

Channel Catfish Management on the San Juan River

Prepared by

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Overview

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, an ongoing two-year study assessing the predatory effect of Channel Catfish on endangered fishes was initiated in 2018.

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. It was determined that work in 2018 and 2019 by the New Mexico Fish and Wildlife Conservation Office (NMFWCO) and Utah Division of Wildlife Resources (UDWR) 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. Additionally, it was determined that mark-recapture would be initiated for Channel Catfish to generate more precise population estimates, detection 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.

Preliminary results after the 2018 sampling by the NMFWCO and UDWR, estimated the adult Channel Catfish population in the sampling area at 19,177 (15,279 – 24,218) individuals. In 2018, 3,438 adult Channel Catfish stomachs were evaluated for contents by KSU, of which 7.6% contained identifiable fish (Hedden et al. 2019). Of those fish identified in Channel Catfish stomachs, 51.88% were native fish, with two being Colorado Pikeminnow. Even with the low occurrence of Colorado Pikeminnow found in Channel Catfish stomachs, a high adult Channel Catfish population could still have a detrimental effect on juvenile Colorado Pikeminnow survival. Piscivory rates ranged from 5% to 25% in the summer months with the highest occurring in mid-July. KSU also estimated Channel Catfish biomass in the San Juan River using the 2018 population estimate, Channel Catfish size structure, and length-weight relationship. In

addition, the biomass of each prey species was estimated. Sky Hedden of KSU estimated the biomass of fish consumed = 16.73 grams (g) wet fish weight per 100 g catfish x San Juan River Channel Catfish biomass. He estimated that 12,040 grams of Colorado Pikeminnow were consumed in 2018 by Channel Catfish, which would equate to an average of 611 (0 – 1,783) Colorado Pikeminnow individuals. He also estimated that removing 25% of the Channel Catfish population annually would potentially result in 3,114 g of Colorado Pikeminnow biomass from being not being consumed by Channel Catfish, which would result in an estimated additional 158 (0 – 461) Colorado Pikeminnow surviving annually due to mechanical removal of adult Channel Catfish.

Until a detailed review of the data from the two-year diet study is completed to aid the SJRBRIP in the development of a future nonnative fish management program, we are proposing a concentrated effort of nonnative removal focusing on removing large adult Channel Catfish from the San Juan River during winter months when flows and turbidity are low, maximizing efficiency and sampling conditions. Previous years data has shown that raft-mounted electrofishing in the San Juan River is negatively impacted by turbid water, usually caused by rain events causing sand washes to flood in to the river increasing turbidity and resulting in lower catch rates for Channel Catfish due to limited visibility in the water. Higher flows make it harder for netters to effectively capture Channel Catfish due to the raft moving too fast downstream as Channel Catfish are in full electro taxis and take longer to float to the surface of the water. Sampling during winter months should result in more desirable sampling conditions as flows and turbidity should be low and more predictable.

Objectives

- 1.) Conduct a marking pass to tag fish in order to quantify annual exploitation rates and population estimates of adult Channel Catfish.
- 2.) Mechanically remove adult Channel Catfish during winter to maximize sampling efficacy.

Methods

Study Area

Sampling will take place from Four Corners Bridge (River Mile 119) to Sand Island, Utah (River Mile 76). One marking pass and three sampling trips will be conducted during the winter months (November – March) when sampling conditions are optimal to maximize sampling efficacy of collecting adult Channel Catfish. Trips will only be conducted when flows are less than 1,000 CFS and turbidity is low (>250mm Secchi disk).

Tagging Protocol

Channel Catfish ≥ 300 mm total length (TL) captured during the marking pass will be fitted with an individual numerical T-bar anchor tag and implanted with a Passive Implant Transponder (PIT) tag and released back to the river. Tag data, length (mm) and mass (grams) will be recorded for every tagged fish. Tagging of Channel Catfish will allow us to generate exploitation rates during the sampling period as well as generate Lincoln-Peterson population estimates.

All Channel Catfish ≥ 300 mm TL captured on the subsequent three sampling trips after the marking pass will be removed the river. All fish will be measured to the nearest millimeter for total length, weighed to the nearest gram, and examined for a tag before being removed from the river. As the main focus of this project is removing large predatory adult Channel Catfish from the San Juan River, due to the timing of the trips and the geomorphic reach, we do not expect to see large numbers of juvenile Channel Catfish during these sampling trips, however if juvenile Channel Catfish or any other nonnative fish is observed, they will be collected and removed from the river.

Rare Fishes Captures

Due to the demographic monitoring of Colorado Pikeminnow and Razorback Sucker already taking place in the fall on the San Juan River, rare fishes will not be collected during nonnative removal efforts.

Deliverables

Data will be entered, analyzed, and presented to the SJRIP Biology Committee at a workshop following the field season. A draft report will be submitted to the Program Office by 31 March 2020 and a final report will be completed by 1 June 2020. All data will be submitted to the Program Office by 31 December 2020.

Budget

FY 2020 Budget

Nonnative fish removal - 4 trips, Four Corners Bridge, UT to Sand Island, UT. NMFWCO supplying 5 people per trip

Labor Cost - Field Work (4 trips x 5 days/trip)

<u>Position</u>	<u>Grade/Step</u>	<u>Hourly Rate</u>	<u>Fringe</u>	<u>Salary w/benefits</u>	<u>Hours/Day</u>	<u>Total Days</u>	<u>Sub-Total</u>
Supervisory Fish Biologist	GS 12/7	\$43.09	29.51%	\$59.48	9	20	\$10,706.40
Fish Biologist	GS 11/7	\$35.95	25.57%	\$47.75	9	20	\$8,595.00
Fish Biologist	GS 9/7	\$29.71	26.46%	\$39.92	9	20	\$7,185.60
Remote Biologist	GS 9/2	\$25.59	25.16%	\$33.74	9	20	\$6,073.20
Biological Tech	GS 5/1	\$16.34	7.11%	\$17.55	9	20	\$3,159.00

Overtime Hours (weekend or >9 hour work days)

Fish Biologist	GS 9/7	\$40.91	26.46%	\$51.73	3	12	\$1,862.28
Remote Biologist	GS 9/2	\$37.14	25.16%	\$46.48	3	12	\$1,673.28
Biological Tech	GS 5/1	\$24.51	7.11%	\$26.25	3	12	\$945.00

Administrative, Reporting, Planning

Fish Biologist	GS 9/7	\$29.71	26.46%	\$39.92	9	20	\$7,185.60
Remote Biologist	GS 9/2	\$25.59	25.16%	\$33.74	9	20	\$6,073.20
Supervisory Fish Biologist	GS 12/7	\$43.09	29.51%	\$59.48	9	5	\$2,676.60
Administrative Officer	GS 9/9	\$31.36	26.18%	\$42.22	9	2	\$759.96

Total Labor	\$56,895.12
FY20 3% increase	\$1,706.85
Total FY20 Labor	\$58,601.97

<u>Travel and Per Diem</u>	<u>Days</u>	<u>Rate</u>	
Hotel Costs	16	\$94.00	\$1,504.00
Per Diem (Travel Day)	40	\$41.25	\$1,650.00
Per Diem (Full Day)	60	\$55.00	\$3,300.00
			Total Travel/Per Diem \$6,454.00

<u>Equipment</u>	<u>Miles/Qty</u>	<u>Total Miles</u>	<u>Rate</u>	
Floy Tags	2000		\$0.70	\$1,400.00
Vehicle Fuel				
3 trucks X 4 trips - ABQ to Sand Island, UT 574 mi RT	574	6,888	\$0.58	\$3,995.04
Generator Fuel	120		\$2.85	\$342.00
30 gallons/trip x 4 trips				
Maintenance, repair, replace (i.e. life jackets, waders, generator repair, dip nets, etc.)				\$3,000.00
				Equipment Total \$8,737.04

Sub-total for 3 trip pop est. - NMFWCO	\$73,793.01
USFWS Administrative Overhead (3%)	\$1,913.92
Total for 3 trip pop est. - NMFWCO	\$75,706.94

Literature Cited

Hedden, S. and K. Gido. 2019. Incidence and consumption of endangered fishes by Channel Catfish (*Ictalurus punctatus*) in the San Juan River. Kansas State University. Unpublished data.

San Juan River Basin Recovery Implementation Program. 2015. Long-range plan. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

U.S. Fish and Wildlife Service. 2002a. Colorado pikeminnow (*Ptychocheilus lucius*) Recovery Goals: amendment and supplement to the Colorado Squawfish Recovery Plan. U.S. Fish and Wildlife Service, Mountain-Prairie Region (6), Denver, Colorado.

U.S. Fish and Wildlife Service. 2002b. Razorback sucker *Xyrauchen texanus* Recovery Goals: amendment and supplement to the Razorback Sucker Recovery Plan. U.S. Fish and Wildlife Service, Mountain-Prairie Region (6), Denver, Colorado.

Response to Comments

Scope #	Project	PI(s)
17	SOW-17-Channel Catfish management on the San Juan River	Duran, NMFWCO

Harry Crockett, Colorado DNR, BC member

How can the technical aspects of this SOW be improved?

No recommendations.

What is this SOW's contribution to recovery?

Remains a subject of debate within the BC, but the *preliminary* diet study data presented last year suggests that removing catfish, especially larger sizes, could at minimum give the endangered fish a short-term leg up. Support continuing until the KSU diet study is finalized & then reevaluate.

Vince Lamarra, Navajo Nation, BC member

How can the technical aspects of this SOW be improved?

Winter catfish removal seems valid given the environmental conditions (low and stable flows and increased water clarity).

What is this SOW's contribution to recovery?

I support the project in that we need some level of adult catfish removal given that it is one cause of rare fish declines in the San Juan River.

Jacob Mazzone, Jicarilla Apache Nation, BC member

How can the technical aspects of this SOW be improved?

I am not in favor of just netting one target species and size, it leads to complacency. If the target fish is 300mm or greater Channel Catfish than those should be top priority, but if the netter is not saturated, all fish should be netted, and all catfish/non-natives regardless of size should be euthanized. Especially as the PI stated juvenile target species numbers should be at low density at the time of sampling. **All nonnative fish will be netted and removed. Collections of Common Carp and other nonnatives are relatively low and should not affect netter from effectively netting Channel Catfish.**

What if a weather event hits half way through the trip? There is no easy way to conduct multiday trips in optimal conditions, if turbidity rises during a trip, the majority of the costs have already been incurred, do you continue in bad conditions or take out asap? It seems, shorter, less logistically intensive trips might be easier to maneuver around inclement weather/turbidity/flows/etc. **Since the trips will be three days long, I feel that using eyes on the ground (remote biologist) and weather predictions should allow us to complete a trip in optimal**

sampling conditions. If a flash occurs that increases turbidity, we will cease sampling until the river returns to favorable sampling conditions.

What is this SOW's contribution to recovery?

By removing large-bodied Channel Catfish, one could presumably create a recruitment “window” for stocked Colorado Pikeminnow. By removing larger bodied fish the reproductive capacity, and size structure of the population might be impacted in the short term. This scopes contribution to recovery is unknown, and often debated. Maybe this is an annual, or triennial “maintenance” type activity? **That will be for discussion by the BC once the diet study is complete. This SOW could help guide future nonnative management actions if the shift to winter sampling results in higher exploitation rates.**

Mark McKinstry, BOR, BC member

How can the technical aspects of this SOW be improved?

The SOW states that “Channel Catfish biomass in the San Juan River was estimated using the 2018 population estimate, Channel Catfish size structure, and length-weight relationship. In addition, the biomass of each prey species was estimated. It is estimated that 12,040 grams of Colorado Pikeminnow were consumed in 2018 by Channel Catfish, which would equate to an average of 611 Colorado Pikeminnow individuals.” Are these figures correct? Seems like what Sky presented at BC meeting the number was in 500's??? **The number I got from Sky's presentation was 611(0 - 1,783) individuals.**

I think all catfish released as part of marking trip should get both floy and PIT tag. Marking catfish is cheap and we may get more information about movements when we either recapture them or detect them on antennas. The more PIT tagged fish the better in my mind. **Great suggestion. I will make the change in the SOW and we will floy and PIT tag catfish during the marking pass.**

What is this SOW's contribution to recovery?

Removal of CCF during periods of low flow and low turbidity COULD increase efficiency and exploitation rates. If we decided to continue NNF removal this would be very useful for effective use of time and money. **Agree**

Bill Miller, Southern Ute Indian Tribe, BC member

How can the technical aspects of this SOW be improved?

The SOW is clear that the objective is to remove adult Channel Catfish and provide data needed for estimating populations. The sampling is proposed to occur from November through March. The impact of cold water temperatures on electrofishing efficiency is not stated in the SOW. Has electrofishing been conducted after November and before March (e.g December, January) that would show whether the effort during those months would be successful. It may be more productive to concentrate the trips during the warmer times of the

proposed time frame in November and March. **Based on my observations during February 2018 sampling in freezing temperatures and the large number of adult Channel Catfish collected I feel sampling during winter months will be successful.**

What is this SOW's contribution to recovery?

The SOW continues a management action that addresses a stated threat to recovery.

David Mueller, BLM, BC member

How can the technical aspects of this SOW be improved?

If Common Carp are also found to be a detriment to recovery, are they being removed as well? The data presented at the end of Nov suggested that Channel Catfish were opportunistic, with piscivory focused on prey slightly smaller than the individual, mainly other Channel Catfish. The data also suggested that removal did not alter abundance, but instead altered the age class structure. My concern is that targeted removal of large Channel Catfish will result in more small individuals that would in turn, target smaller individuals, possibly native species. I agree with effort being targeted towards the time/location where the most success will occur of removing all detriments to recovery and further informing the degree of threat and if removal is actual having a significant impact. **Yes, Common Carp are removed as well, however collections of Common Carp have become infrequent. While Channel Catfish did prey upon other catfish, 32% of the fish consumed were native fishes with an average total length of 110 mm.**

What is this SOW's contribution to recovery?

This will further inform the degree of threat from nonnative fishes and somewhat mitigate that threat from removal of individuals

Ben Schleicher, USFWS R6, BC member

How can the technical aspects of this SOW be improved?

Does existing data show that there are large fish in the section from Shiprock Bridge to Sand Island in the spring or winter? In past years when NNR was starting early, catfish were hard to find the first 24 miles. There are known "hot spots" for catfish that exist below Sand Island as well. **Based on sampling trips by KSU in February 2018 and the adult monitoring sampling that took place from Shiprock Bridge, NM to Clay Hills, UT in March 2019, adult Channel Catfish were observed in higher densities from Four Corners Bridge to Sand Island.**

What is this SOW's contribution to recovery?

If large catfish are a threat to small bodied native fish then removal of this threat would be the most direct way to aid in recovery.

Tom Wesche, Water Development Interests, BC member*How can the technical aspects of this SOW be improved?*

Based on past experience, the PI should be able to propose sampling on a set number of river miles where success may be likely. Also, some additional discussion of the efficacy of winter sampling would be helpful. While it true that low flow and clear water conditions should be helpful, the inactivity of the fish at this time of year may affect their catchability. Has the Program made past winter fish collections that would substantiate the benefits of winter collection?

Sampling will take place from Four Corners Bridge (RM 119) to Sand Island, UT. (RM 76). Based on recent sampling by KSU in February 2018 and the adult monitoring sampling that took place from Shiprock Bridge, NM to Clay Hills, UT in March 2019, fish inactivity did not seem to affect catch rates of Channel Catfish in the areas proposed for sampling in this SOW. This SOW would help answer some of the unknowns about winter sampling efficacy and help guide future nonnative fish management actions.

What is this SOW's contribution to recovery?

Until the KSU Diet Study is completed and reviewed, the contribution of this SOW to recovery is a lower priority when compared to other SOW's being reviewed. I recommend it be held back until more is known about channel catfish effects on the endangered fish. When the KSU diet study is completed, it will be two years of not doing any nonnative removal in the San Juan River. While the second year of data will help the Program decide on future nonnative fish management, nonnative removal at some level should be completed in FY20. Removing adult Channel Catfish in the winter of 2019 could potentially aid in the survival of juvenile Colorado Pikeminnow and Razorback Sucker overwinter.

Brian Westfall, BIA, BC member*How can the technical aspects of this SOW be improved?**What is this SOW's contribution to recovery?*

With all the question on the need and effectiveness of NN removal to the recovery of CPM and RBS this should be at the bottom of the list.

Matt Zeigler, NMDGF, BC member*How can the technical aspects of this SOW be improved?*

This SOW lacks measurable objectives. What is the target exploitation rate? How will the population level effect of nonnative removal on both endangered species be measured? How will efficiency of winter mechanical removal be measured? 25% or greater would be a desired exploitation rate. While population level effects on rare fish would be difficult to measure, we will use the demographic monitoring data to determine survivorship of age-1 Colorado Pikeminnow. Using the 2018-2019 diet study Channel Catfish population

estimate, Channel Catfish size structure, and length-weight relationship we can estimate the amount of Channel Catfish biomass removed and the potential estimate of the number of Colorado Pikeminnow that would be “saved” by removing these Channel Catfish. Catch per unit effort will be used to compare winter removal to previous year’s data during other seasons to determine if catch rates are higher during winter months and sampling conditions.

The SOW states that the section of river sampled and the timing of trips will be determined using previous data collected during the winter. What data is the PI referring to? Does this data support the shift to winter sampling? Second, why is the analysis of data to identify the proposed section to be sampled not included in this SOW? This information should be presented in the SOW so it can be reviewed. Although this section of river has not been intensively sampled during winter months, following discussions with other biologists, researchers and using some anecdotal data would suggest we concentrate our efforts between Four Corners Bridge and Sand Island, UT. Data has shown that turbidity effects catch rates when electrofishing for Channel Catfish in the San Juan River. Most times sudden increases in turbidity can be caused by rain events, sand washes flooding in to the river, increased flows and irrigation returns. By sampling during winter months, these factors increasing turbidity should greatly be reduced. This is why I proposed to try sampling in the winter to reduce the effectiveness of higher turbidity on catch rates.

What does the author define as “low” turbidity? A comparison of available turbidity data from the Four Corners, CO USGS gage (gage # 09371010) indicates that turbidity during the proposed winter sampling months (November – March) is not any different than summer months (April – August), except for 2018 (Figure 1). Given the planning required for these trips, it also seems unlikely that they can be flexible enough to sample only when certain conditions are present (i.e., flow less than 1,000 cfs and low turbidity). I would define low turbidity as anything 250mm or greater on a secchi disk reading. Figure one does show summer and winter months can have no significant differences in turbidity, however, when looking at the turbidity data for those same winter months that you’re saying are no different than summer months, there are definitely gaps where lower turbidity exists and a trip can be completed. These trips will be three days long and consists of four personnel from the NMFWCO office, making these trips less extensive to plan and increases the flexibility of getting trips completed during optimal sampling conditions and rescheduling if conditions are not favorable.

What are the expected effects of low water temperature on capture rates of Channel Catfish? Capture rates of Colorado Pikeminnow are much lower in the winter compared to summer and fall, is there any data to suggest that it is opposite for Channel Catfish? I expect the lower water temps to help increase catch rates of Channel Catfish. Observations I made in February 2018 during sampling with KSU near Montezuma Creek, Utah in freezing temperatures we

found large numbers of adult Channel Catfish in shallow areas of the river.

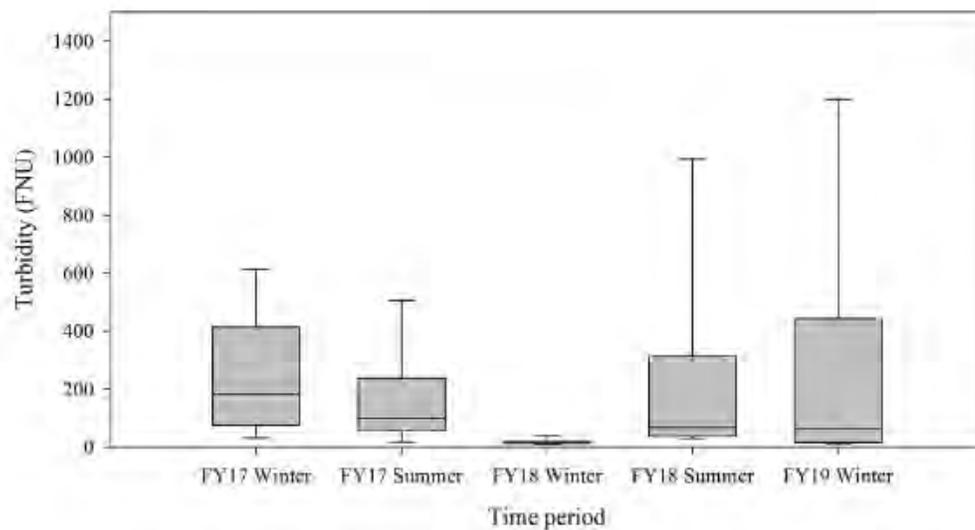


Figure 1. Box whisker plots of daily mean turbidity readings of the San Juan River in the winter (November to March) and summer (April to August) at Four Corners, CO in fiscal year (FY) 2017, 2018, and 2019. The boundary of the box closest to zero indicates the 25th percentile, the middle line the median, and the boundary of the box farthest from zero indicates the 75th percentile. The whiskers indicate the 10th and 90th percentiles.

What is this SOW's contribution to recovery?

A significant amount of Program effort has been expended the past several years to determine the effect of Channel Catfish removal. However, both the experimental design and the first year's results from the predation study have shown no significant population level effects of Channel Catfish on either endangered species. Given the results of these studies (and prior ones) I cannot see how this project has any meaningful contribution to recovery. The SOW also provides no evidence that shifting removal to winter will be more effective. It appears that nonnative removal is reverting to previous methods that have shown no contribution to recovery. **Previous methods of nonnative removal were focused on trying to crash the Channel Catfish population riverwide. This SOW is focused on removing adult Channel Catfish in a smaller reach during a time we feel will optimize sampling conditions. During the 2016 spring sampling using the experimental treatment/control design, we showed that with desirable sampling conditions (low flow, low turbidity) and smaller reaches, we were able to reach an exploitation rate of 48.6% for adult Channel Catfish. Although there is not a lot of data to suggest shifting efforts to winter will be more effective, we feel that sampling conditions will be more consistent and favorable and this SOW will help answer that question and help guide future nonnative fish management actions.**

Brian Bledsoe, Peer Reviewer

How can the technical aspects of this SOW be improved?

Not my expertise.

What is this SOW's contribution to recovery?

Wayne Hubert, Peer Reviewer

How can the technical aspects of this SOW be improved?

It is recognized that the author of the SOW is presenting the findings of other researchers in the summary of 2018 results. The sources of the information in the paragraph should be clearly explained. More detail would be worthwhile in the paragraph beginning at line 56.

Heddon et al. (2018) is referenced on line 59, but the citation is not included in the Literature Cited. Not only should the citation be included, but a description of the research team and what they are doing should be presented in the SOW.

The expanded information should identify who conducted the population estimates and include details of the population estimate including the estimator used, the precise estimate, and (most importantly) the 95% confidence interval for the estimate.

On line 58 it is stated that 3,438 channel catfish stomachs were sampled and two Colorado pikeminnows were found. The source of these data should be clearly identified and the fact that these are preliminary data should be acknowledged. In order to justify the focus on adult fish removal in 2020, the occurrence of fish in stomachs as a function of length could be described. **All of the above comments have been corrected in the SOW.**

Beginning on line 67, data used in the bioenergetics modeling exercise are presented (i.e., it was estimate that 12,040 g of Colorado pikeminnow were consumed). The source of these data should be identified and it should be noted that they are preliminary. The modeling exercise is key to justifying continued removal of channel catfish; consequently, it should be fully explained. It should be identified that USFWS staff conducted the bioenergetics modeling. Further, what was the model that was used and what parameter estimates were needed to run the model? The accuracy and precision of parameter estimates used in the model computations should be divulged and the assumptions made in the computations should be described. It was concluded that 611 Colorado

pikeminnows were likely to have been consumed in 2018 without acknowledgment of the potential for proliferation of error in the estimate or the precision of the estimate. This should be addressed. **Corrected in the SOW**

A change in removal methods is proposed for 2020 with a focus on removal during winter (line 70). The rationale for this change in strategy needs full explanation. It is stated on line 98 that “sampling conditions are optimum” during winter. Explanation is needed as channel catfish are generally less susceptible to boat electrofishing during winter. Are modifications of the electrofishing gear or capture techniques planned? **Modifications of gear or capture techniques are not planned for winter sampling, other than changing settings to meet conductivity of water requirements. Rational for sampling during winter is to target fish during low turbidity/low flow conditions.**

How will the estimates of channel catfish abundance and length frequency be altered by winter sampling? Potential biases when comparing to previous years of data should be considered. It is noted (line 100) that a Lincoln-Peterson Index will continue to be applied. Is there a better estimator? It would be good to consult with experts in population estimation methods to determine if this is the best approach. **A marking pass at the beginning of the sampling period will allow us to generate exploitation rates and population estimate. I will look in to other methods for estimating population size. I will note the bias to comparing this to previous years, however that is not the goal of this SOW and exploitation rates of winter sampling can show how effective we are at mechanically removing fish in the winter.**

What is this SOW's contribution to recovery?

It is not known if the removal of channel catfish is an effective strategy in the recovery efforts.

There is indication from the bioenergetics modeling that channel catfish predation may be affecting recovery. However, the outcome of the bioenergetics modeling to date is rudimentary. As mentioned above, more focus is needed on the quality of the parameter estimates, proliferation of error in the model computations, and the accuracy and precision of subsequent consumption estimates. The outcome of the research by the team from Kansas State University is needed to inform future decision regarding channel catfish removal.

The focus on the 2020 removal efforts will be on large channel catfish. Understandably, this is the segment of the population that is most likely to prey on Colorado pikeminnow or naturally spawned razorback sucker. However, juvenile channel catfish recruit to adults rather quickly in the San Juan River. Is a focus on adult removal an effective strategy for channel catfish population control? Assessment of this question is needed to better understand the potential contribution of channel catfish removal efforts to recovery of the endangered fishes. **Although it is unknown of removal of Channel Catfish is**

having a positive effect on recovery efforts and will always be hard to tease apart from other environmental factors, one cannot argue that currently there are positive responses by both species of rare fish happening in the San Juan river to management actions of the Program. We have had record numbers of wild juveniles for both species in the last few years, while this could be a result of flows, habitat or many unknowns, it could be argued that intensive nonnative removal gives juvenile Colorado Pikeminnow and Razorback Sucker a better chance at survival. It can also be argued that Channel Catfish predation doesn't impact rare fish populations. The KSU study is designed to give us a predation rate for Channel Catfish and right now it's more than zero. The program is at a milestone for recovery of these fishes and with record numbers of juvenile Razorback Sucker and Colorado Pikeminnow in the system, any effort to reduce predation or competition for these fishes and aid in their survival shouldn't be taken lightly.

Steve Ross, Peer Reviewer

How can the technical aspects of this SOW be improved?

My main concern is that the rationale for the study does not reflect the current understanding of the impact of Channel Catfish on native fishes. The rationale for this SOW is to concentrate on a smaller reach of river where Channel Catfish abundance is higher and during a time when sampling conditions are not effected by turbidity or high flows. We believe in doing so, we will be more effective at removing larger numbers of fish with less effort (i.e. number of trips). While the impact of Channel Catfish on rare fish survival continues to be studied and quantified, we still feel that Channel Catfish need to be managed in some effort.

What is this SOW's contribution to recovery?

I was surprised, as apparently was Bobby, that the Program Office wanted a nonnative removal proposal given the initial findings of the diet study on Channel Catfish being conducted by Heddon and others. The diet study showed only minimal predation on the listed fishes (from my notes, only two Colorado Pikeminnow consumed out of 832 stomachs examined and no Razorback Suckers consumed). Unless the second year of the study provides very different information, the hypothesis that predation is a major threat of Channel Catfish on the listed fishes is not supported. If the predation hypothesis is not supported by scientific evidence, this SOW would have no contribution to recovery and, in fact, could have a negative impact from the intensive electrofishing and consequent frequent disturbance of the aquatic ecosystem of the San Juan River resulting from this SOW. I understand that some may prefer to wait until the final report of the predation study next year before making a decision on the role of nonnative removal- if the nonnative target is Channel Catfish. However, the existing evidence provided by Heddon et al., along with the fact that Channel Catfish are not targeted for removal in the upper basin, makes it seem unlikely that continuing with removal of Channel Catfish in the San Juan River is a wise use

of Program funds.

However, I think it is important to recognize that nonnative fishes could have impacts on native fishes other than through predation. For instance, the hypothesis that Channel Catfish have a negative competitive impact on the native fishes has not been tested, in part because of the challenges of doing so. Competitive impacts of Channel Catfish on Colorado Pikeminnow could occur directly through the common use and depletion of shared resources (e.g., food or habitat), termed exploitation competition. Note that the common use of resources by itself does not indicate competition- the resource must be limiting. In this scenario, the removal of large Channel Catfish, which is a major focus on the proposed SOW, could shift the size structure to smaller Channel Catfish leading to an increase in the possibility of competition with juvenile Colorado Pikeminnow. Conversely, removal of large Channel Catfish could potentially reduce exploitation competition by curtailing the overall population growth through the removal of the highly fecund large fish, given that fecundity in fishes generally is positively correlated with body size. Of the two possible outcomes of removal on exploitation competition, I consider the first much more likely than the second.

A second form of competition is interference, whereby one species excludes another species from access to resources. This form of competition could occur between Channel Catfish and both Razorback Sucker and Colorado Pikeminnow at various life stages.

As it now stands, there is strong evidence, albeit with another year of study still to happen, that Channel Catfish do not pose a significant predation threat to the listed fishes. In addition, no hypotheses involving types of competition have been tested. Consequently, at this point in time there is no rigorous scientific evidence to support the removal of Channel Catfish. **Even with the low occurrence of Colorado Pikeminnow found in Channel Catfish stomachs in 2018, a high adult Channel Catfish population could still have a detrimental effect on juvenile Colorado Pikeminnow survival. There is a year left of the diet study (2019) to add to the 2018 results to help get a better understanding on the impact Channel Catfish have on native and rare fishes.**

Mel Warren, Peer Reviewer

How can the technical aspects of this SOW be improved?

It is not clear if this is being done to supplement information in the diet study or not. If it's not critical to interpretation or extrapolation of the diet study, I see no clear reason to conduct the work. If it's a critical aspect of the diet study then that should be clearly spelled out in the introduction. The introduction does indicate this SOW and the diet study will be "used in concert", but it does not detail what that means. Perhaps that is explained in SOW 18-26, but the reader should at least be given some idea of how this data is essential to the diet study. **This**

SOW is not designed or being done to supplement the diet study in any way. This SOW is meant to be a management action of conducting nonnative removal in some form in the San Juan River. Past studies and removal efforts have shown us how environmental factors such as turbidity and high flows can reduce our catch rates for Channel Catfish, that is why we are proposing to sample during winter months when these factors should be reduced.

Since part of the rationale is to increase efficiency (clear water, low flows), how will you measure an increase in efficiency? We will be using exploitation rates to measure if our efficiency increases during winter sampling. We can also compute catch per unit effort and compare to previous years seasonal differences.

It is stated that 12,040 g of CPM were estimated to have been consumed and this equates to an average of 611 CPM. How can 611 be an average? Also 611 CPM of what size? Colorado Pikeminnow size was average 19.7 grams per individual.

It's not clear what the study area encompasses? What is a "determined section"? Does this mean you will only shock a portion of the area from Shiprock to Sand Island? Not clear. If you have the data on past catch rates and conditions can't you select the section now and tell us where it will be? The reach has now been determined to take place from Four Corners Bridge to Sand Island, Utah. At the time that this SOW was submitted there was still a trip being completed sampling from Shiprock Bridge to Clay Hills, UT in March. I wanted to use this trip as a measure of Channel Catfish distribution to help aid in the decision of what section to sample to maximize our efforts.

How will a population estimate on a small portion of the river inform the diet study on predation of catfish riverwide? Are the fish being used in the diet study from the same section of river that you will be sampling? The section sampled in this SOW is within the same section of river that was used for the diet study. However, this SOW is aimed towards increasing effectiveness of removing adult Channel Catfish from the river.

What is this SOW's contribution to recovery?

Given past results on Catfish removal (e.g., minimal effects, MSY limits, capture efficiency, removal rates, population relatively stable, low predation) it is not clear how this will contribute to recovery. This SOW could help the Program in future management actions towards nonnative fish control. Until the diet study is completed and reviewed by the Program, the data collected during these winter trips will help researchers make decisions on sampling during the most effective conditions and time of the year. This SOW could contribute to recovery by being a management action that by removing any number of Channel Catfish could potentially result in increased survival of the record numbers of wild Razorback Sucker and Colorado Pikeminnow juveniles that have been observed the last

few years.

Program Office

How can the technical aspects of this SOW be improved?

Lines 89-92: It would be beneficial to identify areas of high adult Channel Catfish concentrations based on data that have previously been collected. **Corrected on the revised SOW. Sampling will take place from Four Corners Bridge to Sand Island, Utah.**

Hedden et al. 2019 presented Catfish population sizes, probability of prey consumed versus catfish-prey TL relationships. Given there are data on exploitation rates of adult Catfish, could you estimate how many you will likely be able to remove and how many CPM that might result in “saving”? **I will work on estimating the number of Channel Catfish we can potentially remove and its potential impact to “save” CPM.**

What is this SOW's contribution to recovery?

While evidence to date does not suggest substantial Channel Catfish predation on endangered fishes in the San Juan River, a second year of that study is yet to be completed and this SOW allows the SJRIP to move forward in a conservative approach to managing the threat of Channel Catfish. Additionally, an unknown level of competition is likely present between Channel Catfish and the endangered fishes in the San Juan River. At this time it is not clear what level of nonnative fish management the SJRIP should conduct that is commensurate with the threat nonnative fish pose. Nonetheless, this proposal is an effort to increase exploitation rates by focusing efforts both temporally and spatially to maximize the removal of Channel Catfish. Further discussion at upcoming BC meetings and the results of the KSU predation study will further elucidate this proposal's contribution to recovery.