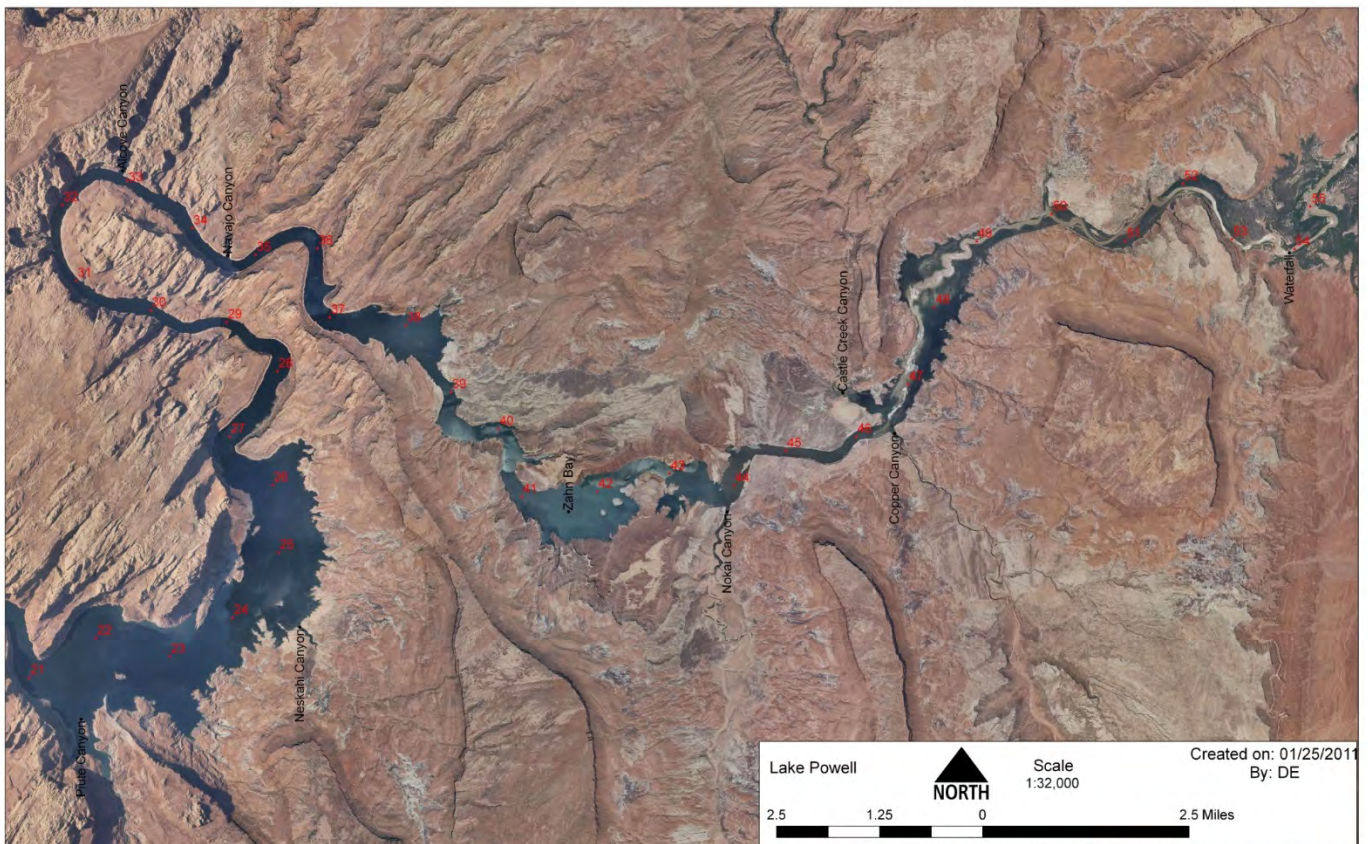


Scope of Work (FY 2020): Population size, mobility, and early life history of Razorback Suckers in the San Juan River – Lake Powell complex (BOR Award #R17AC00039)

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Background

Sampling efforts dating back to the 1980s in the San Juan River arm of Lake Powell have documented the occurrence of Razorback Sucker (*Xyrauchen texanus*). Between the 1980s and 2010, regular captures of Razorback Suckers have been made by different investigators and different sampling gears. In 2011 and 2012, Francis et al. (2015) conducted intensive surveys on the San Juan River arm of Lake Powell and captured 147 adult Razorback Suckers. Population estimations from samples in 2012 suggested a population size of 527 (239 – 1312) in the reservoir, but due to poor recapture rates and limited sampling of a large geographical area, these estimates are likely biased low and inaccurate. Furthermore, additional sampling in the Colorado River arm of Lake Powell has identified even greater numbers of Razorback Suckers, including many fish that use areas outside of the inflow area, suggesting that the lake may provide suitable habitat for adult Razorback Suckers. Indeed, Cathcart et al. (in prep) used a combination of remote PIT antennas and sampling to document the occurrence of over 499 Razorback Suckers below the San Juan River waterfall near Piute Farms in spring 2015 (hereafter termed Piute Farms Waterfall, Figure 1). The detection of these fish at the waterfall during 4 months in 2015 suggests a much larger number of fish are using this area, especially if 20-40% of Razorback Sucker are untagged (C. N. Cathcart and M. M. McKinstry, unpublished). Preliminary detection data from 2017 (February 11th-March 26th) show that 503 unique Razorback Suckers have been detected. Fish caught in the 1980s and 1990s were clearly wild fish, however, more recent captures of PIT tagged fish, indicate at least some of the Razorback Suckers in the river-reservoir habitat complex were stocked in the upper San Juan River and have dispersed downstream. However, a relatively large percentage of fish (i.e., 20 – 40%) captured in Lake Powell and in the river below the waterfall were not PIT tagged. Although this might be due to tag loss or fish that were never tagged prior to stocking, there is the potential for natural recruitment in the river-reservoir habitat complex.



Figure 1. Piute Farms Waterfall, Utah.

Given the uncertainty in the size of the population of Razorback Sucker in the river-reservoir habitat complex, potential for natural recruitment, and the seemingly high abundance of fish below the Piute Farms Waterfall, the overarching goals of this proposal are centered on hypothesized life history strategies of Razorback Sucker. Specifically, we hypothesize three potential life history strategies of Razorback Sucker in this river-reservoir complex. First, some Razorback Sucker are river-

residents that spawn in the San Juan River and offspring remain in the river and recruit to mature adults. Some are reservoir-resident that spawn in Lake Powell and offspring remain in the reservoir and recruit to mature adults. Finally, some are transient that would move between the river and reservoir if not impeded by the waterfall.

Specific objectives

- 1) Estimate adult population size of Razorback Sucker in the San Juan River – Lake Powell habitat complex.
 - a. This population might include transient and reservoir resident fish.
- 2) Determine the number of Razorback Suckers stocked in the San Juan River that move to Lake Powell and the San Juan River below the waterfall.
 - a. This would provide an estimate of the transient fish that are stocked.
- 3) Identify if spawning and recruitment of Razorback Sucker occurs in the San Juan River – Lake Powell habitat complex.
 - a. This would identify the ability of reservoir resident or transient fish to reproduce and recruit in this habitat complex.
- 4) Characterize movement behaviors of Razorback Sucker within the San Juan River – Lake Powell habitat complex and fish transplanted above the Piute Farms Waterfall.
 - a. By tracking the movement of tagged adults, we can classify them into one of the three different life history strategies.

Study Area, Access and Personnel Needs

Previous research has focused on the area between Piute Canyon and the Piute Farms Waterfall (Figure 2). A similar study area is proposed here. Because this area is extremely remote, the logistics of access will potentially limit sampling effort. However, recent efforts by USFWS, Utah DWR, BOR, and Kansas State University have provided evidence on the feasibility of working in this area. The Piute Farms Waterfall is accessed by dirt road and can serve as a base camp and/or boat launching site. Additionally, it may be possible to use the Clay Hills access to launch a boat that can be portaged over the waterfall. For sampling in Lake Powell and its



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

confluence with the San Juan River it is possible to launch a boat at Hall's Crossing and motor to the study area (~60 miles to Piute Canyon) or use an inflatable boat (e.g., Zodiac) to access the lake from the waterfall. It is likely that a combination of boat types and access will be necessary. Boats and motors necessary for field work are available through the Bureau of Reclamation, Salt Lake City office and are not requested here. Additionally, USFWS and Utah DWR are funded to assist in collections in the San Juan River arm of Lake Powell, and this effort will be tightly linked to the objectives of the proposed research.

One or two people funded on this project will help assist USFWS and Utah DWR with the lake sampling. A minimum crew of 3 people also will be present for sampling the river portion of the study reach. To ensure the safety of the field crews, they will be outfitted with satellite phones and we will develop contingency plans for exiting the study reach in the case of boat or motor failure. Two people (one graduate student and one research technician) that have extensive experience with boats and river sampling on the San Juan River and elsewhere have been identified for the project (Note, in response to feedback from the SJRBRIP).

Methods

Objective 1: Estimate adult population size of Razorback Sucker in the San Juan River – Lake Powell habitat complex

Surveys of the San Juan River arm of Lake Powell will be conducted by USFWS and Utah DWR with a combination of boat electrofishing and trammel nets (Francis et al. 2015) who are funded to continue their sampling efforts for Razorback Sucker in the San Juan River arm of Lake Powell. Crews from KSU will assist the USFWS and UDWR. The proposed sampling effort will coordinate sampling to maximize the number of fish marked and recaptured, leading to greater accuracy and precision in population estimates as well as tracking dispersal of marked individuals. To maximize efficiency, locations where large numbers of Razorback Suckers were previously located will be targeted (e.g., Spencer's Camp and Neskehi Wash). In addition, acoustic- and radio-tagged fish (see below) will be used to identify aggregations and spawning locations. Additional sampling at randomly-selected locations throughout the reservoir-inflow area will be used to identify other potential locations within this habitat complex. These random sampling locations will also help evaluate sampling location bias in Mark-Recapture population models (see below).

Surveys of the San Juan River between the Piute Farms Waterfall and the confluence with Lake Powell will be conducted with boat mounted electrofishing, seines, cast netting, trammel nets, and trap nets. We know from efforts in 2015 and 2016 that we are able to launch boats below the waterfall and the crew can be picked up in the reservoir with a large boat launched at Bullfrog Marina or Hall's Crossing. We estimate sampling this reach will take 2 days and we would be able to electrofish the entire reach.

Population estimates of Razorback Sucker between the waterfall and Piute Canyon in Lake Powell will be made in April/May 2020 using multiple mark and recapture models (i.e., multiple recapture events will occur within and across years; White and Burnham 1999). We will work closely with population modelers to identify the appropriate model structures to account for

potential bias in our sampling. Anticipated bias might include open population, random distribution of sampling effort, and sex biased capture probabilities. Given the previous success at recapturing large numbers of individuals, it is likely we will be able to obtain robust population estimates.

Objective 2: Determine the number of Razorback Suckers stocked in the San Juan River that move to Lake Powell and the San Juan River below the waterfall.

Through active capture methods (netting and electrofishing) and detections at PIT tag antennas, the number, composition (age, sex, size), and encounter history (stocked, captured and tagged) of both PIT-tagged and non-PIT tagged fish will be determined. To detect PIT tagged individuals, a remote PIT tag antenna (submersible type) was placed (February 2017) and will be maintained in the river-right eddy immediately downstream of the waterfall across seasons to assess seasonal detection patterns. Raft electrofishing will take place in early spring to capture adults used in telemetry and translocation experiments. We will also work closely with USFWS and UDWR crews sampling in the lake (described in Objective 1) to identify PIT tagged fish stocked upstream of the waterfall.

Objective 3: Identify if spawning and recruitment of Razorback Sucker occurs in the San Juan River – Lake Powell habitat complex

To identify if spawning and recruitment of Razorback Sucker occurs downstream of the Piute Farms Waterfall, sampling will be conducted in the riverine area downstream of the waterfall to Lake Powell. Similar to larval fish sampling efforts upstream of the waterfall (Farrington et al. 2015), low-velocity habitats will be opportunistically seined (3 m x 1.5 m x 0.8 mm) as they are available. Larval seines will be used to quantify density (number per unit area) of fishes in these habitats. We will measure the length of each seine haul, as well as the area and maximum depth of each habitat sampled (e.g., backwater). Light traps will also be used to passively capture larvae and identify potential spawning areas. All larval fishes will be preserved in 10% formalin for identification in laboratory conditions. Any identifiable native fishes will be measured for total length (TL, mm) and returned to their place of capture. Larval sampling will be conducted monthly from March to July as flows allow.

Concurrent with larval fish sampling, small-bodied fish sampling will take place at 3-mile intervals (Zeigler and Ruhl 2015) from downstream of the waterfall to upstream of the inflow area of Lake Powell. An additional sampling trip will be made in September or October to match the surveys in the river above the waterfall. Multiple pre-sampling scouting trips indicated that only low-velocity and primary channel, but no secondary channel, habitats occurred between the Piute Farms Waterfall and Lake Powell. Wadeable habitats will be sampled with a combination of seines (3 m x 1.5 m x 0.8 mm; 4.6 m x 1.8 m x 3.2 mm) depending on substrate. Pilot sampling suggests that smaller seines are more efficient when the substrate type is dominated by silt (C. Pennock, personal observation). As above, we will measure the length of each seine haul and record mesohabitats types sampled at each site. Additionally, five depth and substrate measurements will be taken at three representative transects along a site. Fishes will be identified to species, measured to TL and returned to their place of capture. Voucher specimens of juvenile

suckers, non-natives, and any unidentifiable fishes will be preserved in 10% formalin for identification in the laboratory. We will classify endangered individuals captured into recruitment classes defined as larvae, age-0 juveniles and age-1+ juveniles.

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

In spring 2016, 2017, 2018, and 2019 Razorback Suckers captured below the Piute Farms Waterfall were implanted with either 4-year acoustic-radio transmitters or PIT tags and released ~ 2 miles upstream of the Piute Farms Waterfall. In 2016, some fish were released near the Hogback Diversion. An additional 5 Razorback Suckers were captured near the Hogback Diversion and implanted with acoustic tags and released in the river. Movement of tagged fish is being tracked passively using SURs located throughout the San Juan River arm of Lake Powell as well as PIT antennas in the San Juan River between Mexican Hatt and the Hogback Diversion.

To characterize movement of tagged Razorback Sucker, similar methods will be used in 2020. Additional SURs will be maintained through coordination with USFWS and UDWR at the lower end of the study area (Piute Canyon, Lake Powell) and at least one other location in the reservoir (e.g., Neskahi Wash and the Great Bend area). SURs, PIT antennas, and active tracking of acoustic- and radio-tagged fish will be used to identify locations and movements of fish during various times of the year. Razorback Sucker will be located with a radio receiver followed by a combination of SURs and a directional hydrophone to identify unique tag codes. Active tracking trips will be conducted throughout the spring on a monthly basis as river flows allow. Data from prior tracking efforts (2016 – 2019) will help inform tracking efforts in 2020. Habitat use of fish in the reservoir and river as well as the number of fish that attempt to move upstream but are impeded by the Piute Farms Waterfall will help identify the percentage of fish that are lake residents, river residents, and fish that use both habitats (i.e., transient).

Deliverables

A draft final will be submitted to the Program Office by 31 March 2020 and a revision that includes responses to BC member comments submitted by 30 June 2020. All data will be submitted to the Program Office by 31 December 2020. An oral report will be given at the winter SJRIP Biology Committee (BC) meeting.

Data management

All field notes will be scanned and electronic files will be archived on a server at Kansas State University that has daily backups. All data will be entered in database format in spreadsheets and files stored on the KSU server. Every year we will provide PIT data to the SJRBRIP program office by 31 December.

Literature

Cathcart, C.N., C.A. Cheek, M.C. McKinstry, P.D. MacKinnon and K.B. Gido. In prep. Endangered fish conservation implications of a newly formed waterfall at a river-reservoir interface.

Farrington, M.A., R.K. Dudley, J.L. Kennedy, S.P. Platania, and G.C. White. 2015. Colorado Pikeminnow and Razorback Sucker larval fish survey in the San Juan River during 2014. Final Report. San Juan River Basin Recovery Implementation Program.

Francis, T.A., B.J. Schleicher, D.W. Ryden and B. Gerig. 2015. San Juan River Arm of Lake Powell Razorback Sucker (*Xyrauchen texanus*) Survey: 2012. Interim Progress Report (Draft Final), 10th February, 2015

White, G. C., and K. P. Burnham. 1999. [Program MARK](#): survival estimation from populations of marked animals. Bird Study 46 Supplement:120-138.

Zeigler, M.P. and M. Ruhl. 2015. Annual report small-bodied fishes monitoring San Juan River. San Juan River Basin Recovery Implementation Program.

Budget (FY 2020)

Period: Year 4 October 1, 2019 to September 30, 2020

<u>Task 1 Razorback Sucker use of the San Juan River below the Piute Farms Waterfall and San Juan Arm of Lake Powell</u>		
Task Description		Total
Task	Item	
Salaries		
Project PI: Advise student and coordinate graduate project	1 month	\$ 11,576
Graduate Student	1 year (0.5 FTE, 20 hrs/week)	\$ 31,603
Research Assistant	6 months	\$ 23,152
Fringe benefits		
Project PI	30.00%	\$ 3,473
Graduate Student	6.00%	\$ 1,896
Research Assistant	30.00%	\$ 6,946
Travel		
Field and meeting travel expenses	Per diem	\$ 2,284
	Lodging-Bluff, UT	\$ 1,750
	Vehicle mileage (mile; 2000 miles round trip Manhattan, KS to Bluff, UT and travel to field sites)	\$ 4,000
	Airfare (Manhattan, KS to Durango, CO)	\$ 1,000
Supplies		
Field Sampling Gear	Trammel net (Memphis Net and Twine)	\$ 2,404
	Sonic tags	\$ 13000
	Satellite phone subscription	\$ 123
Tuition (no overhead)		
Graduate Student Tuition and Fees-Spring	KSU Tuition and Fees for Graduate student course work (no overhead)	\$ 8,137
Total direct costs - Task 1		\$ 111,345
17.5% MTDC F&A		\$ 18,061
Total costs - Task 1		\$ 129,406

Budget Justification

Personnel – Each year, funds are requested to support one month of the lead PI (Gido) one month

summer salary and a (0.5 FTE) graduate research assistant. Funds are requested to support an experienced field assistant for 6 months to assist with field work and laboratory and data analysis when not in the field. Both the graduate research assistant and the field assistant will be skilled in boating and sampling large rivers.

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

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

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