# FY 2020 SCOPE OF WORK

## TO

## BUREAU OF RECLAMATION

## FROM

New Mexico Department of Game and Fish
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## FOR

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

## REPORTING DATES:

10/01/2019 through 9/30/2020

## NEED

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

## GOAL

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

## MONITORING OBJECTIVES

The specific objectives for SBF monitoring include:

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

## STUDY AREA

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

Sampling in 2020 will occur from RM 180.6 (Animas River confluence) downstream to RM 52.7 (Mexican Hat, UT) (Figure 2). Lack of wild age-0 endangered fish captures after the implementation of the flexible sampling schematic indicates that sampling a set section of the San Juan River every year may be more beneficial for the continuality of long-term sampling. Additionally, no endangered fish have

ever been captured upstream of RM 180.6 during SBF monitoring. Sampling from RM 180.6 downstream to RM 52.7 will ensure the continuity of the long-term data set for Reaches 3 – 6 and also allow for the backwater at Lime Creek to be sampled on a yearly basis. Lime Creek has continually produced wild age-0 Colorado Pikeminnow and Razorback Sucker when sampled over the previous three years. The proposed section of river to be sampled will also cover the entire reach sampled during the Demographic Monitoring project. The spatial extent of area sampled could be expanded to include other areas on a yearly basis based on new evidence of increased endangered species presence in the areas above or below the sampling area.

## METHODS

Small-bodied fishes monitoring is designed to sample habitats which have the greatest likelihood of supporting age-0 large-bodied fishes and all age classes of small-bodied fishes. Sampling will occur at designated 3-mile intervals in the primary channel, and at all secondary (less than 20% of total flow) and zero velocity channels (i.e., backwaters and embayments; > 30 $m^2$) when encountered (SJRIP 2012). Sample reaches will be approximately 200 m long (measured along the shoreline) at primary channel sample sites and, depending upon the extent of surface water, 100 – 200 m long at secondary and zero velocity channel sample sites.

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

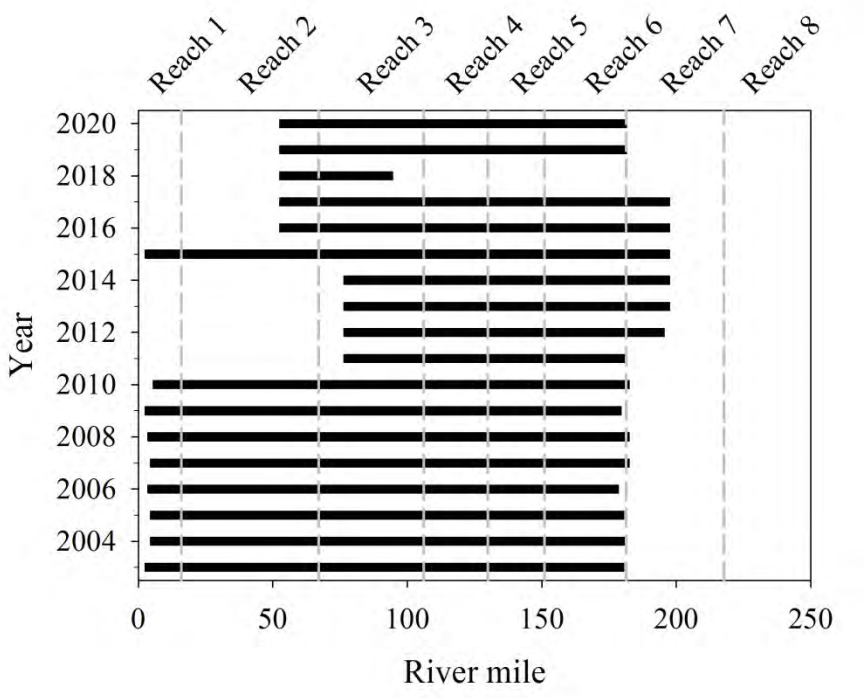


Figure 1. Spatial extent of sampling during small-bodied fishes monitoring on the San Juan River since 2003. The spatial extents of sampling in 2019 and 2020 are proposed. Note that river miles begin at the inflow of Lake Powel in Utah (River Mile 0) and end at Navajo Dam in New Mexico (River Mile 224).

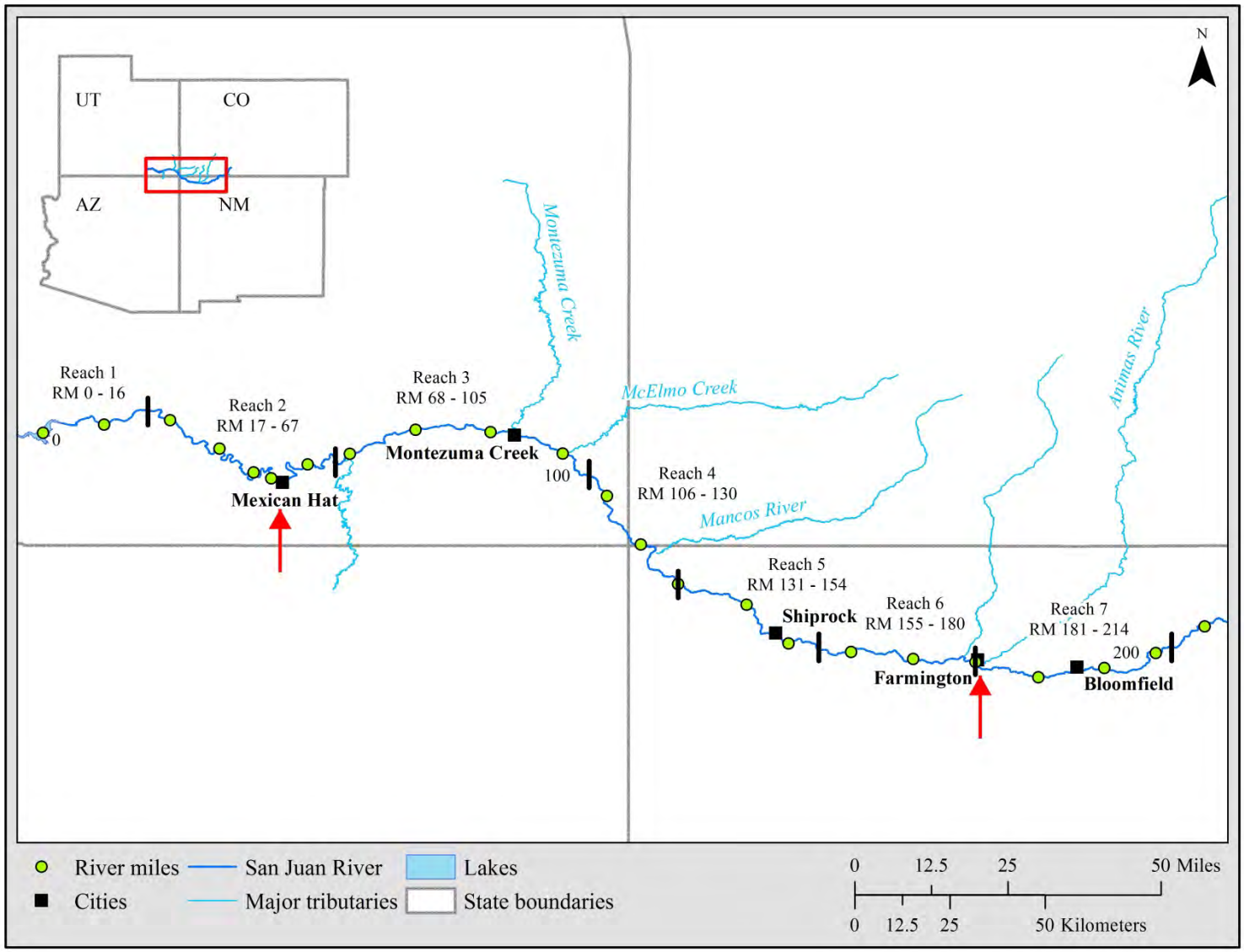


Figure 2. The San Juan River in New Mexico, Colorado, and Utah with river miles and geomorphic reaches indicated. The section between the red arrows will be sampled during 2020 small-bodied fishes monitoring (Animas River confluence downstream to Mexican Hat, UT). Inset indicates location of San Juan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

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

All captured fishes will be identified to species and enumerated. Small-bodied fishes (e.g., Fathead Minnow *Pimephales promelas*, Red Shiner *Cyprinella lutrensis*, and Speckled Dace *Rhinichthys osculus*) will be counted and up to 25 age-0 large-bodied fishes (e.g., Bluehead Sucker *Catostomus discobolus*, Channel Catfish *Ictalurus punctatus*, and Flannelmouth Sucker *Catostomus latipinnis*) in a single seine haul will be measured for total length (mm TL). Any captured endangered or rare species (i.e., Colorado Pikeminnow, Razorback Sucker, and Roundtail Chub *Gila robusta*) will also be weighed (g) and, if ≥ 130 mm, injected with a 12 mm PIT tag. All Colorado Pikeminnow will also be checked for a calcein mark. All native fishes will be released and nonnative fishes removed from the river. Fishes too small to easily identify in the field will be fixed in 10% formalin and returned to the laboratory.

After collection of fish, the sampled width and length of each mesohabitat is measured to the nearest 0.1 m and recorded. The depth and dominant substrate at five generalized locations, and any cover (e.g., boulders, debris piles, large woody debris) associated with the mesohabitat will also be recorded. Retained specimens will be identified and measured (TL and SL) in the laboratory to the nearest 0.1 mm and accessioned to the University of New Mexico Museum of Southwest Biology, Division of Fishes.

After data collection, all original field notes will be checked for errors and missing data. Data will be entered into Excel spreadsheets with a similar template as a project specific database. All entered data will be cross-checked with the original field notes by a different biologist. Data from the Excel spreadsheets will be imported into the database. Specific conditions for each data field in the database prevent the entry of incorrect data and typographical errors. Database queries will be used to identify and rectify any additional errors.

## DATA ANALYSIS AND REPORTING

Analyses will be based on density (i.e., catch-per-unit-effort, CPUE) of individual species, calculated by seine haul, as the number of fish captured per square meter sampled (width x length). To account for the significant number of zeros and highly skewed data, density for each species will be analyzed using a Delta-GLM approach which combines two separate components: (1) a logistic model estimating the probability of presence ($CPUE_{0/1}$) fitted using a GLM with a binomial distribution and logit link, and (2) a model for CPUE only when the species is present ($CPUE^{+}$) fitted using a GLM with a lognormal distribution (Fletcher et al. 2005; Acou et al. 2011; Vasconcelos et al. 2013). The predicted density, E(CPUE), is then obtained by (3) multiplying the response variables predicted by the binomial and lognormal models for each individual seine haul. This approach models the two aspects of the data (i.e., presence/absence and positive density) separately, allowing for evaluation of how covariates influence the two separate processes. Furthermore, the approach is much simpler and easier to interpret than other methods such as mixture models (Fletcher et al. 2005). Calculation of density will be limited to those species which have greater than 3% of all seine hauls (2003 – 2020) with at least one capture.

Several models using a combination of covariates will be used in both the logistic and positive lognormal model. Both abiotic and biotic covariates will be investigated for their use in each model (Table 1). The negative logliklihood from both models will be combined to calculate Akaike's Information Criterion with a correction for finite sample sizes ($AIC_c$). The combined model with the lowest $AIC_c$ will then be used to model the final binomial and lognormal models for each species. Residual plots will be examined to ensure that the final positive lognormal model meets the assumptions of normally distributed and equal variance residuals.

Final binomial, lognormal, and Delta-GLM models will be assessed for goodness-of-fit and predictive capability. The predictive accuracy for the binomial model will be tested using the Area Under the Curve (AUC) of the Receiver Operating Characteristic (ROC). The ROC analysis involves plotting the proportion of known presences predicted against the proportion of known absences predicted (Peterson et al. 2008). The values of the AUC of the ROC curve range from 0.5 to 1.0 with 0.5 indicating no fit and a 1.0 a perfect fit (Fielding and Bell 1997). For the positive lognormal and Delta-GLM models, a linear regression between observed (x-axis) and predicted (y-axis) CPUE will be used to test predictive ability. The coefficient of determination ($R^2$) of this relationship shows the proportion of the linear variation in y (predicted values) explained by the variation in x (observed values), the intercept of this linear regression model describes bias, and the slope describes consistency.

Data collected from the six RERI and the Phase II secondary channels will be reported for each year since these channels were restored. Information for the RERI and Phase II secondary channels will include if the channel was sampled, reasoning for why it was not sampled, and number of endangered, native, and nonnative species captured.

An annual report will provide a summation of data obtained in FY2020, a synthesis of data across years to document/assess species populations' trends, and a summary of mesohabitat associations. Separate data summaries and analyses will also be conducted for any wild age-0 CPM and RBS, if needed. All data collected will be recorded on electronic spreadsheets and provided to USFWS Program Office by the principal investigator, along with the annual final report, by 30 June 2021.

Table 1. Name and description of abiotic and biotic covariates which may be used in both the logistic and lognormal models to predicted expected density (E(CPUE)).

| Covariate Name | Description |
|---|---|
| sampYear | Year in which the sample was taken. |
| Reach | Geomorphic reach in which the sampled was taken. |
| RiverMile | The river mile where the sample was taken. |
| ChannelType | The channel type in which the sampled was taken. |
| Mesohabitat | The mesohabitat in which the sample was taken. |
| sampDis | Discharge at time the sample was taken. |
| NNC_1_Den | The density of nonnative competitors in the Reach where the sample was taken. Calculated as the total density of Fathead Minnows, Red Shiners, and Western Mosquitofish captured during annual small-bodied fishes monitoring. |
| NNC_2_Den | The density of nonnative competitors in the Reach where the sample was taken. Calculated as the total density of Channel Catfish, Fathead Minnows, Red Shiners, and Western Mosquitofish captured during annual small-bodied fishes monitoring. |
| NNC_3_Den | The density of nonnative competitors in the Reach where the sample was taken. Calculated as the total density of Channel Catfish captured during annual small-bodied fishes monitoring. |

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# FY 2020 Budget

## Sampling - Animas River to Shiprock, NM

Personnel

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

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

Per Diem

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

Vehicles

| | | |
|---|---|---|
| Round-trip to Shiprock, NM – 500 miles @ $0.55/mile | $ | 275 |
| **Sub-total** | **$** | **275** |

**Animas River to Shiprock Sampling Sub-total $ 12,032**

## Sampling - Shiprock, NM to Mexican Hat, UT

Personnel

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

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

| | | |
|---|---|---|
| Per Diem | | |
| 3 days @ $85/day (standard NM in-state rate) * 4 biologists | | $ 1,020 |
| 7 days @ $115/day (stanadard NM out-of-state rate) * 4 biologists | | 3,220 |
| | **Sub-total** | **$ 4,240** |
| Vehicles | | |
| Round-trip to Mexican Hat, UT – 800 miles @ $0.55/mile | | $ 440 |
| | **Sub-total** | **$ 440** |
| | **Shiprock to Mexican Hat Sampling Sub-total** | **$ 31,322** |
| **Field Equipment & Supplies** | | |
| Water quality instrument maintence 2 @ $400 | | $ 800 |
| Life Jackets 5 @ $60 | | $ 300 |
| Raft maintenance | | $ 500 |
| Whirlpacks (500) @ $50.00/per 500 | | $ 50 |
| Formalin (6 gal) @ $25/gal | | $ 150 |
| | **Sub-total** | **$ 1,800** |
| | **Sampling Sub-total** | **$ 45,154** |

**Specimen Management**

Personnel

*Tasks* - Processing (sorting, identification, and data-entry); 10 days of in the laboratory (8 hrs day) = 80 hours.

| | | |
|---|---|---|
| Project Biologist (1) | | |
| 80 hrs regular @ $38.24/hr ($27.91/hr (base salary) + $10.33 (benefits)) | | $ 3,059 |
| | **Specimen Management Sub-total** | **$ 3,059** |

**Data Management/Analysis and Report Preparation**

Personnel

*Tasks* – Data management and QA/QC, data analysis and synthesis, table and graph preparation, report drafting and revision; Project Leader (120 hrs) and one Project Biologist (200 hrs each).

| | | |
|---|---|---|
| Project Leader (1) | | |
| 120 hrs regular @ $47.73/hr ($34.84/hr (base salary) + $12.89/hr (benefits)) | | $ 5,728 |
| Project Biologist (1) | | |
| 200 hrs regular @ $38.24/hr ($27.91/hr (base salary) + $10.33 (benefits)) | | $ 7,648 |
| | **Data Management/Analysis & Report Preparation Sub-total** | **$ 13,376** |

**FY 2020 Total**

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