Analysis of Long-term Datasets in Application to SJRRIP Species Recovery and Management Actions

University of New Mexico and Museum of Southwestern Biology

Fiscal Year 2019 Scope of Work

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Background – San Juan River Data Integration and Synthesis

Since its inception in 1992, the San Juan River Basin Recovery Implementation Program (SJRRIP) has been instrumental in managing and restoring native fish populations in the San Juan River Basin. 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. The overarching goal of data integration and synthesis remains the same in FY 2019 as before: to provide a data-driven and scientifically sound approach to making recommendations regarding flow management, recovery criteria for endangered species, and measurements of Program success (Tables 1 & 2). Data integration and synthesis activities have made important contributions towards demonstrating a number of potential life-stage specific recruitment bottlenecks that may be limiting population sustainability and recovery of the endangered species. Putative factors contributing to these bottlenecks have been identified in previous integration tasks that have spurred management activities directed at ameliorating these effects. For instance, recent data analyses have established that the Public Service Company of New Mexico (PNM) weir remains a significant barrier to upstream movement of Razorback Sucker that precludes connectivity with upstream habitats (Franssen et al. 2014, Clark et al. *in review*). Recent analysis of movement failed to detect consistent seasonal movements using in-hand recaptures; however, regular PIT detections at PNM weir demonstrate repeated attempts of upstream movements during peak spawning periods (Clark et al. *in review*). As a result, directed efforts are currently underway at PNM to facilitate increased access and passage efficiency to the upper reaches of the river. As these recruitment barriers are now at the forefront of the Program's initiatives, a first step towards eliminating these recovery barriers will be to identify and mitigate factors responsible. Continued analysis directed at these recovery impediments is warranted, especially relating to hypothesized factors driving low life-stage specific survival and recruitment of Razorback Sucker and Colorado Pikeminnow (Clark et al. *in review*). These activities are of such importance that a dedicated researcher with strong quantitative, writing, and research skills, is needed to address questions without other time commitments or demands to assist the Program move quickly and efficiently towards developing effective management actions.

The postdoctoral researcher will continue to collaborate closely with those responsible for directing relevant studies (e.g., adult monitoring, nonnative fish removal, and native fish reproduction) and key researchers associated with the Program, identifying and addressing critical questions for integration and analysis to aid in Program objectives and recovery goals. Products/results from the research will be presented to both the Program's Biology and Coordination Committees, as well as interested public, and submitted to scientific journals for peer review and publication. As one of the primary goals of recovery plans is to support research directed at increasing our knowledge of imperiled species, peer-reviewed publications can promote recovery objectives (Gibbs and Currie 2012) and provide objective transparency in decision-making (Mooers et al. 2010). 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.

Data Integration Objectives and Status of Projects

The following is a list describing the status of recent data integration activities (FY17 & FY18) and outlined proposed projects for FY 19. A brief summary of data integration activities and products are provided in Tables 1 & 2.

FY 2017

1) Evaluation of age-specific survival of Colorado Pikeminnow (*Ptychocheilus lucius*)

Results from this study identified that age-specific survival was consistently less than 25% until stocked Colorado Pikeminnow reached age 4. This analysis provided strong evidence of a recruitment bottleneck limiting the Program's ability to effectively and efficiently reach recovery goals for Colorado Pikeminnow. Further, we were also able to identify potential capture effects that may be impacting recovery efforts. Resulting management actions from this work included a reduction of sampling intensity and handling frequency of juvenile Colorado Pikeminnow to minimize any detrimental capture effects until a more thorough investigation of factors contributing to these effects can be evaluated (e.g., tagging effects on survival). The manuscript entitled: "*Age-specific estimates indicate deleterious capture effects and low survival of stocked juvenile Colorado Pikeminnow* (Ptychocheilus lucius)" was submitted to the journal *Fisheries Research* (rejected February 2018), and has been revised and submitted to *North American Journal of Fisheries Management*. Authors included Scott Clark, Mary Conner (Utah State

University), Scott Durst and Nathan Franssen. Results from this project were presented during the Nonnative Fish Workshop on November 30, 2017, to the Biology Committee on February 21, 2018, and will be presented to the Coordination Committee in May 2018.

2) Evaluation of movement and condition of Razorback Sucker (*Xyrauchen texanus*)

Results from this study contributed to the current efforts to evaluate the efficiency of the PNM fish passage (currently being evaluated in FY18; see below). Analyses identified consistent downstream dispersal of stocked Razorback Sucker that was best predicted by stocking location. Despite these regular downstream movements, Razorback Sucker appear to be selecting suitable habitat between RM 118 and RM 166. This pattern was consistent through time (adults residing in the river for multiple years post-stocking) suggesting a resident river population persisting in this reach. Contrary to previous investigations, post-stocking annual movements were minimal, with little evidence of consistent seasonal movements; however, observed movement patterns may reflect restricted dispersal resulting from in-stream barriers (i.e., PNM weir). A manuscript "*Post-stocking and subsequent annual and seasonal movements of Razorback Sucker* (Xyrauchen texanus) *in a fragmented southwestern river*" authored by Scott Clark, Scott Durst and Nathan Franssen is currently under review for the journal *Environmental Biology of Fishes*. Results from this project were presented to the Biology Committee on February 21, 2018 and will be presented to the Coordination Committee in May 2018.

<u>FY 2018</u>

3) Improvement of biological metrics and inferences from remotely detected PIT tags

The increasing number of temporary and permanent PIT tag antennae arrays deployed in the San Juan River has generated an immense amount of data. As of March 2018, greater than 227,000 detections, representing over 6,700 unique individuals, have been logged from Razorback Sucker (>191,000 detections; >5600 individuals) and Colorado Pikeminnow (>36,000 detections; >1100 individuals). These data have the potential to answer important questions for the Program such as:

1) Are traditional sampling methods 'missing' fish or certain ages/groups?
2) Do the antennae increase resolution of movement and biological metrics (e.g., survival, detection probabilities) (Hewitt et al. 2010, Kanno et al 2014)?
3) Are antennae arrays a cost effective approach compared to/in conjunction with traditional sampling methods (Barbour et al. 2012)?

As the SJRRIP moves forward in recovery efforts, a better understanding of the most effective use of resources will be essential to provide the most efficient and comprehensive biological data to base management decisions and recovery efforts. Answering these types of questions will aid the Program in placement of additional antennae arrays, provide data outside of traditional sampling activities and will potentially allow for estimation of demographic parameters (e.g., survival, population estimates) while minimizing handling effects (Clark et al. *in review*). Refinement of models and interpretation of PIT tag datasets will allow for a means to assess and monitor the status of populations, as focal species move through the down-listing process and beyond. This project is currently ongoing and progress will be presented to the Biology Committee during the fall meeting in 2018 and to the Coordination Committee in May 2019.

4) Assess the efficacy of PNM fish passage facility on endangered San Juan fishes

Movement patterns of Razorback Sucker indicate PNM weir continues to act as a significant barrier limiting movement to the upper reaches of the river (Clark et al., *in review*) that may be contributing to the low proportion of adults (<3%) contributing to the annual reproductive output (Diver et al., *in prep*). Antennae detections at the weir indicate disproportionately higher detection frequencies of Razorback Sucker during March-May compared to other seasons, suggestive of spawning-related movement attempts. If recruitment is affected by reproductive output that is driven by access to suitable spawning habitats, increasing upstream passage at PNM may result in increased spawning output and the number of individuals contributing to larval production.

The fish passage is currently open and operating un-selectively (March-May) to facilitate access of Razorback Sucker to the upper reaches of the river. Data loggers were installed in the fish passage on February 23, 2018 to provide insight into environmental conditions (flow, temperature) throughout the fish passage (capture basin, and upper and lower PIT antennae) that may influence passage efficiency. An additional PIT tag antenna (20' × 4') was installed at the inflow of the fishway (upstream side of the weir) on February 24, 2018 that will allow detection of individuals successfully navigating the passage. This project is currently ongoing and a progress update will be presented to the Coordination Committee in May 2018 and to the Biology Committee during the fall meeting in 2018. As these recent actions may dictate potential operational changes to managing the fish passage facility in subsequent and future years,

FY 2019

5) Investigate larval fish dynamics in relation to habitat and flow variability

The availability, permanence and connectivity of suitable rearing habitats are strong drivers of annual recruitment rates of larval fishes (Naus and Adams 2018). The proposed project could provide a crucial link between abiotic factors (habitat and flow) that influence larval fish distributions (Turner et al. 1994, Garcia et al. 2018) throughout the San Juan River. Results from this study could provide direct connections (both individually or collectively with other ongoing/proposed projects) with a number of the potential bottlenecks addressing Razorback Sucker larval dynamics identified during the Recruitment Bottleneck Workshop on February 22, 2018. For instance, a better understanding of contemporary factors that regulate larval fish dynamics in off-channel habitats in the San Juan River will aid in prioritizing secondary channels for restoration activities (e.g., Phase III restoration), identifying relationships with backwater productivity/resource availability (e.g., Whitney, proposed SOW), and provide potential environmental thresholds regulating larval densities within critical backwater habitats.

Ongoing work by personnel at the Program Office and Ecosystems Research Institute (ERI) is currently evaluating the effects of flow variation on habitat availability (e.g., predictability, frequency and abundance of backwater/secondary channel habitats) throughout the San Juan

River. While this will provide important information that will aid in directing future management and restoration activities; no direct link to available fish data has been integrated into these habitat-flow relationships. We propose to utilize the annual larval fish collections to relate larval fish distributions and assemblage dynamics to critical backwater habitat characteristics and availability. To complete this objective, we will utilize the experience and expertise of involved PIs and collaborate closely with personnel from American Southwest Ichthyological Researchers (Mike Farrington), ERI (Vince and Dan Lamarra) and the Program Office. While the emphasis will primarily focus on Razorback Sucker, a better understanding of the spatiotemporal variability of larval fish assemblages (i.e., all species collected) could identify key attributes of backwater habitats (e.g., type [mainstem backwater, secondary channel], size, permanence, etc.) influencing larval dynamics throughout the San Juan River. To assess larval fish dynamics in relation to flow and habitat variability, we plan to address the following hypotheses:

1) The distribution of larval fishes varies spatially (longitudinally) and temporally (annually) across backwater habitats in the San Juan River.
2) Backwater characteristics (e.g., size, permanence) regulate larval fish assemblage structure (species presence/abundance).
3) Species-specific patterns of occurrence and abundance varies longitudinal and with characteristics of backwater habitats.
4) The relative distribution and abundance of native and nonnative species is related to backwater characteristics and varies across space and time.

Following a preliminary evaluation of putative sites (i.e., the presence of a larval collection at a mapped backwater habitat) using larval collections (June and July samples) and river habitat maps from 2013-2016, we have identified at least 10-15 backwaters (in each year) with corresponding larval collections between RM 68 and 148. Additional years will be included following future assessment of available data (e.g., May collections to include peak occurrence of Razorback Sucker larvae; Farrington et al. 2017).

Spatial and temporal assessment of assemblage structure will utilize traditional multivariate methods (e.g., non-metric multidimensional scaling) to summarize larval collections. We will use appropriate methods (e.g., generalized mixed-effects models, indicator species analysis, regression tree) to address hypotheses relating larval assemblages and individual species-specific patterns to predictor variables of interest (backwater characteristics, longitudinal position).

6) Re-evaluation of experimental Razorback Sucker stocking protocols

Beginning in 2014, a series of experimental stocking designs were implemented to assist the Program in quantifying the effectiveness of Razorback Sucker augmentation and to provide recommendations for future stocking plans. Cursory data analyses performed by Clark, Durst and Franssen (presented to the Biology Committee on February 21, 2018) identified potential stocking effects of interest; however, limited sample sizes (in-hand recaptures) and number of sample years currently preclude robust and rigorous analyses of these data. For example, flow-conditioning appeared to result in higher recapture rates and decreased dispersal distances compared to fish housed in static conditions, and may represent a potential stocking management option that could increase stocking efficiency and retention of Razorback Sucker in the river.

Here, we propose to revisit and finalize these analyses in FY19, with another year of data available, while also exploring options to integrate remotely-sensed detections into the analyses to boost sample sizes and inferential capability. Apparent survival and detection probabilities will be modeled using the Program MARK (White and Burnham 1999). We will use linear or generalized linear models to evaluate movement (distance and/or rates) in response to the stocking variables of interest in each stocking design. Additionally, the inclusion of detections at the waterfall will provide an estimate of emigration rates of stocked individuals. Below is a brief description and preliminary findings of each stocking design.

1) **Stocking location and hatchery source –** Razorback Sucker were stocked in at four locations along the San Juan (Montezuma Creek, PNM weir, Bloomfield) and Animas (Berg Park) rivers from fish actively harvested from NAPI and Ouray. The dataset currently includes stocked individuals from 2014 and 2015 (die-off in NAPI ponds did not allow stocking at all locations in 2016) and recapture data from 2015-2017. Preliminary analysis of apparent survival indicated significant location effects (lower survival of fish stocked at Berg Park and Bloomfield), significant size (TL) effects with survival increasing linearly with TL, and significant source effects (fish stocked from Ouray exhibited consistently higher survival). Future analyses will also evaluate movement of recaptured individuals to examine similar location and source effects on dispersal directionality and distance.

2) **Hard versus soft stocking –** Passively-harvested Razorback Sucker from NAPI ponds were stocked in 2014-2016 to evaluate the effects of hard versus soft releases. All, fish were stocked at PNM – hard-released fish were released into the fish ladder; and soft-released fish were held and acclimated 24 hours in the PNM sluiceway. Despite low recaptures, weak trends were evident following a mark-recapture analysis that indicated higher first year survival of hard released fish. In contrast, analysis of movement data (stocking to first recapture) suggest both movement distance (km) and movement rates (km/day) may be larger and more variable for hard-released Razorback Sucker. Furthermore, it appears smaller individuals are moving downstream farther and faster from their stocking locations, patterns that corroborate findings in other systems (Zelasko et al. 2010).

3) **Hatchery enrichment (flow-conditioning) –** In September 2016, 1063 Razorback Sucker housed at SNARRC were assigned to one of two treatments (flow/static) and housed for approximately six weeks. Fish in the flow treatment (n = 533) were exposed to flowing conditions that were incrementally increased at two-week intervals and subsequently soft-released at PNM on November 2. Although one year of recapture data precluded traditional mark-recapture analysis, recapture rates of flow-conditioned fish were approximately three times higher (5.3%) compared to fish exposed to static conditions (1.9%). Similarly, while based on relatively low number of recaptures, dispersal of flow-conditioned fish appears to be substantially lower, with maximum movement distances approximately 50% lower than fish housed in static conditions. An additional year of data will allow for a traditional mark-recapture analysis (Program MARK) to estimate apparent survival and detection probabilities.

Products and Updates

As some of the analytical approaches associated with the proposed tasks are fluid at this stage until available data are compiled and rigorously investigated; we will work closely with PIs and the Program Office personnel to develop these methods to best suit the needs of the SJRRIP. Updates will be subsequently provided to the BC and other interested parties as these methods and analytical approaches are refined. Summary annual report(s) on data integration activities will be developed and presented to the Program that outline task goals and hypotheses, data sources and integration approaches, analytical methods, and interpretations and conclusions. Preliminary results and project updates will be given during the February Biology Committee meeting and the May annual meeting as well as other meetings when appropriate.

References

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Clark, S.R., S.L. Durst and N.R. Franssen. *In review*. Post-stocking and subsequent annual and seasonal movements of Razorback Sucker (*Xyrauchen texanus*) in a fragmented southwestern river. Environmental Biology of Fishes.

Clark, S.R., M.M. Conner, S.L. Durst and N.R. Franssen. *In review*. Age-specific estimates indicate deleterious capture effects and low survival of stocked juvenile Colorado Pikeminnow (*Ptychocheilus lucius*). North American Journal of Fisheries Management.

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Zelasko, K. A., K. R. Bestgen, and G. C. White. 2010. Survival rates and movement of hatchery-reared Razorback Suckers in the Upper Colorado River basin, Utah and Colorado. Transactions of the American Fisheries Society 139:1478-1499.

Table 1. List of Data Integration activities and primary insights that have contributed to recovery efforts of the endangered species.

Integration Investigation	**Major Findings/Insights Towards Recovery**
Effects of mechanical nonnative fish removal on native and nonnative fishes	• Removal efforts have reduced Channel Catfish densities in specific reaches • Responses of native fishes to removal efforts were limited • Initiated experimental design to assess effects on native fishes
Biotic and abiotic factors influencing the spatial distribution of Colorado Pikeminnow (*Ptychocheilus lucius*)	• Densities of Age-1 Colorado Pikeminnow were positively related to native fish prey densities • Densities of Age-2+ Colorado Pikeminnow were higher in reaches with increased densities of fish prey, regardless of native or nonnative
Temporal patterns of movement and growth of Colorado Pikeminnow (*Ptychocheilus lucius*)	• Colorado Pikeminnow engage in seasonal upstream movements during spring and early summer; followed by limited movements throughout summer and fall • Colorado Pikeminnow make long downstream movements during winter • Growth rates were related to seasonality and size
Long-term spatial and temporal patterns of native and nonnative fish densities and their relation to environmental conditions	• Native and nonnative large-bodied fishes respond to local habitat variation • Assemblage composition varied longitudinally, representing two distinct assemblage transitions • Augmentation efforts have increased densities of endangered species
Effects of spatial stream channel heterogeneity on the densities of native and nonnative small-bodied fish densities	• Native fish densities were highest in the upper reaches of the river with limited lateral channel complexity; nonnative densities were highest in braided reaches • Assemblages in restored secondary channels were similar to those occupying natural secondary channels • Secondary channels likely provide important low-velocity habitats to native fishes
Survival and movement of stocked Razorback Sucker (*Xyrauchen texanus*)	• Survival was low the first year following stocking but increased in subsequent years • Survival increased with size, and was variable across stocking locations and sources • Spurred an experimental stocking design (beginning in 2014) that will be evaluated in FY19

Table 1 (continued)

Predicted responses of nonnative Channel Catfish (*Ictalurus punctatus*) to managed exploitation	• Current levels of exploitation will not crash the Channel Catfish population, but will likely reduce the total river-wide biomass • Channel Catfish population size and biomass structure have been reduced since the early 1990s following removal efforts
Evaluation of age-specific of Colorado Pikeminnow (*Ptychocheilus lucius*)	• Apparent survival of stocked Colorado Pikeminnow was consistently less than 0.25 until individuals reach age-4+ • Identified potential capture-related effects that may be contributing to the low survival rates and limiting recovery
Evaluation of movement and condition of Razorback Sucker (*Xyrauchen texanus*)	• Post-stocking movements were consistently downstream and related to stocking location, but resulted in selection of a suitable reach of habitat • Consistent annual and seasonal movements were limited using in-hand recaptures • Passive PIT tag detections at PNM weir demonstrate regular spawning-related movements as detections regularly peaked during March-May

Table 2. List of peer-reviewed publications resulting from Data Integration activities

Franssen, N.R. and S.L. Durst. 2013. Prey and nonnative fish predict the distribution of Colorado Pikeminnow (*Ptychocheilus lucius*) in a south-western river in North America. Ecology of Freshwater Fish 23:395-404
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Franssen, N.R., S.L. Durst, K.B. Gido, D.W. Ryden, V. Lamarra and D.L. Propst. 2016. Long-term dynamics of large-bodied fishes assessed from spatially intensive monitoring of a managed desert river. River Research and Applications 32:348-361
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
Pennock, C.A, S.L. Durst, B.R. Duran, B.A. Hines, C.N. Cathcart, J.E. Davis, B.J. Schleicher and N.R. Franssen. 2018. Predicted and observed responses of a nonnative Channel Catfish *Ictalurus punctatus* population following managed removal to aid the recovery of endangered fishes. North American Journal of Fisheries Management doi:10.122/nafm.10056
Clark, S.R., M.M. Conner, S.L. Durst and N.R. Franssen. *In review*. Age-specific estimates indicate deleterious capture effects and low survival of stocked juvenile Colorado Pikeminnow (*Ptychocheilus lucius*). North American Journal of Fisheries Management
Clark, S.R., S.L. Durst and N.R. Franssen. *In review*. Post-stocking and subsequent annual and seasonal movements of Razorback Sucker (*Xyrauchen texanus*) in a fragmented southwestern river. Environmental Biology of Fishes

Budget Fiscal Year 2019 1 October 2018 to 30 September 2019

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 Post-Doctoral Associate	$26.23/HR	1920 HRS			$50,367.00	$50,367.00
UNM Faculty Summer Salary	$77.71/HR	160 HRS			$12,433.00	$12,433.00
FRINGE BENEFITS – Explain the type of fringe benefits and how applied to various categories of personnel.						
UNM Post-Doctoral	26.80%	1 EA			$13,498.00	$13,498.00
UNM Summer Faculty	22.00%	1 EA			$2,735.00	$2,735.00
TRAVEL—dates; location of travel; method of travel x estimated cost; who will travel						
SJRRIP Meetings	$1,500/traveler	4 EA/YR			$6,000.00	$6,000.00
TOTAL DIRECT COSTS--					$85,033.00	$85,033.00
INDIRECT COSTS – **17.5%**						
					$14,881.00	$14,881.00
TOTAL PROJECT/ACTIVITY COSTS FY19					$99,914.00	**$99,914.00**

FY 2019 Budget Summary

FY 2019 Grand Total

Data Synthesis and Integration for SJRRIP Program

$99,914.00

Attachment A

Out-year budgets for Data Synthesis and Integration for the San Juan River Restoration Implementation Program

2020-2024

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

Budget Fiscal Year 2020 1 October 2019 to 30 September 2020

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 Post-Doctoral Associate	$27.02/HR	1920 HRS			$51,878.00	$51,878.00
UNM Faculty Summer Salary	$80.04/HR	160 HRS			$12,806.00	$12,806.00
FRINGE BENEFITS – Explain the type of fringe benefits and how applied to various categories of personnel.						
UNM Post-Doctoral	27.30%	1 EA			$14,163.00	$14,163.00
UNM Summer Faculty	22.00%	1 EA			$2,817.00	$2,817.00
TRAVEL—dates; location of travel; method of travel x estimated cost; who will travel						
SJRRIP Meetings	$1,500/traveler	4 EA/YR			$6,000.00	$6,000.00
TOTAL DIRECT COSTS--					$87,664.00	$87,664.00
INDIRECT COSTS – **17.5%**						
					$15,341.00	$15,341.00
TOTAL PROJECT/ACTIVITY COSTS FY20					$103,005.00	**$103,005.00**

Budget Fiscal Year 2021 — 1 October 2020 to 30 September 2021

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 Post-Doctoral Associate	$27.83/HR	1920 HRS			$53,434.00	$53,434.00
UNM Faculty Summer Salary	$82.44/HR	160 HRS			$13,190.00	$13,190.00
FRINGE BENEFITS – Explain the type of fringe benefits and how applied to various categories of personnel.						
UNM Post-Doctoral	27.90%	1 EA			$14,908.00	$14,908.00
UNM Summer Faculty	22.00%	1 EA			$2,902.00	$2,902.00
TRAVEL—dates; location of travel; method of travel x estimated cost; who will travel						
SJRRIP Meetings	$1,500/traveler	4 EA/YR			$6,000.00	$6,000.00
TOTAL DIRECT COSTS--					$90,434.00	$90,434.00
INDIRECT COSTS – **17.5%**						
					$15,826.00	$15,826.00
TOTAL PROJECT/ACTIVITY COSTS FY21					$106,260.00	**$106,260.00**

Budget Fiscal Year 2022 1 October 2021 to 30 September 2022

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 Post-Doctoral Associate	$28.67/HR	1920 HRS			$55,037.00	$55,037.00
UNM Faculty Summer Salary	$84.91/HR	160 HRS			$13,586.00	$13.586.00
FRINGE BENEFITS – Explain the type of fringe benefits and how applied to various categories of personnel.						
UNM Post-Doctoral	27.90%	1 EA			$15,355.00	$15,355.00
UNM Summer Faculty	22.00%	1 EA			$2,989.00	$2.989.00
TRAVEL—dates; location of travel; method of travel x estimated cost; who will travel						
SJRRIP Meetings	$1,500/traveler	4 EA/YR			$6,000.00	$6,000.00
TOTAL DIRECT COSTS--					$92,967.00	$92,967.00
INDIRECT COSTS – **17.5%**						
					$16,269.00	$16,269.00
TOTAL PROJECT/ACTIVITY COSTS FY22					$109,236.00	**$109,236.00**

Budget Fiscal Year 2023 1 October 2022 to 30 September 2023

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 Post-Doctoral Associate	$29.53/HR	1920 HRS			$56,688.00	$56,688.00
UNM Faculty Summer Salary	$87.46/HR	160 HRS			$13,994.00	$13,994.00
FRINGE BENEFITS – Explain the type of fringe benefits and how applied to various categories of personnel.						
UNM Post-Doctoral	27.90%	1 EA			$15,816.00	$15,816.00
UNM Summer Faculty	22.00%	1 EA			$3,079.00	$3,079.00
TRAVEL—dates; location of travel; method of travel x estimated cost; who will travel						
SJRRIP Meetings	$1,500/traveler	4 EA/YR			$6,000.00	$6,000.00
TOTAL DIRECT COSTS--					$95,577.00	$95,577.00
INDIRECT COSTS – **17.5%**						
					$16,726.00	$16,726.00
TOTAL PROJECT/ACTIVITY COSTS FY23					$112,303.00	**$112,303.00**

Budget Fiscal Year 2024 1 October 2023 to 30 September 2024

BUDGET ITEM DESCRIPTION	COMPUTATION		RECIPIENT FUNDING	OTHER FUNDING	RECLAMATION FUNDING	TOTAL COST
	$/Unit 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 Post-Doctoral Associate	$30.41/HR	1920 HRS			$58,389.00	$58,389.00
UNM Faculty Summer Salary	$90.09/HR	160 HRS			$14,414.00	$14,414.00
FRINGE BENEFITS – Explain the type of fringe benefits and how applied to various categories of personnel.						
UNM Post-Doctoral	27.90%	1 EA			$16,291.00	$16,291.00
UNM Summer Faculty	22.00%	1 EA			$3,171.00	$3,171.00
TRAVEL—dates; location of travel; method of travel x estimated cost; who will travel						
SJRRIP Meetings	$1,500/traveler	4 EA/YR			$6,000.00	$6,000.00
TOTAL DIRECT COSTS--					$98,265.00	$98,265.00
INDIRECT COSTS – **17.5%**						
					$17,196.00	$17,196.00
TOTAL PROJECT/ACTIVITY COSTS FY24					$115,461.00	**$115,461.00**

Appendix I. Reviewer comments and responses.

	23	**(23) Integration of Long-term Monitoring Data**	**Turner, UNM**
PO	**How can the technical aspects of this SOW be improved?** As suggested by others, we agree efforts among James Whitney, ASIR, and UNM be coordinated as to avoid redundancy as well as increase integration among all projects. **What is this SOW's contribution to recovery?** The UNM data integration work has a strong track record of producing high quality science that continues to increase our understanding of the ecology of the endangered species and aids decision making by the BC. UNM's two most recent investigations of CPM survival and Razorback Sucker movement resulted in relatively rapid management alterations (reduced capture and handling of some endangered individuals and making PNM passage non-selective for a few months in the spring) which were unanimously supported by the BC. Moreover, the two proposed investigations for FY19 are directly linked to better understanding recruitment roadblocks by linking habitat variation to larval fish densities as well as assessing was to increase the efficiency of our stocking program. Therefore, we support inclusion of this SOW in the FY19 Work Plan.		
Schleicher (BC)	**How can the technical aspects of this SOW be improved?** Will a reduced sampling effort compromise the "finalizing" of some of the preliminary results; there will be less sampling done this in FY18 as there was in FY17 more than likely resulting in less recaptures. ***While we agree the changes in sampling protocols result in fewer total annual captures, this will only reduce sample sizes for the FY18 sampling interval, but will not preclude analyses. Survival and detection estimates are derived on an annual basis; thus estimates from FY18 sampling will solely reflect adult monitoring catches. Similarly, analysis of movement rates have/will primarily utilize recaptures resulting from large-bodied monitoring in order to standardize duration/sampling effort.*** **What is this SOW's contribution to recovery?** #5) Using existing data this SOW will inform what habitats appear to be preferred by larval RZ, and potentially what flows would favor these conditions. #6) This will inform us as to how fish would need to be stocked to retain in the system longer and closer to where they are stocked.		
Wesche (BC)	**How can the technical aspects of this SOW be improved?** This proposal is well written and clearly describes what has been accomplished in recent years and what is planned for the upcoming year. Much improved from what UNM was submitting several years ago! The hypotheses on page 5 are presented as questions and should be re-stated in a more traditional hypothesis format. ***Questions have been revised.*** **What is this SOW's contribution to recovery?**		

	This work addresses several important bottlenecks to recovery identified during the February Workshop and has the potential to make important contributions to our understanding and management of the system to further our progress.
Mazzone (BC)	**How can the technical aspects of this SOW be improved?** No Comment. **What is this SOW's contribution to recovery?** Unsure: until this scope of work is completed, which is why integration projects are so interesting. The production of high quality peer reviewed materials free from interested party, and departmental or programmatic bias is essential to the advancement of the Programs overall knowledge of the SJR native fishes. The proposed hypotheses outlined in this scope, and the others that will be developed throughout the process should be of great interest to the Program.
Lamarra (BC)	**How can the technical aspects of this SOW be improved?** FY 19 tasks seem timely as we focus on the bottlenecks for the two endangered species. The larval data and habitat data are logical starting point **What is this SOW's contribution to recovery?** No Comment
Davis (BC)	**How can the technical aspects of this SOW be improved?** Line 157: How much of this task will overlap with that of Dr. Whitney's if his project is also funded? It seems that they would complement each other but making sure to avoid needless redundancy would be important. ***Reiterating the comments from the PO above, we will coordinate with appropriate PIs and researchers to minimize redundancy and promote integration of the various projects.*** **What is this SOW's contribution to recovery?** Through the assessment of potential bottlenecks, the activities proposed for FY 2019 support recovery efforts for the two endangered fishes. Further analyses into augmentation efforts will help to improve the augmentation program.
Warren (PR)	**How can the technical aspects of this SOW be improved?** Although, the author concedes that analytical approaches that might be applied to some of the data at this point are fluid, this SOW would be improved by adding as much of the "how" as possible. The results to date are impressive, but we are still asked to take it on good will that the promised work can be completed with the available data. That said I approve the overall ideas being pursued. ***We have included additional analytical details for FY19 tasks where applicable.*** **What is this SOW's contribution to recovery?** The results to date (1 & 2) are impressive and certainly informative to future sampling protocols (capture/handling) and management actions (operation/improvement of PNM weir) affecting recovery. I really regret missing those presentations. Other ongoing studies (3 & 4) ask questions important to

	measuring recovery (e.g., antennas vs e-fishing) and drill down on weir effects on passage of RZB and hence recovery of that species. The proposed larval work is of high interest, but I question whether sample sizes will be large enough for either listed species to really produce insight. That said, the study may paint a picture of the spatio-temporal distribution of other fishes that in turn may shed light on the listed species. Other: Line 54-58 This is awkward and unclear, recast. ***This sentence has been revised for clarity.***
Hubert (PR)	**How can the technical aspects of this SOW be improved?** P. 1, l. 37 and l. 43. This is a minor criticism, but one for the authors to consider into the future. On the lines cited, the following are inserted as citations: Clark et al. *in prep* and Clark et al. *in review*. These are not documents accessible to the reader. The citations provide no scientific evidence supporting the points being made. Similar citations show up later in the SOW. It is recommended that the authors make the effort to explain emerging research findings that support their point. For example, a brief explanation of the findings described in Clark et al. *in prep* would provide some evidence that is not otherwise available to the reader. ***Revisions and/or additions to the text have been incorporated to help clarify citations. Brief summaries of the findings are also presented when discussing the FY17 tasks which are the basis for these citations/manuscripts.*** P. 3, l. 106. The section **FY 2018** describes activities going on currently during FY 2018. It would be beneficial to clearly state at the beginning of the section that the two listed research projects will continue into FY 2019 and that completion of the projects is dependent on FY 2019 funding. While not a “technical” criticism, this is an important strategic point. ***This is a good point – and applies more to the assessment of passage efficiency at PNM compared to the PIT tag arrays. While these data are currently being evaluated, assessment of the impact(s) of the recent management actions (e.g., efforts to promote greater passage efficiency at PNM) will be dependent on an appropriate and comparable temporal scale to evaluate passage (i.e. an entire operation period) that will likely result in this task being completed during FY19. A sentence has been added to the PNM passage task noting this point.*** P. 6, l. 225-227. Another minor criticism. The sentence reads “Razorback sucker were stocked in at four locations along the San Juan and Animas rivers (Montezuma Creek, PNM weir and Bloomfield, Berg Park).” As written it appears that there are only three sites in the list when there are actually four. ***This sentence has been revised for clarity.*** **What is this SOW’s contribution to recovery?** The contributions to recovery that are being made by the integration efforts are very substantial. They should be strongly emphasized in the SOW. The

	introduction, **<u>Background – San Juan River Data Integration and Synthesis</u>**, describes some recent progress. It would be insightful to develop a couple of tables. One would be a list all the projects that have been conducted since efforts at integration were initiated and the insights contributing to recovery obtained from each. A second list of peer-reviewed publications would be impressive. The tables could be added to each year to demonstrate the strides being achieved by integration efforts. Emphasize the achievements! ***Suggested tables have been added to the SOW.***
Ross (PR)	I have provided my comments on this SOW and certainly have been as objective as possible. However, I am associated with both Dr. Turner and Dr. Clark through my position as Curator Emeritus of Fishes at the Museum of Southwestern Biology. **How can the technical aspects of this SOW be improved?** Lines 54-57. Be careful in citing supportive papers. The following statement attributable to Gibbs and Currie seems a bit overenthusiastic. “As one of the primary goals of recovery plans is supporting research directed at increasing our knowledge of imperiled species, successful completion of recovery objectives strongly relates to the amount of published, peer-reviewed publications (Gibbs and Currie 2012).” What Gibbs and Currie (2012) actually showed was that the best of their four statistical models relating measures of recovery to various recovery actions only explained 13% of the variation. The number of peer-reviewed publications was a significant part of this model, but the amount of variation explained would have been < 13%.. ***This statement has been revised.*** Line 155-FY 2019. The approaches to data analysis in this section are more general, given that data are still being obtained. However, given the track record of deliverables from this integration program, I don’t see that as a problem. ***We have added more detail to analytical approaches where applicable.*** Lines 187-197. As a clarification, these are important research questions, but they are not formal hypotheses. ***Questions have been revised.*** **What is this SOW’s contribution to recovery?** Beginning with Dr. Nate Franssen and continuing with Dr. Scott Clark, SJRIP data integration associated with a dedicated post-doctoral researcher has proven to be highly successful and has made major contributions to understanding impacts of recovery efforts. A key to this success has been the ability of the post-doctoral researchers to work closely with the Program Office and with the biologists involved in the monitoring programs. Most recently, the work of Dr. Clark, in association with Dr. Franssen, Scott Durst, and others, has identified bottlenecks to the recovery of Colorado Pikeminnows and Razorback Suckers that can then be addressed by specific Program actions (e.g., increase upstream movement through the PNM weir; reduce handling of Colorado Pikeminnows to increase survivorship

	of early life stages). Item #3, Improvement of biological metrics and inferences from remotely detected PIT tags, addresses a major suggestion in the Peer Reviewers 2018 report that more rigor is needed in the design and analysis of PIT tagging studies. This is a highly important SOW with a strong track record over the time the post-doctoral research program has been in place. I expect the current SOW to make major contributions to guiding recovery efforts of the listed species.
Zeigler	**How can the technical aspects of this SOW be improved?** The technical aspects of this SOW seem adequate to meet the objectives of the proposed studies. I do not see any additional information that needs to be added. Minor comments/edits: - Line 225: The "s" in sucker needs to be capitalized ***Revised.*** **What is this SOW's contribution to recovery?** The integration work completed by these PIs has been instrumental in decreasing uncertainties associated with the recovery of Colorado Pikeminnow and Razorback Sucker in the San Juan River. The proposed projects for FY2019 will be beneficial for understanding larval dynamics and Razorback Sucker stocking protocols. Both projects will contribute to recovery by increasing our understanding of the effects of flow and available habitat for larval fish and helping to further refine stocking protocols for Razorback Sucker.