

**San Juan River Specimen Curation, Upper Colorado River Basin Larval Fish Collections,
and SJRIP Data Integration and Synthesis
by the Museum of Southwestern Biology**

Fiscal Year 2016 Scope of Work

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Award R13SS40013

1 October 2015 to 30 September 2016

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 1990's 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 has 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, 42,718 lots or 1,676,650 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 19,413 San Juan River collection sites have been georeferenced and can be mapped in ArcView. Approximately, 18,514 pages of field notes (locality data) and data sheets have been captured in the MSB database. A total of 24,587 pages of original San Juan River field notes and data sheets have been digitally captured, cleaned, and saved in both tiff and pdf formats for the electronic archives; the original field notes and data sheets are permanently stored in acid-free document boxes for long-term conservation.

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

Upper Colorado River Basin Larval Fish Collections and Identifications—One graduate student RA will be dedicated to the collections, identifications, and integration of larval fishes taken from the 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. See note in budget summary.

Data Integration and Synthesis—Since its inception in 1992, the San Juan River Basin Recovery Implementation Program (Program) 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.

Nathan R Franssen, Ph.D. was hired (2012) as postdoctoral research associate to synthesize, analyze, and integrate relevant elements of this immense database in conjunction with the Program Office biologist. The work requires strong quantitative, writing, and research skills that address the questions without other time commitments or demands. Products/results from the research are presented to the Program's Biology and Coordination Committees, as well as interested public, and submitted to scientific journals for peer review and publication. The research associate collaborates 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 to identify critical questions for integration and analysis (especially early in the process). Collaboration will continue with appropriate project leaders and researchers in analyzing data and drafting manuscripts detailing results of investigations. The overarching goal of these efforts will be 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.

Nathan Franssen has subsequently left this post doc position and has taken a permanent job with the Program Office. Therefore, a new person will be needed to fill Nathan's vacancy in FY16. The PI's mentioned above as well as staff in the Program Office are currently looking for new candidates to fill this position. Nonetheless, the new hire will work with the Program Office's staff to accomplish the proposed projects below.

Study Area

The object of this project is to process 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 in the permanent museum archives. 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 takes place at the University of New Mexico, the USFWS SJRRIP Program Office in Albuquerque, and 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 is responsible for SJRRIP data synthesis and integration, meeting the research goals of the SJRRIP Program.

Curation and Collections Care Objectives

1. Provide a secure and organized permanent 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.

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.

Data Integration Tasks and Objectives

The research associate will conduct data analyses and syntheses in an office provided by the University of New Mexico, Museum of Southwestern Biology. They will work with researchers in the Program Office, USFWS Albuquerque NM to compile and analyze SJRRIP data.

The following is a list of suggested investigations by the PI's during the initial meeting (Fall 2012) and potential projects outlined since 2012 that have been the focus of data integration. It is likely that discussions with key Program personnel, the Biology and Coordination Committees, and researchers will identify additional studies or alterations to those suggested here. Some of these suggested investigations have been completed or near completion and their progress to date has been noted. In FY(16), completed projects (manuscripts) will be disseminated to the Biology and Coordination Committees upon submission for peer-reviewed publication.

1) What are the effects of nonnative fish removal on native and nonnative fishes in the San Juan River?

Results of this project were presented to the Biology Committee on February 21, 2013 and to the Coordination Committee on May 8, 2013 and subsequently published:

Franssen, N.R., J.E. Davis, D.W. Ryden, and K.B. Gido. 2014. Fish community responses to mechanical removal of nonnative fishes in a large southwestern river. *Fisheries* 39:352–363.

2) What factors are driving the spatial distribution of Colorado pikeminnow in the San Juan River and can these factors help elucidate biotic interactions that may be limiting recruitment success?

Results of this project were presented to the Biology Committee on February 21, 2013 and the Biology Committee and subsequently published:

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.

3) What are the growth and movement patterns of Colorado pikeminnow in the San Juan River and how are these linked to environmental variation (e.g., habitat, temperature)?

Results of this project were presented to the Biology Committee on February 21, 2013 and to the Coordination Committee on May 8, 2013 and was subsequently published:

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.

4) How has flow manipulation, nonnative fish removal, and endangered fish augmentation influenced the fish community of the San Juan River?

This study was divided into two separate investigations, the first focused on large-bodied fishes while the second assessed small-bodied fishes.

The first study quantified spatial and temporal variation in the large-bodied fishes in the San Juan River between 1994 and 2012. Results of this project were presented to the Biology and Coordination Committees May, 2014 and was subsequently published:

Franssen, N.R., S.L. Durst, K.B. Gido, D.W. Ryden, V. Lamarra, and D.L. Propst. 2014. Long-term dynamics of large-bodied fishes assessed from spatially intensive monitoring of a managed desert river. *River Research and Applications*. doi: 10.1002/rra.2855

The second project assessed spatial variation in small-bodied fishes and specifically quantified habitat use of fishes in secondary channels was also investigated in FY(14). Results of this study were presented to the Biology and Coordination Committees in May, 2014 and was subsequently published:

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.

5) Quantify Razorback sucker stocking and population estimates to assess future stocking needs.

Results of survival and detectability of Razorback sucker were presented to the Biology Committee February 19, 2015 and to the Coordination Committee May, 2015. This project was submitted to the Biology and Coordination Committees before submission for peer review. The paper was rejected from Transactions of the American Fisheries Society and is currently being revised for resubmission.

Franssen, N.R. and S.L. Durst. Survival and movement of stocked Razorback Suckers (*Xyrauchen texanus*) in the San Juan River, NM and UT.

6) How has annual variation in the San Juan River's flow regime altered densities of native and nonnative fishes?

This project is ongoing, but results were presented to the Biology Committee February 19, 2015 and the Coordination Committee May, 2015. After further investigation into the small-bodied data set, it was apparent substantial portions of data were incorrect or missing. These data inconsistencies need to be rectified prior to completing analyses. Researchers in the Program Office and at the New Mexico Department of Game and Fish are working on rectifying these data errors.

7) Characterize movement and reproductive strategy of Channel catfish.

Extensive efforts have been underway to reduce the density of Channel Catfish through mechanical remove with limited success. We propose to quantify the spatial distribution, movement patterns, and reproductive strategy of Channel Catfish in order to aid nonnative fish removal management actions. This should be completed in FY(15).

8) What are the environmental drivers of spawning and recruitment success of Channel Catfish?

This project is ongoing. Substantial progress was not made due to the limited amount of length at age data on Channel Catfish in the San Juan River. We plan to obtain better estimates of lengths at age and proceed with a population model assessing age structured responses to removal.

9) How do environmental factors (e.g., annual flow regime, population densities) affect condition of native and nonnative fishes?

Identifying environmental factors that drive variation in condition of fishes will aid in understanding relationships between flow management and biological responses. We propose to use the extensive Length-Weight data collected from large-bodied monitoring to construct condition indices of native and nonnative fishes. We will then be able to assess how spatial and temporal variation in fish condition is linked to local habitat conditions as well as annual variation in flow regimes.

Projects (7) should be completed in FY(15) while projects (8) and (9) should be completed in FY(16). Project (6) could be returned to in FY(16) provided data problems are rectified.

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 2014 San Juan River, upper Colorado River Basin specimen curation, larval fish sampling and identification, and data integration activities will be prepared and distributed by 31 March 2015 to the San Juan River Biology Committee for review. Upon receipt of written comments, that report will be finalized and disseminated to members of the San Juan River Biology Committee by 1 June 2015.

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. A minimum of two manuscripts will be prepared in FY(16).

REFERENCES

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Budget Fiscal Year 2016 1 October 2015 to 30 September 2016

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	\$13.00/HR	1582 HRS			\$20,573.00	\$20,573.00
UNM Student Assistants(2)	\$12.00/HR	780 HRS			\$9,360.00	\$9,360.00
UNM Post-Doctoral Associate	\$20.81/HR	2080 HRS			\$43,286.00	\$43,286.00
UNM Graduate Student RA	\$9.64/HR	2080 HRS			\$20,056.00	\$20,056.00
UNM Faculty Summer Salary	\$60.30/HR	161 HRS			\$9,690.00	\$9,690.00
FRINGE BENEFITS – Explain the type of fringe benefits and how applied to various categories of personnel.						
UNM Staff and Faculty	35.60%	1 EA			\$7,324.00	\$7,324.00
UNM Undergraduate	1%	2 EA			\$94.00	\$94.00
UNM Post-Doctoral	26.30%	1 EA			\$11,385.00	\$11,385.00
UNM Graduate Student	1%	1 EA			\$201.00	\$201.00
UNM Summer Faculty	22.0%	1 EA			\$2,132.00	\$2,132.00
TRAVEL —dates; location of travel; method of travel x estimated cost; who will travel						
Researcher & 3 others 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	\$236.00	12 MOS			\$2,830.00	\$2,830.00
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	\$640.00	12 MOS			\$7,679.00	\$7,679.00
UNM Graduate Student Health	\$134.00	12 MOS			\$1,605.00	\$1,605.00
TOTAL DIRECT COSTS--					\$142,215.00	\$142,215.00
INDIRECT COSTS – 17.5%						
					\$23,544.00	\$23,544.00
TOTAL PROJECT/ACTIVITY COSTS FY16					\$165,759.00	\$165,759.00

FY 2016 Budget Summary

2016 Grand Total Curation of SJRRIP Specimen Collections \$47,312

2016 Grand Total Data Synthesis and Integration for SJRRIP Program \$89,005

2016 Grand Total Graduate Student GA \$29,541

Note: \$29,541 has been added to the budget for a Graduate Student Assistantship (salary, tuition and health insurance) to expand the data base for SJRRIP. This amount is charged to another source of funding (USBR) and not the SJRRIP. The duties of this GA are to sort and identify larval fishes collected from the Colorado River, Grand Canyon in order to understand fish species distributions in the Upper Colorado River Basin.