

UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

FY 2022 ANNUAL REPORT

PROJECT: 128

Project Title:

Abundance estimates for Colorado pikeminnow in the Green River Basin, Utah and Colorado

Bureau of Reclamation Agreement Number:

R14AP00001

Project/Grant Period:

Start date: 10/01/2018

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Is this the final report? No

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Abstract:

Sampling conducted during this project is designed to obtain capture-mark-recapture data needed to estimate abundance and vital rates of Colorado pikeminnow *Ptychocheilus lucius* in the lower Yampa (exclusive of Yampa Canyon) and lower White rivers and the Green River

UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

downstream of the Yampa River confluence (Whirlpool and Split Mountain canyons excluded). Abundance estimates of endangered Colorado pikeminnow are needed to better monitor population status and provide benchmarks against which progress toward recovery can be measured. This project segment was designed to have three years (2022-2024) of sampling followed by two years of data analysis and report writing; this follows a sampling hiatus of three years from 2019-2021. The design is essentially the same as that employed for sampling conducted from 2000-2003, 2006-2008, 2011-2013, and 2016-2018 in the same areas (Bestgen et al. 2005; Bestgen et al. 2010; Bestgen et al. 2018). Sampling during the most recent three-year period began in spring 2022, and will continue through 2024, with Colorado Parks and Wildlife and the Larval Fish Laboratory responsible for sampling the Yampa River, the U. S. Fish and Wildlife Service, Vernal, Utah, responsible for the reach of the Green River from downstream of the White River to Green River State Park in Green River, Utah, and the White River downstream of Kenney Reservoir, and the Utah Division of Wildlife Resources responsible for the Green River reaches from lower Whirlpool Canyon to downstream of the White River confluence and from Green River State Park downstream to the Colorado River. The Larval Fish Laboratory also provides coordination, data checking, and data analysis. Our primary goal was to capture, mark, and recapture as many Colorado pikeminnow as possible on at least three different sampling occasions in each river reach. Sampling occurred before or during spring runoff and was finished before the Colorado pikeminnow spawning migration. Electrofishing via raft or flat-bottomed boat was the primary sampling gear. Captured pikeminnow were scanned for the presence of a PIT tag, unmarked fish were marked, and all were released near the point of capture. These data will be used to obtain abundance estimates for each river reach if possible, noting captures and recaptures having been declining which makes abundance estimation more difficult.

Study Schedule:

Ongoing as needed, this segment is from 2022-2024.

Relationship to RIPRAP:

Green River:

V. Monitor populations and habitat and conduct research to support recovery actions (research, monitoring, and data management)

V.C. Conduct population estimate for Colorado pikeminnow

Accomplishment of FY 2022 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Main objectives in FY 2022 were to finalize reporting of results from the 2016-2018 estimation period and conduct sampling for the next round of estimates. We have developed estimates for years 2016-2018 which were provided to the Recovery Program office. The final report is under construction and a draft is anticipated in late spring 2023.

Per 2022 sampling, we revised and used a Standard Operating Procedure (SOP) for field personnel for use during the Colorado pikeminnow sampling season to ensure a consistent sampling approach and timely completion of tasks. The SOP reduced project and sampling complexity, which was due to the short duration of the sampling design each year, and also increased consistency among the five relatively autonomous units that completed this work. This was especially important for Green River crews, where

UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

large numbers of razorback sucker captured sometimes overwhelmed processing efforts and slowed the pace of sampling to the point that work could not be completed efficiently. Revised sampling strategies varied by sampling group and involved identifying river reaches, sometimes 1 out of every 10 river miles, where razorback suckers were netted and scanned for PIT tags while in other reaches, none were netted or scanned. Discussions are underway to revise this further, and may include added personnel in the Middle Green River, who will operate a chase boat and scan and measure fish for electrofishing crews, with a goal to streamline sampling. The overall goal of middle Green River razorback sucker sampling is to identify what type of sampling and fish capture is possible in the middle Green River, which will guide future sampling there and in other reaches.

During 2022, each field crew completed three sampling passes through the five Green River Basin reaches listed below to capture juvenile, sub-adult, and adult Colorado pikeminnow:

- a) Green River between the confluence of the White River upstream to the lower end of Whirlpool Canyon (i.e., upper Rainbow Park, but not Split Mtn. Canyon).
- b) White River between its confluence with the Green River upstream to Taylor Draw Dam,
- c) Yampa River between Deerlodge Park and Craig, Colorado, excluding Cross Mountain Canyon,
- d) Green River from downstream of the White River confluence downstream to Green River State Park near Green River, Utah, and,
- e) Green River from Green River State Park near Green River, Utah, downstream to the confluence with the Colorado River.

In addition to the three standard sampling passes in all reaches, LFL and CPW attempted additional sampling passes in portions of the Yampa River, which were also associated with smallmouth bass *Micropterus dolomieu* and northern pike *Esox lucius* removal projects, which aids in obtaining a more precise and accurate Colorado pikeminnow abundance estimate. Data were grouped under three passes for all reaches to accommodate the need for symmetrical capture histories among reaches.

2022 results.--Specific results to report based on 2022 sampling are below. The basic data for estimating abundance of various life stages of Colorado pikeminnow are the numbers of unique individuals captured in various sampling passes and reaches among years. Based on the recapture rates of those same individuals, estimates of abundance can be developed. If recapture rates remain approximately the same over sampling years, the number of unique pikeminnow captured in each age class can also be used as a metric of abundance of Colorado pikeminnow over time.

Number of unique captures for data collected through 2022 (Figure 1) have declined over time. For example, in 2001 when all reaches of the Green River basin were sampled, nearly 1,000 adult (≥ 450 mm TL) Colorado pikeminnow were captured. Those numbers have declined steadily since that time and 2022 was the lowest level ever at 101 adult (≥ 450 mm TL) Colorado pikeminnow captured. An additional three sub-adults (400-449 mm TL), and 20 juvenile individuals (< 400 mm TL), were captured.

Among reaches, no Colorado pikeminnow were captured in the Yampa River, 24 were captured from each of the White and lower Green river reaches, 35 were from the Desolation-Gray Canyon reach of the Green River, and 38 were from the Middle Green River (Table 1). The low abundance of small fish in

UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

any reach was especially notable. A qualitative comparison of sampling effort in terms of electrofishing hours per pass during 2022 compared to 2000-2003 (Bestgen et al. 2005; Bestgen et al. 2010; Bestgen et al. 2018) showed effort was similar, so low overall abundance of Colorado pikeminnow in 2022 is not likely to be an artifact of lower sampling effort.

Length frequency histograms showed the sizes of Colorado pikeminnow and their abundance in each reach of the Green River basin (Figure 2). The 500-549 mm TL size group was the most abundant in the basin, followed by 550-599 mm TL. Most Colorado pikeminnow captured < 450 mm TL (73%) were from the lower Green River.

The number of recaptures of fish among passes in a given year are the basis for abundance estimates, where greater numbers of recaptures reduce bias and increase precision of estimates. Only three individual adult Colorado pikeminnow were recaptured among sampling passes completed in 2022; two were from the lower Green River and one was from the Desolation-Gray Canyon reach. Low recapture numbers among passes will make abundance estimation more difficult, and results will be imprecise. In reaches where no recaptures are observed, abundance estimates are not possible if conducted only for that year. Robust design, multi-state capture recapture models allow for estimation of population abundance in reaches where no recaptures were made because probabilities of recapture are estimated across reaches and time when pikeminnow were recaptured. In the past, absence of recaptures in reaches was rare. Sixty-one of 121 (50%) Colorado pikeminnow captured for the first time in 2022 were tagged in a previous year, but those recaptures are not useful in closed capture-recapture sampling designs, which require they be among passes in a given year. The 2022 data will be incorporated into robust design, multi-state capture recapture models as time permits.

New task (Task 6 in scope of work). Razorback sucker abundance and survival estimation, Green River Basin.

Task 6 in the scope of work for FY 2016-2017 involved razorback sucker abundance and survival estimation in the Green River Basin, using data collected during Colorado pikeminnow abundance estimation through 2013. We completed the report that report, and it was approved by the Biology Committee (https://www.coloradoriverrecovery.org/documents-publications/technical-reports/rsch/Zelaskoetal2018_Final_1Feb2018.pdf).

We also completed a new report that investigated effects of using physical captures during sampling (captures) as well as numerous additional PIT tag records gained by detections from antennas (detections), both from stationary and from portable kinds, on survival rates of razorback sucker from 2003-2017. A fish that is “encountered” is one captured by physical sampling or detected by antennas. Detections used included those from the Green River Basin as well as the Upper Colorado and San Juan River basins. We used the Barker model to incorporate detections with captures from nearly 1,300 miles of those rivers and associated inflow areas to Lake Powell. Of the 321,233 UCRB-stocked razorback suckers included in our analysis, 93% were never seen again; 7% were later encountered. Of those encountered, 62% were physically captured over the 15-year study period, while 30% were detected and were nearly all in the last five years (2013-2017). The remaining 8% were encountered by both physical sampling and antenna detections.

The survival portion of the top-ranked model included effects of time since stocking, season of stocking, and total length at stocking. Survival rates were low in a fish’s first year after stocking and lowest for

UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

smaller fish stocked in summer, supporting earlier analyses (Zelasko et al. 2009; 2010). Mean first-year survival rates for 350-mm-TL razorback suckers stocked in spring, summer, and autumn were 0.57, 0.18, and 0.46, respectively, and mean survival after the first year was 0.80. The survival estimates were all higher—some substantially so—than those from previous analyses. The increased first-year survival rate estimates that incorporated detection data, combined with a modest increase in the subsequent-year survival rate, resulted in 74, 60 and 26% increases in numbers of fish remaining in the river after two years, when stocked in spring, summer, and autumn, respectively, compared to prior estimates using only physical captures. With no evidence that environmental conditions, stocking rates, physical capture probabilities, or fish quality have dramatically altered razorback sucker survival rates, and having accounted for season and TL effects in the estimates, we attributed most of the increase in survival rates to the addition of antenna detection information.

The effect was also apparent for current survival rate estimates after the first year, which were consistently high and precise for nearly all years after 2009, when antennas first contributed substantial detection data. Coefficients of variation for first-year survival rates were also greatly improved, declining from an average of 15% in the 1995–2006 period to 7% in this study, indicating precision more than doubled. Capture probabilities from physical encounters were low during first sampling occasions (mean: 0.06, range: 0.01–0.18) and declined thereafter, similar to previous estimates. Detection probabilities (passive encounters) increased through time and were higher for fish stocked into the Green River subbasin (mean: 0.03, range: <0.01–0.16), where antenna coverage was greater, than the Colorado River subbasin (mean: 0.01, range <0.01–0.04), which had fewer antennas and detections. That report (citation below) was approved after review of the Recovery Program coordinators and peer reviewers.

Zelasko, K. A., K. R. Bestgen, and G. C. White. 2022. Incorporating passive antenna detections with physical recaptures in the Barker model increases razorback sucker survival rate estimates and their precision. Final report to the Upper Colorado River Endangered Fish Recovery Program. Denver, Colorado. Larval Fish Laboratory Contribution 225.

In addition to that work, we evaluated efficacy of using 2016–2018 Razorback Sucker data collected during Colorado pikeminnow estimation to conduct abundance estimates. Specifically, we compiled physical captures and passive antenna detections of razorback suckers in the Green River basin, 2016–2018, to determine if including detection data could mitigate the chronic problem of low probabilities of capture in past abundance estimation studies that used solely physical captures. Ultimately, detection data could not make up for the low physical capture rates of razorback suckers, and neither type of data was suited for abundance estimation in the 2016–2018 period. Managers and researchers should consider these findings when choosing appropriate measures and estimation techniques for razorback sucker demographics, prioritizing antenna types and placements, and planning for field work. That work is summarized in a report:

Zelasko, K. A., and K. R. Bestgen. 2022. Obstacles to abundance estimation for razorback suckers *Xyrauchen texanus* in the Green River, 2016–2018. Final report to the Upper Colorado River Endangered Fish Recovery Program. Denver, Colorado. Larval Fish Laboratory Contribution 229. DOI: 10.13140/RG.2.2.35137.02401

Additional noteworthy observations: NA

UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

Recommendations:

Continue sampling in 2023 and out years.

Project Status:

Ongoing and on-track.

FY 2022 Budget Status

Funds Provided: \$133,895

Funds Expended: \$118,811

Difference: \$15,084

Percent of the FY 2022 work completed, and projected costs to complete: >85% completed, no new funds needed to complete.

Recovery Program funds spent for publication charges: 0

Status of Data Submission

NA

Signed:

Principal Investigator: Kevin R. Bestgen

Date: 13 March 2023

References

- Bestgen, K. R., J. A. Hawkins, G. C. White, K. Christopherson, M. Hudson, M. Fuller, D. C. Kitcheyan, R. Brunson, P. Badame, G. B. Haines, J. Jackson, C. D. Walford, T. A. Sorensen, and T. B. Williams. 2005. Population status of Colorado pikeminnow in the Green River Basin, Utah and Colorado. Larval Fish Laboratory Contribution 140. 112 pp.
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- Bestgen, K. R., C. D. Walford, G. C. White, J. A. Hawkins, M. T. Jones, P. A. Webber, M. Breen, J. Skorupski, J. Howard, K. Creighton, J. Logan, K. Battige, and F. B. Wright. 2018. Population status of Colorado pikeminnow in the Green River sub-basin, Colorado and Utah, 2000–2013. Final Report. Colorado State University, Larval Fish Laboratory to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado. Larval Fish Laboratory Contribution 200.
- Zelasko, K. A., K. R. Bestgen, and G. C. White. 2009. Survival rate estimation and movement of hatchery-reared razorback suckers *Xyrauchen texanus* in the Upper Colorado River Basin, Utah and Colorado. Final report to the Recovery Implementation Program for Endangered Fishes in

UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

the Upper Colorado River Basin. U. S. Fish and Wildlife Service, Denver, CO. Larval Fish Laboratory Contribution 159.

Zelasko, K. A, K. R. Bestgen, and G. C. White. 2010. Survival rate estimation and movement of hatchery-reared razorback suckers *Xyrauchen texanus* in the Upper Colorado River Basin, Utah and Colorado. Transactions of the American Fisheries Society 139:1478-1499.

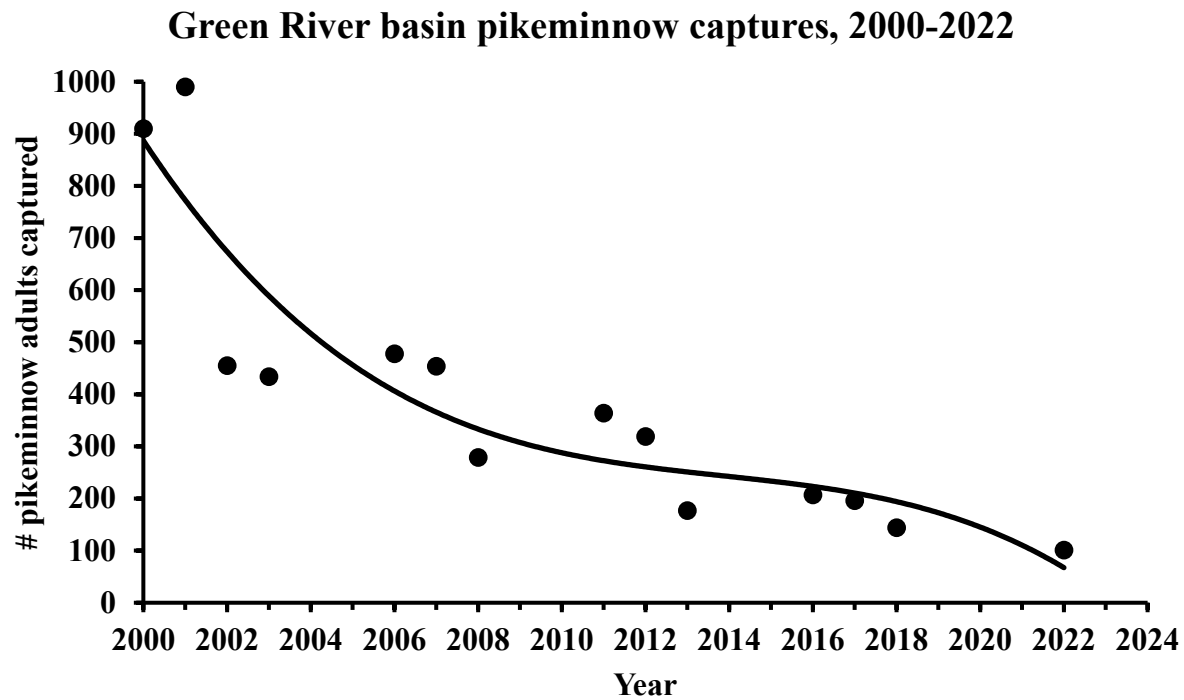


Figure 1. Number of unique Colorado pikeminnow adults (≥ 450 mm TL) captured each year in the period 2000-2022, Green River basin, Utah and Colorado. The trend is steadily downwards since the study began from about 1,000 individuals in 2001 to about 100 in 2022.

UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

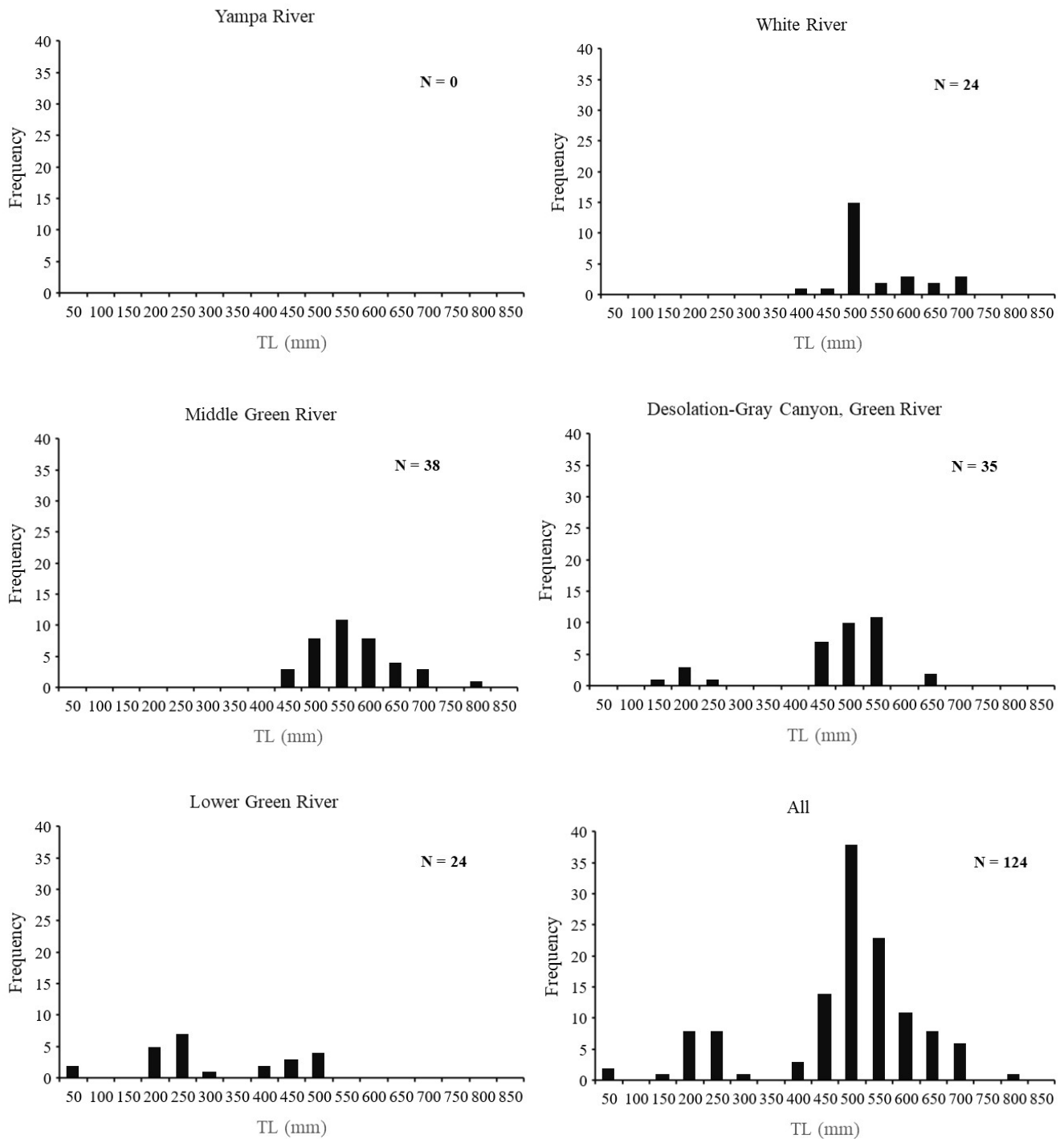


Figure 2. Length-frequency histograms for Colorado pikeminnow captured in five reaches of the Green River basin, 2022. No pikeminnow were captured in the Yampa River, White River and middle Green River fish were mainly ≥ 450 mm TL, and only the Desolation-Gray Canyon and lower Green River reaches had a mixture of sizes including younger individuals, but overall, few individuals of any size were captured.

UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

Table 1. Project 128, 2022 sampling dates, number of days sampled (includes partial days), river reaches (river km), sampling effort, and numbers of juvenile, sub-adult, and adult Colorado pikeminnow sampled (includes recaptures) or recaptured (all lengths are TL); the three recaptures were adults.

Reach and Pass	Dates	Days	River km Sampled	Electrofishing Effort (hours)	Juveniles (< 400 mm)	Sub-adults (400-449 mm)	Adults (>=450 mm)	Pikeminnow Recaptured ²
Yampa River								
Pass 1	April 21 - May 19	29	200-81	52.5				
Pass 2	May 17 - 1 June	16	200-76	57.3				
Pass 3	June 4 - June 7	4	200-161	34.8				
Total		49		144.6	0	0	0	0
White River								
Pass 1	May 3 - 13	11	168-0	65.5				
Pass 2	May 17 - 26	10	168-0	60.9				
Pass 3	May 31 - June 3	4	168-0	64				
Total		25		190.4	0	1	26	0
Middle Green River								
Pass 1	April 4 - 21	18	534-372	47.9				
Pass 2	April 25 - May 5	11	538-372	53.7				
Pass 3	May 10 - 26	17	538-372	75				
Total		46		176.6	0	0	38	0

UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

**Desolation-Gray
Canyon, Green
River**

Pass 1	April 19 - 25	7	372-193	76.5				
Pass 2	May 2 - 9	8	372-193	61.4				
Pass 3	May 17 - 22	6	372-193	61.2				
Total		21		199.1	5	0	30	1

**Lower Green
River**

Pass 1	April 23 - 1 May	9	193-0	86.8				
Pass 2	May 10 - 18	9	193-0	95.2				
Pass 3	27 May - June 4	9	193-0	87.9				
Total		27		269.9	15	2	7	2
All reach totals		168		980.6	20	3	101	3

¹ All Colorado pikeminnow PIT tagged

² Only adults recaptured during 2022 sampling passes