FY 21 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, a two-year study assessing the predatory effect of Channel Catfish on endangered fishes was initiated in 2018.

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 22,149 individuals. A population estimate was not calculated in 2019 due to such few recaptures of tagged fish. In 2018-2019, 4,649 adult Channel Catfish stomachs were evaluated for contents by KSU, of which 7.7% contained identifiable fish (Hedden et al. 2020). Of those fish identified in Channel Catfish stomachs, 54% 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. Hedden et al. 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. Estimated total fish consumption (wet weight) by the Channel Catfish population was estimated to be 23.5 (19.0-29.2) kg/rkm in 2018 and 10.9 (8.8-13.5) kg/rkm in 2019. Estimated biomass of fish consumed =

16.73 grams (g) wet fish weight per 100 g catfish x San Juan River Channel Catfish biomass. There was an estimated 3,900 (3,150-4,845) native fish consumed in 2018 and 1,759 (1,420-2,185) native fish consumed in 2019 per rkm by the San Juan River Channel Catfish population. Observed fish consumption was two times higher in 2018 largely because of turbid water events that occurred during the warmer summer months, giving sharp rises in fish consumption, compared to 2019 when turbid water events occurred largely in the cooler spring months. Hedden et al. estimated that 19,250 grams of Colorado Pikeminnow were consumed in 2018 by Channel Catfish, which would equate to an average of 795 Colorado Pikeminnow individuals. They also estimated that removing 25% of the Channel Catfish population annually would potentially result in 3,114 grams of Colorado Pikeminnow biomass from being not being consumed by 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 proposed in FY20 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 tetany 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.

Preliminary results from FY20 winter sampling suggests that targeting Channel Catfish in this section and time of the year was successful and resulted in higher exploitation rates than previously observed in the San Juan River. Sampling was completed from January 21,2020 – March 12,2020. The marking pass resulted in 921 adult Channel Catfish being tagged and released back into the river. The next three subsequent removal trips resulted in 4,193 adult Channel Catfish being removed from the river with most fish being captured greater than 400 mm total length (TL). Exploitation rates were calculated by size class of adults as 17% for fish 300-399 mm TL, 28.5% for fish 400-499 mm TL, and 31% for fish $\geq$ 500 mm TL and a total exploitation rate of 22.8% for all adult Channel Catfish. All trips were completed under the set protocol that river flow would be less than 1000cfs and turbidity would be greater than 250mm Secchi Disk. One trip was started but canceled and rescheduled due to conditions not meeting the sampling protocol.

While it is encouraging to observe total exploitation rates over 20% with only three removal passes encompassing 42 river miles, we feel that the exploitation rates would have continued to rise with more removal passes. Movement of Channel Catfish in the San Juan has shown to negatively impact exploitation rates, however we feel that during the winter months these fish are not moving as much in the river and by focusing trips in this section during the winter and under optimal sampling conditions we have positively increased our efficacy resulting in favorable exploitation rates.

We propose to continue with this sampling during the winter months for another year, FY21. We will be adding an additional removal pass in FY21 compared to the three removal passes in FY20. We feel conducting a marking pass prior to removal passes is still important to be able to quantify exploitation rates and population estimates. By adding one more removal pass it could potentially raise exploitation rates and potentially result in additional 1,500 large adult Channel Catfish being removed from the San Juan River. In the diet study by KSU large Channel Catfish consumed substantially more fish than small individuals. For example, a 300 mm TL Channel Catfish, averaged across all water turbidity levels, had a 12% (range 3-28%) chance of having a fish prey present in its stomach, compared to a 600 mm fish with a 50% (21-80%) chance (Hedden et al. 2020).

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 four removal trips in the 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 76.5) using raft-mounted electrofishing. Two rafts will be used on adjacent shorelines and sample 12-15 river miles per day. One marking pass and four removal trips will be conducted during the winter months (November – March). All trips will be completed 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 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 removal 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. A draft report will be submitted to the Program Office by 31 March 2022 and a final report will be completed by 1 June 2022. All data will be submitted to the Program Office by 31 December 2022.

Budget Justification

The increase in budget compared to the previous year is based on an additional non-native fish removal pass, and in our need to fully account for the costs incurred on all projects. These increased costs mainly come from the hourly salary rate with benefits, annual cost of living increases, and mandatory overtime for non-exempt employees.

FY 2021								
Nonnative fish removal - 5 trips, Four Corners Bridge, UT. to Sand Island, UT. NMFWCO supplying 5 people per trip								
Labor Cost - Field Work (5 trips x 5 days/trip)								
Position	**Grade/Step**	**Salary w/**	**Hours/Da**	**Total Days**			**Sub-Total**	
Fish Biologist	GS 11/7	$52.04	8	25			$10,408.00	
Fish Biologist	GS 9/7	$47.16	8	25			$9,432.00	
Remote Biologist	GS 9/4	$41.72	8	25			$0.00	$8,344.00
Biological Tech	GS 5/1	$18.67	8	25			$3,734.00	
Biological Tech	GS 5/1	$18.67	8	25			$3,734.00	
5 days. 53 hours per trip								
Overtime Hours (weekend or >9 hour work days	**Grade/Step**	**Salary w/**	**Hours/Da**	**Total Days**				
Fish Biologist	GS 11/7	$52.04	2.75	25			$3,577.75	
Fish Biologist	GS 9/7	$62.93	2.75	25			$4,326.44	
Remote Biologist	GS 9/4	$56.18	2.75	25			$3,862.38	
Biological Tech	GS 5/1	$27.34	2.75	25			$1,879.63	
Biological Tech	GS 5/1	$27.34	2.75	25			$1,879.63	
Administrative, Reporting, Planning								
Fish Biologist	GS 9/7	$47.16	8	35			$13,204.80	
Remote Biologist	GS 9/4	$41.72	8	35			$0.00	$11,681.60
Supervisory Fish Biologist	GS 13/4	$71.12	8	5			$2,844.80	
Adminstrative Officer	GS 9/9	$46.93	8	5			$1,877.20	
Biological Tech	GS 5/1	$18.67	8	25			$3,734.00	
Biological Tech	GS 5/1	$18.67	8	25			$3,734.00	
					Total Labor		**$68,228.61**	
Travel and Per Diem	**Days**	**Rate**						
Lodging Costs (House Rental)	5	$600.00					$3,000.00	
Per Diem (Travel Day)	50	$41.25					$2,062.50	
Per Diem (Full Day)	75	$55.00					$4,125.00	
Concur Fee	50	$14.75					$737.50	
					Total Travel/Per Die		**$9,925.00**	
Equipment	**Miles/Qty**	**Total Mil**	**Rate**					
Floy Tags	2000		$0.70				$1,400.00	
Vehicle Fuel								
1 trucks X 4 trips - ABQ to Sand Island, UT 574 mi RT								
1 truck X 4 trips- Farming. To Sand Island, UT 216	574/216	3,950	$0.58				$2,291.00	
Generator Fuel	150		$2.85				$427.50	
30 gallons/trip x 4 trips								
Maintenance, repair, replace							$3,000.00	
(i.e. life jackets, waders, generator repair, dip nets, etc.)								
					Equipment Total		**$7,118.50**	
Remote Biologist Savings	$20,025.60							
				Total for 4 trips NNR. - NMFW			**$85,272.11**	
				Overhead 3%			$2,558.16	
				Grand Total			$87,830.28	

Literature Cited

Hedden, S. and K. Gido. 2020. 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

17	SOW-17-FY 21 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?

In comparing scenario 1 to scenario 2, exploitation rate will certainly go up with an additional pass if that pass catches any catfish at all. More to the point, how large an increase is needed to justify the extra pass? Would be good to work that out in advance & then see if the extra pass achieves it (assuming scenario 2 is closen). Exploitation rates would only increase if we recaptured tagged Channel Catfish. On the last removal trip of the sampling period (trip 4) we removed 1,522 adult Channel Catfish and 65 of those were tagged. Theoretically if we had done one more trip, we estimate we would have removed about the same amount of Channel Catfish. For example, if we recaptured 50 tagged fish during that extra pass, exploitation rates would jump from 22.8% to 28.2%.

What is this SOW's contribution to recovery?

Electrofishing preferentially removes larger catfish, which we know from the KSU study account for a large percentage of predation by catfish of all sizes. Therefore, the removal project may substantially reduce predation on endangered fish, even though exploitation rates are nowhere near high enough to actually control the catfish population.

Steve Davenport, USFWS Region 2, BC member

How can the technical aspects of this SOW be improved?

The SOW could include a plan to collect turbidity measurements in order to establish a relationship between water clarity and CPUE. This relationship could be used to determine a bench mark for turbidity levels that are too high to effectively remove channel catfish. If this is done it would require moving this work to an evaluation of sampling efficiency which would mean removal efforts would continue despite turbidity levels. Which may not be desired. While it is not stated in the SOW, we did take Secchi disk readings every morning and multiple times throughout the day if conditions changed. We also took multiple readings on the trip that we rescheduled due to increased turbidity. We will be able to plot these Secchi disk readings on top of the hydrograph from Four Corners gauge and see if there's a noticeable threshold of turbidity and flows and if spikes on the USGS gauge equals spikes in turbidity in the river. The Secchi disk readings compared to the USGS gauge FNU readings will help us determine the

relationship between FNU's and actual visibility in the river.

What is this SOW's contribution to recovery?

This SOW will facilitate Colorado Pikeminnow recovery by removing large Channel Catfish individuals, which represent a disproportionately high component of endangered fish consumption.

Vince Lamarra, Navajo Nation, BC member

How can the technical aspects of this SOW be improved?

I can see the logic of having another removal trip based on the exploitation rates measured in 2020. However, I do question the continued need to measure that rate each year. That first (marking trip) did have 921 fish in hand. Maybe we only need to document the rate and population size of catfish every third or fourth year? That is a very good point that generated some good discussion during the BC meeting. Since this is the second year of sampling during the winter, generating exploitation rates would give us a way to measure the efficiency of sampling and allow us to compare it to the first year's results.

What is this SOW's contribution to recovery?

No comment

Colin Larrick, Ute Mountain Ute Tribe, BC member

How can the technical aspects of this SOW be improved?

The technical aspects of this SOW appear sound and sufficient to accomplish the objectives.

What is this SOW's contribution to recovery?

Implementing this SOW should improve the survival rates and improve recovery for endangered fish in the San Juan River.

Jacob Mazzone, Jicarilla Apache Nation, BC member

How can the technical aspects of this SOW be improved?

No Comment

What is this SOW's contribution to recovery?

The KSU study made an argument that Channel Catfish predation could severely impact Colorado Pikeminnow if left unchecked. This refined non-native removal effort is the culmination of many years of removal experience and seems to avoid many of the pitfalls identified from previous efforts. A scope of this nature requires flow and turbidity to be within range and therefore some leeway and extensive system knowledge to complete successfully.

Mark McKinstry, BOR, BC member

How can the technical aspects of this SOW be improved?

It appears that exploitation rates of larger catfish is actually pretty goo for this work and seems to be more effective than summer removal.

1) It would be good to see what the expected exploitation rate would be with an extra trip? They estimate 1,500 more fish would be removed, with a current exploitation rate of 22.8% with three removal trips. What would it be with another trip. On the last removal trip of the sampling period (trip 4) we removed 1,522 adult Channel Catfish and 65 of those were tagged. Theoretically if we had done one more trip, we estimate we would have removed about the same amount of Channel Catfish. For example, if we recaptured 50 tagged fish during that extra pass, exploitation rates would jump from 22.8% to 28.2%.

2) I agree that keeping the marking trip is important to evaluate the removal rates. Agreed.

3) There is some evidence that catfish, maybe even bigger ones, congregate in lower stretches of the river during the winter. Would it be worth a trip during this time of year to investigate that? I realize it would be a camping trip, but…might be worth trying it. I will talk to Brian Hines since they use to sample in the lower canyon during this time period and see what he thinks. It seemed like there were plenty of large adult Channel Catfish in the section we sampled.

4) It would be good if the authors acknowledged the Pennock et al. (2018) publication in this SOW. It is a pretty critical piece of research that has led to this work being modified over the years and should be referenced (maybe multiple times) in this SOW. I will incorporate Pennock et al. for the report for this SOW. We will use Casey's paper when comparing exploitation rates to previous years sampling and what his models showed about the effect of various levels of exploitation

5) I would support another removal trip after more discussion with BC and looking at the budget. Perhaps money saved from 2020 work not being done could be used to do this extra trip? The SOW has been modified to add one more removal pass after the discussion at the last BC meeting.

What is this SOW's contribution to recovery?

Control of NNF is likely important at some level. This project seems like a good compromise between removing what we think are the problem fish, i.e., larger CCF, and level of effort toward this goal.

Bill Miller, Southern Ute Indian Tribe, BC member

How can the technical aspects of this SOW be improved?

There are a few grammatical and editorial corrections needed. The preliminary exploitation rates seem to indicate that this time of year is better than summer for removal. I am concerned that if the fourth trip is added it will conflict with the monitoring for wild age 1 Razorback in SOW 19b. I recommend not electrofishing much past early March to avoid impact to any Razorback Suckers that may be staging for spawning. Agreed. We will move up the sampling dates to make sure we are done electrofishing before early March.

What is this SOW's contribution to recovery?

No comment

Ben Schleicher, USFWS R6, BC member

How can the technical aspects of this SOW be improved?

Lines 71-74: Has this been proven or is this an assumption? Could this be a metric of habitat availability (or lack thereof in 2018), concentrating fish would tend to favor predators. This was an assumption Sky made based on stomach contents in 2018 vs 2019 when comparing turbid conditions at time of stomach collection.

Lines 91-92: Do you mean tetany? Full taxis would have the fish swimming at the anode taking the speed of the current out of the equation. Yes, I meant "tetany". Thank you for catching that error.

Line 135: Why was this area selected? Is there past data that would point to a better section of river to be removing nonnatives? While there is not much data on this exact time of sampling in any part of the river, I chose this area based on the spring Razorback Sucker trip that was done in 2019 and crews did not observe Channel Catfish until after Four Corners bridge. I also used observations Sky and I made during February sampling of 2018 for the diet study which resulted in observations of high abundance of adult Channel Catfish in the area. I think our results support that we chose an area that could produce large numbers of adult Channel Catfish.

Line 141: "…positively increased our efficacy resulting in favorable exploitation rates." Compared to what rates? Rates observed during the diet study or previous nonnative removal, would these account for seasonality or difference in spatial sampling (river miles)? I believe that higher catch rates would be expected given that there hasn't been a catfish removed from the river in the past two years. We have not compared exploitation rates to all other years of tagging data prior to this winter sampling yet. This project was completed two weeks before the SOW was due. A FY20 report will compare this project to previous data to compare exploitation rates and catch rates.

What is this SOW's contribution to recovery?

Management or removal of a predator in a system is one of a few management actions that we as a program can do for help recovery of T&E fish. While the quantitative level of predatory threat of catfish on CPM or RBS is still up for debate, the fact is that catfish are still a threat and this SOW is removing a threat.

Tom Wesche, Water Development Interests, BC member

How can the technical aspects of this SOW be improved?

While the proposal is clearly and concisely written, I question the need to repeat the catfish population estimates each and every year. Previous years' work has shown us our exploitation rates are quite high for the larger size classes of catfish we want to remove. I suggest we put all the effort into removing these fish and not spend valuable resources counting and re-counting them every year. I can see your side of the argument and it is hard to throw back 900+ fish back in the river when you have them in hand. This topic generated some good discussion during the BC meeting. Since this is the second year of sampling during the winter, generating exploitation rates would give us a way to measure the efficiency of sampling and allow us to compare it to the first year's results. If we continue doing this project and can replicate high exploitation rates in multiple years then maybe we can transition to strictly removing fish and cease the tagging efforts.

What is this SOW's contribution to recovery?

The KSU catfish diet study has given us some guidance on the quantitative aspects of predation on native fishes, including the endangered species. While catfish removal may not give us the most "bang for the buck", it is one management tool we have that can provide at least some level of quantifiable positive results in terms of recovery..

Matt Zeigler, NMDGF, BC member

How can the technical aspects of this SOW be improved?

Line 108-110: Provide exploitation rates by pass for winter 2020 removal efforts. Obviously another pass would have resulted in additional fish removed and an increase in the exploitation rate. However, the important thing is how much more exploitation would have occurred given the effort it would have required. Exploitation rates are not linear with effort expended. Exploitation rates by pass and comparison of data from this sampling and previous years tagging efforts will be explained in more detail in the report. This SOW was due two weeks after this project was completed. Yes exploitation rates are not linear and it all depends on how many fish are recaptured during that pass. On all three passes we recaptured more than 50 fish per trip. Just as an estimate if we were to have completed one more trip and recapture 50 Channel Catfish, exploitation rates would have increased from 22.8% to 28.2%.

Line 110-114: Provide empirical evidence that movement rates of Channel Catfish are lower during winter months. This data analysis was not completed by the time the SOW was due but out of all the recaptured Channel Catfish during the winter sampling, average movement between tagging and recapture was 2.7 miles downstream. Range of movement was one fish that moved 11 miles downstream and one fish that moved 11 miles upstream.

Lines 118-121: Where does the 1,500 additional large Channel Catfish come from? You reported in the SOW that on all 4 trips (including the tagging trip) a total of 5,114 Channel Catfish were captured which is an average of 1,279 fish per trip. If only the removal trips are used, then an average of 1,398 fish were removed per trip. Also what is considered a "large adult Channel Catfish" and how many of these were removed during the three trips? Yes the average was around 1,400 fish per trip but I went off of the last trip which was finished right before this SOW was due. On that last trip we removed 1,522 adult Channel Catfish and 65 of those were tagged. Theoretically if we had done one more trip, we estimate we would have removed about the same amount of Channel Catfish. I consider a large Channel Catfish to be > 400mm TL. Number of fish >400mm TL removed during the three removal trips were 1) 481, 2) 902, 3) 759.

Line 136-137: Please provide information that supports the reasoning for removal in this section of river versus another section. While there is not much data on this exact time of sampling in any part of the river, I chose this area based on the spring Razorback Sucker trip that was done in 2019 and crews did not observe Channel Catfish until after Four Corners bridge. I also used observations Sky and I made during February sampling of 2018 for the diet study which resulted in observations of high abundance of adult Channel Catfish in the area. I think our results support that we chose an area that could produce large numbers of adult Channel Catfish.

Line 169: Has the Program agreed to conducting a workshop to just go over this data? Thanks for the catching that. That was part of the FY20 SOW that was not deleted as there was talk about conducting a nonnative fish management discussion during the May meeting before the COVID situation.

What is this SOW's contribution to recovery?

There have been multiple studies assessing the effects of nonnative removal on both endangered species in the San Juan River. None of those studies have provided any evidence of a positive effect. If the Program deems Channel Catfish to be a significant threat to the recovery of Colorado Pikeminnow and Razorback Sucker in the San Juan River, then rigorous evaluation of results from all recent studies needs to be conducted so that nonnative removal benchmarks can be developed. Failure to develop any benchmarks will only result in the continued expansion of nonnative removal until it again utilizes a

significant portion of the Programs resources with no measurable contribution to recovery. Expanding nonnative removal efforts above their current levels should not be considered until benchmarks are developed. In addition to developing benchmarks, the Program needs to investigate novel ideas for eradicating Channel Catfish from the San Juan. Until the species is completely eliminated from the system, an unnecessary amount of resources will be expended in an attempt to control their population.

Wayne Hubert, Peer Reviewer

How can the technical aspects of this SOW be improved?

The proponents experienced substantial success in removing adult Channel Catfish from a 42 mile reach of the SJR between January 21 and March 12, 2020. The average exploitation rate was 22.8%, but varied by length class among adult fish. The proponents should be commended in the development of summary statistics for inclusion in the FY 2021 SOW within a few days of completion of field work.

The SOW for FY2021 is to conduct a similar control effort, but to add one additional removal trip and to begin earlier in the winter. This seems to be a reasonable modification.

There is a need to utilize the data from FY2020 and FY2021 in association with the findings from the KSU research to further assess long-term Channel Catfish removal efforts in the SJR. What would be the effect of long-term annual removal of adult channel catfish during winter throughout the SJR on the abundance and size structure of Channel Catfish? Considering growth of Channel Catfish from winter through the following summer, what is the potential effect of long-term removal on Channel Catfish population abundance and structure, and potential predation on Colorado Pikeminnow? Is it feasible to fund and conduct a long-term Channel Catfish removal effort that will have measurable benefits to Colorado Pikeminnow and Razorback Sucker in the SJR? Given modification of Colorado Pikeminnow stocking from 400,000 age-0 fish to 12,000 age-1 fish annually, how should Channel Catfish removal be approached in the future? Using results from FY 2021 and additional modeling based on KSU data, insights may be attained that can direct future Channel Catfish management actions. The PO should probably plan for a substantial data analysis, modeling, and decision-making effort utilizing expertise beyond the NMFWCO following completion of FY2021 removal efforts. Agreed. This SOW will give researchers more knowledge and data that will help the BC make management decisions regarding nonnative fish management. I agree that data from KSU diet study, Casey Pennock's publication and two years of winter nonnative removal, plus all additional years of different approaches to nonnative removal need to be integrated and rigorously evaluated to direct a clear path forward in regard to nonnative fish management in the San Juan River.

What is this SOW's contribution to recovery?

This project is providing data that will be important in determining if long-term Channel Catfish suppression efforts can/should be maintained in the SJR to benefit recovery of the endangered species.

Mel Warren, Peer Reviewer

How can the technical aspects of this SOW be improved?

Think about removing a bunch of large catfish that are competing for resources (e.g., space, food) with and eating small catfish. Why won't this accelerate growth rates of small catfish so that they to recruit to larger sizes quicker? If that's true, it's just wash, rinse, repeat.

79- "additional 158 (0 -461) Colorado Pikeminnow surviving annually" The confidence interval contains zero! Having zero in one's confidence interval implies that a treatment effect (catfish predation) could have a positive or negative effect on the outcome of interest. I would remove this calculation. When a peer reviewed paper comes out on Hedden et al. work then you could include what they say there. But in my opinion, he's misinterpreted (or ignored) what the confidence intervals are telling us. Removed from the SOW and will include in the report after more data analysis has been reviewed.

123- "12% (range 3-28%) chance of having a fish prey present in its stomach, compared to a 600 mm fish with a 50% (21-80%) chance" These confidence intervals overlap indicating there no difference in fish consumption between the two sizes. Again, ignoring what the CIs are telling us. It also suggests he didn't find enough catfish with fish in their stomachs (low power) to detect differences if they do exist. I am leaving this in the SOW for right now until I can have further discussions with Sky Hedden and I will remove or clarify for the report.

Minor typos (highlighted text)
66

What is this SOW's contribution to recovery?

I still don't really know. What are these e-fishing passes doing to endangered fish?

Program Office

How can the technical aspects of this SOW be improved?

- Paragraph starting on line 95: it would be helpful to compare these exploitation rates to previous years (i.e., did changing to winter sampling increase exploitation rates?). The PIs may need to calculate them similar to Pennock et al. 2018. Those comparisons and incorporating Pennock's publication will be included in the report. This SOW was due two weeks after the completion of our

last sampling trip and I calculated exploitation rates to show the preliminary results from the project. A more detailed analysis and discussion will be included in the report.

- Line 109: it is likely exploitation would always continue to rise with more removal passes, but what is the goal and what number of passes are required to reach that target? We did not set an exact goal for exploitation rates. I think anything over 20% would be a positive achievement. We can use the FY20 data to compare to the models Casey Pennock used in his publication when looking at that effect different levels of exploitation rates would have on the Channel Catfish population.
- A different way to think about what this SOW's goal is would be to quantify how many Colorado Pikeminnow were "saved" by the number of Channel Catfish removed in the winter 2020. Then indicate how many or what percent of the population of Colorado Pikeminnow this SOW is aiming to "save." That is a good suggestion and we will work on that for the report that comes out for the FY20 work that was completed.
- Line 120: suggests an additional 1,500 adult catfish would be removed if an additional pass is conducted (from 3 to 4). How was that number derived? It was just an estimate of fish we felt could be removed with one more pass based off the average of fish removed on all three removal passes (1,398) and the number of fish removed on the last removal pass of the project (trip 4; 1,522).
- 141: It is not clear how to make the decision of three or four passes. A graph with the cumulative trip exploitation may be helpful to figure out how to make this decision (i.e., what is the cumulative exploitation over successive passes compared to the increased cost?). We have revised the SOW to remove the option of two scenarios and will move forward with adding an additional pass to the proposed work.
- Line 169: "Data will be entered, analyzed, and presented to the SJRIP Biology Committee at a workshop following the field season." It would be helpful to describe how the data will be analyzed. After the completion of the FY20 we will have a better explanation of what data analysis was done.

What is this SOW's contribution to recovery?

Reducing the densities of large, predatory Channel Catfish likely reduces the predatory impact to endangered fishes in the San Juan River.