RECOVERY PROGRAM Recovery Program Project Number: 125
FY 2020-2021 SCOPE OF WORK for:
Middle Yampa smallmouth bass and northern pike removal

Reclamation Agreement number: New Agreement pending
Agreement term: Oct. 1, 2018 – Sep. 30, 2023

Lead agency: Larval Fish Laboratory (LFL)
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This project includes personnel and equipment assistance from USFWS- see attached budgets.

Date Submitted: 5/15/2019
Date Last Modified: 5/15/2019

Category:
_X Ongoing project
__ Ongoing-revised project
__ Requested new project
__ Unsolicited proposal

Expected Funding Source:
_X Annual funds
__ Capital funds
__ Other *[explain]*

I. Title of Proposal: **Evaluation of smallmouth bass and northern pike management in the middle Yampa River.**

II. Relationship to RIPRAP: S*ee RIPRAP at* http://www.coloradoriverrecovery.org/documents-publications/foundational-documents/recovery-action-plan.html

	Action Plan: General Recovery Program Support.
III.	**REDUCE NEGATIVE IMPACTS OF NONNATIVE FISHES AND SPORTFISH MANAGEMENT ACTIVITIES (NONNATIVE AND SPORTFISH MANAGEMENT)**
III.A.	Reduce negative interactions between nonnative and endangered fishes.
III.A.1.	Where not already generally known, identify negative impacts (e.g., predation, competition, hybridization) of problem species.
III.A.1.c.	Re-evaluate levels of hybridization with white sucker and assess effects on razorback sucker populations. (Program will monitor for evidence of hybridization as razorbacks increase in the system.)
III.A.1.c.(1)	If necessary, implement actions to minimize hybridization between white sucker and razorback sucker.
III.A.2.	Identify and implement viable active control measures.

III.A.2.c.	Evaluate the effectiveness (e.g., nonnative and native fish response), develop, and implement an integrated, viable active control program.
III.A.2.c.(1)	Project-level synthesis: synthesize data on each species/river nonnative fish control effort and concomitant native fish response (e.g., smallmouth bass in the Yampa River and native fish response in the Yampa River) (completed by PI′s and identified as a task in individual scopes of work). (YS G-3) See Bestgen et al., 2007 for Yampa River native fish response report (2003-2006) and Skorupski et al 2012 for Middle Green River native fish response report (2005-2008).
	Action Plan: Yampa River.
III.B.1.c.(1)	Implement remedial measures to reduce pike reproduction in Yampa River.
III.B.2.	Control nonnative fishes via mechanical removal
III.B.2.a.	Estimate nonnative abundance, status, trends & distribution (YS I-3)
III.B.2.c.	Identify and evaluate gear types and methods to control nonnative fishes (YS I-5)
III.B.2.d.	Remove (formerly "and translocate") northern pike from Yampa River. See Hawkins et al. 2005. (YS J-1)
III.B.2.d.(1)	Remove northern pike and smallmouth bass above designated critical habitat (Craig, CO) (YS C-3).
III.B.2.e.	Remove (formerly "and translocate") smallmouth bass in Yampa River designated critical habitat. (YS J-1).
III.B.2.h.	Monitor native and endangered fish response (YS L-2)

III. Study Background/Rationale and Hypotheses:

Temporarily reducing riverine smallmouth bass and northern pike populations appears viable under certain environmental conditions but both species can easily reverse these reductions in population abundance and return to pre-removal abundances under favorable environmental conditions (Breton et al. 2014; Zelasko et al. 2015). Therefore, mechanical removal efforts will attempt to reach eradication of nonnative fish populations in the river. However, recent synthesis reports investigating effectiveness of in-river removal efforts for northern pike and smallmouth bass determined that reducing in-river populations of these two species would not be successful unless in-river reproduction and reservoir escapement were controlled (Breton et al. 2014; Zelasko et al. 2015). Therefore, mechanical removal efforts will continue to temporarily suppress riverine populations, and will focus on reducing in-river reproduction when feasible. Simultaneously, Program partners will work on other means to reduce in-river reproduction and reservoir escapement, in order to make mechanical removal more effective and to attempt to reach complete eradication of riverine populations.

IV. Study Goals, Objectives, End Products

We are implementing mechanical removal of nonnative smallmouth bass and northern pike in the middle and upper Yampa River; we coordinate our sampling with Colorado Parks and Wildlife (CPW) and U.S. Fish and Wildlife Service (FWS) who are responsible for removal of those species in adjacent reaches during certain times of the year.

CPW will be responsible for management and analysis of northern pike data collected from this project in the middle Yampa River. We (CSU) will be responsible for management and analysis of smallmouth bass data collected by CPW and CSU from the middle Yampa River, and northern

pike data collected from our study reach in the upper Yampa River.

Smallmouth bass
The goal is to reduce the number of smallmouth bass and decrease their spawning success in the middle Yampa River in order to benefit native fishes and assist in the recovery of endangered fishes.

Objectives:
- Obtain an annual estimate of the number of smallmouth bass in Little Yampa Canyon using a mark-recapture abundance estimator.
- Conduct at least one adequate marking pass in Little Yampa Canyon and additional removal passes in the reaches of the Yampa River between South Beach and Deerlodge Park.
- Reduce the success of smallmouth bass spawning in the South Beach, Little Yampa Canyon, Lower Juniper, and Maybell reaches.
- Calculate the proportion of juvenile and adult smallmouth bass removed from Little Yampa Canyon based on initial population size.
- Remove large numbers of age-0 and age-1 smallmouth bass from a 12-mile treatment reach (RM100-112) in Little Yampa Canyon in coordination with Recovery Program Project 140 (Native fish response evaluation).

Northern pike
The goal is to reduce the number of northern pike from the middle Yampa River between South Beach and Deerlodge Park and from the upper Yampa River between Steamboat Springs, CO and the Hayden Power Station Intake Boat ramp (originally Project 98c) in order to benefit native fishes and assist in the recovery of endangered fishes. We will coordinate northern pike removal with CPW and FWS.

Objectives:
In the upper Yampa River between Steamboat Springs and Hayden (Project 98c):
- Obtain an estimate of the number of northern pike using a mark-recapture abundance estimator in 2019 and future years as directed.
- Remove northern pike on two or more removal passes.
- Identify potential spawning locations.

In the lower Yampa River sites:
- Conduct removal passes for northern pike.
- Provide data on pike removed to CPW for analysis.

Other species
The goal is to reduce the number of other nonnative species from all treatment reaches in order to benefit native fishes and assist in the recovery of endangered fishes.

Objectives:
- Remove white sucker, white sucker hybrids, common carp, and other nonnative species such as green sunfish, black crappie, black bullhead, and brook stickleback. These species will be removed on all sample occasions if the effort for their removal does not

reduce our ability to remove target species of smallmouth bass and northern pike.
- Evaluate changes in relative abundance of these species over time using catch per unit effort (CPUE).

V. Study Area:

Upper Yampa River:
Steamboat – Hayden: 24 miles: Tree Haus Bridge (RM 189.2) to CPW boat ramp at Highway 40 Bridge and Hayden Power plant intake (RM 170.6).
March-April: Adult pike sampling with raft electrofishing (timing dependent upon flows, temperatures, and access).
June-October: Young-of-year (YOY) pike sampling with seine, dipnet, backpack electrofisher, light traps, or electric seine.

Middle Yampa River:
South Beach – Deerlodge Park 90 miles:
April – July: Smallmouth bass sampling with boat electrofishing using a 10-days on and 4-days off rotation including eight consecutive sampling days and two travel days. Both northern pike and smallmouth bass are susceptible to electrofishing when they occupy shallow shoreline and flooded off-channel habitats during runoff flows. Spring runoff sampling also allows for safer navigation with large electrofishing boats. As discharge declines and water clears, young smallmouth bass become more susceptible to capture.

July- August: Age-0 bass sampling during base flow from Lily Park and the lower 12-miles of the Little Yampa Canyon reach. Removing age-0 bass only in the 12-mile treatment reach in Little Yampa Canyon maintains the Control-Treatment study design originally designated in 2004 in the native fish response evaluation by Project 140.

VI. Study Methods/Approach:

Upper Yampa River- Pike: This reach is primarily located within private property and most of the access points (boat ramps) require landowner permission. Although much of the work can occur on the water without touching land, gaining access to launch boats, take-out boats, set nets, or process fish requires landowner permission. The short section through Steamboat Springs contains several low bridges that are not navigable during higher flow events and this section has minimal northern pike habitat. For those reasons, it will be excluded from sampling if navigation is deemed unsafe or unproductive for catching northern pike. The PI will contact and seek landowner permission for bank access for the mentioned activities. CPW will provide electrofishing rafts for CSU use. We will focus primarily on sampling backwaters to reduce potential negative effects on sport fish (trout and whitefish). The reach will be sampled on at least three occasions, typically in April or May, depending on access and flows. We will remove northern pike on all sampling occasions except in years determined necessary to monitor abundance. In those years, we will complete at least two mark-recapture occasions, followed by three or more removal occasions. Abundance will be estimated using a modified Lincoln-Petersen estimator. Abundance was estimated in 2019 and we suggest it be repeated in 4 years or after significant management actions are complete. Catch per unit effort will be calculated for each pass for comparison with other reaches where pike are being removed.

We will note sex and sexual conditions of all pike captured and obtain GPS locations of confirmed or potential spawning sites. If we can obtain permission, we will return to those locations and sample with fyke, trammel, or gill nets during high flows.

Spawning locations will be confirmed by sampling for YOY later in the year. We will sample backwaters where we captured ripe fish or where there is suitable spawning habitat. Knowledge of spawning locations will direct future removal or management efforts that target removal of spawning pike in an attempt to reduce production.

Lower Yampa River:
Sampling protocol— Each year, we will remove northern pike and smallmouth bass from the middle Yampa River on multiple occasions in an attempt to reduce their number and size structure. In three of five years (FY 2021-2023), effort will also focus on monitoring of Colorado pikeminnow to support population estimation under project 128. Sampling in May and early June will be accomplished in coordination with CPW, who has committed to assist according to the specifics found in project 98a. CSU crews will maintain flexibility to react to hydrologic conditions to accomplish early season sampling in conjunction with CPW.

Fish will be captured with boat electrofishing from April through July when flow is sufficient (>1000 cfs) to navigate the river with 17-ft. aluminum, Jon-boats fitted with outboard jet motors. Both shorelines will be sampled concurrently with two electrofishing boats using ETS brand, pulsed–DC current following Standard Operating Procedures (Martinez and Kolz, 2015). Sampling will occur in a downstream direction covering about 6-10 miles per day until the entire reach is sampled.

Other sampling gear may include backpack or bank electrofisher, seine, trammel, fyke, or gill net, angling, or suction devices for young fish. A third boat will be used to process, maintain, and transport live fish as needed. We will sample each reach on multiple occasions each year with an interval of 4–10 days between occasions. In the Little Yampa Canyon reach only, smallmouth bass >100 mm TL will be marked with a numbered Floy tag and released on at least one sample occasion each year to serve as a mark for abundance estimation. On all other non- marking sample occasions, smallmouth bass will be removed from the river. For a description of the sampling protocol see Hawkins et al. (2009a).

Marked smallmouth bass that are returned to the river will be Floy tagged and released within the ½- mile section from which they were captured. Backwater and flooded tributary mouth areas will be sampled by electrofishing boat, fyke, gill, or trammel nets or block-and-shock techniques described by Nesler (1995). To determine spawning locations and timing of smallmouth bass reproduction, we will note when we observe males moving off nests and the reproductive condition of captured fish. Spawning areas will be intensively targeted for removal of nesting, spawning or nest guarding adult fish, young bass will be removed from active nests, and nest sites will be physically destroyed when possible.

Removal effort— We will complete at least three removal passes per year or more based on time

and resources.

Removal evaluation— Each year we will estimate the abundance and capture probability of smallmouth bass at Little Yampa Canyon using mark-recapture methods. We will calculate catch per unit effort (CPUE) for adult smallmouth bass for each sample occasion and obtain an average CPUE for all sample occasions each year. Removal effectiveness will be determined primarily by examining changes in annual abundance of juvenile (100-199mm TL) and adult (>200 mm TL) smallmouth bass in Little Yampa Canyon.

The Surge-Intensive sampling during smallmouth bass spawning —We will use current knowledge about smallmouth bass spawning ecology to focus and increase removal of spawning smallmouth bass. Once temperatures reach 16° C, we will increase removal efforts in areas with known or potential spawning habitat by organizing and coordinating a multi-agency effort known as "The Surge". Our goal is to disrupt all stages of the spawning period, including pre-spawn nest building, spawning, and nest guarding. This activity has been shown to increase the catch of adult fish, disrupt the spawning event, remove guarding males from active nests, and is expected to ultimately reduce the survival of young hatchlings. Modeling shows that disrupting early season nests via the Surge is an effective means to reduce overwinter survival of young bass, thus reducing the abundance of year classes throughout the future. Removing spawning adults from nesting areas during the earlier nest building and spawning stages will create a sink in these areas for late spawners which will then be targeted for removal. Adult bass on nests are vulnerable to electrofishing gear because they are in shallow water and they have a tendency to remain and protect the nest rather than flee.

Our plan is to remove spawning fish and create a void in desirable spawning habitat so that new bass can move in and occupy those areas and be removed on subsequent sampling occasions. In that process, we will also be disrupting and decreasing the survival of eggs or young in nests. Sampling effort will be directed at river sections with concentrations of spawning bass. We will focus on the reaches between South Beach and Lower Juniper (RM 135–90), because those reaches have abundant spawning habitat.

Smallmouth bass spawning —Spawning activity begins when temperatures reach about 16–18^0 C (60–65^0 F) which in the Yampa River can range from early to late June. Hatching dates based on otolith increments support a start of spawning near 16^0 C but vary depending on discharge volume and timing (Bestgen and Hill 2016). Hatching dates range from two to nine days after spawning, depending on temperatures. Optimum incubation and hatching temperatures range from 19–22^0 C (66-72° F) and shorten hatching time. After hatching, larvae drop into the gravel nest and they eventually emerge and remain in the nest for an additional 6–15 days. Males will often remain in the area and guard the slowly dispersing young for as long as 28 days.

Removing the male from a nest (typically reported in the literature by angling) often results in large losses of eggs or larvae due to predation on the young or abandonment of the nest by the male if released back to the water.

Additional resources during The Surge— Increased removal effort requires additional people and

equipment; therefore, we (CSU) will work closely with CPW and FWS crews. During intensive spawning sampling, CPW will increase sampling in South Beach, upper and lower Maybell, and Lower Juniper and will contribute a total of six people and three boats. FWS Grand Junction FWCO will assist with intensive sampling for 2 weeks and provide three people, two electrofishing jet boats or rafts, and two trucks. FWS Green River Basin FWCO will assist for 2 weeks and provide two people and one truck. See attached budgets for FWS field station participation. CPW budget is included in the SOW for project 98a.

Effort required to complete one pass of the South Beach, Little Yampa Canyon, and lower Juniper reaches is about 7 days. But with one extra crew (in addition to the CSU crew), we can increase our sampling effort to complete all three reaches within 3-4 days. We will also allow each section to have about a 3-4-day reset period before returning to resample in order to allow spawning habitat to reset with either displaced fish or new spawners.

Prediction of spawning period —CSU will measure water temperature daily at the Maybell gage and report to CPW and FWS when temperatures are expected to reach 16^0 C. Based on past years, this typically occurs between late-May and the end of June. Spawning generally starts during the last part of the descending hydrograph and ends when young bass leave the nest about the time runoff drops to base flow. Bass nests are active for 10-20 days depending on temperatures and we plan to sample intensively so that almost all nests, no matter when started, would be disturbed on two to five occasions. Intensive sampling should start within 5 days of temperatures reaching 16^0 C and continue for approximately 4 weeks or until water levels decline to a point that the river is un-navigable.

Spawning habitat probably occurs in all reaches but nests are often dispersed along the river shoreline or in backwaters and can vary in density. We propose sampling through all three spawning reaches at least once to discover and document either specific locations or sections of river where spawning is concentrated. We will then target spawning concentrations or river sections with high densities of spawning habitat on future removal occasions. If time and logistics allow, we will extend some effort in other reaches where spawning could be occurring after we have confirmed that spawning is occurring in known reaches.

YOY bass removal: After spawning and during low stream discharge in July and August, we will focus on removing young (age-0 and age-1) smallmouth bass from the lower 12-mile section of the Little Yampa Canyon study site (i.e. the original treatment reach designated in 2004). This reach is part of the control–treatment design within the native fish evaluation study (Bestgen et al. 2007). Young smallmouth bass will be captured with a 10 m-long electric seine powered by a 2000-watt generator.

Other gear may include boat or backpack electrofisher, angling, seine, trap net, or cages with baited or scented attractants. We will conduct at least three separate sampling occasions, in July and August, each about 10 days long and reaches will be sampled multiple times on each occasion. We will sample primarily shallow, low-velocity shorelines associated with backwaters, embayments, or among boulders deposited from talus slopes. All native and nonnative species will be handled as they are during boat electrofishing and as specified in Table 2 unless specified

differently by the state collecting permit. Results from this sampling will be analyzed and reported under Project 140.

Fish handling — Fish captured with boat electrofishing will be placed in a live well, total length (TL) measured to the nearest mm, and weighed with a Pesola® spring scale. Northern pike will be euthanized. Smallmouth bass > 100 mm TL captured in Little Yampa Canyon will be tagged with a numbered, Floy® t-bar anchor tag (model FD-94) and released on one sampling occasion for information about abundance, growth, and movement and on all other sample occasions they will be euthanized. At all other reaches smallmouth bass will be euthanized on all sample occasions. Fish that are euthanized will be overdosed with Tricaine methanesulfonate (MS-222). Fish that are euthanized will be provided to CPW researchers, kept as voucher specimens, cataloged into the LFL fish collection, or disposed of per state collecting permit requirements. We will evaluate if we are having a removal effect on white sucker and common carp by comparing their CPUE and relative abundance.

Endangered fishes and roundtail chub will be handled per guidelines and permits of the CPW and the FWS. All Colorado pikeminnow and roundtail chub will be captured, PIT tagged per Recovery Program protocol, and their location recorded within 0.1 mile. Other native fishes will be captured, measured, and released. All trout species and channel catfish will be measured and released in the river. Other nonnative species captured that will be euthanized include northern pike, centrarchids, black bullhead, walleye, brook stickleback, common carp, white sucker, and white sucker hybrids. Any other species captured that is on the Colorado prohibited species list will be removed and euthanized. When large numbers of non-targeted, nonnative species are captured in a sample, we will reduce handling time by counting the number captured and subsampling lengths for length-frequency histograms. See Colorado's prohibited species list: http://wildlife.state.co.us/RulesRegs/Regulations/.

Justification for marking and releasing fish: Middle Yampa Smallmouth bass

Methods: Smallmouth bass >=100 mm total length in the 24-mile Little Yampa Canyon (LYC) reach would be marked with a numbered Floy tag on one sampling occasion (pass). On all other passes, bass will be removed and euthanized. Reasons to mark bass include:

- The primary purpose is to obtain abundance (population size) data.
- We have marked smallmouth bass here since 2003 and consider it a sentinel reach because it is within the epicenter of smallmouth bass production in the Yampa River.
- It will allow us to continue monitoring the effects of changing management activities on smallmouth bass population dynamics.
- Marked fish will provide information about dispersal, movement, and growth; things that may change as the population responds to environmental or removal effects.
- Tracking abundance and immigration into LYC may help evaluate the effectiveness of the Elkhead screen. Recall that most of the bass that escaped Elkhead Reservoir moved into LYC and abundance data could help determine the effectiveness of that screen in reducing immigration and therefore abundance of smallmouth bass in LYC.
- Abundance data from mark and release studies have historically provided the best evidence of the effects of removal.

Upper Yampa northern pike

Methods: Northern pike in the upper 28-mile reach of the Yampa River from Steamboat Springs-Hayden Power Plant Intake will be removed and euthanized, except in years we are conducting an abundance estimate, and marking and releasing tagged fish on the first two sample occasions. Reasons to mark pike include:

- The primary purpose is to obtain abundance data and secondary purpose will be to track movement.
- Since 2005, there has been a large effort by CPW to remove northern pike from the river upstream of Steamboat Springs and from Catamount Reservoir. This effort has most likely reduced the dispersal of northern pike into the study reach and an abundance estimate will determine the population change compared to 10 years ago.
- An initial abundance estimate in 2019 will provide a baseline population estimate and future estimates will help assist the success of management or removal projects in or near the reach.

VII. Task Description and Schedule:

Task 1 Oct-Jan: (Project 125/ 98c) Consolidate data collected during previous fiscal year, write annual report, assemble and submit data to Recovery Program and Colorado Collecting Permit (SciColl) databases. Summarize results for National Park Service Investigator's Annual Report. Attend coordinating meetings and workshops with other agencies and PIs including database workshop, nonnative PI coordinating meeting, and training workshops. Prepare and present results of the previous year's fieldwork at: Dinosaur River Symposium, nonnative workshops, and Researcher's Annual Meeting. (6 weeks)

Task 2 Feb-Mar: (Project 125/ 98c) Prepare equipment, train crew, assemble maps and land ownership information, coordinate with CPW regarding access. Contact landowners and obtain permission for access on private property. Hire and train field crew; purchase, prepare, and fabricate equipment. (4 weeks)

Task 3 Apr: (Project 98c) Conduct three passes for northern pike between Steamboat and Highway 40 Bridge (4 weeks).

Task 4a Apr-May: (Project 125) Early season sampling. This activity will shift to Colorado pikeminnow sampling (Project 128) for abundance estimation in FY 2021-2023, but nonnative fish removal will still occur during Project 128 passes. In 2020, focus on removal of northern pike and smallmouth bass as part of this project. Coordinate with CPW to accomplish sampling during May (4 weeks in 2020).

This task is included in SOW 128 in FY 2021-2023 because it will focus on providing data for Colorado pikeminnow population estimates.

Task 4b Jun-Jul: (Project 125) Sampling in middle Yampa River to capture and remove smallmouth bass, northern pike and other invasive nonnative species. Coordinate with CPW in early June. (8 weeks) – This task reduced by budget cuts.

Task 5 Jul-Aug: (Project 125) Coordinate and conduct smallmouth bass removal and spawning disruption during the spawning period. (4 weeks)

Task 6 Jun-Aug: (Project 98c) Sampling for YOY pike to confirm spawning locations. Otolith removal, preparation, and aging to determine spawning dates. (4 weeks)

Task 7 Aug: (Project 125) Capture and remove YOY and yearling smallmouth bass from treatment sites. (4 weeks)

Task 8 Sept: (Project 125/ 98c) Equipment maintenance. Data entry and analysis. Meetings, interaction, and data sharing with other biologists and researchers. (4 weeks)

Table of Task schedule, Note Task 4a for Project 128 which samples in April and May and concentrates on capturing pikeminnow for abundance estimates

Task	Project	Oct	Sep	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	125 98c	x	x	x	x	x								
2a	125 98c					x	x	x						
3	98c								x					
4a	125 128								x	x				
4b	125										x	x		
5	125											x	x	
6	98c										x	x	x	
7	125												x	
8	125 98c													x

VIII. Deliverables, Due Dates, and Budget by Fiscal Year:

FY —2020-2021

Deliverables: Project annual reports to Program Directors Office by November each year.

Budget details in attached BOR Budget projection spreadsheets for each participating agency/group.

IX. Budget Summary:

	CSU- LFL	FWS- Grand Junction	FWS- Vernal	Total
FY-2020	$439,790	$16,587	$25,479	$481,856
FY-2021	$360,772	$16,831	$21,875	$399,478
FY-2022	$366,943	$17,080	$22,310	$406,333
FY-2023	$373,255	$17,334	$22,754	$413,343
FY-2024	$470,531	$17,592	$27,102	$515,225
Totals	$2,011,291	$85,424	$119,519	$2,216,235

X. Reviewers: Tildon Jones

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