

I. Project Title: **Middle Yampa River northern pike removal and evaluation;  
smallmouth bass removal and evaluation**

II. Bureau of Reclamation Agreement Number: R13AP40029

Project/Grant Period: Start date: July 11, 2013

End date: September 30, 2017

Reporting period end date: December 30, 2017

Is this the final report? No

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IV. Abstract:

This project is one of several designed to facilitate the removal of northern pike and smallmouth bass within the Yampa River basin, with an evaluation of the efficiency of such efforts. The study area consisted of Yampa River miles 134.2 to 50.5 which were sampled to capture and remove smallmouth bass and northern pike. During the 2015 sampling season, 1132 northern pike individuals were handled and euthanized. Compared to 2014, this river section yielded an overall increased catch per unit effort, almost entirely attributable to a strong 2015 northern pike age-class captured during late season electrofishing (the Surge). Based on 2015 capture data and growth rates, around 68% of all northern pike captured were from the 2015 year class. See 2015 report #125 for a detailed analysis of smallmouth bass data collected in the study area.

V. Study Schedule:

Initial Year: 2005 (CDOW assisted Colorado State University (CSU) in 2004)

Final Year: Ongoing

VI. Relationship to RIPRAP:

This study involved removing northern pike and smallmouth bass from the middle Yampa River, and evaluating the efficiency of that effort.

Green River Action Plan: Yampa and Little Snake Rivers:

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

III.A.1. Implement Yampa Basin aquatic wildlife management plan in

reaches of the Yampa River occupied by endangered fishes. Each control activity will be evaluated for effectiveness and then continue as needed.

- III.A.1.b. Control northern pike.
- III.A.1.b. (1) Remove northern pike and other nonnative sport fishes from the Yampa River.
- III.B.2 Control nonnative fishes via mechanical removal
- III.B.2.e Remove smallmouth bass

VII. Accomplishments of FY 2014 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

A. FY 2015 Tasks and Deliverables

Task 1. Establish landowner contacts and obtain permission to access riverside and backwater property for fish sampling.

Schedule: March 2015

Deliverable: **Task Completed**

Task 2. Plan logistics, hire and train personnel, order and maintain equipment, and prepare for sampling.

Schedule: March-April, 2015

Deliverable: **Task Completed**

Task 3. Sample study area to capture and remove northern pike and smallmouth bass. Limited data entry

Schedule: April-Aug, 2015

Deliverable: **Task Completed**

Task 4. Maintenance of equipment. Data entry, data analysis, and prepare final report. Present findings during the Annual Nonnative Fish Control Workshop, and at the Annual Recovery Program Researchers Meeting.

Schedule: August-December, 2015

Deliverable: **Task Completed.** Annual Report Completed and presentation will be given at the Annual Nonnative Fish Control Workshop.

B. Discussion of Initial Findings and Shortcomings

**Study Area**

The study area for this project with regard to northern pike has been consistent since 2005. It includes the entire portion of the middle Yampa River sampled by CPW and CSU combined, from river mile (RM) 134.2 to 50.5 (Figure 1). Generally this reach is downstream of Craig, Colorado to Dinosaur National Monument. CPW samples Reach 1 (RM 134.2 – 124.0), CSU samples Little Yampa Canyon (LYC; RM 124 – 100), CPW samples Reaches 2 through 5 (RM 100 – 60.6), and CSU samples Lily Park (RM 55.5 – 50.5) (Table 1).

## CPW Study Methods/Approach

Since 2005, CPW has analyzed the combined northern pike removal efforts of CPW and CSU. As such, this report will describe the total efforts of both CPW and CSU for northern pike removal in the middle Yampa River study area (described above). Conversely, fiscal year 2015 marks the seventh consecutive year in which all smallmouth bass data collected by CPW were submitted to CSU for a combined analysis of smallmouth bass. See 2015 report #125 for a detailed analysis of smallmouth bass data collected in the study area.

In addition to standard sampling within the study area, CPW, CSU, and USFWS also participated in an enhanced sampling effort called the ‘Surge’. The Surge focused on the removal and disturbance of spawning adult smallmouth bass in river reaches with relatively high concentrations of adult smallmouth bass. In 2015, the Surge lasted from June 23 to July 28. Because northern pike were also removed during passes accomplished under the Surge, additional removal passes that were accomplished during the Surge are accounted for in the following paragraphs describing effort.

From 2004-2012, a mark-recapture study was incorporated into the northern pike removal effort to estimate northern pike abundance. However, in an effort to increase northern pike removals, mark passes have not been conducted since 2012.

Between river-mile 134 and 50.5, crews conducted between 1 and 9 passes on each individual reach (Table 1), although not every mile of river within a given reach was shocked on every pass. Pass numbers varied in order to maximize impacts to nonnative species and to target as much habitat as limited flows would allow. A total of 5 removal passes were conducted in Reach 1 (Southbeach: RM 134.2 – 124.0), 1 in Reach 2 (Juniper: RM 100 – 91.0), 6 in Reach 3 (Upper Maybell: RM 88.7 – 79.2), 1 pass in Reach 4 (Lower Maybell: RM 79.2 – 71.0) and none in Reach 5 (Sunbeam: RM 71.0 – 60.6) (Table 1). In CSU’s study area, ten removal passes were conducted in Little Yampa Canyon (RM 124 – 100) and 5 sampling passes were conducted in Lily Park (RM 58.9 – 55.5) (Table 1).

Northern pike and smallmouth bass were captured using ETS boat mounted electrofishing gear. Electrofishing effort was recorded by reach sampled and by date. In addition, “Block and shock” and “snare and scare” techniques were utilized with trammel nets at the mouths of backwaters. Water conductivity and temperatures were recorded at the beginning of each sampling day. All northern pike captured were euthanized; none were translocated to any location. This was the second year in which no northern pike were translocated.

All northern pike, smallmouth bass, and roundtail chub were measured for total length to the nearest millimeter (mm) and most were weighed to the nearest gram (g). Northern pike and smallmouth bass captured were examined for the presence of FLOY tags and fin clips. Colorado pikeminnow and roundtail chub were scanned for the presence of passive integrated transponder (PIT) tags. Individuals without PIT tags were implanted with a new PIT tag following the protocol of the Upper Colorado River Recovery Program. All Colorado pikeminnow and roundtail chub were released back to the water immediately. In nearly all cases, incidental centrarchids, cyprinids, catostomids, ictalurids, and salmonids were also identified to species,

measured for total length to the nearest millimeter (mm), and weighed to the nearest gram (g). This was the third year of CPW's "net everything" approach to sampling. Previously CPW had only netted the target species: smallmouth bass, northern pike, roundtail chub, and Colorado pikeminnow.

### Determination of Population Estimates, Catch Per Unit Effort, and Movement

#### *Population Estimates*

In 2015, marking passes were not conducted and therefore population estimates were not performed.

#### *Catch Per Unit Effort (CPUE)*

Catch per unit effort (CPUE) was reported in terms of number of northern pike captured per electrofishing hour. All capture events were considered independent of one another, and all individuals that were recaptured on the same day or a different day, were included in total capture events.

In addition to overall catch per unit effort, CPUE was reported for three sub-sections within the study area: (1) Juniper (RM 134.2 to 91.0), (2) Maybell (RM 88.7 to 60.6), and (3) Lily Park (RM 55.5 to 50.5). For these three sub-sections CPUE was broken down into four categories and reported for each pass. The four categories for which CPUE was reported were: (1) NPK < 300mm TL, (2) NPK  $\geq$  300mm TL, (3) NPK  $\geq$  450mm TL, and (4) Total NPK.

#### *Movement*

Movement was broadly described in terms of number of fish that were recaptured in 2015, which were initially tagged in a previous year.

Individual northern pike had to be captured more than once to be included in the movement analysis. No further marking passes are taking place for northern pike, and no northern pike are being marked in upstream reservoir locations; consequently all movement data collected are from individuals marked in the river prior to 2013 or in a reservoir prior to 2015. No tagged northern pike were collected by electrofishing in 2015. The two tagged pike used in the analysis were captured during backwater netting operations. Movement distance for individuals was calculated by subtracting river mile at initial tagging location from river mile at subsequent recapture location; negative values represented downstream movement and positive values represented upstream movement. Distance moved was plotted against number of months at large between capture events.

### **Results and Discussion**

Twenty one different fish species were collected within CPW study reaches. Summary data for all species captured and handled by CPW in 2015 are presented in Table 2.

## Northern Pike

### *Overview*

Overall, CPW and CSU captured 1132 individual northern pike. The total number of northern pike capture events in 2015 (1132) increased from 437 in 2014. All northern pike were euthanized in 2015, representing 100% of northern pike individuals that were handled (Table 4). Northern pike were not translocated to State Park Headquarters West Pond, as 2015 was the second year that no fish were translocated to any water body (Table 5).

Three hundred twenty six of 1132 northern pike removed from the river in 2015 were considered adult northern pike ( $\geq 300\text{mm}$ ; Table 4 and Figure 2). One hundred nineteen of 1132 northern pike removed were  $\geq 450\text{mm}$  (Figure 2). No northern pike captured while electrofishing were fish that had been previously marked by CPW, CSU, or USFWS and only two such fish were captured in backwater netting (Table 6). Northern pike recaptures continued to decrease in 2015 due to the fact that northern pike have not been marked in the Yampa River since 2012 when the last mark/recapture population estimate took place.

### *Population Size Structure*

Northern pike total length frequency histograms for the entire section of river sampled by CPW and CSU from 2004 to 2015 are presented in Figure 2. In 2015, the northern pike catch featured fewer adult fish ( $\geq 300\text{mm}$ ), 29% of total capture events, and more juvenile northern pike ( $< 300\text{mm}$ ), 71% of total capture events. By comparison, in 2014, 81% of northern pike captured were adults and 19% juveniles. Eleven percent of all northern pike captured in 2015 were large adults  $\geq 450\text{mm}$ , a substantial decrease compared to 43% in 2014. The largest northern pike captured in 2015 was 940 mm.

Compared to past removal efforts, a substantially larger number of young of year (YOY) northern pike were captured in 2015 (Figure 3). Northern pike YOY were defined as  $\leq 200\text{mm}$  fish captured after June 1 of each corresponding year. Two hundred seventy eight YOY were captured in 2011, 8 in 2012, 18 in 2013, 64 in 2014, and 673 in 2015. The first YOY of 2015 was captured on June 22 (compared to July 8, 2014) and was 110mm. This is the largest number of YOY pike captured in a season since the inception of control efforts on the Middle Yampa River.

The large number of YOY northern pike is concerning. Effort was roughly comparable to recent years and thus cannot account for the dramatic increase in YOY catch rate. Some environmental conditions were measurably different in 2015 than prior years and may have contributed to production of an apparently exceptionally large cohort of YOY northern pike. The Yampa River hydrograph for 2015 shows a bimodal flow pattern that was the result of early runoff peaking on May 9, 2015 followed by protracted rain and snow resulting in a second peak on June 3, 2015 (Figure 4). Additionally, the onset of runoff was nearly a month earlier than in 2014 (Figure 4). The resulting protracted, moderate flows were likely sufficient to allow northern pike access to spawning habitat well before electrofishing commenced. Direct evidence from the spring backwater netting effort documents earlier onset of spawning in 2015 compared to 2014 (see “Significant Additional Work” section, below). Once electrofishing was underway, flows remained low enough to impede access to spawning areas by electrofishing boats for longer than

usual. Protracted moderate flows may also have increased the duration of the spawn and improved quality and connectivity of northern pike nursery habitat.

Water temperatures in 2015 were also atypical. The maximum daily temperature in the Yampa River throughout February and most of March was much higher than in the past three years (Figure 5). Warmer temperatures may have improved conditions for northern pike YOY survival and growth (possibly by increasing primary productivity early in the season), and may also have contributed to an earlier or longer spawning season

The apparently large 2015 cohort may also reflect a compensatory response to reduced numbers of adult pike. Catch rates of adult pike >300mm continued to decline in 2015, as did the raw number of pike removed during backwater netting (see below). Northern pike are known to limit their own populations through cannibalistic predation (Mann 1982). Increasingly successful removal efforts in recent years may have resulted in reduced predation from larger size classes and greater survival of the YOY age class in 2015. If this mechanism is in effect, there may be a need to investigate methods to suppress larval and YOY northern pike in nursery habitat, or prevent their emigration from rearing habitat to the main channel.

It was difficult to make meaningful comparisons of northern pike growth rates with those from previous years (i.e. Wright 2010), due to the limited number of individuals recaptured in 2015, and the relatively large sizes of those recaptured. The growth rates for the two northern pike were 0.24 mm/day and 0.28 mm/day (Table 7). These rates are much smaller compared to the average growth rates of comparable fish (between-year recaptured fish that were  $\leq 450$ mm during the first capture event) analyzed between 2011 and 2013 whose growth rates averaged 0.53 mm/day in 2011, 0.51 in 2012, 0.52 in 2013, and 0.40 mm/day in 2014. The substantially reduced growth rates are noteworthy, but are based on an extremely small sample size.

#### *Population Estimate: South Beach to Lily Park*

Northern pike population estimates were not calculated for the 2015 sampling season since a mark pass was not conducted. Population estimates from 2004-2012 are shown in Table 8 and Figure 6.

#### *Catch Per Unit Effort (CPUE)*

CPUE was calculated for sub-sections of the study area (Juniper, Maybell, and Lily Park) and compared to previous years (Table 9). Additionally, CPUE was calculated for four size categories (<300mm,  $\geq 300$ mm,  $\geq 450$ mm, and all sizes of northern pike) across all passes conducted in three sub-sections (Juniper, Maybell, and Lily Park), and expressed as number of northern pike captured per hour of electrofishing (# of NPK/hour electrofishing) (Tables 9-10; Figures 7-9). As in most years, overall CPUE in Lily Park was considerably lower than in the other two sub-sections (Table 9).

In the Juniper sub-section (Figure 7), CPUE was highest during the Surge passes, when large numbers of YOY captured increased CPUE to over 3.5 northern pike per hour. A similar increase in CPUE was seen in the Maybell sub-section, where CPUE in pass 4 increased to over

2.5 northern pike per hour due to large numbers of YOY encountered (Figure 8). In Lily Park, CPUE was also highest during the last pass analyzed, but the high CPUE, over 1.2 northern pike per hour was due to high captures of individuals over 450mm. All northern pike captured in Lily Park were  $\geq 300$ mm (Figure 9).

The large numbers of YOY captured in 2015 increased the overall CPUE in the study area from 0.68 northern pike per hour in 2014 to 2.08 northern pike per hour in 2015. This reverses a declining trend in CPUE between 2012 (CPUE = 1.29) and 2014 (Figure 10). If only captures of adults ( $> 300$ mm) are considered ( $n = 326$ ), then CPUE for 2015 is only 0.58, essentially identical to the CPUE of adult fish in 2014: 0.55 ( $n = 352$ , effort = 643.61 hours). CPUE is a useful tool in assessing trends in catch rate that may be associated with various factors such as temperature, discharge, population size, and age-structure of the northern pike population as removal efforts continue.

### *Movement*

No northern pike were recaptured during electrofishing efforts in the Middle Yampa River in 2015. Only two tagged fish were recaptured during CPW backwater netting operations in 2015 (Table 6). The decrease in recapture of tagged fish is unsurprising because no mark passes for northern pike have been completed since 2012. The two northern pike recaptures were both fish previously tagged by CSU in 2011 and 2012. No northern pike from off-channel locations were captured (see below for escapement summary).

Northern pike net movement was described in terms of the number of recaptured northern pike that moved varying distances in both upstream and downstream directions, and was plotted against number of months at large (Figure 11). Only two northern pike were recaptured. One fish was recaptured 40.5 miles upstream from its marking location, nearly 4 years after being tagged. The other fish moved 25 miles upstream in a little less than 3 years (Figure 11).

Discontinuing tagging efforts in the Yampa River after 2013 for population estimates and discontinuing translocation of pike in 2014 greatly shapes the expected recaptures of tagged fish. During the two sampling seasons in 2013 and 2012, it was rare to catch a pike tagged three or more years previously (one 2010 fish caught in 2013). As a result, we expect that recaptures of tagged fish will be even lower in future years.

### *Escapement*

Translocation of northern pike to Loudy Simpson Pond was officially discontinued in 2011. No fish were recaptured that were previously translocated to Loudy Simpson Pond. No northern pike were recaptured that were initially tagged and released in Elkhead Reservoir. Water releases at Elkhead Reservoir were carefully managed, which, along with moderate flows, prevented the reservoir from spilling in 2015. It is not expected that any escapement of northern pike, including YOY fish, took place from Elkhead in 2015. The installation of a spillway net and the implementation of a new Lake Management Plan are expected to eliminate escapement from the reservoir in future years. In addition, northern pike removal continues to take place in Lake Catamount upstream of Steamboat Springs. Removal efforts at Lake Catamount have

significantly decreased the overall size of northern pike as well as numbers. Habitat near the spillway of Lake Catamount is not preferred for smaller size-classes of northern pike which comprise the majority of the current population. Therefore, CPW believes that escapement of northern pike from Lake Catamount is nominal or non-existent (Bill Atkinson, personal communication).

### *Concentration Areas*

Northern pike distribution is not geographically uniform, which is why our removal efforts are not constant in all river reaches. Specific types of habitat, mainly backwaters, tributary mouths, and other slack water areas, generally hold more northern pike and these types of habitat are not available in all reaches. Most northern pike captured (859 out of 1132, 76%) were removed from Southbeach and Little Yampa Canyon combined (Figure 12). The utility of targeting removal efforts to areas where northern pike concentrate needs to be balanced against various other goals of the field activities. Removal of smallmouth bass is also an important consideration, and removal of white suckers to benefit native sucker species should also be a consideration for removal work.

### Colorado Pikeminnow

No Colorado pikeminnow were captured by CPW in 2015 in the Middle Yampa River. By comparison, one Colorado pikeminnow was captured by CPW in 2014.

### Roundtail Chub

Two roundtail chub were captured by CPW in 2015 (Table 11; Figure 13). One roundtail chub was 224mm TL, weighed 106g and was captured at river mile 87.9 on May 6, 2015. The other was 221mm TL, weighed 140g and was captured at river mile 91.5 on June 23, 2015. Neither roundtail chub had a tag when captured, and both were given PIT tags.

### Significant Additional Work Outside of Scope of Work:

In addition to tasks included under the 98a scope of work, CPW crews continued targeted spring netting within key in-channel backwater northern pike spawning areas. CPW gained access through private landowners to net several high-priority backwaters. CPW crews netted 16 locations with a focus on 4 backwaters that were the most productive. In 3 of the 4 backwaters (151, Wyman, Weber), nets were set for 27 days and the fourth, at river mile 132.8, had nets set for 28 days straight in addition to three days with daytime (10 – 11 hour) net sets. Three of those 4 backwaters lie within the geographic area of 98b and one within 98a (Figure 14). At the peak of the netting CPW was fishing 18 gill nets, in 14 locations.

Netting began in most locations on April 2, 2015 or April 3, 2015 and ceased the last week of April as catch rates decreased and it became difficult to conduct netting concurrently with required electrofishing effort. During the netting operation 828 fish were captured including 8 different species (Table 12). Based on the catch data there was very minimal undesired bycatch from netting as only a single native fish, a flannelmouth sucker, was captured by CPW crews. A total of 450 northern pike were captured and euthanized. In 2014, 235 of 245 (96%) of female

northern pike captured were either hard or gravid females, while only 10 of 245 (4%) were spent females that had already spawned. In 2015, 155 northern pike were identified as females; of that number, 36 (23%) were spent. Even though backwater netting started in the same week as in 2014, a substantially higher percentage of the females that were captured were spent. This indicates that backwater netting in 2015 did not span the entire spawn and that spawning likely began earlier in 2015 than in 2014.

#### VIII. Additional Noteworthy Observations:

A summary of all fish species captured and processed is included in Table 2. Noteworthy observations, discussed above, included the 2 capture events of roundtail chub >150mm (Table 11). These captures occurred as a result of the CPW strategy to net all fishes, rather than only targeting smallmouth bass, northern pike, roundtail chub, and Colorado pikeminnow. As a result of netting and processing all fishes, thousands of <150mm white suckers were removed and two roundtail chub <150mm were captured, measured, weighed and PIT tagged. It is unclear how much these captures are influenced by the change in sampling regime or fluctuations in the roundtail chub population. Nonetheless, these captures are noteworthy and make netting all species of fish encountered worthwhile.

#### IX. Recommendations:

- A. Establish predefined conditions under which a population estimate using mark/recapture techniques is appropriate to balance both the need to understand the population demographics of northern pike and the need to remove all individuals that may reproduce in the study area.
- B. Continue early spring netting and exploitation of backwater areas to reduce northern pike spawning success.
- C. Repeat 2015 standard northern pike removal effort, and continue to allocate greater effort to periods when catch rates are higher, i.e., shifting effort from after the peak of the hydrograph to the ascending limb of the hydrograph. If feasible, consider reallocating electrofishing effort during less productive times to increasing backwater netting effort as well.
- D. Also prioritize sampling that occurs later in the sampling season, i.e., the Surge, to document the presence or absence of YOY northern pike in future years.
- E. Repeat the 2015 Surge effort in future years, as the Surge was complimentary to northern pike management objectives in the Yampa River.
- F. Continue shifting effort to time periods and concentration areas where northern pike are most vulnerable to capture.
- G. Continue work to control potential northern pike source populations. Prioritize work schedule to focus on populations of immediate concern.
- H. Continue marking and documentation of roundtail chub and Colorado pikeminnow.
- I. Continue the net-everything approach adopted by CPW in 2013 and continued in 2014 and 2015 to help further document recruitment of roundtail chub and stocking success of bluehead suckers in CPW reaches.
- J. Continue contacts with Yampa River landowners and stakeholders before, after, and during the study.
- K. Develop techniques that target larval and YOY northern pike to allow efficient exploitation of additional life stages.

- X. Project Status: This project is considered on track, with minor revisions to be considered. Study direction and sampling design for 2016 may be adjusted per results from the 2015 Nonnative Fish Control Workshop. Funding of backwater netting and exploitation work must be considered and allocated to the appropriate scope of work if it is to be continued in FY 2016.
- XI. FY 2015 Budget Status:
- A. Funds Provided: \$199,181
  - B. Funds Expended: \$199,181
  - C. Difference: -0-
  - D. Percent of the FY 2015 work completed: 100%
  - E. Recovery Program funds spent for publication charges: -0-
- XII. Status of Data Submission: Data for Colorado pikeminnow collected by CPW will be provided to the database Manager by March 1, 2016.
- XIII. Signed:                      Cory Noble                      November 6, 2015  
Principal Investigator                      Date

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## Appendix: Tables and Figures

Table 1. Middle Yampa River reaches, river sections, reach descriptions, river miles, agency responsible, and pass summaries for 2015

<b>River Reach</b>	<b>River Section</b>	<b>Reach Description</b>	<b>River Miles</b>	<b>Agency Responsible</b>	<b># Mark/Release Passes</b>	<b># Removal Passes</b>	<b># Total Passes</b>
1	Juniper	South Beach launch to Round Bottom	134.2-124.0	CPW	0	5	5
CSU 1	Juniper	Little Yampa Canyon	124.0-112.0	CSU	0	9	9
CSU 2	Juniper	Little Yampa Canyon	112.0-100.0				
2	Juniper	Ups. Government bridge to mouth of Juniper Canyon	100.0-91.0	CPW	0	1	1
3	Maybell	Dwn. Juniper Canyon to Old Maybell launch	88.7-79.2	CPW	0	6	6
4	Maybell	Old Maybell launch to Sunbeam launch	79.2-71.0	CPW	0	1	1
5	Maybell	Sunbeam launch to ups. Cross Mountain launch	71.0-60.6	CPW	0	0	0
CSU 3	Lily Park	Lily Park	55.5-50.5	CSU	0	5	5

Table 2. A summary of the total number of individuals captured for all species of interest by CPW, unless otherwise noted, in the Middle Yampa River in 2015. Non-natives that were lethally removed include: black bullhead, black crappie, brook stickleback, creek chub, common carp, green sunfish, white sucker, and all white sucker hybrids.

<b>Species</b>	<b>Number of Capture Events</b>
Northern Pike	1132 (CSU 978 + CPW 154)
Smallmouth Bass	2509
Roundtail Chub	2 (2 > 150mm)
Black Bullhead	7
Black Crappie	1
Bluehead Sucker	56
Brook Stickleback	10
Brown Trout	26
Creek Chub	109
Common Carp	10
Green Sunfish	28
Flannelmouth Sucker	21
Fathead Minnow	6
Mottled Sculpin	1
Mountain Whitefish	98
Rainbow Trout	31
Sand Shiner	55
Speckled Dace	8
White Sucker	3403
White x Bluehead Sucker Hybrid	18
White x Flannelmouth Sucker Hybrid	49
<b>Total CPW Capture Events (Individual Fish Processed)</b>	<b>6602</b>

Table 3. Middle Yampa River sampling season 2004 to 2015. 1<sup>st</sup> NPK Capture was the date for a given year when the first northern pike was captured by electrofishing. Last NPK Capture was the date for a given year when the last northern pike was captured by electrofishing. # Days Between 1<sup>st</sup> and Last Capture was number of calendar days between dates listed for a given year.

<b>Year</b>	<b>Date of 1st NPK Capture</b>	<b>Date of Last NPK Capture</b>	<b># Days Between 1st and Last Capture</b>
2004	4/21/2004	7/8/2004	78
2005	4/22/2005	7/21/2005	90
2006	4/21/2006	7/4/2006	74
2007	4/17/2007	6/30/2007	74
2008	4/15/2008	7/15/2008	91
2009	4/7/2009	7/14/2009	98
2010	4/13/2010	7/11/2010	89
2011	4/26/2011	8/22/2011	118
2012	4/17/2012	6/19/2012	63
2013	4/18/2013	7/12/2013	85
2014	4/21/2014	7/24/2014	94
2015	5/5/2015	6/25/2015	51

Table 4. Number of northern pike  $\geq 300$ mm TL tagged on the marking pass, number northern pike  $\geq 300$  mm TL that were tagged on the marking pass and recaptured on the recapture pass, number of northern pike in all TL classes that were tagged on the marking pass and removed during all subsequent passes, % of northern pike of all size classes that were tagged on the marking pass and removed on subsequent passes, total number of northern pike handled during study period, total number of northern pike that were removed during study period, and percent of handled northern pike that were removed in the middle Yampa River from 2004 through 2015. Population estimates could not be calculated for the 2013-2015 sampling seasons as 2013 was the first year a mark pass was not conducted.

<u>Year</u>	<u># NPK Tagged on First Pass</u>	<u># NPK Recaptured on the Second Pass</u>	<u># NPK Tagged, Recovered, and Removed on Subsequent to Marking Pass</u>	<u>%Recovery of Tagged NPK</u>	<u>Total # of NPK Individuals Handled</u>	<u>Total #NPK Removed</u>	<u>%NPK Handled that were Removed</u>
2004	159	NA	76	48%	942	665	71%
2005	195	NA	83	43%	526	410	78%
2006	214	NA	79	37%	520	384	74%
2007	181	NA	93	51%	878	775	88%
2008	154	41	72	47%	503	417	83%
2009	92	13	16	17%	558	495	89%
2010	67	11	31	46%	662	623	94%
2011	79	11	20	25%	824	765	90%
2012	165	14	39	22%	618	475	77%
2013	NA	NA	NA	NA	610	*608	100%
2014	NA	NA	NA	NA	437	437	100%
2015	NA	NA	NA	NA	1132	1132	100%

\*CSU-LFL had 2 northern pike escape or get eaten from a live pen after an otter break in; all other northern pike captured were translocated or euthanized.

Table 5. Disposition totals for northern pike removed from the middle Yampa River in 2015. All northern pike were euthanized, no fish were translocated.

<b>Disposition</b>	<b>Number of Northern Pike</b>
<b>State Park Headquarters Pond (Total)</b>	<b>0</b>
CPW	0
CSU-LFL	0
Loudy Simpson	0
Elkhead Reservoir	0
<b>Euthanized and Incidental Mortality (Total)</b>	<b>1132</b>
CPW	154
CSU-LFL	978
<b>Total</b>	<b>1132</b>

Table 6. Number of northern pike (NPK) 2015 recaptures that featured “foreign” tags, including those tagged and released by CPW and CSU in 2008, 2009, 2010, 2011, and 2012 as well as those tagged by project 98b in previous years and those tagged by CPW in Elkhead Reservoir in 2011, 2012, 2013, or 2014. The two recaptured northern pike in 2015 were captured during backwater netting efforts.

<b>Source of “Foreign” Tags</b>	<b>Number of NPK Recaptured</b>
Tagged and Released by CPW and CSU in 2008	0
Tagged and Released by CPW and CSU in 2009	0
Tagged and Released by CPW and CSU in 2010	0
Tagged and Released by CPW and CSU in 2011	1
Tagged and Released by CPW and CSU in 2012	1
Tagged and Released by CPW and CSU in 2013	0
Tagged and Released by USFWS (98b) in Previous Years	0
Tagged and Released by CPW in Elkhead Reservoir in 2011	0
Tagged and Released by CPW in Elkhead Reservoir in 2012	0
Tagged and Released by CPW in Elkhead Reservoir in 2013	0
Tagged and Released by CPW in Elkhead Reservoir in 2014	0
<b>Total Number of NPK Recaptures</b>	<b>2</b>

Table 7. Growth rate calculations based on capture history of northern pike that were recaptured in 2015 in backwater netting operations. For each fish fitting such description, the table includes TL (mm) at first capture, date of first capture, TL (mm) at recapture, date of recapture, length difference between the two capture events, growth rate expressed in mm/week, and growth rate expressed in mm/day.

<u>Date of First Capture</u>	<u>TL @ First Capture (mm)</u>	<u>Date of Second Capture</u>	<u>TL @ Second Capture (mm)</u>	<u>Change in TL(mm)</u>	<u>Growth Rate(mm/week)</u>	<u>Growth Rate (mm/day)</u>
6/4/2012	565	4/29/2015	822	257	1.70	0.24
5/14/2011	347	4/26/2015	755	408	1.97	0.28

Table 8. Northern pike  $\geq 300$  mm TL population estimate and the 95% confidence interval, generated using Program MARK Huggins closed estimate; estimated capture probability (p-hat); number of northern pike  $\geq 300$ mm removed; and exploitation rate of northern pike in terms of percent of the abundance point estimate removed for 2004 through 2012 in the middle Yampa River. Population estimates could not be calculated for the 2013-2015 sampling season as mark passes have not been conducted since 2012.

<b>Year</b>	<b>NPK <math>\geq 300</math> mm Population Estimate and 95% Confidence Interval</b>	<b>P-Hat</b>	<b>Number NPK <math>\geq 300</math> mm Removed</b>	<b>NPK <math>\geq 300</math> mm Exploitation Rate</b>
2004	981 (774-1288)	0.23	560	57.1%
2005	678 (555-861)	0.22	380	56.0%
2006	623 (517-780)	0.22	328	52.6%
2007	1073 (825-1321)	0.23	679	63.3%
2008	633 (518-806)	0.28	384	60.7%
2009	765 (553-1160)*	0.15	378	49.4%
2010	664 (492-1002)**	0.20	481	72.4%
2011	641 (505-912)***	0.15	460	71.8%
2012	1580 (1069-2482)****	0.08	410	25.9%
2013	NA	NA	588	NA
2014	NA	NA	352	NA
2015	NA	NA	326	NA

\*137 northern pike were removed prior to conducting the abundance estimate and were added to the point estimate and upper and lower confidence limit for comparison with previous years

\*\*175 northern pike were removed prior to conducting the abundance estimate and were added to the point estimate and upper and lower confidence limits for comparison with previous years.

\*\*\*246 northern pike were removed prior to conducting the abundance estimate and were added to the point estimate and upper and lower confidence limits for comparison with previous years.

\*\*\*\*130 northern pike were removed prior to conducting the abundance estimate and were added to the point estimate and upper and lower confidence limits for comparison with previous years.

Table 9. Northern pike Catch Per Unit Effort (CPUE) from 2004 to 2015 in three sub sections of the middle Yampa River: (1) Juniper (RM 134.2 – 91.0), (2) Maybell (RM 88.7 – 79.2), and (3) Lily Park (RM 55.5 – 50.5)

<b>Year</b>	<b>Juniper CPUE</b>	<b>Maybell CPUE</b>	<b>Lily Park CPUE</b>
2004	2.01	2.92	1.96
2005	1.69	1.23	0.81
2006	1.48	1.64	0.58
2007	1.90	2.26	0.54
2008	0.93	1.15	0.49
2009	1.05	1.04	0.27
2010	1.13	1.07	0.41
2011	1.27	0.75	0.37
2012	0.97	2.23	1.76
2013	0.69	1.64	0.91
2014	0.71	0.71	0.41
2015	2.74	1.67	0.80

Table 10. Number of northern pike captured, electrofishing effort expended (hours), and northern pike catch per unit effort (CPUE; # NPK/ hour electrofishing) across each pass for each of sub-section (Juniper: RM 134.2-91.0, Maybell: RM 88.7-60.5, and Lily Park: RM 55.5-50.5) in 2015.

	<b>Pass 1</b>	<b>Pass 2</b>	<b>Pass 3</b>	<b>Pass 4</b>	<b>Pass 5 (Surge Efforts)</b>	<b>Sub Section Totals</b>
<b>JUNIPER</b>						
NPK Captured	47	29	17	39	805	937
Effort (hours)	62.7	43.4	36.2	78.0	225.1	445.43
CPUE (NPK/hour)	0.75	0.67	0.47	0.49	3.57	2.10
<b>MAYBELL</b>						
NPK Captured	15	33	2	33		83
Effort (hours)	10.3	20.6	8	12.9		51.8
CPUE (NPK/hour)	1.45	1.60	0.25	2.56		1.60
<b>LILY PARK</b>						
NPK Captured	13	8	14	8	12	55
Effort (hours)	17.2	14.1	14.8	13	9.5	68.6
CPUE (NPK/hour)	0.76	0.57	0.95	0.61	1.26	0.80

Table 11. Number of roundtail chub (RTC) >150mm capture events, number of RTC marked, number of RTC recaptures, number of RTC released, number of RTC removed, and number of RTC mortalities for across all passes in 2014 performed by CPW. The increase in number of RTC <150mm was directly impacted by CPW's decision to start netting all fishes during 2014 electrofishing, not solely focusing on NPK, SMB, RTC, and CPM.

<u>CPW Reach</u>	<u>#RTC Capture Events</u>	<u>#RTC Marked</u>	<u>#RTC Recaptures</u>	<u>#RTC Released</u>	<u>#RTC Removed</u>	<u>#RTC Mortalities</u>
Southbeach	0	0	0	0	0	0
Juniper	1	1	0	1	0	0
Upper Maybell	1	1	0	1	0	0
Lower Maybell	0	0	0	0	0	0
Sunbeam	0	0	0	0	0	0
<u>Total</u>	2	2	0	2	0	0

Table 12. A summary of the total number of individuals captured for all species by CPW during spring backwater netting in 2015. Non-natives that were lethally removed are: black bullhead, northern pike, white sucker, and all white sucker hybrids.

<u>Species</u>	<u>Count</u>
Black Bullhead	2
Brown Trout	11
Flannelmouth Sucker	1
Northern Pike	450
Rainbow Trout	5
White Sucker	342
White x Bluehead Hybrid	3
White x Flannelmouth Hybrid	14
Total	828

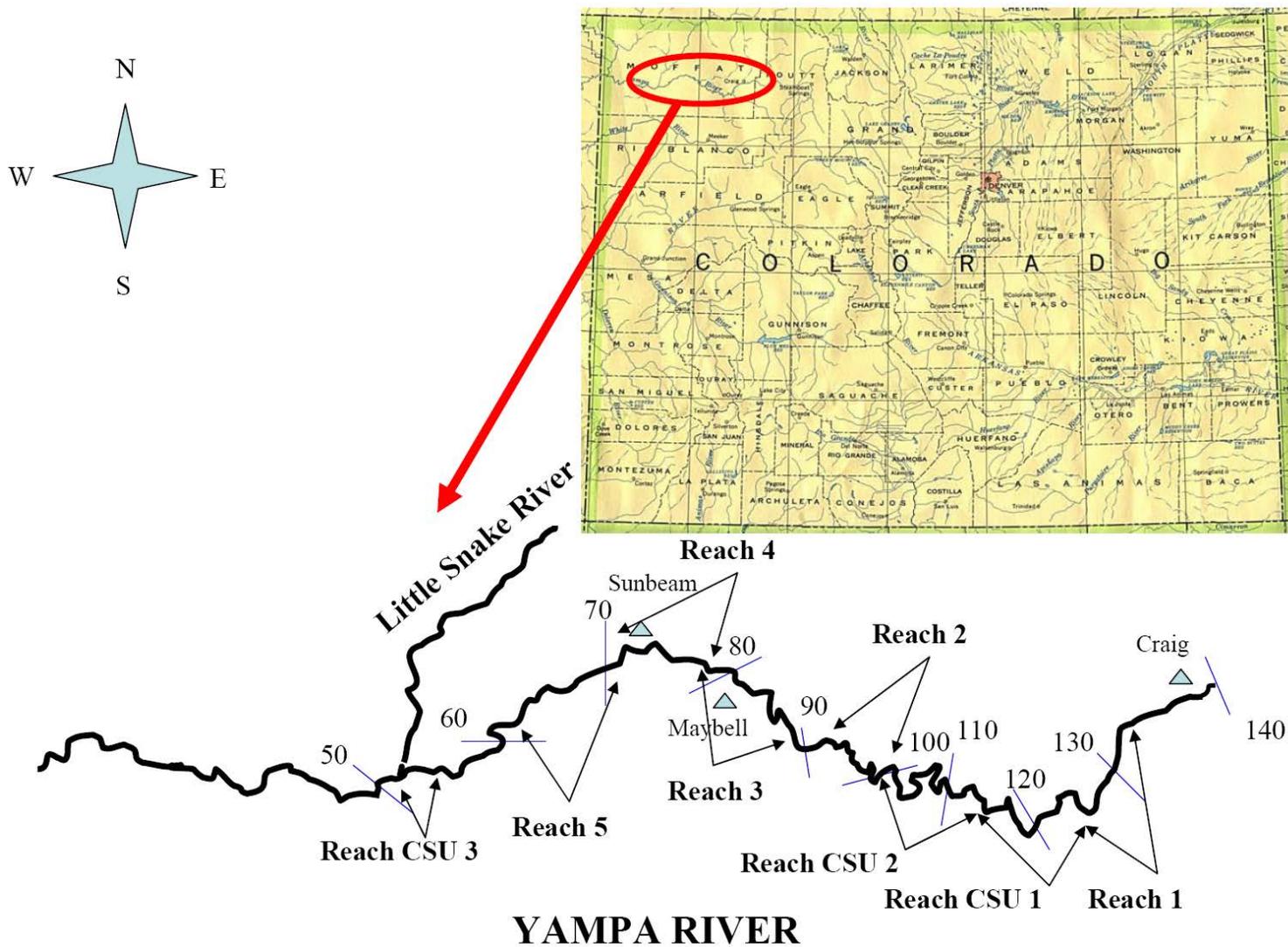


Figure 1. River reaches of the middle Yampa River sampled by the CDOW and CSU (Graphics courtesy of P. Martinez and R. Anderson)

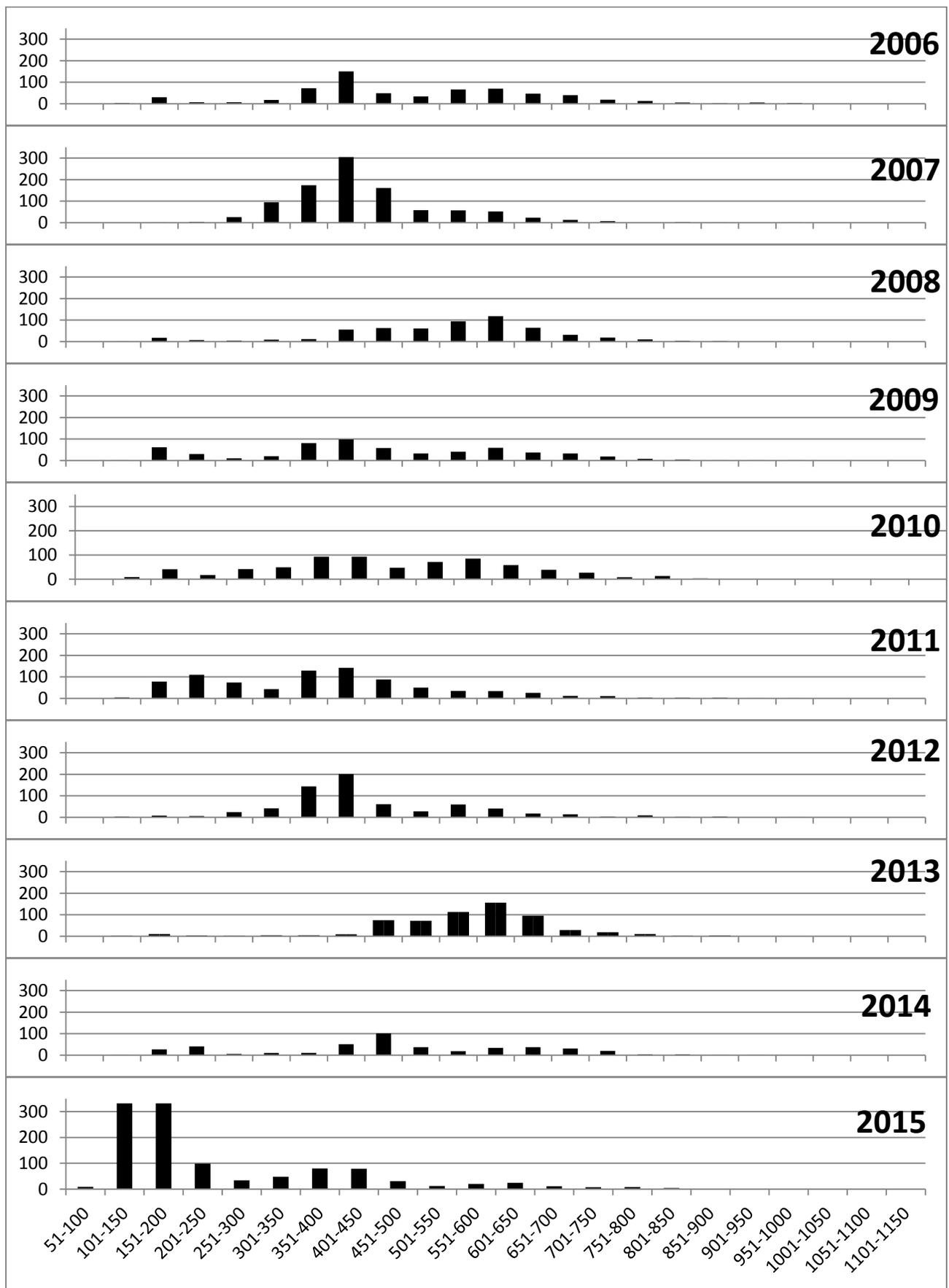


Figure 2. Northern pike total length frequency distributions, in the middle Yampa River, South Beach to Lily Park (RM 134.2-50.5)

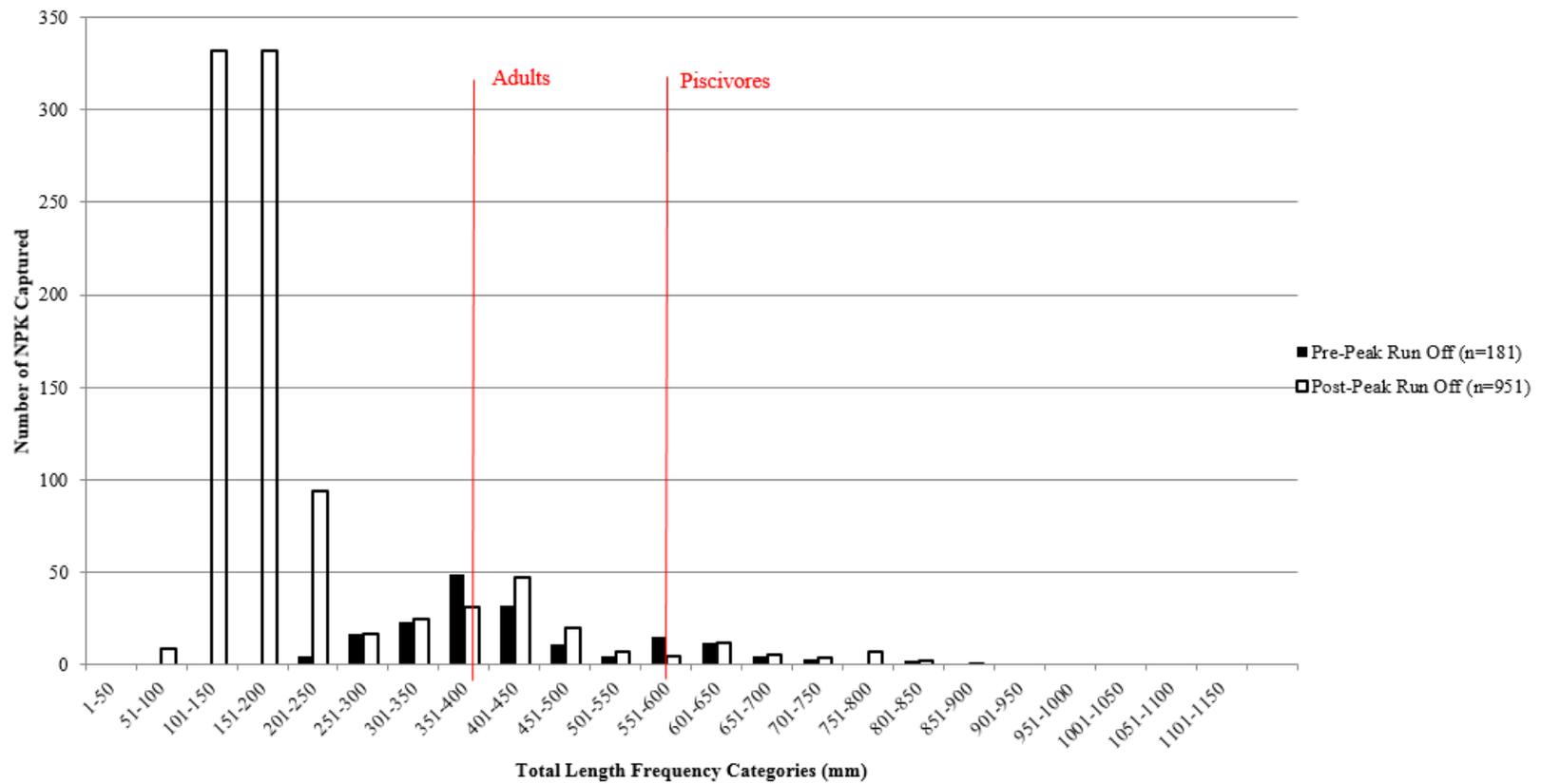


Figure 3. Northern pike length frequency distribution in increments of 50mm for fish captured in 2015 during electrofishing operations.

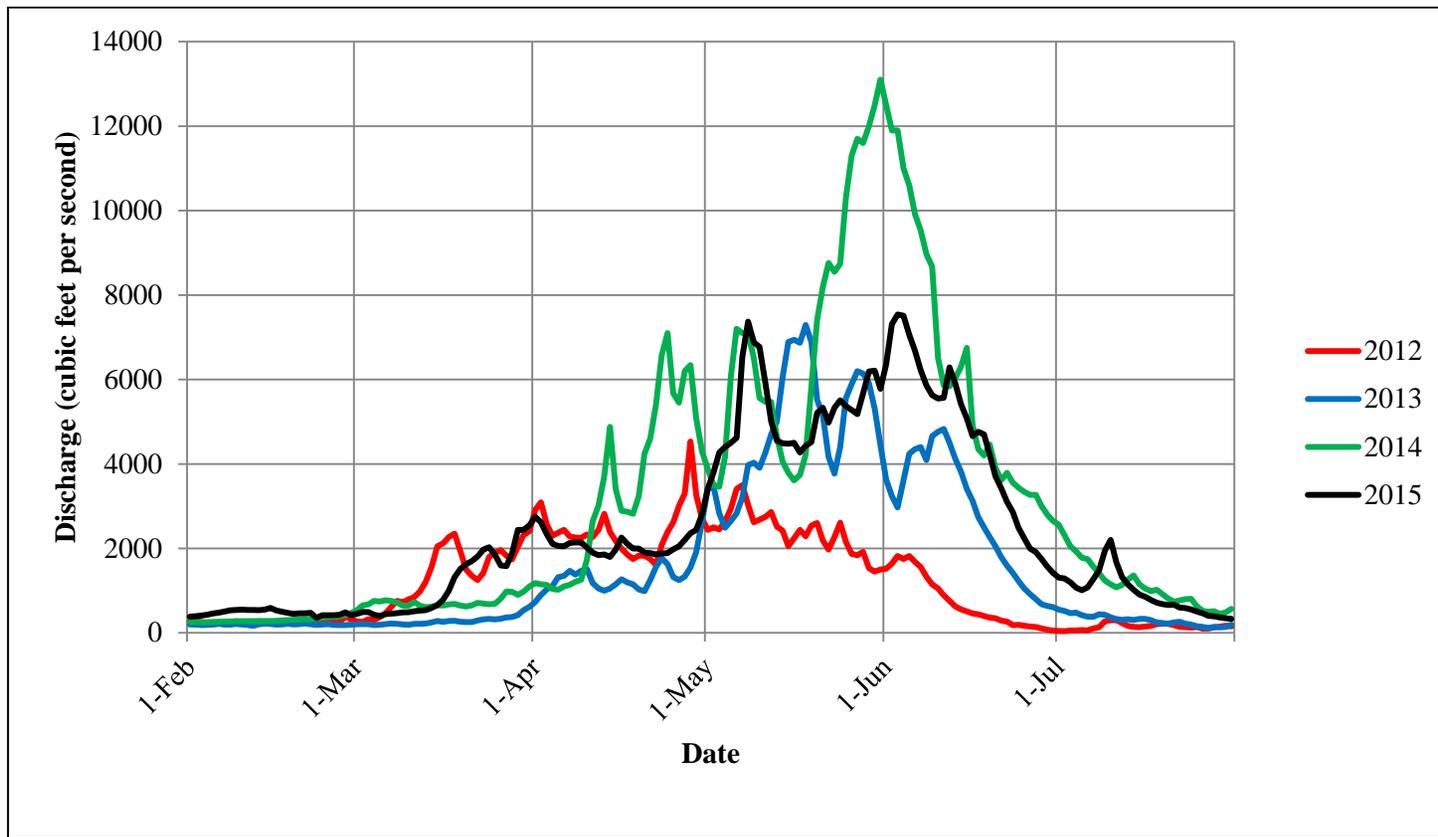


Figure 4. United States Geological Survey Maybell gaging station data for 2012 to 2015 spring runoff. Peak runoff in 2015 occurred on June 3<sup>rd</sup> (7540 cfs)..

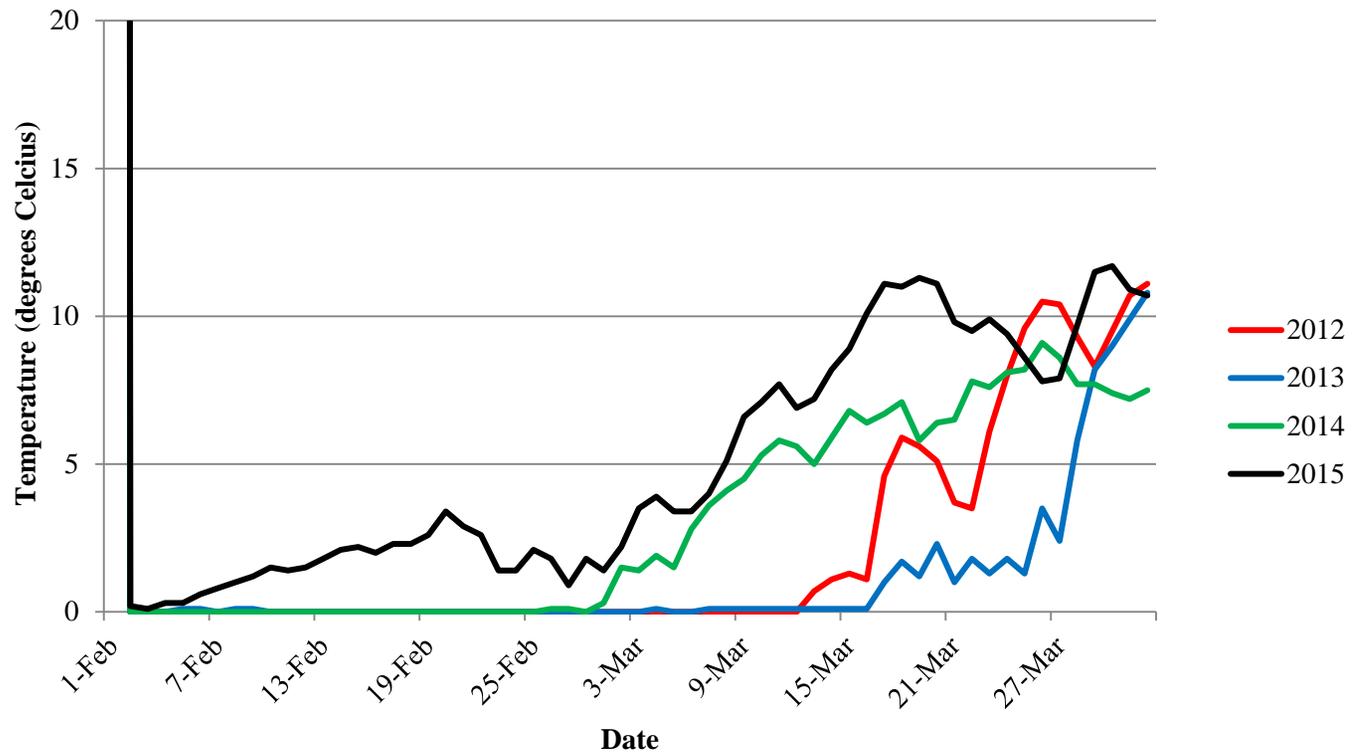


Figure 5. United States Geological Survey Maybell gaging station data for maximum daily temperature between February 1<sup>st</sup> and April 1st, 2012 through 2015.

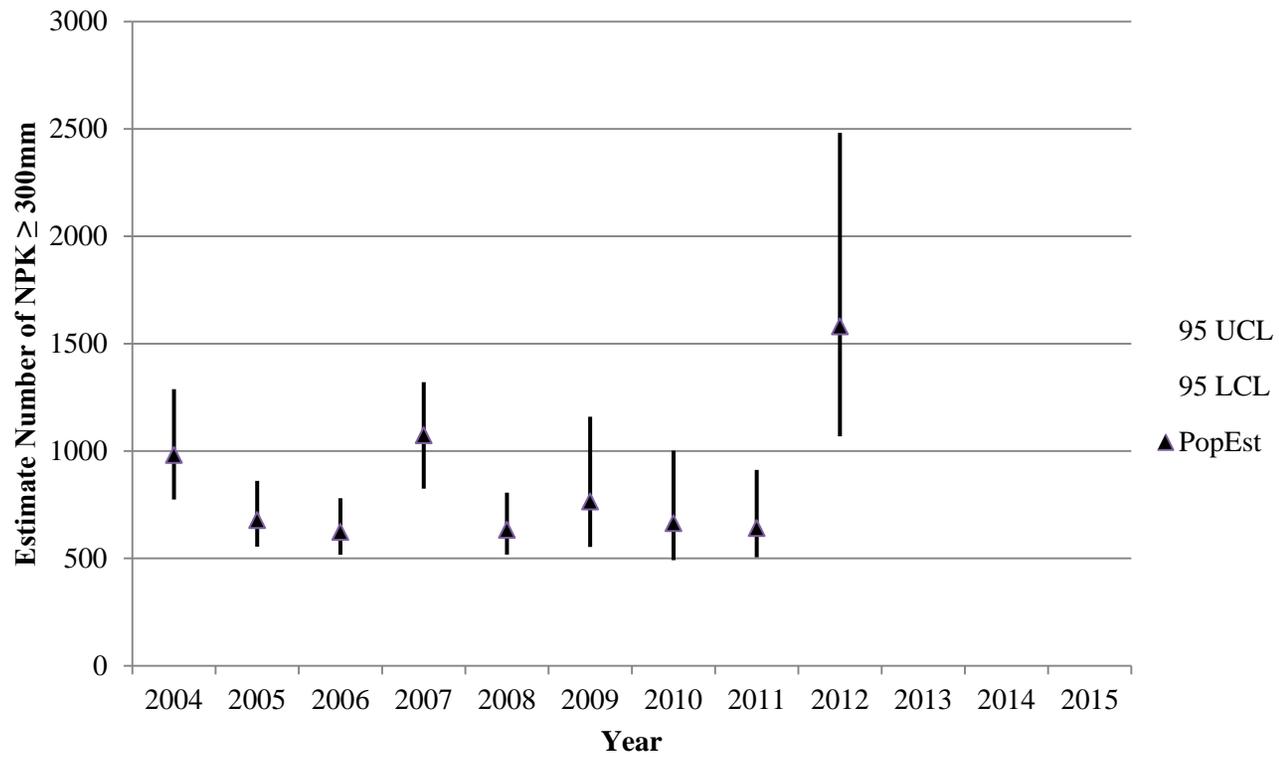


Figure 6. Northern pike  $\geq 300$  mm TL population estimates and 95% Confidence Interval generated for Yampa River northern pike from river mile 134.2 to 50.5. Population estimates could not be calculated for the 2013, 2014 and 2015 sampling seasons as no mark recapture study was conducted and all northern pike captured were euthanized.

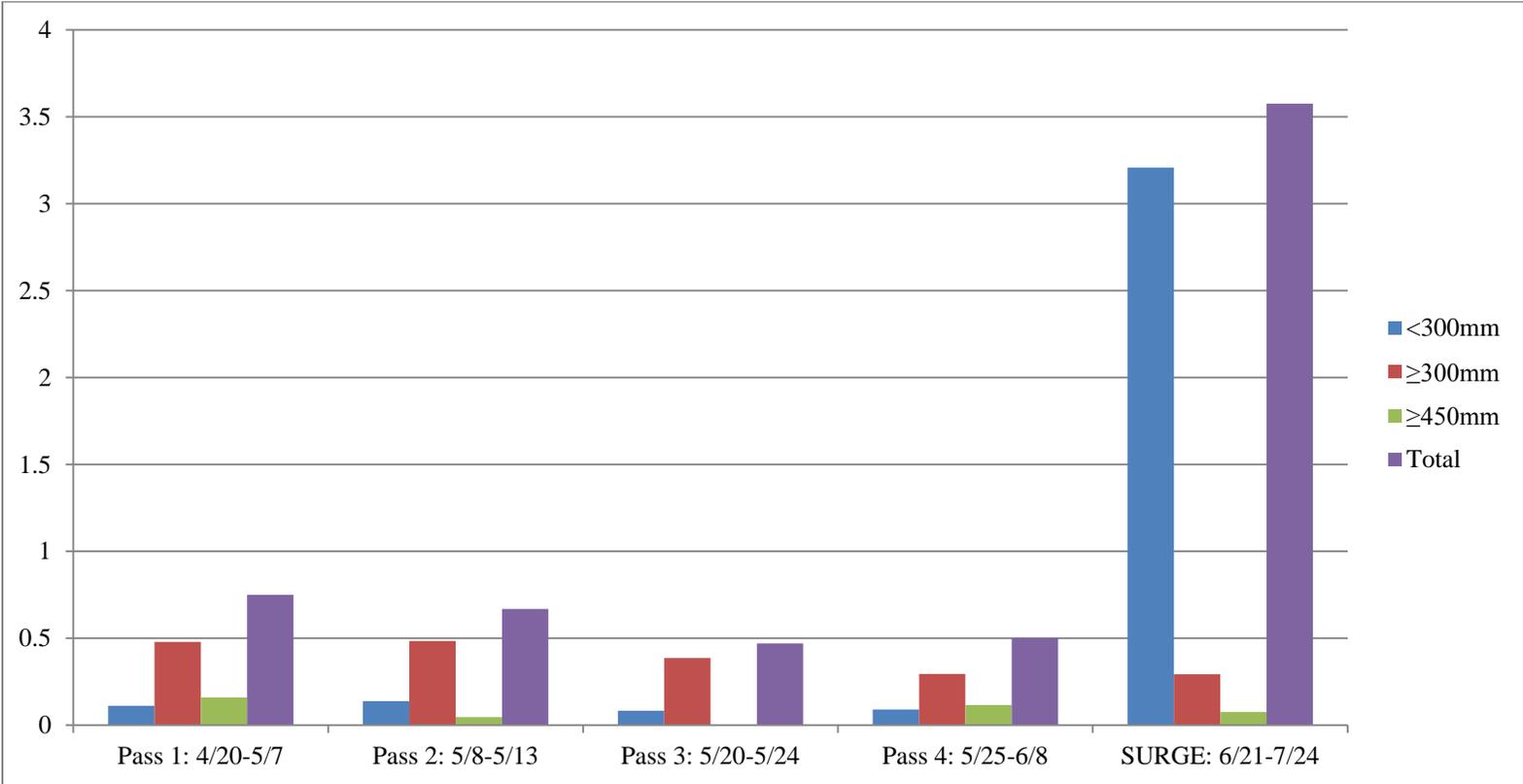


Figure 7. Northern pike (NPK) catch per unit effort (CPUE; # NPK/hour) for three categories (< 300mm, ≥ 300mm, ≥ 450mm and all NPK) across 2015 sampling periods in Juniper sub-section.

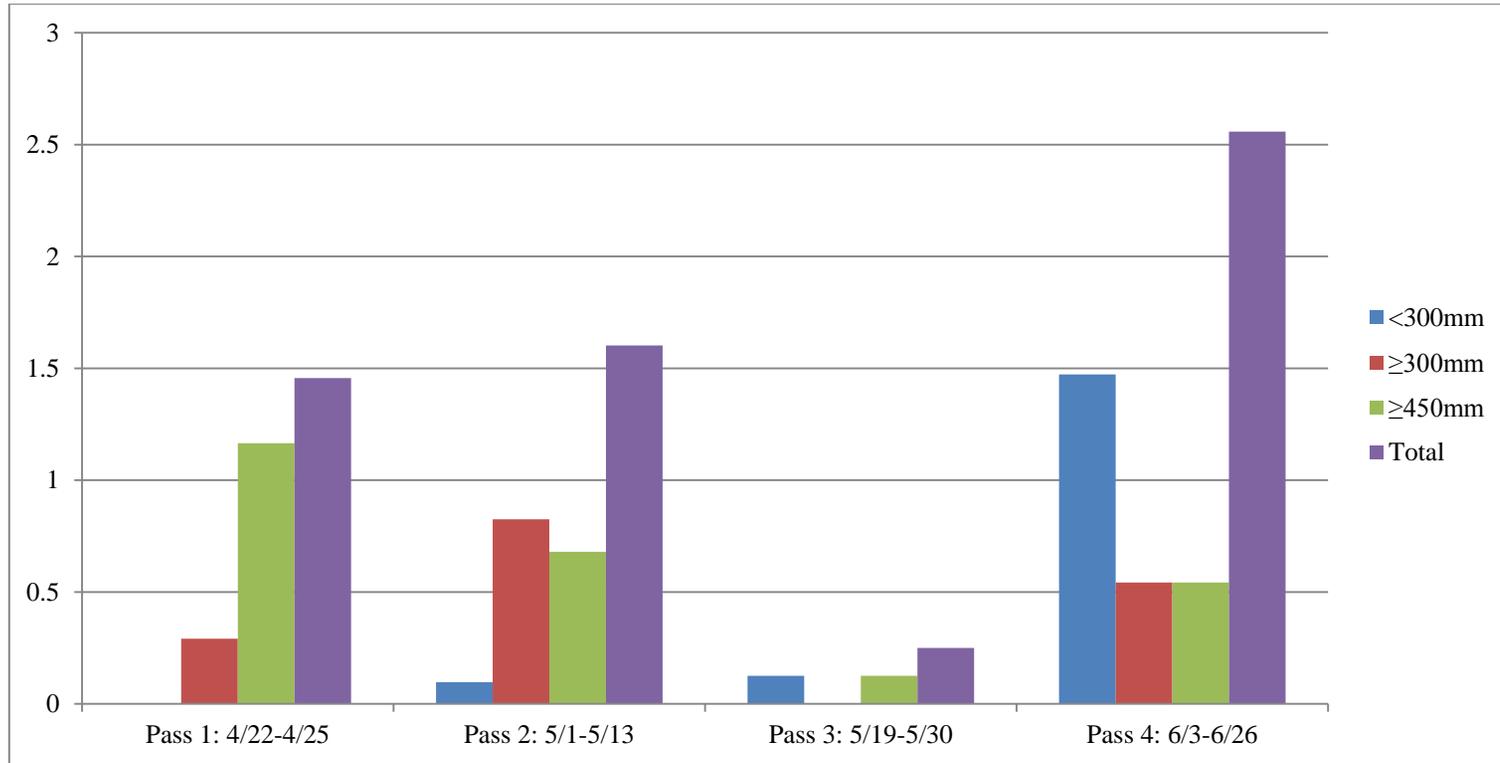


Figure 8. Northern pike (NPK) catch per unit effort (CPUE; # NPK/hour) for three categories (< 300mm, ≥ 300mm, ≥ 450mm and all NPK) across 2015 sampling periods in Maybell sub-section.

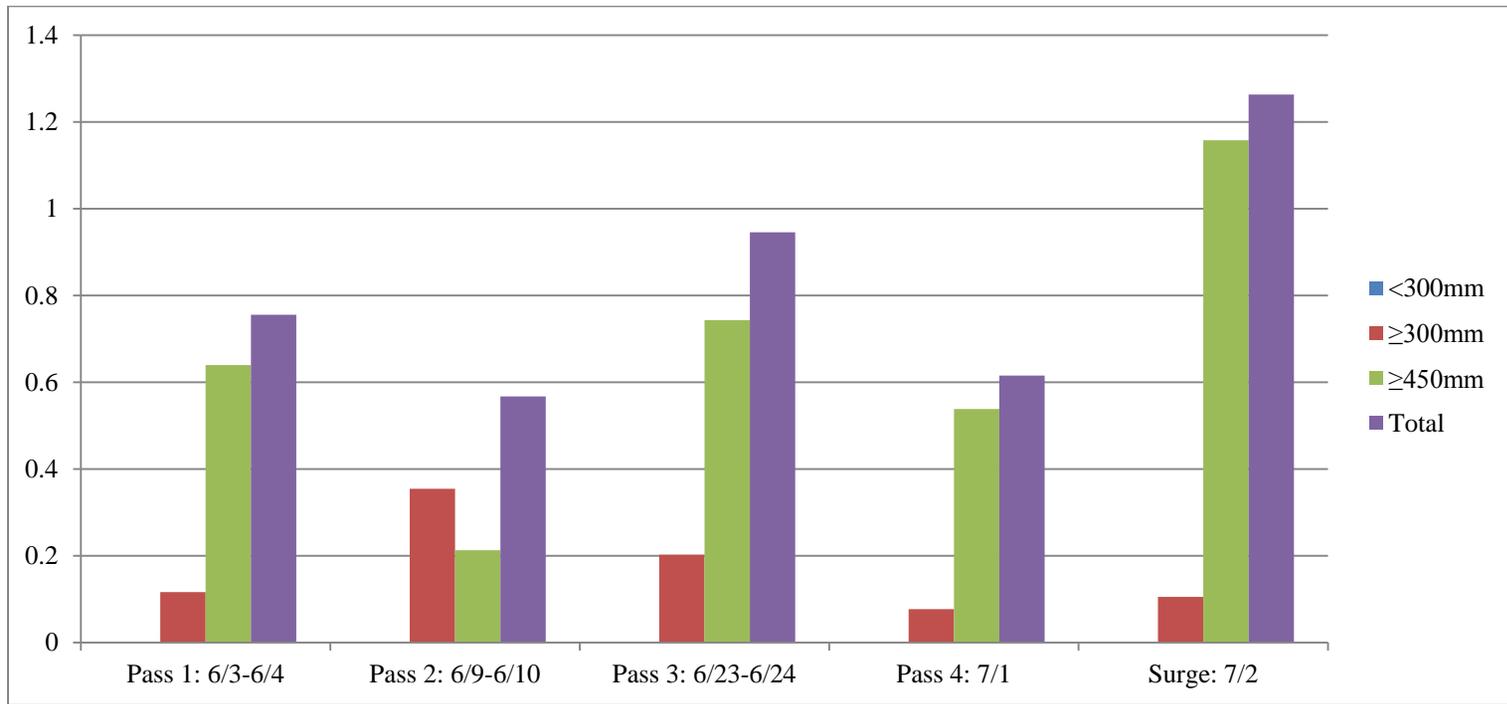


Figure 9. Northern pike (NPK) catch per unit effort (CPUE; # NPK/hour) for three categories (< 300mm, ≥ 300mm, ≥ 450mm and all NPK) across 2015 sampling periods in Lily Park sub-section.

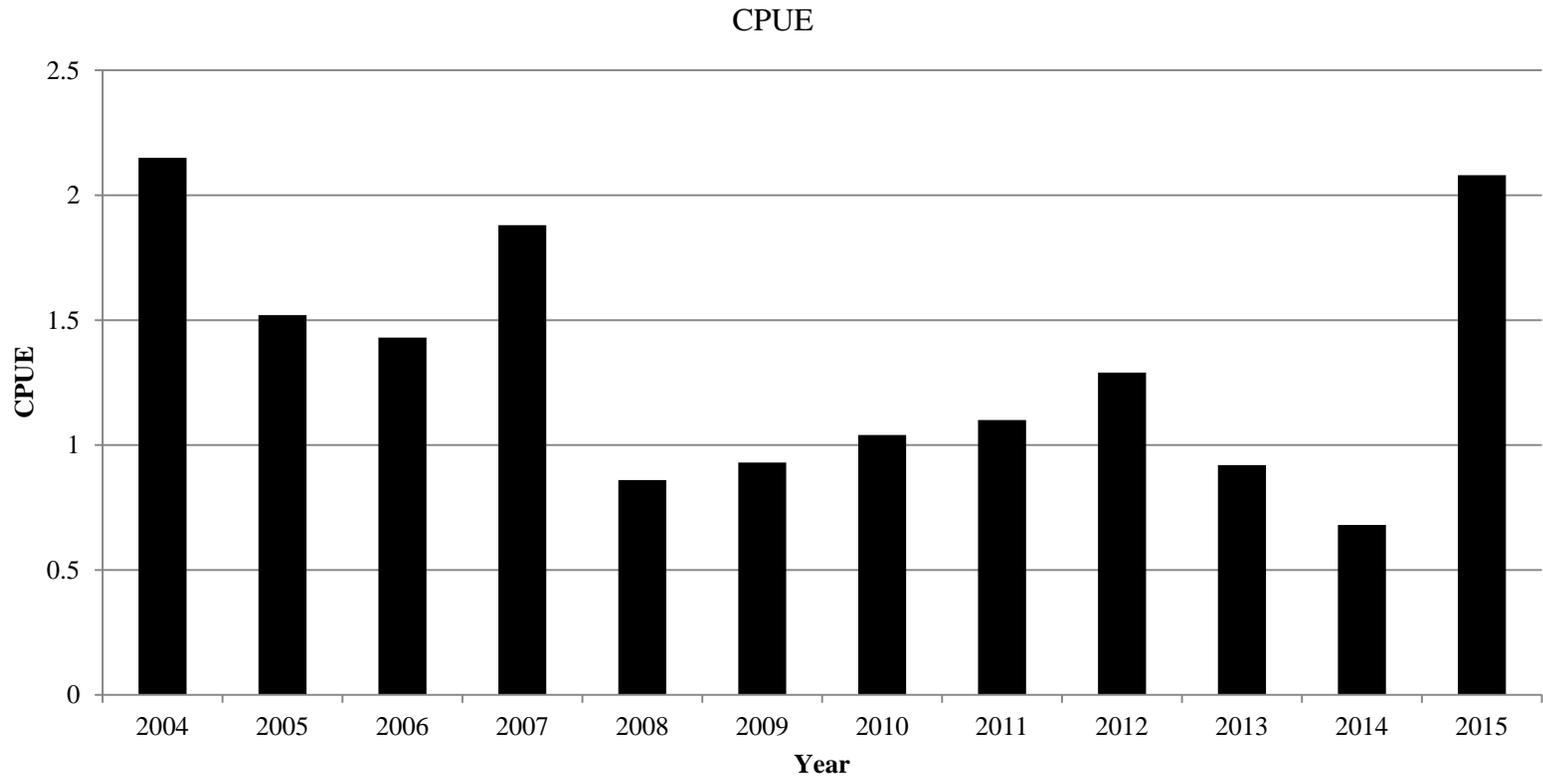


Figure 10. Northern pike Catch Per Unit Effort (CPUE; number of NPK/hour) across all passes in entire study area sampled by CPW and CSU, for 2004 through 2015.

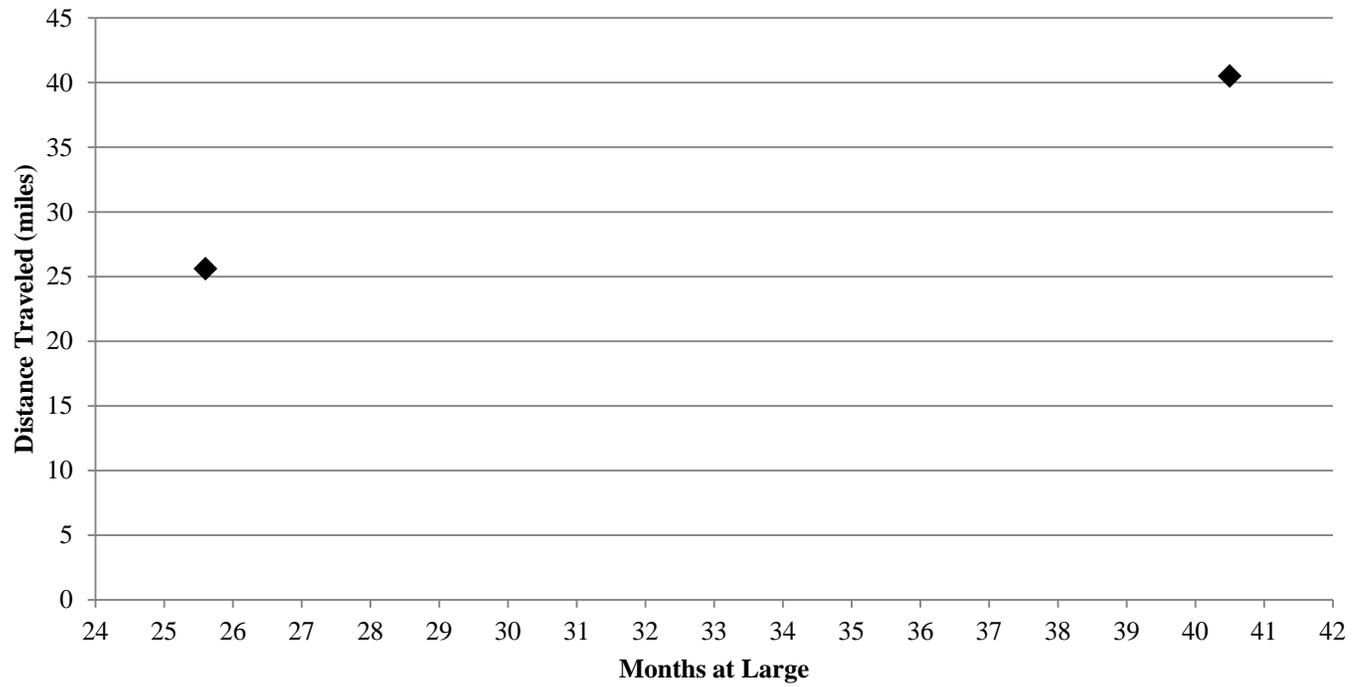


Figure 11. Movement distances of northern pike recaptured (n=2) in the middle Yampa River in 2015, initially tagged in previous years, plotted against number of months each fish spent at large between capture events. The positive values on the y-axis represent upstream movement.

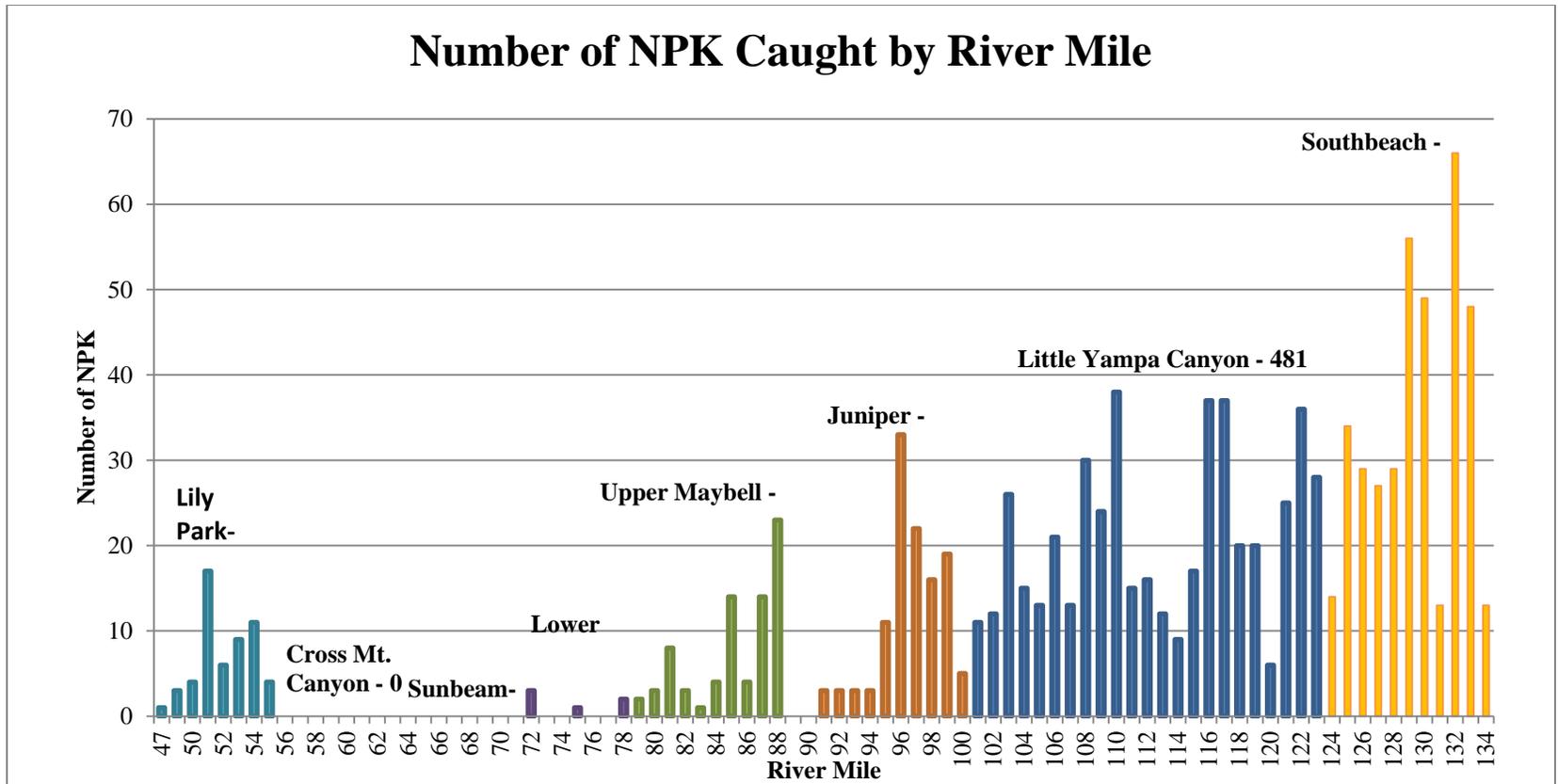


Figure 12. Number of northern pike captured within each river mile during 2015 sampling. Each color represents a different sampling reach (labeled above bars).

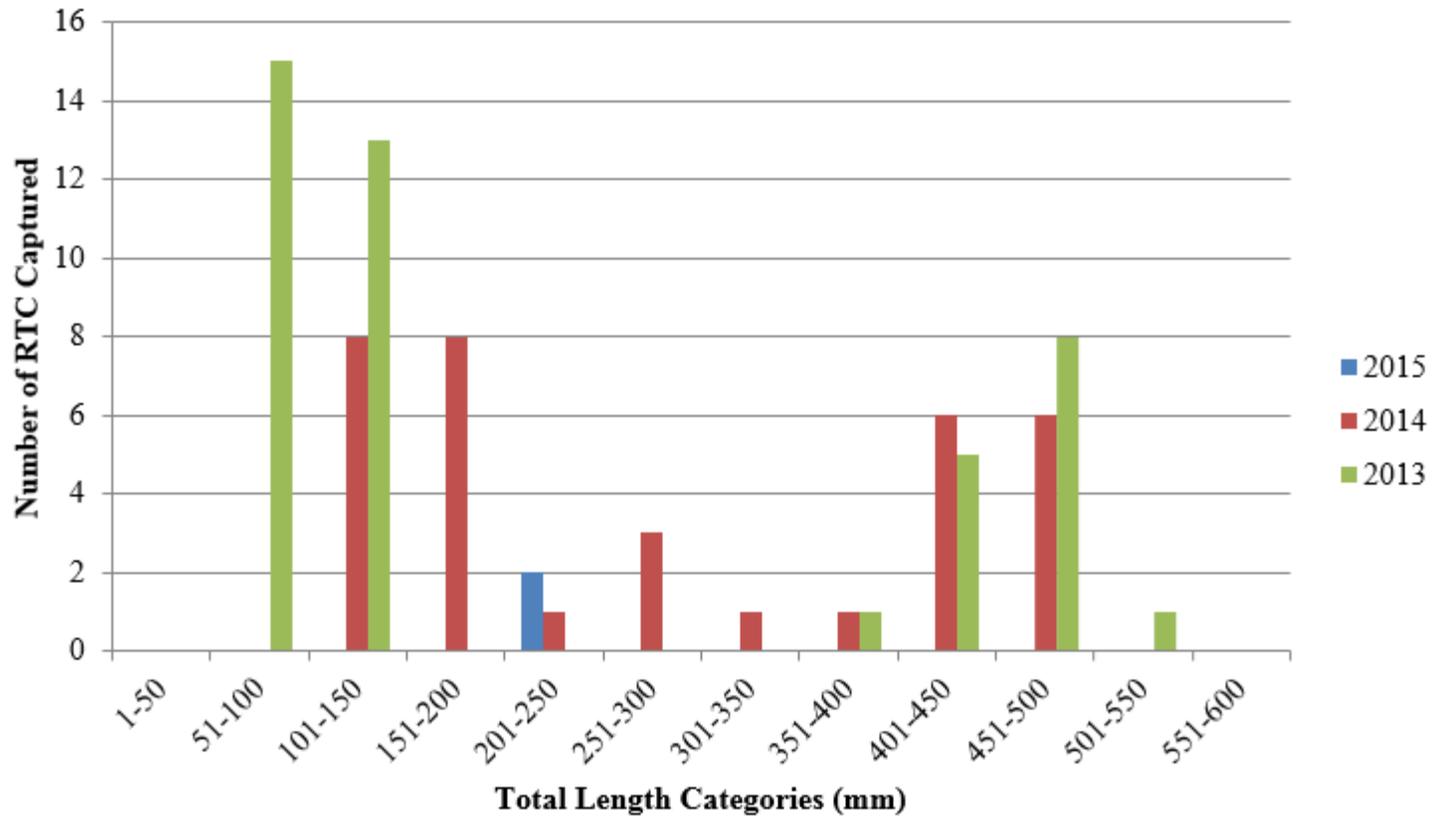


Figure 13. Roundtail chub (RTC) total length (mm) frequency distribution, with size classes in increments of 50 mm, for RTC captured by CPW in the five reaches of the middle Yampa River in 2013 and 2014.

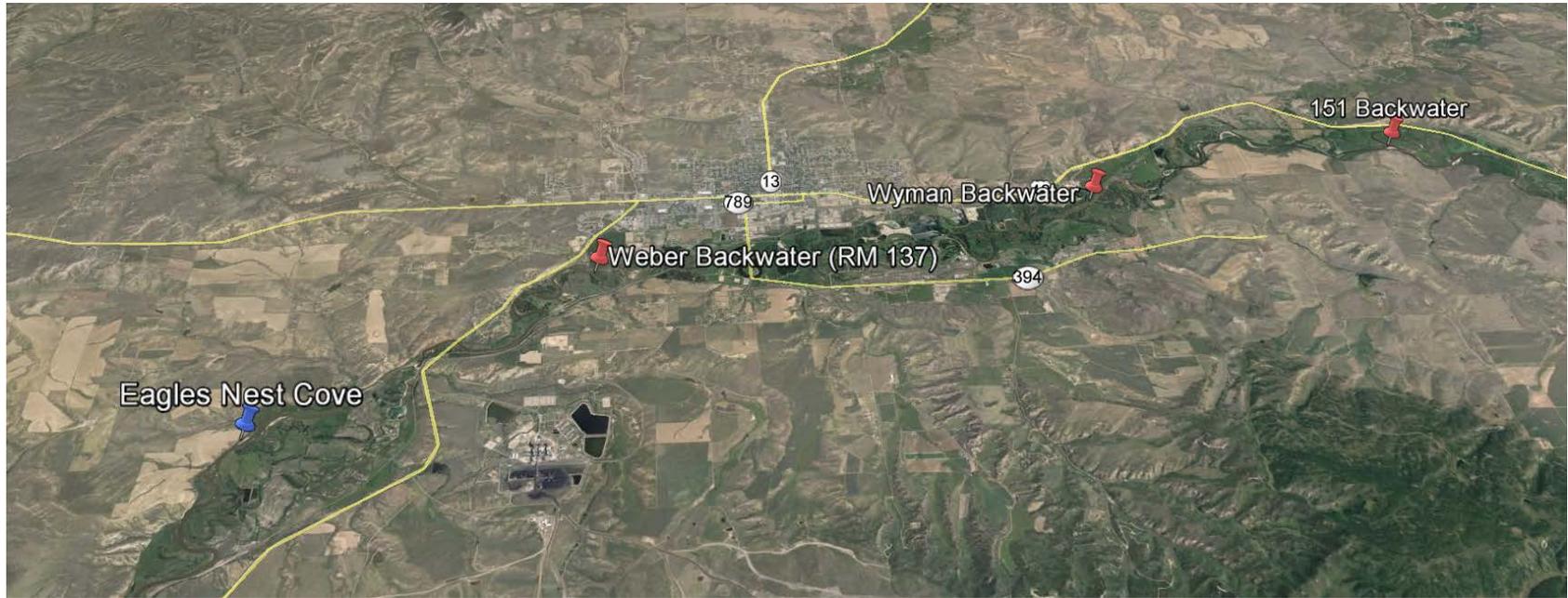


Figure 14. Aerial image showing 4 main spring backwater netting locations. Red pins correspond to backwaters within 98b and the blue pin corresponds to a backwater within 98a (imagery courtesy of Google Earth).