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

II. Bureau of Reclamation Agreement Number: 08FG402776

Project/Grant Period: Start date: June 4, 2008
End date: December 30, 2013
Reporting period end date: December 30, 2013
Is this the final report? No

III. Principal Investigator:

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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 2013 sampling season, 611 northern pike individuals were handled, 285 were translocated to the Yampa State Park pond, and 326 were euthanized. Data collected for this river section yielded an overall decreased catch per unit effort but a greater number of northern pike ≥450mm being captured. Based on 2013 capture data and growth rates the majority of all northern pike captured were from the 2011 year class of northern pike. See 2013 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 and translocate 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 2013 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

A. FY 2013 Tasks and Deliverables

Task 1. Establish landowner contacts and obtain permission to access riverside and backwater property for fish sampling.
Schedule: March 2013
Deliverable: **Task Completed**

Task 2. Plan logistics, hire and train personnel, order and maintain equipment, and prepare for sampling.
Schedule: March-April, 2013
Deliverable: **Task Completed**

Task 3. Sample study area to capture, remove, and translocate northern pike and smallmouth bass. Limited data entry
Schedule: April-Aug, 2013
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, 2013

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 Yampa River study area (described above). Conversely, fiscal Year 2013 marks the fifth consecutive year in which all smallmouth bass data collected by CPW were submitted to CSU for a combined analysis of smallmouth bass. See 2013 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 2013, the Surge lasted from June 13 to July 12. 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. This is the first year mark passes were eliminated.

Between river-mile 134 and 50.5, crews conducted between 3 and 11 passes on each individual reach (Table 1). Pass numbers were varied based on maximizing impacts to nonnative species. CPW conducted eleven total removal passes in Reach 1 (Southbeach: RM 134.2 – 124.0), six in Reach 2 (Juniper: RM 100 – 91.0), eight 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, nine total removal passes were conducted in Little Yampa Canyon (RM 124 – 100) and five total sampling passes were conducted in Lily Park (RM 58.9 – 55.5) (Table 1).

In CSU's study area, four removal passes were conducted in Little Yampa Canyon (RM 124 – 100) with an additional five passes 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. Fish that were less than 508mm in total length were euthanized, and the majority of those greater than 508mm total length were translocated to Yampa State Park Headquarters Pond. All translocated northern pike were marked near the dorsal fin with a unique, numbered, grey, t-bar FLOY tag, if they did not already have one, as well as a left pelvic fin clip. Northern pike that were

translocated but not already tagged, received a new, grey FLOY tag, with tag numbers ranging from 7844 to 7914 or 8072 to 9029 for CSU, and from 08326 to 09669 or 03386 to 03400 for CPW.

All northern pike, smallmouth bass, Colorado pikeminnow, and roundtail chub were measured for total length to the nearest millimeter (mm) and 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 PIT (passive integrated transponder) 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 marked the first year CPW adopted a "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 2013, 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 ≥ 300mm TL, (3) NPK ≥ 450mm TL, and (4) All NPK.

Movement

Movement was broadly described in terms of number of fish that were recaptured in 2013, 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

Twenty-nine different fish species were collected within CPW study reaches. Summary data for all species captured and handled by CPW in 2013 are presented in Table 2.

Northern Pike

Overview

Overall, CPW and CSU captured 610 individual northern pike. The total number of northern pike capture events in 2013 (611) decreased from 669 in 2012. Six hundred and eight northern pike were removed in 2013, representing 99.7% of northern pike individuals handled (Table 4)[1]. Two hundred and eighty four northern pike were translocated to State Park Headquarters West Pond, up from 64 translocated in 2012. This significant increase is due to the high numbers of northern pike from the 2011 cohort recruiting into the >508mm size class. Three hundred and twenty four northern pike were euthanized (Table 5), down from 2012 when 407 were euthanized.

Five hundred and eighty five of 608 northern pike removed from the river in 2013 were considered adult northern pike (≥ 300mm) (Table 4 and Figure 2). Five hundred and three of 608 northern pike removed were ≥450mm (Figure 2). Fifty three of these fish were recaptured fish previously marked by CPW, CSU, or USFWS (Table 6).

Population Size Structure

Northern pike total length frequency histograms for the entire section of river sampled by CPW and CSU from 2004 to 2013 are presented in Figure 2. In 2013, the northern pike population featured more adult fish (≥ 300mm), 96% of total capture events, and fewer small northern pike (< 300mm), 4% of total capture events, when compared to recent years. Eighty two percent of all northern pike captured in 2013 were ≥450mm, a significant increase compared to 27% in 2012. Again, this is a direct result of continued growth of northern pike from the 2011 cohort who have recruited into these larger size classes. The largest northern pike captured was 898mm, and was a fish that had not previously been captured.

Compared to recent years, fewer young of year (YOY) northern pike were captured in 2013. Northern pike YOY were defined as 1-200mm fish captured after June 1 of each corresponding year. Two hundred and seventy eight YOY were captured in 2011 compared to only eighteen in 2013. The first YOY of 2013 were captured on June 25 (compared to June 6, 2012) and ranged from 115 to 151mm. This result was directly affected by relatively low flows (Figure 3) which made 2013 a shorter sampling season than 2011 (as defined by number of days between first and last northern pike captured; Table 3). In 2013, only 15 days of sampling were conducted after the first YOY capture event compared to 45 days in 2011, partially explaining discrepancies between capture numbers of YOY northern pike between years. It is also likely that lower flows in 2012 and 2013 led to a suppressed spawning season and potentially decreased spawning success, leading to fewer overall YOY northern pike.

[1] 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

In 2011, YOY 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. 2012 and 2013 sampling provided no further insight into the possibility of increasing in-river reproduction and recruitment, due to the abbreviated sampling season and limited captures of 2013 YOY northern pike (Figures 2 and 4).

Northern pike growth rates, based on capture history of fish recaptured in 2013 that were tagged in previous years were consistent with previous years (Wright 2010), ranging from 0.04 to 0.76 mm/day (Table 7). Average growth rates of between year recaptured fish that were ≤ 450mm 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.

Population Estimate: South Beach to Lily Park

Population estimates could not be calculated for the 2013 sampling season as 2013 was the first year 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 (<300mm, ≥ 300mm, ≥ 450mm, 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 the highest during the second pass but remained above 0.75 NPK/hour for the first four passes before decreasing below 0.75 NPK/hour over passes 5 and 6. The second pass CPUE spike observed in this sub-section was slightly misleading as presented in Figure 6 because overall CPUE for each individual reach remained similar but Pass 2 is the only set of dates that includes 2 removal passes in Southbeach, a reach with high pike densities, hence the increase in CPUE. Catch per unit effort in the Maybell sub-section increased over the first two passes then decreased but never fell below 0.5 NPK/hour during any pass (Figure 7). The dramatic increase during pass 2 is due to the fact that the Lower Maybell and Sunbeam reaches were not sampled between 5/1 to 5/3, only the Upper Maybell reach was sampled. Northern pike catch rates in Upper Maybell are the highest out of any reach sampled by CPW and CSU and as a result additional passes were completed in Upper Maybell. In Lily Park, CPUE decreased steadily over all passes and all northern pike captured were ≥300mm (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 (NPK per hour electrofishing) in 2012, but decreased in 2013 to

0.92 (NPK per hour electrofishing) (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, Another factor impacting northern pike CPUE in 2013 is a longer sampling season and extended Surge effort in 2013 compared to 2012. Increased effort during the Surge lowers overall northern pike CPUE because it is significant amounts of additional effort dedicated later in the season to catching spawning bass, a time period when overall CPUE of northern pike has generally decreased. Nonetheless, 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

Fifty three northern pike were recaptured that were tagged by CPW, CSU, or USFWS in previous years (Table 6). One of those northern pike recaptures was originally tagged and released by CPW in Elkhead Reservoir during April 2011. One northern pike was recaptured in 2013 that had been tagged 5 days earlier in 2013 and had been recorded as being translocated to the Yampa State Park pond. This fish was recaptured seven miles downstream of its initial capture, two miles downstream of the end of the reach it was captured in, and eighty one miles downstream of the Yampa State Park pond. It is believed this fish was accidentally released back into the river during handling and transport, not that it was illicitly stocked from the park pond.

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). Thirty two northern pike that were recaptured in 2013 moved more than one mile in a downstream direction, while 17 northern pike moved distances greater than one mile upstream. Average between-year movement of northern pike was 10.6 miles. Northern pike that demonstrated downstream movement moved distances from 0.1 to 62.6 miles, while the greatest distance moved upstream was 23.8 miles (Figure 10).

Results from 2013 movement analyses contradict what was observed in 2012 and 2011 with the majority of fish recaptured in 2013 showing downstream movement between years. However, 2013 recaptured fish that had been at large for 2 years tended to display overall upstream movement.

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. One northern pike was recaptured that was initially tagged and released in Elkhead Reservoir in April 2011. Data on this fish are specified in Table 7 and Figure 10. CPW initiated a study in 2011, during which 420 northern pike were tagged and released in Elkhead Reservoir in April of 2011, prior to the reservoir spilling over. In April 2012 two hundred and eleven additional FLOY tags were

deployed in Elkhead Reservoir northern pike. During the spring of 2013 an additional 210 northern pike were tagged in Elkhead Reservoir to further document escapement. Relatively low runoff levels in 2013 resulted in no reservoir spillover in 2013. 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 smallmouth bass 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 typical higher prior to peak runoff and then decreases after peak runoff. In 2013, electrofishing prior to peak runoff accounted for 69% of the total number of northern pike captured (Figure 4) despite accounting for only 38% of the total effort in 2013.

Northern pike distribution is also not geographically uniform. Specific types of habitat, mainly backwaters, creek mouths, and other slack water areas, generally hold more northern pike and these types of habitat are not available in all reaches. Three hundred and ninety five of 611 (64.6%) northern pike captured were removed from Southbeach and Upper Maybell combined (Figure 11). These two reaches also have the highest number of backwater and slack water areas compared to all other reaches within 98a. Over all 81 river miles within project 98a, 55% 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, two Colorado pikeminnow capture events were documented by CPW in 2013 (Table 12), thirty four less than in 2011. Both Colorado pikeminnow were captured in Upper Maybell. One was captured during Pass 1 on April 23 and was 620mm and one during Pass 3 on May 3 which was 512mm. Mean total length of Colorado pikeminnow captured by CPW in 2013 was 556mm. The Colorado pikeminnow captured on May 3 was not a recaptured fish and was given a new PIT tag. The two Colorado pikeminnow capture events occurred in the main channel, with no capture events in backwaters as low flows resulted in many typical backwater areas remaining dry most of the sampling season. No evidence of northern pike attack was found on either Colorado pikeminnow.

Roundtail Chub

Overall, 43 roundtail chub capture events were documented by CPW in 2013 (Table 13). Five roundtail chub were captured during Pass 1, two were captured during Pass 2, and one was captured during Pass 3. A total length frequency histogram was developed for all roundtail chub individuals captured by CPW since 2008 (Figure 12). Eleven of fifteen roundtail chub captured that were > 150mm did not possess a pit tag and are presumed to be "new" fish. Twenty eight RTC captured were <150 mm TL (Table 14). The capture of these fish was a direct result of a change in CPW netting strategy. In 2013, 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 (<150mm) white suckers, several RTC<150mm were also captured. Documenting recruitment of RTC, primarily in the Juniper reach, is an interesting result of the change in sampling procedure. The mean total length of roundtail chub captured in 2013 was 230mm compared to 464mm in 2012, a direct result of capturing 28 RTC < 150mm. With RTC < 150mm excluded the mean total length was 461mm.

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 26 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 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, twenty six 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 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.
B. Repeat 2013 standard northern pike removal effort and consider shifting more effort from the peak of the hydrograph, when northern pike catch rates have been shown to be lower, to the descending limb of the hydrograph, when northern pike catch rates have been shown to be higher. The highest catch rates of northern pike occur prior to and after peak runoff.
C. Prioritize sampling to occur later in the sampling season, which can be accomplished by the Surge, to document the presence or absence of YOY northern pike in future years.
D. Repeat the 2013 Surge effort in future years, as the Surge was complimentary to northern pike management objectives in the Yampa River.
E. Consider shifting effort to time periods and concentration areas where northern pike are most vulnerable to capture.
F. Continue work to control potential northern pike source populations. Prioritize work schedule to focus on populations of immediate concern.
G. Continue marking and documentation of roundtail chub and Colorado pikeminnow.
H. Continue the net-everything approach adopted by CPW in 2013 to help further document recruitment of roundtail chub in CPW reaches.
I. Look into the potential of habitat modifications to certain backwaters to disadvantage northern pike in the Yampa River.
J. Continue contacts with Yampa River landowners and stakeholders before, after, and during the study.

Acknowledgements: The author wishes to thank in particular previous 98a lead biologist Boyd Wright, CPW, for his assistance during field work and analysis, Jenn Logan, CPW, for her leadership assistance in the field, and Lori Martin, CPW, for her lead on this project from 2004 to 2007. The author also appreciates the assistance of numerous CPW personnel and personnel from other agencies who assisted during the field season. The author recognizes Aaron Weber and John Hawkins for sharing and exchanging data.

X. Project Status: This project is considered on track, with minor revisions to be considered. Study direction and sampling design for 2014 may be adjusted per results from the 2013 Nonnative Fish Control Workshop.

XI. FY 2013 Budget Status:

A. Funds Provided: $205,073, Funds Expended: $205,073
B. Difference: -0-
C. Percent of the FY 2013 work completed: 100%
D. 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, 2014.

XIII. Signed: Kyle Battige (Principal Investigator) November 13, 2013 (Date)

. **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 2013.

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	7	4	11
CSU 1	Juniper	Little Yampa Canyon	124.0-112.0	CSU	0	4	5	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	3	3	6
3	Maybell	Dwn. Juniper Canyon to Old Maybell launch	88.7-79.2	CPW	0	7	1	8
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	5	0	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 2013. Non-natives that were lethally removed include: black bullhead, bluegill, brook stickleback, creek chub, common carp, green sunfish, white sucker, and all white sucker hybrids.

Species	**Number of Capture Events**
Northern Pike	611 (CSU 156 + CPW 455)
Smallmouth Bass	2964
Colorado pikeminnow	2
Roundtail Chub	44 (15 > 150mm)
Black Bullhead	1
Bluegill	1
Bluehead Sucker	181
Bluehead x Flannelmouth Sucker Hybrid	3
Brook Stickleback	23
Brown Trout	82
Channel Catfish	1
Creek Chub	201
Common Carp	115
Colorado River Cutthroat Trout	1
Green Sunfish	10
Flannelmouth Sucker	180
Fathead Minnow	23
Longnose Dace	4
Mottled Sculpin	9
Mountain Whitefish	16
Rainbow Trout	42

Redside Shiner	2
Rainbow x Cutthroat Hybrid	1
Sand Shiner	29
Speckled Dace	4
White Sucker	10784
White x Bluehead Sucker Hybrid	22
White x Flannelmouth Sucker Hybrid	132
White x Flannelmouth x Bluehead Sucker Hybrid	8
Total CPW Capture Events (Individual Fish Processed)	**15340**

Table 3. Middle Yampa River sampling season 2004 to 2013. 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

Table 4. Number of northern pike ≥ 300mm 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 2013. Population estimates could not be calculated for the 2013 sampling season as 2013 was the first year a mark pass was not conducted.

Year	# NPK Tagged on First Pass	# NPK Recaptured on the Second Pass	# NPK Tagged, Recovered, and Removed on Subsequent to Marking Pass	%Recovery of Tagged NPK	Total # of NPK Individuals Handled	Total #NPK Removed	%NPK Handled that were Removed
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%

*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 2013. Northern pike were either translocated to the State Park Headquarters Pond or euthanized.

Disposition	Number of Northern Pike
State Park Headquarters Pond (Total)	**284**
CPW	190
CSU-LFL	94
Loudy Simpson	0
Elkhead Reservoir	0
Euthanized and Incidental Mortality (Total)	**324**
CPW	264
CSU-LFL	60
***Unknown (Escaped or Dead)**	2
Total	**610**

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

Table 6. Number of northern pike (NPK) 2013 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, and 2013.

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	1
Tagged and Released by CPW and CSU in 2011	9
Tagged and Released by CPW and CSU in 2012	40
Tagged and Released by CPW and CSU in 2013	*1
Tagged and Released by USFWS (98b) in Previous Years	1
Tagged and Released by CPW in Elkhead Reservoir in 2011	1
Tagged and Released by CPW in Elkhead Reservoir in 2012	0
Tagged and Released by CPW in Elkhead Reservoir in 2013	0
Total Number of NPK Recaptures	**53**

*CPW had one northern pike that was tagged and recorded as translocated to Yampa State Park that was recaptured 7 miles downstream from where it was initially captured. This fish was likely accidentally released back into the river and then recaptured on a subsequent removal pass.

Table 7. Growth rate calculations based on capture history of northern pike that were recaptured in 2012 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.

TL @ first Capture(mm)	Date of First Capture	TL @ Second Capture(mm)	Date of Second Capture	Change in TL(mm)	Growth Rate(mm/week)	Growth Rate (mm/day)
202	5/8/12	520	5/29/13	318	5.77	0.82
287	5/2/10	620	5/10/13	333	2.11	0.30
309	5/7/12	505	5/1/13	196	3.83	0.55
315	5/11/12	440	4/23/13	125	2.53	0.36
326	5/8/12	560	5/9/13	234	4.47	0.64
328	5/3/12	606	5/3/13	278	5.35	0.76
339	5/8/12	570	5/20/13	231	4.29	0.61
340	5/13/11	615	5/3/13	275	2.67	0.38
342	5/9/12	587	4/30/13	245	4.82	0.69
346	5/8/12	604	6/19/13	258	4.44	0.63
350	5/7/12	449	5/8/13	99	1.89	0.27
350	5/14/11	515	5/1/13	165	1.61	0.23
350	5/9/11	586	5/20/13	236	4.39	0.63
353	5/7/12	578	5/3/13	225	4.36	0.62
355	5/7/12	601	4/25/13	246	4.88	0.70
355	5/10/12	561	5/9/13	206	3.96	0.57
361	5/8/12	595	4/23/13	234	4.68	0.67
362	5/9/12	589	4/30/13	227	4.47	0.64
366	5/14/11	658	5/29/13	184	3.34	0.48
366	5/7/12	556	5/1/13	190	3.71	0.53
368	5/8/12	589	5/1/13	221	4.32	0.62
371	5/11/12	520	5/1/13	149	2.94	0.42

372	5/8/12	582	5/9/13	210	4.02	0.57
375	5/8/12	602	4/25/13	227	4.52	0.64
375	5/10/12	530	5/29/13	155	2.82	0.40
375	5/12/11	595	4/23/13	220	2.16	0.31
375	5/9/12	618	5/18/13	243	4.55	0.65
377	5/14/11	634	4/19/13	257	2.55	0.36
379	5/11/12	520	5/1/13	149	2.94	0.42
382	5/9/12	453	4/22/13	71	1.43	0.20
384	5/8/12	600	5/9/13	216	4.13	0.59
391	5/8/12	605	5/28/13	214	3.89	0.56
394	5/2/12	595	5/20/13	201	3.67	0.52
396	5/8/12	655	5/8/13	259	4.98	0.71
404	5/13/11	688	5/3/13	284	2.76	0.39
405	5/3/12	595	4/18/13	190	3.81	0.54
425	5/8/12	619	5/7/13	194	3.73	0.53
426	5/10/11	568	5/20/13	142	1.34	0.19
432	5/4/12	636	5/3/13	204	3.92	0.56
450	5/8/12	634	5/29/13	184	3.34	0.48
505	5/10/12	584	5/9/13	79	1.51	0.22
510	5/10/12	615	5/1/13	105	2.07	0.29
521	5/10/12	608	5/1/13	87	1.71	0.24
544	5/10/12	605	5/29/13	61	1.13	0.16
566	4/27/10	885	6/4/13	319	2.00	0.28
569	5/6/12	641	5/21/13	72	1.33	0.19
572	5/10/12	693	5/1/13	121	2.38	0.34
594	5/10/12	684	5/1/13	90	1.77	0.25

598	5/10/11	775	5/3/13	177	3.46	0.49
601	5/7/12	721	5/9/13	120	2.29	0.33
682	5/6/12	722	5/14/13	40	0.75	0.11
*865	4/21/11	895	5/4/13	30	0.28	0.04

*Northern pike originally tagged in Elkhead Reservoir (n=1).

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 ≥ 300mm 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 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

*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 2013 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

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 2013.

	Pass 1	Pass 2	Pass 3	Pass 4	Pass 5	Pass 6	Pass 7	Pass 8	Pass 9	Sub Section Totals
JUNIPER										
NPK Captured	44	103	72	52	13	28	6	4	0	322
Effort (hours)	57.51	52.33	60.68	68.66	41.81	80.61	39.17	35.20	27.47	463.44
CPUE (NPK/hour)	0.77	1.97	1.19	0.76	0.31	0.35	0.15	0.11	0	0.69
MAYBELL										
NPK Captured	39	86	57	22	25	12				241
Effort (hours)	27.22	20.56	33.25	22.41	24.85	18.83				147.12
CPUE (NPK/hour)	1.43	4.18	1.71	0.98	1.01	0.64				1.64
LILY PARK										
NPK Captured	21	13	6	4	2					46
Effort (hours)	9.85	12.46	11.49	8.12	8.59					50.51
CPUE (NPK/hour)	2.13	1.04	0.52	0.49	0.23					0.91

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	204	123	10	4	60	40
Little Yampa Canyon	103	60	23	5	55	22
Juniper	17	8	10	3	47	30
Upper Maybell	191	121	11	4	63	36
Lower Maybell	46	21	8	2	46	25
Sunbeam	4	0	10	0	0	0
Lily Park	46	0	9	0	0	0
Total	611	333	81	18	55	22

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 2013 performed by CPW.

CPW Reach #	#CPM Capture Events	#CPM Marked	#CPM Recaptures	#CPM Released	#CPM Removed	#CPM Mortalities
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	2	1	1	2	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
Total	2	1	1	2	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 2013 performed by CPW. The increase in number of RTC <150mm was directly impacted by CPW's decision to start netting all fishes during 2013 electrofishing, not solely focusing on NPK, SMB, RTC, and CPM.

CPW Reach #	#RTC Capture Events	#RTC Marked	#RTC Recaptures	#RTC Released	#RTC Removed	#RTC Mortalities
1	0	0	0	0	0	0
2	1	0	1	1	0	0
3	2	2	0	2	0	0
4	5	3	2	5	0	0
5	9	8	1	9	0	0
Total	17	13	4	17	0	0

Table 14. Number of roundtail chub (RTC) <150mm capture events across all passes in 2013 performed by CPW. RTC <150mm were not tagged.

CPW Reach #	#RTC Capture Events	#RTC Marked	#RTC Recaptures	#RTC Released	#RTC Removed	#RTC Mortalities
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	23	0	0	23	0	0
4	3	0	0	3	0	0
5	0	0	0	0	0	0
Total	26	0	0	26	0	0

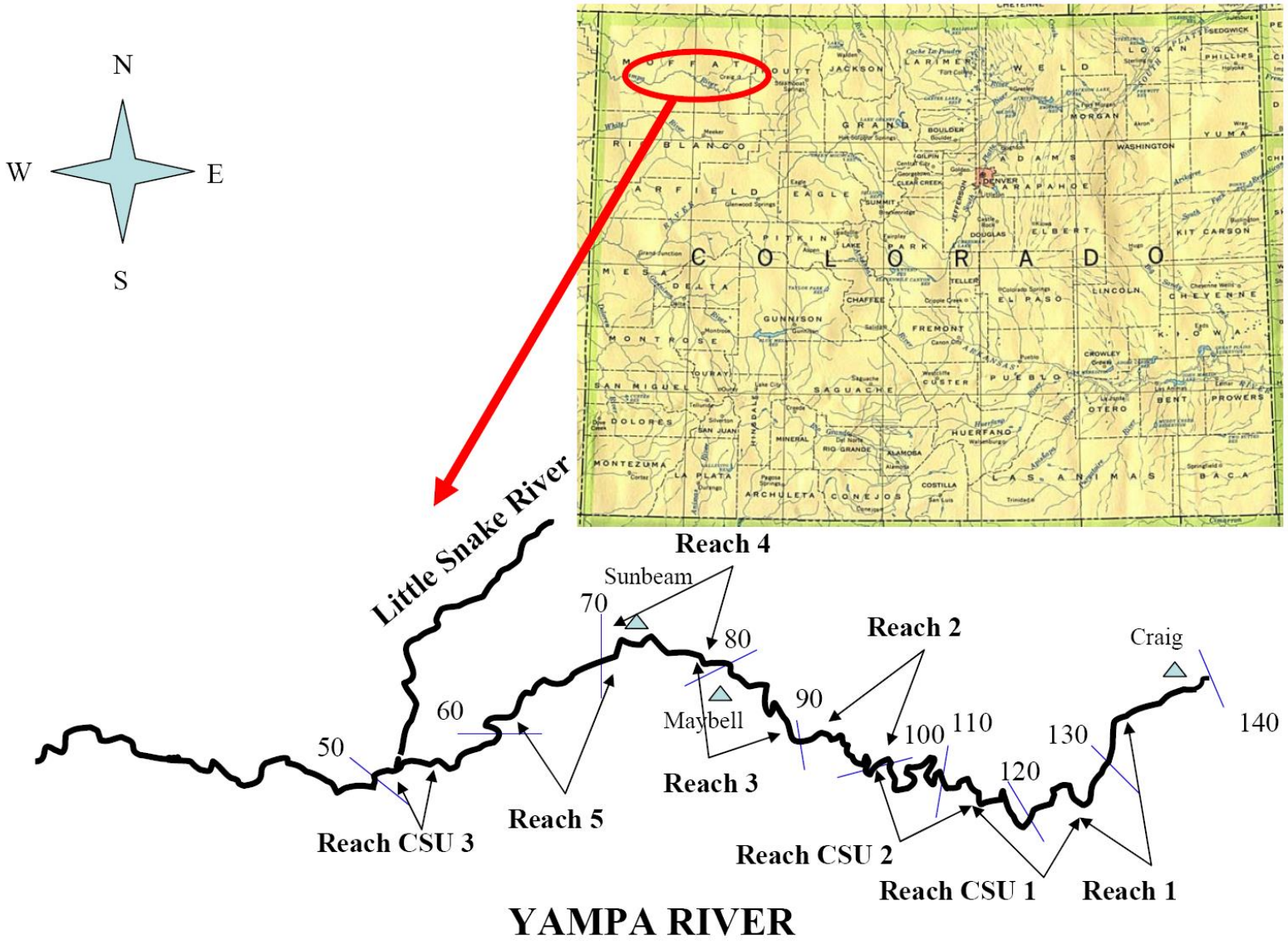

Figure 1. River reaches of the middle Yampa River sampled by the CDOW and CSU (Graphics courtesy of P. Martinez and R. Anderson)

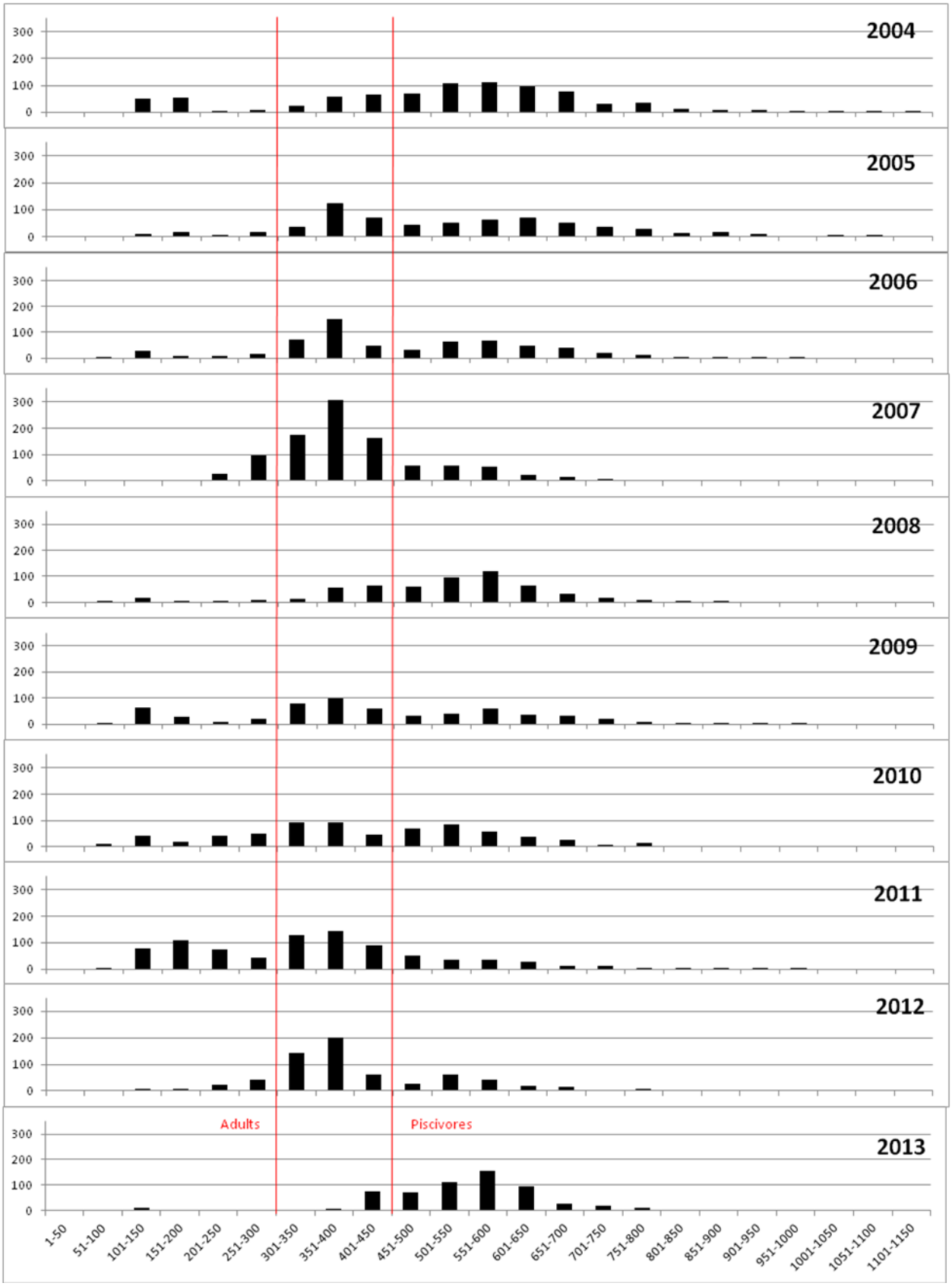

Figure 2. Northern pike total length frequency distributions, in the middle Yampa River, South Beach to Lily Park (RM 134.2-50.5)

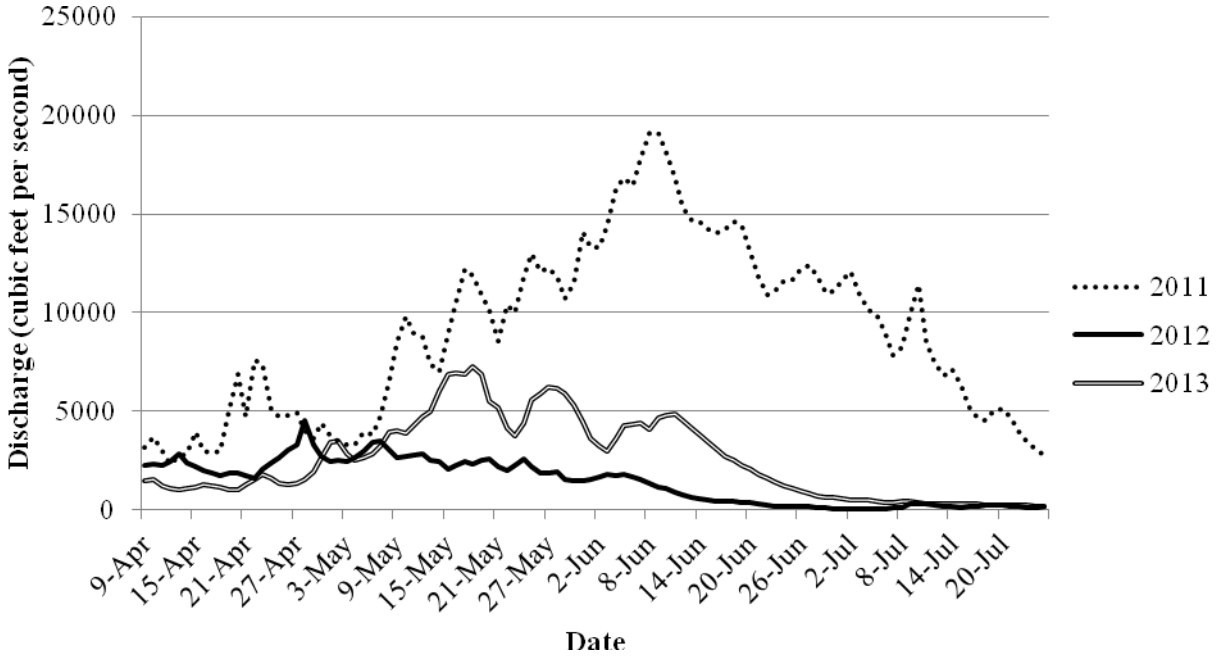

Figure 3. United States Geological Survey Maybell gaging station data for 2011 to 2013 spring runoff.

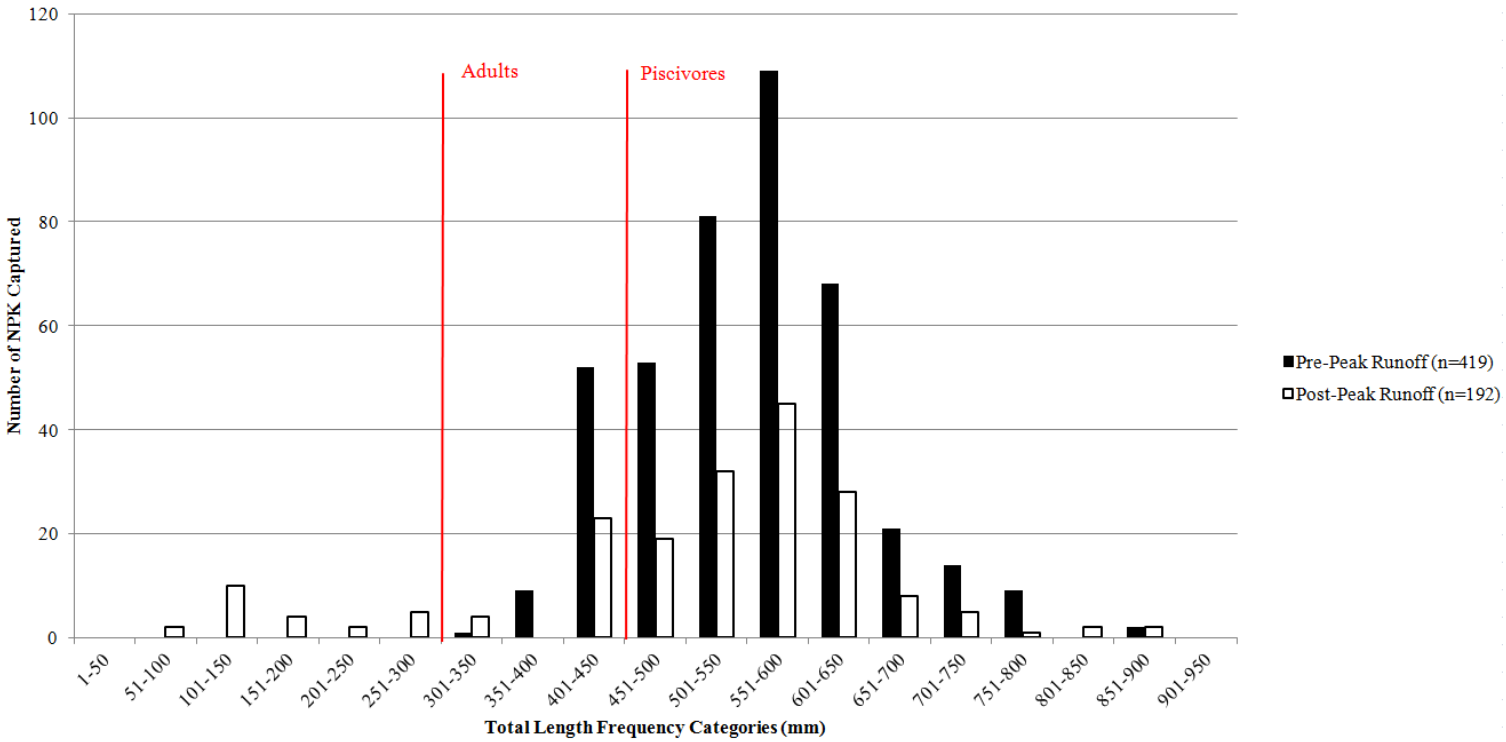

Figure 4. Northern pike length frequency distribution in increments of 50mm for early in the study (white bars), prior to peak runoff, and late in the study (solid bars) after peak runoff in 2013.

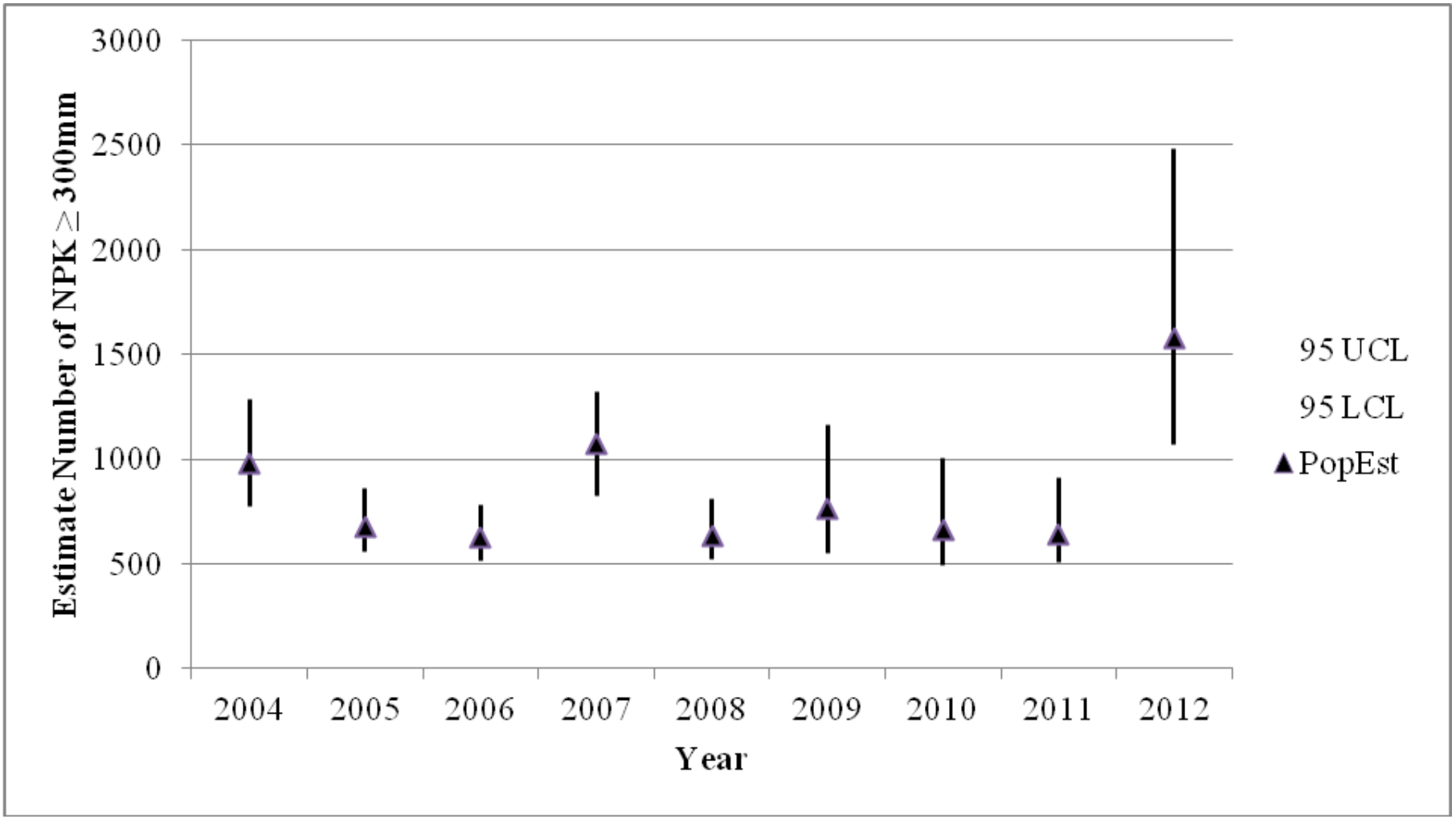

Figure 5. Northern pike ≥300 mm TL population estimates and 95% Confidence Interval generated for Yampa River northern pike from river mile 134.2 to 50.5. Population estimates could not be calculated for the 2013 sampling season as 2013 was the first year a mark pass was not conducted.

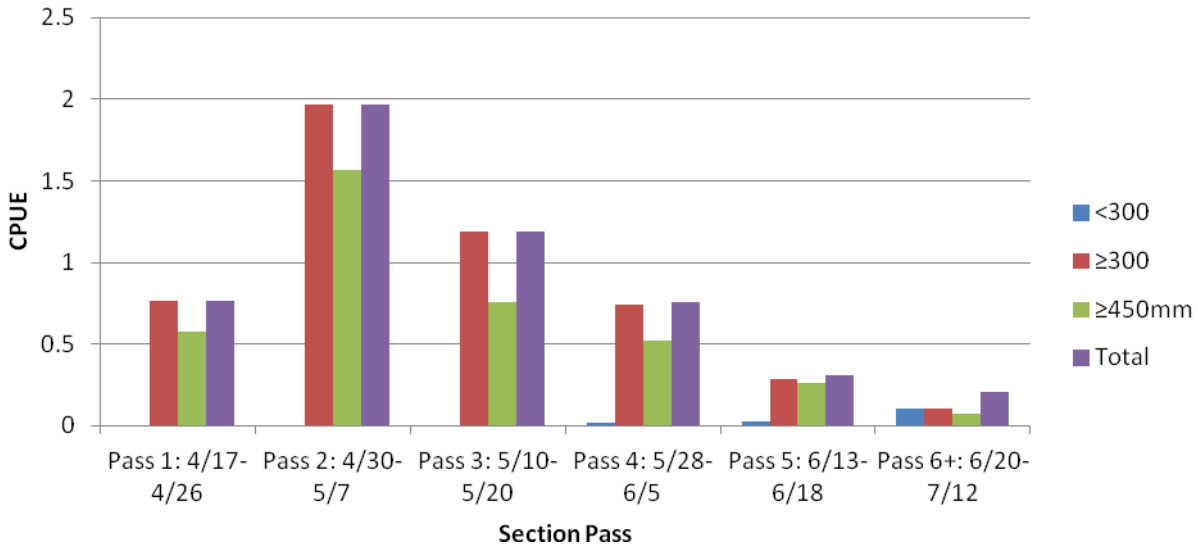

Figure 6. Northern pike (NPK) catch per unit effort (CPUE; # NPK/hour) for three categories (< 300mm, ≥ 301mm, and all NPK) across 2012 sampling periods in Juniper sub-section.

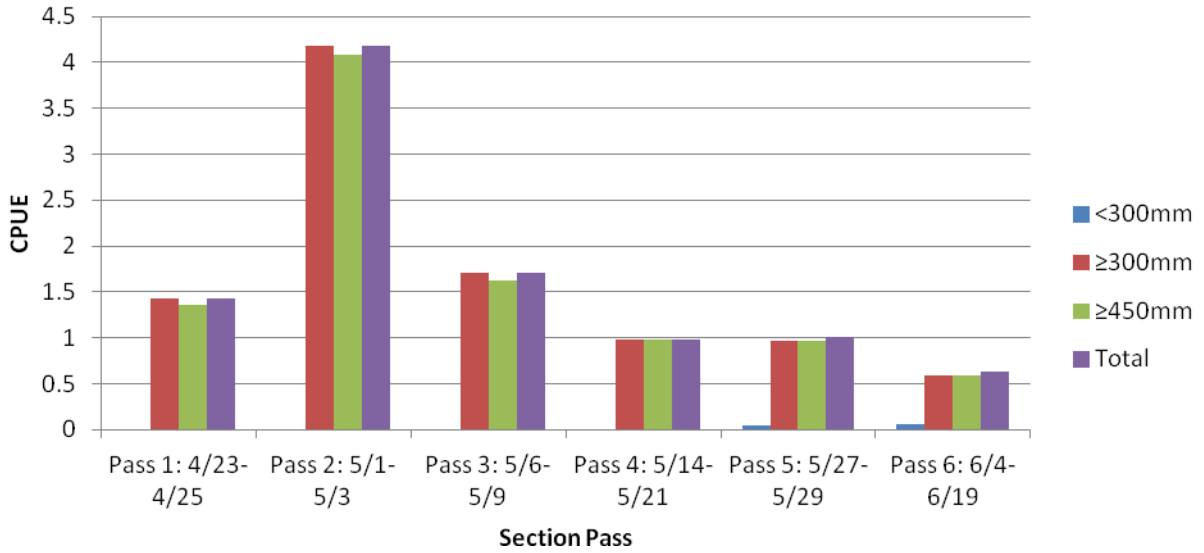

Figure 7. Northern pike (NPK) catch per unit effort (CPUE; # NPK/hour) for three categories (< 300mm, ≥ 301mm, and all NPK) across 2012 sampling periods in Maybell sub-section.

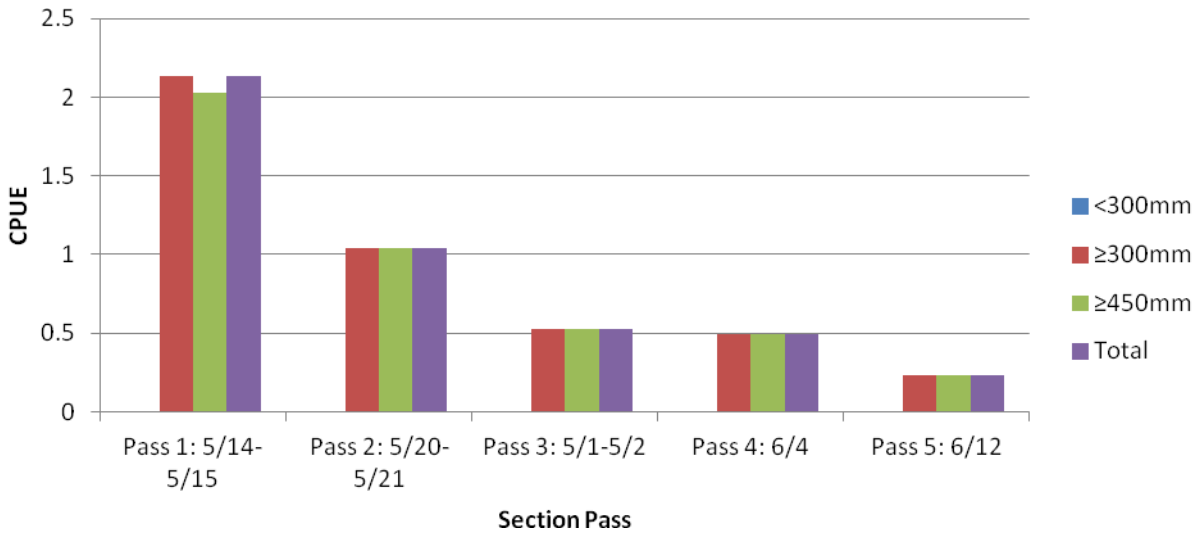

Figure 8. Northern pike (NPK) catch per unit effort (CPUE; # NPK/hour) for three categories (< 300mm, ≥ 301mm, and all NPK) across 2012 sampling periods in Lily Park sub-section.

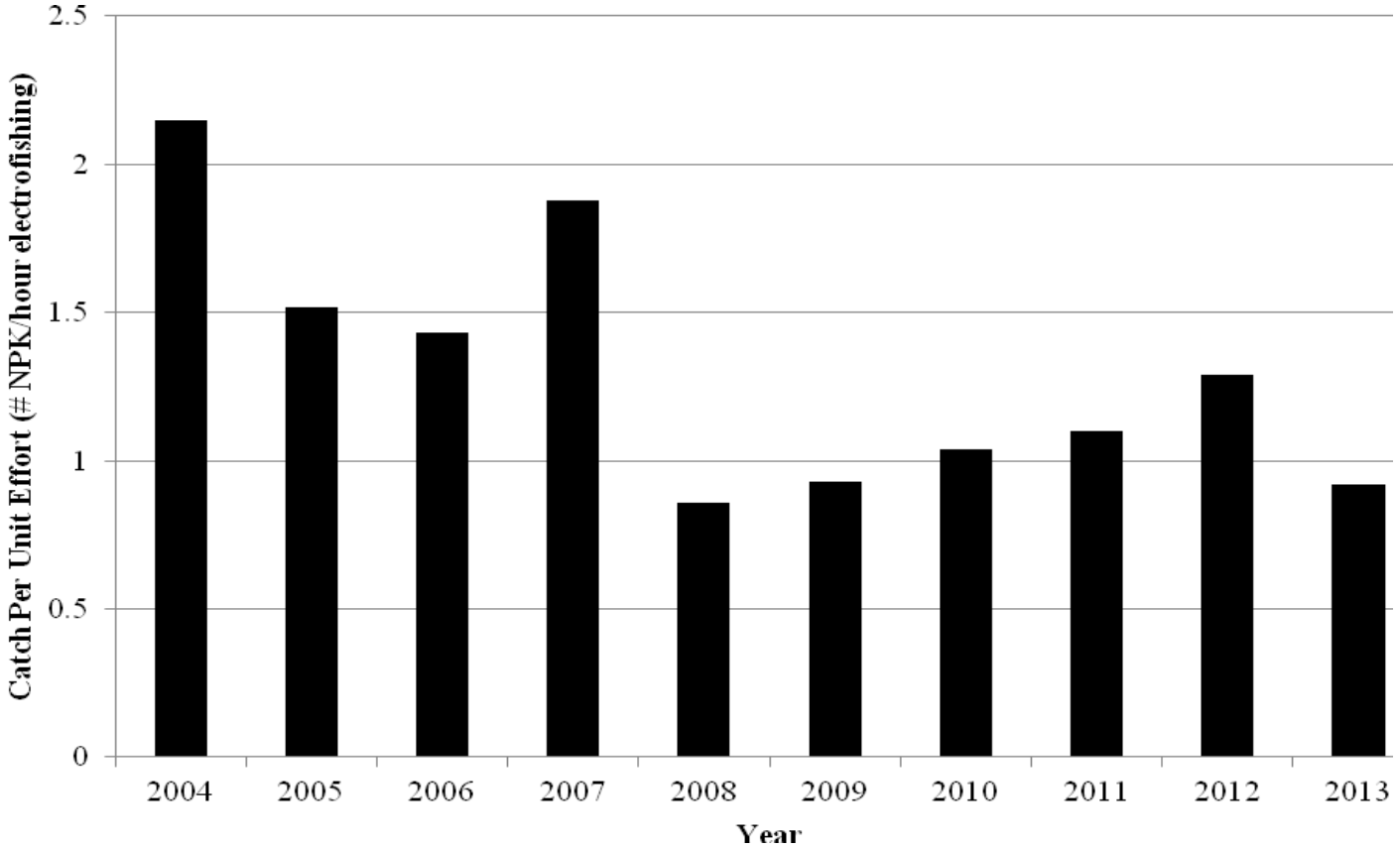

Figure 9. Northern pike Catch Per Unit Effort (CPUE; number of NPK/hour) across all passes in entire study area sampled by CPW and CSU, for 2004 through 2013.

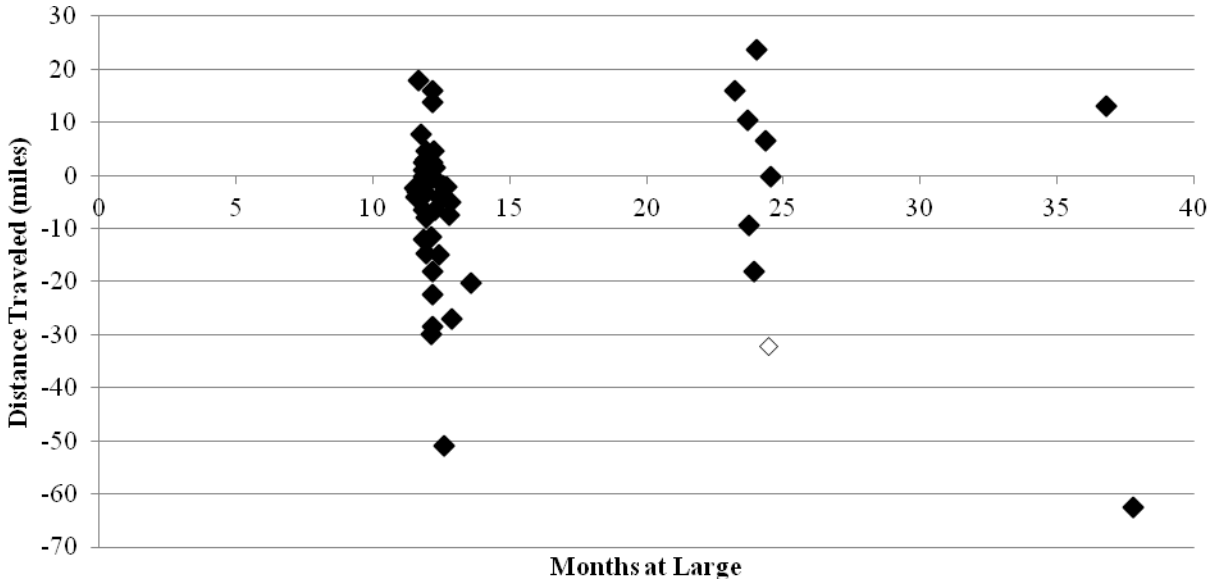

Figure 10. Movement distances of northern pike recaptured (n=53) in the middle Yampa River in 2013, initially tagged in previous years, plotted against number of months each fish spent at large between capture events. Negative values on y-axis represent downstream movement and positive values represent upstream movement. ◇ represent northern pike originally tagged in Elkhead Reservior in 2011 (n=1).

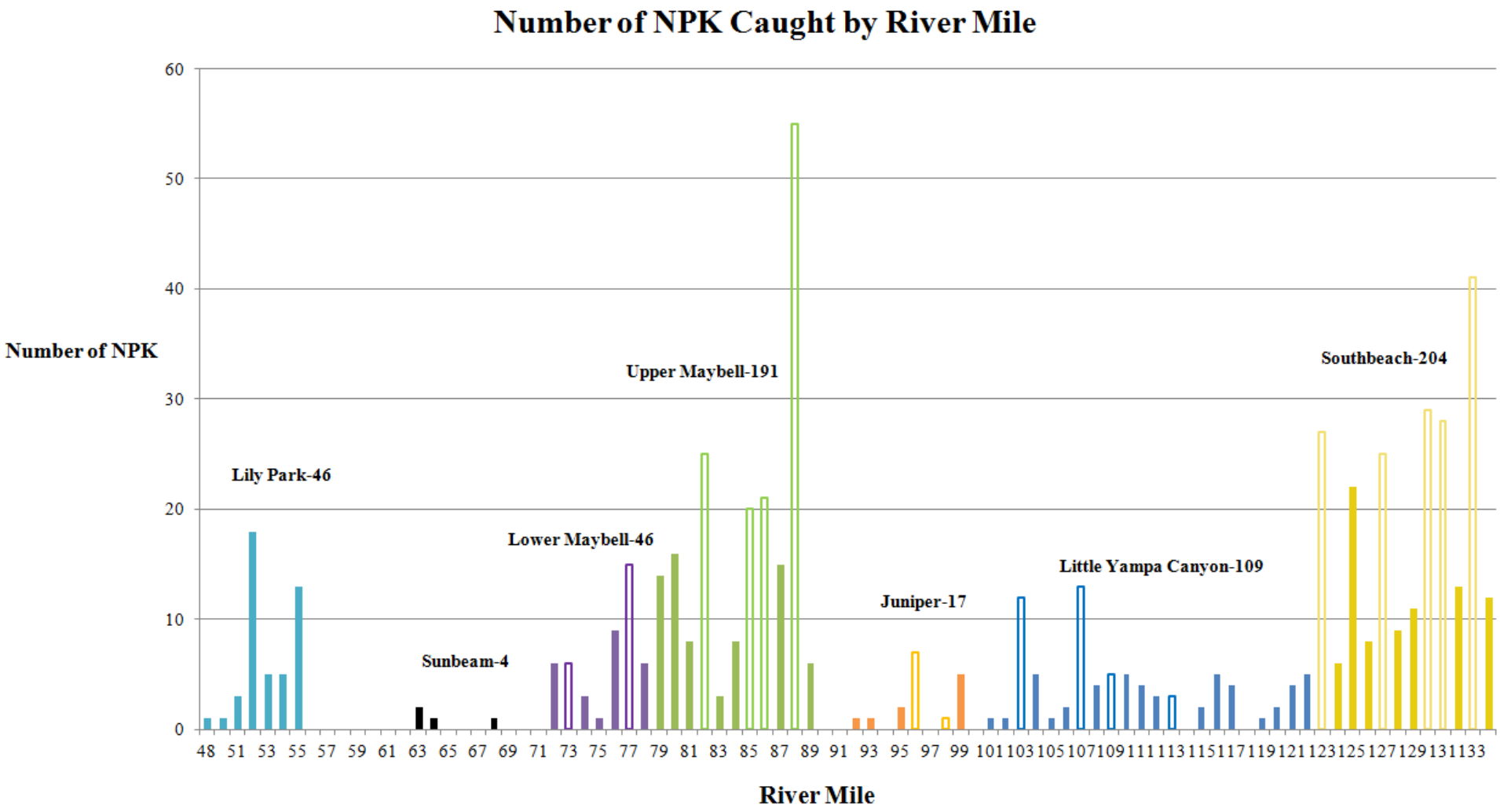

Figure 11. Number of northern pike captured within each river mile during 2013 sampling. Unfilled bars represent river miles containing backwaters; solid bars represent river miles without an associated backwater.

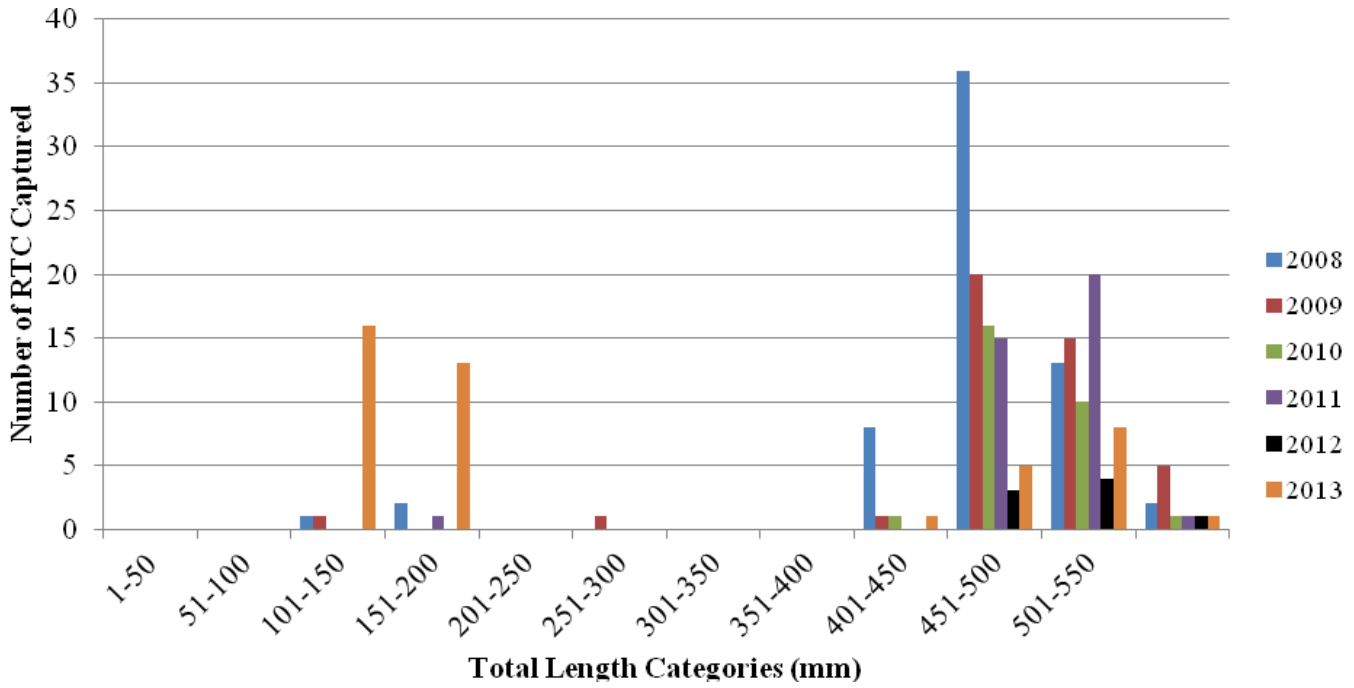

Figure 12. Roundtail chub (RTC) total length (mm) frequency distribution, with size classes in increments of 50 mm, for RTC captured by CPW in the five reaches of the middle Yampa River from 2008 to 2013.