CHANNEL CATFISH MANAGEMENT ON THE SAN JUAN RIVER, SUPPORT OF KSU DIET STUDY 2018-2019

FINAL REPORT

PREPARED FOR:

SAN JUAN RIVER BASIN RECOVERY IMPLEMENTATION PROGRAM

CHANNEL CATFISH MANAGEMENT ON THE SAN JUAN RIVER, SUPPORT OF KSU DIET STUDY 2018-2019

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SAN JUAN RIVER BASIN RECOVERY IMPLEMENTATION PROGRAM

BIOLOGY COMMITTEE

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EXECUTIVE SUMMARY

1. A total of 2,976 adult Channel Catfish were collected in 2018 from river miles 147.9 – 52 in 393.4 hours of electrofishing.

2. A total of 860 adult Channel Catfish were collected in 2019 from river miles 147.9 – 52 in 201 hours of electrofishing.

3. This project contributed a total of 3,632 Channel Catfish stomach samples to support the KSU diet study in 2018 – 2019.

4. Adult Channel Catfish CPUE was higher in both sections in 2018 compared to 2019.

5. Size structure of Channel Catfish was similar in both years of sampling, however there were far less large (>500 mm TL) fish captured in 2019.

6. A population estimate for adult Channel Catfish in 2018 was calculated at 56,224 individuals (95% CI; 45,352 – 69,920).

7. Estimated capture probabilities were highly variable and ranged from 0.00756 – 0.0285

8. Survival estimates could not be calculated using two years of data.

9. Twenty-one adult Colorado pikeminnow (> 450 mm total length) were collected during this study.

10. In 2018, there were 41 wild juvenile Razorback Sucker captured. One additional juvenile Razorback Sucker was captured in 2019. These fish ranged from 65 – 187 mm TL.

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INTRODUCTION

The establishment of nonnative fishes including Channel Catfish (*Ictalurus punctatus*) and Common Carp (*Cyprinus carpio*) has been identified as a detriment to the recovery of Colorado Pikeminnow (*Ptychocheilus lucius*) and Razorback Sucker (*Xyrauchen* texanus) (USFWS 2002a, b). Reducing the impacts of nonnative fishes has specifically been identified as a management element in the San Juan River Basin Recovery Implementation Program's Long Range Plan (SJRBRIP 2015). However, the level of threat that Channel Catfish pose on endangered fishes remains unknown. In the absence of rigorous evaluation, Channel Catfish are thought to pose a threat to native fishes in multiple forms such as: predation, competition for resources, and as a choking hazard to the piscivorous Colorado Pikeminnow. In an effort to quantify the threat nonnative fish pose to recovery, a study assessing the predatory effect of Channel Catfish on endangered fish was initiated in 2018. This study was designed to be conducted over a two-year period, 2018-2019.

On November 30, 2017, the San Juan River Basin Recovery Implementation Program (SJRBRIP) convened a nonnative fish workshop to discuss results from the modified management during 2016-2017 and to plot a course for future nonnative fish management efforts on the San Juan River. Several options were presented and ultimately agreement among the Biology Committee for one option was realized. It was determined that work in 2018 and 2019 would support efforts, as identified in Kansas State University's (KSU) SOW 18-26 *Incidence and consumption of endangered fishes by Channel Catfish (Ictalurus punctatus) in the San Juan River,* to quantify the predatory effects Channel Catfish have on the two endangered fishes in the San Juan River. All nonnative removal efforts would be focused on capturing Channel Catfish to collect stomach contents to boost the sample size for the KSU study. Additionally, it was determined that mark-recapture would be initiated for Channel Catfish to generate more precise population estimates, capture probabilities, and annual survival rates. Data from both stomach content analysis (i.e., percent predation) and abundance/survival estimates (number of predatory fish), when used in concert, will aid the SJRBRIP in the development of a future nonnative fish management program commensurate with the level of threat.

Objectives

1.) Collect stomach contents, in support of SOW18-26, to quantify predation on endangered fishes by Channel Catfish.

2.) Calculate capture probabilities and abundance estimates for Channel Catfish.

3.) Support SJRBRIP projects to estimate age-1 Colorado Pikeminnow abundance and ongoing calcein marking study of Colorado Pikeminnow (2018). This was not done in 2019.

Methods

Study Area

Sampling trips occurred from July 16 to September 2 during 2018 and from July 8 to August 8 during 2019. Sampling took place from Shiprock Bridge, New Mexico (River Mile (RM) 147.9) to Mexican Hat, Utah (RM 52). The New Mexico Fish and Wildlife Conservation Office (NMFWCO) was responsible for sampling from Shiprock Bridge, NM to Montezuma Creek, UT (RM 93.6) and Utah Division of Wildlife Resources (UDWR) sampled from Montezuma Creek to Mexican Hat, UT. Four sampling trips were conducted post spring runoff (July and August) in 2018 and three trips were completed in 2019. The timing of these trips was planned to be in concurrence when predation by Channel Catfish was presumably higher. Channel Catfish were collected using raft-mounted electrofishing. Two rafts sampled adjacent shorelines on each trip. Crews sampled 15 miles per day and stopped to work up fish every three miles. Trips were scheduled simultaneously to where both agencies were sampling their respective area at the same time

Tagging Protocol, Stomach Contents and Data Analysis

Channel Catfish ≥200 mm total length (TL) captured during the sampling efforts were fitted with an individual numerical T-bar anchor tag, implanted with a passive integrated transponder (PIT) tag and released back to the river. Double tagging of fish will minimize issues of under estimating capture probabilities or over estimating abundance due to tag loss between sampling periods. Tag data, total length (mm) and mass (grams) were recorded from all recaptured Channel Catfish. Any newly captured, untagged Channel Catfish collected during sampling effort was double tagged under the aforementioned tagging protocol except during the last trip of the sampling season. During the fourth trip of 2018 and the third trip of 2019, all Channel Catfish that were not tagged at time of capture were removed from the river. All recaptured Channel Catfish collected on the last trip of the sampling season were released back in to the river to obtain over-winter survival estimates. All Channel Catfish <200 mm TL captured during any trip were removed from the river.

All Channel Catfish ≥300 mm TL collected on all trips had stomach contents removed using a nonlethal pulsed gastric lavage procedure (Waters et al. 2004). Stomach contents were preserved per KSU protocol and provided to KSU for lab analysis (Hedden et al. in press). Channel Catfish with stomach contents too large to be removed through pulsed gastric lavage were sacrificed and stomachs were removed and preserved. Professional judgement and expertise

was used in determining when this was necessary. All mortalities that occurred prior to the last trip were excluded from the mark-recapture analysis to avoid biasing estimates of capture probability and abundance.

Closely timed multi-pass electrofishing surveys enabled the calculation of annual population estimates and capture-recapture probabilities using closed population models in program MARK (White and Burnham 1999). Closed population models assume no changes in abundances occur from births, deaths, immigration, and emigration. These are reasonable assumptions given that our analysis included only fish ≥200 mm TL, trips occurred during a six week time frame and at a time of year when mortality of adult fish is low. Data was transcribed and converted from a long format to short format encounter histories that detail whether an individual fish was encountered or not during each sampling trip. Using the encounter histories, three closed capture population models were constructed: a constant-capture model with unchanging capture probability (M_0), a time-dependent model with capture probabilities that vary by sampling trip (M_t), and a behavioral model with separate probabilities for initial capture and recapture (M_b). Model selection was made using AIC_c, the top model chosen had the lowest AIC_c of all candidate models, and all models within 2 ΔAIC_c of the top model were considered as likely candidate models (Burnham and Anderson 2002).

Rare Fishes Captures

During sampling, only certain size classes of Colorado Pikeminnow and Razorback Sucker were collected. In 2018, all age classes of Colorado Pikeminnow were collected. Age-1 Colorado Pikeminnow, ≥130 mm TL, were collected to implant PIT tags and to support the calcein marking study initiated on newly stocked Colorado Pikeminnow in FY 2018. Based on data analysis that showed apparent detrimental effects of capture events on age-1 Colorado Pikeminnow survival (Clark et al. 2018), the SJRBRIP decided to limit the capture of Colorado Pikeminnow during 2019 Channel Catfish sampling. In 2019, only Colorado Pikeminnow bigger than 150 mm TL were collected. Only Razorback Sucker <300 mm TL were netted in 2018 and 2019. With new stocking protocols to only stock Razorback Sucker greater than 300 mm TL, it is assumed any Razorback Sucker captured less than 300 mm TL would be a wild fish. Tag number, length, and mass were recorded for all fish captured and if a fish was lacking a detectable tag, it was implanted with a new PIT tag before being released.

Results

In support of the KSU diet study, the New Mexico Fish and Wildlife Conservation Office and Utah Division of Wildlife Resources collected 2,781 Channel Catfish stomachs samples (2,519 containing gut contents) during 2018 and 851 Channel Catfish stomach sampled were

collected (777 containing gut contents) during 2019. Catch Per Unit Effort (CPUE; fish per hour of electrofishing) was calculated for each trip within year in each sampling section. Catch rates for adult Channel Catfish were similar in both sections within years. Catch rates in 2018 for the NMFWCO section were 7.6 fish/hr and 8.0 fish/hr in the UDWR section. Lower catch rates were observed in both sections in 2019, 4.4 fish/hr in NMFWCO section and 4.1 fish/hr in the UDWR section. The hydrograph of the San Juan River indicates that higher flows occurred in 2019 compared to 2018 (Figure 3). Population size structure of sampled Channel Catfish was similar during 2018 and 2019 (Figures 1 and 2). However, fewer large fish were captured in 2019, with 109 Channel Catfish ≥500 mm TL captured in 2018 and 13 Channel Catfish ≥500 mm TL captured in 2019. Lengths of captured Channel Catfish varied from 40 – 720 mm TL in 2018 and 20 – 560 mm TL in 2019.

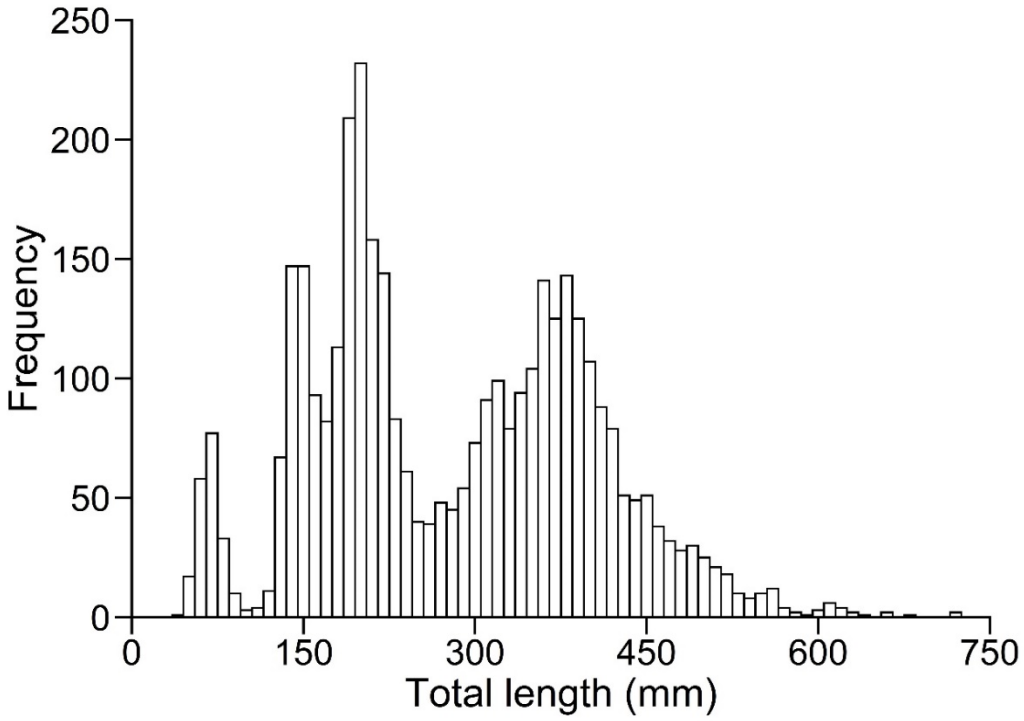

Figure 1. Length frequency histogram of Channel Catfish captured during 2018 diet study support trips.

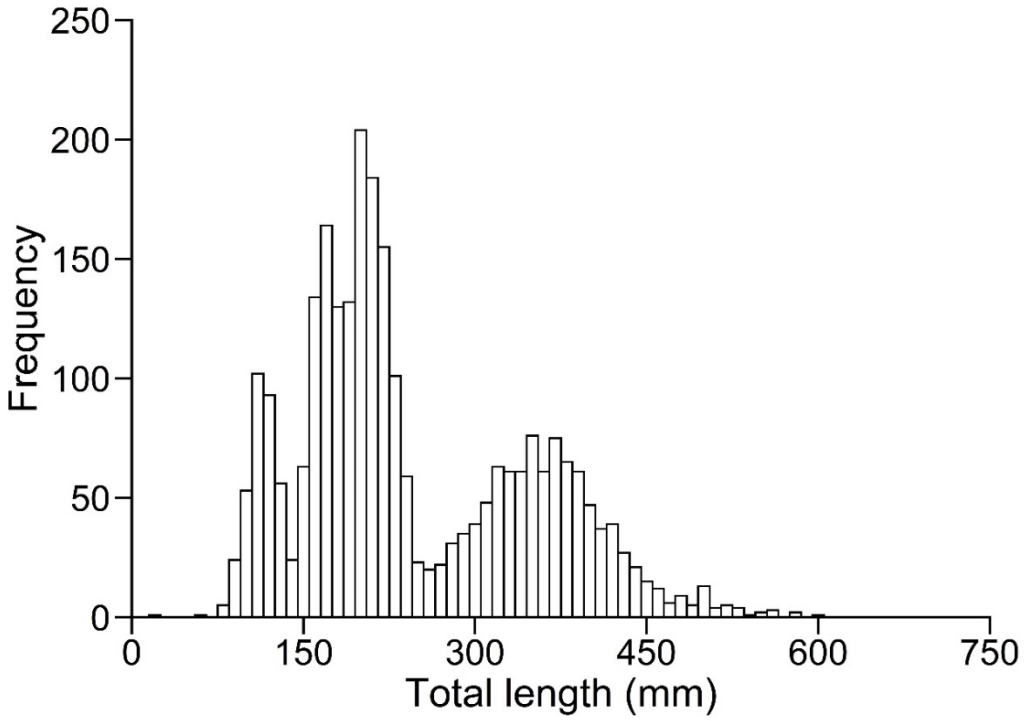

Figure 2. Length frequency histogram of Channel Catfish captured during 2019 diet study support trips.

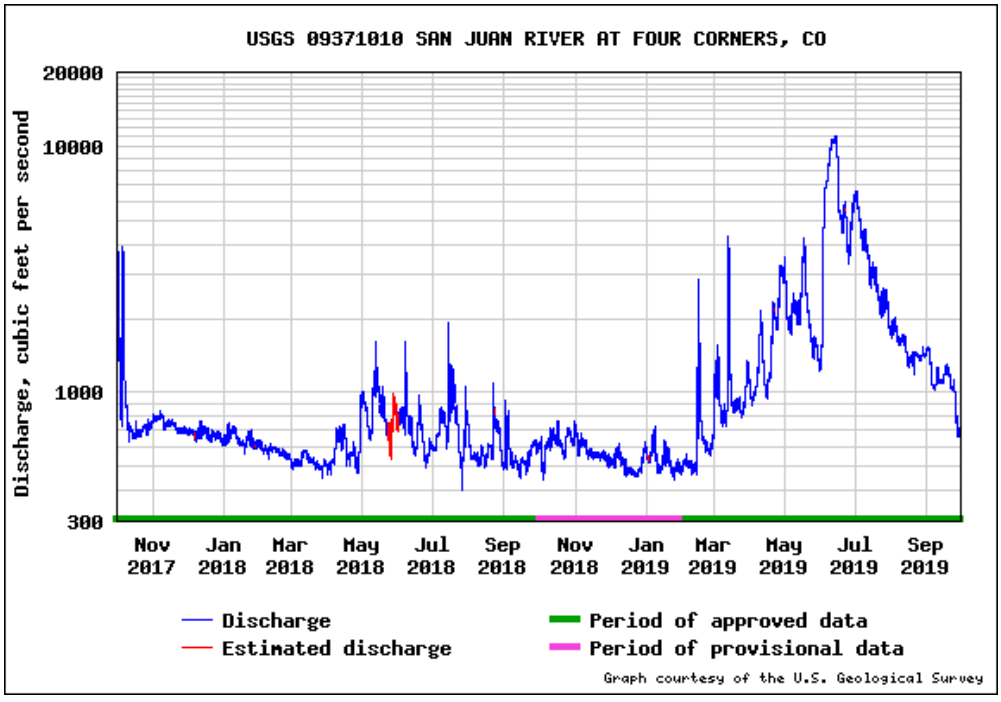

Figure 3. Hydrograph of San Juan River at Four Corners bridge during the 2018 and 2019 water years. Graph and data provided by USGS.

During 2018, 3,488 Channel Catfish ≥200 mm TL were sampled within 3,562 capture events (Table 1). The top model for the 2018 data was a time-varying capture probability model. This model had clear support as the top model with an AIC_c weight of 1.000 and no other models within 2 ΔAIC_c (Table 2). Estimated capture probabilities were highly variable and ranged from 0.00756 – 0.0285 (Table 3). Abundance from the top model was estimated as 56,224 adult Channel Catfish, with 95% confidence intervals ranging 45,352 – 69,920. Capture rates in 2019 were much lower than capture rates in 2018. These low capture rates resulted in a low number of encounter histories, and encounter histories that were depauperate. As a result, the model parameterization process produced biologically unrealistic results and Program MARK issued error messages indicating issues with model parameterization. Therefore, the capture probabilities and abundance estimates from 2019 data were excluded from this report.

Table 1. Encounter histories for all adult Channel Catfish captured during 2018. Each encounter history indicates whether a fish was captured for each trip. For a given individual's encounter history, a one indicates a capture and a zero indicates no capture. The order of digits in an encounter history indicate capture events, with trip dates in chronological order from left to right.

Encounter History	**Count**
1000	406
0100	598
0010	1546
0001	862
1100	2
0110	23
0011	23
1001	6
1010	11
0101	10
0111	1
1110	0
1101	0

1011	0
1111	0

Table 2. Model name, AIC_c, ΔAIC_c, and model weight for adult Channel Catfish abundance models generated from data collected in 2018

Model	**AIC_c**	**ΔAIC_c**	**AIC_c Weight**
M_t	-40,302.75	0.00	1.0000
M_b	-39,487.93	814.82	0.0000
M_0	-39,449.59	853.16	0.0000

Table 3. Capture probabilities, SE, and 95% confidence intervals for top adult Channel Catfish abundance model

Sample period	**Capture Probability**	**Standard Error**	**95% Confidence Interval**
1	0.00756	0.000914	0.00596–0.00958
2	0.0113	0.00133	0.00895–0.0142
3	0.0285	0.00324	0.0228–0.0356
4	0.0160	0.00186	0.0128–0.0201

Endangered fishes were captured during this study when they were appropriate lengths to meet sample criteria. During the study, a total of 42 Razorback Sucker were captured and 22 were implanted with a PIT tag (Table 4). These wild Razorback Sucker varied in length from 65 – 187 mm TL. During the study, a total of 147 Colorado Pikeminnow were captured, including 101 that were implanted with a PIT tag and 41 that were recaptured from separate tagging occasions (Table 4). There were 21 individual adult Colorado Pikeminnow collected during the two-year sampling efforts.

Table 4. Endangered fish species, year, and numbers captured, tagged, and recaptured during 2018 and 2019.

Species	Year	Number Captured	Number Tagged	Number Recaptured
Razorback Sucker	2018	41	21	0
	2019	1	1	0
Colorado Pikeminnow	2018	90	68	21
	2019	57	33	20

Discussion

While the control of nonnative fishes has become an increasingly important management action, the exact level of threat that Channel Catfish pose on endangered fishes was unknown. In the absence of rigorous evaluation, a two-year study assessing the predatory effect of Channel Catfish on endangered fishes was initiated in 2018. The purpose of this project was to support Kansas State University by collecting stomach samples to boost the sample size of their study, as well as calculate abundance estimates, capture probabilities, and survival estimates for Channel Catfish. This report focuses on the findings and results of sampling conducted under our scope of work and will not focus on the diet content analysis results from KSU.

By implementing this project to support the KSU diet study we were able to add 3,632 stomach samples to the KSU diet analysis. Due to a budget reallocation for an endangered fish demographic monitoring project, one trip was removed from the 2019 sampling effort. Even with one less trip in 2019, the total number of Channel Catfish collected was quite a bit lower in 2019 compared to 2018. Catch per unit effort in 2019 was almost half of CPUE values observed in 2018. While CPUE is often used as an indicator of abundance, other factors can drive changes in CPUE. Environmental variables influence CPUE and represent a potential explanation for the differences in CPUE observed in this study (Chifamba 2000). Low captures in 2019 precluded the estimation of reliable capture probability and abundance parameter. Environmental factors that vary year to year such as discharge and temperature may influence CPUE and bias abundance estimates. San Juan River Basin runoff was below normal in 2018 and above normal in 2019, and this resulted in lower discharge and higher temperatures during 2018 and higher discharge and lower temperatures in 2019. These differences in environmental variables are likely to explain the differences in CPUE observed rather than changes in abundance. Many years of widespread targeted Channel Catfish removal on the San Juan River did not significantly reduce abundance (Pennock et al. 2018) and Channel Catfish have not been intensively removed in the San Juan River since 2017.

The top abundance model did not include separate parameters for capture and recapture probabilities, indicating there is no behavioral response associated with prior capture such as attraction or avoidance. There was minimal support for an abundance model with a capture probability that remains unchanged from one trip to the next, indicating that environmental or capture factors drive changes in capture probabilities. Capture probabilities estimated for the top abundance model were highly variable between sampling trips. This research project occurred during summer monsoon season, when turbidity is highly variable depending on recent precipitation. Increases in turbidity often decrease catch rates when visibility declines. Thus, the high variability observed in capture probabilities may have been driven by fluctuations in turbidity. Survival estimates could not be calculated using two years of data, however using data from the FY20 Channel Catfish sampling during the winter, we hope to gather enough data to be able to calculate survival estimates.

The purpose of this project was to support data collection for a diet study and estimate population abundance of Channel Catfish in the San Juan River. Endangered fish sampling was not a primary focus, however, capture and marking of endangered fishes provides useful data to evaluate SJRBRIP recovery goals. Thus, we conducted opportunistic sampling of Razorback Sucker and Colorado Pikeminnow during this project. During sampling in both years of the project we captured wild juvenile Razorback Sucker with the majority being collected in 2018. In addition, sampling efforts for other projects captured wild juvenile Razorback Sucker during 2018. This marked the greatest documentation of successful wild recruitment from egg to juvenile life stage in the San Juan River since recovery activities began.

When used in conjunction with the KSU diet study, this project will help inform future management decisions regarding Channel Catfish removal and endangered fishes augmentation on the San Juan River. By quantifying the predation threat for endangered fishes at a population level, this study will help determine the magnitude of future Channel Catfish removal efforts, and possible augmentation strategies that minimize Channel Catfish consumption of endangered fish.

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