

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

II. Bureau of Reclamation Agreement Number: R13AP40029

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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 2014 sampling season, 437 northern pike individuals were handled and euthanized. Compared to 2013, this river section yielded an overall decreased catch per unit effort and fewer northern pike. Based on 2014 capture data and growth rates, around 23% of all northern pike captured were from the 2011 year class. See 2014 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 2014 Tasks and Deliverables

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

Schedule: March 2014

Deliverable: **Task Completed**

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

Schedule: March-April, 2014

Deliverable: **Task Completed**

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

Schedule: April-Aug, 2014

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, 2014

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). 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 2014 marks the sixth consecutive year in which all smallmouth bass data collected by CPW were submitted to CSU for a combined analysis of smallmouth bass. See 2014 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 2014, the Surge lasted from June 17 to July 24. 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 were not conducted in 2013 or 2014.

Between river-mile 134 and 50.5, crews conducted between 3 and 12 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. A total of twelve removal passes were conducted in Reach 1 (Southbeach: RM 134.2 – 124.0), nine in Reach 2 (Juniper: RM 100 – 91.0), five in Reach 3 (Upper Maybell: RM 88.7 – 79.2), and three passes each in Reach 4 (Lower Maybell: RM 79.2 – 71.0) and 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) with 5 of those passes being completed during Surge efforts. Five total 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; no fish were translocated to any location. This was the first year in which all translocation was ceased.

All northern pike, smallmouth bass, Colorado pikeminnow, 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 most 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 second year of CPW's "net everything" approach to sampling. Previously CPW had only netted target species: smallmouth bass, northern pike, roundtail chub, and Colorado pikeminnow.

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

Population Estimates

In 2014, mark 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 2014, 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. 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

Thirty different fish species were collected within CPW study reaches. Summary data for all species captured and handled by CPW in 2014 are presented in Table 2.

Northern Pike

Overview

Overall, CPW and CSU captured 437 individual northern pike. The total number of northern pike capture events in 2014 (437) decreased from 611 in 2013. All northern pike were removed in 2014, representing 100% of northern pike individuals handled (Table 4). Northern pike were

not translocated to State Park Headquarters West Pond, as 2014 was the first year no fish were translocated to any water body. All 437 northern pike were euthanized (Table 5), up from 324 in 2013, however the increase is due to the translocation of 284 northern pike ≥ 508 mm in 2013.

Three hundred fifty two of 437 northern pike removed from the river in 2014 were considered adult northern pike (≥ 300 mm) (Table 4 and Figure 2). One hundred eighty nine of 437 northern pike removed were ≥ 450 mm (Figure 2). Seven of those 189 were recaptured fish previously marked by CPW, CSU, or USFWS (Table 6). Northern pike recaptures continued to decrease in 2014 due to the fact that northern pike marking ceased in 2012 with the last mark/recapture population estimate and also that translocation of northern pike to off-channel locations has also stopped.

Population Size Structure

Northern pike total length frequency histograms for the entire section of river sampled by CPW and CSU from 2004 to 2014 are presented in Figure 2. In 2014, the northern pike population featured fewer adult fish (≥ 300 mm), 81% of total capture events, and more juvenile northern pike (< 300 mm), 19% of total capture events, compared to 2013 data, 96% adults to 4% juveniles. Forty three percent of all northern pike captured in 2014 were ≥ 450 mm, a significant decrease compared to 82% in 2013. Again, this is a direct result of continued removal efforts and fewer northern pike from the 2011 cohort that have recruited into these larger size classes. The largest northern pike captured was 908mm, and was a fish that had not previously been captured.

Compared to recent years, more young of year (YOY) northern pike were captured in 2014. Northern pike YOY were defined as 1-200mm fish captured after June 1 of each corresponding year. Two hundred seventy eight YOY were captured in 2011, 8 in 2012, 18 in 2013, and 64 in 2014. The first YOY of 2014 was captured on July 8 (compared to June 25, 2013) and was 165mm. This result was directly affected by relatively high flows (Figure 3) which made 2014 a longer sampling season than 2012 and 2013 (as defined by number of days between first and last northern pike captured; Table 3). In 2014, only 16 days of sampling were conducted after the first YOY capture event compared to 15 days in 2013; however, 46 additional northern pike YOY were captured in 2014 suggesting the potential of a stronger year class of northern pike in 2014. It is likely that higher flows in 2014, compared to the lower flows of 2012 and 2013, led to a longer spawning season and potentially increased spawning success, leading to more overall YOY northern pike.

In 2011, YOY northern pike represented a considerably higher proportion of the catch than in any previous year (Figure 2). Wright (2011) suggested that this might indicate a greater amount of within-channel and connected backwater reproduction than was previously suspected. It has long been believed that most northern pike recruitment in the Yampa River is attributable to immigration from off-channel source populations (Hill 2005, Wright 2009, Wright 2010). Alternatively, Wright (2011) speculated that the observed increase in relative abundance of YOY might be an artifact of the extraordinarily long 2011 sampling season documenting YOY recruitment that went undetected in previous years. Sampling in 2012 and 2013 provided no further insight into the possibility of increasing in-river reproduction and recruitment, due to the

abbreviated sampling seasons and limited captures of YOY northern pike (Figures 2 and 4). However, the increased number of YOY captured in 2014 compared to 2013 with only one additional day of sampling after the first detected YOY could be evidence of a strong northern pike cohort in 2014.

Northern pike growth rates, based on capture history of fish recaptured in 2014 that were tagged in previous years were consistent with previous years (Wright 2010), ranging from 0.36 to 0.50 mm/day (Table 7). Average growth rates of between year recaptured fish that were ≤ 450 mm during the first capture event have been consistent over the last three years 0.53 mm/day in 2011, 0.51 in 2012, and 0.52 in 2013, but was slightly lower in 2014 at 0.4 mm/day.

Population Estimate: South Beach to Lily Park

Population estimates could not be calculated for the 2014 sampling season as a mark pass was not conducted. Population estimates from 2004-2012 are shown in Table 8 and Figure 5.

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 (<300 mm, ≥ 300 mm, ≥ 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 6-8). In the Juniper sub-section (Figure 6) CPUE was highest during the first pass but remained above 0.5 NPK/hour for the first three passes before decreasing to 0.17 NPK/hour for pass 4 then increasing back to above 0.5 NPK/hour for pass 5. Catch per unit effort in the Maybell sub-section decreased over every pass and 2014 CPUE values were lower for every corresponding pass when compared to 2013 (Figure 7). Catch per unit effort remains higher within the Upper Maybell reach compared to Lower Maybell and Sunbeam, as 68 NPK were removed in Upper Maybell compared to 20 in Lower Maybell and 0 in Sunbeam. In Lily Park, CPUE decreased steadily over the first three passes and then increased over the last two passes. All northern pike captured in Lily Park were ≥ 300 mm (Figure 8).

Overall CPUE for all passes across the entire study area had increased from 1.1 (NPK per hour electrofishing) in 2011, to 1.29 in 2012, but decreased in 2013 to 0.92 and continued to decrease to 0.68 in 2014 (Figure 9). Slight increases in overall CPUE have been documented each year since 2008 until 2013 which was the first year a decrease was observed. However, it should be noted that effort in areas that are known to support relatively higher numbers of northern pike has also increased. Thus, overall CPUE as an index to actual abundance is somewhat biased by change in sampling regime, but the magnitude and direction of this bias cannot be certainly known. However, in 2014, reaches with increased presence of northern pike, Southbeach and Upper Maybell, were targeted by CPW for additional passes yet there was still an overall decrease in CPUE. Another factor impacting northern pike CPUE in 2014 is a longer sampling season and extended Surge effort in 2014 compared to 2012 and 2013. In 2014, increased effort during the Surge led to increased CPUE for every reach sampled during the Surge compared to the previous pass (Table 10). This was due to increased catch of YOY northern pike during

Surge efforts. In the end, CPUE remains a useful tool in assessing trends in catch rate that may be associated with various factors such as discharge and depletion of northern pike numbers as the study progresses.

Movement

Seven northern pike were recaptured that were tagged by CPW, CSU, or USFWS in previous years (Table 6). The seven northern pike recaptures were all fish previously tagged by CPW or CSU during the population estimate mark pass in 2012, which was the last year of northern pike population tagging efforts in the Yampa River. This abundance of fish captured 2 years after initial tagging is similar to what was seen in 2013, when 9 fish were captured from 2011 tagging efforts. No northern pike from off-channel locations were captured (see below for escapement summary).

Discontinuing tagging efforts in the Yampa River in 2013 for population efforts and discontinuing translocation of pike in 2014 greatly shapes the expected recaptures of tagged fish. Over the last two sampling seasons (2013 and 2012), it has been 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 very low in future years.

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 10). Two northern pike that were recaptured in 2014 moved less than one mile from their initial capture location. Average between-year movement of northern pike was 9.9 miles. Northern pike that demonstrated downstream movement moved distances from 0.5 to 22.2 miles, while upstream movement ranged from 0.5 to 22.5 miles (Figure 10).

Results from 2013 and 2014 movement analyses contradict what was observed in 2012 and 2011 with the majority of fish recaptured in 2013 and 2014 showing downstream movement between 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.

In 2011, CPW initiated an Elkhead Reservoir northern pike escapement study and began capturing and tagging northern pike to document escapement rates of northern pike from Elkhead Reservoir. Each spring CPW crews conduct a targeted netting effort in the reservoir during northern pike spawning season and tag every northern pike captured. Since 2011 CPW crews have deployed FLOY tags in 1153 individual northern pike, with 53% of northern pike captured in 2014 being previously tagged fish. In 2014, Yampa River removal efforts, no northern pike were recaptured that had been initially tagged and released in Elkhead Reservoir. Relatively low runoff levels in 2012 and 2013 resulted in no reservoir spillover either year.

However, in 2014 increased runoff resulted in spillover over the Elkhead Reservoir spillway on two occasions, once in April and once in May. Escapement of translocated smallmouth bass from Elkhead Reservoir has been previously documented (Hawkins 2010), but prior to the study initiated by CPW in 2011 it was impossible to document escapement of resident northern pike and smallmouth bass from Elkhead Reservoir. Tagging of additional northern pike and continues in Elkhead Reservoir and allows the escapement of resident fish into the Yampa River to be evaluated in greater depth.

Concentration Areas

Northern pike captures in 98a are neither consistent over time nor space. Catch rates are influenced by flows, turbidity, water temperature, etc. Catch per unit effort is typically higher prior to peak runoff and then decreases after peak runoff. In 2014, electrofishing prior to peak runoff accounted for 65% of the total number of northern pike captured (Figure 4) despite accounting for only 55% of the total effort.

Northern pike distribution is also 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. Three hundred eight of 437 (70%) northern pike captured were removed from Southbeach and Little Yampa Canyon combined (Table 11 and Figure 11). Over all 81 river miles within project 98a, 56% of all northern pike captured were captured within a river mile that incorporated an identified backwater type habitat despite these habitats being found in only 22% of all river miles (Table 11).

Colorado Pikeminnow

Overall, one Colorado pikeminnow was captured by CPW in 2014 (Table 12). The single Colorado pikeminnow was captured in Sunbeam on June 3rd, was 580mm, and was a previously tagged fish. The fish was captured in a side channel along the shoreline. There was no evidence of northern pike attack found.

Roundtail Chub

Overall, 34 roundtail chub capture events were documented by CPW in 2014 (Table 13). Twenty of 34 roundtail chub were captured prior to peak runoff and the remaining 14 were captured after peak runoff. A total length frequency histogram was developed for all roundtail chub individuals captured by CPW in 2013 and 2014 (Figure 12). Twenty-one of twenty-six roundtail chub captured that were ≥ 150 mm did not possess a PIT tag and are presumed to be “new” fish. Eight roundtail chub captured were < 150 mm (Table 14). The capture of these fish was a direct result of a change in CPW netting strategy started in 2013. In 2014, CPW crews netted and processed all fish that were shocked rather than targeting only smallmouth bass, northern pike, roundtail chub, and Colorado pikeminnow. As a result of netting and removing thousands of small (< 150 mm) white suckers, several roundtail chub < 150 mm were also captured. Documenting recruitment of roundtail chub, primarily in the Juniper reach, is an interesting result of the change in sampling procedure. The mean total length of roundtail chub captured in 2014 was 289mm compared to 230mm in 2013, and 464mm in 2012, a direct result

of capturing 8 roundtail chub < 150mm. With roundtail chub < 150mm excluded the mean total length was 333mm.

Significant Additional Work Outside of Scope of Work:

In addition to normal tasks included under the 98a scope of work CPW crews also implemented 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 7 locations with a focus on 4 backwaters that were the most productive. In those 4 locations, nets were set for 23 days, 19 days, 18 days, and 15 days respectively. Three of those 4 backwaters lie within the geographic area of 98b and one within 98a (Figure 13). At the peak of the netting CPW was running 10 nets, a combination of fyke and gill nets, in 6 backwaters.

Netting began in most locations the first week of April and ceased the last week of April as catch rates decreased and it became difficult to conduct netting and required electrofishing effort. During the netting operation 1,036 fish were captured including 11 different species (Table 15). Based on the catch data there was very minimal undesired bycatch from netting, as 97.8% were non-native species that were removed by CPW crews. Six hundred two northern pike were captured and euthanized, compared to 368 northern pike during electrofishing efforts of 98b in 2014. In addition to catching more fish, based on the condition of female northern pike captured, our netting effort spanned the majority of the spawning season. Two hundred thirty five 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 addition to backwater netting, CPW, in conjunction with John Hawkins and CSU-LFL, also conducted targeted sampling of YOY northern pike in late July. The goal of this work was to document in-channel natural recruitment within backwaters that had been targeted during spring netting efforts. The results from that work are being reported within the 98c annual report.

VIII. Additional Noteworthy Observations:

A summary of all fish species captured and processed is included in Table 2 of the appendix. Noteworthy observations, discussed above, included the 8 capture events of roundtail chub <150mm (Table 14). The majority of these captures occurred in the Juniper CPW reach and was a direct result of the new strategy incorporated by CPW crews in 2013 and continued in 2014 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, including thousands of <150mm white suckers, eight roundtail chub <150mm were captured and processed. It is unclear how much these captures are influenced by the change in sampling regime or a potentially stronger year class of roundtail chub. Nonetheless, these captures are noteworthy and something to continue to track into the future.

IX. Recommendations:

- A. Consider an adaptive management approach based on environmental conditions to determine whether or not to conduct a mark recapture estimate during years with high northern pike catch rates, or to adjust the timing of mark and recapture passes to maximize removal efforts.

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Literature Cited:

Hawkins, J.A. 2010. Evaluation of smallmouth bass and northern pike management in the middle Yampa River. Annual Report to the Colorado River Recovery and Implementation Program.

Hill, C.G. 2005. Dynamics of northern pike spawning and nursery habitat in the Yampa River. Report to the Colorado River Recovery Implementation Program.

Wright, F.B. 2009. Middle Yampa River northern pike removal and evaluation. Annual Report to the Colorado River Recovery and Implementation Program.

Wright, F.B. 2010. Middle Yampa River northern pike removal and evaluation. Annual Report to the Colorado River Recovery and Implementation Program.

Wright, F.B. 2011. Middle Yampa River northern pike removal and evaluation. Annual Report to the Colorado River Recovery and Implementation Program.

Appendix: Tables and Figures

Table 1. Middle Yampa River reaches, river sections, reach descriptions, river miles, agency responsible, and pass summaries for 2014.

| River Reach | River Section | Reach Description | River Miles | Agency Responsible | # Mark/Release Passes | # Removal Passes | # Surge Passes | # Total Passes |
|--------------------|----------------------|---|--------------------|---------------------------|------------------------------|-------------------------|-----------------------|-----------------------|
| 1 | Juniper | South Beach launch to Round Bottom | 134.2-124.0 | CPW | 0 | 8 | 4 | 12 |
| CSU 1 | Juniper | Little Yampa Canyon | 124.0-112.0 | CSU | 0 | 5 | 5 | 10 |
| 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 | 2 | 7 | 9 |
| 3 | Maybell | Dwn. Juniper Canyon to Old Maybell launch | 88.7-79.2 | CPW | 0 | 8 | 0 | 5 |
| 4 | Maybell | Old Maybell launch to Sunbeam launch | 79.2-71.0 | CPW | 0 | 3 | 0 | 3 |
| 5 | Maybell | Sunbeam launch to ups. Cross Mountain launch | 71.0-60.6 | CPW | 0 | 3 | 0 | 3 |
| CSU 3 | Lily Park | Lily Park | 55.5-50.5 | CSU | 0 | 2 | 3 | 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 2014. Non-natives that were lethally removed include: black bullhead, black crappie, bluegill, brook stickleback, creek chub, common carp, green sunfish, white sucker, and all white sucker hybrids.

| Species | Number of Capture Events |
|---------------------------------------|---------------------------------|
| Northern Pike | 437 (CSU 232 + CPW 205) |
| Smallmouth Bass | 2042 |
| Colorado pikeminnow | 1 |
| Roundtail Chub | 34 (26 > 150mm) |
| Black Bullhead | 7 |
| Black Crappie | 1 |
| Bluegill | 0 |
| Bluehead Sucker | 97 |
| Bluehead x Flannelmouth Sucker Hybrid | 1 |
| Brook Stickleback | 4 |
| Brown Trout | 41 |
| Channel Catfish | 13 |
| Creek Chub | 131 |
| Common Carp | 48 |
| Colorado River Cutthroat Trout | 0 |
| Green Sunfish | 18 |
| Flannelmouth Sucker | 86 |
| Fathead Minnow | 3 |
| Longnose Dace | 0 |
| Mottled Sculpin | 0 |
| Mountain Whitefish | 17 |
| Rainbow Trout | 64 |

| | |
|---|-------------|
| Redside Shiner | 0 |
| Rainbow x Cutthroat Hybrid | 0 |
| Sand Shiner | 8 |
| Speckled Dace | 11 |
| White Sucker | 4610 |
| White x Bluehead Sucker Hybrid | 22 |
| White x Flannelmouth Sucker Hybrid | 120 |
| White x Flannelmouth x Bluehead Sucker Hybrid | 2 |
| Total CPW Capture Events (Individual Fish Processed) | 7819 |

Table 3. Middle Yampa River sampling season 2004 to 2014. 1st NPK Capture was the date for a given year when the first northern pike was captured. Last NPK Capture was the date for a given year when the last northern pike was captured. # Days Between 1st and Last Capture was number of calendar days between dates listed for a given year.

| Year | Date of 1st NPK Capture | Date of Last NPK Capture | # Days Between 1st and Last Capture |
|-------------|--------------------------------|---------------------------------|--|
| 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 | 4/18/13 | 7/12/13 | 85 |
| 2014 | 4/21/14 | 7/24/14 | 94 |

Table 4. Number of northern pike ≥ 300 mm TL tagged on the marking pass, number northern pike ≥ 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 2014. Population estimates could not be calculated for the 2013-2014 sampling season 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% |

*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 2014. All northern pike were euthanized, no fish were translocated.

| Disposition | Number of Northern Pike |
|--|--------------------------------|
| State Park Headquarters Pond (Total) | 0 |
| CPW | 0 |
| CSU-LFL | 0 |
| Loudy Simpson | 0 |
| Elkhead Reservoir | 0 |
| Euthanized and Incidental Mortality (Total) | 437 |
| CPW | 205 |
| CSU-LFL | 232 |
| Total | 437 |

Table 6. Number of northern pike (NPK) 2014 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.

| Source of “Foreign” Tags | Number of NPK Recaptured |
|---|---------------------------------|
| 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 | 0 |
| Tagged and Released by CPW and CSU in 2012 | 7 |
| 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 |
| Total Number of NPK Recaptures | 7 |

Table 7. Growth rate calculations based on capture history of northern pike that were recaptured in 2014 and spent a minimum of 30 days at large between capture events. 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> |
|------------------------------|--------------------------------|-------------------------------|---------------------------------|-------------------------|-----------------------------|-----------------------------|
| 5/8/2012 | 346 | 6/4/2014 | 618 | 272 | 2.51 | 0.36 |
| 5/7/2012 | 356 | 6/10/2014 | 736 | 380 | 3.48 | 0.50 |
| 5/6/2012 | 350 | 6/23/2014 | 731 | 381 | 3.42 | 0.49 |
| 5/8/2012 | 316 | 5/12/2014 | 655 | 339 | 3.23 | 0.46 |
| 5/8/2012 | 372 | 7/12/2014 | 735 | 363 | 3.19 | 0.46 |
| 5/10/2012 | 349 | 4/25/2014 | 625 | 276 | 2.70 | 0.39 |
| 5/11/2012 | 372 | 5/12/2014 | 682 | 310 | 2.96 | 0.42 |

Table 8. Northern pike ≥ 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 ≥ 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 2013-2014 sampling season as 2013 was the first year a mark pass was not conducted.

| Year | NPK ≥ 300 mm Population Estimate and 95% Confidence Interval | P-Hat | Number NPK ≥ 300 mm Removed | NPK ≥ 300 mm Exploitation Rate |
|------|---|-------|----------------------------------|-------------------------------------|
| 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 |

*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 2014 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)

| Year | Juniper CPUE | Maybell CPUE | Lily Park CPUE |
|-------------|---------------------|---------------------|-----------------------|
| 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 |

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 2014.

| | Pass 1 | Pass 2 | Pass 3 | Pass 4 | Pass 5 (Surge Efforts) | Sub Section Totals |
|------------------|---------------|---------------|---------------|---------------|-------------------------------|---------------------------|
| JUNIPER | | | | | | |
| NPK Captured | 112 | 49 | 36 | 13 | 113 | 323 |
| Effort (hours) | 85.31 | 40.64 | 64.77 | 74.91 | 190.41 | 456.04 |
| CPUE (NPK/hour) | 1.31 | 1.21 | 0.56 | 0.17 | 0.59 | 0.71 |
| MAYBELL | | | | | | |
| NPK Captured | 28 | 40 | 12 | 8 | | 88 |
| Effort (hours) | 27.06 | 40.91 | 32.54 | 22.93 | | 123.44 |
| CPUE (NPK/hour) | 1.03 | 0.98 | 0.37 | 0.35 | | 0.71 |
| LILY PARK | | | | | | |
| NPK Captured | 12 | 5 | 2 | 3 | 4 | 26 |
| Effort (hours) | 17 | 16.6 | 10.3 | 7.6 | 6.5 | 58 |
| CPUE (NPK/hour) | 0.71 | 0.30 | 0.20 | 0.40 | 0.62 | 0.41 |

Table 11. Breakdown of northern pike captures by reach and river miles (RM) with available backwater (BW) habitat present.

| Reach | Total # NPK Captured | # NPK Captured in RM containing a BW | Total RM | RM Containing a BW | % NPK Captured in RM containing a BW | % RM containing a BW |
|----------------------------|-----------------------------|---|-----------------|---------------------------|---|-----------------------------|
| Southbeach | 148 | 81 | 10 | 4 | 54.7 | 40 |
| Little Yampa Canyon | 160 | 87 | 23 | 5 | 54.3 | 21.2 |
| Juniper | 15 | 8 | 10 | 4 | 53 | 40 |
| Upper Maybell | 68 | 53 | 11 | 4 | 77.9 | 36.3 |
| Lower Maybell | 20 | 16 | 8 | 3 | 80 | 37.5 |
| Sunbeam | 0 | 0 | 10 | 0 | 0 | 0 |
| Lily Park | 26 | 0 | 9 | 0 | 0 | 0 |
| Total | 437 | 245 | 81 | 20 | 56.1 | 22.2 |

Table 12. Number of Colorado pikeminnow (CPM) capture events, number of CPM marked, number of CPM recaptures, number of CPM released, number of CPM removed, and number of CPM mortalities for across all passes in 2014 performed by CPW.

| CPW Reach # | #CPM Capture Events | #CPM Marked | #CPM Recaptures | #CPM Released | #CPM Removed | #CPM Mortalities |
|---------------|---------------------|-------------|-----------------|---------------|--------------|------------------|
| Southbeach | 0 | 0 | 0 | 0 | 0 | 0 |
| Juniper | 0 | 0 | 0 | 0 | 0 | 0 |
| Upper Maybell | 0 | 0 | 0 | 0 | 0 | 0 |
| Lower Maybell | 0 | 0 | 0 | 0 | 0 | 0 |
| Sunbeam | 1 | 0 | 1 | 1 | 0 | 0 |
| Total | 1 | 0 | 1 | 1 | 0 | 0 |

Table 13. 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 | 9 | 9 | 0 | 9 | 0 | 0 |
| Upper Maybell | 2 | 2 | 0 | 2 | 0 | 0 |
| Lower Maybell | 6 | 4 | 2 | 6 | 0 | 0 |
| Sunbeam | 9 | 6 | 3 | 9 | 0 | 0 |
| <u>Total</u> | 26 | 21 | 5 | 26 | 0 | 0 |

Table 14. Number of roundtail chub (RTC) <150mm capture events across all passes in 2014 performed by CPW. RTC <150mm were not tagged.

| <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 | 6 | 0 | 0 | 6 | 0 | 0 |
| Upper Maybell | 0 | 0 | 0 | 0 | 0 | 0 |
| Lower Maybell | 2 | 0 | 0 | 2 | 0 | 0 |
| Sunbeam | 0 | 0 | 0 | 0 | 0 | 0 |
| <u>Total</u> | 8 | 0 | 0 | 8 | 0 | 0 |

Table 15. A summary of the total number of individuals captured for all species by CPW during spring backwater netting in 2014. Non-natives that were lethally removed include: black bullhead, green sunfish, northern pike, smallmouth bass, white sucker, and all white sucker hybrids.

| Species | Count |
|--|--------------|
| Black Bullhead | 2 |
| Brown Trout | 7 |
| Flannelmouth Sucker | 2 |
| Green Sunfish | 11 |
| Northern Pike | 602 |
| Rainbow Trout | 13 |
| Smallmouth Bass | 2 |
| White Sucker | 290 |
| White x Bluehead Hybrid | 3 |
| White x Flannelmouth Hybrid | 79 |
| White x Flannelmouth x Bluehead Hybrid | 1 |
| Total | 1036 |

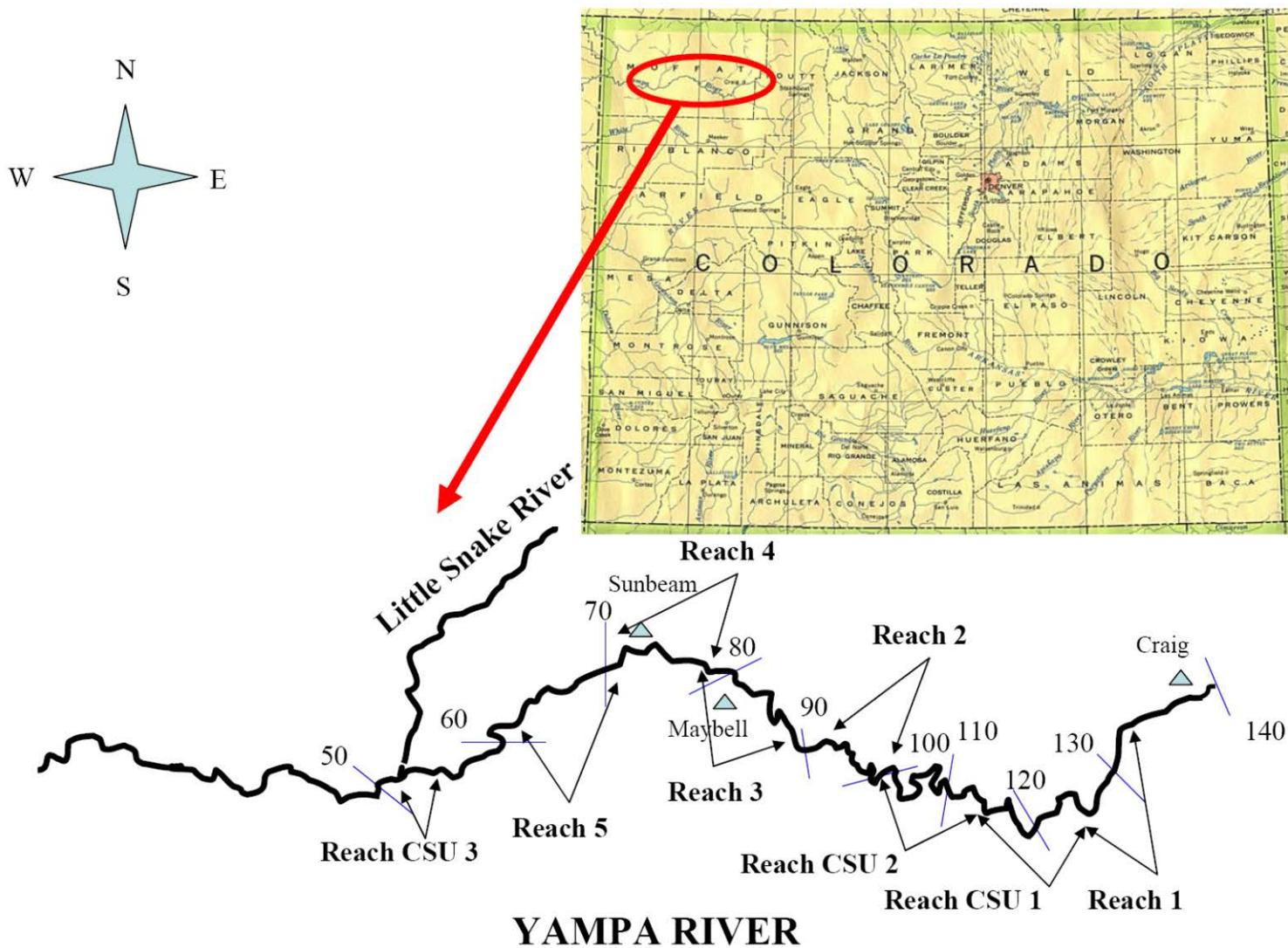


Figure 1. River reaches of the middle Yampa River sampled by the CDOW and CSU (Graphics courtesy of P. Martinez and R. Anderson)

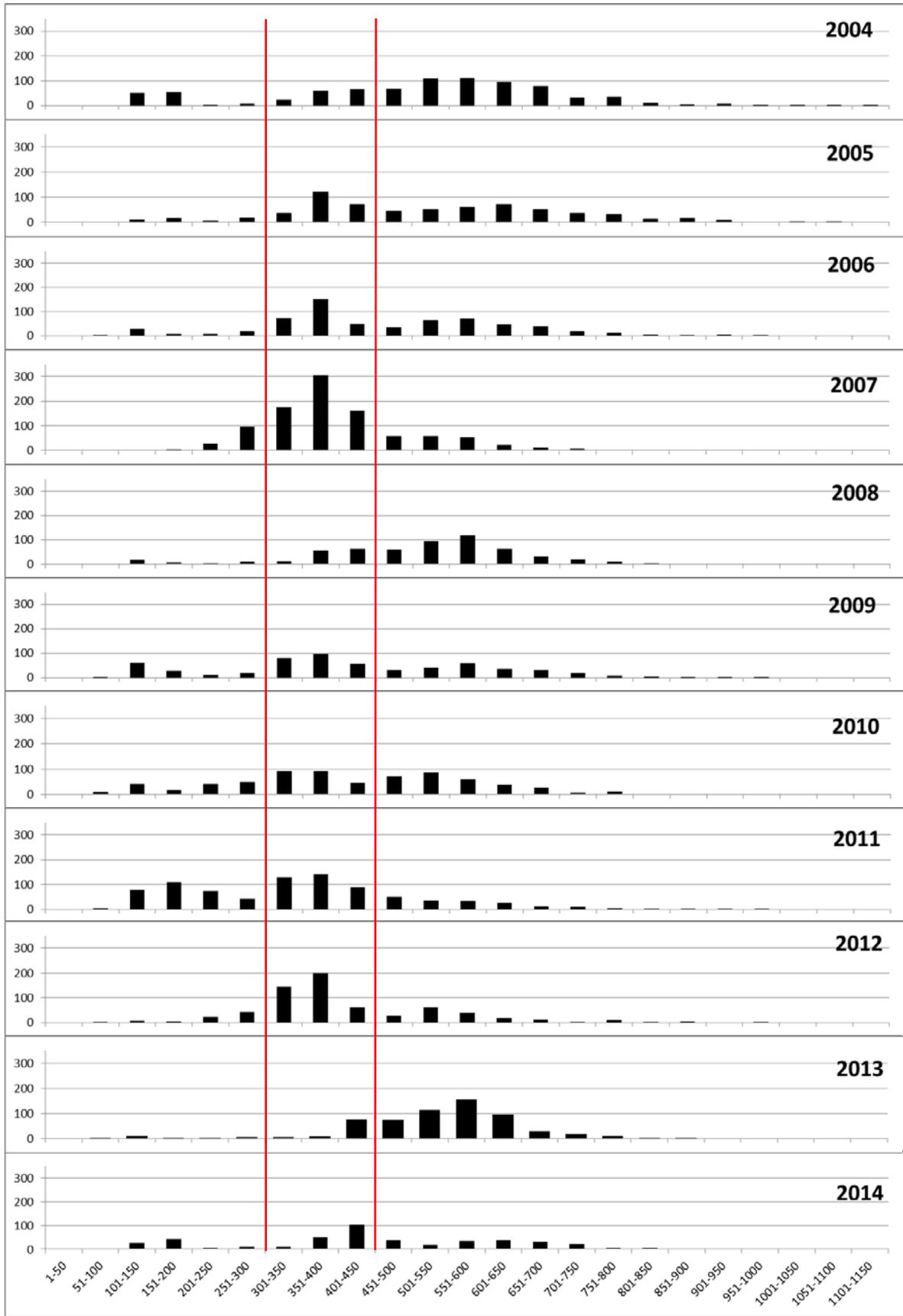


Figure 2. Northern pike total length frequency distributions, in the middle Yampa River, South Beach to Lily Park (RM 134.2-50.5)
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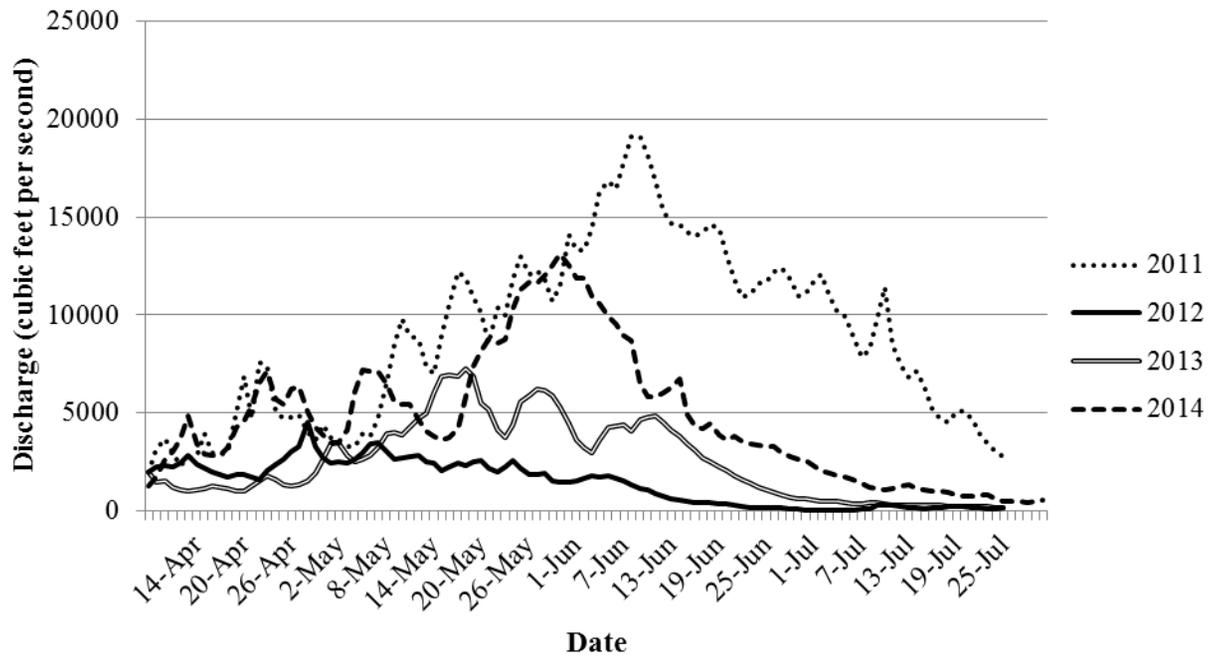


Figure 3. United States Geological Survey Maybell gaging station data for 2011 to 2014 spring runoff.

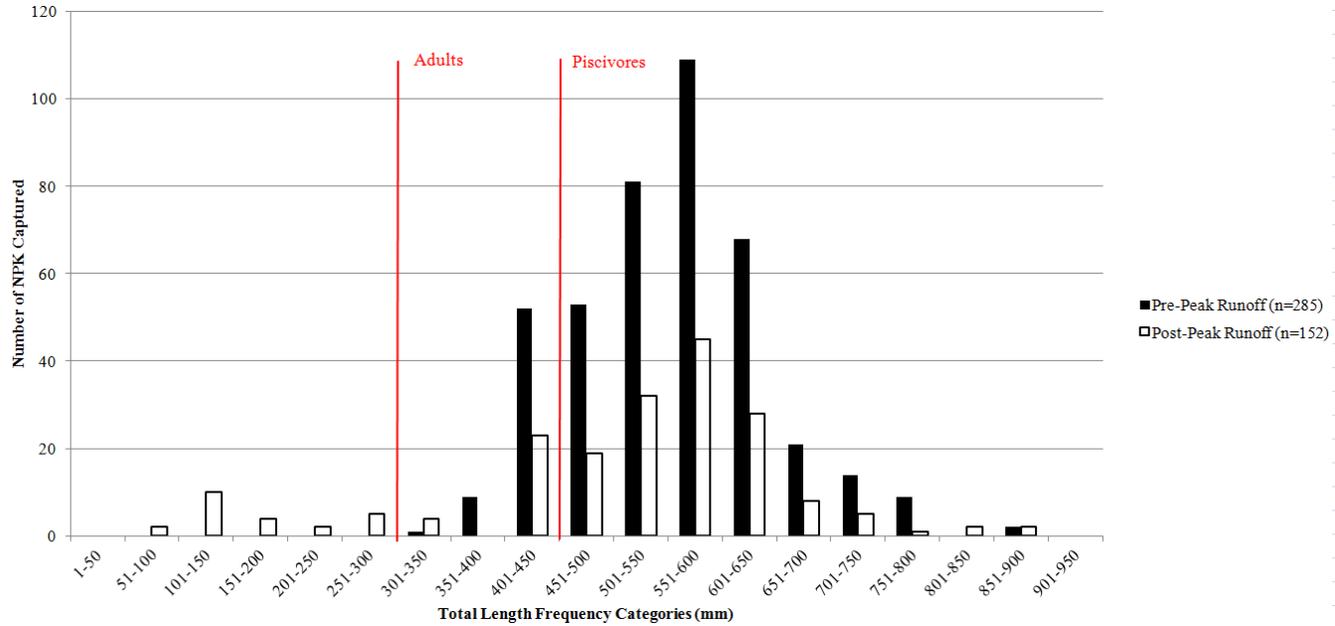


Figure 4. Northern pike length frequency distribution in increments of 50mm for early in the study (white bars), prior to peak runoff, and late in the study (solid bars) after peak runoff in 2014. Peak runoff in 2014 occurred on May 31st.

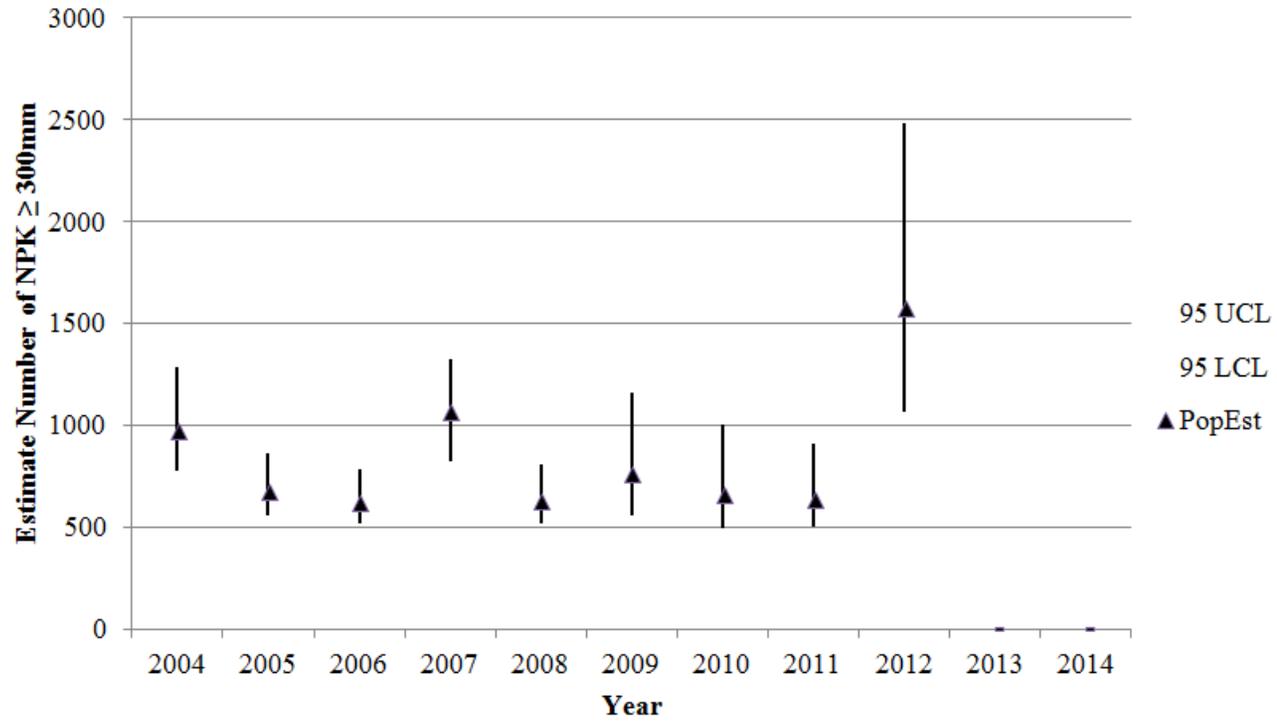


Figure 5. Northern pike ≥ 300 mm TL population estimates and 95% Confidence Interval generated for Yampa River northern pike from river mile 134.2 to 50.5. Population estimates could not be calculated for the 2013 and 2014 sampling season as no mark recapture study was conducted, all northern pike were euthanized.

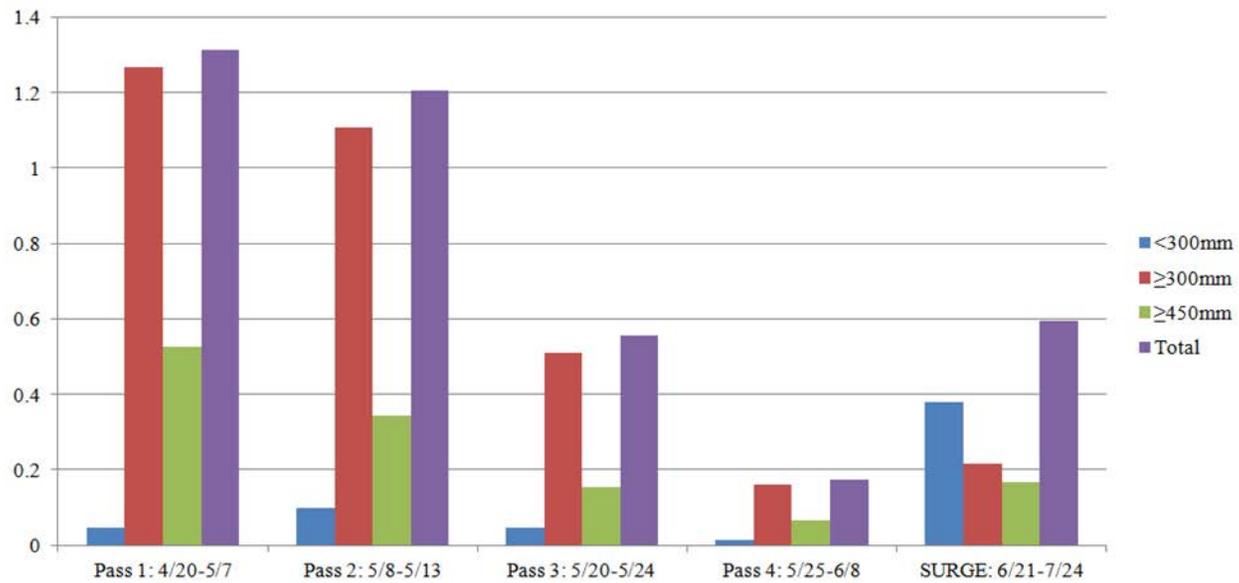


Figure 6. Northern pike (NPK) catch per unit effort (CPUE; # NPK/hour) for three categories (< 300mm, ≥ 300mm, ≥ 450mm and all NPK) across 2014 sampling periods in Juniper sub-section.

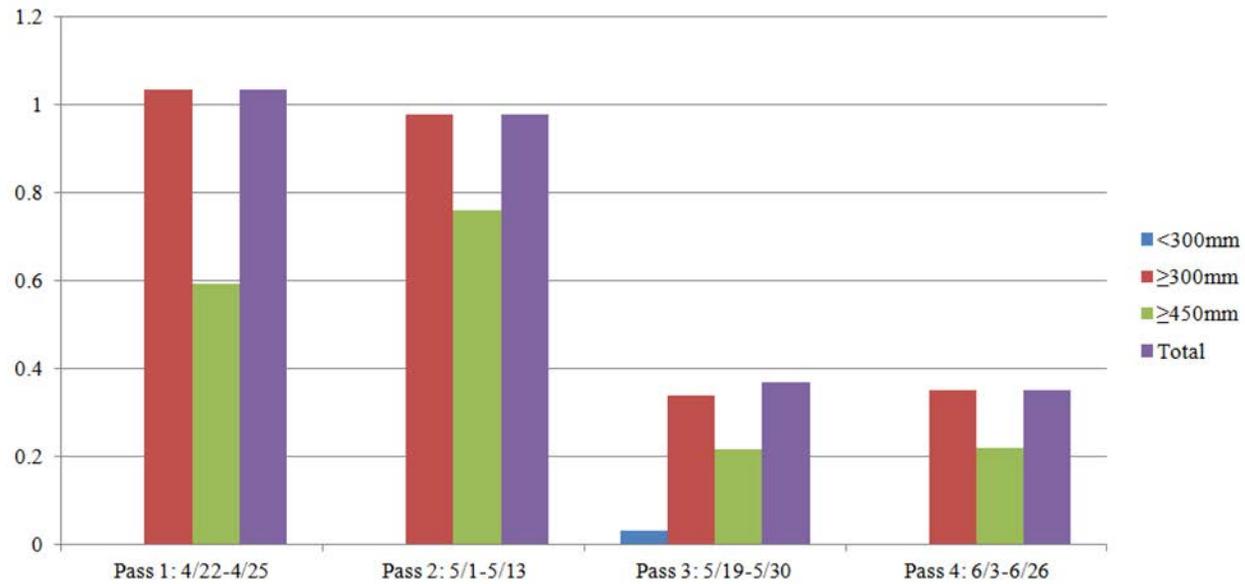


Figure 7. Northern pike (NPK) catch per unit effort (CPUE; # NPK/hour) for three categories (< 300mm, ≥ 300mm, ≥ 450mm and all NPK) across 2014 sampling periods in Maybell sub-section.

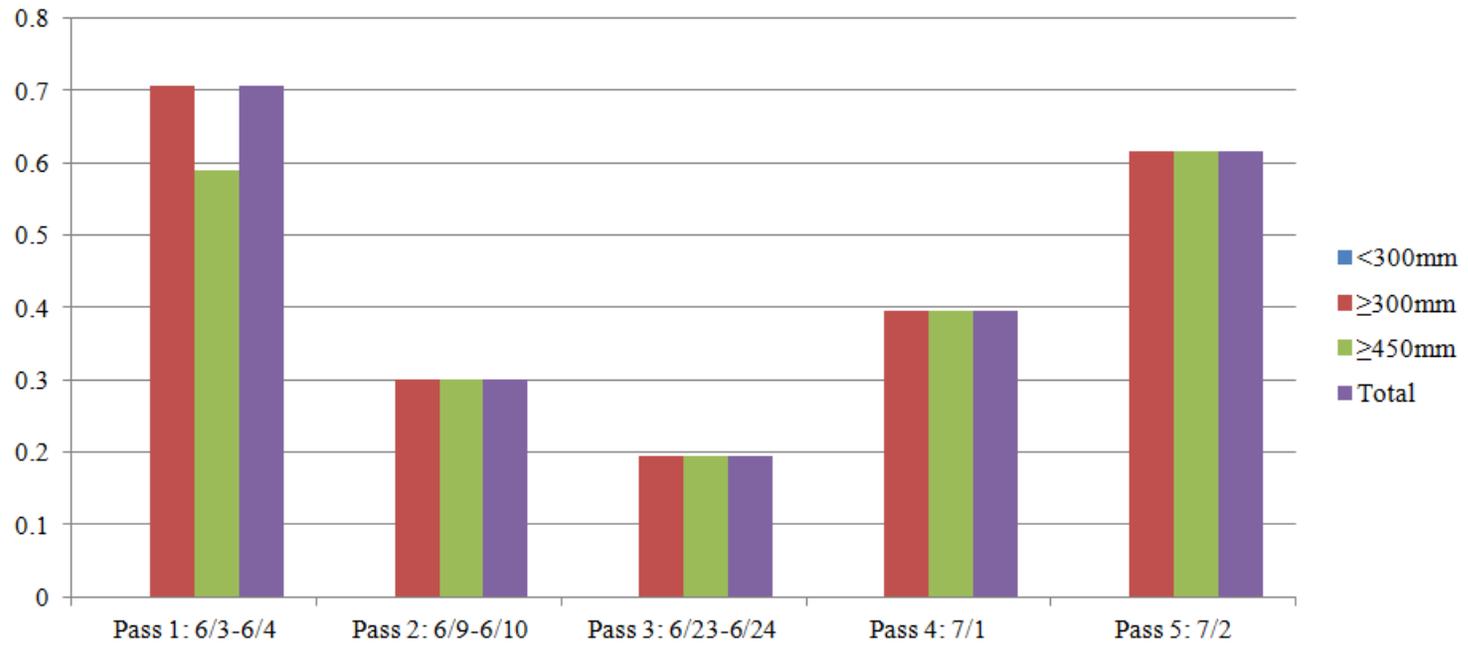


Figure 8. Northern pike (NPK) catch per unit effort (CPUE; # NPK/hour) for three categories (< 300mm, ≥ 300mm, ≥ 450mm and all NPK) across 2014 sampling periods in Lily Park sub-section.

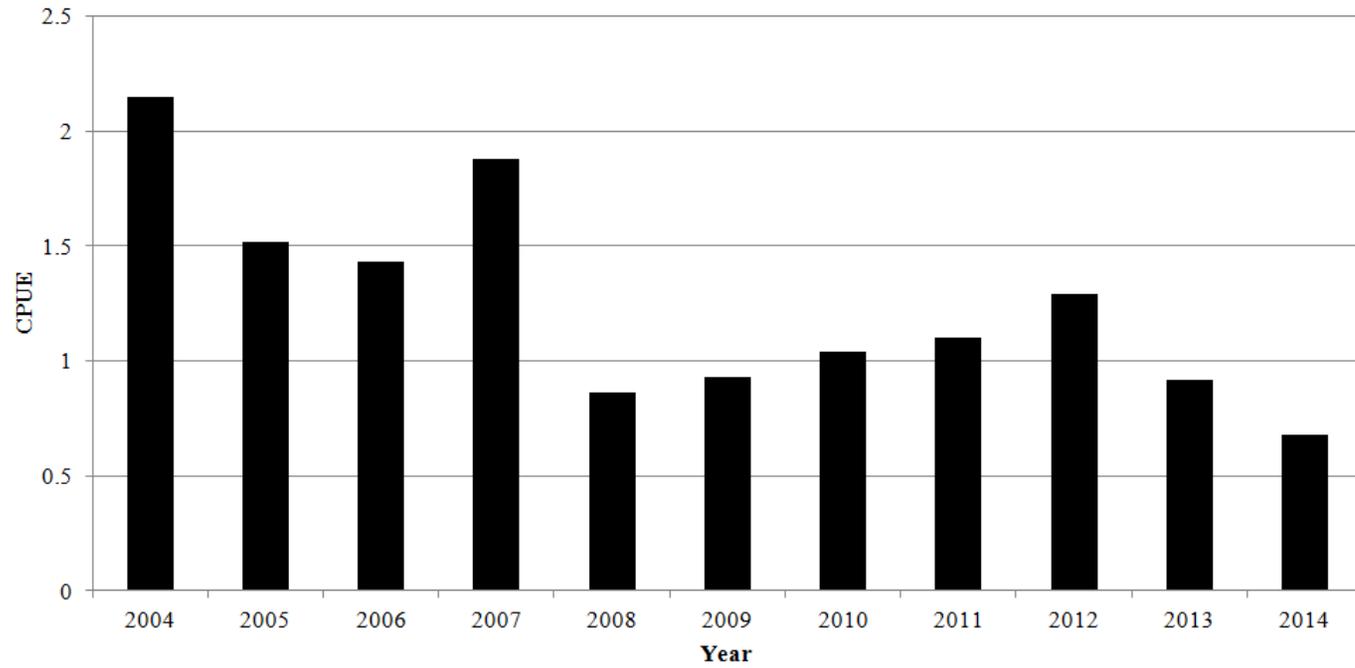


Figure 9. Northern pike Catch Per Unit Effort (CPUE; number of NPK/hour) across all passes in entire study area sampled by CPW and CSU, for 2004 through 2014.

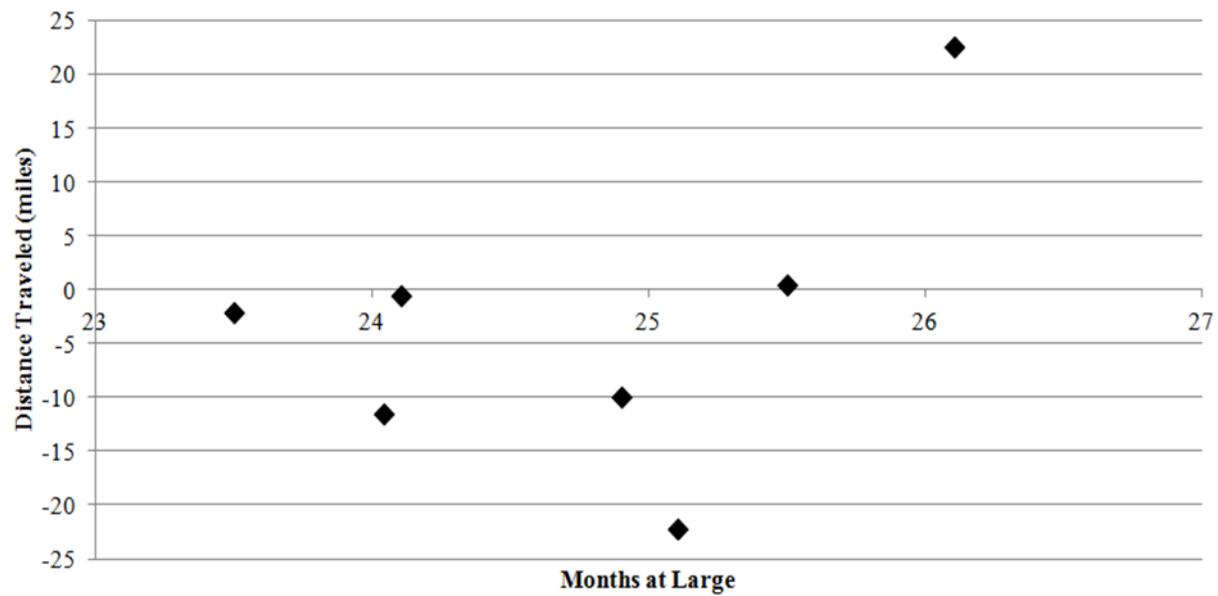


Figure 10. Movement distances of northern pike recaptured (n=7) in the middle Yampa River in 2014, initially tagged in previous years, plotted against number of months each fish spent at large between capture events. Negative values on y-axis represent downstream movement and positive values represent upstream movement.

Number of NPK Caught by River Mile

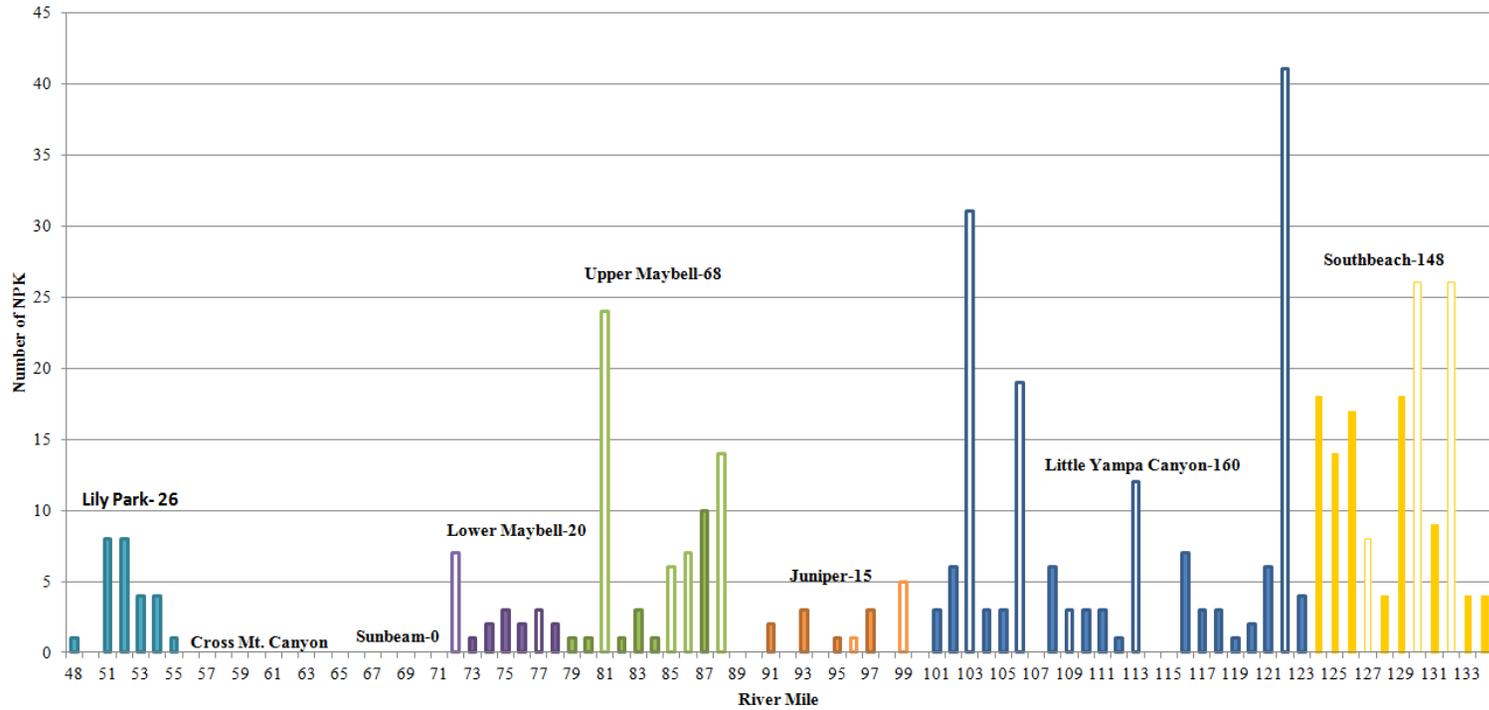


Figure 11. Number of northern pike captured within each river mile during 2014 sampling. Unfilled bars represent river miles containing backwaters; solid bars represent river miles without an associated backwater; and each color represents a new sampling reach (labeled above bars).

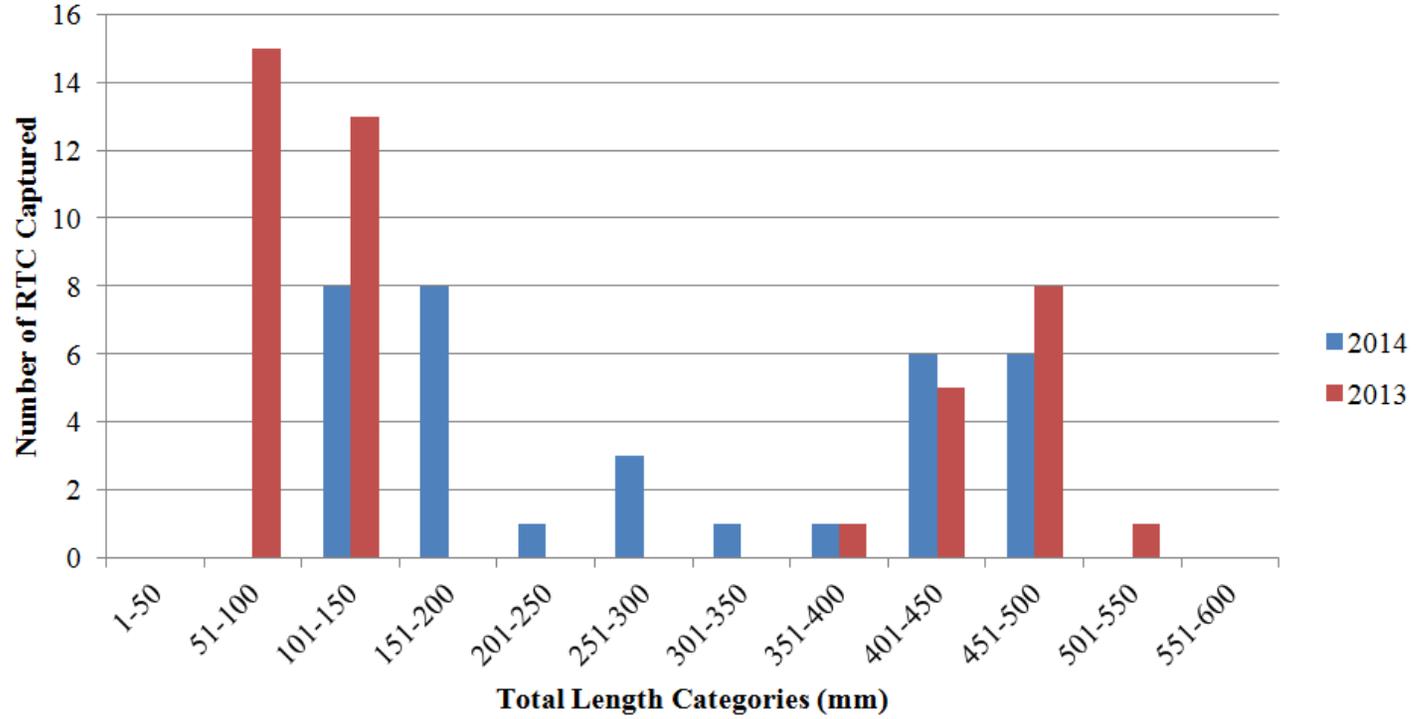


Figure 12. Roundtail chub (RTC) total length (mm) frequency distribution, with size classes in increments of 50 mm, for RTC captured by CPW in the five reaches of the middle Yampa River in 2013 and 2014.

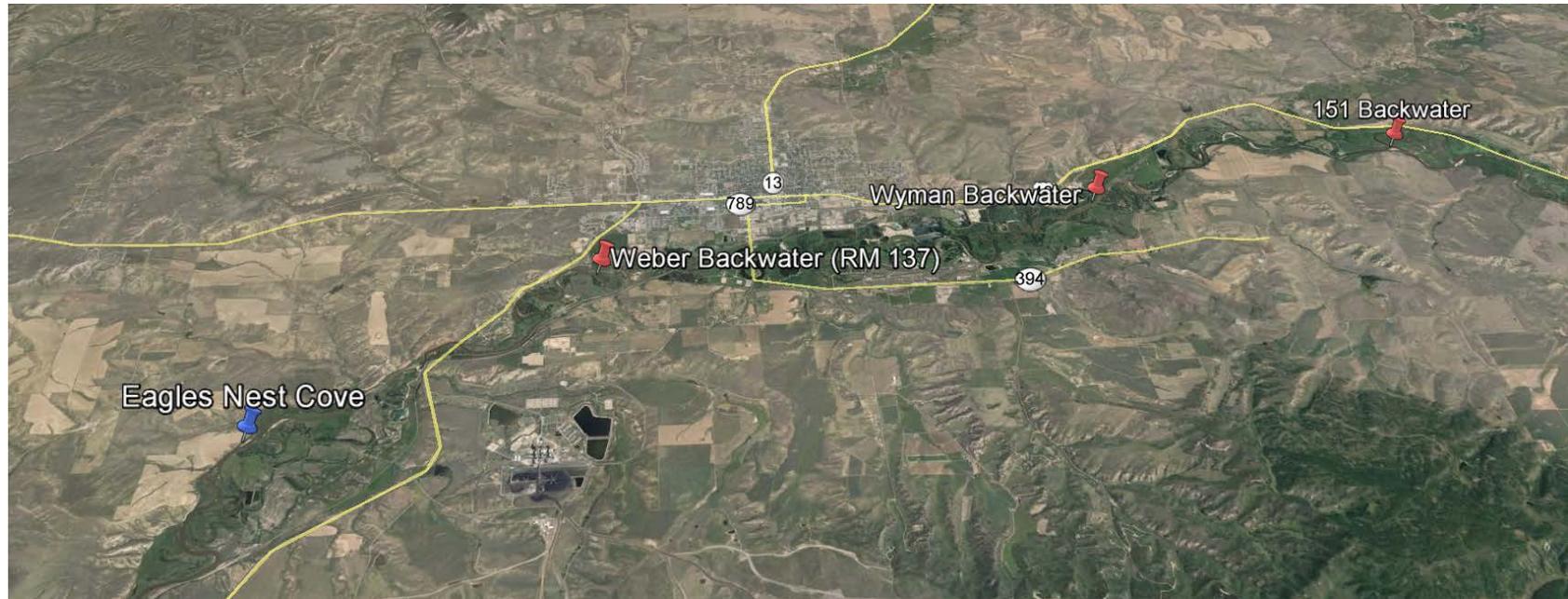


Figure 13. Aerial image showing 4 main spring backwater netting locations. Red pins correspond to backwaters within 98b and the blue pin corresponds to a backwater within 98a (imagery courtesy of Google Earth).