COLORADO RIVER RECOVERY PROGRAM
FY 2015 ANNUAL PROJECT REPORT

RECOVERY PROGRAM
PROJECT NUMBER: 125

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

II. Bureau of Reclamation Agreement Number(s): ): 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: 09/30/2015
Is this the final report? Yes _____ No _x___

III. Principal Investigator(s):

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 critical habitat for Colorado pikeminnow *Ptychocheilus lucius* in the Yampa River. The study area included 87 miles of the middle Yampa River from South Beach boat launch (river mile; RM 134.2) near Craig, Colorado to just upstream of Dinosaur National Monument (RM 47.5) and was divided into seven reaches. Boat electrofishing occurred on one to nine occasions (passes) from April through July using two electrofishing boats that sampled both shorelines in all but one reach (Sunbeam). Smallmouth bass ≥ 100 mm were marked and released on one occasion in one reach (Little Yampa Canyon) to estimate their abundance, to evaluate how the population responds to removal, and to monitor fish movement and growth. Using mark-recapture methods, we estimated 4,265 sub-adult (100–199-mm) (200—8,330, 95% CI; CV=49%) and 611 adult (≥ 200-mm) (284—938, 95% CI; CV=27%) smallmouth bass inhabited Little Yampa Canyon in 2015. In addition to electrofishing, we removed small, primarily Age-0 smallmouth bass using an electric seine from August through October, in the lower 12-mile portion of Little Yampa Canyon. In total, we captured 18,128 smallmouth bass by all gears in all sampled reaches, of which 17,753 were removed.

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 area between Steamboat Springs and Hayden, identify spawning areas, and capture young pike to confirm reproduction. Using a Lincoln- Petersen abundance estimator, we estimated there were 215 northern pike in the reach between Steamboat and Hayden with

the 95% confidence interval placing between 51 and 379 pike in the reach. We removed 91 pike or 42% of the estimated population on two removal passes using raft electrofishing.

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

VI. Relationship to RIPRAP:[1]: Version: *April 22, 2014*
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 | Implement CPW Yampa Basin aquatic wildlife management plan and the Recovery Program's Yampa River Nonnative Fish Control Strategy. Each control activity will be evaluated for effectiveness and then continued as needed. See also III.A.2.c.1&2 under General Recovery program Support Action Plan. |
| III.B.1 | Prevent nonnative fish introduction; reduce invasion and recruitment. |
| III.B.1.c | Remove northern pike and smallmouth bass above Craig, CO (YS C-3). |
| III.B.1.D. | Target spawning areas (YS C-4) |
| III.B.1.D.1 | Northern pike |
| III.B.1.D.2 | Smallmouth bass |
| 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 and translocate northern pike from the Yampa River. See Hawkins et al 2005. (YS J-1). |
| 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. (YS J-1). |

VII. Accomplishment of FY 2015 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Initial findings and preliminary results for 2015 are provided in the attached report, 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 and Wright 2009.

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

[1] See RIPRAP at
www.coloradoriverrecovery.org/documents-publications/foundational-documents/RIPRAP/RIPRAPApril2014Z.pdf

IX. Recommendations:

Recommendations for Middle Yampa Smallmouth bass

- Continue adult smallmouth bass removal during runoff.
- 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.
- Expand intensive Surge efforts to include more removal passes in Lower Juniper, Upper Maybell, and Craig reaches, especially focusing on reaches with complex, braided channels that provide spawning habitat.
- Expand the use of raft EL after the Surge into the base flow period.
- Continue to use and evaluate E-seine, fyke nets and other gear in potential spawning backwaters during and after the Surge.
- Develop a decision tree to identify bass vulnerabilities and identify opportunities for higher exploitation.

Recommendations for Upper Yampa River Northern pike

- Continue to educate and develop positive relationships with landowners in the reach.
- Obtain an estimate of abundance using mark/recapture in 2016.
- Continue removal of adult northern pike with raft electrofishing, including more of the shoreline habitat in addition to backwaters.
- Identify gear (fyke, gill, trammel nets, or angling) that efficiently captures spawning adult pike in backwaters during runoff.
- Continue to collect YOY pike and age otoliths to identify the spawning period.

X. Project Status: on track and ongoing

XI. FY 2015 Budget Status

A. Funds Provided: $319,100
CSU: $289,128
FWS-Vernal: $15,014
FWS-Grand Junction: $14,958
B. Funds Expended: $319,100
C. Difference: $0
D. Percent of the FY 2014 work completed, and projected costs to complete:100%
E. Recovery Program funds spent for publication charges: none

XII. Status of Data Submission (Where applicable): Endangered fish capture data and other database records of field collections will be submitted by early 2016.

XIII. Signed: John Hawkins 11/17/15
Principal Investigator Date

APPENDICES:
Annual Performance Progress Reports (3)
A: Preliminary Results of smallmouth bass removal in the middle Yampa River, 2015

B: Preliminary results of northern pike removal in the upper Yampa River, 2015.

## 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. 2018
Reporting period end date: 13 Nov. 2015
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 including: We obtained an estimate of the number of smallmouth bass in Little Yampa Canyon. We coordinated mark-recapture and Surge sampling with CDOW and USFWS. We conducted one marking pass in Little Yampa Canyon and multiple removal passes in Little Yampa Canyon and Lily Park study reaches. We removed large numbers of invasive nonnative predators from Critical Habitat on multiple occasions from April through October. We conducted one marking pass and two removal passes for northern pike between Steamboat Springs and Highway 40 Bridge and sampled for YOY pike to confirm spawning locations. We produced an annual report on activities and will present data at workshops and meetings in December 2015 and January 2016.

## ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

BUREAU OF RECLAMATION AGREEMENT NUMBER: R13PG40020

UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: 125

Project Title: Middle Yampa smallmouth bass and northern pike removal

Principal Investigator: Chris Smith and Tildon Jones
U.S. Fish and Wildlife Service
1380 S 2350 W, Vernal, UT 84078
christian_t_smith@fws.gov; (435) 789-0351

Project/Grant Period: Start date (Mo/Day/Yr): 10/01/2013
End date: (Mo/Day/Yr): 9/30/2015
Reporting period end date (Mo/Day/Yr): 09/30/2015
Is this the final report? Yes __X__ No ____

Performance: USFWS completed its portion of task 4, "conduct smallmouth bass removal and spawning disruption during the spawning period." We performed two weeks of electrofishing in order to remove smallmouth bass adults in spawning habitats. Data has been submitted to the project lead at CSU, who will be responsible for data analysis and reporting.

## 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
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): 9/30/2015
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 2015 smallmouth bass "Surge" effort was targeted to remove smallmouth bass as the Yampa River neared base flows. From June 25-30, we provided two jet-powered, hard-bottomed, electrofishing boats and a 3-person crew for 6 days (18 man days). Then from July 6-11, we provided two electrofishing rafts and a 3-person crew for 6 days (18 man days).

Appendix A:

**Preliminary results of the removal of smallmouth bass from the middle Yampa River and northern pike from the upper Yampa River, 2015.**

Hawkins, J. (CSU), C. Walford, (CSU), K. Battige, (CPW), and C. Noble, (CPW).

Overview: This report provides a preliminary summary of data that was collected in 2015 and therefore contains minimal analysis and discussion. Findings will be presented and discussed in greater detail at the nonnative workshop in December.

## Methods-Middle Yampa SMB removal

The study area was primarily within an 87-mile reach of the middle Yampa River, between South Beach boat ramp near Craig, Colorado (river mile; RM 134.2) and Dinosaur National Monument boundary (RM 47.5) and consisted of seven reaches totaling 79.6 miles of sampled waters. These reaches were sampled by Colorado Parks and Wildlife (CPW) and Colorado State University-Larval Fish Laboratory (CSU). Smallmouth bass data collected by both agencies are summarized in this report. Additional sampling was conducted during the Surge by USFWS-Vernal and Grand Junction (see table below).

Location of study reaches in the middle Yama River.

| Reach | Agency | River miles | Length (miles) |
|---|---|---|---|
| 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 – 134.2 | 10.5 |
| Hayden-Craig | FWS | 171-134.5 | 36.5 |

Fish sampling occurred with boat electrofishing on up to nine occasions (passes) at each reach during runoff from April through July, typically using two electrofishing boats sampling both shorelines continuously downstream. Reaches with higher catch rates received greater effort through more passes. Smallmouth bass were removed from all reaches except on one pass in Little Yampa Canyon when they were marked and released, primarily to track abundance, but also to monitor movement and growth. On that marking pass, smallmouth bass ≥100-mm total length were marked with a numbered Floy tag and released. On all other passes in Little Yampa Canyon and in the other reaches smallmouth bass were removed and euthanized upon capture.

Smallmouth bass were grouped by life stages based on their length: juvenile (< 100 mm), sub-adult (100–199 mm), and adult (≥200-mm). We also reported the number of smallmouth bass ≥325-mm TL for each reach; bass this size and larger are considered a higher predatory threat than smaller sizes.

The primary CSU study sites were Little Yampa Canyon and Lily Park, where all species of fish were captured and measured on all sample occasions to describe the fish community structure

and composition. We also removed other invasive nonnative species including northern pike and those data were shared with and reported primarily by CPW though the Project # 98a annual report. In addition, white sucker, white sucker hybrids, centrarchids, bullheads, creek chubs, and common carp were removed from all reaches. This was the first year that white sucker and common carp were removed from the upper 12 miles of Little Yampa Canyon. In prior years this was a control reach where those species were released.

**Spawning disruption (The Surge)**

In 2015, we completed the sixth year of an intensive removal program during smallmouth bass spawning with the goal of increasing our catch of adult bass and disrupting reproduction (The Surge). Increased effort during the Surge was obtained by assembling field crews and equipment from CSU, CPW, and FWS (Vernal and Grand Junction field stations) to assist with removal. As flows declined towards base flow, we optimized our catch rates by shifting effort away from sections of river that had low complexity and low catch rates (e.g very-shallow, inner bends with little structure or cover) and increasing effort in sections of river with high complexity and high catch rates. Targeted areas typically were outer bends having complex structure, such as rubble or boulder substrate, or braided sections that create side channels or backwaters with decreasing flows. Water temperatures of 16°C initiate smallmouth bass spawning and defined the start of Surge removal. We observed 16°C at the Maybell Gage on June 17th, and initiated the Surge on June 22. This year's (2015) discharge was lower than that in 2014 and similar in peak to 2013, but had a longer duration of high flow than in 2013 (Figure 6).

We shifted from larger Jon boats during runoff to electrofishing rafts as flows declined to levels too low for safe Jon boat navigation (approximately 1000 cfs) during the Surge. We effectively disrupted nest building, spawning, and nest guarding between June 22nd and July 28$^{th}$, focusing our efforts in South Beach, Little Yampa Canyon, and Lower Juniper reaches. The additional resources of boats and people allowed us to intensively sample known spawning concentrations of smallmouth bass by repeatedly sampling those reaches and disrupting the spawn. Fish were removed from nests in target reaches every 2-5 days at the peak of spawning and some sites were visited more than seven times during the spawn.

**Age-0 smallmouth bass removal**

After bass spawning ended, we removed Age-0 and Age-1 smallmouth bass with an electric seine in the lower 12-miles of Little Yampa Canyon from August through October. Removal did not occur in other reaches. Bass were not removed from the upper 12 miles of LYC because it is a Control reach for Project 140 ("Evaluating the effects of nonnative predator fish removal on the native fishes in the Yampa River"). In addition, we sampled the small-bodied fish community with seines and backpack electrofisher every 5-miles from upstream of Craig to lower Cross Mountain Canyon (RM 145—55.5) to determine the distribution of young smallmouth bass and examine the small-bodied fish community.

## Results-Middle Yampa SMB removal

**Smallmouth bass abundance and exploitation**

Using a Lincoln-Petersen model, we estimated 611 adult smallmouth bass (284—938, 95% CI; CV=27%) inhabited Little Yampa Canyon in 2015 (Table 1; Figure 1). Density of adult smallmouth bass in Little Yampa Canyon was 25 adult bass per mile. We estimated that 4,265 sub-adult smallmouth bass (200—8,330, 95% CI; CV=49%) inhabited Little Yampa Canyon in

2015 (Table 1). Density was 178 sub-adult smallmouth bass per mile. Abundance estimates for both life stages were imprecise based on high CVs caused by low capture probability on the recapture pass. Of 135 tagged and released adults, 50% (n=67) were recaptured in 2015, including nine recaptured on the next pass after release, 46 recaptured on subsequent EL boat passes, and 12 recaptured angling. Of the 236 sub-adult smallmouth bass tagged, 18% (n=43) were recaptured in 2015, including three recaptured on the next pass after release, 38 were recaptured on subsequent EL boat passes, and 2 recaptured by angling.

**Exploitation Rates**

We used the number of fish removed by boat electrofishing on all passes divided by the abundance estimate to obtain the exploitation rate of smallmouth bass in Little Yampa Canyon. We removed 68% (n=2,887) of the sub-adults and 100+% (n=720) of the adults from Little Yampa Canyon in 2015 (Table 1). Removal rates higher than 100% were likely due to inaccurate (low) estimates of abundance. We plan to recalculate abundance using program MARK for a less biased, more accurate estimate.

**Fish removal effort**

In 2015, we sampled a total of 575.3 hours with boat electrofishing from April through July and 27.1 hours with electric seine and 92.9 hours of angling from August through October (Table 2). Total effort in 2015 was similar to that in 2014.

**Captures by gear type**

We captured 18,128 smallmouth bass by all gears of which 17,753 were removed. This included 13,074 smallmouth bass captured by electrofishing boats during spring sampling from April-July, which included 375 marked and released in Little Yampa Canyon for abundance estimates. We caught an additional 4,407 by electric seine and 647 by angling from August through October (Table 2). We marked and released less than 3% (n=375) of all smallmouth bass captured in the spring by EL boats.

Large piscivores ($\geq$ 325 mm TL) comprised just less than one percent of all smallmouth bass captured by boat electrofishing (117 of the 13,074 smallmouth bass captured). Piscivores were highest in South Beach (3.3%), Lower Juniper (1.7%), and Craig (1.5%), and lowest in Little Yampa Canyon (1%), Upper Maybell (0.5%), and Lily Park (0.2%).

During the Surge we increased our effort significantly within a short period of time in known spawning reaches (Craig, South Beach, Little Yampa Canyon, and Lower Juniper). Surge sampling was highly effective because during spawning smallmouth bass are very territorial and typically remain near their nests in shallower water where they are highly susceptible to the electrofishing gear. By removing spawning fish from active spawning sites we open up habitat to new spawners who are then vulnerable to our next pass. When possible we allowed 2-5 days between removal passes for these areas to refill with new fish and then resampled them to remove another wave of new spawners. Removal during spawning was an effective method of obtaining higher catch rates of adult bass and disrupting the production of new bass.

We observed large numbers of smaller adult and sub-adult smallmouth bass using small, deep backwaters as flows dropped during and after the Surge. These fish were apparently moving into these areas to feed on abundant small fishes and were highly vulnerable to capture by electrofishing because they were easily confined and captured. Although we had originally

planned to use E-seines during the latter part of the Surge to catch sub-adult bass, we found bass were readily captured with raft electrofishing during lower flows. This was evidenced when 41% of all sub-adult bass captured in Little Yampa Canyon were captured on one pass (Surge Pass 9) when EL rafts were in use. We recommend extending the use of electrofishing rafts into the base flow period to exploit this behavior and remove greater numbers of sub-adult bass.

**Catch Rates**

Smallmouth bass live in all reaches of the middle Yampa River, but were most abundant in reaches with the best habitat. Boat electrofishing catch rates of adult smallmouth bass ($\geq$ 200 mm) were highest in Lily Park (12.6 fish/hr) and upper Maybell (8 fish/hr), followed by Lower Juniper (4.7 fish/hr). Adult catch rates in Craig, South Beach, and Little Yampa Canyon were similar at about 2.5 fish/hr in each reach (Table 2). Lily Park and Upper Maybell also had the highest catch rates for sub-adult (100-199 mm; 34.8 and 27.8 fish/hr; respectively), followed by Lower Juniper and Little Yampa Canyon (both with 9.6 fish/hr), South Beach (5.5 fish/hr), and Hayden-Craig (2.9 fish/hr). Juvenile smallmouth bass (<100 mm ) are primarily 1-year old fish hatched the previous year and their catch rate was highest in Upper Maybell (12.1 fish/hr) and Lily Park (10.3 fish/hr). In Upper Maybell high catch rates may reflect local reproduction in that reach or in the adjacent upstream Lower Juniper reach. There appears to be little spawning habitat in Lily Park, so high juvenile abundance there probably reflects reproduction and dispersal from upstream reaches. Highest catch rates for all life stages was in Lily Park followed by Upper Maybell (Figure 7). Sunbeam (RM 61-71) was not sampled in 2015, although in prior years few bass were typically captured there.

Of significance was the dramatic increase in catch rates of juveniles and sub-adults in Upper Maybell where juveniles increased seven fold and sub-adults increased eight fold from 2014 to 2015. These fish represented strong cohorts produced in 2013 and 2012 and likely either originated in the Upper Maybell reach or moved there from Lower Juniper where they exhibited high densities in 2014 (Hawkins et al. 2014; Table 2).

Gross CPUE for all smallmouth bass captured by boat electrofishing was 23 fish/hr, E-seine was 163 fish/hr, and angling was 7 fish/hr (Table 2).

**Spawning observations**

Spawning started around June 17 and continued into late July based on adequate habitat, water temperatures, capture of ripe males in spawning habitat, and ripe females. Smallmouth bass were observed or captured over nesting-type habitat in all Surge reaches.

**Fish Community Sampling**

Nonnative fish still dominate the fish community, comprising 96% of all fish collected in four, 1-mile sites in Little Yampa Canyon, about the same as in 2014 (Table 4). Smallmouth bass and white suckers were the most abundant fishes collected. At Lily Park, native fish have typically outnumbered nonnative numbers prior to 2013. In 2012, native fish comprised 85% of the fish collected during 1-mile community sampling, from 2013 through 2015 native fish comprised 25%, 37%, and 24% of the fish community. Relative abundance of flannelmouth suckers in Lily Park have increased since 2013 when they comprised 15% of the catch and in 2014 and 2015 they comprised 31% and 21% of the catch, respectively. The percent of bass and white sucker captured in the Lily Park 1-mile reach increased from 40% in 2014 to 61% in 2015.

In addition to the 1-mile community sampling, we also collected and measured all fish species on all sampling occasions in Little Yampa Canyon and Lily Park. At Lily Park, we handled six native species, nine nonnative species, and two nonnative sucker hybrids. Colorado pikeminnow were encountered on 15 occasions, once in Lower Juniper and 14 times in Lily Park (Table 5). Five were new captures and were tagged and the other encounters were recaptures of fish tagged in previous years. Size ranged between 510 and 628 mm TL. At Little Yampa Canyon we captured seven native species, 14 nonnative species, and three nonnative sucker hybrids (Table 6). We captured no Colorado pikeminnow in Little Yampa Canyon by electrofishing. Of significance was the collection of four possible white crappie between 130 and 150 mm TL from a backwater at RM 129.9. They were considered white crappie based on spiny fin ray counts of 5-6 typical of white crappie vs the 7-8 spiny rays typical of black crappie. No voucher specimens were retained and thus the identifications were not confirmed. In 2016, all crappie captured will be preserved for verification and white crappie will be preserved for voucher specimens.

In 2015, CPW stocked PIT tagged bluehead sucker in Milk Creek which has a confluence with the Yampa River at RM 119.2. We recaptured 222 of those PIT tagged fish in 2015 in Little Yampa Canyon and during the Surge in South Beach and Lower Juniper (Table 7). Lengths ranged from 154-320 mm and fish were recaptured as far as 12 miles upstream and 23 miles downstream of the Milk Creek confluence. One recaptured bluehead (170 mm TL) was recovered from inside a 481-mm northern pike stomach. These tagged fish made up a large portion (77%) of the bluehead sucker catch in Little Yampa Canyon (Table 6). This suggests that we are efficient at capturing bluehead suckers in the subadult and adult size ranges but it appears that few naturally produced bluehead suckers survive in this reach.

We observed a sharp increase in the number of northern pike captured in Little Yampa Canyon and adjacent reaches, but a reduction in average size. In 2015, in Little Yampa Canyon we captured 485 pike compared to 143 in 2014. Of the 978 northern pike captured by CSU in South Beach, Little Yampa Canyon, Lower Juniper, Upper Maybell, and Lily Park, 75% (731) were YOY fish < 250 mm TL (Figure 5).

**Recommendations for Middle Yampa Smallmouth bass**

- Continue adult smallmouth bass removal during runoff.
- 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.
- Expand intensive Surge efforts to include more removal passes in Lower Juniper, Upper Maybell, and Craig reaches, especially focusing on reaches with complex, braided channels that provide spawning habitat.
- Expand the use of raft EL after the Surge into the base flow period.
- Continue to use and evaluate E-seine, fyke nets and other gear in potential spawning backwaters during and after the Surge.
- Develop a decision tree to identify bass vulnerabilities and identify opportunities for higher exploitation.

**Acknowledgements**

We thank the field crews that assisted with collections. CSU field crew included: Carli Baum, Kyle Dick, Drew Ebner, Robert Garza, and Don Tuttle. CPW field crew included Dustin Mullen, and Nathan Thompson. FWS crews included Travis Francis and Christopher Smith and their

field crews. Dave Speas (BOR) and Matt Tohl (UDWR) Vernal. CPW received assistance from: Billy Atkinson, Kyle Battige, Jenn Logan, Lori Martin (CPW) and a host of District Wildlife Managers, other CPW, Forest Service, and BLM staff.

**References**

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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 (≥200 mm) smallmouth bass in Little Yampa Canyon, Yampa River, 2015. Abundance was estimated using a Lincoln-Petersen estimator. SE = Standard Error. CV= Coefficient of Variation. Exploitation rate is based on the number of smallmouth bass removed by boat electrofishing after the marking passes were completed.

| Life Stage | Abundance | lower – upper 95% CI | SE | CV % | Density #fish/mile | # removed | % removed |
|---|---|---|---|---|---|---|---|
| Little Yampa Canyon (24 miles) | | | | | | | |
| Sub-adult | 4265 | 200—8330 | 2074.1 | 49 | 178 | 2887 | 68% |
| Adult | 611 | 284—938 | 166.8 | 27 | 25 | 720 | 100%+ |

Table 2—CPUE (Catch per unit effort) for smallmouth bass captured by boat electrofishing in the middle Yampa River, 2015. Catch rates for E-Seine, and angling are included for Little Yampa Canyon. Life stages were based on length: juvenile (<100 mm), sub-adult (100-199 mm), and adult (≥200 mm).

| **Hayden-Craig** | | | | 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-Surge | Jun 22-23 | FWS | 10.0 | 1 | 12 | 19 | 32 | 0.1 | 1.2 | 1.9 | 3.2 |
| 2-Surge | Jun 26,29 | FWS | 8.9 | 1 | 27 | 23 | 51 | 0.1 | 3.0 | 2.6 | 5.7 |
| 3-Surge | Jun 1 | FWS | 5.2 | 3 | 30 | 17 | 50 | 0.6 | 5.8 | 3.3 | 9.7 |
| Total | | | 24.1 | 5 | 69 | 59 | 133 | 0.2 | 2.9 | 2.4 | 5.5 |

| **South Beach** | | | | 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 5 | CPW | 11.3 | 4 | 48 | 33 | 85 | 0.4 | 4.3 | 2.9 | 7.5 |
| 2 | May 7 | CPW | 9.9 | | 7 | 6 | 13 | 0.0 | 0.7 | 0.6 | 1.3 |
| 3 | May 13 | CPW | 10.4 | 12 | 31 | 17 | 60 | 1.2 | 3.0 | 1.6 | 5.8 |
| 4 | Jun 3 | CPW | 10.4 | 12 | 59 | 25 | 96 | 1.1 | 5.7 | 2.4 | 9.2 |
| 5-Surge | Jun 24, 26 | CSU, CPW, FWS | 14.4 | 42 | 115 | 59 | 216 | 2.9 | 8.0 | 4.1 | 15.0 |
| 6-Surge | Jun 29 | CSU,FWS | 10.9 | 43 | 78 | 35 | 156 | 4.0 | 7.2 | 3.2 | 14.4 |
| 7-Surge | Jul 7, 9 | CSU,FWS | 13.0 | 14 | 49 | 19 | 82 | 1.1 | 3.8 | 1.5 | 6.3 |
| 8-Surge | Jul 9-14 | CSU,FWS | 12.3 | 25 | 126 | 38 | 189 | 2.0 | 10.3 | 3.1 | 15.4 |
| Total | | | 92.5 | 152 | 513 | 232 | 897 | 1.6 | 5.5 | 2.5 | 9.7 |

| **Little Yampa Canyon-EL Boat** | | | | 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, 22, 28-30 | CSU | 14.5 | 19 | 9 | 37 | 65 | 1.3 | 0.6 | 2.6 | 4.5 |
| 2-Mark | May 1-5 | CSU | 34.4 | 252 | 242 | 135 | 629 | 7.3 | 7.0 | 3.9 | 18.3 |
| 3-Recap. | May 12-15 | CSU | 33.5 | 91 | 72 | 53 | 216 | 2.7 | 2.1 | 1.6 | 6.4 |
| 4 | May 16-19 | CSU | 25.9 | 25 | 17 | 19 | 61 | 1.0 | 0.7 | 0.7 | 2.4 |
| 5-Surge | May 27, 30,31 | CSU | 34.3 | 181 | 105 | 64 | 350 | 5.3 | 3.1 | 1.9 | 10.2 |
| 6-Surge | Jun 11-13 | CSU | 33.3 | 254 | 221 | 72 | 547 | 7.6 | 6.6 | 2.2 | 16.4 |
| 7-Surge | Jun 24-30 | CSU,FWS | 48.2 | 232 | 490 | 149 | 871 | 4.8 | 10.2 | 3.1 | 18.1 |
| 8-Surge | Jul 7-14 | CSU | 35.1 | 130 | 534 | 88 | 752 | 3.7 | 15.2 | 2.5 | 21.4 |
| 9-Surge | Jul 22-28 | CSU | 42.3 | 376 | 1197 | 103 | 1676 | 8.9 | 28.3 | 2.4 | 39.6 |
| Total | | | 301.4 | 1560 | 2887 | 720 | 5167 | 5.2 | 9.6 | 2.4 | 17.1 |

Table 2-cont.

**Little Yampa Canyon-E-Seine**

| | | | | 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 | Aug 13-18 | CSU | 5.1 | 444 | 47 | 4 | 495 | 87 | 9 | 0.8 | 97 |
| 2 | Aug 25-Sep 1 | CSU | 5.7 | 566 | 78 | 2 | 646 | 99 | 14 | 0.4 | 113 |
| 3 | Sep 9-11 | CSU | 5 | 820 | 82 | 1 | 903 | 164 | 16 | 0.2 | 181 |
| 4 | Sep 22-29 | CSU | 5.4 | 920 | 60 | 0 | 980 | 170 | 11 | 0.0 | 182 |
| 5 | Oct 6-12 | CSU | 5.3 | 1310 | 69 | 1 | 1380 | 247 | 13 | 0.2 | 260 |
| 6* | Oct 21-24 | CSU | 0.6 | 3 | 0 | 0 | 3 | 5 | 0 | 0.0 | 5 |
| Total | | | 27.1 | 4063 | 336 | 8 | 4407 | 150 | 12 | 0.3 | 163 |

*Pass 6 E-Seine sampling was in Isolated Pools where few bass occur.

**Little Yampa Canyon-Angling**

| | | | | 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 | Aug 17 | CSU | 12.5 | | 25 | 35 | 60 | | 2.0 | 2.8 | 4.8 |
| 2 | Aug 25-Sep 1 | CSU | 46.75 | | 250 | 207 | 457 | | 5.3 | 4.4 | 9.8 |
| 3 | Sep 10 | CSU | 6.25 | | 43 | 47 | 90 | | 6.9 | 7.5 | 14.4 |
| 4 | Sep 27 | CSU | 25 | | | 19 | 19 | | 0.0 | 0.8 | 0.8 |
| 5 | Oct 11 | CSU | 2.4 | | | 21 | 21 | | 0.0 | 8.8 | 8.8 |
| Total | | | 92.9 | | 318 | 329 | 647 | | 3.4 | 3.5 | 7.0 |

**Lower Juniper**

| | | | | 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 23 | CSU | 0.7 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | Jun 23 | CPW | 2.5 | 34 | 23 | 22 | 79 | 13.7 | 9.3 | 8.9 | 31.8 |
| 3-Surge | Jun 27 | CSU,FWS | 9.3 | 36 | 80 | 72 | 188 | 3.9 | 8.6 | 7.7 | 20.2 |
| 4-Surge | Jun 30 | CSU,FWS | 11.1 | 61 | 136 | 36 | 233 | 5.5 | 12.2 | 3.2 | 21.0 |
| 5-Surge | Jul 7-8 | CSU | 6.0 | 23 | 37 | 21 | 81 | 3.8 | 6.1 | 3.5 | 13.4 |
| 6-Surge | Jul 12 | CSU | 6.9 | 17 | 93 | 25 | 135 | 2.5 | 13.5 | 3.6 | 19.6 |
| 7-Surge | Jul 21 | CSU | 5.5 | 13 | 37 | 21 | 71 | 2.4 | 6.7 | 3.8 | 12.9 |
| Total | | | 42.1 | 184 | 406 | 197 | 787 | 4.4 | 9.6 | 4.7 | 18.7 |

Table 2--cont.

| **Upper Maybell** | | | | 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 6 | CPW | 10.3 | 9 | 178 | 58 | 245 | 0.9 | 17.3 | 5.6 | 23.8 |
| 2 | May 12 | CPW | 8.3 | 56 | 311 | 64 | 431 | 6.7 | 37.3 | 7.7 | 51.8 |
| 3 | May 14 | CPW | 4.4 | 93 | 220 | 49 | 362 | 20.9 | 49.5 | 11.0 | 81.5 |
| 4 | Jun 4 | CPW | 8.0 | 42 | 212 | 41 | 295 | 5.2 | 26.4 | 5.1 | 36.7 |
| 5-Surge | Jun 22 | CPW | 5.9 | 180 | 111 | 45 | 336 | 30.3 | 18.7 | 7.6 | 56.6 |
| 6-Surge | Jun 25 | CSU,CPW | 7.0 | 154 | 186 | 96 | 436 | 21.8 | 26.4 | 13.6 | 61.9 |
| Total | | | 44.1 | 534 | 1218 | 353 | 2105 | 12.1 | 27.6 | 8.0 | 47.7 |

| **Lower Maybell** | | | | 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 15 | CPW | 2.3 | 1 | 9 | 4 | 14 | 0.4 | 3.9 | 1.7 | 6.0 |
| Total | | | 2.3 | 1 | 9 | 4 | 14 | 0.4 | 3.9 | 1.7 | 6.0 |

| **Lily Park** | | | | 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 28-29 | CSU | 17.2 | 106 | 647 | 342 | 1095 | 6.2 | 37.6 | 19.9 | 63.6 |
| 2 | Jun 1-2 | CSU | 14.1 | 45 | 498 | 232 | 775 | 3.2 | 35.3 | 16.5 | 55.0 |
| 3 | Jun 9-10 | CSU | 14.8 | 179 | 611 | 154 | 944 | 12.1 | 41.3 | 10.4 | 63.7 |
| 4 | Jun 15-16 | CSU | 13.0 | 212 | 374 | 96 | 682 | 16.2 | 28.7 | 7.4 | 52.3 |
| 5 | Jun 23-24 | CSU | 9.5 | 169 | 262 | 44 | 475 | 17.7 | 27.5 | 4.6 | 49.8 |
| Total | | | 68.7 | 711 | 2392 | 868 | 3971 | 10.3 | 34.8 | 12.6 | 57.8 |

| **Totals by Gear Type** | | | Number of fish | | | | CPUE (# fish/hr) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Gear | Sampling Period | Effort (Hrs) | Juv | Sub-adult | Adult | All sizes | Juv | Sub-adult | Adult | All sizes |
| EL-Boat | Apr-Jul | 575.3 | 3147 | 7494 | 2433 | 13074 | 5.5 | 13.0 | 4.2 | 22.7 |
| Angling | Aug-Oct | 92.9 | 0 | 318 | 329 | 647 | 0 | 3.4 | 3.5 | 7.0 |
| E-Seine | Aug-Oct | 27.1 | 4063 | 336 | 8 | 4407 | 150 | 12 | 0.3 | 163 |
| Grand Total | | | 7210 | 11178 | 2770 | 18128 | | | | |

Table 3— Number of smallmouth bass captured by boat electrofishing during large-bodied fish sampling in the middle Yampa River, spring, 2015. Includes 375 smallmouth bass marked and released in Little Yampa Canyon for abundance estimation.

| Reach | Electrofishing boat |
|---|---|
| Craig | 133 |
| South Beach | 897 |
| Little Yampa Canyon | 5167 |
| Lower Juniper | 787 |
| Upper Maybell | 2105 |
| Lower Maybell | 14 |
| Sunbeam | Not sampled |
| Lily Park | 3971 |
| Total | 13074 |

Table 4---Relative abundance of fish collected with boat electrofishing in the 1-mile fish community sample sites of the Yampa River, 2015. Little Yampa Canyon contained four, 1-mile sites and Lily Park contained one site.

| | Little Yampa Canyon | Lily Park |
|---|---|---|
| *nonnative species* | | |
| smallmouth bass | 32.1 | 61.4 |
| northern pike | 4.1 | 0.6 |
| white sucker | 55.4 | 12.6 |
| white x flannelmouth sucker | 0.5 | - |
| white x bluehead sucker | 0.3 | 0.1 |
| white x flannelmouth x bluehead | 0.05 | - |
| creek chub | 1.7 | - |
| channel catfish | 0.7 | 0.3 |
| green sunfish | 0.5 | - |
| rainbow trout | 0.5 | - |
| brown trout | 0.1 | - |
| black bullhead | 0.2 | 0.1 |
| common carp | - | 0.5 |
| *native species* | | |
| flannelmouth sucker | 0.5 | 20.7 |
| bluehead sucker | 2.8 | 2.8 |
| roundtail chub | 0.1 | 0.6 |
| Colorado pikeminnow | - | 0.1 |
| mottled sculpin | 0.05 | - |
| speckled dace | 0.4 | - |
| mountain whitefish | 0.1 | - |
| Total number of fish | 2216 | 957 |
| % nonnative fish | 96.2 | 75.8 |
| % native fish | 3.8 | 24.2 |

Table 5---Number of fish captured by boat electrofishing in Lily Park in the Yampa River, 2015.

| | Removed * | Released | Total |
|---|---|---|---|
| *nonnative species* | | | |
| smallmouth bass | 3971 | - | 3971 |
| northern pike | 55 | - | 55 |
| white sucker | 828 | 1 | 829 |
| white x flannelmouth sucker | 8 | - | 8 |
| white x bluehead sucker | 6 | - | 6 |
| common carp | 69 | - | 69 |
| channel catfish | - | 34 | 34 |
| creek chub | 6 | - | 6 |
| black bullhead | 1 | - | 1 |
| green sunfish | 2 | - | 2 |
| brown trout | - | 1 | 1 |
| *native species* | | | |
| flannelmouth sucker | 1 | 1479 | 1480 |
| bluehead sucker | - | 173 | 173 |
| roundtail chub | - | 52 | 52 |
| Colorado pikeminnow | - | 14 | 14 |
| mottled sculpin | - | 1 | 1 |
| speckled dace | - | 4 | 4 |
| Total number of fish | 4947 | 1759 | 6706 |

*Native fish were euthanized and removed only when they were severely injured.

Table 6---Number of fish captured by boat electrofishing in Little Yampa Canyon in the Yampa River, 2015.

| | Removed * | Released | Total |
|---|---|---|---|
| *nonnative species* | | | |
| smallmouth bass | 4792 | 375 | 5167 |
| northern pike | 485 | - | 485 |
| white sucker | 6709 | - | 6709 |
| white x flannelmouth sucker | 72 | - | 72 |
| white x bluehead sucker | 28 | - | 28 |
| white x flannelmouth x bluehead | 1 | - | 1 |
| creek chub | 318 | - | 318 |
| green sunfish | 82 | - | 82 |
| black crappie | 1 | - | 1 |
| white crappie (presumed)** | 4 | - | 4 |
| black bullhead | 13 | - | 13 |
| brown trout | - | 21 | 21 |
| rainbow trout | 2 | 57 | 59 |
| channel catfish | - | 81 | 81 |
| common carp | 1 | - | 1 |
| fathead minnow | - | 4 | 4 |
| sand shiner | - | 1 | 1 |
| *native species* | | | |
| roundtail chub | - | 4 | 4 |
| bluehead sucker | - | 255 | 255 |
| flannelmouth sucker | 1 | 32 | 33 |
| Cutthroat trout | - | 2 | 2 |
| mottled sculpin | 1 | 23 | 24 |
| speckled dace | 3 | 118 | 121 |
| mountain whitefish | 1 | 31 | 32 |
| Total number of fish | 12514 | 1004 | 13518 |

*Native fish were euthanized and removed only when they were severely injured.
** presumed white crappie, see text.

Table 7-- Number of PIT-tagged bluehead suckers capture events in the middle Yampa River by CSU, 2015. Fish were stocked by CPW in Milk Creek which confluences with the Yampa River in Little Yampa Canyon at RM 119.2.

| | # capture events | # BH recaptured | % of events that were recaptures |
|---|---|---|---|
| South Beach | 11 | 4 | 36.4 |
| Little Yampa Canyon | 255 | 196 | 76.9* |
| Lower Juniper | 57 | 22 | 38.6 |
| Upper Maybell | 14 | 0 | 0 |
| Lily Park | 173 | 0 | 0 |
| Total | 510 | 222 | 43.5 |

- Includes 15 fish recaptured twice.

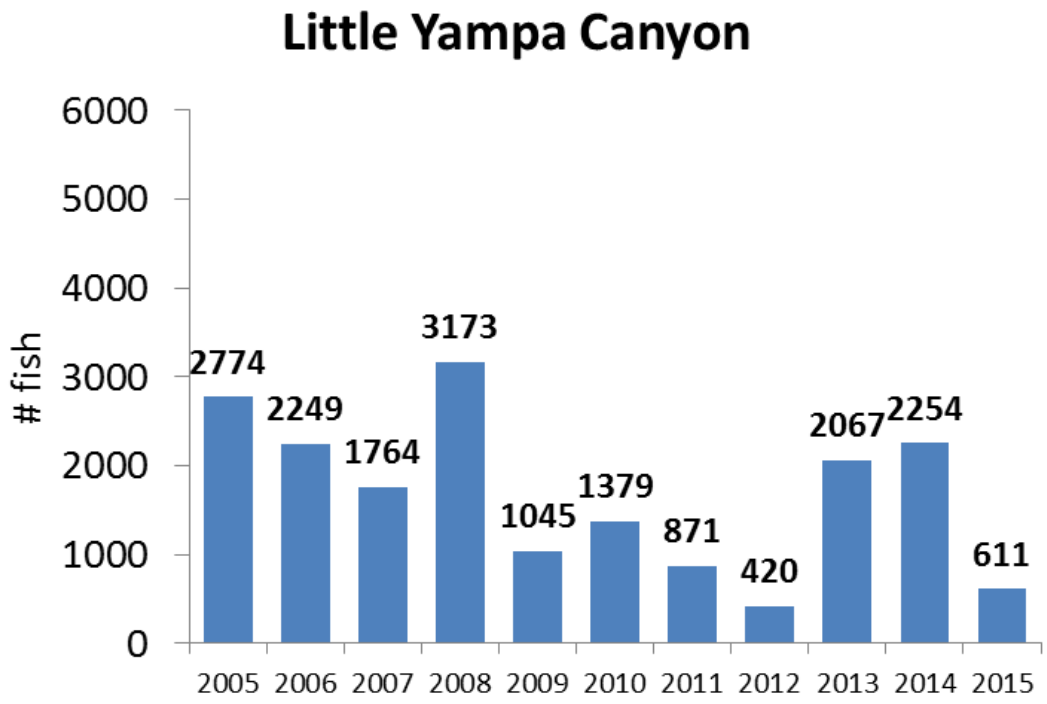



Figure 1---Estimated abundance of adult smallmouth bass(≥ 200 mm) in Little Yampa Canyon in the Yampa River, 2004—2015. Abundance estimated with a modified Lincoln-Peterson estimator.

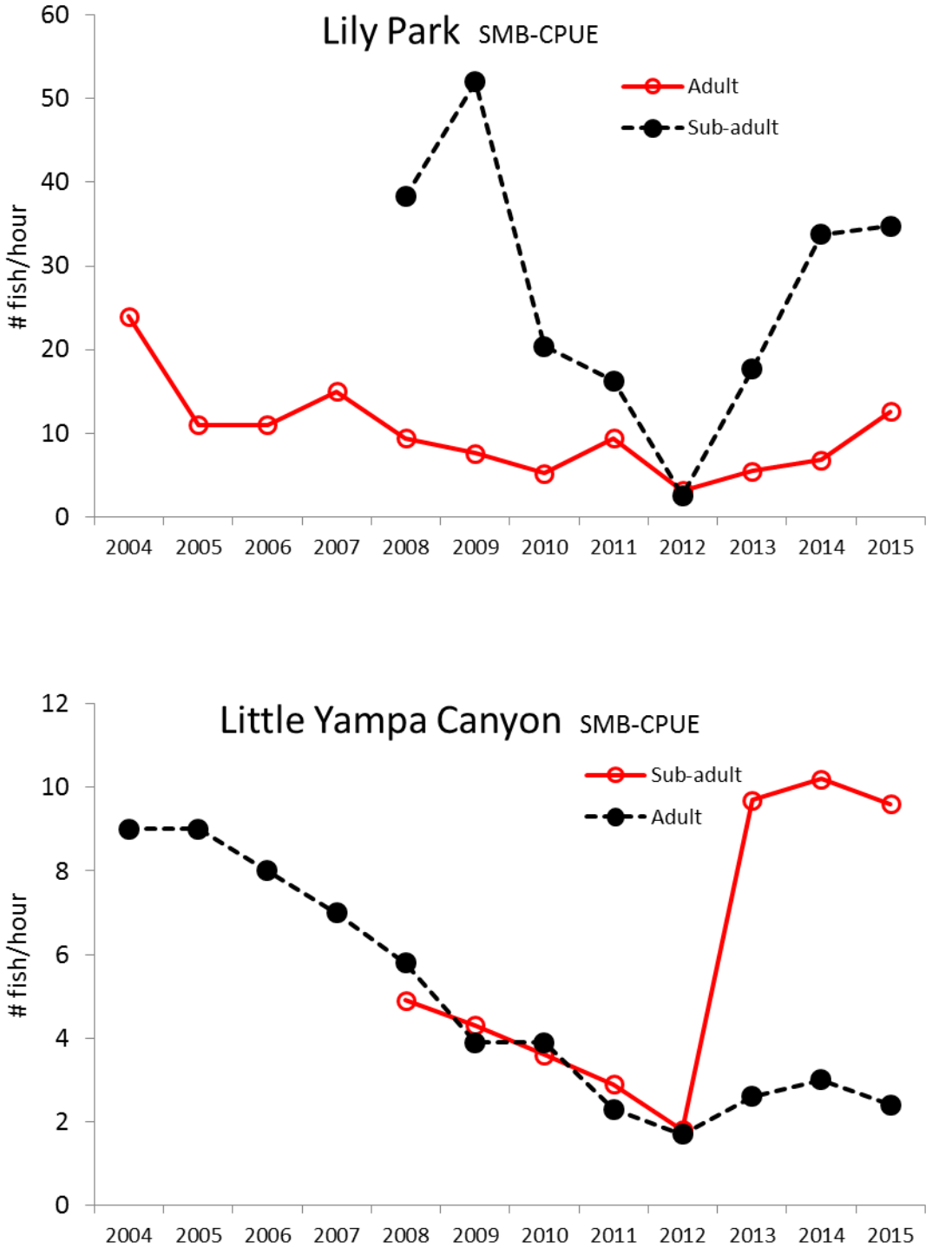



Figure 2—Number of sub-adult (100-199 mm) and adult (≥200 mm) smallmouth bass captured per hour of boat electrofishing in two reaches of the Yampa River, 2004-2015.

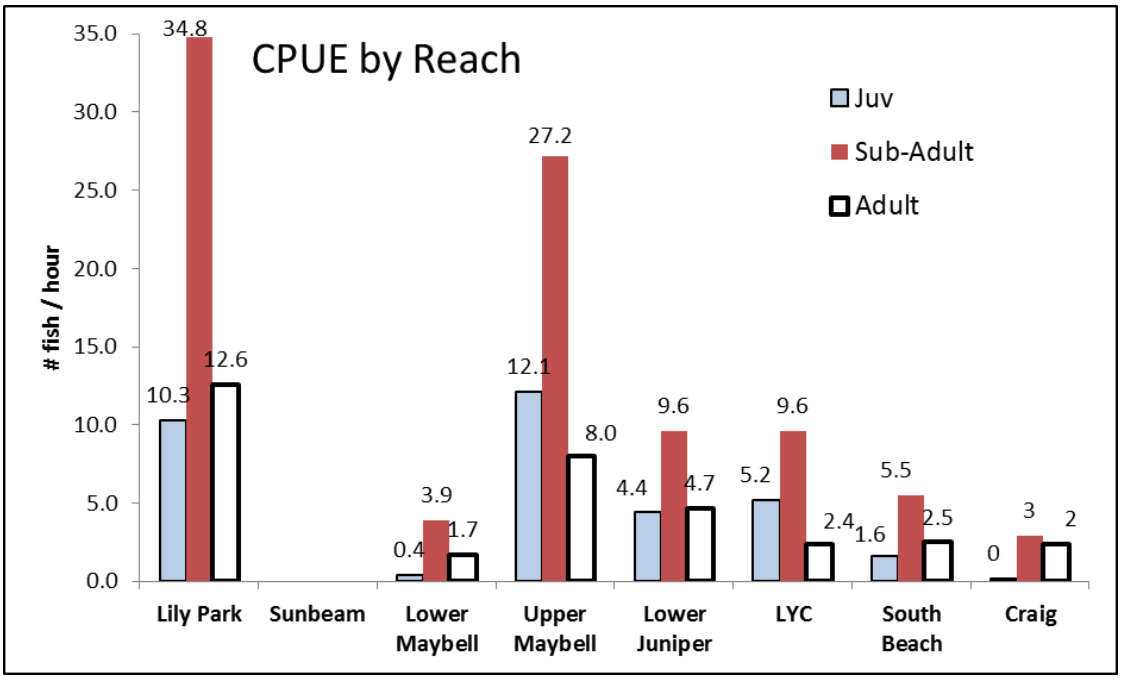



Figure 3—Catch per unit effort along a longitudinal gradient of the middle Yampa River, 2015.

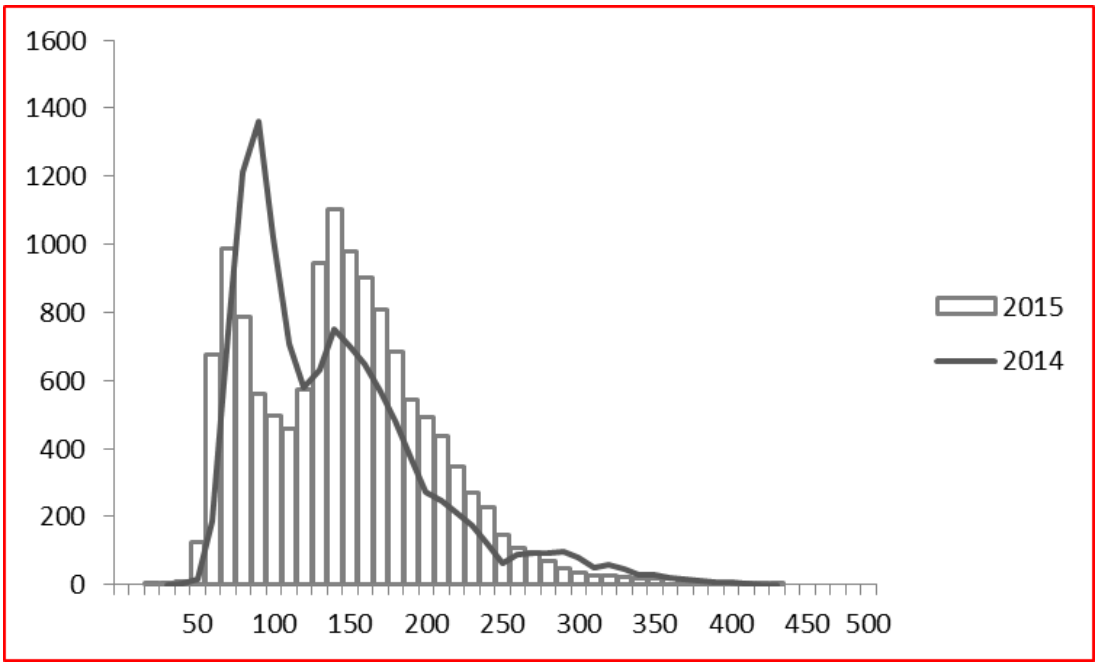



Figure 4---Length frequency of smallmouth bass captured by boat electrofishing, trammel nets, and fyke nets in all reaches of the middle Yampa River, 2014 and 2015.

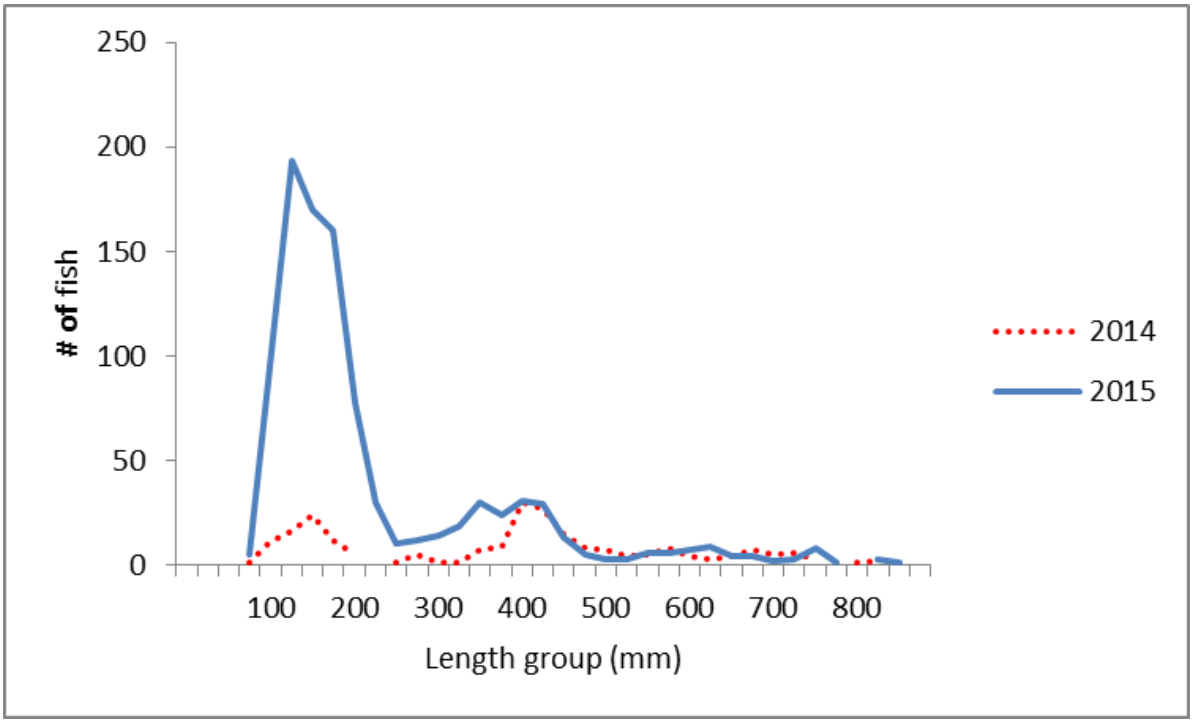



Figure 5 Length-frequency of northern pike captured in the middle Yampa River by CSU, 2014 and 2015, Length group increments are 25 mm.

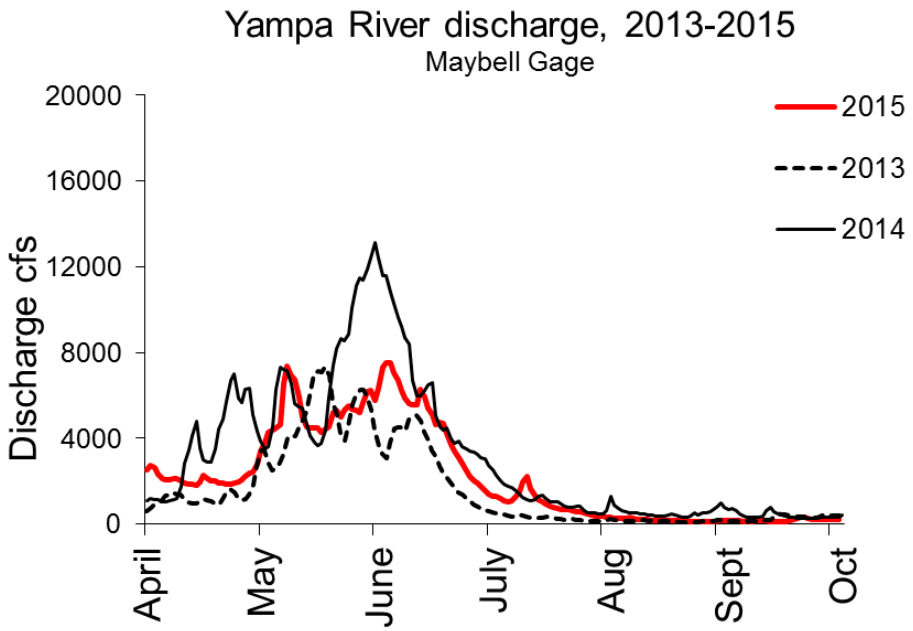
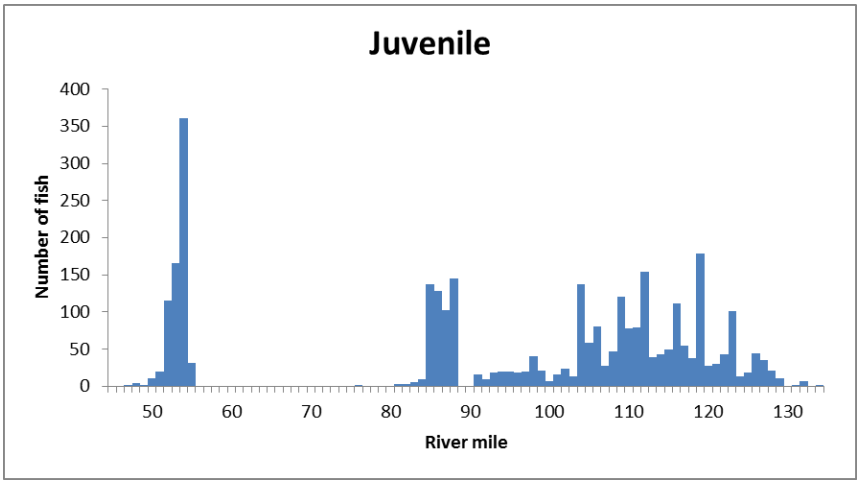
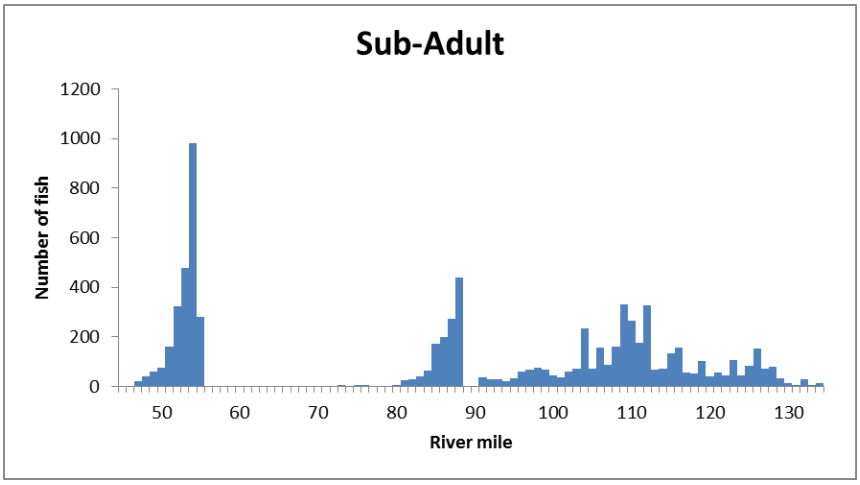



Figure 6-- Comparison of flow discharge at the Maybell USGS gage on the Yampa River, 2011-2014.



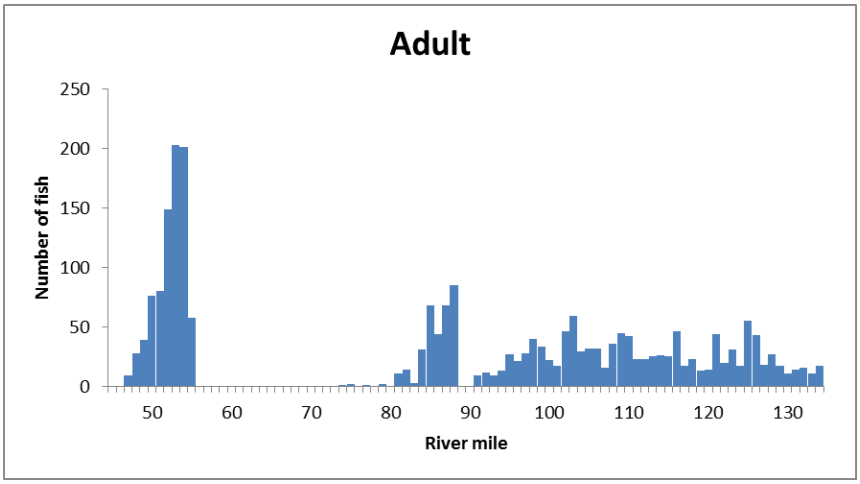




Figure 7—Number of smallmouth bass captured per mile in the middle Yampa River, 2015. RM 61-71 (Sunbeam) was not sampled in 2015.

Appendix B:
**Preliminary results of the removal of northern pike from the upper Yampa River, 2015.**

Hawkins, J. and D. Tuttle III

Overview: This report provides a preliminary summary of data collected in 2015 and therefore contains minimal analysis and discussion. Findings will be presented and discussed in greater detail at the nonnative workshop in December.

## Methods-Upper Yampa NP removal

Northern pike occupy the entire Yampa River and are currently being removed from the river downstream of Highway 40 Bridge to the confluence with the Green River under Recovery Program projects 98a, 98b, 110, and 125 to benefit endangered fishes in Critical Habitat. Pike are currently removed by Colorado Parks and Wildlife (CPW) in Catamount Reservoir and in the Yampa River from Catamount to Steamboat Springs to prevent their dispersal downstream and to benefit local trout and mountain whitefish fisheries. However, there have been no removal efforts for northern pike residing in the reach between Steamboat Springs and Hayden. In 2004 and 2005, the reach was sampled on two and three occasions, but all northern pike were marked with Floy tags and released back in the river to monitor movement, growth, and to obtain an abundance estimate (Finney and Atkinson 2004; 2005). They partitioned their study area into upper, middle, and lower reaches. Our study area is the same as their middle and lower reaches, but their 5-mile long upper reach is now sampled by CPW. Northern pike in this 5-mile reach are currently removed by CPW. Our study area was between Tree Haus Bridge in Steamboat Springs and Highway 40 Bridge at the Hayden Power Plant water intake (RM 194.2-170.6).

The study plan in 2015 was to sample in April before runoff to obtain an estimate of the number of northern pike that occupy the 24-mile study reach from Steamboat to Hayden. Abundance was estimated by using mark/recapture techniques which required marking all pike captured on the fish occasion with a tag and releasing them and then trying to catch those marked fish again on the second occasion. All northern pike captured on the second and third occasions were removed from the river using raft electrofishing. We also sampled a few selected backwaters from May through July to catch remaining adult and young-of-year (YOY) northern pike. YOY were collected to confirm whether or not spawning had occurred in the reach and to obtain hatch dates of those fish by aging their otoliths for daily increments. Identifying the spawning period and the associated environmental conditions in a given year will help us define the precise timing and location of spawning and therefore increase our efficiency in catching northern pike. Precision in our sampling will increase catch rates and increase spawning disruption.

Almost all of our study site reach is located within private property. Although much of the electrofishing can occur on the water without touching land, gaining access to launch or take-out boats, set nets in backwaters, or stop and process fish, requires landowner permission. In 2015, cooperation and permission was granted by a strong majority of landowners who saw the benefit to native trout by removing northern pike in the reach.

CPW provided electrofishing rafts and we conducted one marking pass and two removal passes between April 2$^{nd}$ and April 30$^{th}$. In May, June, and July, we set trammel and gill nets for adult pike and backpack electrofished for YOY pike in accessible backwaters at river miles (RM) 194.2, 186.9, and 186.8.

**Results-Upper Yampa NP removal**

Almost all landowners contacted agreed to allow access and were in favor of removing northern pike, primarily because they saw great value in protecting the fishery for trout and Mountain whitefish in that corridor. Flows measured at Steamboat Springs (USGS Gage 09239500) were delayed in 2015 compared to those in 2014 and generally lower through April, allowing us to keep rafts on the water until May (Figure 1). Runoff in 2015 was sustained by abundant spring rains. Because our daily sampling reaches were about 10 miles long, we primarily sampled backwaters in 2015. In 2016 we will try to sample more river habitats in addition to backwaters if we can obtain access points that shorten our daily sample reaches.

We had 118 northern pike capture events, 104 occurred during raft EL in April and the remaining 14 during netting or backpack electrofishing in later months. Spawning was confirmed with capture of six ripe females and 34 ripe males. Length of pike ranged 290--890 mm TL in April and 126--745 mm in later months. We marked 22 adult northern pike ($\geq$300 mm) with Floy tags on the marking pass and recaptured five of those tagged fish on a subsequent recapture pass. Using a Lincoln- Petersen abundance estimator, we estimated there were 215 (51-379, 95% CI) northern pike in the reach between Steamboat and Hayden. Standard error was 83.6 and the CV was 39%. The previous population estimates from 2004 and 2005 were not directly comparable to our estimate because they included an additional 5-mile reach that was outside of our study area and that reach contained a high proportion of the pike captured in those years. Furthermore, in 2004 they estimated the population based on fish >340 mm fish, while we estimated it for fish $\geq$300 mm. In 2004, the population size of northern pike >340 mm was 616 (560-691 95% CI; Finney and Atkinson 2004). In 2005, the population size of northern pike $\geq$300 mm was 722 (509-935 95% CI; Finney and Atkinson 2005). Northern pike captured in the 5-mile section that was outside our study reach represented at least half of the pike population, including 49% and 53% of all pike captured in 2004 and 2005, respectively. Thus if we reduce the 2004 and 2005 estimates by 50% to represent the portion of pike that live in our study area then the numbers of pike are more comparable to the estimates from our study area and likely contained approximately 300-350 fish, a population a little larger than we estimated. However most of our sampling occurred in backwaters while 2004 and 2005 sampling included backwaters and shorelines down both sides of the river, thus our estimate probably underestimated the total population size of northern pike in the reach.

We removed 91 pike or 42% of the estimated population on two removal passes using raft electrofishing. We observed, but seldom landed, other species such as brown trout, rainbow trout, mountain whitefish, mottled sculpin, and white sucker. We also captured one 282 mm TL smallmouth bass at RM 187.0.

Three of the pike that we examined contained large prey items that were 40-46% of the length of the pike that ate them. These included 280 mm and 262 mm rainbow trout and 295 mm mountain whitefish, which were eaten by pike which were 610, 638, and 745 mm, respectively.

Many backwaters remained connected to the river through mid-June. We sampled those to see if gill and trammel nets would be effective at catching adult pike and to catch YOY pike to confirm that reproduction had occurred in the reach. We sampled backwaters on five occasions and captured four juveniles (<300 mm) and 12 adults. Two YOY pike (126 and 152 mm) were

captured on July 13 at Tree Haus Bridge backwater (RM 194.2), confirming local reproduction. Otoliths from 36 YOY pike collected from backwaters near Craig and Steamboat Springs in 2014 and 2015 were also aged to determine spawning dates. To estimate the date of spawning, we counted daily increments since hatching for each young pike and added seven days to represent incubation time. YOY collected in the Craig area spawned May 3-31 in 2014 and April 12-26 in 2015 (Table 2). Delayed spawning in 2014 was likely due to cooler, higher runoff. YOY collected in Steamboat spawned on April 29 and May 8, later than those in Craig due to cooler upstream water temperatures. In 2015, some of the adult pike that we removed were early spawners. Otolith ages of young pike identified that some spawning occurred after we finished sampling in April, therefore to sample the entire spawning period will require techniques other than raft electrofishing to extend pike removal into the peak runoff period.

**Recommendations for upper Yampa River Northern pike**

- Continue to educate and develop positive relationships with landowners in the reach.
- Obtain an estimate of abundance using mark/recapture in 2016.
- Continue removal of adult northern pike with raft electrofishing, including more of the shoreline habitat in addition to backwaters.
- Identify gear (fyke, gill, trammel nets, or angling) that efficiently captures spawning adult pike in backwaters during later runoff.
- Continue to collect YOY pike and age otoliths to identify the spawning period.

**Acknowledgements**

We thank the CSU field crew that assisted with collections including: Carli Baum, Drew Ebner, Robert Garza, and Ed Kluender. Pike otoliths were aged by Kyle Dick. We also thank CPW personnel in the Steamboat Springs office: Billy Atkinson, Jim Haskins (AWM), and Justin Pollock (DWM) and Yampa Valley landowners who graciously allowed access on private property during sampling.

**References**

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Table 1--Number of northern pike captured by raft and backpack electrofishing (EL), gill net (GN), and trammel net (TR) and catch per unit effort (CPUE) for raft EL from Steamboat Springs to Hayden in the upper Yampa River, 2015. Life stages were based on length: juvenile (<300 mm) and adult (≥300 mm). *Mark pass includes 22 marked and released fish.

| | | | | Number of fish | | | CPUE (# fish/hr) | | |
|---|---|---|---|---|---|---|---|---|---|
| Pass | Sampling Period | Sampling Gear | Effort (Hrs) | Juv | Adult | All sizes | Juv | Adult | All sizes |
| **Raft EL River sampling** | | | | | | | | | |
| 1-mark | Apr 2-14 | Raft EL | 3.2 | | 24* | 24 | | 7.5 | 7.5 |
| 2 | Apr 22-24 | Raft EL | 6.3 | | 46 | 46 | | 7.3 | 7.3 |
| 3 | Apr 28-29 | Raft EL | 6.2 | 1 | 31 | 32 | 0.2 | 5 | 5.2 |
| Total | | | 15.7 | 1 | 101 | 102 | 0.06 | 6.2 | 6.5 |
| **BP, GN, and TR in accessible backwaters** | | | | | | | | | |
| | | BP | 0.3 | | | | | | |
| 3 | Apr 30 | GN, TR | 1.5 | 1 | 1 | 2 | | | |
| 4 | May 18 | GN, TR | 2.6 | | 1 | 1 | | | |
| 5 | Jun 12 | GN, TR | 9.6 | | 5 | 5 | | | |
| | | BP | 0.3 | | | | | | |
| 6 | Jun 24 | GN, TR | 3.4 | 1 | 2 | 3 | | | |
| | | BP | 1.0 | | | | | | |
| 7 | Jul 13 | GN, TR | 0.3 | 2 | 3 | 5 | | | |
| Total | | | | 4 | 12 | 16 | | | |
| Grand Total | | | | 5 | 113 | 118 | | | |

Table 2—Estimated spawning dates of northern pike based on otolith ages of YOY. Spawning date = 7 days prior to estimated hatch date.

| | # fish aged | Length range of YOY pike (mm) | Hatch date range | Spawning date range |
|---|---|---|---|---|
| 2014-Craig area | 18 | 97-166 | May 10--June 7 | May 3-31 |
| 2015-Craig area | 16 | 95-233 | Apr 19-May 3 | Apr 12-26 |
| 2015-Steamboat area | 2 | 126-152 | May 6-15 | Apr 29-May 8 |

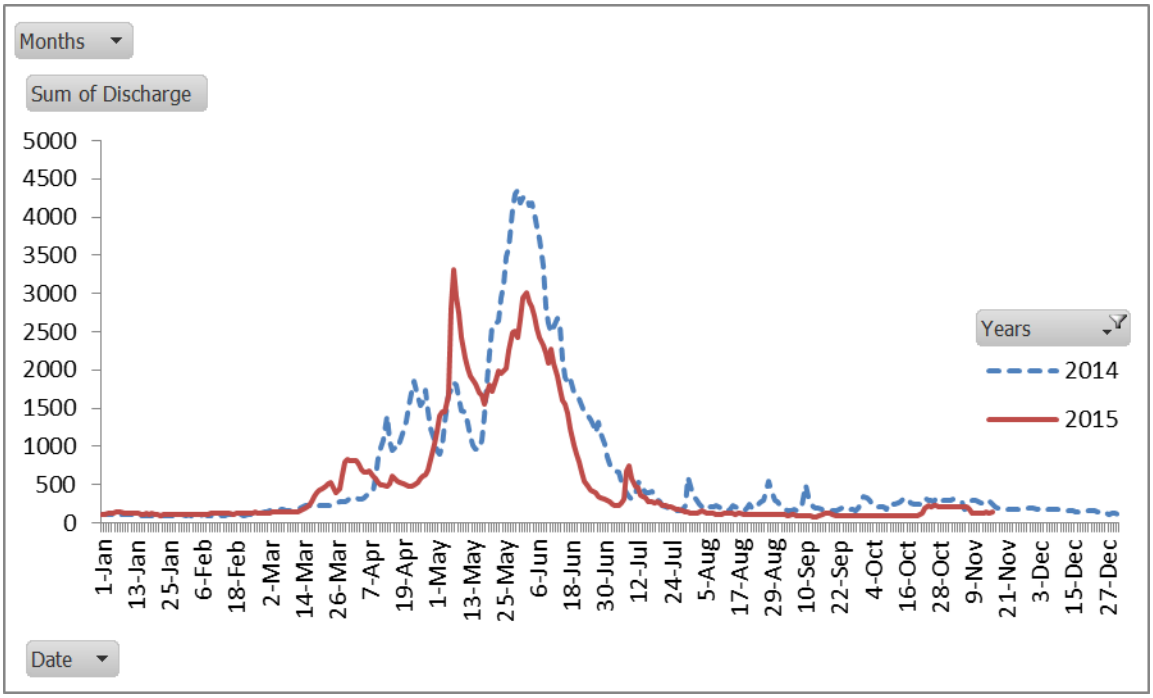


Figure 1- Steamboat gage (USGS# 09239500) discharge, 2014 and 2015.

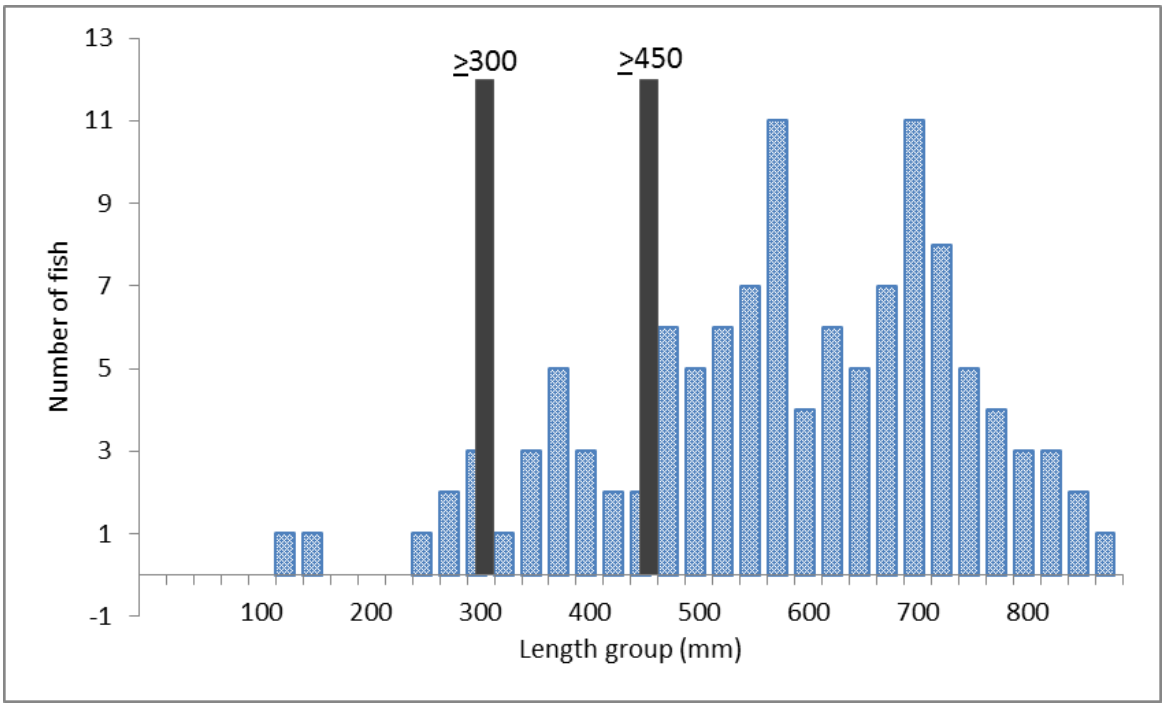


Figure 2-- Length frequency of northern pike captures in the upper Yampa River, 2015. Solid bars represent size of adult fish ≥ 300 mm TL and piscivores ≥450 mm TL. Mean length of northern pike captured was 593 mm, minimum length was 126 mm, and maximum length was 890 mm.