

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

II. Bureau of Reclamation Agreement Number(s): R17AP00301

Project/Grant Period: Start date (Mo/Day/Yr): September 22, 2017
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Is this the final report? Yes _____ No X

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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 2019 sampling season, 220 northern pike were removed by Colorado Parks and Wildlife (CPW) during early spring (April 3 through May 10) backwater gill netting efforts. CPW and Colorado State University (CSU) also removed 751 northern pike during electrofishing efforts which began April 17 and continued through August 12. Northern pike electrofishing catch rate was 1.21 fish/hour, which is an increase in catch rate compared to 2018 and reverses a trend of decreasing catch rate each year since 2015. Please see CSU's 2019 Annual Report for Project #125 for a detailed analysis of smallmouth bass 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. Accomplishment of FY 2019 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.

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 early April through the middle of May. The main channel, including backwater areas, was boat and raft electrofished utilizing block-and-shock techniques within backwaters from mid-April through much of August. Specific river segments sampled included: South Beach: RM 134.2 (South Beach launch) to RM 124.0 (Round Bottom), Juniper: RM 100.0 (upstream of 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). Approximately two miles of river within Juniper Canyon were not sampled, due to non-navigable riverine conditions.

CSU removed northern pike within additional stretches in conjunction with their smallmouth bass study; CPW did not work in these reaches. For example, CSU performs removal of northern pike in 24 miles of river through Little Yampa Canyon, RM 124.0 (Round Bottom) to RM 100.0 (near Government bridge) during their smallmouth bass removal work. 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 2019 Annual Report for Project #125.

Study Methods/Approach

April through early May: 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 April through early May (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 and thus reduce 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 from landowners, 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 the U.S. Fish and Wildlife Service (USFWS). Seventeen, standardized 1.5” mesh size gill nets, ranging from 50’ to 150’ in length, were set in 12 backwaters located between RMs 170.0 and 122.0. Between two and five gill nets were set in each of the two largest backwaters as river discharge fluctuated, increasing or decreasing the size of each backwater.

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 or at the completion of the project. Variable flows in 2019 caused some backwaters to fluctuate from being inundated to dry multiple times during the project. Some locations included continuous net sets for the duration of the project (April 3 – May 10), while other locations involved occasional net sets that were 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.

As part of a separate effort, northern pike were captured, tagged internally with passive integrated transponder (PIT) tags and externally with FLOY tags, and released into the Project #98b study area. This work was completed to calculate a mark-recapture population estimate, prior to our backwater gill netting project. As part of the gill netting project, all fish captured were identified to species, measured for total length (tl) to the nearest millimeter (mm), and weighed to the nearest gram (g). Northern pike were also scanned to determine the presence of PIT tags and visually checked for an external FLOY tag as part of the population estimate study. PIT tag number was recorded and stored in the PIT tag reader for those fish encountered with PIT tags and FLOY tag color and number were recorded on the data sheet for fish encountered with FLOY tags. Results of the mark-recapture population estimate are still pending and will be provided by CSU sometime in 2020.

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 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 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. 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 Mid-August: Mainstem Electrofishing and Backwater Block-and-Shock

Main channel electrofishing and block-and-shock techniques in backwaters to target northern pike and smallmouth bass were the focus of the sampling effort that began April 17 and continued through August 12. Efforts after July 11 and continuing through August 12 (the Surge) were similar, but primarily targeted smallmouth bass. CPW, CSU, and the USFWS 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; results from these additional removal passes are accounted for in the following paragraphs.

CSU conducted the first electrofishing pass on the South Beach and Juniper reaches, which allowed CPW additional time to continue spring backwater netting efforts on the ascending limb of the hydrograph. CPW began mainstem electrofishing on May 9. CPW and CSU together completed from two to eleven passes in each reach including: eleven passes in South Beach, (CPW n=5, CSU n=6), ten passes in Little Yampa Canyon (CSU n=10), nine passes in Juniper (CPW n=5, CSU n=4), eight passes in Upper Maybell (CPW n=5, CSU n=3), four passes in Lower Maybell (CPW n=4), two passes in Sunbeam (CPW n=2), 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.

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, habitat type (main channel or backwater), 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 tl to the nearest mm, and weighed to the nearest g. 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 were 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 collected were scanned to determine the presence of PIT tags and examined for FLOY tags. Smallmouth bass collected were examined for the presence of FLOY tags and fin clips. PIT tag number, 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 included northern pike: (1) < 300mm tl, (2) \geq 300mm tl, (3) \geq 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. Backwater netting effort in the upstream portion of the project from Hayden to Craig was postponed for one week while the USFWS conducted a marking pass to tag northern pike for a population estimate. Additionally, cold spring weather delayed snowmelt and navigable river conditions, meaning the USFWS service could not start a marking pass for northern pike as early as anticipated. Overall, 2019 netting efforts from Hayden to Craig commenced 15 days later than 2018 netting efforts (Eyre 2018). Netting commenced on April 3 (April 11 for upstream locations) and ended on May 10, when efforts were exchanged to meet mainstem electrofishing obligations.

Seventeen gill nets were set in 12 different backwaters (Figure 2). Two to five nets were set in each of the two largest backwaters (Lower Carpenter 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, 705 fish were captured during spring backwater gill netting efforts (Table 1). Thirty one percent of those fish were comprised of northern pike, while white sucker accounted for 61.5% of the fish collected (Figure 3). The only native fish captured during spring backwater gill netting included one flannelmouth sucker and three mountain whitefish. Crews removed 220 northern pike across six weeks of the spring backwater netting.

Of the 220 northern pike captured during spring backwater netting, only 175 fish could be measured because 45 fish had been scavenged. All measurable northern pike were adult fish exceeding 300mm tl (Figure 4). One hundred and seventy two of the 175 measurable northern pike were identified by sex. Seventy nine of the 175 (45%) northern pike were identified as mature females. Of the mature female northern pike handled, 62% (n=49) were captured in pre-spawning conditions (not ripe). Twenty seven percent (n=21) of northern pike collected were in spawning conditions (ripe with eggs), and ready to spawn. Only 6% (n=5) of mature female northern pike handled had spawned prior to capture by gill nets. An additional four female northern pike were captured, identified as females, but sexual condition was not recorded. Northern pike spawning activity spanned the entirety of the backwater netting project. The first ripe female northern pike was captured on April 5, only two days after the project started. The last ripe female captured was encountered on May 3 and green females were encountered until May 5.

Northern pike catch rate was variable depending on the backwater sampled (Figure 5). The highest observed catch rate was 3.71 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, causing unsafe boating conditions. The gill net at the Round Bottom backwater was pulled on April 19 because the upper end of the backwater connected to the main channel, creating a flowing side channel. The least productive backwater was the Wyman backwater, with 0.18 northern pike per net-night. Beavers constructed a dam across most of the Wyman backwater in 2018 which excluded fish at low flows in 2019.

On average, 0.82 northern pike were captured per net-night during the backwater netting project in 2019, an increase compared to 2018. In 2018, 0.66 northern pike on average were captured per net-night (Eyre 2018). Increased catch rate in 2019 during the backwater netting project is consistent with increased catch rates observed during mainstem electrofishing efforts discussed later in this report.

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

A total of 25 different fish species, including catostomid hybrids, were captured by CPW during mainstem electrofishing and using backwater block-and-shock techniques (Table 2). Overall, from April 18 through June 29, 622.9 hours were expended by CPW and CSU electrofishing the study area (Table 3). Electrofishing effort in 2019 increased compared to 2018 when crews expended 606.11 hours (Eyre 2018). The largest amount of effort was completed by CSU in the largest sampling reach of Little Yampa Canyon

(264.8 hours), while the Sunbeam reach (21.9 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 also collect data to generate a smallmouth bass population estimate.

Northern Pike

Population Overview and Size Structure

Overall, CPW and CSU captured 751 individual northern pike during electrofishing operations in 2019 (Tables 2 and 3). This was a substantial increase compared to individual northern pike captured in 2018 (n=140) and 2017 (n=236) (Eyre 2018, Eyre 2017).

The majority (60%) of northern pike captured in 2019 were juvenile fish less than 300mm tl (Table 3, Figure 6). In 2018, only 14% of the total northern pike catch consisted of juvenile fish (Eyre 2018). Considerably more juvenile northern pike were captured in 2019 than recent years. Although more northern pike were captured in all size categories in 2019 compared to 2018, the drastic increase in 2019 total catch is largely a result of increased captures of juvenile fish. Adult northern pike ($\geq 300\text{mm tl}$) represented 40% of the total northern pike catch in 2019. Only 14% of northern pike encountered in 2019 qualified as piscivores ($\geq 450\text{mm tl}$).

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 7). Total catch rates were highest in South Beach (2.52 northern pike/hour), Upper Maybell (1.36 northern pike/hour), and Little Yampa Canyon (1.19 northern pike/hour). Juniper (0.76 northern pike/hour), Lily Park (0.66 northern pike/hour), Lower Maybell (0.43 northern pike/hour) and Sunbeam (0.05 northern pike/hour) all had noticeably low catch rates, compared to the other reaches sampled. Catch rate increased considerably in the South Beach, Little Yampa Canyon, Juniper, and Lower Maybell reaches in 2019 compared to 2018 and 2017 (Figure 8). The only reach where catch rate decreased from 2018 to 2019 was Lily Park, which is the most downstream reach in the project area. Catch rate at the second most downstream reach, Sunbeam, increased modestly compared to 2018.

Combined electrofishing northern pike CPUE for all river reaches in 2019 was 1.21 northern pike/hour, the highest catch rate since 2015 (Figure 9). This increase in northern pike catch rate reverses a strong downward trend in overall northern pike CPUE from 2015 through 2018. The increased catch rate in 2019 for northern pike is largely due to an increase in numbers of juvenile ($\leq 300\text{mm tl}$) captures in the three most upstream reaches (South Beach, Little Yampa Canyon, Juniper) toward the end of the electrofishing season in August (Figures 10,11,12).

The increase in number of northern pike caught as well as the northern pike catch rate in 2019 is of concern. As noted previously, most of the northern pike captured were juvenile fish in the upstream portion of the study area. Similar to 2019, a large cohort of juvenile northern pike was also observed in 2015 (Figure 6). This cohort progressed in size each year since 2015, but appeared to be more susceptible to annual capture efforts as the fish grew larger. By 2017, this initially large cohort of fish had been effectively reduced in size, with captures of fewer adult fish ($\geq 300\text{mm}$ tl). As northern pike from the 2019 cohort recruit into larger size classes, these fish should also be more susceptible to both backwater netting and electrofishing removal efforts. Future removal efforts should focus on targeting the large 2019 juvenile northern pike cohort in known concentration areas within the upstream three reaches of the study area.

Explaining why crews captured a noticeably larger cohort of juvenile northern pike in 2019 is complex and influenced by multiple factors. Spawning success and young-of-year recruitment increased in 2019 compared to recent years. The magnitude and duration of runoff in the Yampa River was well above average in 2019, resulting in increased habitat available for spawning (Figure 13). Above average discharge in April and early May, when northern pike are spawning, created additional shallow, low velocity areas which northern pike utilize. Crews targeted all known spawning hot spots that were accessible during the backwater netting season, but with additional spawning habitat present overall, a smaller proportion of available habitat was targeted with netting efforts.

As mentioned previously, favorable river conditions allowed crews to continue electrofishing until August 12, 2019, much later than in 2018 (June 29) and 2017 (July 20) (Eyre 2018, Eyre 2017). Juvenile northern pike are encountered most frequently after runoff for multiple reasons. Water clarity increases, making smaller fish more visible. Also, since northern pike continue to grow throughout the year, these fish are larger and more susceptible to electrofishing late in the season. The large number of juvenile northern pike captured in 2019 is partially explained by favorable electrofishing conditions and an increased timeframe in which crews were able to exploit these fish.

Northern pike distribution is not geographically uniform, which is why electrofishing and block-and-shock 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 and temporally between river reaches. Across the five reaches sampled by CPW (South Beach, Juniper, Upper Maybell, Lower Maybell, and Sunbeam), 37.4% ($n=52$ of 139) of northern pike captured in 2019 were encountered in backwaters. The South Beach and Upper Maybell reaches both contain backwaters that hold a large number of northern pike, contributing to proportionally higher catch rates in those reaches compared to Juniper, Lower Maybell, and Sunbeam reaches (Table 3, Figures 8 and 14). The utility of targeting removal efforts in areas where northern pike concentrate most was balanced against various other goals of our field activities, including removing smallmouth bass. Preferred habitat for smallmouth bass often does not overlap with habitat preferred by northern pike.

Colorado Pikeminnow

Colorado pikeminnow were not captured by CPW in 2019, 2018, nor 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 12 roundtail chub and no juveniles (<150mm tl) were captured by CPW during electrofishing efforts (Table 4, Figure 15). Overall, this is the fewest number of roundtail chub captured across the past four years (Figure 15). Of the 12 roundtail chub captured, one roundtail chub was encountered in the Upper Maybell reach, four in the Lower Maybell reach, and seven in the Sunbeam reach (Table 5 and Figure 16). Since 2017, the majority of roundtail chub captured were younger fish ($\leq 300\text{mm tl}$). Unfavorable habitat conditions associated with below average river discharge in 2018 likely impacted roundtail chub spawning and recruitment success, at least partially explaining why crews did not capture juvenile roundtail chub \leq in 2019 (Figure 13).

Significant Work Outside of Scope of Work

4th 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 fourth 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 2019 tournament was held from June 22 through June 30, which included nine days and two weekends. Across the tournament, 270 anglers removed 492 smallmouth bass (Figure 17) and 419 northern pike (Figure 18) from the reservoir. Angler participation and total harvest decreased in 2019 compared to the 2018 tournament, in which 269 anglers removed 540 smallmouth bass and 319 northern pike.

In order to evaluate smallmouth bass and northern pike harvest success as a result of the tournament, CPW conducted a mark-recapture population estimate for adults of both species, utilizing Chapman's modification of the Lincoln-Petersen estimator. The first Elkhead Reservoir Fishing Classic was held in 2016, but population estimates were not generated until 2017, and then, only for smallmouth bass. The first year in which a population estimate was generated for northern pike was 2019, when biologists were able

to capture and mark enough fish prior to the fishing tournament.

Anglers have reduced the adult smallmouth bass ($\geq 150\text{mm}$ tl) population in Elkhead Reservoir from an estimated 3,590 \pm 721 (95% confidence interval) fish prior to the 2017 tournament to an estimated 1,883 \pm 533 (95% confidence interval) fish after angler harvest efforts of the 2019 tournament (Figure 19). In 2019, 335 adult northern pike ($\geq 300\text{mm}$ tl) were marked prior to the tournament. During the 2019 tournament, 284 adult northern pike were turned in by anglers, of which 27 had been marked before the tournament. The adult population was estimated at 3,419 \pm 1,131 (95% confidence interval) northern pike prior to the tournament, and 3,135 \pm 1,131 (95% confidence interval) after anglers harvested 284 fish during the tournament (Figure 20).

In 2019, anglers were most effective at catching adult smallmouth bass ($\geq 150\text{mm}$ tl), which is consistent with all tournaments prior to 2019 (Figure 17). The most frequent size class of northern pike caught by anglers in 2019 was between 301mm and 350mm tl. (Figure 18). The most common northern pike size class caught by anglers has varied over the years. These changes may be reflected by anglers targeting fish of specific sizes, as well as environmental factors such as weather and water temperature that may affect angler success.

Cash awards, fishing gear, and other prizes were provided as part of a program with the Colorado Water Conservation Board. Anglers also 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 2019 PIT tagged smallmouth bass, but did successfully catch the 2019 PIT tagged northern pike during the tournament. Additionally a smallmouth bass PIT tagged and never captured during the 2018 tournament was caught in 2019. Another angler turned in a northern pike containing a PIT tag associated with the 2016 tournament. Since the 2019 PIT tagged smallmouth bass was not caught, a drawing was held to give away that cash prize. 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. Overall, the tournament was well-received by both local anglers as well as those who traveled from the East Slope of Colorado to participate.

VIII. Additional Noteworthy Observations:

One yellow perch was captured in the Elgen backwater while electrofishing the mainstem Yampa River. This is the first year that a yellow perch was encountered by CPW in the Project #98a study area.

IX. Recommendations:

Continue the spring backwater gill netting effort as early as water conditions allow, and as long

as possible before in channel electrofishing obligations must be met. Consider using backwater netting and main channel electrofishing simultaneously in early May when manpower is sufficient.

- A. Continue contacts and sharing of information with Yampa River landowners and stakeholders before, during, and after the study.
- B. Consider shifting mainstem electrofishing efforts in 2020 to target known northern pike hot spots within certain reaches more frequently, in hopes of reducing the large juvenile northern pike cohort observed in 2019.

X. Project Status:

This project is considered on track, with minor revisions to be considered. Additional evaluation of project commitments and efforts will be made internally by CPW in 2019. Additional refinement of the techniques used in the study is appropriate and will serve to further increase the efficiency of removal effort.

XI. FY 2019 Budget Status:

- A. Funds Provided: \$245,630 for all projects: 98a, 126b/167b, 128
- B. Funds Expended: \$150,891 for all projects
- C. Difference: \$94,739. Funds expended includes expenditures through September 30th, 2019. Additional expenditures occurred after that time period and will occur in 2019.
- D. Percent of the FY 2019 work completed, and projected costs to complete: 100%
- E. Recovery Program funds spent for publication charges: \$0

XII. Status of Data Submission: Data for Colorado pikeminnow collected by CPW will be provided to the USFWS database manager by March 1, 2019.

XIII. Signed: Tory Eyre 11/15/2019
Principal Investigator Date

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Literature Cited:

Eyre, T. 2018. Middle Yampa River northern pike removal and evaluation. Annual Report to the Colorado River Recovery and Implementation Program

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

Appendix: Tables and Figures

Table 1. A summary of the total number of individuals captured during spring backwater gill netting in the middle Yampa River in 2019. Nonnative fish 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	220
White Sucker	432
Brown Trout	14
Flannelmouth Sucker	1
Rainbow Trout	25
Rainbow Trout x Cutthroat Trout Hybrid	1
Smallmouth Bass	1
Mountain Whitefish	3
White x Bluehead Hybrid	2
White x Flannelmouth Hybrid	3
Total Number Individuals Captured	702

Table 2. A summary of the total number of individuals captured during electrofishing in the middle Yampa River in 2019. Nonnative fish 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	751 (CSU 612 + CPW 139)
Smallmouth Bass	954
Roundtail Chub	12
Black Bullhead	12
Black Crappie	5
Bluehead Sucker	24
Brook Stickleback	11
Brown Trout	122
Creek Chub	109
Cutthroat Trout	1
Common Carp	1
Green Sunfish	23
Flannelmouth Sucker	6
Fathead Minnow	48
Mountain Whitefish	6
Plains Killifish	3
Rainbow Trout	40
Rainbow Trout x Cutthroat Trout Hybrid	3
Redside Shiner	1
Sand Shiner	309
Speckled Dace	5
White Sucker	10,382
White Sucker x Bluehead Sucker Hybrid	15
White Sucker x Flannelmouth Sucker Hybrid	25
Yellow Perch	1
Total Individual Fish Processed	12,869

Table 3. The number of northern pike (NPK) captured during electrofishing for each river reach in the middle Yampa River study area along with total electrofishing effort (hour) and catch-per-unit-effort (CPUE) in 2019. Each parameter by river reach is split further to show numbers for northern pike in three separate size categories: < 300millimeter (mm) total length (tl), ≥ 300mm tl, and ≥ 450mm tl. * indicates the total number of NPK captured including two fish that were not measured for tl.

	South Beach	Little Yampa Canyon	Juniper	Upper Maybell	Lower Maybell	Sunbeam	Lily Park	Total: All Reaches
# of NPK Captured	232	314	65	87	19	1	33	751*
< 300mm tl	148	217	51	27	3	0	3	449
≥ 300mm tl	84	95	14	60	16	1	30	300
≥ 450mm tl	27	22	5	22	6	1	23	106
Effort (hr.)	91.9	264.8	85.9	64.1	44	21.9	50.3	622.9
NPK CPUE	2.52	1.19	0.76	1.36	0.43	0.05	0.66	
< 300mm tl	1.61	0.82	0.59	0.42	0.07	0.00	0.06	
≥ 300mm tl	0.91	0.36	0.16	0.94	0.36	0.05	0.60	
≥ 450mm tl	0.29	0.08	0.06	0.34	0.14	0.05	0.46	

Table 4. Number of roundtail chub (RTC) >150 millimeter total length capture events, number of roundtail chub marked, number of roundtail chub recaptures, and number of roundtail chub mortalities for the middle Yampa River in 2019.

<u>River Reach</u>	<u>#RTC Capture Events</u>	<u>#RTC Marked</u>	<u>#RTC Recaptures</u>	<u>#RTC Released</u>	<u>#RTC Mortalities</u>
South Beach	0	0	0	0	0
Juniper	0	0	0	0	0
Upper Maybell	1	1	0	1	0
Lower Maybell	4	4	0	4	0
Sunbeam	7	5	0	7	0
<u>Total</u>	12	10	0	12	0

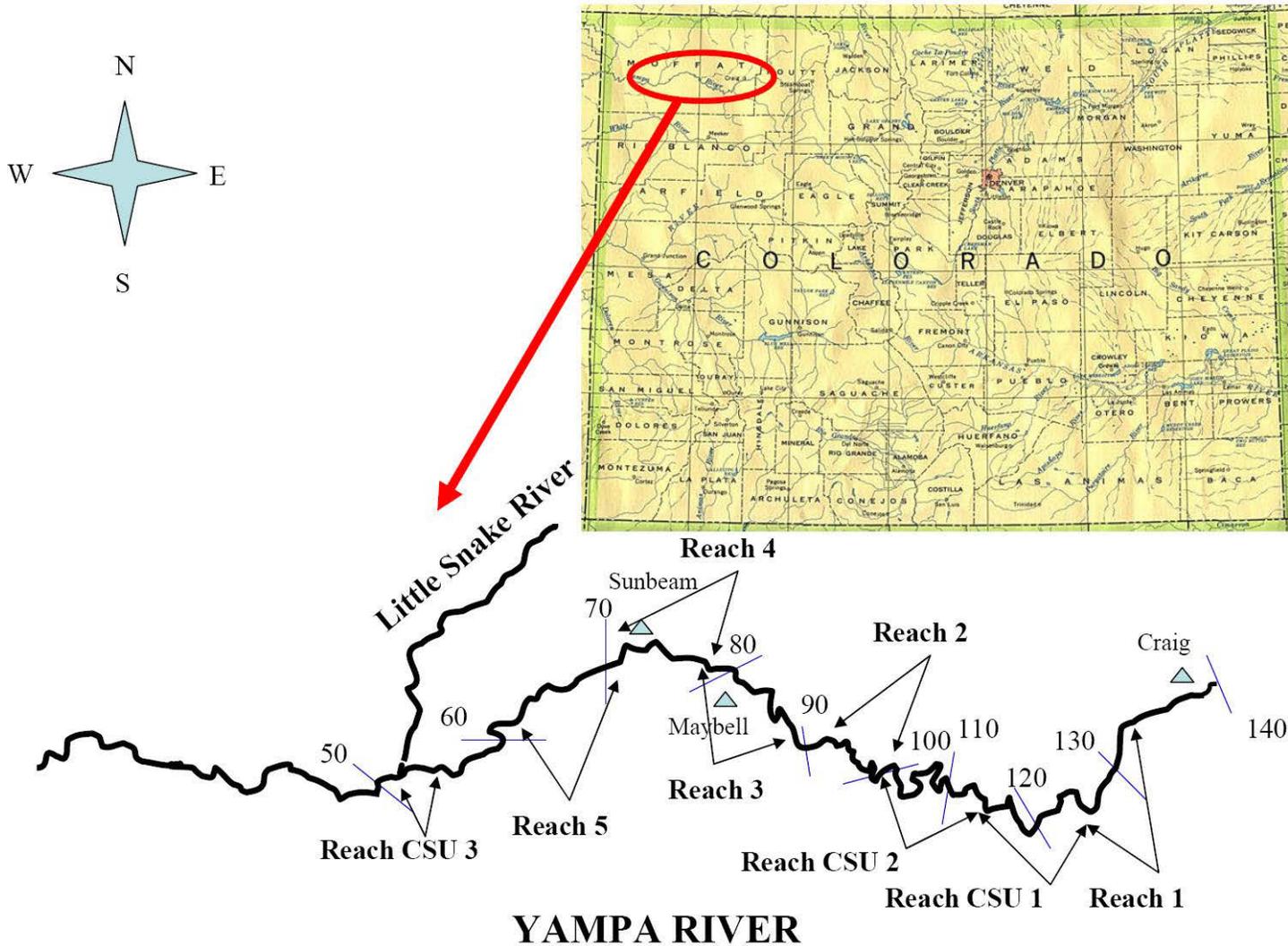


Figure 1. River reaches of the middle Yampa River sampled by Colorado Parks and Wildlife and Colorado State University (CSU). Reaches, upstream to downstream, include: Reach 1 (South Beach), Reach CSU 1 and Reach CSU 2 (Little Yampa Canyon), Reach 2 (Juniper), Reach 3 (Upper Maybell), Reach 4 (Lower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



Figure 2. Satellite image showing 12 spring backwater gill netting locations in 2019. Backwater gill netting locations are spread along the middle Yampa River between River Miles 169.2 and 122.5 (imagery courtesy of Google Earth).

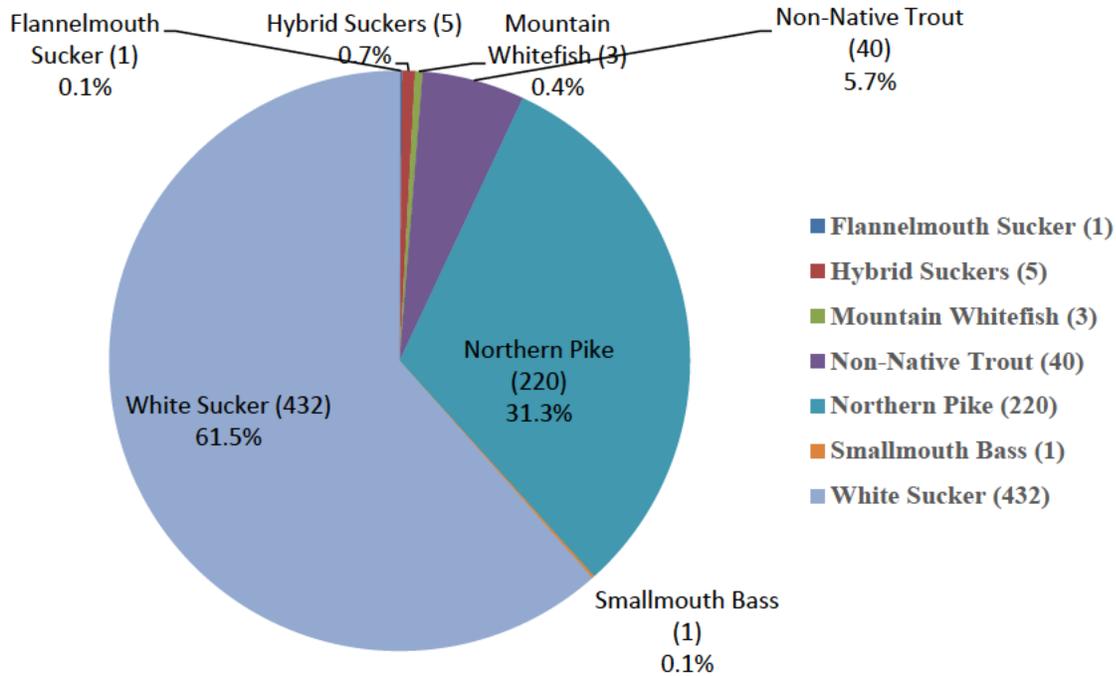


Figure 3. Relative abundance of fish captured during spring backwater gill netting in the middle Yampa River in 2019. Nonnative trout species included rainbow and brown trout. Numbers in parentheses represent number of individuals by species captured.

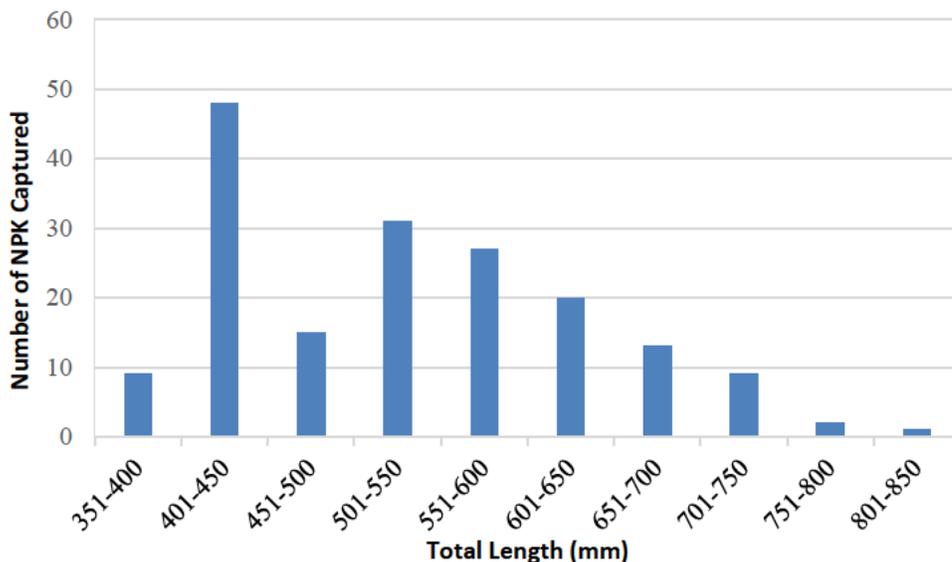


Figure 4. Northern pike (NPK) length frequency distribution in millimeters (mm) for fish captured during spring backwater gill netting in the middle Yampa River in 2019. An additional 45 northern pike captured could not be measured due to being scavenged while in the gill nets.

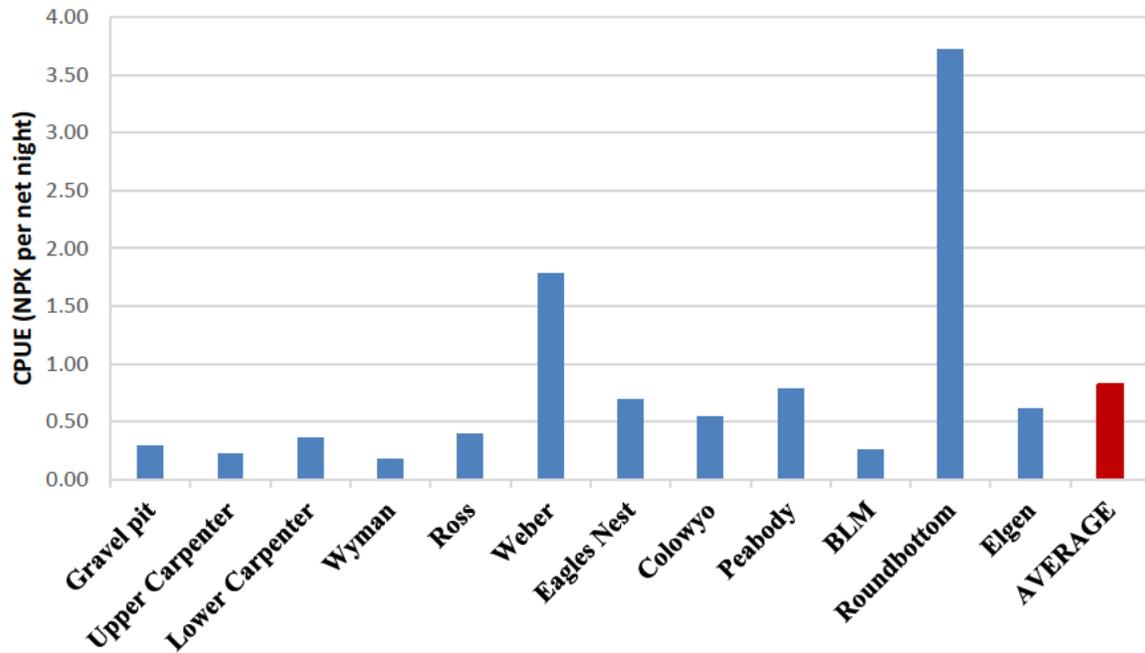


Figure 5. Northern pike (NPK) catch per unit effort (CPUE) by backwater (upstream to downstream) and the average CPUE across all backwaters during spring gill netting in the middle Yampa River in 2019.

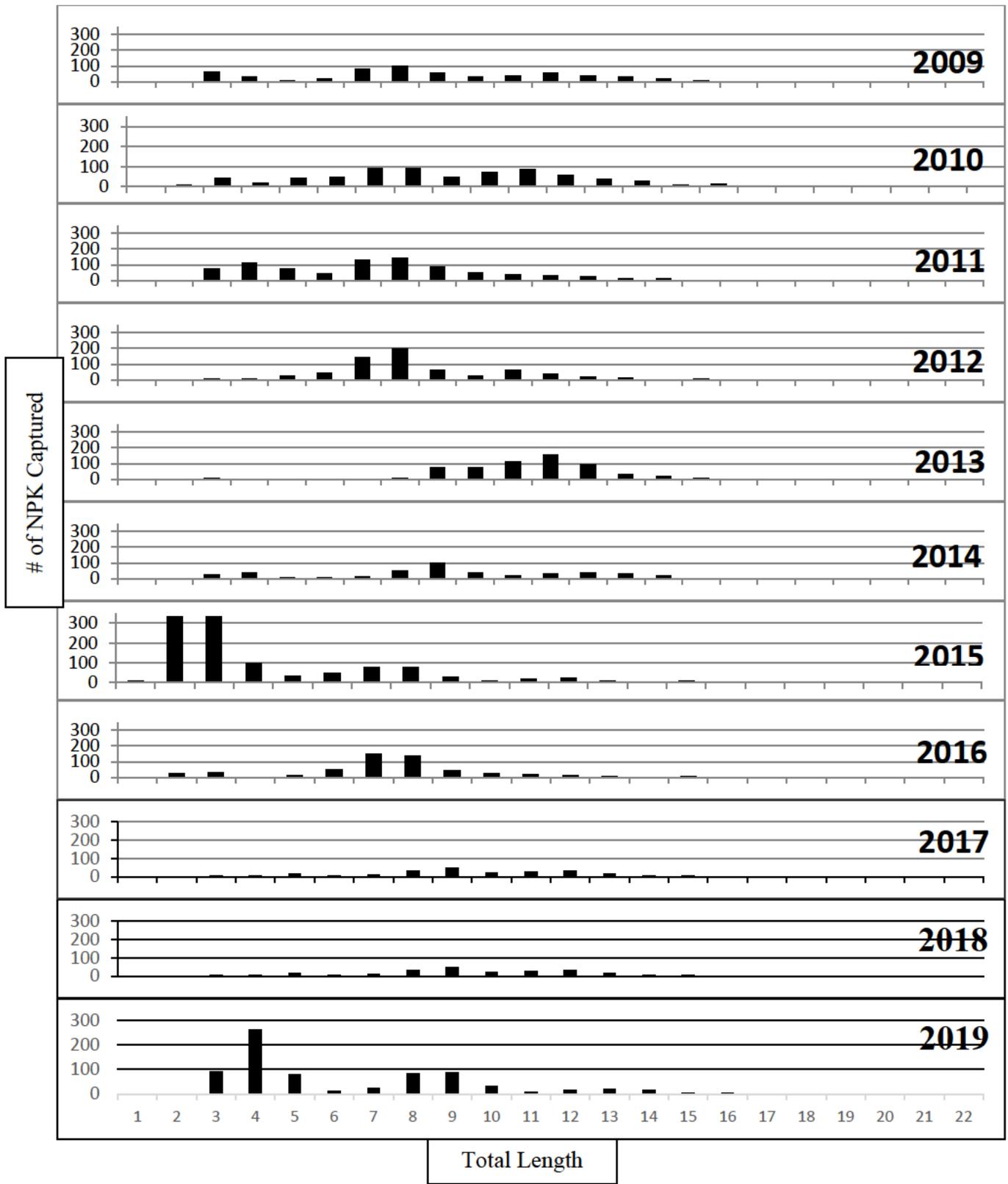


Figure 6. Northern pike (NPK) total length frequency distributions in millimeters (mm), in the middle Yampa River, South Beach to Lily Park (River Mile 134.2-50.5), from 2009-2019.

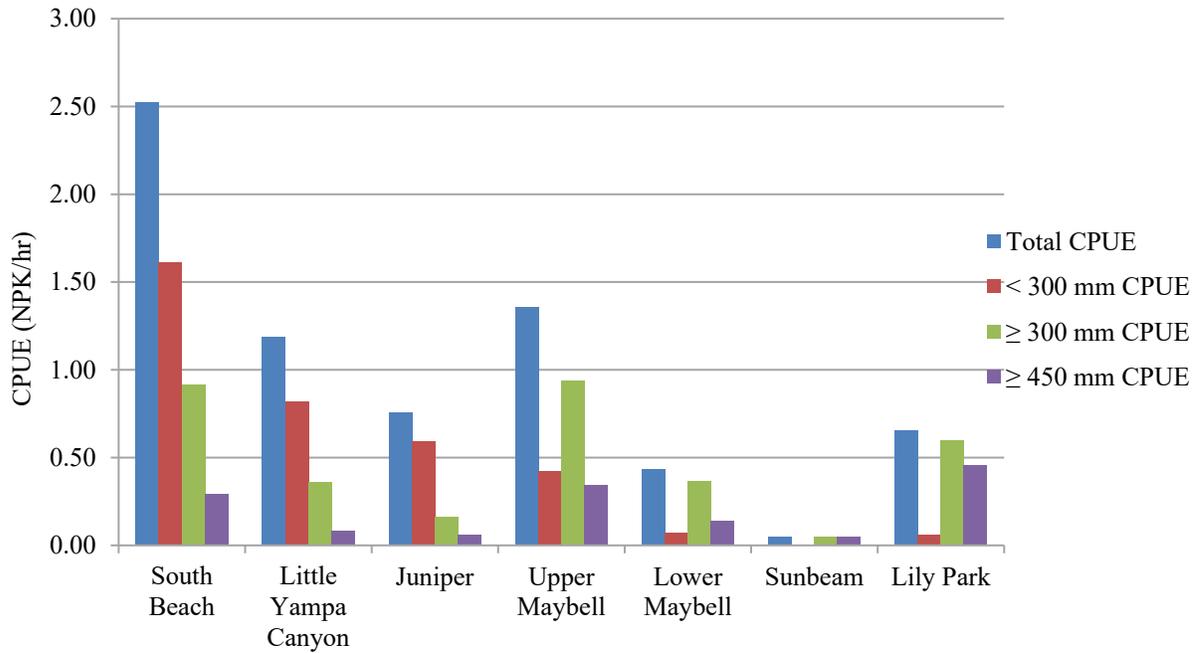


Figure 7. Northern pike (NPK) electrofishing catch-per-unit-effort (CPUE), and CPUE for juvenile (<300mm total length-tl) and adult (≥300mm tl and ≥450mm tl) by river reach in the middle Yampa River in 2019. River reaches are presented from upstream to downstream.

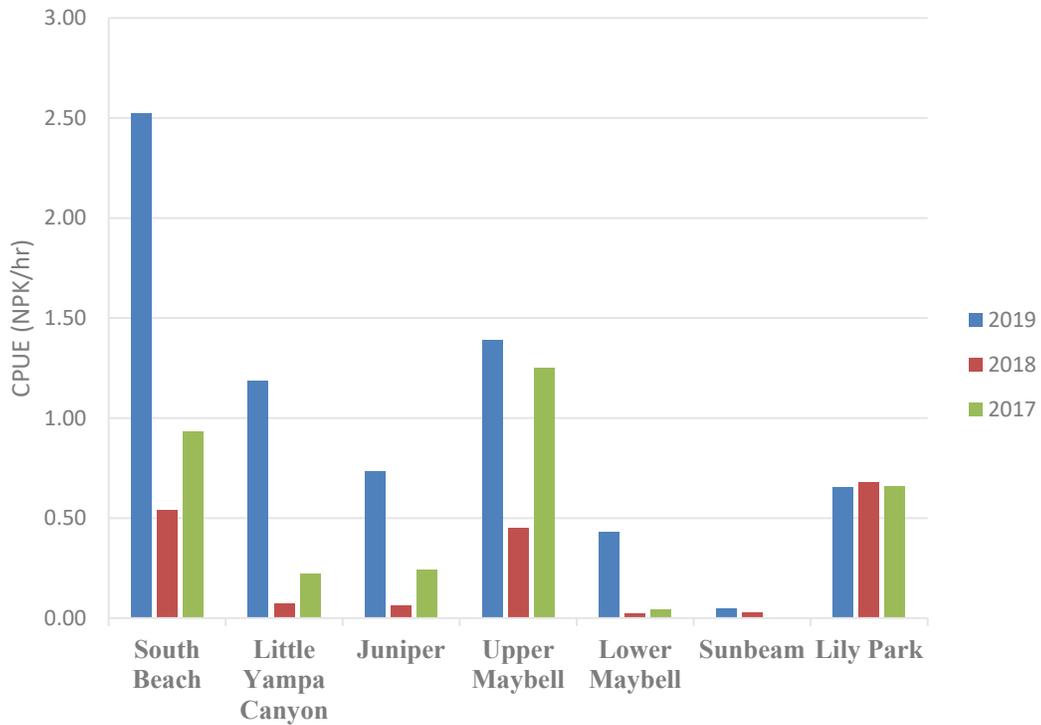


Figure 8. Northern pike (NPK) electrofishing catch-per-unit-effort (CPUE) by river reach in the middle Yampa River 2017-2019. River reaches are presented from upstream to downstream.

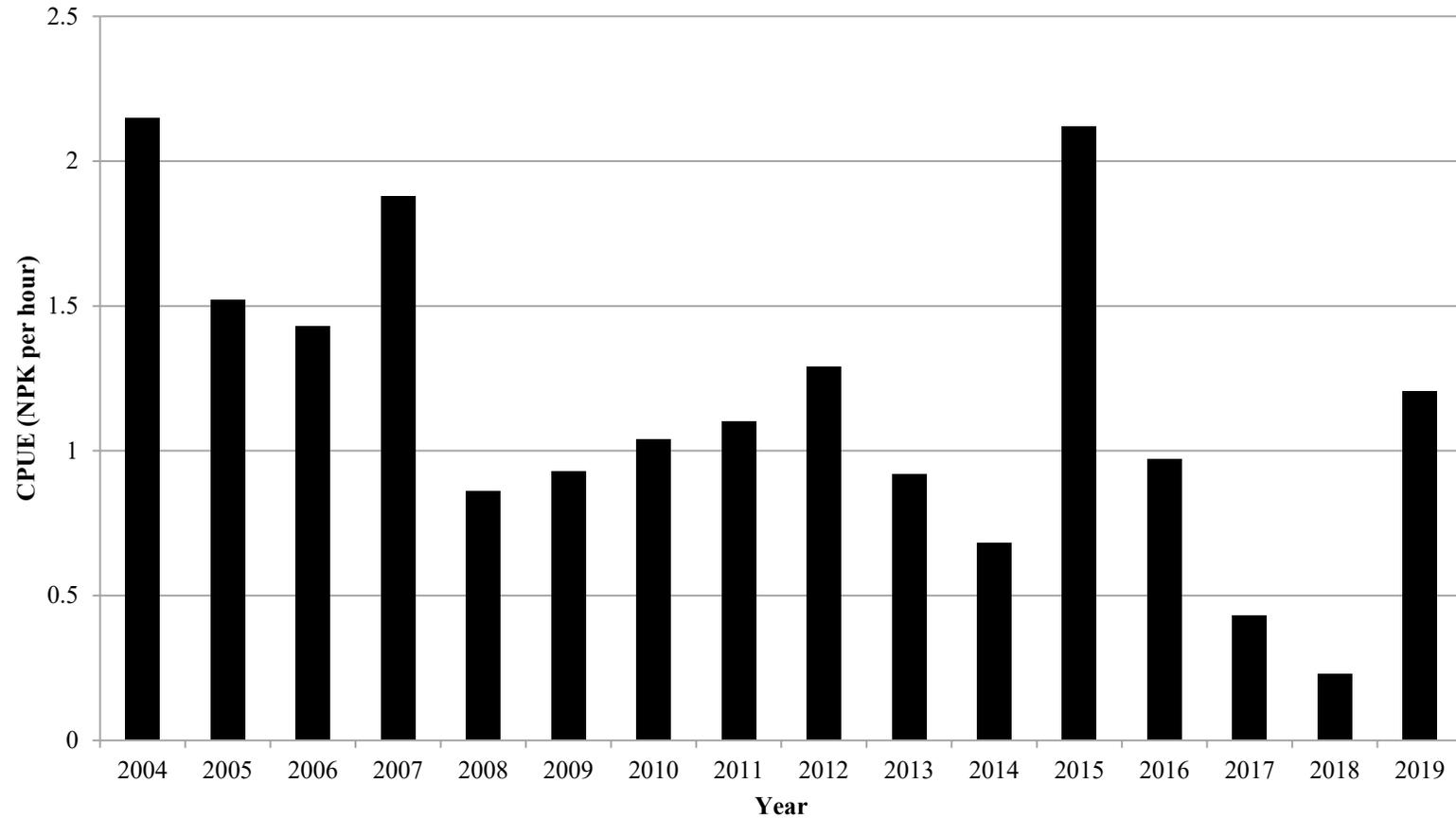


Figure 9. Northern pike (NPK) electrofishing catch-per-unit-effort (CPUE) across all passes in the study area of the middle Yampa River sampled by Colorado Parks and Wildlife and Colorado State University, from 2004 through 2019

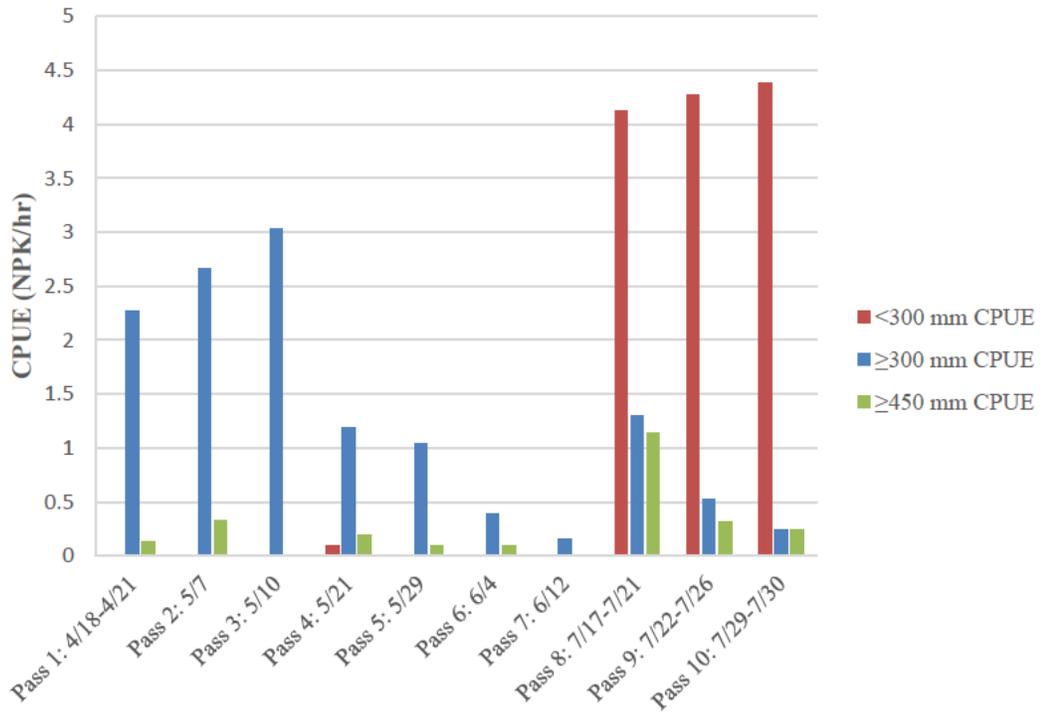


Figure 10. Northern pike (NPK) electrofishing catch-per-unit-effort (CPUE) by pass in the South Beach reach (River Mile 134.2 to 124.0) in 2019.

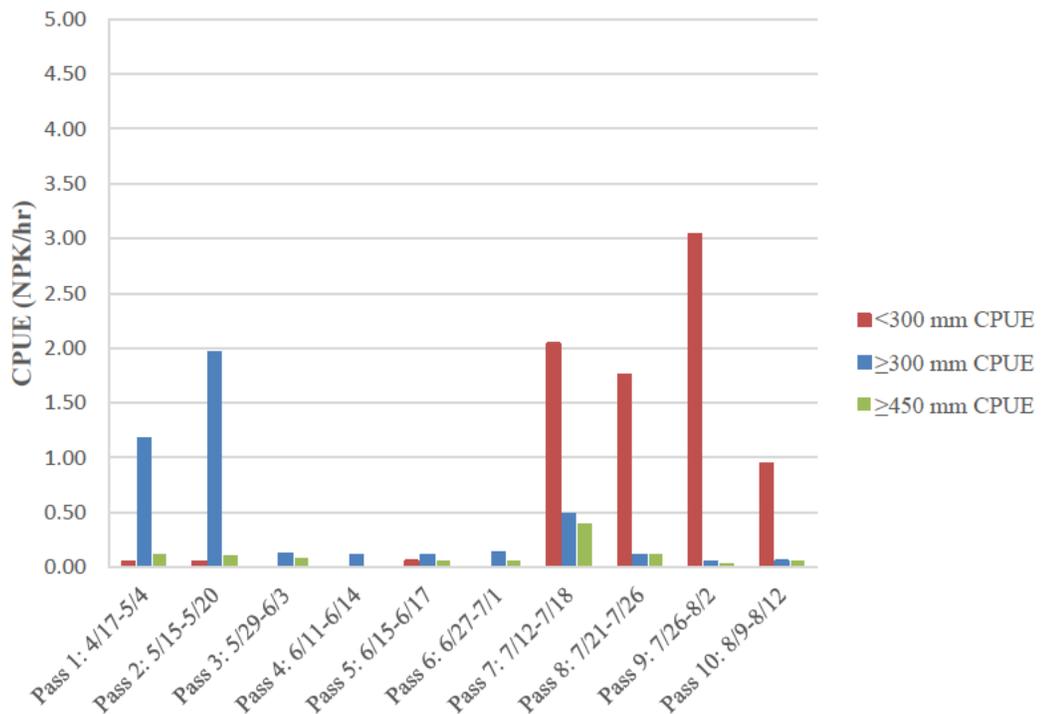


Figure 11. Northern pike (NPK) electrofishing catch-per-unit-effort (CPUE) by pass in the Little Yampa Canyon reach (RM 124.0 to 100.0) in 2019.

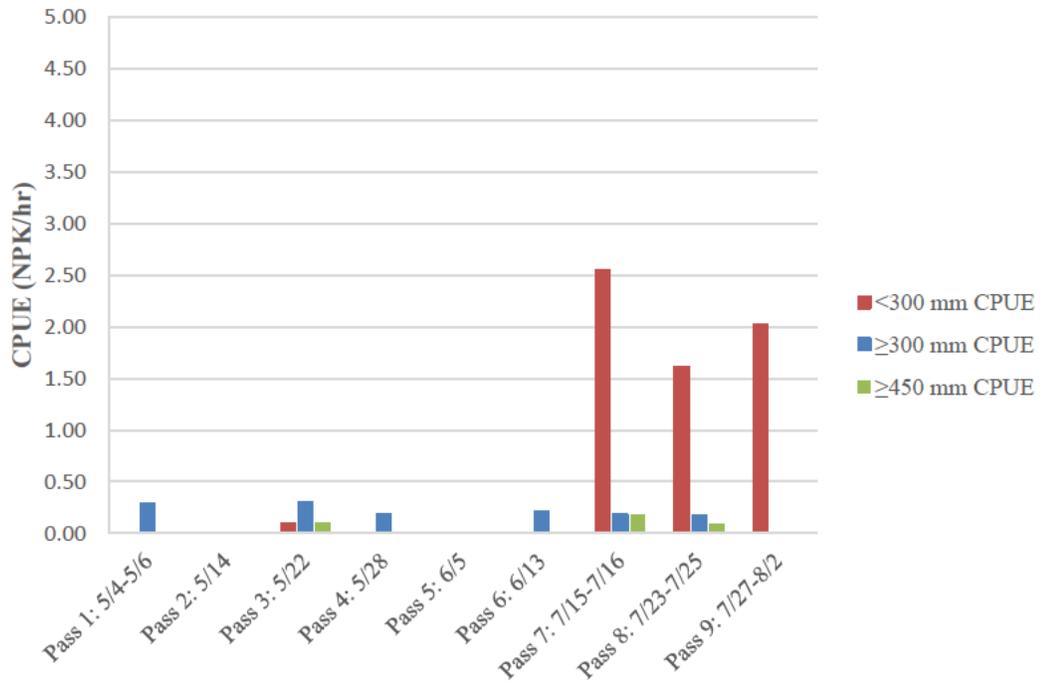


Figure 12. Northern pike (NPK) electrofishing catch-per-unit-effort (CPUE) by pass in the Juniper reach (River Mile 100.0 to 91.0) in 2019.

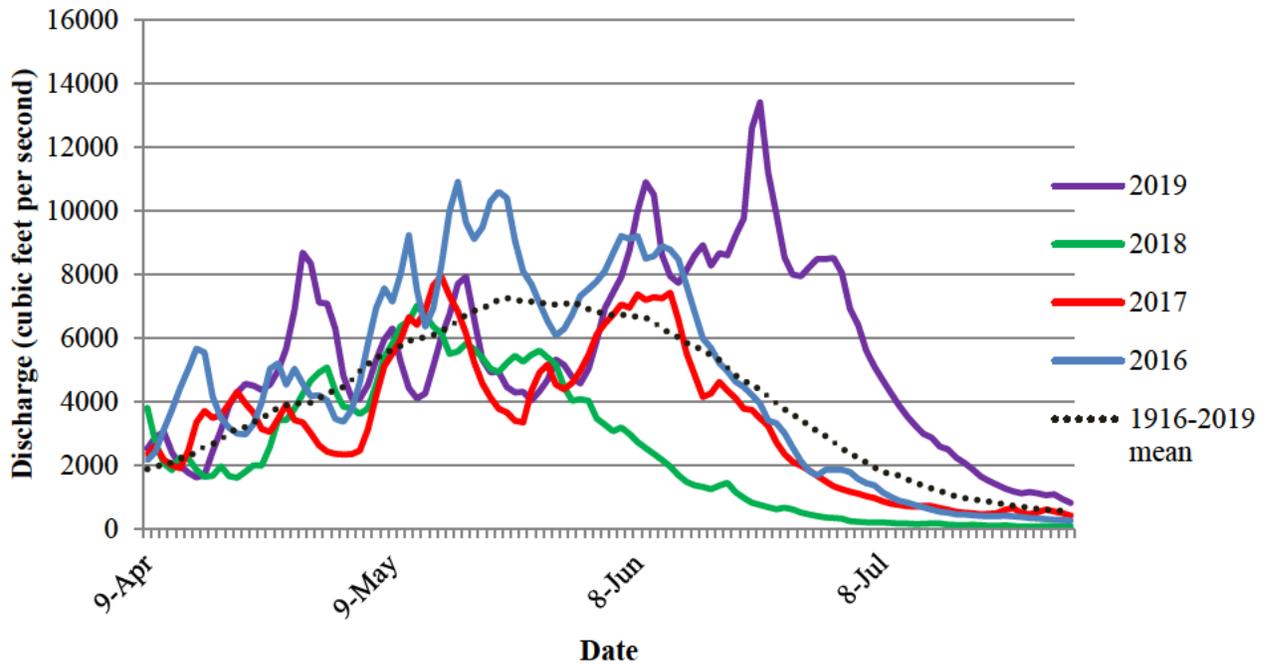


Figure 13. Mean daily discharge for the Yampa River at the United States Geological Survey Maybell gage station for 2016 to 2019 spring runoff. Dotted line represents the mean of daily mean discharge values from 1916-2019. Peak runoff in 2019 occurred on June 23 (13,400 cfs) (Flow data courtesy of waterdata.usgs.gov).

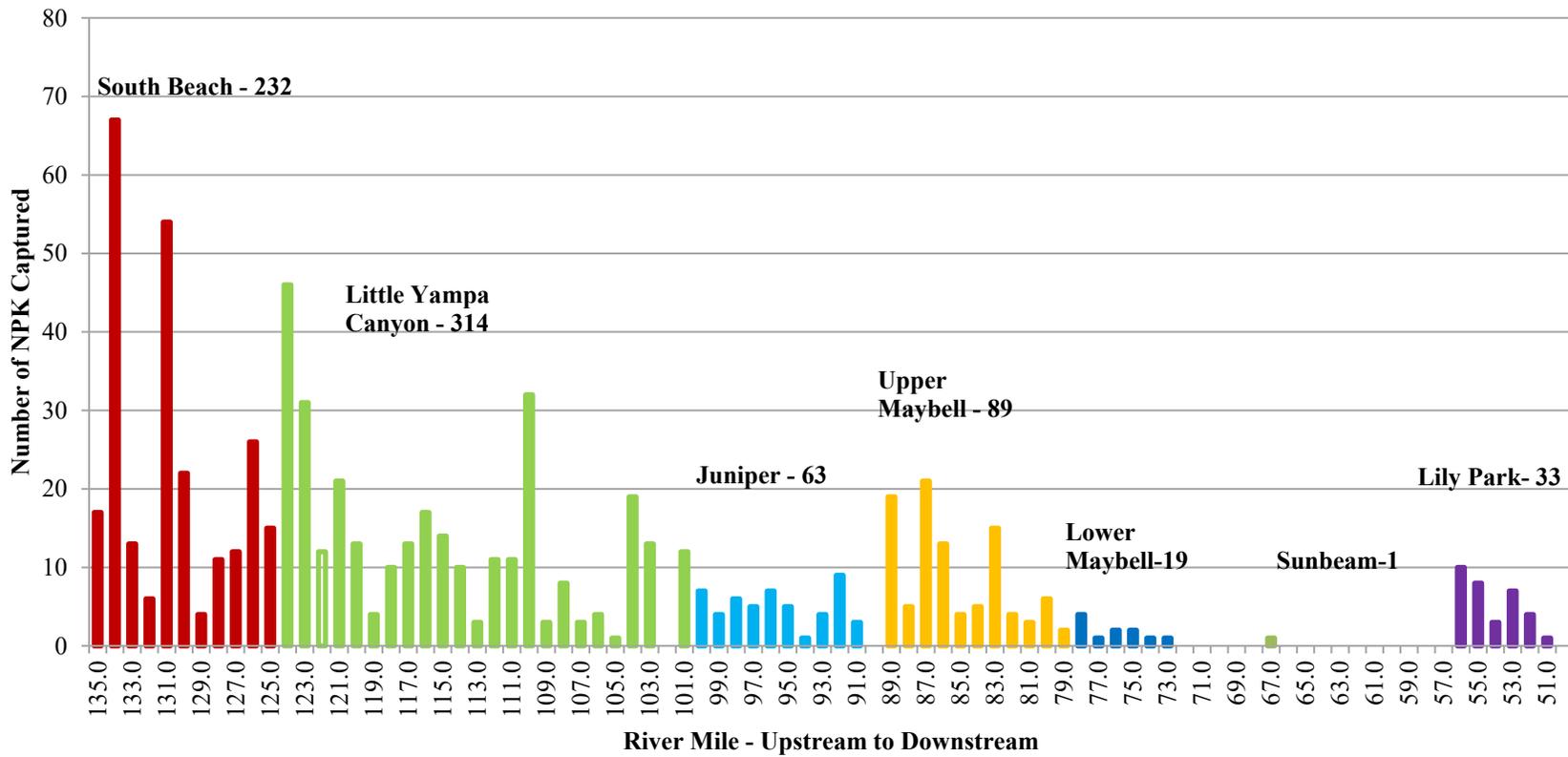


Figure 14. Number of northern pike (NPK) captured by electrofishing within each river mile of the middle Yampa River study area during 2019. Each color represents a different river reach (labeled above bars).

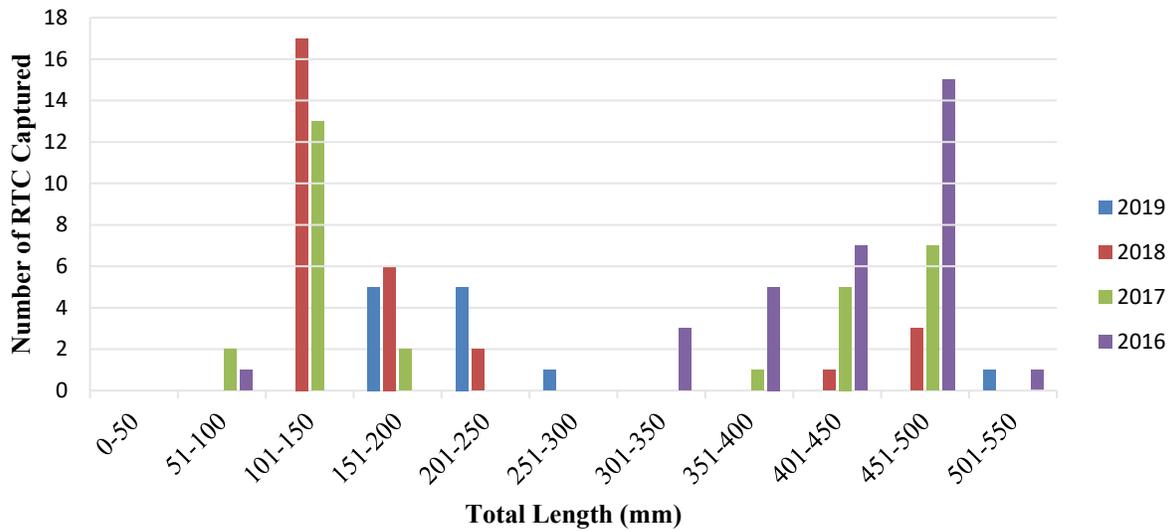


Figure 15. Roundtail chub (RTC) length frequency distribution in millimeters (mm) for the middle Yampa River study area between 2016 and 2019.

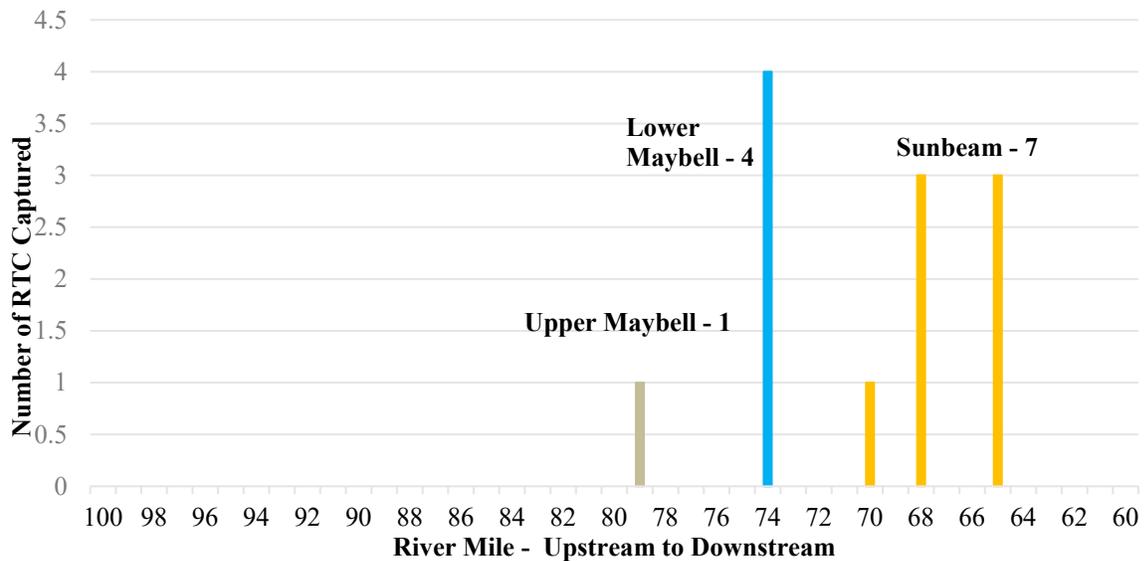


Figure 16. Roundtail chub (RTC) capture locations in the middle Yampa River study area in 2019. No roundtail chub were captured upstream of River Mile 100.0. Each color represents a different river reach (labeled above bars)

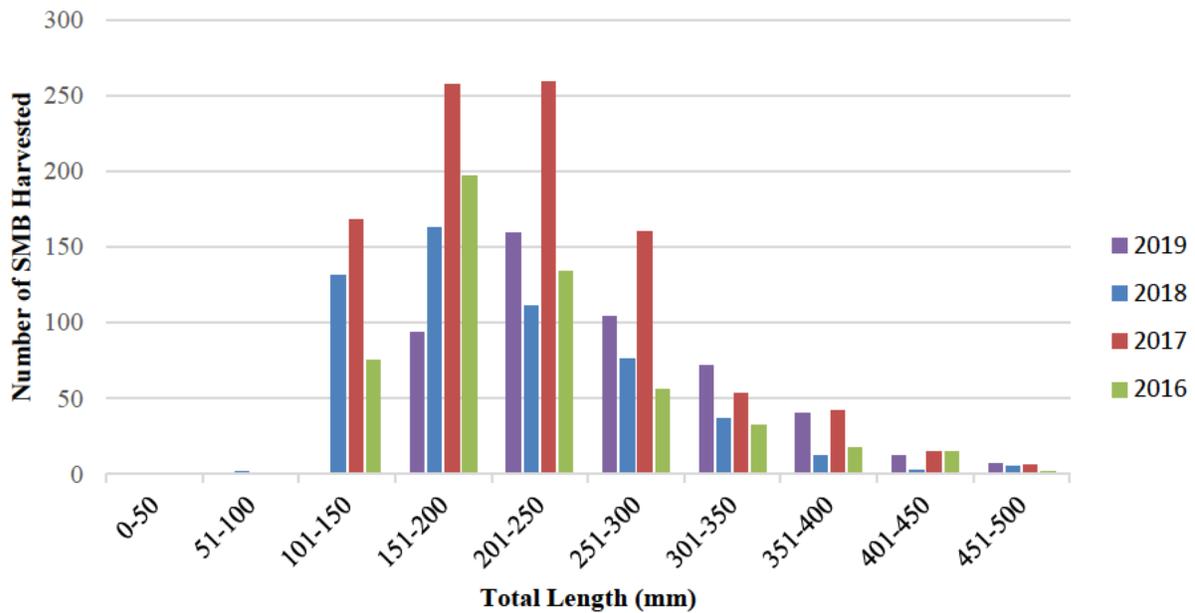


Figure 17. Length frequency distribution in millimeters (mm) for smallmouth bass (SMB) harvested by anglers during the Annual Elkhead Reservoir Fishing Classic in 2019 (n=492), 2018 (n=540), 2017 (n=963) and 2016 (n=529).

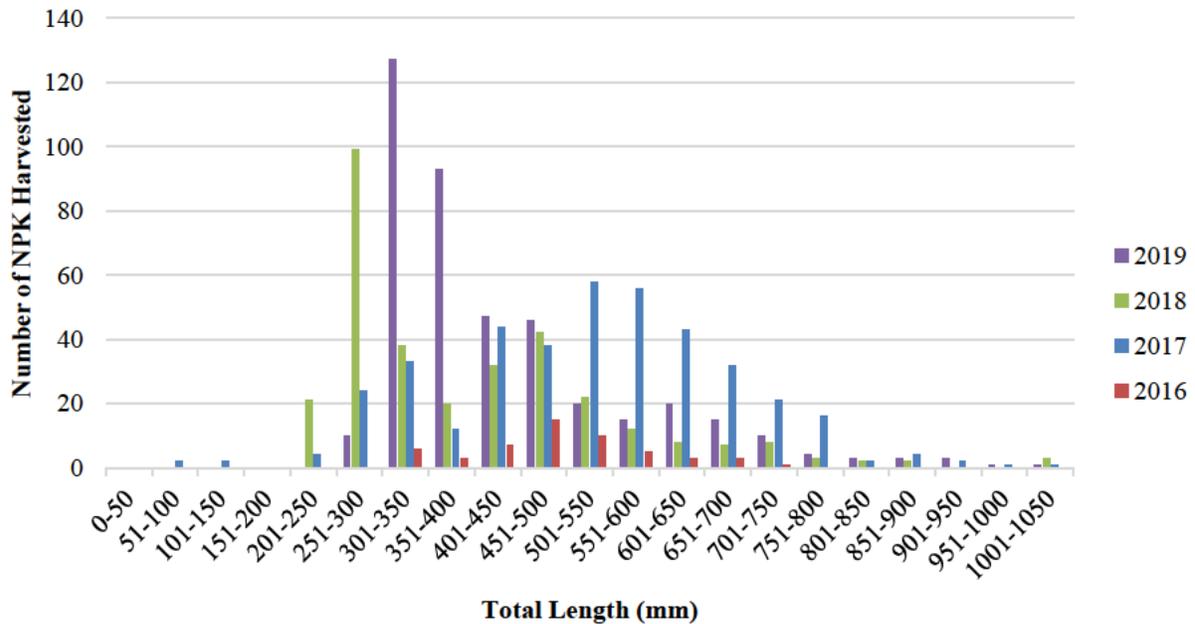


Figure 18. Length frequency distribution in millimeters (mm) for northern pike (NPK) harvested during the Annual Elkhead Reservoir Fishing Classic in 2019 (n=419), 2018 (n=319), 2017 (n=395), and 2016 (n=53).

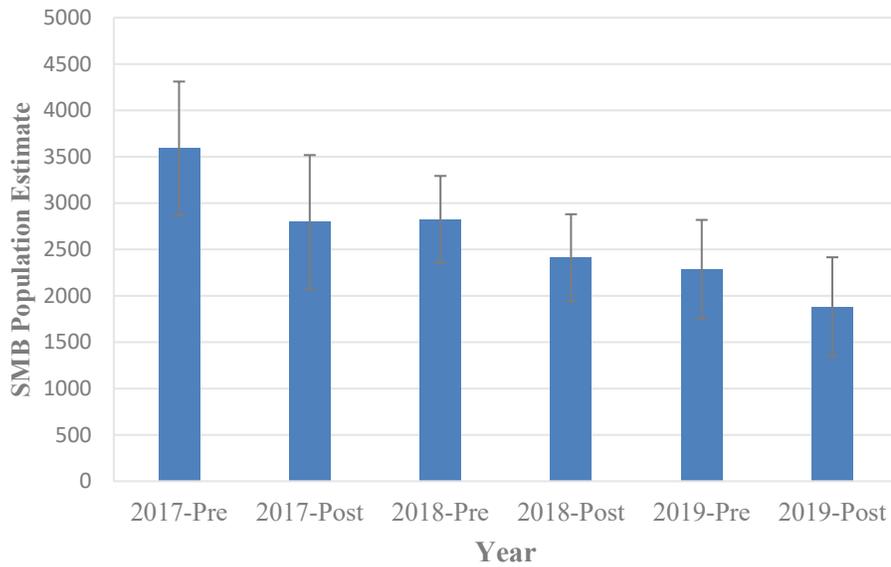


Figure 19. Adult smallmouth bass ($\geq 150\text{mm}$ tl) (SMB) population estimates and 95% confidence intervals generated for Elkhead Reservoir prior to (“pre”) and after (“post”) the Elkhead Reservoir Fishing Classic from 2017-2019. Population estimates after the fishing tournament account for smallmouth bass that anglers harvested during the tournament.

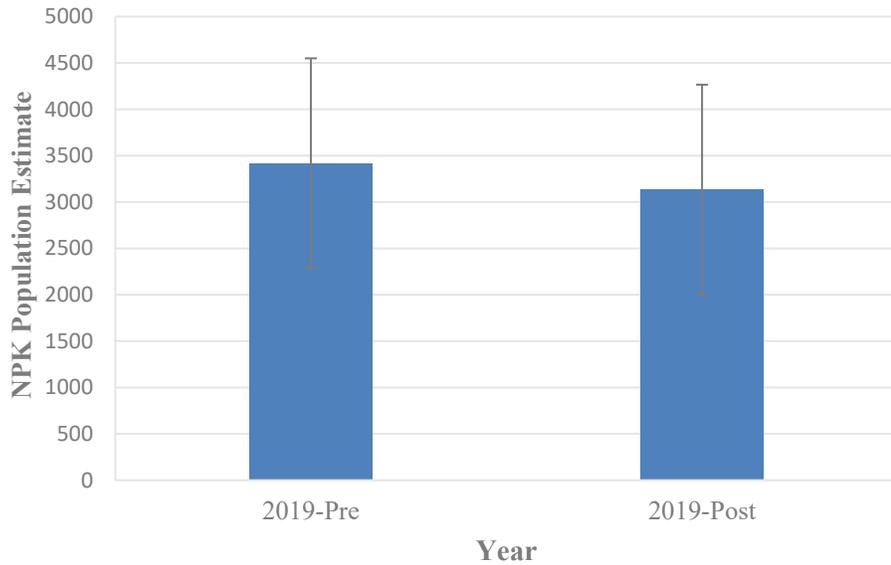


Figure 20. Adult northern pike ($\geq 300\text{mm}$ tl) (NPK) population estimates and 95% confidence intervals generated for Elkhead Reservoir prior to (“pre”) and after (“post”) the Elkhead Reservoir Fishing Classic for 2019. Population estimates after the fishing tournament account for northern pike that anglers harvested during the tournament.

ANNUAL PERFORMANCE PROGRESS REPORT (PPR)

BUREAU OF RECLAMATION AGREEMENT NUMBER: #R17AP00301

UPPER COLORADO RIVER RECOVERY PROGRAM PROJECT NUMBER: 98a

Project Title: Middle Yampa River nonnative fish management

Principal Investigator:

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Project/Grant Period: Start date (Mo/Day/Yr): September 22, 2017
 End date: (Mo/Day/Yr): September 30, 2022
 Reporting period end date (Mo/Day/Yr): November 15, 2019
 Is this the final report? Yes No X

Performance:

All tasks were completed as outlined in the Scope of Work for this project.

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 2019 sampling season, 220 northern pike were removed by Colorado Parks and Wildlife (CPW) during early spring (April 3 through May 10) backwater gill netting efforts. CPW and Colorado State University (CSU) also removed 751 northern pike during electrofishing efforts which began April 17 and continued through August 12. Northern pike electrofishing catch rate was 1.21 fish/hour, which is an increase in catch rate compared to 2018 and reverses a trend of decreasing catch rate each year since 2015. Please see CSU’s 2019 Annual Report for Project #125 for a detailed analysis of smallmouth bass data collected in the study area.