

I. Project Title: **Evaluation of Smallmouth Bass and Northern Pike management in the middle Yampa River.**

II. Bureau of Reclamation Agreement Number: R14AP00001  
*Performance Progress Reports (PPR) attached for CSU and FWS.*

Project/Grant Period: Start date: 10/01/2008  
End date: 09/30/2018  
Reporting period end date: 09/30/2018  
Is this the final report? Yes \_\_\_\_\_ No x

III. Principal Investigator:  
John Hawkins John.Hawkins@ColoState.EDU  
Larval Fish Laboratory (970) 491-2777  
Dept. of Fish, Wildlife, and Conservation Biology (970) 491-5091 fax  
1474 Campus Mail  
Colorado State University  
Ft Collins, CO 80523 -

IV. Abstract:  
This study was an evaluation of whether Smallmouth Bass *Micropterus dolomieu* numbers can be controlled through active removal from reaches of the Yampa River that are critical habitat for Colorado Pikeminnow *Ptychocheilus lucius*. The study area included 103.5 miles of the middle Yampa River from near Craig, Colorado (River Mile, RM 151.0) to Dinosaur National Monument (RM 47.5) and was divided into eight reaches. Boat electrofishing occurred on up to nine occasions (passes) from April through June using two electrofishing Jon-boats or rafts that sampled both shorelines. Smallmouth Bass  $\geq 100$  mm were marked and released on one occasion in one reach (Little Yampa Canyon, RM 124.0-100.0) to estimate their abundance, evaluate how the population responds to removal, and monitor fish movement and growth. Using mark-recapture methods, we estimated 219 adult Smallmouth Bass (93—345, 95% CI; CV=29%) inhabited Little Yampa Canyon in 2018 which is substantially fewer than the 846 adults estimated in 2017. We estimated that 1,351 sub-adult Smallmouth Bass (101—3,197, 95% CI; CV=69%) occupied Little Yampa Canyon. A reduction in the adult population from 2017 to 2018 was supported by non-overlapping confidence intervals for the two abundance estimates. But, there was no support for a change in the sub-adult population due to overlapping confidence intervals and high coefficients of variation for that life stage in both years. In 2018, high confidence intervals and a high coefficient of variation was caused by low sample sizes, especially in the recapture pass due to poor environmental conditions that reduced catch rates during that sampling event. We only marked 52 sub-adult and 43 adult Smallmouth Bass and only recaptured one sub-adult and seven adults. Based on abundance estimates, density in Little Yampa Canyon was nine adult and 56 sub-adult Smallmouth Bass per mile.

With boat electrofishing in the spring, we removed 9,911 bass from all reaches of the middle Yampa River. In addition to spring boat electrofishing, from July through October, we removed 788 bass by angling and 8,422 bass using an electric seine. In total, we captured 19,121 Smallmouth Bass in all middle Yampa River reaches in 2018, almost twice as many as in 2017 (n=10,533), even though effort was similar. This total included 12,436 juveniles (<100 mm), 4,781 sub-adults (100-199 mm), and 1,905 adults (>=200 mm).

We also removed all Northern Pike from the middle Yampa River study area. Data for Northern Pike were provided to Colorado Division of Wildlife (CPW) biologists and those results are reported in Project # 98a. A final task was to remove adult Northern Pike from the reach between Steamboat Springs and Hayden (RM 194.2—170.6), identify and prioritize spawning areas, and capture young pike to confirm reproduction and obtain daily otolith ages to pinpoint spawning dates. We removed 107 Northern Pike from the upper Yampa River including 98 captured on four sampling occasions using raft electrofishing and nine captured using backpack electrofishing.

V. Study Schedule: *Initial year-2003 Final year- on going.*

VI. Relationship to RIPRAP:<sup>1</sup> Version: *May 17, 2018*  
Green River Action Plan: Yampa and Little Snake rivers

III Reduce negative impacts of nonnative fishes and sport fish management activities (nonnative and sport fish management).

III.B.1 Prevent nonnative fish introduction; reduce invasion and recruitment.

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 the Yampa River. See Hawkins *et al.* 2005. (YS J-1).

III.B.2.e. Remove (*formerly* "and translocate") Smallmouth Bass in Yampa River designated critical habitat. (YS J-1).

VII. Accomplishment of FY 2018 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Initial findings and preliminary results for 2018 are provided in the attached Appendices, but are subject to change as data are further analyzed. For comparison with previous results see Hawkins *et al.* 2008; 2009a; 2009b; 2010; 2011; 2012; 2013, 2014, 2015, 2016, 2017 and Wright 2009.

---

<sup>1</sup> Link to RIPRAP document: <http://www.coloradoriverrecovery.org/documents-publications/foundational-documents/RIPRAP/2018FinalRIPRAP.pdf>

VIII. Additional noteworthy observations: See attached report of preliminary results.

IX. Recommendations:

Recommendations for middle Yampa Smallmouth Bass removal

- Continue mark-recapture efforts to estimate Smallmouth Bass abundance in Little Yampa Canyon.
- Continue Smallmouth Bass removal.
- Continue intensive Smallmouth Bass nest disruption (The Surge) focusing on major production areas, especially in Little Yampa Canyon, South Beach, Lower Juniper, and Upper Maybell.
- Reallocate effort to ensure removal during the spawning period in Upper Maybell.
- Continue using raft EL into the base flow period to increase removal of sub-adult bass.

Recommendations for upper Yampa River Northern Pike removal

- Continue to focus Northern Pike removal in backwaters using raft electrofishing.
- Increase the use of gill and fyke nets in backwaters as appropriate.
- Conduct two mark passes for Northern Pike abundance in 2019.
- Follow 2019 marking passes with at least three removal passes.
- Identify spawning period with collection of YOY pike for daily otolith aging.
- Collect attribute data for spawning areas.

X. Project Status: on track and ongoing

XI. FY 2018 Budget Status

A. Funds Provided:	\$449,828
CSU:	\$411,491
FWS-Vernal:	\$22,739
FWS-Grand Junction:	\$15,598
B. Funds Expended	\$317,798
C. Difference:	\$132,030
D. Percent of the FY 2018 work completed, and projected costs to complete:90%	
Costs to complete: Funds were delayed and equipment maintenance and purchases earmarked in 2018 were postponed until now. Remaining monies will be spent on the following:	
Task 2: Annual Service- 5 boat engines	\$2,750
Service and repair of electrofishing equipment and boats	\$2,300
Task 2b:Purchase 17 ft Electrofishing boat and motor	\$29,900
Purchase 115 HP boat motor	\$11,000
Task 3: Repair and maintenance EL Rafts	\$1,150
Purchase ETS backpack electrofisher	\$6,700
Task 4: Purchase Field supplies and electrofishing supplies	\$4,200
Task 6: Labor- lab analysis of Pike otoliths	\$4,500
Purchase new boat motor to replace motor blown up in 2018.	\$11,000
Purchase truck- earmarked in 2017	<u>\$35,000</u>
Total of expenses that need completion:	\$108,500
E. Recovery Program funds spent for publication charges: none	

XII. Status of Data Submission: Endangered fish capture data and other database records of field collections will be submitted by early 2019.

XIII. Signed: John Hawkins                      11/16/18  
Principal Investigator                      Date

APPENDICES:

Annual Performance Progress Reports (3)

A: Preliminary Results of Smallmouth Bass removal in the middle Yampa River, 2018

B: Preliminary results of Northern Pike removal in the upper Yampa River, 2018.

## ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

BUREAU OF RECLAMATION AGREEMENT NUMBER: R14AP00001

UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: FR-125

Project Title: Evaluation of Smallmouth Bass and Northern Pike management in the middle Yampa River.

Principal Investigator: John Hawkins

Larval Fish Laboratory

Dept. of Fish, Wildlife, and Conservation Biology

Colorado State University

Ft Collins, Colorado 80523

970-491-2777/ fax 970-491-5091

john.hawkins@colostate.edu

Project/Grant Period:            Start date (Mo/Day/Yr): 1 Oct. 2008  
   End date: (Mo/Day/Yr): 30 Sept. 2019  
   Reporting period end date: 30 Sept. 2018  
   Is this the final report? Yes \_\_\_\_\_ No X

Performance: The Larval Fish Laboratory completed all tasks and objectives of the Smallmouth Bass portion of this work. We obtained an estimate of the number of Smallmouth Bass in Little Yampa Canyon. We coordinated Surge sampling with CPW and USFWS. We conducted one marking pass followed by five removal passes in Little Yampa Canyon and five removal passes in Lily Park. We assisted Colorado Parks and Wildlife in removal of nonnative fishes in South Beach and Lower Juniper reaches. Large numbers of invasive nonnative predators were removed from Critical Habitat on multiple occasions from April through October.

We conducted four removal passes for Northern Pike between Steamboat Springs and Highway 40 Bridge and sampled for YOY pike to confirm spawning locations and timing. We produced an annual report on activities in 2018 and plan to present data at meetings in January 2019.

## ANNUAL PERFORMANCE PROGRESS REPORT

BUREAU OF RECLAMATION AGREEMENT NUMBER: R15PG00083

UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: 125

Project Title: Evaluation of Smallmouth Bass and Northern Pike management in the middle Yampa River.

Principal Investigator:

Christian Smith  
1380 S 2350 W, Vernal, UT 84078  
christian\_t\_smith@fws.gov; 435-789-0351 x21

Project/Grant Period:

Start date: 10/01/2014  
End date: 09/30/2019  
Reporting period end date: 09/30/2018  
Is this the final report? Yes \_\_\_\_\_ No  X

Performance:

US Fish & Wildlife Service Green River Basin FWCO contributed personnel and equipment for two weeks in June to assist with the 2018 Yampa River Surge. All data were submitted to the CSU Larval Fish Lab, who will compile, analyze, and report the results.

## ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

BUREAU OF RECLAMATION AGREEMENT NUMBER: -R15PG00083

UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: 125

Project Title: Evaluation of Smallmouth Bass and Northern Pike Management in the Middle Yampa River (Surge)

Principal Investigator: Travis Francis, Fish Biologist  
Dale Ryden, Project Leader  
U.S. Fish and Wildlife Service  
Grand Junction FWCO  
445 West Gunnison Ave., Suite 140  
Grand Junction, Colorado 81501  
Phone: (970) 628-7204  
Fax (970) 628-7217  
Email: travis\_francis@fws.gov  
dale\_ryden@fws.gov

Project/Grant Period: Start date (Mo/Day/Yr): 10/1/2014  
End date: (Mo/Day/Yr): 9/30/2019  
Reporting period end date (Mo/Day/Yr): 9/30/2018  
Is this the final report? Yes \_\_\_\_\_ No  X

### Performance:

We were tasked with providing a 3-person field crew for 8 days (total of 24 man days) with administrative support to assist crews from the CSU – Larval Fish Laboratory sometime from mid-June to mid-July. The 2018 Smallmouth Bass “Surge” effort was targeted to remove Smallmouth Bass as the Yampa River neared base flows. From June 18-22, we provided two jet-powered, hard-bottomed, electrofishing boats and a 4-person crew for 5 days (20 man days). Then from June 25-29, we provided two electrofishing rafts and a 4-person crew for 5 days (20 man days).

Appendix A:

**Preliminary results of the removal of Smallmouth Bass from the middle Yampa River, 2017.**

Hawkins, J. (CSU), C. Walford, (CSU), D. Tuttle III (CSU) and T. Eyre (CPW).

**Methods-Middle Yampa SMB removal**

The study area was primarily within a 103.5-mile reach of the middle Yampa River, between Craig, Colorado (river mile; RM 151.0) and Dinosaur National Monument boundary (RM 47.5) and consisted of eight reaches totaling 96.1 miles of river sampled by Colorado Parks and Wildlife (CPW) and Colorado State University-Larval Fish Laboratory (CSU). An additional study area included a 16.5-mile section between Hayden and Craig, Colorado sampled during Smallmouth Bass spawning by US Fish and Wildlife Service (FWS). Data for Smallmouth Bass captured by those agencies are summarized in this report.

Study reaches in the middle Yama River.

<u>Reach</u>	<u>Agency</u>	<u>RM</u>	<u>Area sampled (miles)</u>
Lily Park	CSU	47.5 -- 55.5	8.0
Sunbeam	CPW	60.6 -- 71.0	10.4
Lower Maybell	CPW	71.0 -- 79.2	8.2
Upper Maybell	CPW	79.2 – 88.7	9.5
Lower Juniper	CPW	91.0 – 100.0	9.0
Little Yampa Canyon	CSU	100.0 – 124.0	24.0
South Beach	CPW	124.0 – 134.5	10.5
Hayden-Craig	FWS	134.5-151.0	16.5

Fish sampling occurred with boat electrofishing on up to nine occasions (passes) at each reach during runoff from April through June, typically using two electrofishing boats or rafts sampling both shorelines continuously downstream. Reaches with higher catch rates received greater effort by increasing the number of passes. We removed and euthanized Smallmouth Bass from all reaches on all sampling occasions except during one pass in Little Yampa Canyon when bass were marked and released, to estimate abundance, movement, and growth. On that marking pass, Smallmouth Bass  $\geq 100$ -mm total length were marked with a numbered, yellow, Floy tag and released.

Smallmouth Bass were assigned to life stages based on their total length: juvenile ( $< 100$  mm), sub-adult (100–199 mm), and adult ( $\geq 200$ -mm). We also grouped large, piscivorous Smallmouth Bass ( $\geq 325$ -mm) that are considered the highest predatory threat to native fishes. In each reach, we estimated catch rates (# fish captured/hour) for each pass and in Little Yampa Canyon we also estimated abundance and compared results with previous years. Annual length frequency histograms exposed strong or weak year classes.

Concurrent with Smallmouth Bass sampling, in all reaches we removed other invasive nonnative species including Northern Pike, White Sucker, white sucker hybrids, centrarchids, Black Bullhead, Creek Chub, and Common Carp. We measured lengths and released alive all trout and Channel Catfish. Northern Pike data were reported by CPW in Project # 98a annual report. In



Little Yampa Canyon and Lily Park, we (CSU) captured and measured all species of fish encountered on all sample occasions and reported fish community structure and composition.

### **Spawning disruption (The Surge)**

In 2018, we completed the ninth year of an intensive removal program (The Surge) targeting the spawning period for Smallmouth Bass within the Craig, South Beach, Little Yampa Canyon, and Lower Juniper reaches. This area has a high concentration of spawning areas for Smallmouth Bass and is easily accessible. The goal was to remove large numbers of adult bass and reduce reproductive success by capturing or displacing adult fish during nest building, spawning, or nest guarding. Field crews and equipment from FWS (Vernal and Grand Junction) assisted with Surge sampling. During the Surge, as flows declined towards base flow, we maximized catch rates by focusing on reaches with known spawning habitat where spawning adult bass were highly susceptible to capture. Targeted spawning areas included braided river sections, backwaters, scour holes, or pools below debris fans. We declared the start of spawning when minimum daily water temperatures remained above 16°C at the USGS Maybell Gage (09251000) and in 2018, this began on June 12<sup>th</sup>. Smallmouth Bass were removed in target reaches on up to four occasions from June 12<sup>th</sup> through June 29<sup>th</sup> using Jon-boat and raft electrofishers.

### **Young-of-Year (YOY) Smallmouth Bass removal**

After bass spawning ended, we sampled from July through October with an electric seine or backpack electrofisher to determine spawning success and remove small-bodied, primarily YOY, Smallmouth Bass from a 12-mile Treatment reach in Little Yampa Canyon (RM 112-100).

### **Results-Middle Yampa SMB removal**

#### **Smallmouth Bass abundance and exploitation**

Using a Lincoln-Petersen model, we estimated 219 adult Smallmouth Bass (93—345, 95% CI; CV=29%) inhabited Little Yampa Canyon in 2018 (Table 1; Figure 1). We estimated that 1,351 sub-adult Smallmouth Bass (101—3,197, 95% CI; CV=69%) inhabited Little Yampa Canyon in 2018. Point estimates of abundance for both life stages were lower than in 2017, when sub-adult abundance was 3,149 fish (489—5809, 95% CI; CV=43%) and adult abundance was 846 fish (497—1194, 95% CI; CV=21%). A reduction in the adult population from 2017 to 2018 was supported by non-overlapping confidence intervals for the two abundance estimates. But, there was no support for a change in the sub-adult population due to overlapping confidence intervals and high coefficients of variation for that life stage in both years. In 2018, high confidence intervals and a high coefficient of variation was caused by low sample sizes, especially in the recapture pass due to poor environmental conditions that reduced catch rates during that sampling event. We only marked 52 sub-adult and 43 adult Smallmouth Bass and only recaptured one sub-adult and seven adults. Based on 2018 abundance estimates, densities of Smallmouth Bass in Little Yampa Canyon were 9 adults and 56 sub-adults per mile (Table 1).

#### **Exploitation Rates**

As a measure of the percentage of Smallmouth Bass that we removed from Little Yampa Canyon each year (exploitation rate), we divided the number of fish removed by boat electrofishing on all passes by the abundance estimate. We calculated that we removed 79% (n=1070) of the sub-adult and 177% (n=388) of the adult Smallmouth Bass from Little Yampa Canyon in 2018

(Table 1). Unfortunately, our confidence is low for both exploitation rates because the abundance estimates are likely imprecise and underestimate the size of each life stage. This would result in overestimating the exploitation rate. It is not likely that there was a large increase in the number of adult fish in the reach in 2018, because our unpublished movement data of Smallmouth Bass from prior years in the reach do not support large immigrations of adult fish from adjacent reaches. Finally, the possibility of sub-adults that reside in the reach, growing and recruiting to the adult group is low because most of our removal occurs in the early spring, prior to optimum temperatures that initiate growth of Smallmouth Bass. An exploitation rate higher than our estimated population size is more likely indicative of an underestimated population due to low sample sizes during both the mark and the recapture passes. Therefore, it is more likely that adult abundance is actually greater than we estimated and exploitation rates are less than 100% of the population.

To understand the potential impacts of releasing tagged fish back in the wild, we examined the number of those fish that we recaptured and removed on subsequent passes. We marked and released 6% (n=95) of the 1,555 sub-adult and adult Smallmouth Bass captured by boat electrofishing in Little Yampa Canyon. Of the 95 Smallmouth Bass tagged, we recaptured 34 during additional sampling throughout the year, including 9 (17%) of the 52 tagged sub-adult smallmouth bass and 25 (58%) of the 43 tagged adult smallmouth bass originally tagged and released in 2018. We also recaptured an additional 19 smallmouth bass originally tagged in Little Yampa Canyon in 2016 and 2017.

### **Fish removal effort**

In 2018, we sampled a total of 628 hours with boat and raft electrofishing from April through June. Most of that effort occurred in Little Yampa Canyon (229 hours). Other reaches with high effort included South Beach (105 hours), Lower Juniper (70 hours), and Upper Maybell (75 hours; Table 2). The remaining four reaches (Craig, Lower Maybell, Sunbeam, and Lily Park) had between 20 and 50 hours of electrofishing effort. In Little Yampa Canyon, we angled with hook and line fishing for 110 man-hours. E-seine and backpack electrofishing effort at Little Yampa Canyon included 34 hours during six sample passes from July through October. Effort for each gear was slightly higher in 2018 than in 2017 when sampling effort totaled 610 hours of boat and raft electrofishing, 86 hours of angling, and 30 hours of electric seine.

### **Total captures by gear type**

We captured 19,121 Smallmouth Bass including 9,911 captured by boat electrofishing, 788 captured by angling, and 8,423 captured by electric seine (Table 3). The number of Smallmouth Bass captured in 2018 was almost twice as many as the total number we captured by boat electrofishing (n=5,385) and electric seine (n=4,599) in 2017. We captured about the same percentage of large piscivore-sized Smallmouth Bass ( $\geq 325$  mm TL) in 2018 as in 2017. In 2018, 0.4% (n=36) of 9,911 Smallmouth Bass were  $\geq 325$  mm TL, similar to the 0.3% observed in 2017 and fewer than the 1.0% observed in 2016.

### **Catch Rates- boat electrofishing**

Smallmouth Bass occupy all reaches of the middle Yampa River and catch rates reflect a combination of fish density in each reach and environmental conditions on any given pass. Catch rates (CPUE) for Smallmouth Bass captured by boat electrofishing were highest in Craig (31 fish/hr), Upper Maybell (26 fish/hr) and Lily Park (25 fish/hr; Table 2; Figure 2). Catch rates

were high in the Craig reach because all sampling reported here occurred during the spawning period when bass were highly vulnerable to capture and catch rates were therefore high. High overall catch rates were driven by high numbers of juvenile fish produced in 2017 as shown in the 2018 length-frequency histogram (Table 2; Figure 4). Adult catch rates were highest at Lily Park (6 fish/hr) and Upper Maybell (5.5 fish/hr); otherwise, adult catch rates were between 2-3 fish/hr in other reaches. Sub-adult catch rates were highest at Craig (11 fish/hr), Upper Maybell (11 fish/hr), and Lower Juniper (8 fish/hr; Table 2; Figure 3). Juvenile catch rates were highest in Craig (20 fish/hr), Lily Park (13 fish/hr), and Upper Maybell (11 fish/hr). There is little spawning habitat in Lily Park, so high juvenile abundance there reflects reproduction and dispersal from other reaches.

Catch rates were lower than in prior years for the first passes in Little Yampa Canyon and Lower Juniper, and on the first and third passes in Lily Park in 2018 compared to prior years because during those passes we targeted Colorado pikeminnow, rather than trying to capture both Colorado Pikeminnow and Smallmouth Bass. Electrofishing techniques that targeted Colorado Pikeminnow sampled the shoreline with the electrofishing boat facing downstream and moving at the same speed as the current; whereas, techniques that targeted Smallmouth Bass faced the boat upstream and used engine power to hover or move downstream backwards, often slower than the current, in order to pull bass from cover along the shore.

During the Surge, we increased our effort significantly during spawning season in reaches with known spawning concentrations (Craig, South Beach, Little Yampa Canyon, and Lower Juniper). Our highest catch rates occurred during Surge passes and a large percentage of Smallmouth Bass were captured during those passes. For example, in the three Surge reaches sub-adult or adult Smallmouth Bass catch rates averaged 1.2 fish/hr during early sampling; whereas, during the surge we averaged 7.6 fish/hr.

We recommend the continued use of electrofishing boats during higher flows periods and electrofishing rafts during lower flow periods to exploit high capture rates of sub-adult Smallmouth Bass. Sampling during the spawn was highly effective because spawning Smallmouth Bass are territorial and remain near their nests in shallow water where they are highly susceptible to the electrofishing gear. By removing spawning fish from active spawning sites we open habitat to new spawners who are then available for capture on our next pass. When possible we allowed 2-5 days between removal passes for these areas to refill with new fish and then resampled each area to remove another wave of spawners.

At base flow, after spawning, Smallmouth Bass were readily captured with raft electrofishing in backwaters and along outer bends with boulder or rubble cover. Sub-adult bass were easily trapped and captured by raft electrofishing in short, deep, clear backwaters where they were attracted to abundant, small, forage fishes.

We tracked year-class strength of Smallmouth Bass produced the year before by monitoring the number of juveniles (<100 mm) captured by boat electrofishing in the early spring. Juveniles captured in the spring are almost entirely of age-1 fish produced the year before. In 2018, Juvenile captures (n=4,725) represented a large proportion (48%) of Smallmouth Bass captured in all reaches in the early spring by boat electrofishing (n=9,911; Table 2). High capture rates

suggested production of a strong year class in 2017 and similar to the abundant 2013 cohort captured in 2014 (Figure 4).

Comparatively fewer juveniles were captured by boat electrofishing in the spring in 2017 and 2016, suggesting year-class-strength was poor in 2015 and 2016 and partially explain why fewer adults were captured in recent years. Environmental effects from flash floods in 2015 had a potentially large effect on success of nesting bass, resulting in low catch rates of juveniles in the spring of 2016. Contrast this to the strong year classes produced in 2012 and 2013 that persisted up until age 3 (Figure 4). However, even those strong year classes did not persist after age-3, possibly because catch rates increased as those fish grew to larger sizes and became more susceptible to capture by boat electrofishing gear (Breton et al. 2014).

### **Catch Rates-electric seine, backpack electrofisher, and angling**

From July through October, when flows were too low to use large electrofishing boats, we shifted to techniques and gear that targeted smaller-sized Smallmouth Bass and sampled for 32.5 hours with an electric seine and 1.8 hours with a backpack electrofisher in the 12-mile study reach of Little Yampa Canyon. E-Seine catch rates for juvenile Smallmouth Bass in 2018 (225 fish/hr) were higher than in 2017 (150 fish/hr), but similar to 2016 catch rates (232 fish/hr). We also sampled opportunistically with hook and line angling for additional removal of Smallmouth Bass. Angling effort totaled 110 person-hours, removed an additional 788 Smallmouth Bass, and provided relatively high catch rates of 7.2 fish/hr. (Table 2).

### **Spawning observations**

Spawning started around June 12 based on minimum water temperatures that reached and remained above 16<sup>0</sup>C and spawning continued through the end of June based on adequate habitat, water temperatures, and captures of ripe males or females in spawning habitat. Smallmouth Bass were observed or captured over nesting-type habitat in all Surge reaches.

### **Fish Community Sampling**

During boat electrofishing, we captured, counted, and measured all fish species on all sampling occasions in Little Yampa Canyon and Lily Park. Nonnative fish still dominated the fish community, comprising 96% of all fish collected in Little Yampa Canyon (Table 4). Smallmouth Bass and White Sucker were the most abundant fishes collected in Little Yampa Canyon. Black Crappie increased ten-fold from their numbers in 2017. Only 15 Northern Pike were captured in Little Yampa Canyon in 2018, compared to 51 in 2017. Data that we collected in the field on Northern Pike was provided to CPW and they summarized and reported that data in their annual report for Project 98a. We did not capture Colorado Pikeminnow in Little Yampa Canyon in 2018. At Lily Park, the number of native fish captured was similar to previous years but the percentage of native fishes declined from 63% in 2017 to 45% in 2018 due to a substantial increase in the number of White Sucker and Smallmouth Bass captured in 2018. Smallmouth Bass and White Sucker increased their numbers by a factor of two and three respectively, compared to 2017. We captured 29 Northern Pike in Lily Park in 2018, similar to the 26 captured in 2017. We captured nine Colorado Pikeminnow in Lily Park compared to two captured in 2017. Because Colorado Pikeminnow numbers have declined drastically in recent years, one of our goals was to use sampling techniques to increase their catch. These techniques were discussed above in the section on catch rates for boat electrofishing. Several small-bodied fish species were present in our samples in low numbers, including nonnative Redside Shiner,

Sand Shiner, Brook Stickleback, and native Speckled Dace and Mottled Sculpin. However, the numbers of those species collected by boat electrofishing are low because our techniques and gear do not target those sizes. For example, most small-bodied species are small enough, even as adults, to slip through the mesh of our dipnets.

### **Recommendations for Middle Yampa Smallmouth Bass**

- Continue mark-recapture efforts to estimate Smallmouth Bass abundance in Little Yampa Canyon.
- Continue Smallmouth Bass removal.
- Continue intensive Smallmouth Bass nest disruption (The Surge) focusing on major production areas, especially in Little Yampa Canyon, South Beach, Lower Juniper, and Upper Maybell.
- Reallocate effort to insure removal during the spawning period in Upper Maybell.
- Continue using raft EL into the base flow period to increase removal of sub-adult bass.

### **Acknowledgements**

We thank field crews that assisted with collections. CSU field crew included, Kyle Dick, Drew Ebner, Erik Cristan, Robert Garza, Kalli Jimmie, Lance Ostrom, Jamie Smith, and Jed Thompson. We thank Travis Francis (FWS, Grand Junction) and Christian Smith (FWS, Vernal, Utah) and their crews for sampling assistance. We thank Kyle Dick, Kalli Jimmie and Tildon Jones (FWS) for reviewing this report.

### **References**

Breton, A., D. Winkelman, J. Hawkins, and K. Bestgen. 2014. Population trends of smallmouth bass in the upper Colorado River Basin with an evaluation of removal effects. Project 161 Final Report to Upper Colorado River Endangered Fish Recovery Program, U.S. Fish and Wildlife Service. Larval Fish Laboratory Contribution 169.

Hawkins. J. 2008. Evaluation of smallmouth bass and Northern Pike management in the middle Yampa River. Project 125. 2008 Annual Report to the Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service.

Hawkins, J. C. Walford, and A. Hill. 2009a. Smallmouth bass control in the middle Yampa River, 2003-2007. Contribution 154 of the Larval Fish Laboratory, Colorado State University. Final Report for the Upper Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service.

Hawkins. J., C. Walford, B. Wright., J. Logan, and A. Hill. 2009b. Evaluation of smallmouth bass and northern pike management in the middle Yampa River. Project 125. 2009 Annual Report to the Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service.

Hawkins. J., C. Walford, and B. Wright. 2010 Evaluation of smallmouth bass and northern pike management in the middle Yampa River. Project 125. 2010 Annual Report to the Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service.

Hawkins, J., C. Walford, and B. Wright. 2011 Evaluation of smallmouth bass and northern pike management in the middle Yampa River. Project 125. 2011 Annual Report to the Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service.

Hawkins, J., C. Walford, and K. Battige. 2012 Evaluation of smallmouth bass and northern pike management in the middle Yampa River. Project 125. 2012 Annual Report to the Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service.

Hawkins, J., C. Walford, and K. Battige. 2013 Evaluation of smallmouth bass and northern pike management in the middle Yampa River. Project 125. 2013 Annual Report to the Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service

Hawkins, J., C. Walford, and K. Battige. 2014 Evaluation of smallmouth bass and northern pike management in the middle Yampa River. Project 125. 2014 Annual Report to the Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service

Hawkins, J., C. Walford, K. Battige, and C. Noble. 2015. Evaluation of smallmouth bass and northern pike management in the middle Yampa River: Preliminary results of the removal of smallmouth bass from the middle Yampa River and Northern Pike from the upper Yampa River. Project 125. 2015 Annual Report to the Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service.

Hawkins, J., C. Walford, and C. Noble. 2016. Evaluation of smallmouth bass and northern pike management in the middle Yampa River: Preliminary results of the removal of smallmouth bass from the middle Yampa River and Northern Pike from the upper Yampa River. Project 125. 2016 Annual Report to the Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service

Hawkins, J., C. Walford, D. Tuttle III, and T. Eyre. 2017. Evaluation of smallmouth bass and northern pike management in the middle Yampa River: Preliminary results of the removal of smallmouth bass from the middle Yampa River and Northern Pike from the upper Yampa River. Project 125. 2017 Annual Report to the Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service

Wright, B. 2009. Middle Yampa River northern pike removal and evaluation: Smallmouth Bass evaluation and limited removal. Project 98a. 2008 Annual Report to the Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service.

Table 1--- Abundance estimates for sub-adult (100-199 mm) and adult ( $\geq 200$  mm) Smallmouth Bass in 24-mile long Little Yampa Canyon, Yampa River, 2018. Abundance estimated used a Lincoln-Petersen estimator. SE = Standard Error. CV= Coefficient of Variation. Exploitation rate (percent removed) calculated as the percent of the population size of Smallmouth Bass removed from Little Yampa Canyon by boat electrofishing after the marking passes were completed.

---

Life Stage	Abundance	95% CI	SE	CV %	Density # fish/mile	# fish removed	% fish removed
Sub-adult	1,351	101—3,197	936.9	69	56	1,070	79%
Adult	219	93—345	64.5	29	9	388	177%

---

Table 2—CPUE (Catch per unit effort) for Smallmouth Bass captured by boat electrofishing, angling, and E-Seine in the middle Yampa River, 2018. Life stages based on length: juvenile (<100 mm), sub-adult (100-199 mm), and adult (≥200 mm).

<b>Craig</b>				Number of fish				CPUE (# fish/hr)			
Pass	Sampling Period	Agency	Effort (Hrs)	Juv	Sub-adult	Adult	All sizes	Juv	Sub-adult	Adult	All sizes
1	Jun 18	FWS	9.2	111	81	12	204	12.1	8.8	1.3	22.2
2	Jun 20-21	FWS	7.2	123	51	3	177	17.2	7.1	0.4	24.7
3	Jun 18-26	FWS	5.4	198	100	3	301	36.8	18.6	0.6	56.0
Total			21.7	432	232	18	682	19.9	10.7	0.8	31.4

<b>South Beach</b>				Number of fish				CPUE (# fish/hr)			
Pass	Sampling Period	Agency	Effort (Hrs)	Juv	Sub-adult	Adult	All sizes	Juv	Sub-adult	Adult	All sizes
1	Apr 21-23	CSU	7.7	--	--	--	--	--	--	--	--
2	May 8	CPW	10.9	6	12	9	27	0.6	1.1	0.8	2.5
3	May 15	CPW	11.9	46	24	21	91	3.9	2.0	1.8	7.7
4	May 25	CPW	12.8	49	30	14	93	3.8	2.4	1.1	7.3
5	May 31	CPW	11.9	29	19	7	55	2.4	1.6	0.6	4.6
6	Jun 7	CSU	13.8	112	33	10	155	8.1	2.4	0.7	11.3
7	Jun 14-18	CSU	9.4	6	40	53	99	0.6	4.3	5.7	10.6
8	Jun20-21	CSU	11.3	78	58	17	153	6.9	5.1	1.5	13.6
9	Jun 24-27	CSU	14.9	215	158	19	392	14.5	10.6	1.3	26.4
Total			104.5	541	374	150	1065	5.2	3.6	1.4	10.2

<b>Little Yampa Canyon-EL Boat</b>				Number of fish				CPUE (# fish/hr)			
Pass	Sampling Period	Agency	Effort (Hrs)	Juv	Sub-adult	Adult	All sizes	Juv	Sub-adult	Adult	All sizes
1	Apr 18-23	CSU	20.6	1	--	2	3	0.0	0.0	0.1	0.1
2-Mark	May 3-8	CSU	33.6	178	52	43	273	5.3	1.5	1.3	8.1
3-Recap	May17-20	CSU	32.8	204	50	39	293	6.2	1.5	1.2	8.9
4	Jun 1-3	CSU	35.9	358	42	36	436	10.0	1.2	1.0	12.2
5	Jun 12-17	CSU	30.9	152	169	152	473	4.9	5.5	4.9	15.3
6	Jun 18-22	CSU	35.9	388	436	124	948	10.8	12.2	3.5	26.4
7	Jun 24-29	CSU	39.6	401	373	37	811	10.1	9.4	0.9	20.5
Total			229.2	1682	1122	433	3237	7.3	4.9	1.9	14.1



Table 2-cont.

**Little Yampa Canyon-E-Seine  
and backpack electrofisher**

Pass	Sampling Period	Agency	Effort (Hrs)	Number of fish			CPUE (# fish/hr)				
				Juv	Sub- adult	Adult	All sizes	Juv	Sub- adult	Adult	All sizes
1	Jul 11-13	CSU	1.65	66	5	2	73	40	3.6	1.2	44.8
2	Jul 25-31	CSU	6.95	1098	117	3	1218	158	16.8	0.4	175.3
3	Aug 9	CSU	0.78	82	1	--	83	105.1	1.3	--	106.4
4	Aug22-25	CSU	3.77	944	83	--	1027	250.4	22.0	--	272.4
5	Sept 5-11	CSU	5.13	792	101	6	899	154.4	19.7	1.2	175.2
6	Sept18-25	CSU	10.5	3796	354	11	4161	361.5	33.7	1.0	396.3
7	Oct 6	CSU	0.66	67	--	--	67	101.5	--	--	101.5
8	Oct 16-18	CSU	4.85	862	31	1	894	177.7	6.4	0.2	184.3
Total			34.29	7707	692	23	8422	224.8	20.2	0.7	245.6

**Little Yampa Canyon-Angling**

Pass	Sampling Period	Agency	Effort (Hrs)	Number of fish			CPUE (# fish/hr)				
				Juv	Sub- adult	Adult	All sizes	Juv	Sub- adult	Adult	All sizes
1	Jun 26	CSU	0.5	--	4	--	4	--	8	--	8.0
2	Jul 11-12	CSU	20	1	85	16	102	0.05	4.3	0.8	5.1
3	Jul 26-27	CSU	18	--	141	34	175	--	7.8	1.9	9.7
4	Aug 24-26	CSU	19	--	80	32	112	--	4.2	1.7	5.9
5	Sept 6-11	CSU	20	2	111	79	192	0.1	5.6	4.0	9.6
6	Sept19-25	CSU	19.8	1	99	90	190	0.1	5.0	4.6	9.6
7	Oct 4	CSU	12.5	--	--	13	13	--	0.0	1.0	1.0
Total			110.0	4	520	264	788	0.04	4.7	2.4	7.2

**Lower Juniper**

Pass	Sampling Period	Agency	Effort (Hrs)	Number of fish			CPUE (# fish/hr)				
				Juv	Sub- adult	Adult	All sizes	Juv	Sub- adult	Adult	All sizes
1	Apr 22	CSU	7.6	--	--	--	--	--	--	--	--
2	May 9	CSU	10.6	18	11	13	42	1.7	1.0	1.2	4.0
3	May 22	CPW	10.0	35	12	9	56	3.5	1.2	0.9	5.6
4	May30- Jun 1	CSU	10.8	45	7	16	68	4.2	0.6	1.5	6.3
5	Jun 13	CSU	11.0	71	120	62	253	6.4	10.9	5.6	22.9
6	Jun 19	CSU	12.3	91	182	56	329	7.4	14.8	4.6	26.8
7	Jun 23-29	CSU	7.8	128	229	53	410	16.4	29.4	6.8	52.6
Total			70.2	388	561	209	1158	5.5	8.0	3.0	16.5

Table 2-cont.

<b>Upper Maybell</b>				Number of fish				CPUE (# fish/hr)			
Pass	Sampling Period	Agency	Effort (Hrs)	Juv	Sub-adult	Adult	All sizes	Juv	Sub-adult	Adult	All sizes
1	May 4	CPW	10.9	53	45	48	146	4.9	4.1	4.4	13.4
2	May10-11	CPW	13.5	50	214	125	389	3.7	15.9	9.3	28.9
3	May 17	CPW	14.0	107	261	87	455	7.6	18.6	6.2	32.4
4	May 29	CPW	12.8	222	132	54	408	17.4	10.3	4.2	32.0
5	Jun 5	CPW	11.5	180	74	40	294	15.7	6.4	3.5	25.6
6	Jun 8	CPW	12.1	119	76	60	255	9.9	6.3	5.0	21.1
Total			74.8	731	802	414	1947	9.8	10.7	5.5	26.0

<b>Lower Maybell</b>				Number of fish				CPUE (# fish/hr)			
Pass	Sampling Period	Agency	Effort (Hrs)	Juv	Sub-adult	Adult	All sizes	Juv	Sub-adult	Adult	All sizes
1	May 1-2	CPW	9.4	8	19	17	44	0.8	2.0	1.8	4.7
2	May 11	CPW	9.6	21	48	32	101	2.2	5.0	3.3	10.5
3	May 18	CPW	7.6	71	31	19	121	9.3	4.1	2.5	15.9
4	May 23	CPW	12.0	103	39	18	160	8.6	3.2	1.5	13.3
5	Jun 6	CPW	11.5	71	26	16	113	6.2	2.3	1.4	9.8
Total			50.2	274	163	102	539	5.5	3.2	2.0	10.7

<b>Sunbeam</b>				Number of fish				CPUE (# fish/hr)			
Pass	Sampling Period	Agency	Effort (Hrs)	Juv	Sub-adult	Adult	All sizes	Juv	Sub-adult	Adult	All sizes
1	May 3	CPW	10.5	25	9	17	51	2.4	0.9	1.6	4.9
2	May 16	CPW	11.5	57	22	12	91	5.0	1.9	1.0	7.9
3	Jun 24	CPW	12.9	40	16	8	64	3.1	1.2	0.6	5.0
Total			34.9	122	47	37	206	3.5	1.3	1.1	5.9

<b>Lily Park</b>				Number of fish				CPUE (# fish/hr)			
Pass	Sampling Period	Agency	Effort (Hrs)	Juv	Sub-adult	Adult	All sizes	Juv	Sub-adult	Adult	All sizes
1	May 2	CSU	6.3		2	18	20	0.0	0.3	2.9	3.2
2	May15-16	CSU	13.3	245	118	120	483	18.5	8.9	9.0	36.4
3	May 21	CSU	6.4	1	5	16	22	0.2	0.8	2.5	3.4
4	May30-31	CSU	10.5	222	90	57	369	21.2	8.6	5.4	35.3
5	Jun 4	CSU	6.1	87	52	44	183	14.3	8.6	7.2	30.1
Total			42.5	555	267	255	1077	13.1	6.3	6.0	25.3

Table 2-cont

<b>Totals by Gear Type</b>		Effort (Hrs)	Number of fish				CPUE (# fish/hr)			
Gear	Sampling Period		Juv	Sub- adult	Adult	All sizes	Juv	Sub- adult	Adult	All sizes
EL-Boat	Apr-Jun	627.8	4725	3568	1618	9911	7.5	5.7	2.6	15.8
Angling	July-Oct	110.0	4	520	264	788	0.04	4.7	2.4	7.2
E-Seine	July-Oct	34.3	<u>7707</u>	<u>692</u>	<u>23</u>	<u>8423</u>	<u>225</u>	<u>20.2</u>	<u>0.7</u>	<u>245.6</u>
Total			12436	4780	1905	19121				

Table 3— Number of Smallmouth Bass captured in the middle Yampa River, 2018. Includes 95 Smallmouth Bass marked and released in Little Yampa Canyon for abundance estimation.

Reach	Boat electrofishing	Number of fish	
		Angling	E-Seine
Craig	682		
South Beach	1,065		
Little Yampa Canyon	3,237	788	8,422
Lower Juniper	1,158		
Upper Maybell	1,947		
Lower Maybell	539		
Sunbeam	206		
Lily Park	1,077		
Total	9,911	788	8,422

Table 4---Number and relative abundance of fish captured by boat electrofishing in Little Yampa Canyon, Yampa River, Colorado, 2018. Released bass were marked with Floy tags and released for estimating abundance, movement, and growth.

LYC	Number of fish			Relative Abundance (%)
	Removed	Released	Total	
<b><i>nonnative species</i></b>				
Smallmouth Bass	3142	95	3237	35.9
Northern Pike	13	-	13	0.1
White Sucker	4860	-	4860	53.9
White X Flannelmouth Sucker	40	-	40	0.4
White X Bluehead Sucker	40	-	40	0.4
Creek Chub	246	-	246	2.7
Green Sunfish	34	-	34	0.4
Rainbow Trout	-	31	31	0.3
Brown Trout	-	64	64	0.7
Cutthroat Trout	-	1	1	0.01
Cutthroat x Rainbow Trout	-	2	2	0.02
Black Bullhead	6	-	6	0.1
Black Crappie	65	-	65	0.7
Redside Shiner	2	-	2	0.01
Sand Shiner	7	-	7	0.1
Brook Stickleback	2	-	2	0.02
Total nonnatives	8457	193	8650	96%
<b><i>native species</i></b>				
Bluehead Sucker	-	280	280	3.1
Flannelmouth Sucker	-	19	19	0.2
Speckled Dace	-	36	36	0.4
Mountain Whitefish	-	8	8	0.1
Mottled Sculpin	-	16	16	0.2
Roundtail Chub	-	6	6	0.1
Total native		365	365	4%
Total number of fish	8457	558	9015	100%

Table 5---Number and relative abundance of fish captured by boat electrofishing in Lily Park, Yampa River, Colorado 2018.

LP	Number of fish			Relative Abundance (%)
	Removed	Released	Total	
<b>nonnative species</b>				
Smallmouth Bass	1077	-	1077	26.9
Northern Pike	29	-	29	0.7
White Sucker	998	-	998	24.9
White X Flannelmouth Sucker	16	-	16	0.4
White X Bluehead Sucker	1	-	1	0.02
Black Crappie	1	-	1	0.02
Brown Trout	-	19	19	0.5
Rainbow Trout	-	1	1	0.02
Creek Chub	1	-	1	0.02
Common Carp	57	-	57	1.4
Total nonnative	2180	20	2200	55%
<b>native species</b>				
Bluehead Sucker	-	135	135	3.4
Flannelmouth Sucker	-	1511	1511	37.7
Mountain Whitefish	-	2	2	0.05
Roundtail Chub	-	139	139	3.5
Mottled Sculpin	-	8	8	0.2
Colorado Pikeminnow	-	9	9	0.2
Total native		1804	1804	45%
Total number	2180	1824	4004	100%

## Little Yampa Canyon

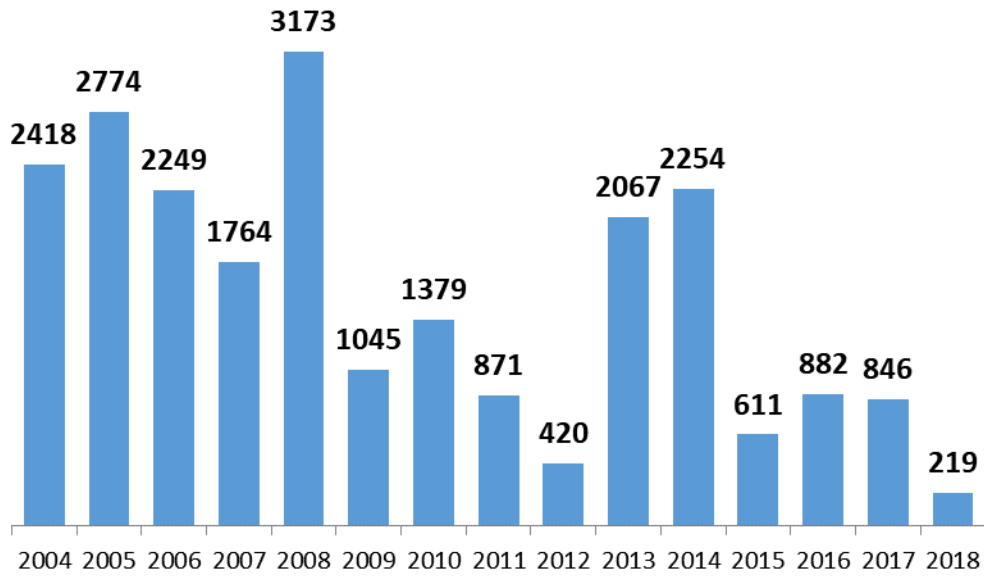


Figure 1---Estimated abundance of adult Smallmouth Bass ( $\geq 200$  mm) in Little Yampa Canyon, Yampa River, 2004—2018. Abundance estimated with a modified Lincoln-Peterson estimator.

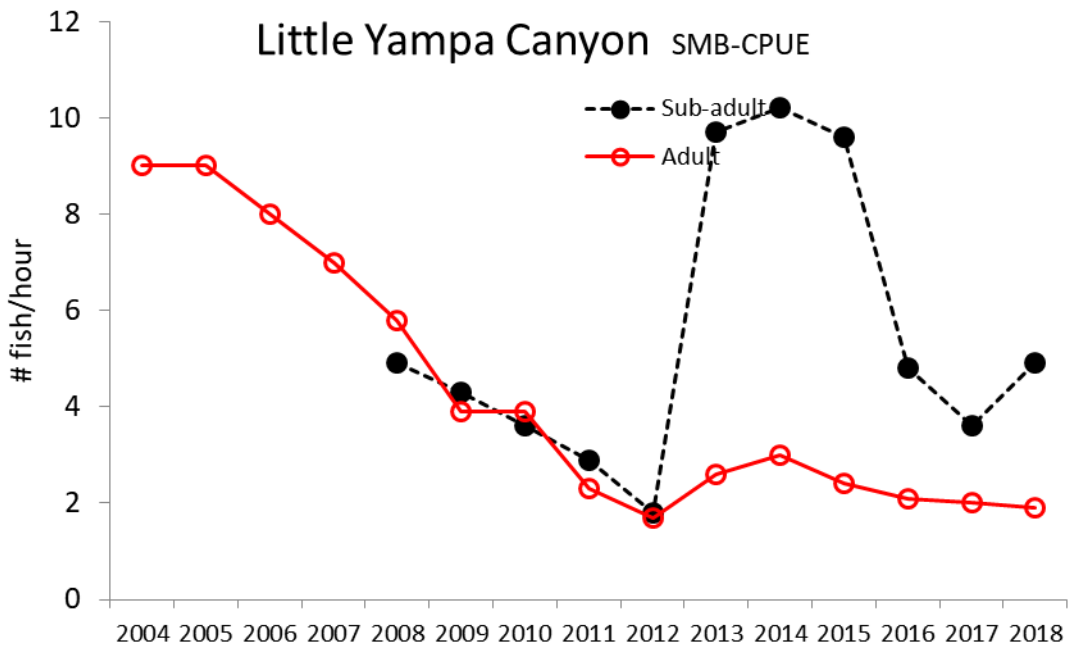
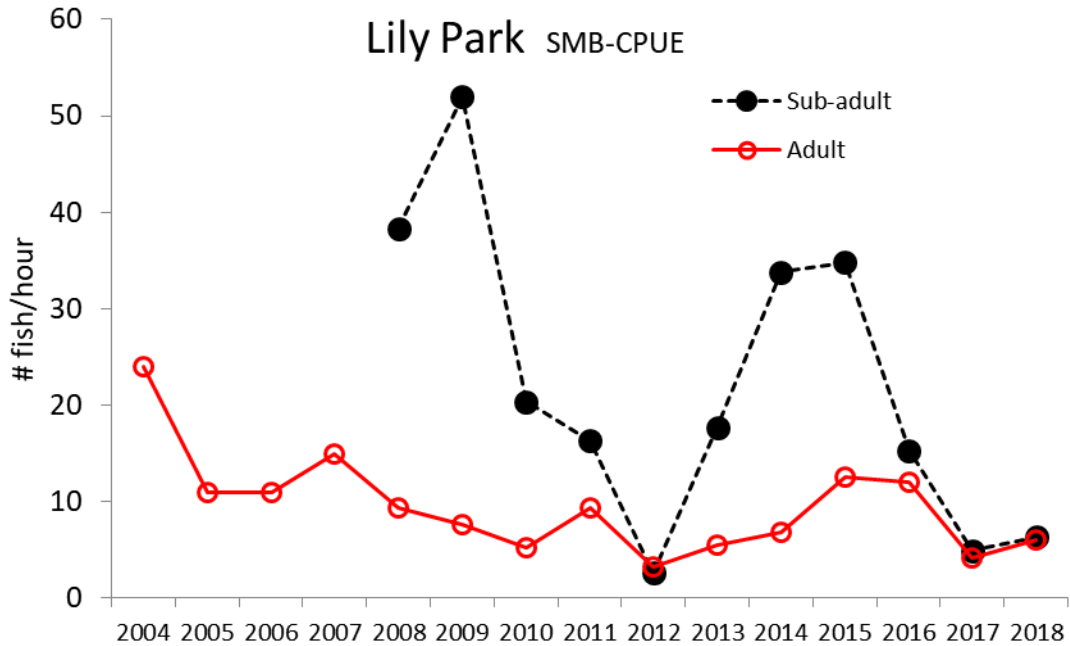


Figure 2—Number of juveniles (<100 mm; LYC only), sub-adult (100-199 mm), and adult (≥200 mm) Smallmouth Bass captured per hour of boat electrofishing in two reaches of the Yampa River, 2004-2018.

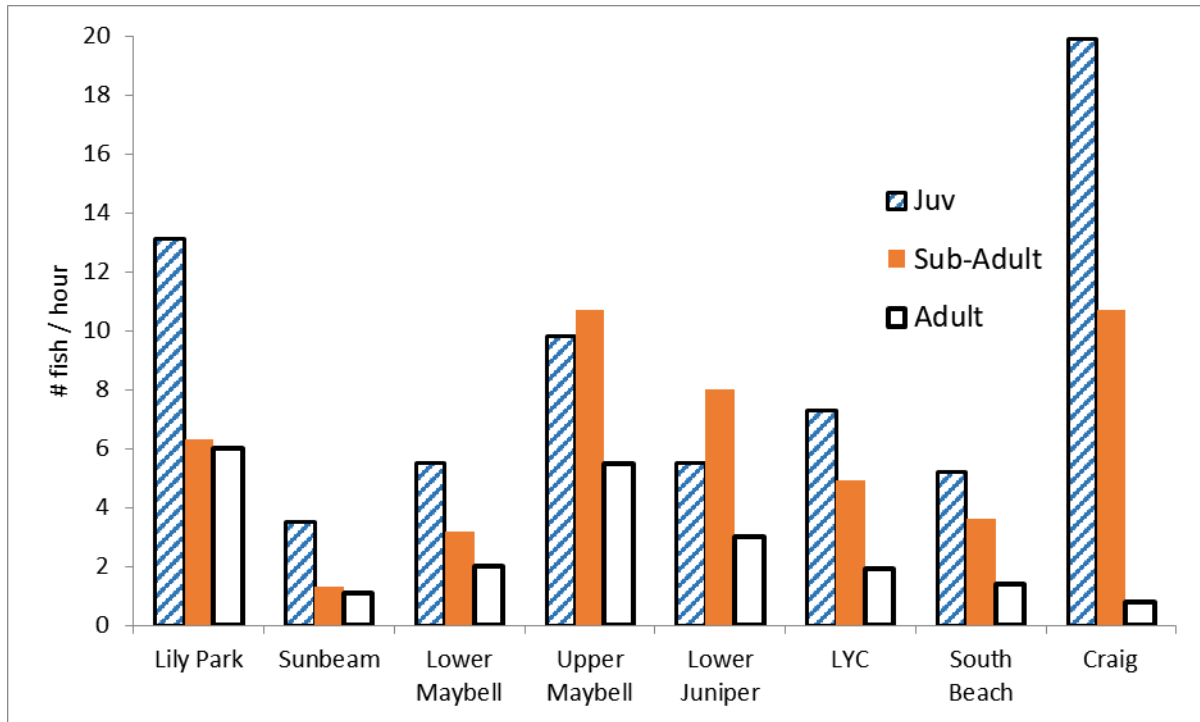


Figure 3—Catch per unit effort for Smallmouth Bass captured by boat electrofishing in study reaches arranged longitudinally from downstream (left) to upstream (right) in the Yampa River, 2018.



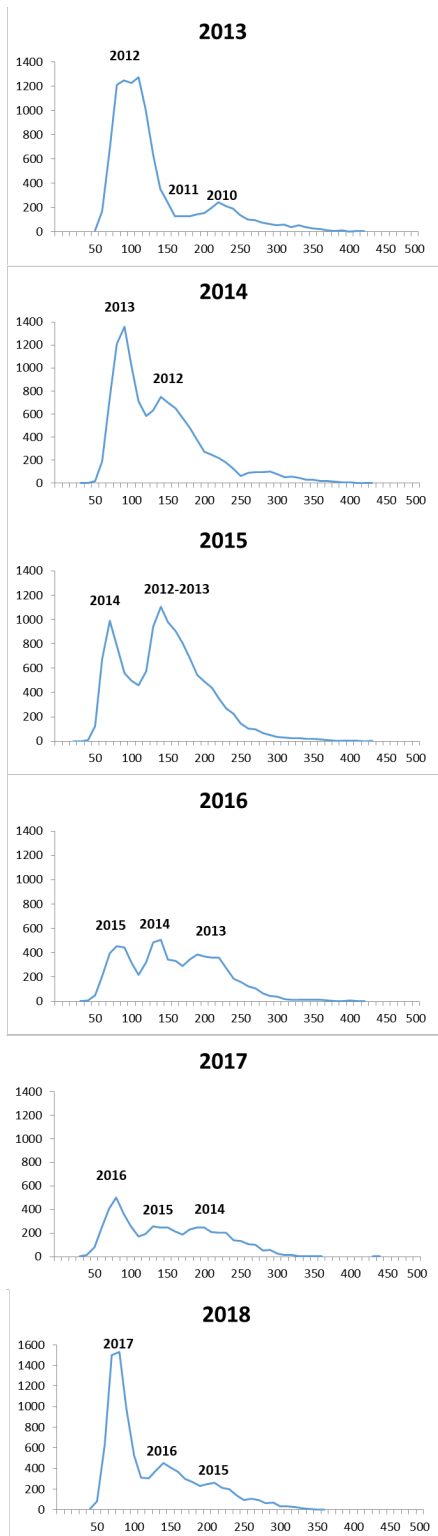


Figure 4—Annual length-frequency of Smallmouth Bass captured with boat electrofishing in the spring in all reaches of the middle Yampa River, 2014-2018. Year classes for the prior three hatch years provided for each graph.

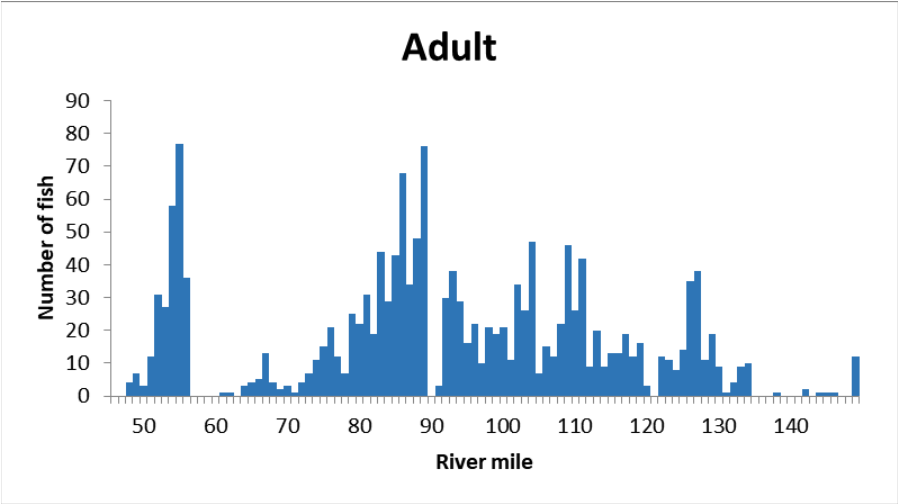
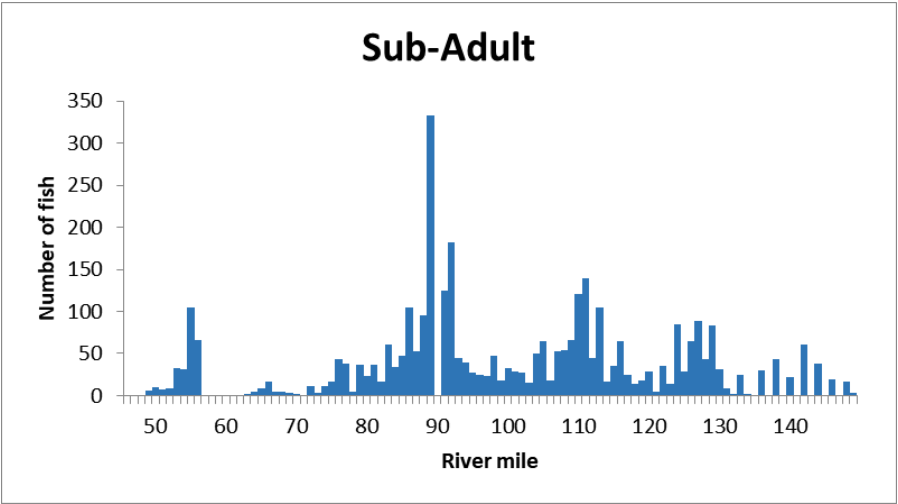
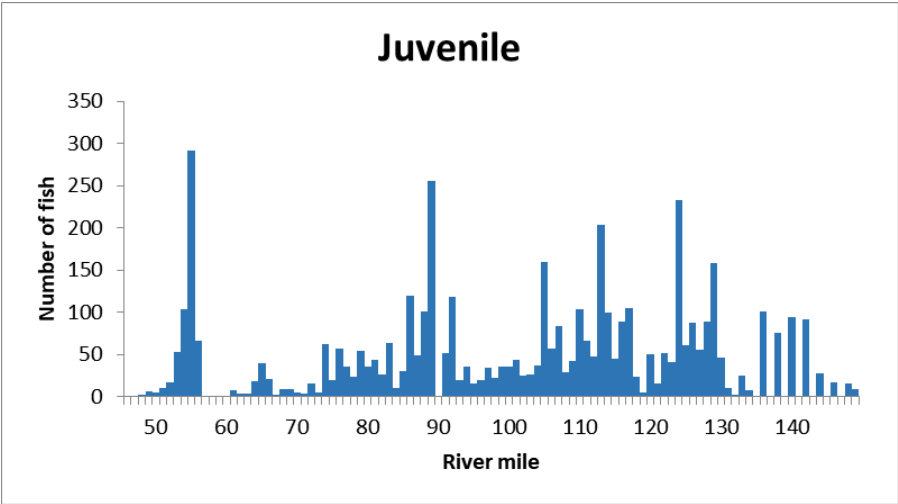


Figure 5—Number of Smallmouth Bass captured with boat electrofishing per mile in the middle Yampa River, 2018.  
 FY 2018 Annual Report. Project # 125/98c - 26

Appendix B:

**Preliminary results of the removal of Northern Pike from the upper Yampa River, 2018.**

Hawkins, J., D. Tuttle III, and K. Dick.

**Introduction**

Northern Pike, *Esox lucius*, are a nonnative gamefish species introduced to the Yampa River in the 1970s (Hawkins et al. 2005). They occupy the Yampa River and reproduce primarily in the reaches upstream of Craig, Colorado, and in several reservoirs within the basin. They are considered a threat to native fishes, endangered fishes, and other gamefish, such as trout and Mountain Whitefish, *Prosopium williamsoni*. To address this threat, biologists remove Northern Pike from the Yampa River downstream of Hayden Pump Station boat ramp near Hayden, Colorado to the confluence with the Green River to benefit endangered fishes in Critical Habitat. Hayden Pump Station boat ramp is located at river mile (RM) 170.6, the distance upstream from the Green River confluence. Colorado Parks and Wildlife (CPW) also removes Northern Pike from Catamount Reservoir and from the Yampa River between Catamount Reservoir and Tree Haus Bridge (RM 194.1) in Steamboat Springs, Colorado to reduce their dispersal downstream into critical habitat and to benefit local trout and Mountain Whitefish populations. This study describes annual results of pike sampling and removal in the reach between Tree Haus Bridge and Hayden Pump Station boat ramp (RM 194.1-170.6). Land along the Yampa River within the study site is primarily private property and although electrofishing can occur in the river without touching land, gaining access to launch or take-out boats, set nets, or stop and process fish requires landowner permission. In 2018 and previous years, permission was granted by a large majority of landowners.

Our goals were to evaluate Northern Pike removal, describe their abundance, density, distribution, spawning phenology, and identify and rank spawning sites for production potential to assist future management actions.

**Methods**

We sampled backwaters and sloughs between KOA campground (RM 189.3) and Hayden Pump Station boat ramp (RM 170.6) in the spring with raft electrofishing. We did not raft electrofish the section through downtown Steamboat Springs between Tree Haus Bridge and KOA due to a lack of backwaters in the reach and concern for safely rafting under several low bridges; however, we did sample Tree Haus Bridge backwater. Backwaters attract and concentrate pike for feeding, resting, conditioning, and spawning. We focused our effort on backwaters where Northern Pike concentrate and are highly vulnerable to capture and we minimized our effort in the main channel where trout and Mountain Whitefish are abundant and Northern Pike are dispersed and difficult to capture. On each sample occasion, we ranked each backwater as high, medium, low, or no spawning potential, based on connectivity to the river, suitable depth, negligible water velocity, and presence of submerged aquatic or terrestrial vegetation. We sampled backwaters with raft electrofishing and blocked the mouth of larger backwaters with a fine-mesh gill net to prevent fish escapement while electrofishing. We targeted Northern Pike in order to reduce captures and stress to salmonids. All Northern Pike were euthanized with an overdose of the FDA approved, fish anesthetic, Fiquel MS-222 (Methanesulfonate). If a salmonid was captured, it was either immediately released away from the boat or placed in a tub of fresh water and released after we completed sampling that backwater. If a captured trout or Mountain Whitefish appeared in physiological distress, we revived it with pure oxygen from a

compressed oxygen bottle that was diffused through an air stone. We also added solar salt to the holding water to improve their osmoregulatory efficiency and aid in their recovery.

From mid-May through mid-June, after pike spawning ended, we sampled for young-of-year (YOY) Northern Pike with a backpack electrofisher to confirm spawning success and collect YOY for otolith ageing to estimate hatch dates.

## Results

Raft electrofishing occurred on four occasions between April 9 and May 8 during flows that ranged from 367-1690 cfs, measured at the “Yampa River at Steamboat Springs, CO”, USGS Gage 09239500. We sampled 60 individual backwaters on one to four occasions for 17 hours with raft electrofishing and 30 hours with gill-nets. We returned between May 14 and June 15 and sampled six accessible backwaters for five hours with a backpack electrofisher to collect YOY for otolith aging. We observed, but seldom netted, non-target species including Brown Trout, Rainbow Trout, Mountain Whitefish, Mottled Sculpin, and White Sucker.

We removed 107 Northern Pike, including 98 with raft electrofishing and gill nets during pike spawning and nine more with backpack electrofishing after the spawning event. Mean length of pike captured in spring was 601 mm and length ranged from 238 to 965 mm (Figure 1). Only three juvenile pike (<300 mm) were captured, all other pike captured during spawning were adults,  $\geq 300$  mm. Eighty-nine percent (n=95) of the 107 pike captured were  $\geq 450$  mm or larger piscivores considered a competitive threat to adult Colorado pikeminnow. We determined sex of all pike by either expression of gametes or dissection and internal examination of gametes and gamete development. Of the 98 Northern Pike captured during spawning sampling, 39 were females, 57 were males, and two were immature and unknown sex. Prey removed from stomachs of Northern Pike included leaches, Brown Trout *Salmo trutta*, Rainbow Trout *Oncorhynchus mykiss*, Creek Chub *Semotilus atromaculatus*, and White Sucker *Catostomus commersonii*. Size of fish prey consumed ranged from small 50-mm minnows to a 290-mm Brown Trout eaten by a 770-mm Northern Pike. Catch rate was highest on the first pass at 8.8 pike/hour. Catch rates on other passes were 4.7 pike/hour on the second pass, 5.4 pike/hour on the third pass, and 4.2 pike/hour on the fourth pass (Table 1).

Ripe male Northern Pike were captured on every Pass from April 10 through May 8, but more of the males captured on the last two passes in late April and early May were ripe. Males often express gametes more easily than females and males can be ripe several weeks before and after spawning. Ripe females are therefore a better indicator of spawning dates because they are ripe for fewer days before and after spawning than males. Ripe or spent females were captured only on the last two passes between April 25 and May 8 (Table 2). Peak spawning likely occurred during the last two sampling passes based on the highest percentage of ripe males and females and it is likely that spawning continued after our last sample date in 2018 (Table 2).

We recommend obtaining an abundance estimate of pike in the study reach in 2019. To improve the precision of the estimate, we suggest that pike be marked and released on two occasions rather than one occasion. We also suggest at least three removal passes after the final mark and release passes.

We identified spawning locations by river mile and UTM's and described their attributes related to spawning on each pass. Biologists removing Northern Pike in other parts of the Yampa River should collect attributes that describe spawning potential for spawning areas in their reaches, suggestions for remediation, and willingness of landowner to cooperate with remediation or removal efforts. These reach and site-specific plans could be prioritized for the entire basin to inform future capital projects and actions by agency managers, assist biologists with mitigation suggestions as they review 404 permits, and inform those doing trout habitat enhancement.

### **Recommendations for Upper Yampa River Northern pike**

- Continue to focus Northern Pike removal in backwaters using raft electrofishing.
- Increase the use of gill and fyke nets in backwaters as appropriate.
- Conduct two mark passes for Northern Pike abundance in 2019.
- Follow 2019 marking passes with at least three removal passes.
- Identify spawning period with collection of YOY pike for daily otolith aging.
- Collect attribute data for spawning areas.

### **Acknowledgements**

We thank the CSU field crew that assisted with field sampling in 2017 including Drew Ebner, Kallie Jimmie, Lance Ostrom. We thank CPW personnel in the Steamboat Springs office including Billy Atkinson, Kris Middendorf (AWM), and Justin Pollock (DWM), Betsy Blakeslee (TNC), and the many Yampa Valley landowners who graciously allowed access on their property during sampling. We thank Tildon Jones for reviewing this report.

### **References**

Finney, S. and B. Atkinson. 2004. Upper Yampa River northern pike tagging. Annual Report to the Colorado River Endangered Fish Recovery Program. U.S, Fish and Wildlife Service.

Finney, S. and B. Atkinson. 2005. Upper Yampa River northern pike tagging. Annual Report to the Colorado River Endangered Fish Recovery Program. U.S, Fish and Wildlife Service.

Hawkins, J. and D. Tuttle, III. Evaluation of smallmouth bass and northern pike management in the middle Yampa River: Appendix B: Preliminary results of the removal of Northern Pike from the upper Yampa River, 2017. Project 125. 2017 Annual Report to the Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service

Hawkins, J. A., C. Walford, and T. Sorenson. 2005. Northern pike management studies in the Yampa River, Colorado, 1992-2002. Final Report for the Upper Colorado River Endangered Fish Recovery Program, Project No. 98a. Lakewood, CO. Larval Fish Laboratory Contribution 137.

Hawkins, J., C. Walford, and K. Battige. 2014. Evaluation of smallmouth bass and northern pike management in the middle Yampa River. Project 125. 2014. Annual Report to the Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service.

Hawkins, J., C. Walford, K. Battige, and C. Noble. 2015. Evaluation of smallmouth bass and northern pike management in the middle Yampa River. Project 125. 2015. Annual Report to the Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service.

Hawkins, J., C. Walford, and C. Noble. 2016. Evaluation of smallmouth bass and northern pike management in the middle Yampa River: Preliminary results of the removal of smallmouth bass from the middle Yampa River and Northern Pike from the upper Yampa River. Project 125. 2016 Annual Report to the Colorado River Endangered Fish Recovery Program, U. S. Fish and Wildlife Service

Table 1--Number and catch rate per hour (CPUE) of Northern Pike captured and removed from the upper Yampa River between Steamboat Springs and Hayden, Colorado, 2018. Life stages based on total length: juvenile (Juv.; <300 mm) and adult ( $\geq$ 300 mm).

<b>Spring sampling</b>				Number of fish			CPUE (# fish/hr)		
Pass	Sampling Period	Sampling Gear	Effort (Hrs)	Juv.	Adult	All sizes	Juv.	Adult	All sizes
1	Apr 10-12	Raft EL	4.0	1	34	35	0.3	8.5	8.8
2	Apr 17-19	Raft EL	3.0	1	13	14	0.3	4.3	4.7
3	Apr 25-26	Raft EL	5.7	1	30	31	0.2	5.3	5.4
4	Apr 30- May 8	Raft EL	4.3		18	18		4.2	4.2
5	May 14-Jun 15	BP, BS	4.7	2	7	9	0.4	1.5	1.9
<b>Total</b>			21.7	5	102	107	0.2	4.7	4.9

Table 2—Percent of ripe male or female Northern Pike captured each pass in the Yampa River, 2018. Ripe females includes two, post spawn, spent fish. Temperature and discharge records from the Yampa River USGS gage 09239500.

	Pass 1 April 10-12	Pass 2 April 17-19	Pass 3 April 25-26	Pass 4 April 30- May 8th
% ripe males	89%	80%	94%	100%
# males captured	19	10	18	10
% ripe females	0%	0%	23%	57%
# females captured	15	4	13	7
mean daily water temp.	5.1—5.9°C	3.7—5.4°C	6.4—6.7°C	6.0—7.1
mean daily discharge	621—680 cfs	367—385 cfs	623—703 cfs	1,100—1,690 cfs

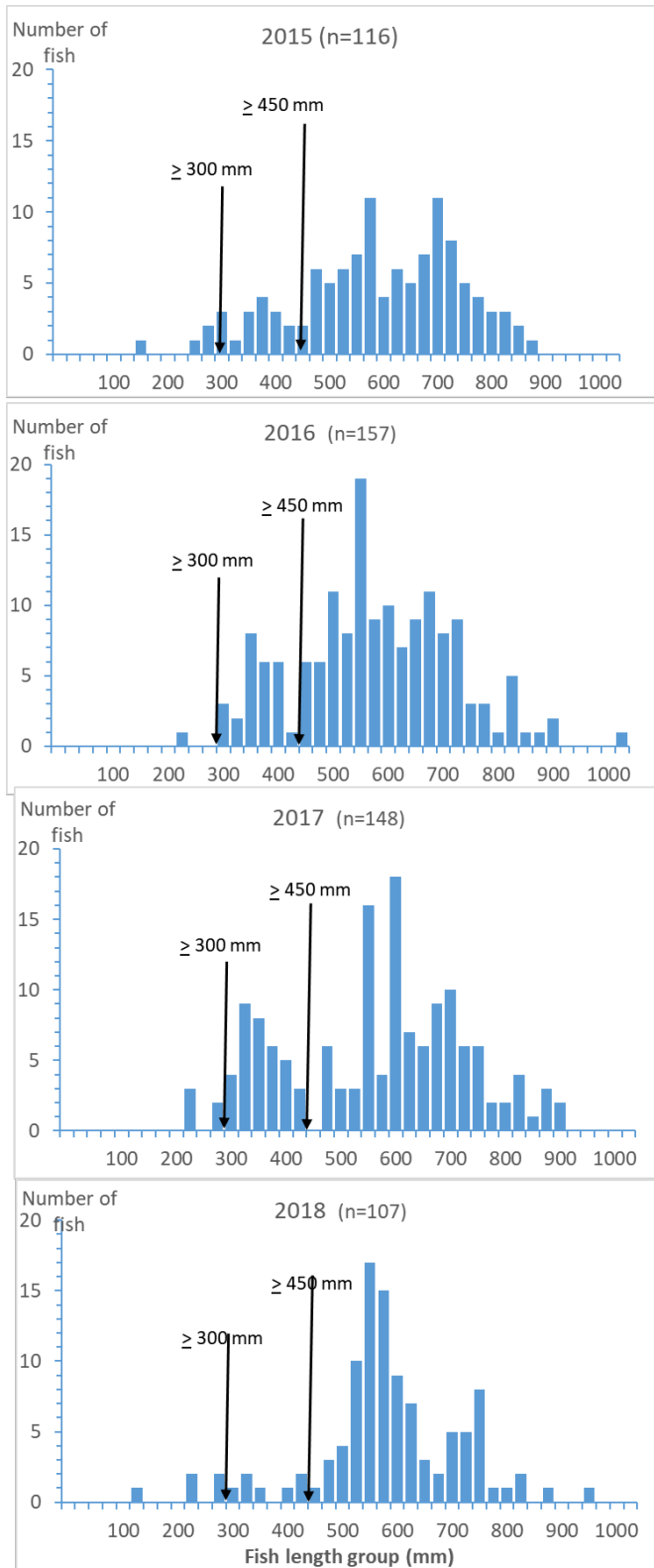


Figure 1—Length frequency of Northern Pike captured in the upper Yampa River, 2015-2018. Vertical arrows indicate the minimum length of adult fish ( $\geq 300$  mm total length; TL) and piscivores ( $\geq 450$  mm TL).