. not flowing) at both sites.

Products

A draft report summarizing the activities and analyzed results of the 2017 Phase II Channel Restoration Site monitoring, including a comparison with 2015 and 2016 results, will be submitted to the Biology Committee for their review by March 31, 2018. The report will be revised and finalized based on comments received and re-submitted to the Biology Committee and Program Office by June 30, 2018. In addition, digital copies of all habitat and fish data collected in 2017 will be delivered to the SJRIP database manager.

Project Duration

This project is designed as 3-year study, with reports submitted each year. This proposal is for the third year of the study. At the end of the third year, the final report (submitted in 2018) will contain recommendations to the Biology Committee on: (1) the effectiveness of restoring secondary channels in recovery of razorback sucker and Colorado pikeminnow; and (2) how the electronic equipment and survey transects may be used in the future to test specific hypothesis about the effect of environmental flow releases on restored channel morphology and function.

The proposed monitoring project supports Goals 4.2 *Monitor Habitat Use and Availability* and 4.3 *Evaluate Habitat Restoration Strategies and Monitor Habitat Restoration Projects* and associated Actions (4.2.3 4.2.4, 4.3.1, 4.3.2) and Tasks (4.2.3.1, 4.2.3.2, 4.2.3.4; 4.2.4.4; and 4.3.1.1, 4.3.1.2, 4.3.1.3; 4.3.2.1) in the 2014 Long Range Plan.

Table 4. List of planned comparisons and statistical tests and the study objectives they address.

Objective No.	**Comparison**	**Statistical Test**
1	Comparison of number (count) of meso-habitats by habitat type seasonally (from before spring runoff to late fall) at restored site; comparison of the total areal cover of meso-habitats by habitat type seasonally (3 field visits in 2015) at the restored site; flow conditions will vary at time of field visits and between field visits which may result in changes in the count and areal cover of meso-habitats over time.	None required, all habitats mapped and counted in restored channels; table or graph for visual inspection Once we have sufficient data (more than three observations), use regression analysis to determine relationship between count and area of habitat by type and the flow at mapping.
5	Comparison of number (count) of meso-habitats by habitat type seasonally (from before spring runoff to late fall) at control site; comparison of the total areal cover of meso-habitats by type seasonally (3 field visits in 2015); flow conditions will vary at time of field visits and between field visits which may result in changes in the occurrence of meso-habitats over time.	None required, all habitats mapped and counted in control channel; table or graph for visual inspection. Once we have sufficient data (more than three observations), use regression analysis to determine relationship between count and area of habitat by type and the flow at mapping.
1, 5	Comparison of the relative proportion of different meso-habitats between field visits (from before spring runoff to late fall) at the restored site; similar comparison at the control site	Chi-square test, N (meso-habitats) x 3 (field visits); N x 3-way table
5	Comparison of the relative proportion of meso-habitats at restored vs. control sites	Chi-square test for each sampling visit
1, 5	Comparison of the relative abundance of native larval fish (CPUE) between sampling periods and by site (restored vs. control); same comparison using relative abundance of non-native fish; summarize data for razorback sucker and CO pikeminnow although probably too few individuals collected for statistical analysis.	Analysis of variance with season (sampling period) and site (restored vs. control) as factors; pairwise comparisons between field visits and between sites using the Tukey-Kramer HSD test. Alternatively, could adopt approach of larval fish monitoring study and use mixed linear models to estimate occurrence (presence-absence) and abundance separately with habitat, season, and site (restored vs. control) as covariates (Farrington et al. 2014). If samples sizes are insufficient to conduct the above analyses, restrict analysis to fewer factors, e.g., combine data across seasons and compare restored and control sites. If CPUE data are not normally distributed, may use non-parametric Kruskal-Wallis one-way analysis of variance. Data will be summarized in table or graph to highlight specific comparisons of interest.
1, 5	Comparison of relative abundance of larval fish for specific species of interest between sampling periods and by site; these species may include flannelmouth sucker, channel catfish, fathead minnow, and redshiner.	Analysis of variance with season (sampling period) and site (restored vs. control) as factors. See above comments for additional details and possibilities.
1, 5	Comparison of number (count) of meso-habitats sampled for larval fish by type between sampling periods; comparison of the number of meso-habitats sampled for larval fish by type at restored vs. control site	Sample sizes probably too small but, if not, Chi square test w/ continuity correction

Objective No.	Comparison	Statistical Test
1, 5	Comparison of the composition of native larval fish (number of individuals collected by species) by season for restored site and control site; comparison of the composition of native larval fish by site (either combining seasons or holding season constant depending on the results of the previous analysis); similar analysis for non-native larval fish	Chi-square test for independence
1, 3, 5	Comparisons of relative abundance of native small-bodied fish (CPUE) by meso-habitat type and by site for each of the 3 sampling periods; could add season as a factor if sample size permits; similar comparisons for non-native small-bodied fish (non-native spp. combined)	Analysis of variance with meso-habitat type and site as factors; pairwise comparisons between meso-habitats and sites using Tukey-Kramer HSD test. If sample sizes of fish abundance in specific meso-habitats are insufficient, restrict analysis to certain meso-habitats and compare restored vs. control sites. If CPUE data are not normally distributed, can use non-parametric Kruskal-Wallis one-way ANOVA with season, mesohabitat, and channel type (restored vs. control) as factors. Post-hoc comparisons to determine differences between groups can be made using Dunn's test for multiple comparisons following a statistically significant Kruskal-Wallis test (Dunn 1964). Data will be summarized in a table or graph to highlight specific comparisons.
1, 5	Summarize number of small-bodied RBS & CPM individuals captured by meso-habitat type and by site for the 3 sampling periods	Probably not sufficient sample sizes for statistical comparisons between meso-habitats, sampling periods and sites.
1, 3, 5	Comparisons of the relative abundance of small-bodied fish (CPUE) for specific species (where we have an adequate sample) by meso-habitat, by season, and by site.	Repeated measures analysis of variance with meso-habitat type, season, and site (channel type) as factors (see above). If sample sizes are insufficient, restrict analyses to specific meso-habitats, hold season constant, and compare by site. Alternatively if data are not normally distributed can use non-parametric Kruskal-Wallis one-way ANOVA with season, mesohabitat, and channel type (restored vs. control) as factors in separate one-way ANOVA analyses. Following a statistically significant Kruskal-Wallis test, post-hoc comparisons to determine differences between groups can be made using Dunn's test for multiple comparisons.
3	Comparisons of the number of small-bodied fish by species captured in different meso-habitats by season; analyze restored and control site separately; can also combine restored and control sites to increase sample size.	Chi-square test for independence; two types of chi-square analysis will be used to test null hypothesis of "no selection"—Pearson chi square statistic (driven by differences between observed and expected number of fish collected in meso-habitats of each type) and log-likelihood Chi-square statistic; the latter tests the selection ratio, w, calculated by dividing the proportion of fish using a specific habitat type by the proportion of that habitat sampled (Bliesner et al. 2010).

Objective No.	Comparison	Statistical Test
1, 5	Comparison of the composition of native small-bodied fish (number of individuals collected by species) by season (holding site constant) and by site (either combining or holding season constant depending on the results of the previous analysis); similar comparisons for non-native small-bodied fish	Chi-square test for independence
1	Comparison of status of the restored site (flowing vs. not flowing) before vs. after restoration (see Figure 3)	Contingency table—status (flowing vs. not flowing) by flow category: 500-569, > 569 cfs; chi-square test of independence.
1	Summarize the number of larval RBS & CPM captured by meso-habitat type at the restored site before and after treatment	Probably not sufficient sample sizes for statistical comparisons between meso-habitats and between time periods (before & after restoration).
1	Comparison of relative abundance of native larval fish (CPUE) at restored site by meso-habitat, by season and by time (before vs. after treatment); a separate comparison/analysis will be run for non-natives.	Analysis of variance with habitat, season, and time (pre- vs. post-treatment) as factors. Alternatively could use the approach of larval fish monitoring study and use mixed linear models to estimate occurrence and abundance separately with habitat and time as covariates. If samples sizes are insufficient to conduct the above analyses, restrict analysis to fewer factors, e.g., analyze meso-habitats separately, combine data across seasons and compare restored and control sites. Data will be summarized in table or graph to highlight specific comparisons of interest.
1	Summarize the number of larval RBS & CPM captured by meso-habitat type at the restored site before and after treatment	Probably not sufficient sample sizes for statistical comparisons between meso-habitats and between time periods (before & after restoration).
1	Comparison of relative abundance of native small-bodied fish (CPUE) at restored site by meso-habitat, by season and by time (before vs. after treatment); a separate analysis will be run for non-natives small-bodied fish.	Analysis of variance with habitat, season, and time (pre- vs. post-treatment) as factors; see above comments regarding restricting analyses if sample sizes are insufficient for full analysis.
1	Comparison of the composition of native small-bodied fish (number of individuals by species collected) at restored site before and after treatment; could do a similar analysis for non-native small-bodied fish	Chi square test for independence

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PROJECT BUDGET

Budget for Participation of Ecosystem Research Institute and The Nature Conservancy under BOR Cooperative Agreement No. R09AP0004 to The Nature Conservancy

Task 1A Habitat Mapping (3 Trips)	**Cost**
Field Labor: Salary & Benefits	
Director of Science (TNC)	$7,726
Senior Fisheries Biologist (ERI)	$14,596
Travel & Per Diem (TNC & ERI)	$3,594
Laboratory Labor: Salary & Benefits	
Technician (ERI)	$8,268
Materials & Supplies (ERI)	$600
Task 1B Physical Transects (1 Trip)	
Field Labor: Salary & Benefits	
Director of Science (TNC)	$1,594
Senior Fisheries Biologist (ERI)	$3,053
Laboratory Labor: Salary & Benefits	
Technician (ERI)	$689
Travel & Per Diem (TNC & ERI)	$1,068
Task 1C Pressure Sensors & Electronic Data	
Field Labor: Salary & Benefits	
Senior Fisheries Biologist (ERI)	$477
Laboratory Labor: Salary & Benefits	
Technician (ERI)	$689
Equipment (pressure sensors, field camera) (ERI)	$2,300
Final Report	
Office Labor: Salary & Benefits	
Director of Science (TNC)	$3,924
Senior Fisheries Biologist (ERI)	$7,632
Editor (ERI)	$848
Materials & Supplies	$500
Total Habitat Monitoring & Report (Direct)	**$57,588**
TNC Federal Indirect Cost Rate (22.50%; FY17)	**$12,951**
TOTAL HABITAT MONITORING & REPORT	**$70,509**

(Budget continued on next page)

Budget for Participation of American Southwest Ichthyological Researchers, L.L.C. under Contract No. GS10F0249X-12PD40037

Laboratory Labor (Pre-Spring Runoff and late Fall samples): Salary & Benefits	
Fisheries Biologist	$3,554
Fisheries Technician	$1,094
Laboratory Labor (Post-Spring Runoff sample): Salary & Benefits	
Fisheries Biologist	$2,221
Fisheries Technician	$547
Materials & Supplies	$435
TOTAL LARVAL FISH IDENTIFICATION	**$7,851**

Budget for Participation of New Mexico Department of Game and Fish (NMDGF) under Agreement Number SJ2631

Field Labor: Salary & Benefits	
NMDGF Biologists (3)	$9,877
Office Labor (Final Report Assistance): Salary & Benefits	
NMDGF Project Leader	$2,740
Travel & Per Diem	$3,158
TOTAL FISH COLLECTION & REPORT ASSISTANCE	**$15,774**

TOTAL PROJECT COST (HABITAT, FISH & REPORT)	**$94,134**

SJRIP O&M of Existing PIT Tag Antennas and Evaluation of Data
2017 Project Proposal

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BACKGROUND:

PIT tags are implanted in various fish species captured through various projects directly supported by the SJRIP, or funded through other agencies and projects (CDP&W, BOR, BLM, NMG&FD, and UDWR). Stationary PIT Tag antennas have been installed at various locations in the San Juan River Basin to passively detect fish as they swim above, through, or underneath the antennas. These antennas require periodic maintenance and support to keep them running and operational. Additionally cell and satellite service is required to access the antennas and download data and perform diagnostics. Locations and numbers of antennas at various sites are listed below:

1) PNM Weir and Fish Passage
    a. Four pass-over antennas, modified with concrete bases are located below the weir
    b. Two pass through antennas are located in the fish passage.
    c. All six antennas are served by a single master controller located in a protected shed at the fish passage facility. The master controller is accessed using a Verizon cell data modem.
2) Hogback Irrigation Canal and Fish Weir, ~ 20 miles upstream of Shiprock, NM
    a. Seven pass-through antennas are installed at various locations in the Hogback Fish Weir facility.
    b. Five antennas are served by a master controller and bank of batteries in a protected shed at the Hogback Irrigation Site that controls the various gates connected to the fish weir. The master controller is accessed using a Verizon cell data modem.
    c. Two antennas are located approximately 0.5 mi upstream of the fish weir near the canal headgate. These antennas are served by a master controller and bank of batteries (connected to 110 AC power source) located at the antennas. This site is accessed using a Verizon cell data modem.
    d. Six antennas will be installed in 2016 in the bypass and raft launch channel that is south of the canal. These antennas will be served by the same Master Controller and power source used to operate the antennas at the head of the headgates.
3) TNC Restoration Site ~ 20 miles west of Shiprock
    a. Four pass-over antennas are installed in a secondary channel created by restoration activities conducted by TNC.
    b. The four antennas are served by a single master controller and solar-energy supplied battery bank on an island created by the restoration activities. The site is accessed using a satellite data modem.
4) McElmo Creek, ~ 25 miles upstream of Bluff, UT
    a. Five pass-over antennas were installed in McElmo Creek approximately 200m upstream of the confluence with the San Juan River.
    b. The antennas are served with a multiplexing antenna controller and the controller is accessed using a Verizon cell data modem.
5) Submersible antennas located near the waterfall on the San Juan River near Gouldings, AZ.

   a. Submersible antennas are installed at various locations including the waterfall near Gouldings, AZ, and Colorado pikeminnow spawning bar near 4-Corners Bridge, CO, UT, AZ, NM.
   b. Additional submersible antennas and batteries are being purchased in 2016 to augment detections at additional sites.
6) Floating PIT tag antenna system
   a. A floating PIT Tag antenna system has been constructed and used in the San Juan in several locations including below the waterfall in the San Juan River and in the river between Hogback diversion and Bluff, UT. The system will also be deployed in the upstream portions of the San Juan Drainage including the Animas and upper San Juan rivers.

METHODS:

1) Stationary PIT tag antennas will be contacted periodically (bi-weekly) to check the settings, download the data, and perform diagnostics of the systems. Sometimes problems arise (batteries drain down due to lack of sun, antennas are washed away, wires are cut) that cannot be solved remotely. In these cases a site visit must be conducted by a technician to repair the system. The SOW and budget include the replacement of one antenna during the work period. If an antenna is not replaced the funding will be used to purchase additional PIT tags or submersible antennas to be used by other biologists.
2) Submersible antennas will be deployed at the waterfall for a continuous period from late February 2017 till August 2017 in an attempt to document fish movements and usage of the river immediately downstream of the waterfall.

TASKS – 2017

1. Maintain and operate stationary and portable PIT tag antennas
2. Replace one PIT tag antenna (likely at McElmo or TNC Restoration site)

FY 2017 BUDGET

O&M of Existing Antenna Systems, Replacement of one Antenna, and Data Management

A) Labor

Position	Salary total/hr	No. persons	Total Hours	Total cost
BOR Technical Representation for Contracts and Agreements	$80.00	1	100	$8,000.00
BioMark or USU Staff (contract)	$80.00	1-2	200	$16,000.00
Contract Employee Data Management	$50.00	1	200	$10,000.00
Total				$34,000.00

B) Travel

Position	Destination	Purpose	Days	Lodging	Per diem	Other*	Total

				per day/total	per day/total		
Reclamation Technical representative	Farmington, Shiprock	Project evaluation or field trips	4 trips @ 5 days/trip	$100/$500	$40/$800	$2750	$3,300.00
BioMark/USU representative	Boise, ID; Kennewick, WA; various	Field trips O&M Antennas	3 trips @ 5 days/trip	$100/$1000	$40/$600	$2500	$2000.00 $1,500.00 $655.00
Total				$1,500.00	$1,400.00	$5,250.00	$11,255.00

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

C) Equipment

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

Budget Summary
FY-2017

Category	**Total**
Labor	$34,000.00
Travel	$5,250.00
Equipment	$10,000.00
Total FY2017 Budget	**$49,250.00**

Projected funding:
FY-2018 $50,000.00
FY-2019 $50,000.00

San Juan River Recovery Implementation Program
Aerial Imagery Acquisition
2016 Project Scope of Work

Ecosystems Research Institute
975 South State Highway 89/91
Logan, Utah 84321
Phone: 435-752-2580

Background:
High definition aerial photography is used the San Juan River Recovery Implementation Program to develop maps of the river and evaluate habitat and geomorphic responses to flow releases from Navajo Reservoir and provide a database that can be used to compare future conditions. The imagery is also used for developing fish-habitat relationships when requested. Aerial imagery will be collected in early August after spring run-off when the San Juan River has reached base flow conditions. This period of time also insures that the program can collect data on critical habitat when it is available for use by the target T&E fish species.

Methods:
Using a Cessna TU-206 with a high definition UltraCam LP camera, Blue Skies Consulting (BSC) will acquire 10 cm GSD direct digital 4 band aerial photography of the San Juan River from the confluence of the Animas river (River Mile 180) to the inflow of Lake Powell (River Mile 0). The flight is planned for 60% forward gain, and in areas requiring it, 30% side overlaps. BSC will process and color balance the raw images data and post process the AGPS/IMU data collected during the flights, exporting exterior orientation coordinate data for each exposure. EO data will be used to support the completion of the aero triangulation. USGS 10 meter surface data will be used for the pixel restitution of all imagery and NIAP imagery will be overlaid for quality control of horizontal accuracy.

Mission requirements area:

1. **1-** All Filming will be done at approximately 3800 feet above ground
2. **2-** Filming speed will be done at approximately 130 miles per hour
3. **3-** River level for flight should be less than 1000 cubic feet per second
4. **4-** Total River miles distance to film is approximately 200 miles.

The aerial images are obtained from:
Michael Grossman
Blue Skies Consulting, LLC
Mike.grossman@blueskies.aero
Office: 505-864-3700

Tasks:

1- Fly San Juan River with Vertically Oriented camera and take HD video and High Resolution Digital Stills.
2- Periodically provide images that are rectified for digital mapping.
3- Archive video/still frames and provide to researchers as requested.

FY 2017 Cost:

Aerial photography and image processing (93 flight lines and 1217 images)	- $33,000.00
Aero triangulation and RGB ortho-photo production	- $19,500.00
Total Fee not including gross receipts tax	- $52,500.00

Fiscal Year 2017
Draft Scope of Work to Conduct
2016 San Juan River Nonnative Fish Control Program
Data and Results Assessment Workshop

Background

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

Based on annual population estimates of Channel Catfish (Duran 2015 and Hines 2015), it is readily apparent the level of nonnative fish removal effort previously put forth will likely not suppress recruitment enough to induce system-wide population decline of this species. Nonetheless, removing individual Channel Catfish from the river by definition lowers their densities, which has the potential to directly impact endangered fishes through reduced competition or predation as well as indirectly through deleterious effects of electrofishing on native fishes. Yet, these potential direct (or indirect) effects of the San Juan River's nonnative fish removal program has been difficult to assess due to the complications mentioned above. Therefore, the nonnative fish removal efforts was redesigned to evaluate by what factor and for how long Channel Catfish densities were lowered and the responses of native fish densities to electrofishing and nonnative fish removal. Continued implementation and evaluation of a more structured nonnative fish removal design should provide the San Juan River Basin Recovery and Implementation Program with a clearer scientific evaluation of the effects of the nonnative removal program on native and nonnative fishes in the San Juan River.

Relevant Long Range Plan Tasks

Task 3.1.1.5 Organize and conduct workshops, as necessary, to develop a comprehensive non-native species management plan, including measurable river wide objective to determine effects of removal effort on native and nonnative fishes.

Study Area

The experimental design will be conducted in geomorphic reaches 5, 4, 3, and 2, from Shiprock Bridge, NM (RM 147.9) to Mexican Hat, UT (RM 52).

Objectives

1. Assess Channel Catfish CPUE and size distributions within removal reaches over time using nonnative fish removal data.

2. Compare Channel Catfish, Razorback Sucker, and Colorado Pikeminnow CPUE between control and treatment reaches using sub-adult and adult fish community monitoring, and nonnative fish removal data.

3. Compare Channel Catfish size distributions between control and removal reaches using sub-adult and adult fish community monitoring, and nonnative fish removal data.

4. Quantify movement of tagged Channel Catfish among treatment and control reaches over the summer.

Methods

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

Due to the disparate removal efforts between the upper and lower sections of the river (i.e., 20 vs 8 passes respectively), we will analyze the two reaches separately. Below we include the primary questions we will address, data sets needed for analyses, and the general structure of statistical analyses that will be applied to the upper and lower reaches. Other potential covariates that may affect sampling efficiency can be included if deemed necessary (e.g., secchi depth, stream discharge at sampling, etc.).

In all models, non-significant (α=0.10) interactions will be sequentially removed until all/any remaining interactions are significant. If any models have significant terms, post hoc tests can be conducted to determine which factor levels differ.

Products

Prior to the workshop the results of analyses will be summarized and distributed to workshop participants. Workshop discussion and deliberations will be summarized and distributed to SJRIP participants.

Estimated FY-16 Budget

The total FY-17 budget for the workshop is estimated to be **$20,000.**

Literature Cited

Duran, B.R. 2015. Endangered fish monitoring and nonnative species monitoring and control in the upper/middle San Juan River: 2014. Final report to the San Juan River Basin Recovery Implementation Program. Albuquerque, New Mexico.

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FY 2017 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 FY17

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-2017

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 FY2016 Budget.**

Peer Review for 2017
Fiscal Year 2017 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 is to use the professional expertise of panel members to improve the Program's scientific operations, particularly on technical and biological issues. Indeed, peer reviewers are invited to join the Program based on their reputations in their respective fields of study. Therefore, this SOW was developed to capitalize on the use of peer review to aid in guiding and defending management decisions made by the Program. Furthermore, the new SOW has incorporated a blind, anonymous peer review process aimed at encouraging candid reviews without the fear of personal/social reprisals. Blind reviews will be handled by the Program Office's (PO) Program Assistant to ensure reviews remain anonymous to PO staff involved in synthesizing reviews, developing the annual peer review SOW, and coordinating the Program.

The new SOW also requires (mostly) independent review from its peer review panel. A diversity of opinions and even disagreement among peer reviewers is acceptable and individual efforts will increase the transparency of contributions of peer reviewers to the PO. Consensus reviews have the potential to diminish the diversity of opinions and independence of peer reviewer input. Although the sum of effort for independent peer review may exceed that of group-reviewed work, the PO finds that cost acceptable in the spirit of increasing the diversity of viewpoints. While group reviews may have provided some synergistic benefits, these benefits cannot be quantified and the PO is willing to sacrifice synergy for independence in reviews.

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 PO by 31 March of each year. After the PO receives SOWs, each peer reviewer will review a list of SOWs assigned by the PO (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 PO). Reviews should focus on

the science, experimental design, data analysis, and relevance of the SOW in achieving recovery or assessing progress toward recovery. We recognize that some SOWs may need more detail compared to their current form to allow peer reviewers to conduct a rigorous assessment. Reviews will then be due back to the PO by 30 April.

The PO would like to see succinct reviews and do not necessarily want to read through track changes on word documents (although blind track changes that include editorial suggestions can be delivered to the PIs through the PO but will not be required for the review). Blind reviewer comments will then be compiled and synthesized by the PO and disseminated to the BC, PIs, and peer reviewers. The PIs will then be required to respond to peer reviewer and PO comments and append those responses to their respective SOW before they will be considered in the annual work plan. The PIs response to comments will be distributed to the all BC members and peer reviewers.

2) 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 outline 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 PO) and send them to the PO by 31 March. These comments should focus on data analysis, clarity of presentation, and interpretation but other general comments will be welcomed. The PO will then compile the reviewer comments and distribute them to the BC and individual PIs. These written comments to the PO 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 PO, BOR staff, and peer reviewers to discuss 'big picture' issues in the Program, especially progress toward recovery, but other concerns with individual projects or the peer review process would be open for discussion as well. The peer reviewers will then draft a group summary of their assessment of the Program's progress towards recovery as well as general suggestions for improvement and send them to the PO by 31 March.

3) Attend workshops/review special documents, annual reports (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 PO asks to be reviewed. Additional guidance and details will be provided for any workshops or special documents the PO asks to be reviewed depending on the nature of the workshop or document.

Peer reviewers will no longer be required to review the Program's annual reports (unless upon the request of the PO). However, the peer reviewers are certainly free to utilize these reports as they may provide background useful in completing the tasks outlined above. The BC should provide review of annual reports as part of their commitment to the Program. Issues with editorial comments and interpretation of data can be provided during this "professional courtesy" review. In the past it

appeared that some in the BC relied on the peer reviewers' review of annual reports rather than conducting their own assessment of annual reports.

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Budget FY-17:
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 2017 (includes travel, meetings, and document review).

The total budget is distributed among the four peer reviewers through individual Services Contracts with Reclamation.

Salaries:	$50,000
Travel:	$10,000
Total	**$60,000**

San Juan River Recovery Implementation Program
Program Coordinator's Office
Fiscal Year 2017 Draft Proposal

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Cooperative Agreement #: R10PG40064 (08-AA-40-2713) and R10PG40086 (07-AA-40-2629)
Period of Performance: 10/01/2016 to 9/30/2017

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 legal 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 part-time Program Assistant.

Program Coordination

Specific Service responsibilities for Program coordination are described in the May 17, 2012 Program Document as follows:

1. coordinating the activities of the Coordination Committee and the Program's technical committees, including providing notices, agendas, information packets, and providing draft and final summaries for committee and subcommittee meetings and conference calls as per the committee meeting procedures described in this document;
2. preparing and updating the LRP with research, monitoring, and recovery elements and goals;
3. ensuring consistency of the LRP with Service-approved species Recovery Plans;
4. prioritizing projects based on the LRP, and preparing AWPs, annual budgets, and annual progress reports;
5. ensuring the approved recovery activities as defined in the LRP and species Recovery Plans are implemented;
6. evaluating project accomplishments and shortcomings and providing an annual report to the Program;
7. monitoring implementation of all Program actions, including those Program actions identified as RPAs and RPMs in BOs, and reporting results to the Service on an annual basis;

8. developing an annual integration report that assesses the preceding year's monitoring data, progress toward recovery, and adaptive management recommendations, including recommendations for changes in direction, termination of projects, new projects, or other pertinent recommendations;

9. coordinating and overseeing development of any revisions to the Program's flow recommendations;

10. maintaining records showing the distribution and expenditures of all annual base and capital funds expended under AWPs by each funding source, and providing to the Coordination Committee at the end of each federal fiscal year an accounting of funds expended during the preceding year;

11. reporting to the Coordination Committee at each of its meetings the status of Program activities, the accomplishment of milestones or delays in meeting milestones, and any problems with maintaining Program work schedules along with recommendations for solving the problems;

12. disseminating information to state, federal, and tribal agencies;

13. ensuring that appropriate collecting permits are provided to each principal investigator;

14. advising Program participants of requests for initiation of consultation;

15. maintaining a list of interested parties as described in the committee meeting procedures provided in this document;

16. managing and maintaining the Program's data, central database, library, website, and listserves;

17. coordinating activities among the Program, the Upper Colorado Program, and the Colorado River Fishes Recovery Team, including participating in the five-year status review and in the updating of recovery goals for Colorado pikeminnow and razorback sucker;

18. implementing Coordination Committee recommendations to resolve problems or issues that may arise with regard to accomplishing Program activities;

19. providing materials and technical support to the non-federal participants for briefings with the members and committees of the U.S. Congress and state legislatures;

20. reviewing BOs for consistency with the Program's Principles;

21. preparing on a biennial basis a written "Sufficient Progress" assessment of the Program's progress towards recovery, the Program's ability to provide ESA compliance for water development and management activities, and any corrective actions needed to ensure future ESA compliance, in accordance with the Program's Principles;

22. working with Reclamation and other Program participants to improve, maintain, and utilize the Hydrology Model; and

23. implementing other activities needed to ensure the success of the Program as assigned by the Service or by the Coordination Committee.

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.

Maintenance of San Juan River Basin Recovery Implementation Program database and integration, synthesis, and analysis of data

San Juan River research efforts that preceded the establishment of the Program, in combination with those that have subsequently resulted from that program, form the basis of the suite of decisions already made and those to be made regarding biologic and hydrologic issues. An immense amount of information has been gathered through the San Juan River monitoring and research activities that have been conducted over the last 25 years. Most of this information has been synthesized and made available in the form of reports or publications. For example, in 2003 and 2004 researchers consolidated and analyzed data from their individual long-term research projects and presented it as an integrated report of five years of research (1999-2003). Likewise, the flow recommendations report released in 1999 represented a synthesis between biological, hydrological, and habitat research activities.

Preparation of integration reports was difficult due to the absence of an updated, standardized, and easily accessible Program database. Keller-Bliesner Engineering, LLC, was originally responsible for maintaining the database and produced and distributed to the researchers CDs containing the updated Program database until 1998. In 2002, responsibility for maintaining the database was transferred to University of New Mexico (UNM). They initiated a project to develop and maintain a web-based system. This project was terminated in 2006. In 2007, the responsibility for managing Program data was transferred to the NMESFO's Computer and Geographic Systems Branch. A great deal of effort was required to inspect, transfer, and integrate UNM's GIS Database into existing and new Program data housed in the NMESFO Program database. Between 2007 and 2008, NMESFO IT staff transferred and incorporated a myriad of researchers' data into a Program database. They maintained, performed quality control, annually updated, and distributed the GIS researcher database using appropriate formats, and established electronic archives of the aforementioned database at the repository for this information (U.S. Fish and Wildlife Service Region 2 Office, Albuquerque, New Mexico).

In 2008, a full-time biologist position was created in the Program Office to take over the responsibility of maintaining the Program database. During 2009, the Program biologist developed an integrated data management system and performed Program data management activities. In 2011, The Program approved the addition of a recovery science biologist to the Program staff to oversee integration, synthesis, and analysis of the expansive Program database to assess and track the Program's progress and to determine the highest priority management actions needed to recover the endangered fish. The recovery science biologist position could not be filled until the first quarter of FY2015 due to government sequestration and Service hiring freezes and budget shortages. Starting in the last quarter of FY2015, the Program Office will be fully staffed.

Relevant Long Range Plan Tasks

Task 1.2.1.1 Maintain a standardized database for all stocked and recaptured RBS and CPM in order to determine the fate of stocked fish.

Task 4.4.2.1 Develop a centralized database that incorporates all data from standardized monitoring and integrate into the Program database.

Task 4.4.3.1 Identify, describe, and implement strategies for improving long-term survival and recruitment of razorback sucker and Colorado pikeminnow including but not limited to nonnative fish removal, enhancing habitat and food resources, enhancing genetic diversity and viability, and mitigating causes of range fragmentation.

Task 4.4.3.2 Use data and information gathered from fish surveys, hatchery augmentation, and survival studies to describe the best strategies for establishing wild populations of endangered fishes and restoring the native fish community.

Task 4.4.3.3 Use data and information gathered from the nonnative fish control program to evaluate effects of nonnative fish removal on distribution, abundance, and demographics (e.g., fish size, age, sexual maturity) of the endangered fish populations, the native fish community, and nonnative fish populations.

Task 4.4.3.4 Use data and information gathered from habitat assessments as the foundation for evaluating the effectiveness of the flow recommendations and operations decision criteria for Navajo Dam in providing suitable habitat for the endangered fishes.

Task 4.5.1.1 Annually, following review of the previous year's findings and data integration, identify and prioritize new projects, activities, questions, and information needs to be addressed in future work plans.

Task 5.1.1.4 Develop a list of prioritized actions and projects for the Annual Work Plan that most benefit recovery of the endangered fish populations.

Task 5.2.1.1 Establish and maintain a Program database of information collected under the various Program projects including all rare fish collections.

Task 5.2.1.2 Conduct annual Program reviews and develop annual reports that integrate monitoring and research data and results to track and assess yearly Program progress toward recovery.

Task 5.2.1.3 Conduct a biennial comprehensive review and assessment of Program progress towards recovery (i.e., Sufficient Progress Report).

Task 5.2.2.2 Develop positive population response criteria for the razorback sucker and Colorado pikeminnow to meet recovery demographic criteria for downlisting and delisting specified in recovery goals/plans adopted by the Service.

Task 5.2.2.3 Identify and evaluate limiting factors and determine research necessary research to identity actions that will minimize or remove these limiting factors.

Task 5.2.2.4 Use monitoring and research information to evaluate and use adaptive management strategies to modify recovery activities, as necessary, to ensure progress toward recovery.

Task 5.2.2.5 Develop interim recovery benchmarks for the Colorado pikeminnow and razorback sucker that are tied to monitoring data and are consistent with the species recovery plans and goals, positive population criteria, Sufficient Progress Assessment, LRP, and Program Document.

Study Area

This project will encompass the San Juan River Basin downstream of Navajo Reservoir but may ultimately be expanded to include the entire San Juan River Basin.

Objectives

1. Maintain and incorporate researchers' data into the Program's Database.
2. Maintain, perform Quality Control, annually update, and distribute current Program researcher database using appropriate format.
3. Establish electronic archives of the aforementioned database at the ultimate repository for this information (U.S. Fish and Wildlife Service, Region 2, Program Office, Albuquerque, New Mexico).
4. Utilize Program data and other information to analyze and assess progress toward recovery and to determine priority management actions to implement.
5. Maintain and update Program website with reports, data, and other relevant documents.

Methods

1. Update and Maintain Database in consultation and coordination with Program researchers, the Program biologists will integrate existing and new data into the existing Program Database. Data will be checked for Quality Control and updated as necessary.
2. Contact and Coordinate with appropriate personnel in the Upper Colorado River Recovery Program and Glen Canyon Environmental Studies offices to investigate the feasibility of linkage of the proposed San Juan River Recovery Implementation Database with other regional fish databases.
3. Analyze and Assess San Juan River Basin data and other information to track progress toward recovery and to determine priority management actions to implement. This work will be conducted on a year-round basis within the Program Office and be coordinated with Program researchers, other biologist within and outside the Service, and other Program participants on a regular basis.

FY2017 Priority

A series of workshops starting in February 2015 have been conducted to evaluate and revise the Program's 1999 flow recommendations (Task 4.4.3.4). In a final workshop held during April 2016, an interim operation for releases from Navajo Reservoir was developed, a revised decision tree was introduced to increase the likelihood of years with high flows, and discussion were started on how the hypothesized effects of flow releases would be measured. Program staff will finalize workshop outcomes in conjunction with BC review in order to move forward with the implementation of revised flow recommendations that continue to be evaluated in an adaptive management context.

Products

A written report that includes a narrative synthesis of the workshops, the rationale and justification for a revised decision tree, hypotheses of flow benchmarks, and a monitoring program to evaluate the flow recommendation will be a priority for Program staff and will be subject to independent peer-review and will be communicated to Program participants on a regular basis.

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 include:

$ 6,000 Congressional Briefing Document (Program Highlights) printing
$ 4,000 Newsletter (Swimming Upstream) printing
$ 4,000 Exhibit fees
$ 2,000 Exhibit repairs/replacement
$16,000 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.

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)

Relevant Long Range Plan Tasks

Task 6.1.1.1 Provide information through news articles, press releases, radio and television ads, and other media in Farmington, Durango, Albuquerque, and others in the area to inform the public of Program activities.

Task 6.1.1.3 Maintain a Program website.

Task 6.1.2.2 Develop and exchange information and materials to incorporate into PowerPoint presentations, newsletters, Program highlights, and Program displays.

Task 6.1.2.3 Participate in selected outreach efforts at local, state, and regional water conferences.

Tasks

1. Coordinate San Juan Program outreach activities with the Upper Colorado River Recovery Program.
2. Proactively participate in education and outreach activities within the San Juan River Basin.
3. Disseminate information on Program activities to the public through brochures, newsletters, and/or the website.
4. Coordinate with outreach activities in the San Juan River Basin such as water users student fairs and local school fairs.

Fiscal Year 2017 Program Management Budget	**USFWS Funding**	**Base Funding**
Personnel/Labor Costs (Federal Salary + Benefits):		
Program Coordinator (GS-13) 1560/520 hours@ $70.55/hr	$110,058	$36,686
Asst. Program Coordinator (GS-12) 1040/1040 hours@ $51.51/hr	$53,570	$53,570
Science Coordinator (GS-12) 520/1560 @ $47.80/hr	$24,856	$74,568
Program Biologist (GS-9/11) 2080 hours @ 37.88/hr	$0	$78,790
Program Assistant (GS-7) 416/416 hours @ 28.24/hr	$11,748	$11,748
Personnel Sub-total	**$200,232**	**$255,363**
Travel/Lodging & Per Diem (based on published FY-2015 Federal Per Diem Rates):		
Hotel – 40 days in Farmington, NM @ $83/night		$3,320
Hotel – 48 days in Durango, CO @ $141/night		$6,768
Hotel – 15 days in Denver, CO @ $163/night		$2,445
Hotel - 6 days in St. George, UT @ $83/night		$498
Hotel – 8 days in Las Vegas, NV @ $96/night		$768
Per Diem – 40 days in Farmington, NM @ $46		$1,840
Per Diem – 48 days in Durango, CO @ $61		$2,928
Per Diem – 15 days in Denver, CO @ $66		$990
Per Diem - 6 days in St. George, UT @ $46		$276
Per Diem – 8 days in Las Vegas, NV @ $71		$568
Per Diem – 20 days camping @ $29 night		$580
Registration Fee – UT Water Users Workshop, St. George, UT		$300
Registration Fee CRWUA, Las Vegas $250 *2		$500
Travel/Lodging & Pier Diem Subtotal	**$0**	**$21,781**
Travel/Airfare & Mileage:		
Airfare to Denver, CO - $300 trip/6 trips		$1,800
Airfare to Las Vegas, NV - $600 trip/2 trips		$1,200
Airfare to St. George, UT - $800/1 trip		$800
Mileage to Farmington - 15 trips@190mi/trip*18 MPG=10.5gpt*4.00pg=$42.20)		$633
Mileage to Durango - 17 trips@220mi/trip*18 MPG=12.5gpt*4.00pg=$48.80)		$816
Rental Car @ $120/day*8 days		$960
Travel/ Airfare & Mileage Sub-Total	**$0**	**$6,209**
Equipment and Supplies:		
Supplies/stamps		$5,700
Public Notices - costs for publishing public meeting notices in local newspapers; $40-150/meeting@ 35 meetings		$2,200
Printing/publication costs		$1,200
Computer Hardware Upgrades		$1,500

Computer Software (ESRI GIS license fees, GIS extension (Spatial Analyst, Xtools, etc.), FTP software license, Stella license)		$1,500
Outreach Materials		$1,000
Equipment and Supplies Sub-total	**$0**	**$17,600**
Facilities Rental Costs for Meetings:		
Farmington@ $100/day *15		$1,500
Durango @$300/day *20		$6,000
Facilities Rental Sub-Total	**$0**	**$7,500**
2017 Budget Subtotal	**$200,232**	**$303,953**
Administrative charge (3%)		**$9,119**
FY2017 Total	**$200,232**	**$313,071**
Carry-Over		**$25,000**
Grand Total	**$200,232**	**$292,706**