

I. Project Title: **Middle Yampa River nonnative fish management**

II. Bureau of Reclamation Agreement Number: R17AP00301

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III. Principal Investigator:

Tory Eyre
Colorado Parks and Wildlife
73485 Highway 64
Meeker, CO 81641
Phone: 970-878-6074
Fax: 970-878-6077
Email: tory.eyre@state.co.us

IV. Abstract:

This project is one of several designed to facilitate the removal of nonnative northern pike and smallmouth bass within the Yampa River basin, with an evaluation of the efficiency of such efforts. The study area consisted of the middle Yampa River miles (RM) 134.2 to 50.5 which were sampled to capture and remove smallmouth bass and northern pike. In the 2018 sampling season, 203 northern pike were removed by Colorado Parks and Wildlife (CPW) during early spring (March 26 through April 27) backwater gill netting efforts. CPW and Colorado State University (CSU) also removed 140 northern pike during electrofishing efforts which began April 19 and continued through June 29. Northern pike electrofishing catch rate was 0.23 fish/hour, which is the lowest catch rate observed since intensive, annual electrofishing in the study area began in 2004. Please see CSU's 2018 Annual Report for Project #125 for a detailed analysis of smallmouth bass data collected in the study area. Crews also sampled for Colorado pikeminnow, but no fish were collected. Please see CSU's 2018 Annual Report for Project #128 for a detailed analysis of Colorado pikeminnow data collected in the study area.

V. Study Schedule:

Initial Year: 2005 (CPW assisted CSU in 2004)
Final Year: Ongoing

VI. Relationship to RIPRAP:

This study involved removing nonnative fish, primarily northern pike and smallmouth

bass from the middle Yampa River near Craig, Colorado (RM 134.2). CPW evaluated the efficiency of that northern pike removal, while CSU evaluated the smallmouth bass removal effort. CPW removed northern pike from selected backwater areas in the middle Yampa River prior to conducting mainstem electrofishing removal passes.

General Recovery Program Support Action Plan

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

III.A. Reduce negative interactions between nonnative and endangered fishes.

III.A.2. Identify and implement viable active control measures.

Green River Action Plan: Yampa and Little Snake rivers:

III.B. Implement CPW Yampa Basin aquatic wildlife management plan (CDOW 1998) and the Recovery Program's Yampa River Nonnative Fish Control Strategy. Each control activity will be evaluated for effectiveness and then continued as needed.

III.B.2. Control nonnative fishes via mechanical removal.

III.B.2.d. Remove (formerly "and translocate") northern pike from Yampa River designated critical habitat.

III.B.2.d. (1) Remove northern pike above Craig, Colorado

III.B.2.e. Remove (formerly "and translocate") smallmouth bass.

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

Task 1. Establish landowner contacts, obtain permission to access property and backwaters for sampling.

Schedule: February -Mid March

Deliverable: Task Completed

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

Schedule: February-April

Deliverable: Task Completed

Task 3. Complete early spring backwater removals utilizing gill nets to target northern pike during the spawning period in the area covering Project #98a and #98b sections of river.

Schedule: Mid March -April

Deliverable: Task Completed

Task 4. Complete main channel and backwater electrofishing within the study area to remove northern pike and smallmouth bass. *This task is included in SOW 128 in FY18, 21, and 22 because it will focus on providing data for Colorado pikeminnow population estimates.*

Schedule: May

Deliverable: Task Completed

Task 5. Complete main channel and backwater electrofishing within the study area to remove northern pike and smallmouth bass. Assist CSU with the Surge to target smallmouth bass utilizing raft electrofishing and other methods during the spawning period and low hydrograph conditions.

Schedule: Early to Mid June; Early July

Deliverable: Task Completed

Task 6. Maintenance of equipment, data entry, data analysis, and preparation of final report. Present findings during the Annual Nonnative Fish Control Workshop/Coordination Conference Calls, and at the Annual Recovery Program Researchers Meeting.

Schedule: August- January

Deliverable: Annual Report Completed. Findings will be discussed during the Annual Nonnative Fish Control Coordination Conference Calls, and presented at the Annual Recovery Program Researchers Meeting.

Study Area

The study area that CPW focuses on for this project includes 47.3 river miles of the middle Yampa River just downstream of Craig, Colorado (RM 134.2) to just upstream of Cross Mountain Canyon (RM 60.6) (Figure 1). Backwater areas within and upstream of the study area (into the Project #98b study area as far upstream as Hayden, Colorado) were netted as ice receded and hydrological conditions allowed, from late March through the end of April. The main channel, including backwater areas, was electrofished via boats and rafts utilizing block-and-shock techniques within backwaters from mid-April through the end of June. Specific river segments sampled included: South Beach: RM 134.2 (South Beach launch) to RM 124.0 (Round Bottom), Juniper: RM 100.0 (upstream Government Bridge) to RM 91.0 (mouth of Little Juniper Canyon), Upper Maybell: RM 88.7 (downstream of Juniper Canyon) to RM 79.2 (Maybell bridge launch), Lower Maybell: RM 79.2 to RM 71.0 (Sunbeam launch), and Sunbeam: RM 71.0 to RM 60.6 (just upstream of Cross Mountain launch).

Northern pike were not removed by CPW in 24 miles of river, RM 124.0 (Round Bottom) to RM 100.0 (near Government Bridge). CSU has established this reach as a smallmouth bass study area. These 24 miles have also been included in previous studies for northern pike removal. Therefore, CSU removed northern pike within these stretches in conjunction with their smallmouth bass study. CSU also removed smallmouth bass and northern pike from downstream of Cross Mountain Canyon (RM 55.5) to just downstream of the Little Snake River confluence (RM 50.5). CPW and CSU's combined study area includes a total of 76.3 river miles. CSU's northern pike data were collated with CPW data and reported by CPW in this report. CPW also removed smallmouth bass across the entire CPW study area. CPW's smallmouth bass data were collated with CSU data and reported by CSU in the 2018 Annual Report for Project #125. Approximately two miles of river within Juniper Canyon were not sampled, due to non-navigable riverine conditions.

Study Methods/Approach

Late March through April: Early Spring Backwater Gill Netting

Backwater areas in the vicinity of Craig, Colorado that have been identified as known or likely northern pike concentration areas were netted as the ice receded and hydrological conditions allowed, from the middle of March through the end of April (a minimum of 30 days of effort). The goal of this effort is to remove northern pike from the backwater areas before they have a chance to spawn, thus reducing the annual cohort contributed to the Yampa River northern pike population by in-channel spawning. Ripe northern pike can be exploited from early April to mid-May as fish seek backwater habitat for spawning (Hill 2005). Backwater areas in Project #98a and #98b sections of the Yampa River where CPW has obtained permission were included in the netting effort. This method of nonnative fish control is relatively simple, efficient, effective, and inexpensive.

Early spring backwater gill netting was a collaborative effort between CPW and U.S. Fish and Wildlife Service (USFWS). Sixteen standardized 1.5" mesh size gill nets, ranging from 50' to 150', were set in 13 backwaters located between RMs 170.0 and 122.0. In 2018, one additional backwater was sampled compared to 2017. Two gill nets were set in each of the three largest backwaters.

A jon boat and float tubes were used to set gill nets in the backwater areas. Nets remained set overnight and were checked each day for the duration of the project. Gill nets were set and pulled depending on water conditions. A net was not set until the backwater was inundated, and was pulled when the backwater disconnected from the river. Variable flows in 2018 caused some backwaters to fluctuate from inundated to dry multiple times during the project. Some locations included net sets for the duration of the project (March 26 – April 27), while some nets were set and pulled as water levels fluctuated. Catch per unit effort (CPUE) was reported as northern pike per net-night and calculated for each backwater in addition to overall CPUE across all backwater locations.

All fish captured were identified to species, measured for total length (tl) to the nearest millimeter (mm), and weighed to the nearest gram (g). Bluehead sucker, flannelmouth sucker, roundtail chub, and Colorado pikeminnow captured were also scanned to determine the presence of passive integrated transponder (PIT) tags. PIT tag number was recorded and stored in the PIT tag reader for those fish encountered with PIT tags. Individuals without PIT tags were implanted with a new PIT tag following the appropriate protocol. Capture locations for these species were recorded to the nearest tenth of a river mile. Universal Transverse Mercator (UTM) coordinates associated with capture locations were also recorded, when possible. All native species captured were immediately released alive. Any native fish captured that was visibly stressed was not processed, but rather returned to the location of capture within the river immediately.

All nonnative fish collected, excluding salmonids and channel catfish, were lethally removed, and either provided to landowners and/or licensed anglers, or disposed of in a landfill. Northern pike and smallmouth bass collected were examined for the presence of

Floy tags and fin clips. Floy tag number and color, and any fin clips were recorded. Nonnative species of unusual occurrence, i.e. walleye, burbot, grass carp, etc. that were collected had their otoliths extracted prior to disposal.

Mid-April through Late June: Mainstem Electrofishing and Backwater Block-and-Shock

Main channel electrofishing to monitor Colorado pikeminnow and block-and-shock techniques in backwaters to target northern pike and smallmouth bass were the focus of the sampling effort that began April 18 and continued through June 8. Efforts after June 8 and continuing through June 29 (the Surge) were similar, but primarily targeted smallmouth bass. CPW, CSU, and the U.S. Fish and Wildlife Service participated in the 'Surge,' which focused on the removal and disturbance of spawning adult smallmouth bass in river reaches with relatively high concentrations of adult smallmouth bass. Northern pike were also removed during Surge passes, and so results from these additional removal passes are accounted for in the following paragraphs.

CPW and CSU performed main channel boat electrofishing from April 18 through June 29. CSU conducted the first electrofishing pass on the South Beach and Juniper reaches to complete effort required for the Colorado pikeminnow population estimate. This effort by CSU allowed CPW additional time to continue spring backwater netting efforts on the ascending limb of the hydrograph. CPW began mainstem electrofishing on May 1. CPW and CSU together completed from three to nine passes in each reach including: nine passes in South Beach, (CPW n=5, CSU n=4), seven passes in Little Yampa Canyon (CSU n=7), seven passes in Juniper (CPW n=3, CSU n=4), six passes in Upper Maybell (CPW n=6), five passes in Lower Maybell (CPW n=5), three passes in Sunbeam (CPW n=3), and five passes in Lily Park (CSU n=5).

Between RMs 134.2 and 50.5, crews conducted removal passes on each individual reach, although not every mile of river within a given reach was electrofished on every pass. Numbers of passes within reaches varied as hydrological conditions allowed to maximize capture efficiencies for target species, and to collect capture data for Colorado pikeminnow for generation of a population estimate; please see the 2018 Annual Report for Project #128 for a detailed analysis of Colorado pikeminnow data collected in the study area by both CPW and CSU.

Two, three-person electrofishing crews utilized jon boats with outboard jet units to perform sampling in the main channel. Each crew simultaneously sampled the left and right shorelines in a downstream direction using ETS electrofishing equipment. Island perimeters were also electrofished. No river segments were electrofished on consecutive days to allow for fish recovery and redistribution. A third chase boat was operated by two or three additional crew members to process fish captured. Electrofishing effort was recorded by reach sampled and by date. Water conductivity and temperature were recorded at the beginning of each sampling day.

Backwaters where CPW obtained permission to sample were also included within this sampling effort, when feasible. Crews sampled backwater areas along both sides of the river. A gill net was used with a block-and-shock technique. Backwater habitats were

sampled until the river receded and habitats were no longer accessible. Output power within backwaters was adjusted based upon changes in river conductivity. Additionally, output power was reduced during the boat approach to the blocked mouth. Both processes minimized the potential for electrofishing injuries to fish.

All fish captured were identified to species, measured for total length to the nearest millimeter, and weighed to the nearest gram. Bluehead sucker, flannelmouth sucker, roundtail chub, and Colorado pikeminnow captured were also scanned to determine the presence of PIT tags. PIT tag number was recorded and stored in the PIT tag reader for those fish encountered with PIT tags. Individuals without PIT tags were implanted with a new PIT tag following the appropriate protocol. Capture locations for these species was recorded to the nearest tenth of a river mile. UTM coordinates associated with capture locations were also recorded, when possible. All native species captured were released alive, immediately. Any native fish captured that was visibly stressed was not processed, but rather returned to the location of capture within the river immediately.

All nonnative fish collected, excluding salmonids and channel catfish, were lethally removed, and either provided to landowners and/or licensed anglers, or disposed of in a landfill. Northern pike and smallmouth bass collected were examined for the presence of Floy tags and fin clips. Floy tag number and color, and any fin clips were recorded. Nonnative species of unusual occurrence, i.e. walleye, burbot, grass carp, etc. that were collected had their otoliths extracted prior to disposal.

CPUE was reported in terms of the number of northern pike captured per electrofishing hour for the entire study area. In addition to overall CPUE, catch effort was reported for all seven river reaches within the study area. For these reaches, CPUE was split into four categories and reported for each pass. The four categories for which CPUE was reported were northern pike: (1) < 300mm tl, (2) ≥ 300mm tl, (3) ≥ 450mm tl, and (4) total number.

Results and Discussion

Early Spring Backwater Gill Netting

Backwater netting began with early spring runoff, once backwaters were inundated or connected to the main channel. In 2018, netting commenced on March 26 and ended on April 27, when efforts were exchanged to meet mainstem electrofishing obligations.

Sixteen gill nets were set in 13 different backwaters (Figure 2). Two nets were set in each of the three largest backwaters (Lower Carpenter, 151, and Weber) in order to maximize capture probability and to compensate for damage to the nets caused by rodents, drifting wood, and other debris. Overall, 538 fish were captured during spring backwater gill netting efforts (Table 1). Thirty-eight percent of those fish were comprised of northern pike, while white sucker accounted for 50% of the fish collected (Figure 3). The only native fish captured during spring backwater gill netting included one mountain whitefish. Crews removed 203 northern pike across five weeks of the spring backwater netting, compared to 140 northern pike removed during mainstem

electrofishing efforts from April 18 through June 29. In total, 343 northern pike were captured during all efforts, which is less than 60% of the total number of northern pike removed during spring backwater netting and electrofishing efforts in 2017 (n=613) and only 14% of the total number of northern pike removed in 2016 (n=1009) (Eyre 2017, Noble 2016). The continued yearly decrease in total northern pike captures since 2015, the first year in which large scale spring backwater netting effort began, is likely at least partially attributable to the effectiveness of spring backwater netting efforts at removing adult northern pike when they are concentrated in backwaters and in pre-spawn conditions.

Of the 203 northern pike captured during spring backwater netting, only 168 fish could be measured because 35 fish had been scavenged. One hundred sixty-five of the 168 (98%) measurable northern pike were adult fish exceeding 300mm tl (Figure 4). One hundred sixty-seven of the 168 measurable northern pike were identified to sex. Fifty-eight of the 167 (35%) northern pike were identified as mature females. Of the mature female northern pike handled, 76% (n=44) were captured in pre-spawning conditions (not ripe). Less than 20% (n=10) of northern pike collected were in spawning conditions (ripe with eggs), and ready to spawn. Only 7% (n=4) of mature female northern pike handled had spawned prior to capture by gill nets. Removing 93% of the mature female northern pike captured prior to spawning is encouraging, and reduces the annual cohort contributed to the Yampa River northern pike population.

Northern pike catch rate was variable depending on the backwater sampled (Figure 5). The highest observed catch rate was 1.79 northern pike per net-night at the Round Bottom backwater. The Round Bottom gill net was not set until April 3 because access to that backwater by boat was restricted due to low water. The least productive backwater was the Wyman backwater, with no northern pike captured. The Wyman backwater was only a small fraction in size in 2018 compared to previous years due to a newly built beaver dam. Since northern pike spawning habitat at the Wyman backwater was greatly reduced, gill net efforts were abandoned after five successive nights without any fish captured in that gill net. Crews instead tried using a fyke net at the Wyman backwater, but it was quickly destroyed by beavers.

General Overview-Mainstem Electrofishing and Backwater Block-and-Shock

A total of 25 different fish species, including catostomid hybrids, were captured within CPW study reaches (Table 2). Overall, from April 18 through June 29, 606.11 hours were expended by CPW and CSU electrofishing the study area (Table 3). Electrofishing effort in 2018 increased compared to 2017 when crews expended 549.05 hours. The largest amount of effort was completed by CSU in the Little Yampa Canyon reach (229.22 hours), while the Sunbeam reach (34.85 hours) received the least amount of attention. Although northern pike captures rates (discussed later in this report) are not typically high in the Little Yampa Canyon reach, total effort in that reach is high since CSU crews are also collecting data for a smallmouth bass population estimate.

Northern Pike

Population Overview and Size Structure

Northern pike were first captured by electrofishing on April 19, and were last captured using the same methodology on June 29 (Table 4). Crews were not able to continue electrofishing as late into the season in 2018 as 2017 due to an early drop in river flow (Figure 6). Overall, CPW and CSU captured 140 individual northern pike during electrofishing operations in 2018 (Tables 2 and 3). This was a substantial reduction compared to individual northern pike captured in 2017 (n=236) and 2016 (n=540) (Eyre 2017, Noble 2016). Reduced northern pike captures from 2017 to 2018 is likely not due to a shorter sampling season since total effort in 2018 (n=606.11 hours) increased from 2017 (n=549.05 hours). Rather, fewer northern pike captures in 2018 is likely a result of fewer northern pike in the system, which may be attributable to multiple upstream projects aimed at controlling and removing northern pike from the Yampa River system. These include efforts at Stagecoach Reservoir (CPW encouraging angler harvest of northern pike; CPW periodic removal of northern pike); Lake Catamount (CPW removal of northern pike); Yampa River Chuck Lewis State Wildlife Area (CPW stream rehabilitation to disadvantage northern pike); Elkhead Reservoir (Multiple partners and CPW install and maintain spillway net; CPW and CWCB angler harvest incentive tournament); and increased efforts by CPW to complete early spring backwater gill netting in the Yampa River.

The size structure of northern pike captured in 2018 was similar to northern pike captured in 2017. Adult northern pike ($\geq 300\text{mm}$ tl) represented 85.7% of the total northern pike catch in 2018, and 86.8% of the total northern pike catch in 2017 (Table 3, Figure 7). About half (54.3%) of northern pike encountered in 2018 were $\geq 450\text{mm}$ tl, again similar to 2017 (49.2%). The largest northern pike captured in 2018 was in Lily Park and measured 914mm tl. Twenty (14.3%) juvenile northern pike ($< 300\text{mm}$ tl) were collected in 2018, compared to 31 (13.1%) in 2017.

In previous years, northern pike were marked with Floy tags in upstream reservoirs, and also within the middle Yampa River to determine population abundance (mark-recapture). In 2018, no Floy tagged northern pike were captured. Northern pike recaptures have become increasingly rare since 2012 when the last northern pike population estimate was generated.

Catch Per Unit Effort (CPUE) and Concentration Areas

Northern pike catch per electrofishing hour (CPUE/catch rate) was calculated for each river reach (Table 3, Figure 8). Total catch rates were highest in Lily Park (0.68 northern pike/hour), South Beach (0.54 northern pike/hour), and Upper Maybell (0.45 northern pike/hour). Lily Park, South Beach, and Upper Maybell have consistently had the highest catch rates since 2016 (Figure 9). Little Yampa Canyon (0.07 northern pike/hour), Juniper (0.06 northern pike/hour), Lower Maybell (0.02 northern pike/hour) and Sunbeam (0.03 northern pike/hour) all had noticeably lower catch rates in 2018.

Total northern pike CPUE in Lily Park increased slightly from 0.66 northern pike/hour in 2017 to 0.68 northern pike/hour in 2018 (Figure 9). Northern pike CPUE also increased in Sunbeam from 2017 (0 northern pike/hour) to 2018 (0.03 northern pike/hour) although only one northern pike was collected in 2018. Total catch rates in all other reaches decreased from 2017 to 2018.

Combined electrofishing northern pike CPUE for all river reaches in 2018 was 0.23 northern pike/hour, the lowest catch rate since intensive, annual electrofishing in the study area began in 2004 (Figure 10). Figure 10 indicates a strong downward trend in overall northern pike CPUE from 2015 through 2018. As discussed earlier in this report, 2015 is when substantial spring backwater netting efforts started (although some experimental netting efforts occurred in 2014). CPUE alone is not a reliable estimation of abundance, but decreasing northern pike CPUE since the first year of spring backwater netting suggests these efforts (among others upstream and previously mentioned) have likely resulted in decreased electrofishing catch rates for northern pike over the past three years.

Northern pike distribution is not geographically uniform, which is why removal efforts are not constant in all river reaches. Specific types of habitat, mainly backwaters, tributary mouths, eddies and other slack water areas, generally hold more northern pike, and availability of these habitat types varies substantially between river reaches. Eighty-five percent (n=119 of 140) of northern pike captured by electrofishing were removed from the South Beach, Upper Maybell, and Lily Park reaches combined (Table 3, Figure 11). Eighty-three percent (n=195 of 236) of northern pike were removed from the same three reaches in 2017 (Eyre 2017).

Across the five reaches sampled by CPW (South Beach, Juniper, Upper Maybell, Lower Maybell, and Sunbeam), 33.8% (n=23 of 68) of northern pike captured in 2018 were encountered in backwaters. The South Beach and Upper Maybell reaches both contain backwaters that hold a high number of northern pike, contributing to proportionally higher catch rates in those reaches compared to Juniper, Lower Maybell, and Sunbeam (Table 3, Figures 8 and 11). The utility of targeting removal efforts in areas where northern pike concentrate most was balanced against various other goals of the field activities, including generating a population estimate for Colorado pikeminnow and removing smallmouth bass. Preferred habitat for both of these species often does not overlap with habitat preferred by northern pike. Therefore, CPW samples the entirety of each river reach and completes multiple passes in each reach, including reaches where we typically encounter fewer northern pike (Juniper, Lower Maybell, and Sunbeam).

Colorado Pikeminnow

No Colorado pikeminnow were captured by CPW in 2018 or 2017. In 2016, two Colorado pikeminnow were captured. The last year in which more than two Colorado pikeminnow were captured by CPW was 2011, when 36 fish were encountered

Roundtail Chub

A total of 29 roundtail chub were captured by CPW during electrofishing efforts in 2018 (Table 5). In 2017, 30 roundtail chub were captured; 33 roundtail chub were captured in 2016; and two roundtail chub were captured in 2015 (Figure 12). Of the 29 roundtail chub captured, six roundtail chub were encountered in the Juniper reach, four in the Upper Maybell reach, eleven in the Lower Maybell reach, and eight in the Sunbeam reach (Table 5 and Figure 13). Roundtail chub captured by CSU (Lily Park and Little Yampa Canyon) are not included in this report. In both 2018 and 2017, the majority of roundtail chub captured were smaller, younger fish, documenting successful recruitment and potentially reproduction of roundtail chub in the study area (Figure 12). Although captures of adult fish have decreased since 2016, increased encounters with younger roundtail chub suggests that recruitment may have increased. Multiple hydrological and ecological factors affect recruitment. Runoff in 2018 was below average and likely detrimental to roundtail chub recruitment with suboptimal habitat conditions available (Figure 6). Fewer northern pike captures may explain an increase in roundtail chub survival, and why more juvenile fish were captured in recent years.

Significant Work Outside of Scope of Work

3rd Annual Elkhead Reservoir Fishing Classic

The management goal of CPW within Elkhead Reservoir is to reduce populations of smallmouth bass and northern pike, and replace these species with those that are compatible (largemouth bass, black crappie, and bluegill) with native fish conservation and recovery efforts. Reducing smallmouth bass and northern pike from Elkhead Reservoir will minimize escapement risk and mitigate potential impacts on native fishes downstream. One tool used by CPW to disadvantage these two species is incentivized angler harvest.

Various methods can be used to incentivize harvest of a species; in the case of Elkhead Reservoir, and for the third year in a row, CPW has offered a free fishing tournament with valuable prizes awarded to anglers who harvest smallmouth bass and northern pike. The 2018 tournament was held from June 23 through July 1, which included nine days and two weekends. Across the tournament, 269 anglers removed 540 smallmouth bass (Figure 14) and 319 northern pike (Figure 15) from the reservoir. Angler participation and total harvest decreased in 2018 compared to the 2017 tournament, in which 332 anglers removed 963 smallmouth bass and 395 northern pike.

Figure 14 indicates a shift in the size classes of smallmouth bass most frequently caught by anglers from 2018 to 2017. In general, anglers caught more smallmouth bass in smaller size classes (younger fish) in 2018 when compared to 2017. Similarly, anglers caught more northern pike in smaller size classes in 2018 when compared to 2017 (Figure 15). These observations may be explained by two possibilities: 1) warmer water temperature in 2018 may have resulted in fish spawning earlier, and less larger fish available in the habitats targeted by anglers, and/or 2) smallmouth bass and northern pike may be displaying compensatory responses to increased angler harvest during and

beyond the fishing tournament.

In order to evaluate smallmouth bass harvest success as a result of the tournament, CPW conducted a smallmouth bass mark-recapture population estimate utilizing Chapman's modification of the Lincoln-Petersen estimator. Six hundred twenty-seven smallmouth bass ≥ 150 mm tl were collected, marked, and released prior to the tournament. Anglers' catch of smallmouth bass during the tournament was used as the recapture event to calculate the population estimate. In 2018, anglers harvested 413 smallmouth bass ≥ 150 mm tl during the tournament. Of those 413 harvested smallmouth bass, 91 were marked fish from the group of 627 smallmouth bass handled prior to the tournament. The adult (>150 mm tl) smallmouth bass population was estimated at 2,825 fish ± 469.2 (95% confidence interval). Anglers harvested approximately 14.6% of the adult smallmouth bass population (413 of an estimated population size of 2,825) in Elkhead Reservoir during the tournament. In 2017, anglers harvested an estimated 20.3% (727 of an estimated population size of 3,590) of the adult smallmouth bass population. Reduced angler harvest of smallmouth bass in 2018 compared to 2017 may be explained by decreased angler participation and tough fishing conditions as previously described. The 2018 average catch rates for smallmouth bass and northern pike were 0.49 and 0.29 fish per hour per angler, respectively.

Mark-recapture population estimates were also attempted to evaluate the success of angler harvest of northern pike. However, too few northern pike were captured during marking efforts to calculate a population estimate. Marking northern pike for a mark-recapture population estimate would likely be more productive if attempted just after ice-off. .

CPW personnel staffed the check-in station during the tournament, and any fish that were alive during check-in were euthanized. Cash awards, fishing gear, and other prizes were awarded to participating anglers. Anglers earned a tournament ticket for every smallmouth bass and northern pike they harvested. Biologists implanted internal PIT tags into one smallmouth bass and one northern pike in advance of the tournament with a plan to award cash prizes to anglers who caught those PIT tagged fish. Anglers did not catch the 2018 PIT tagged smallmouth bass or northern pike during the tournament, although the northern pike PIT tagged (and never captured) during the 2017 tournament was caught in 2018. Another angler turned in a northern pike containing a PIT tag associated with the 2016 tournament. Since neither 2018 PIT tagged fish were caught, a drawing for tournament tickets was held to give away those cash prizes. Cash awards were also provided to anglers who caught the most smallmouth bass and the most northern pike over the duration of the tournament. Fishing gear and other prizes were awarded to anglers daily for six categories, including the most smallmouth bass and northern pike harvested, and the smallest and largest smallmouth bass and northern pike harvested. Although angler participation was lower in 2018 compared to 2017, the tournament was well-received by both local anglers as well as those who traveled from the East Slope of Colorado to participate.

between 2004 and 2007. Thank you to Harry Crockett for reviewing and providing valuable feedback for drafts of this report. The author also appreciates the assistance of all CPW Area 6 personnel, CPW statewide aquatics personnel and personnel from CSU, USFWS and other government agencies who assisted during the field season and with administration of the project. The author recognizes Chris Smith, Tildon Jones, Cam Walford and John Hawkins for sharing and exchanging data. The contributions of Chris Smith and his crew during backwater netting are greatly appreciated.

Literature Cited:

Eyre, T. 2017. Middle Yampa River northern pike removal and evaluation. 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

Noble, C. 2016. Middle Yampa River northern pike removal and evaluation. Annual Report to the Colorado River Recovery and Implementation Program

Appendix: Tables and Figures

Table 1. A summary of the total number of individuals captured during spring backwater gill netting in the middle and Yampa River in 2018. Nonnatives that were lethally removed included northern pike, white sucker, black bullhead, black crappie, smallmouth bass, and white sucker hybrids.

Species	Number of Individuals Captured
Northern Pike	203
White Sucker	270
Black Bullhead	5
Black Crappie	2
Brown Trout	19
Rainbow Trout	31
Smallmouth Bass	3
Mountain Whitefish	1
White x Flannelmouth Hybrid	4
Total Number Individuals Captured	538

Table 2. A summary of the total number of individuals captured during electrofishing in the middle Yampa River in 2018. Nonnatives that were lethally removed included northern pike, smallmouth bass, black bullhead, black crappie, brook stickleback, creek chub, common carp, green sunfish, fathead minnow, plains killifish, sand shiner, white sucker, and white sucker hybrids.

Species	Number of Individuals Captured
Northern Pike	140 (CSU 72 + CPW 68)
Smallmouth Bass	3,279
Roundtail Chub	29
Black Bullhead	12
Black Crappie	86
Bluehead Sucker	77
Brook Stickleback	95
Brown Trout	121
Creek Chub	141
Cutthroat Trout	1
Common Carp	7
Green Sunfish	42
Flannelmouth Sucker	16
Fathead Minnow	209
Mottled Sculpin	5
Mountain Whitefish	78
Plains Killifish	2
Rainbow Trout	47
Rainbow Trout x Cutthroat Trout Hybrid	20
Redside Shiner	6
Sand Shiner	942
Speckled Dace	67
White Sucker	10,843
White Sucker x Bluehead Sucker Hybrid	24
White Sucker x Flannelmouth Sucker Hybrid	44
Total Individual Fish Processed	16,333

Table 3. The number of northern pike (NPK) captured for each river reach in the middle Yampa River study area along with total electrofishing effort (hour) and catch per unit effort (CPUE) in 2018. Each parameter by river reach is split further to show numbers for northern pike in three separate size categories: < 300 mm total length (tl), ≥ 300 mm tl, and ≥ 450 mm tl.

	South Beach	Little Yampa Canyon	Juniper	Upper Maybell	Lower Maybell	Sunbeam	Lily Park	Total: All Reaches
NPK Captured	56	15	4	34	1	1	29	140
< 300mm tl	14	5	0	1	0	0	0	20
≥ 300mm tl	42	10	4	33	1	1	29	120
≥ 450mm tl	19	2	3	24	0	0	28	76
Effort (hr.)	104.46	229.22	70.16	74.75	50.16	34.85	42.50	606.11
NPK CPUE	0.54	0.07	0.06	0.45	0.02	0.03	0.68	
< 300mm tl	0.13	0.02	0.00	0.01	0.00	0.00	0.00	
≥ 300mm tl	0.40	0.04	0.06	0.44	0.02	0.03	0.68	
≥ 450mm tl	0.18	0.01	0.04	0.32	0.00	0.00	0.66	

Table 4.

Middle Yampa River sampling season 2004 to 2018. 1st NPK Capture is the date for a given year when the first northern pike was captured by electrofishing. Last NPK Capture is the date for a given year when the last northern pike was captured by electrofishing. Start and end of smallmouth bass “Surge” effort indicates the starting date and ending date of electrofishing efforts targeting smallmouth bass habitat.

Year	Date of 1st NPK Capture	Date of Last NPK Capture	Start of Smallmouth Bass “Surge” Effort	End of Smallmouth Bass “Surge” Effort
2004	4/21/2004	7/8/2004		
2005	4/22/2005	7/21/2005		
2006	4/21/2006	7/4/2006		
2007	4/17/2007	6/30/2007		
2008	4/15/2008	7/15/2008		
2009	4/7/2009	7/14/2009		
2010	4/13/2010	7/11/2010	6/22/2010	7/11/2010
2011	4/26/2011	8/22/2011	7/14/2011	8/22/2011
2012	4/17/2012	6/19/2012	5/30/2012	6/19/2012
2013	4/18/2013	7/12/2013	6/13/2013	7/15/2013
2014	4/21/2014	7/24/2014	6/21/2014	7/24/2014
2015	5/5/2015	6/25/2015	6/22/2015	7/28/2015
2016	4/19/2016	7/28/2016	6/20/2016	7/29/2016
2017	4/12/2017	7/20/2017	6/27/2017	7/20/2017
2018	4/19/2018	6/28/2018	6/12/2018	6/29/2018

Table 5. Number of roundtail chub (RTC) capture events, number of roundtail chub >150 millimeter total length marked, and number of roundtail chub recaptures.

<u>River Reach</u>	<u>#RTC Capture Events</u>	<u>#RTC Marked</u>	<u>#RTC Recaptures</u>
South Beach	0	0	0
Juniper	6	1	0
Upper Maybell	4	2	0
Lower Maybell	11	6	1
Sunbeam	8	3	0
<u>Total</u>	29	10	4

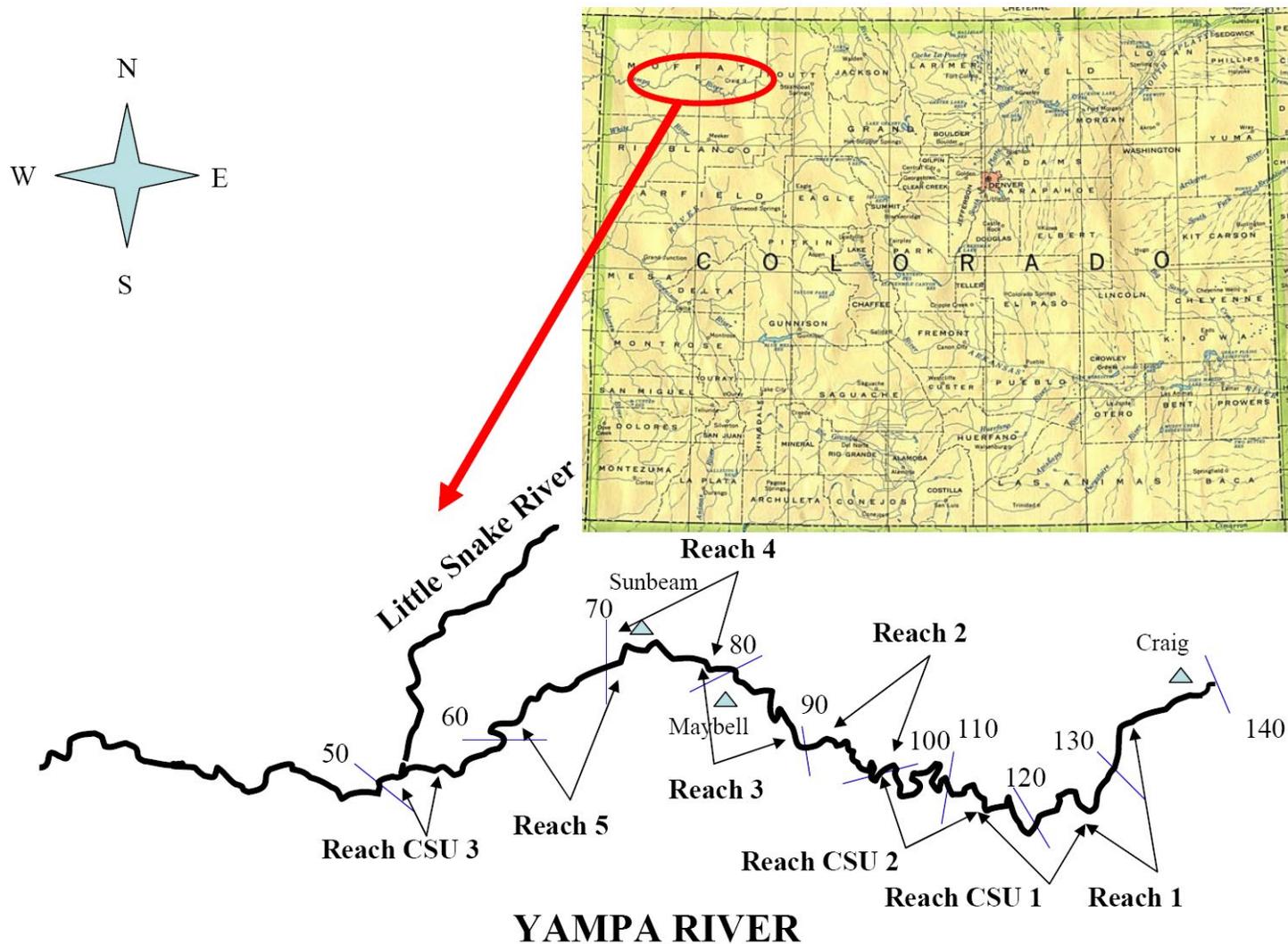


Figure 1. River reaches of the middle Yampa River sampled by Colorado Parks and Wildlife and Colorado State University (CSU). Reaches, upstream to downstream, include: Reach 1 (South Beach), Reach CSU 1 (Little Yampa Canyon), Reach CSU 2 (Little Yampa Canyon), Reach 2 (Juniper), Reach 3 (Upper Maybell), Reach 4 (Lower Maybell), Reach 5 (Sunbeam), and Reach CSU 3 (Lily Park) (Graphics courtesy of P. Martinez and R. Anderson)



Figure 2. Satellite image showing 13 spring backwater gill netting locations in 2018. Backwater gill netting locations are spread along the middle Yampa River between River Miles 169.2 and 122.5 (imagery courtesy of Google Earth).

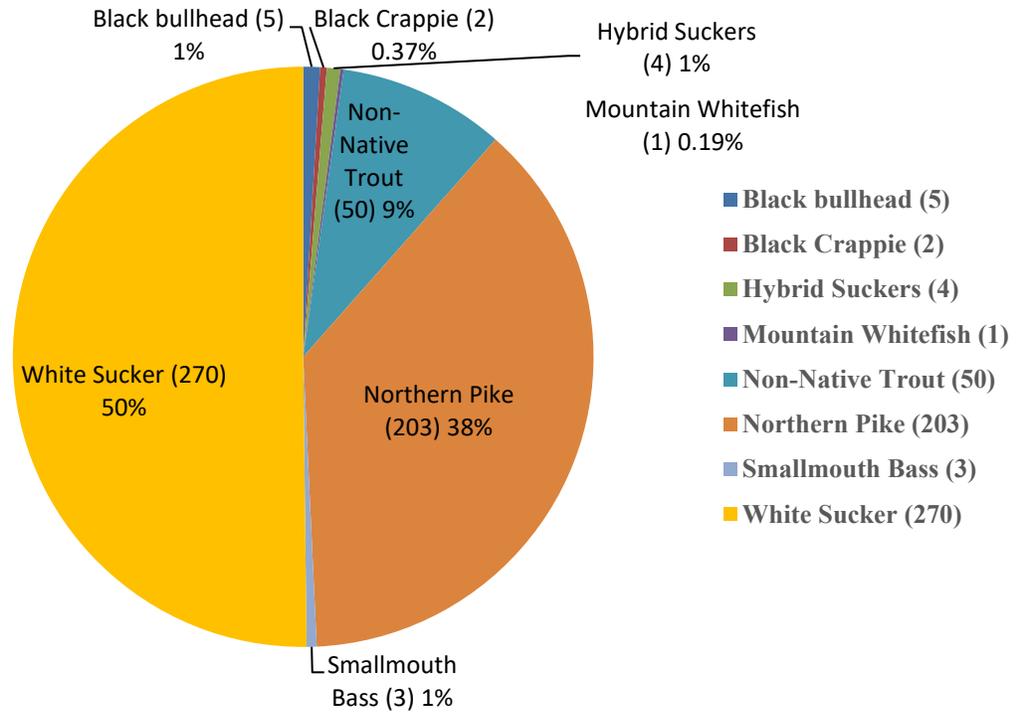


Figure 3. Relative abundance of fish captured during spring backwater gill netting in the middle and Yampa River in 2018. Nonnative trout species included rainbow and brown trout. Numbers in parentheses represent number of individuals by species captured.

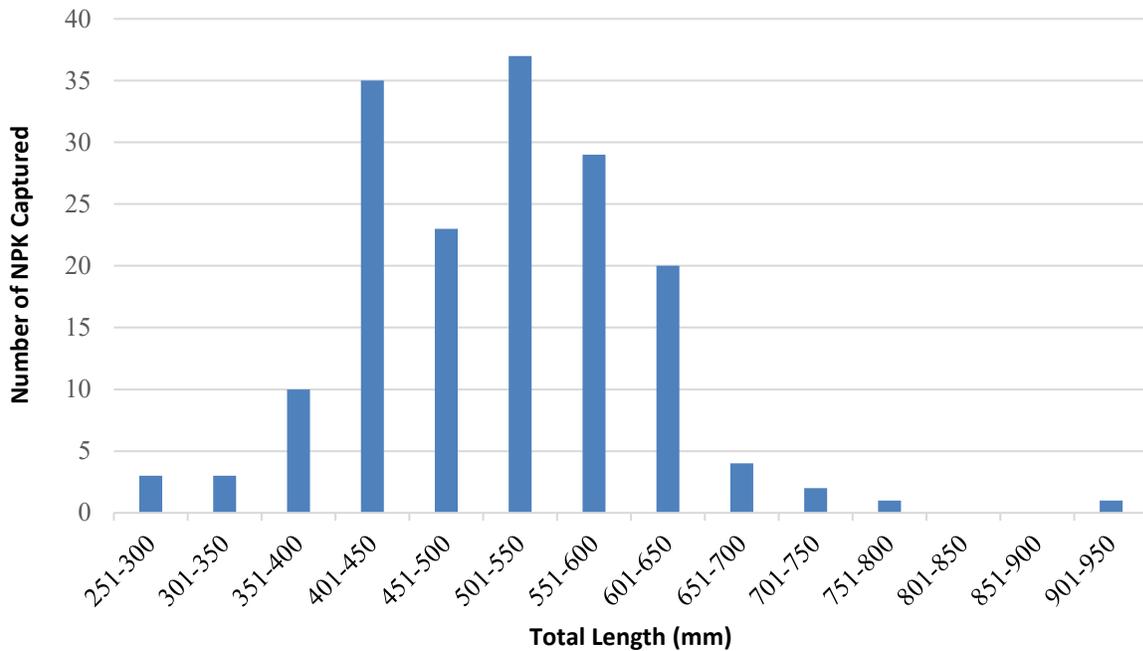


Figure 4. Northern pike (NPK) length frequency distribution in millimeters (mm) for fish captured during spring backwater gill netting in the middle Yampa River in 2018. An additional 35 northern pike captured could not be measured due to being scavenged while in the gill nets.

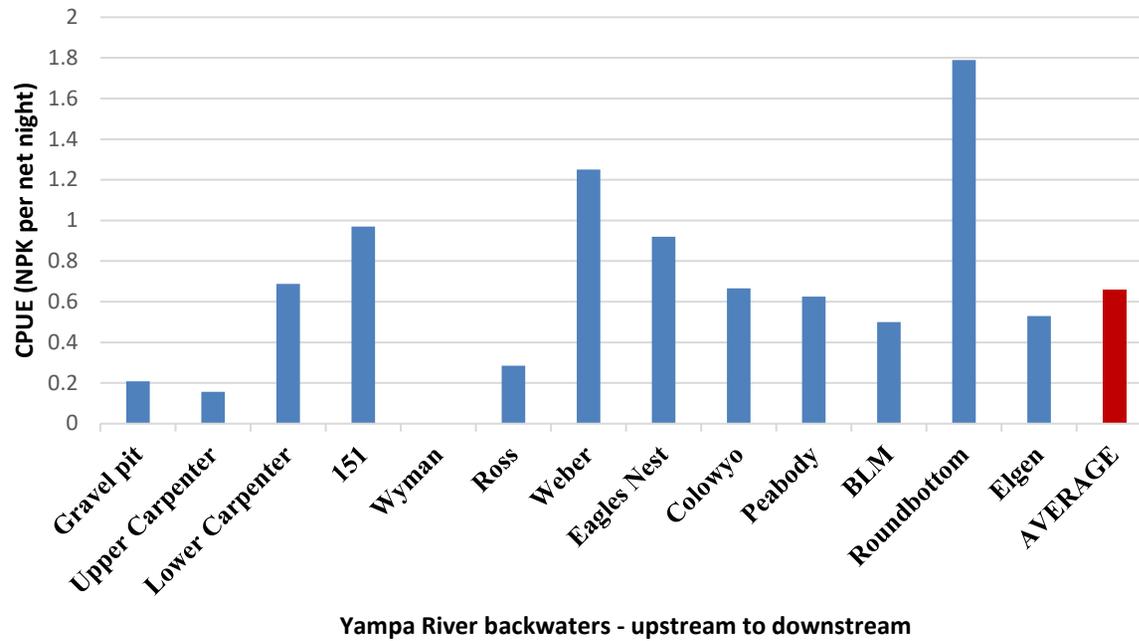


Figure 5. Northern pike (NPK) catch per unit effort (CPUE) by backwater (upstream to downstream) and the average CPUE across all backwaters during spring gill netting in the middle Yampa River in 2018.

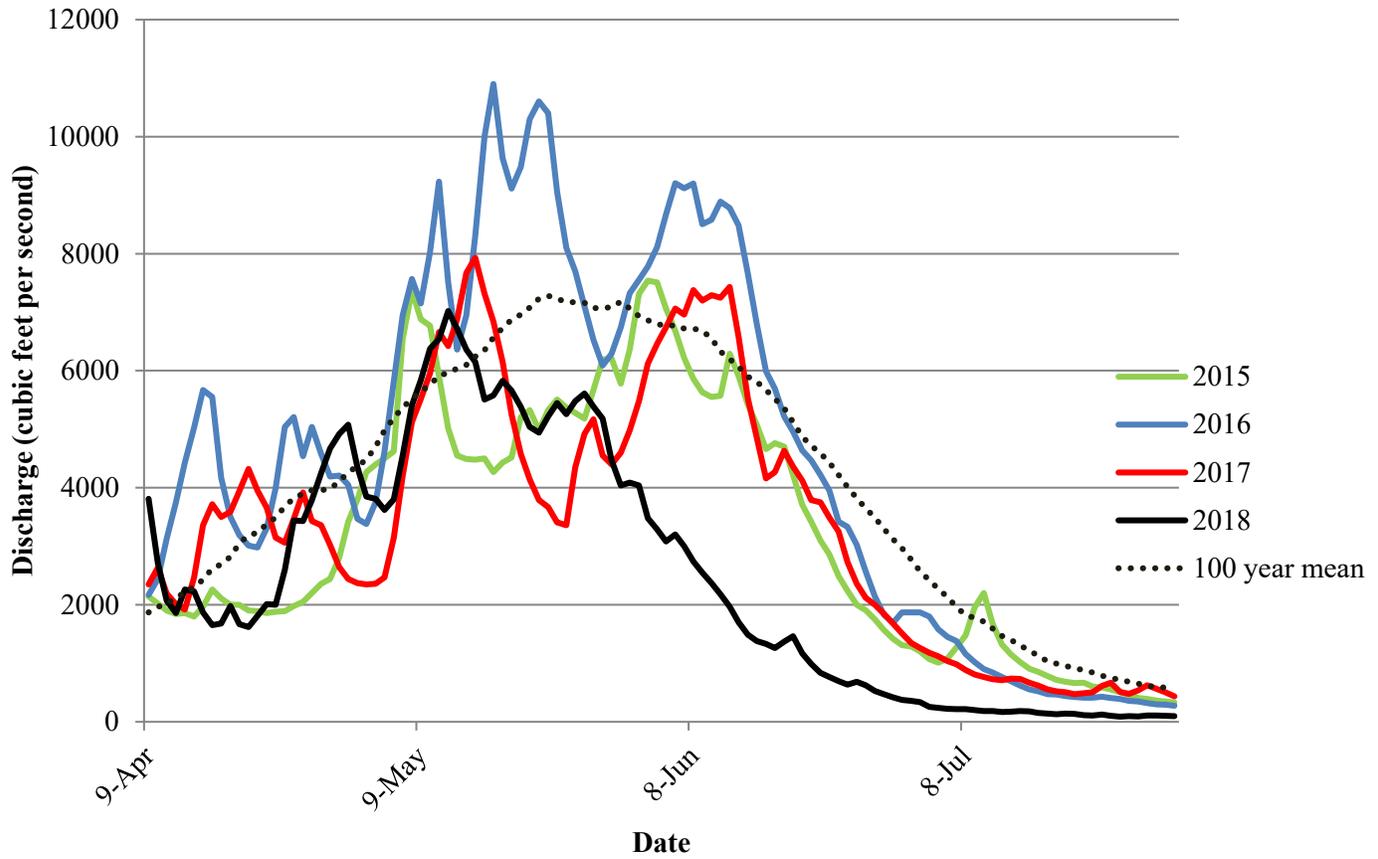


Figure 6. Mean daily discharge for the Yampa River at the United States Geological Survey Maybell gage station for 2015 to 2018 spring runoff. Dotted line represents the 100 year mean of daily mean discharge values. Peak runoff in 2018 occurred on May 12th (7,020 cfs) (Flow data courtesy of waterdata.usgs.gov).

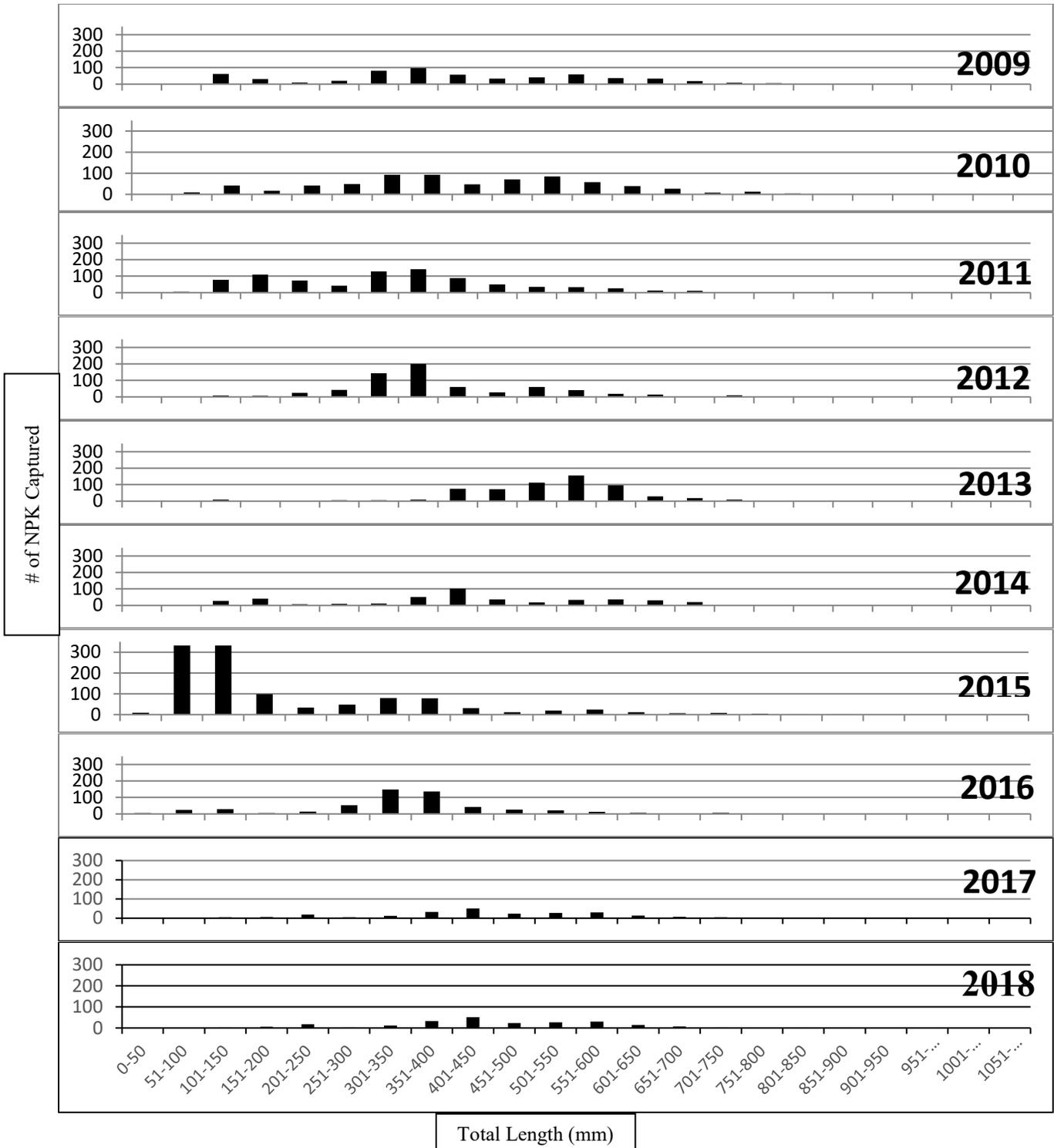


Figure 7. Length frequency histograms for northern pike (NPK) captured via electrofishing in the middle Yampa River, South Beach to Lily Park (RM 134.2-50.5), from 2009-2018.

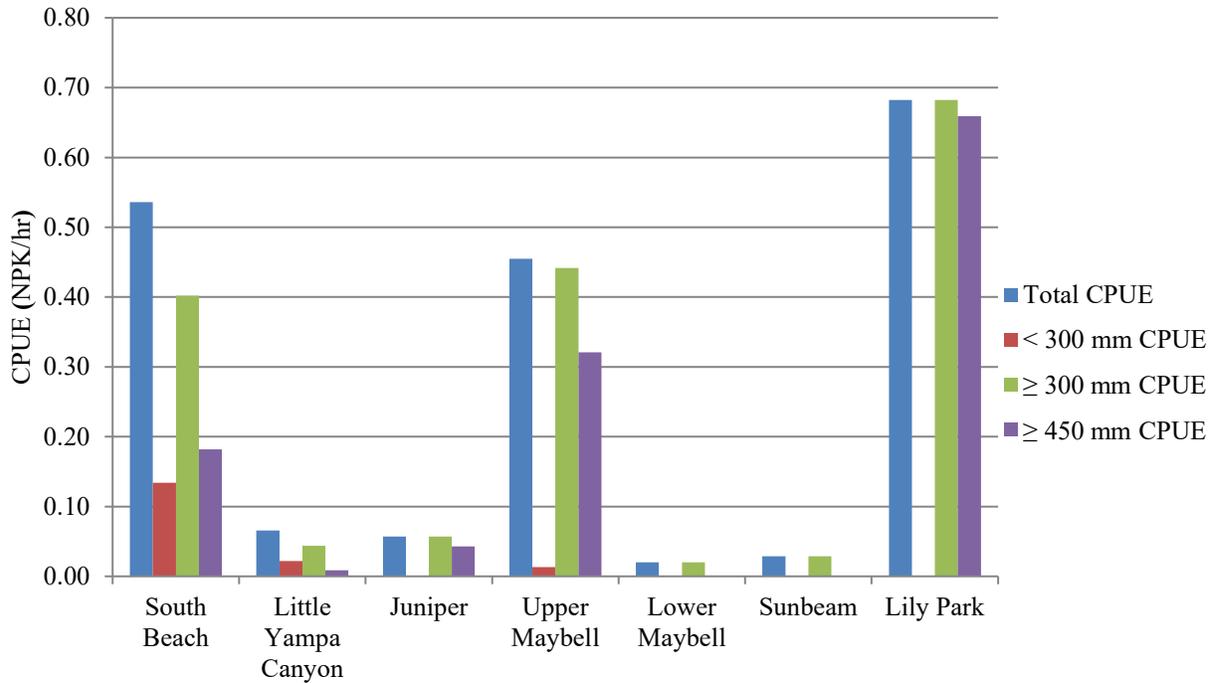


Figure 8. Total northern pike (NPK) catch per unit effort for electrofishing, and catch per unit effort (CPUE) for juvenile (<300mm tl) and adult (≥300mm tl and ≥450mm tl) by river reach in the middle Yampa River in 2018.

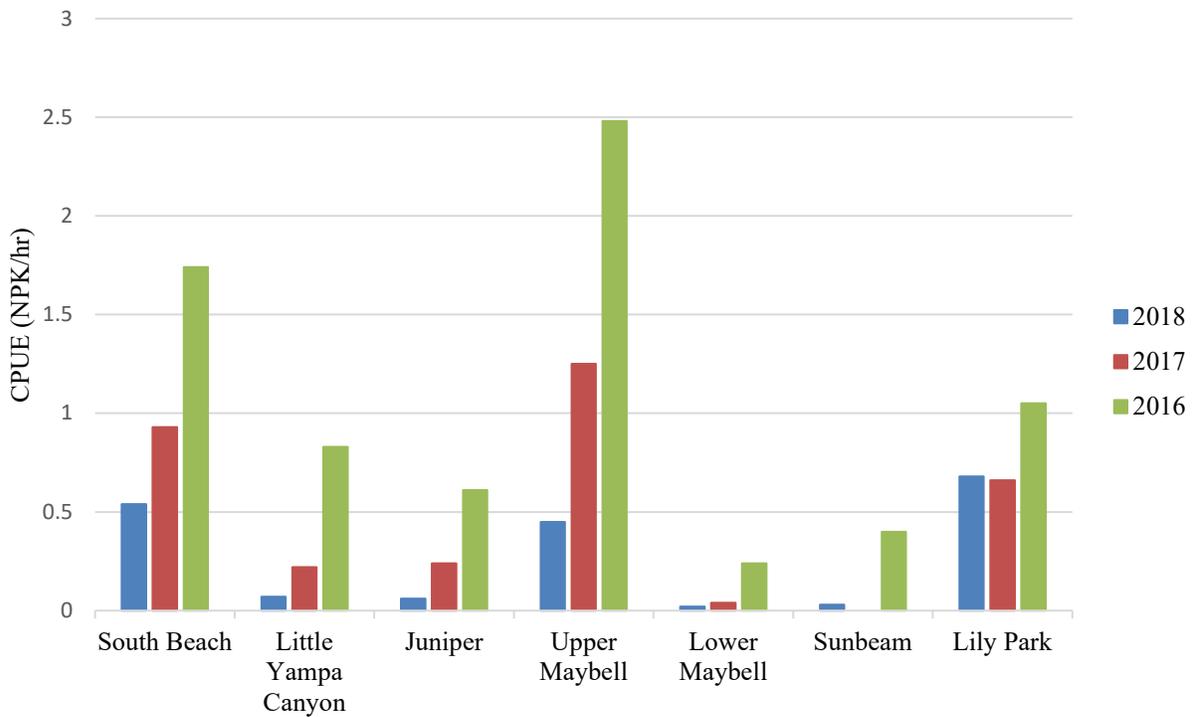


Figure 9. Total northern pike (NPK) catch per unit effort (CPUE) for electrofishing by river reach in the middle Yampa River 2016-2018. No northern pike were captured in the Sunbeam reach in 2017.

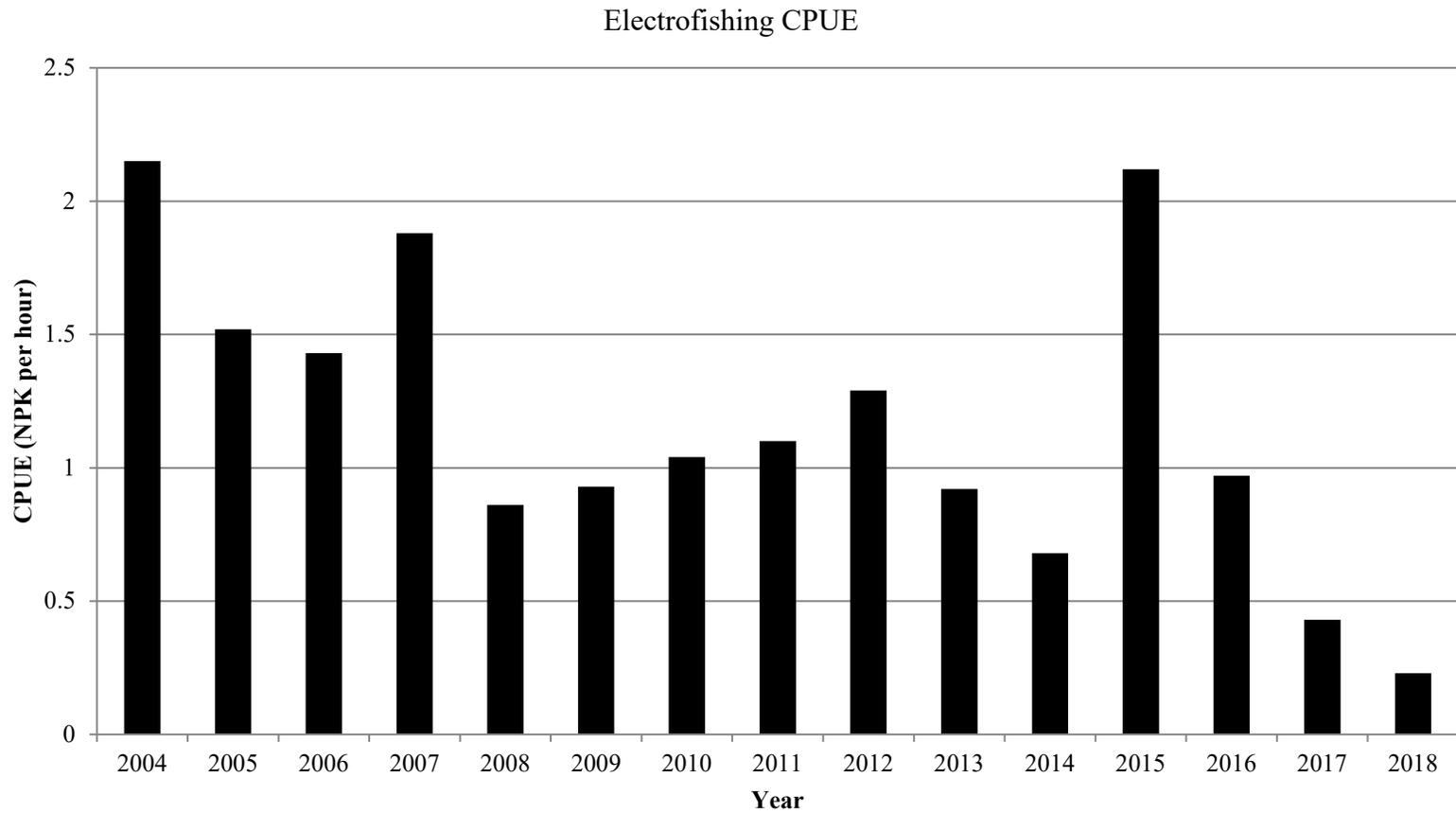


Figure 10. Northern pike (NPK) catch per unit of electrofishing effort (CPUE) across all passes in the study area of the middle Yampa River sampled by Colorado Parks and Wildlife and Colorado State University, from 2004 through 2018.

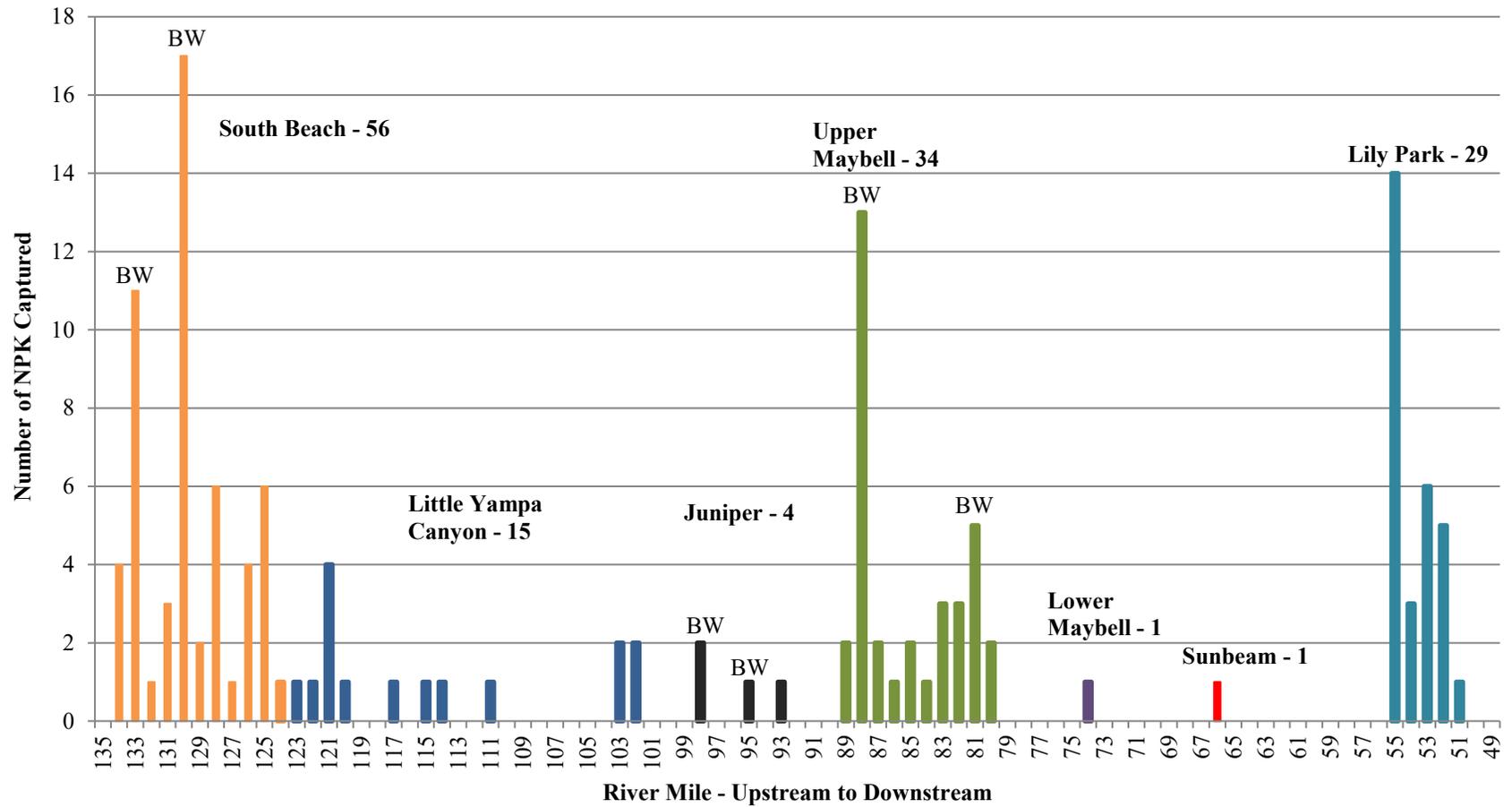


Figure 11. Number of northern pike (NPK) captured within each river mile of the middle Yampa River study area during 2018 electrofishing. Each color represents a different river reach (labeled above bars). Bars labeled above with “BW” indicate river miles containing backwaters. Only stations sampled by CPW have backwaters labelled.

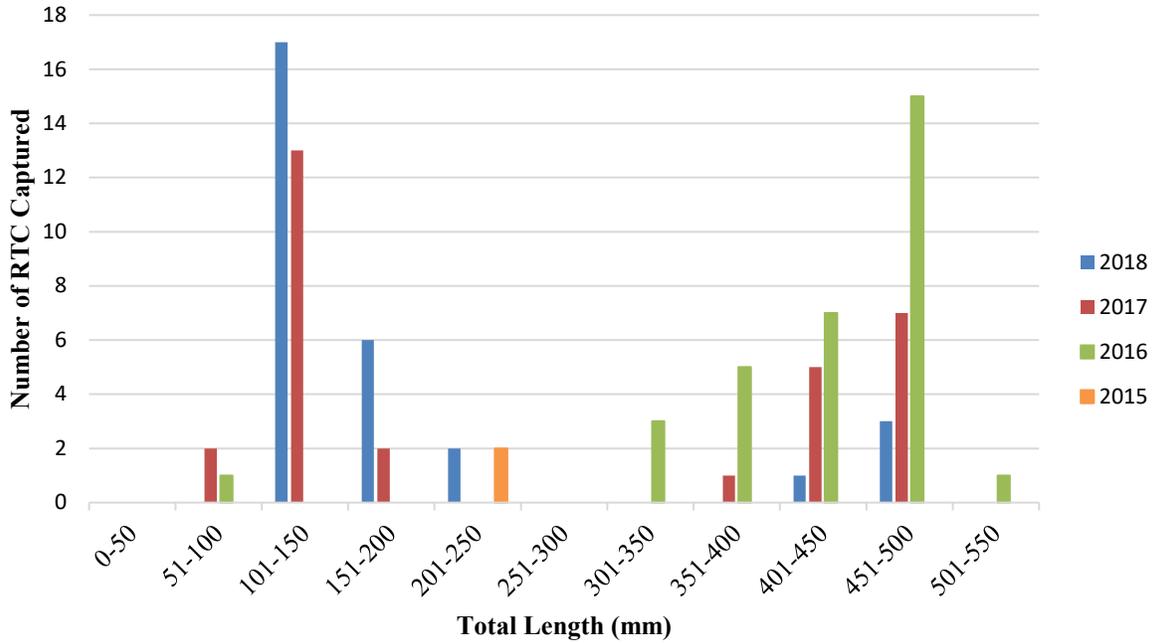


Figure 12. Roundtail chub (RTC) length frequency distribution in millimeters (mm) for the middle Yampa River study area between 2015 and 2018.

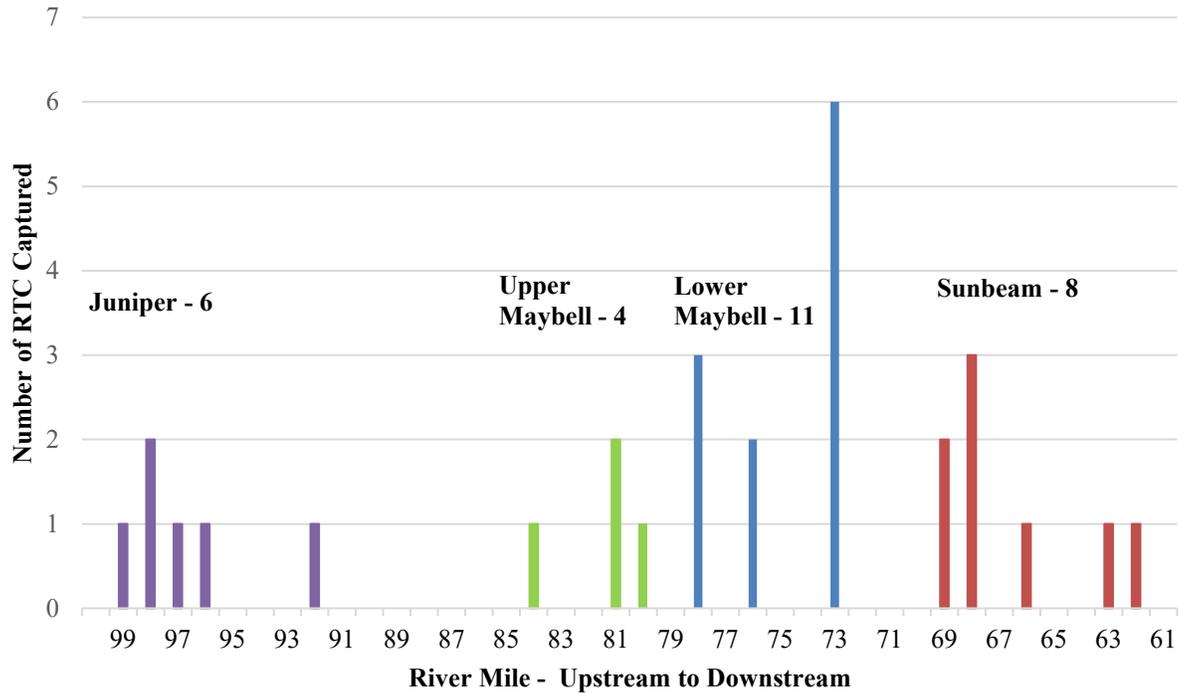


Figure 13. Roundtail chub (RTC) capture locations in the middle Yampa River study area in 2018. No roundtail chub were captured upstream of River Mile 99. Each color represents a different river reach (labeled above bars).

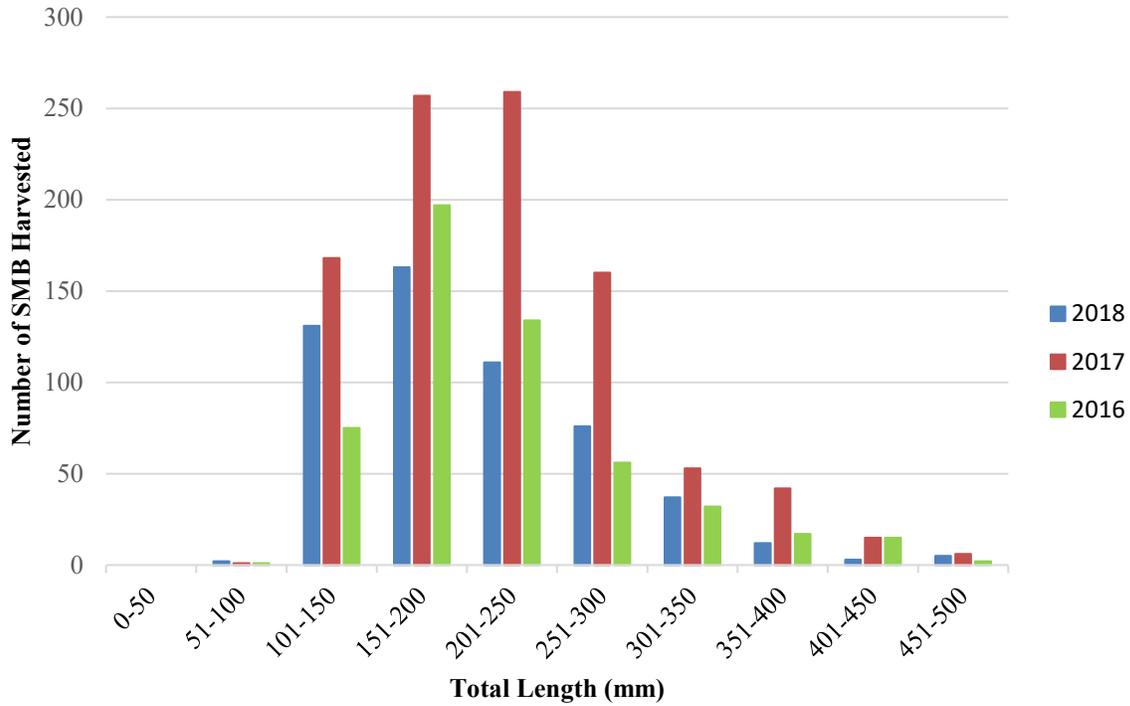


Figure 14. Length frequency distribution in millimeters (mm) for smallmouth bass (SMB) harvested by anglers during the 3rd Annual Elkhead Reservoir Fishing Classic in 2018 (n=540), 2017 (n=963) and 2016 (n=529).

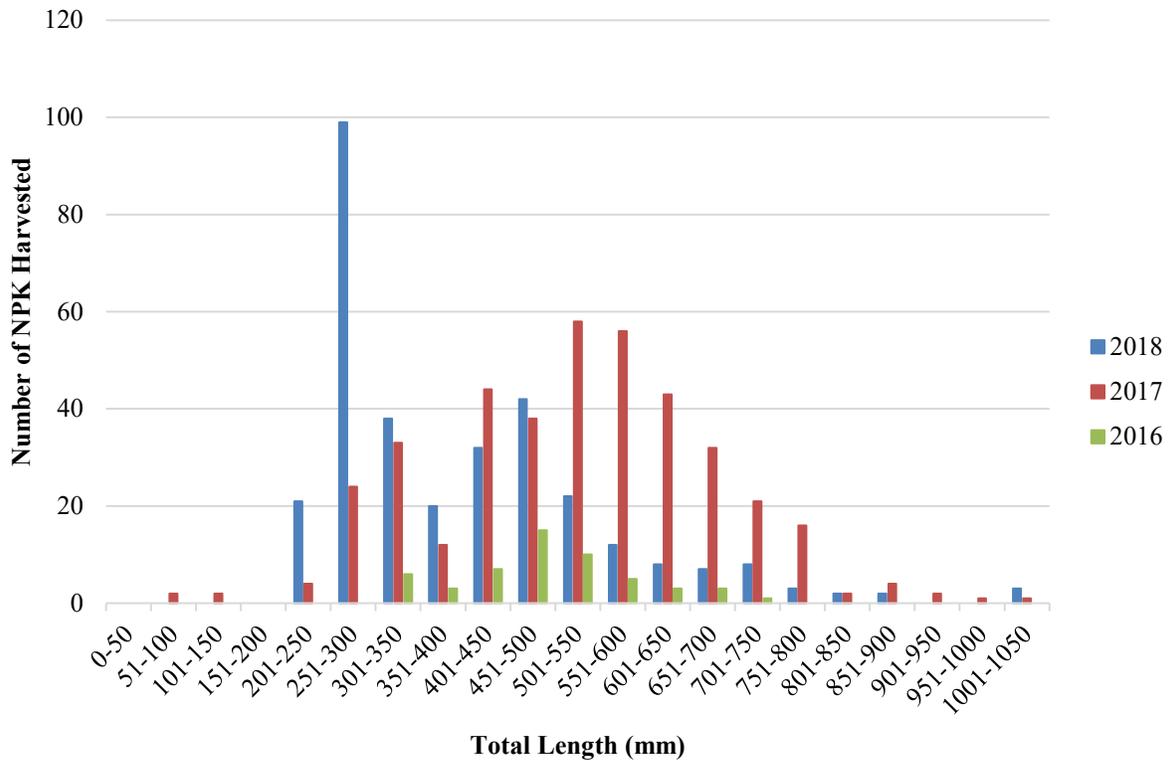


Figure 15. Length frequency distribution in millimeters (mm) for northern pike (NPK) harvested during the 3rd Annual Elkhead Reservoir Fishing Classic in 2018 (n=319), 2017 (n=395), and 2016 (n=53)