SJRRIP Data Integration and Synthesis

Museum of Southwestern Biology

Fiscal Year 2018 Scope of Work

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Performance Dates: 1 October 2017 to 30 September 2018

Backgound – San Juan River Data Integration and Synthesis

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

The U.S. Fish and Wildlife Service's Program Office is the clearinghouse for all Program data. The Program Office is responsible for compiling, integrating, and synthesizing all monitoring data, as necessary, to meet its obligations defined in the Program Document and Long Range Plan. However, the level of integration requested by Program participants exceeds the Program Office Staff's time availability. Therefore, the Program has utilized a dedicated post-doctoral researcher to assist with completion of these tasks. This type of work requires strong quantitative, writing, and research skills, to address questions without other time commitments or demands. Products/results from the research will be presented to both the Program's Biology and Coordination Committees, as well as interested

public, and submitted to scientific journals for peer review and publication. The postdoctoral researcher will collaborate closely with those responsible for directing relevant studies (e.g., adult monitoring, nonnative fish removal, and native fish reproduction) and key researchers associated with the Program, identifying critical questions for integration and analysis (especially early in the process). The overarching goal of data integration and synthesis remains the same in FY 2018 as before: to provide a data-driven and scientifically sound approach to making recommendations regarding flow management, recovery criteria for endangered species, and measurements of Program success.

Data Integration Objectives

Data integration tasks outlined below will be coordinated among UNM, Program PIs and USFWS Program Office Staff. Dr. Clark will be tasked with the following projects to complete during the FY 2018 work plan:

Primary Objective – Evaluation of Remote PIT Tag Arrays

As the number of temporary and permanent PIT tag arrays increases in the San Juan River and tributaries, a detailed cost-benefit analysis of these systems will provide a better understanding of how these arrays improve our inferential capabilities and understanding of population dynamics of endangered fishes within the San Juan Basin. Refinement of models and interpretation of PIT tag datasets will allow for a means to assess and monitor the status of populations, as focal species move through the downlisting process and beyond. Our approach will relate data collected from the remote arrays to the traditional survey methods using detailed statistical evaluation of both data types, where comparable. In order to realize possibilities associated with these avenues of data collection, serious attention to modeling, analysis, and comparison of PIT tag scan data needs to be undertaken now in order to plan appropriately for adaptive management decisions in the near future. A detailed assessment of the relative improvement (and potential limitations) of data collection using remote PIT tag arrays, in combination with traditional sampling methods (i.e. annual monitoring efforts), will provide the SJRRIP with a valuable baseline to monitor the outcome of future management decisions.

Task 1 – Improvement of biological metrics and inferences from remotely detected PIT tags
We will extract, collate, and integrate PIT tag data of Colorado Pikeminnow (*Ptychocheilus lucius*) and Razorback Sucker (*Xyrauchen texanus*) obtained from both passive (antenna) detections and active (in-hand) captures from The Species Tagging, Research, and Monitoring System (STReaMS). We will provide a detailed assessment of the relative utility of existing arrays based on a suite of biological metrics, and propose recommendations on the future utility of additional arrays. As of February 2017, greater than 120,000 remote detections, representing over 3,000 individuals, have been logged from endangered fishes (Colorado Pikeminnow and Razorback Sucker) within the San Juan River basin. PIT tag data will be analyzed and summarized to calculate demographic parameters (survivorship and age structure), population estimates, and detection probabilities in the program MARK (White and Burnham 1999). We will examine how these metrics vary through time (seasonal/year effects), by individual covariates (body size, condition, age) and with annual covariates (seasonal/annual discharge, sampling effort). Models will be ranked and assessed using an information theoretic approach to evaluate predictors that best describe observed metrics. Analyses will first utilize only active captures to provide a suite of baseline metrics, and we will subsequently incorporate the remote detections to evaluate relative improvement of metrics and variance estimates. One of our current tasks (FY17) is utilizing similar analyses to gain insight into the age-specific survivorship of Colorado Pikeminnow, and we, in collaboration with Program Office personnel, are qualified to carry

out these analyses and offer recommendations on the value and potential future use of temporary or permanent arrays in the San Juan Basin. Similar studies have documented significant improvement in inferential capabilities when remote antennae are deployed as an alternative to, or in conjunction with, traditional survey methods (e.g. Hewitt et al. 2010, Barbour et al. 2012). We will further investigate the value of these arrays to better understand spatial and temporal movement patterns (Kanno et al 2014) of the endangered fishes in the San Juan. We will utilize methods developed for assessing seasonal and annual movement (Durst and Franssen 2014), and incorporation of remote detections will presumably allow for a finer-scale assessment of these patterns via more robust detection histories for individuals. We will investigate seasonal and annual movement patterns and how these are influenced by seasonal or annual (e.g. discharge, temperature) and individual covariates (e.g., species, body size, condition, age). Furthermore, as annual monitoring efforts generally operate during March – October, remote detections may provide insight into movement patterns in periods outside of these efforts when sampling effort is reduced (November – February). As the SJRRIP moves forward in recovery efforts, a better understanding of the most effective use of resources will be essential to provide the most efficient and comprehensive biological data to base management decisions and recovery efforts.

Task 2 – Cost-benefit analysis of remote antennae for future management and data collection
While assessment of the relative improvement of data inference using biological metrics is imperative to future management decisions, a detailed cost-benefit analysis (monetary) is similarly needed to fully understand the utility of the inclusion of additional arrays (Barbour et al. 2012). If certain biological thresholds associated with San Juan endangered fishes (e.g. number of wild-spawned adult fish) become attainable in the coming years, the relative value of remote arrays needs to be assessed in order to devise the most effective and efficient sampling strategy to inform and motivate future management actions (e.g. increased traditional sampling effort vs. installation of new arrays).

To conduct a comparative cost-benefit analysis of existing arrays, we will compile all detection records associated with remote and active captures within comparable reaches of the San Juan River. For traditional methods (i.e. annual monitoring efforts) we will compile the costs associated with yearly, basin-wide monitoring efforts (e.g. gear, travel, labor, etc.) and compute a number of relative metrics expressed in units of effort (i.e. recaptures per unit effort) and a per dollar basis (recaptures per dollar). Similarly, we will compute comparable metrics for both the temporary and permanent PIT tag antennae (e.g. installation and yearly maintenance costs). These data will provide the SJRRIP insight into the most efficient and effective sampling strategies when confronted with implementing larger-scale or more intensive population and river-wide survey efforts. We will accomplish this by providing a detailed cost-benefit framework to employ in future management actions and decisions.

Task 3 – Assess the efficacy of PNM fish passage facility on endangered San Juan fishes
Maintaining connectivity of riverine habitats is critical to preserving population and community-level processes. Fish passages are often constructed in order to maintain this connectivity among populations or to facilitate life-history processes (e.g. upstream spawning migrations). However, the relative efficiency of such passages, as well as species-specific passage rates, is not well understood. We propose to investigate the efficiency of the PNM fish pass on successful passage endangered fishes and offer recommendations to promote increased success.

Currently, two PIT antennae (perpendicular to stream flow) are in operation in the fish passage at PNM and multiple antennae are on the downstream side of the PNM weir in the channel of San Juan proper. Relatively low passage rates of endangered fishes have been documented at PNM based on logged detections and subsequent capture in the entrapment bays at the upstream terminus of the pass (approximately 2 and 26% for Razorback Sucker and Colorado Pikeminnow, respectively; Cheek

2014). Furthermore, a substantial number of individuals have been detected at the antennae below the weir, but fail to enter the fish passage based on detection histories, and a more thorough analysis of the putative mechanisms driving these inefficiencies is warranted. The configuration of these antennae present the ability to test the effectiveness of this system to pass PIT-tagged fish through this facility, with emphasis on the native endangered fishes, by asking and answering the following questions using the remotely-sensed data and presence of fished temporarily housed in the upstream entrapment bays.

(1) What proportion of fishes entering the fish passage successfully pass through the facility? What proportion of fishes enter the fish passage (i.e. detected on downstream antenna) but do not pass the upstream antenna?
(2) What proportion of fishes detected at the weir antennae subsequently enter the passage? Of those detected at the weir and enter the passage, what proportion successfully pass through the facility? Alternatively, after failing to traverse the passage, what proportion of fish are detected at the antennae below the weir?
(3) Are these patterns related to abiotic conditions (e.g. depth, flow, temperature or season) or species-specific phenotypic traits (e.g. body size, age, condition) of individuals or is the lack of passage random?

Once appropriate dependent and independent variables are identified, we will use a series of multivariate approaches (e.g. multiple logistic regression, classification and regression trees [CART]) to identify the variables most responsible in facilitating successful passage through the PNM fish passage.

While we explicitly propose to investigate the fish passage at the PNM system, we do note that if adequate data becomes available from the recently installed arrays pending conversion to the new series of operational pumps at the Hogback facility, we will provide, at minimum, a preliminary assessment of fish passage there.

Products and Updates

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

References

Barbour, A.B., A.J. Adams, T. Yess, D.C. Behringer and R.K. Wolfe. 2012. Comparison and cost-benefit analysis of PIT tag antennae resighting and seine-net recapture techniques for survival analysis of an estuarine-dependent fish. Fisheries Research 121-122:153-160.

Cheek, C. 2014. Public Service Company of New Mexico (PNM) fish passage facility 2014 annual report. San Juan River Recovery Implementation Program, Navajo Nation Department of Fish and Wildlife.

Durst, S.L. and N.R. Franssen. 2014. Movement and growth of juvenile Colorado Pikeminnows in the San Juan River, Colorado, New Mexico and Utah. Transactions of the American Fisheries Society 143:519-527.

Hewitt, D.A., E.C. Janney, B.S. Hayes and R.S. Shively. 2010. Improving inferences from fisheries capture-recapture studies through remote detection of PIT tags. Fisheries 35:217-231.

Kanno, Y., B.H. Letcher, J.A. Coombs, K.H. Nislow and A.R. Whiteley. 2014. Linking movement and reproductive history of brook trout to assess habitat connectivity in a heterogeneous stream network. Freshwater Biology 59:142-154.

White, G.C. and K.P. Burnham. 1999 Program MARK: survival estimation from populations of marked animals. Bird Study 46 S1:S120-S139.

Budget Fiscal Year 2018 1 October 2017 to 30 September 2018

BUDGET ITEM DESCRIPTION	COMPUTATION		RECIPIENT FUNDING	OTHER FUNDING	RECLAMATION FUNDING	TOTAL COST
	$/Unit and Unit	Quantity				
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	$25.47/HR	1920 HRS			$48,900.00	$48,900.00
UNM Faculty Summer Salary	$90.72/HR	160 HRS			$14,516.00	$14,516.00
FRINGE BENEFITS – Explain the type of fringe benefits and how applied to various categories of personnel.						
UNM Post-Doctoral	26.30%	1 EA			$12,861.00	$12,861.00
UNM Summer Faculty	22.00%	1 EA			$3,194.00	$3,194.00
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--					$85,471.00	$85,471.00
INDIRECT COSTS – **17.5%**						
					$14,957.00	$14,957.00
TOTAL PROJECT/ACTIVITY COSTS FY18					$100,428.00	**$100,428.00**

FY 2018 Budget Summary

FY 2018 Grand Total

Data Synthesis and Integration for SJRRIP Program

$100,428.00