FY 2022 ANNUAL REPORT PROJECT: XXXX

Project Title
Using non-native vegetation to enhance in-stream habitat for native fishes

Bureau of Reclamation Agreement Number:
R19AC00153

Project/Grant Period:
Start date: 10/01/2021
End date: 09/30/2024
Reporting period end date: 03/31/2022
Is this the final report? Yes _____ No X

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Abstract:
In 2021, we installed a total of 120 woody structures at 12 treatment reaches throughout geomorphic reaches 3 and 4. We sampled fishes, macroinvertebrates, and habitat (depth, velocity, and dominant substrate size) at treatment reaches and paired reference reaches that did not receive wood treatments in

October, November, December, and March 2022. We also deployed submersible PIT tag antennas at a subset of paired treatment and reference reaches. In total, we captured 4,303 fishes and crayfish (392 native fishes). The three most abundant species captured were nonnative Red Shiner *Cyprinella lutrensis* (3,047) and Channel Catfish *Ictalurus punctatus* (754) and native Flannelmouth Sucker *Catostomus latipinnis* (228). Including data from all sampling in fall 2021-spring 2022, average total densities of native fishes were 44% higher in treatment reaches (mean ± SE, 0.011 ± 0.002; p = 0.034) than in reference reaches (0.007 ± 0.002). Total nonnative fish densities were generally higher than native fishes, but were not noticeably different between treatment (0.071 ± 0.013) and reference reaches (0.074 ± 0.021; p = 0.301). We will continue to process macroinvertebrate samples, maintain PIT tag antennas, and analyze data. We plan to repeat the experiment in 2022-2023. Preliminary results suggest experimental wood addition to simplified habitats could be a viable management action to enhance habitat for native fish.

Study Schedule:
2021-Ongoing

Relationship to LRP:
This SOW contributes to Element 2 of the LRP and the following goals, actions, and tasks:

1. Element 2-Protection, Management, and Augmentation of Habitat
    a. Goal 2.1-Provide suitable habitat to support recovery of CPM and RBS populations
        i. Action 2.1.1-Implement habitat restoration strategies to augment habitat complexity and the function of river flow to create and maintain suitable habitat
            1. Task 2.1.1.1.1-Develop and implement a plan for feasible habitat restoration strategies.
    b. Goal 4.3-Monitor and evaluate habitat restoration strategies and projects
        i. Action 4.3.1-Evaluate habitat restoration to augment the function of river flow to create and maintain suitable habitat
            1. Task 4.3.1.1-Use an evaluation of habitat restoration to determine success of restoration and quantify the need for further restoration efforts.

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

<u>Name of Project Segment, Task as desired</u>

Study area and Methods
We sampled fishes, macroinvertebrates, and habitat (depth, velocity, and dominant substrate size) at 12 sites in geomorphic reaches 3 and 4 (Figure 1). We divided sites into an upstream reference reach and a downstream treatment reach. We installed 10 woody structures consisting of multiple branches of nonnative Russian olive (*Elaeagnus angustifolia)* and anchored in place with at least two pine peeler cores (Figure 2). To try and account for variability in flows, we installed structures at different water depths within 5 m of shore at the time of installation. In September 2021, we sampled all sites and reaches before addition of wood, and resampled sites in October, November, December, and March

2022 following wood addition. To sample fishes, we sampled along shore with a straight seine (4.6 m x 1.8 m, 3.2 mm mesh) in both the reference and treatment reaches. We also used backpack electrofishing to sample the woody structures in the treatment reaches. Data from seining and electrofishing were kept separately. We deployed passive integrated transponder (PIT) tag antennas at a subset of paired reference and treatment reaches.

We quantified depth, velocity, and dominant substrate size in reference and treatment reaches along three equally-spaced transects in each reach. We measured these variables at five points along each transect with the first point starting at 0.1 m from shore and the other four points distributed evenly between that point and the edge of the furthest woody structure. We also measured depth, velocity, substrate downstream of and within woody structures. Finally, we deployed temperature loggers at a subset of reaches attached to the PIT tag antennas to assess differences in localized temperature due to woody structure addition, but are still assessing these data.

We sampled macroinvertebrates with a combination of kick sampling using a D-frame net and scrubbing woody structure. We conducted kick sampling in reference and treatment reaches along three transects, and collected wood from woody structures for wood scrubs in the treatment reaches. Macroinvertebrates samples are still being processed in the laboratory.

We built generalized linear mixed effects models (GLMER) for native and nonnative fish densities including experimental reach as a categorical fixed effect (i.e., treatment or reference) and sampling month as a random effect to account for repeated measures. We also included geomorphic reach as a covariate to account for spatial variability in fish densities. Because density data were continuous, positive-only, and contained zeros, we assumed a tweedie distribution with a log-link. We also tested for differences in depth and velocity between experimental reaches using GLMER as described above. We assumed a Gamma distribution with a log-link for depth and a gaussian distribution for velocity data. We did not include geomorphic reach in the habitat models. Analyses was conducted in Program R (R Core Team 2022).

Preliminary results

We captured a total of 4,303 fishes and crayfish. Native fish comprised 9% of the total catch. Flannelmouth Sucker *Catostomus latipinnis* was the most abundant native species, followed by Speckled Dace *Rhinichthys osculus* (Table 1). Captures of nonnative fish were dominated by Red Shiner *Cyprinella lutrensis* and Channel Catfish *Ictalurus punctatus* (Table 1). Of the native fishes captured, we implanted PIT tags into 120 previously untagged native fishes including 100 Flannelmouth Sucker, 11 Colorado Pikeminnow, and 9 Bluehead Sucker. We also recaptured three Colorado Pikeminnow, two Flannelmouth Sucker, and one Razorback Sucker. The three recaptured Colorado Pikeminnow were all stocked in October 2021; two were stocked at Hogback Canal (River Mile [RM] 0.4)and one was stocked in McElmo Creek (RM 10;STReaMS, 04/11/2022). We detected 257 unique Colorado Pikeminnow on submersible PIT tag antennas. Generally, more unique fishes than in treatment reaches (Figure 3). Forty-five percent of detected Colorado Pikeminnow were stocked at Hogback Canal in October 2021. Colorado Pikeminnow stocked into McElmo Creek (RM 0.3, 10) in October and March 2021 made up 12% and 7% of detected fish, respectively. Various stocking/tagging events in the San Juan River accounted for most remaining Colorado Pikeminnow detected (32%).

Total native fish densities were higher on average (44%) in treatment reaches(mean ± SE, 0.011 ± 0.002) than in reference (0.007 ± 0.002) reaches (GLMER: $\chi^2_1 = 4.484$, $p = 0.034$; Figure 4). This pattern was largely driven by abundant Flannelmouth Sucker and Speckled Dace (Figure 4). Conversely, total nonnative fish densities were not different among reference and treatment reaches ($\chi^2_1 = 1.071$, $p = 0.301$; Figure 5.

Average depth (0.34 ± 0.01) and velocity (0.33 ± 0.01) measured at transects did not differ between reference and treatment reaches (both $p > 0.165$; Figure 6 & 7). Compared to habitats without added wood, water velocities were lower within and directly downstream of woody structures (78% and 59%, respectively, on average; Figure 6 & 7). The median velocity within woody structures was 0.07 m/s and directly downstream of woody structures was 0.12 m/s, at least 3x lower than median velocities measured from transects. substantially lower than habitat measured throughout the reference and treatment reaches. Sandbars and low-velocity, shallow habitat formed behind most woody structures that maintained contact with the water. Lower than average flow conditions existed during the study period which contributed to the stranding of some piles, though some woody structures were in contact with the water across all sites and sampling efforts. In total, 40% of woody structures were dry at some point during sampling efforts, though varying flow and shifting sediment reengaged some woody structures.

Additional noteworthy observations:

Three Colorado pikeminnow stocked into McElmo Creek (RM 0.3, 10) were detected in the Powerline reach, approximately 2 miles upstream of the Mancos River-San Juan River confluence (RM 141). Additional Colorado Pikeminnow encountered (captured and detected) were previously captured and tagged further downstream between Recapture Creek (RM 97) and Mexican Hat (RM 69).

We observed evidence of beavers, in the form of chew marks, at every site we installed woody structures. Beavers completely disassembled woody structures in three weeks leaving only the pine peeler cores behind at a site located at RM 110.8.

Recommendations and future directions:

In the second year of this project, we plan to repeat the experiment, but will apply lessons learned during the first year to adapt placement of woody structures. We plan to install fewer, but larger woody structures at sites in 2022 to both reduce the impacts of beaver disassembling the structures and attempt to keep all structures in continuous contact with river flows. We think larger structures will allow us to place them further away from shore in deeper water. We also plan to pre-cut Russian olive branches over the summer to try and reduce palatability to beavers. Along with conducting a second experiment in 2022, we will continue to analyze data throughout the second year of the project.

Project Status:

Ongoing

FY 2022 Budget Status

Funds Provided: $93,374.02

Funds Expended: $93,374.02

Difference: -$0-

Percent of the FY 2022 work completed, and projected costs to complete: 100%

Recovery Program funds spent for publication charges: -0-

Status of Data Submission

All capture and detection data from 2021 were submitted to the SJRIP Program Office 01/04/2022 and were subsequently uploaded to STReaMS. Data from March 2022 and data collected in the fall will be uploaded into STReaMS by the end of (December, 2022 or January, 2023)

Signed:

Casey Pennock
Principal Investigator
06/30/2022

References

R Core Team. 2022. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/.

Species Tagging, Research and Monitoring System (STReaMS). 2022. Accessed via the internet at https://streamsystem.org on 04/11/2022.

Tables

Table 1: Total number and sizes of fishes and crayfish captured across all sampling in fall 2021 and spring 2022.

Species	Status	Reference captures	Treatment captures	Total captured	Mean total length (mm, range)
Bluehead Sucker	Native	10	12	22	142 (52-288)
Colorado Pikeminnow	Native	9	5	14	167 (115-222)
Flannelmouth Sucker	Native	90	138	228	145 (44-490)
Razorback Sucker	Native	0	1	1	493
Speckled Dace	Native	59	68	127	66 (37-95)
Black Bullhead	Nonnative	4	2	6	64 (41-152)
Channel Catfish	Nonnative	357	397	754	65 (27-520)
Common Carp	Nonnative	0	1	1	145
Fathead Minnow	Nonnative	19	14	33	54 (28-73)
Red Shiner	Nonnative	1662	1385	3047	49 (14-85)
Virile Crayfish	Nonnative	32	22	54	63 (33-147)
Western Mosquitofish	Nonnative	3	13	16	28 (22-37)

Figures

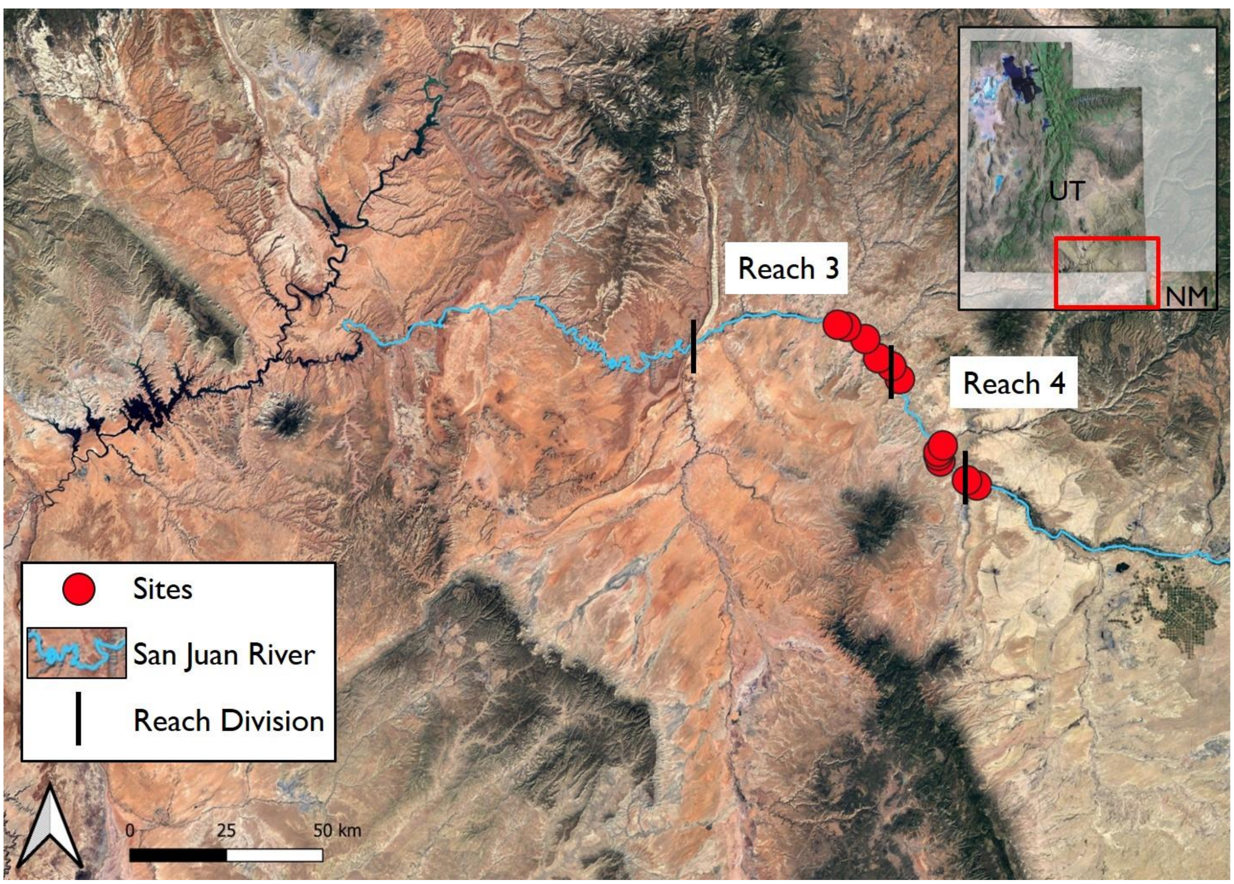


Figure 1: Location of 2021 paired reference/treatment sites sampled in fall 2021 and spring 2022.

Figure 2: Newly constructed Russian olive wood structures (September 2021).

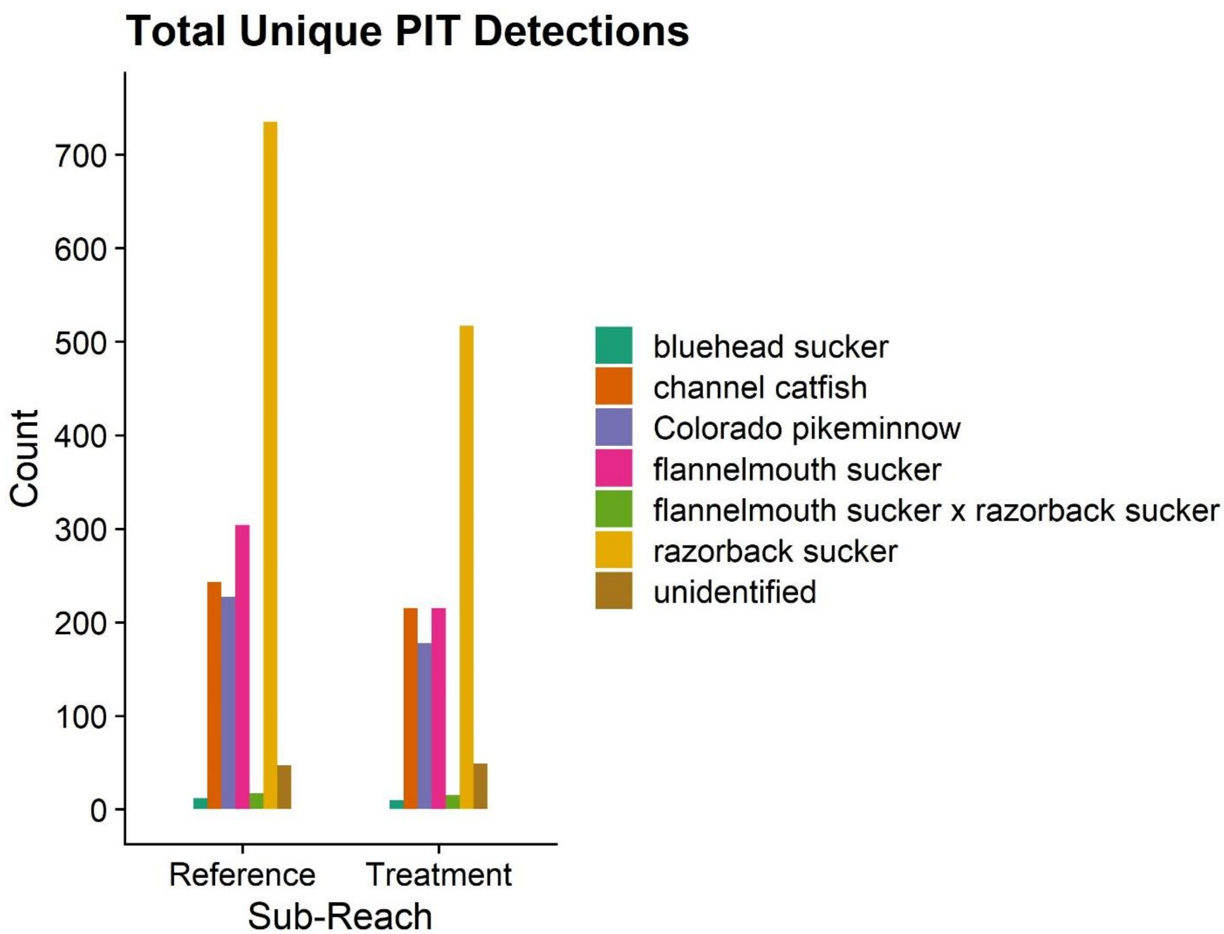


Figure 3: Unique PIT tags, grouped by site, subreach, and species, detected on PIT tag antennas September - December, 2021 and February – May, 2022.

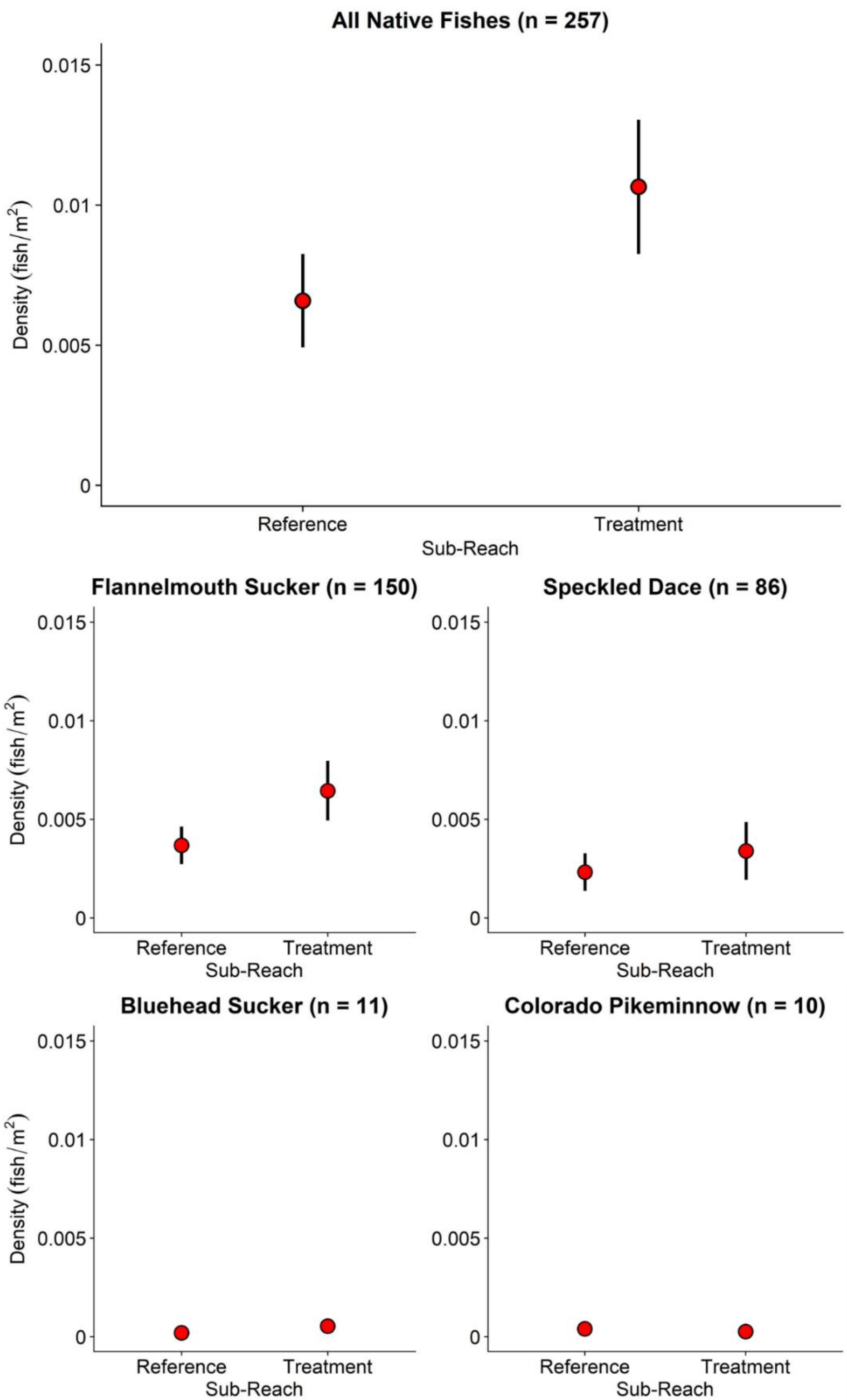
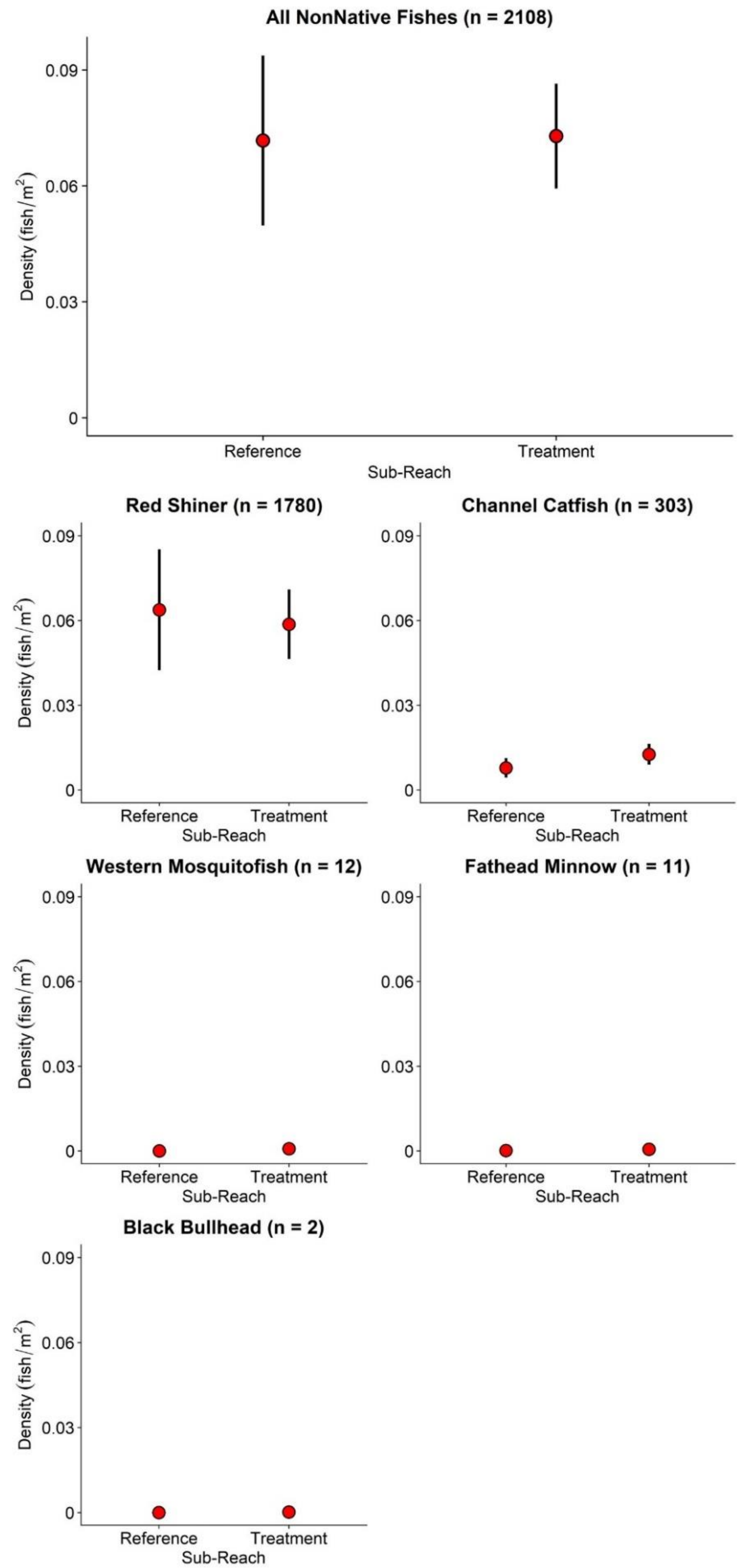


Figure 4: Native fish densities (mean ± SE) for 12 sites following nonnative wood addition (October-March).


All NonNative Fishes (n = 2108)
Red Shiner (n = 1780)
Channel Catfish (n = 303)
Western Mosquitofish (n = 12)
Fathead Minnow (n = 11)
Black Bullhead (n = 2)
Density (fish/m2)
0.09
0.06
0.03
0
Reference
Treatment
Sub-Reach

206

Figure 5: Nonnative fish densities (mean ± SE) for 12 sites following nonnative wood addition (October-March).

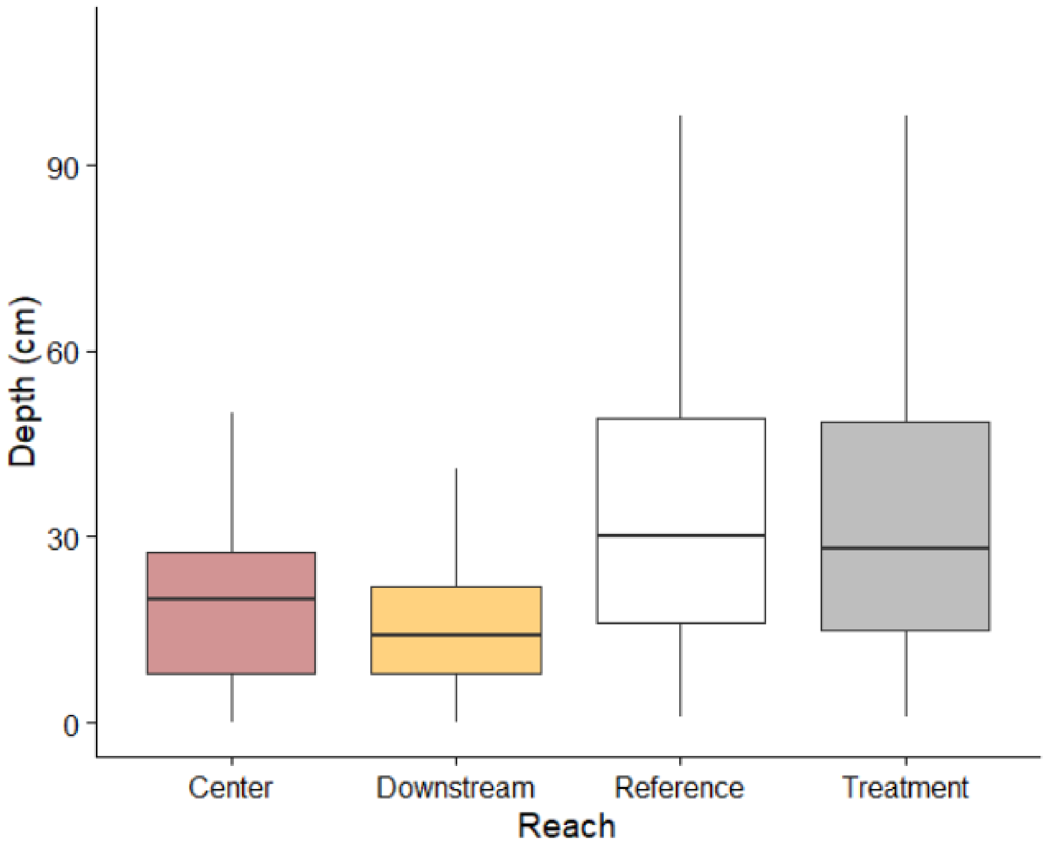


Figure 6: Boxplots of depth measured across transects in experimental reaches (Reference, Treatment) and within and directly downstream of woody structures (Center, Downstream). Box dimensions represent the 25^{th} and 75^{th} percentile ranges, the bold horizontal line represents the 50^{th} percentile, and the whiskers extend from the box edges to the smallest and largest value no further than 1.5x the interquartile range.

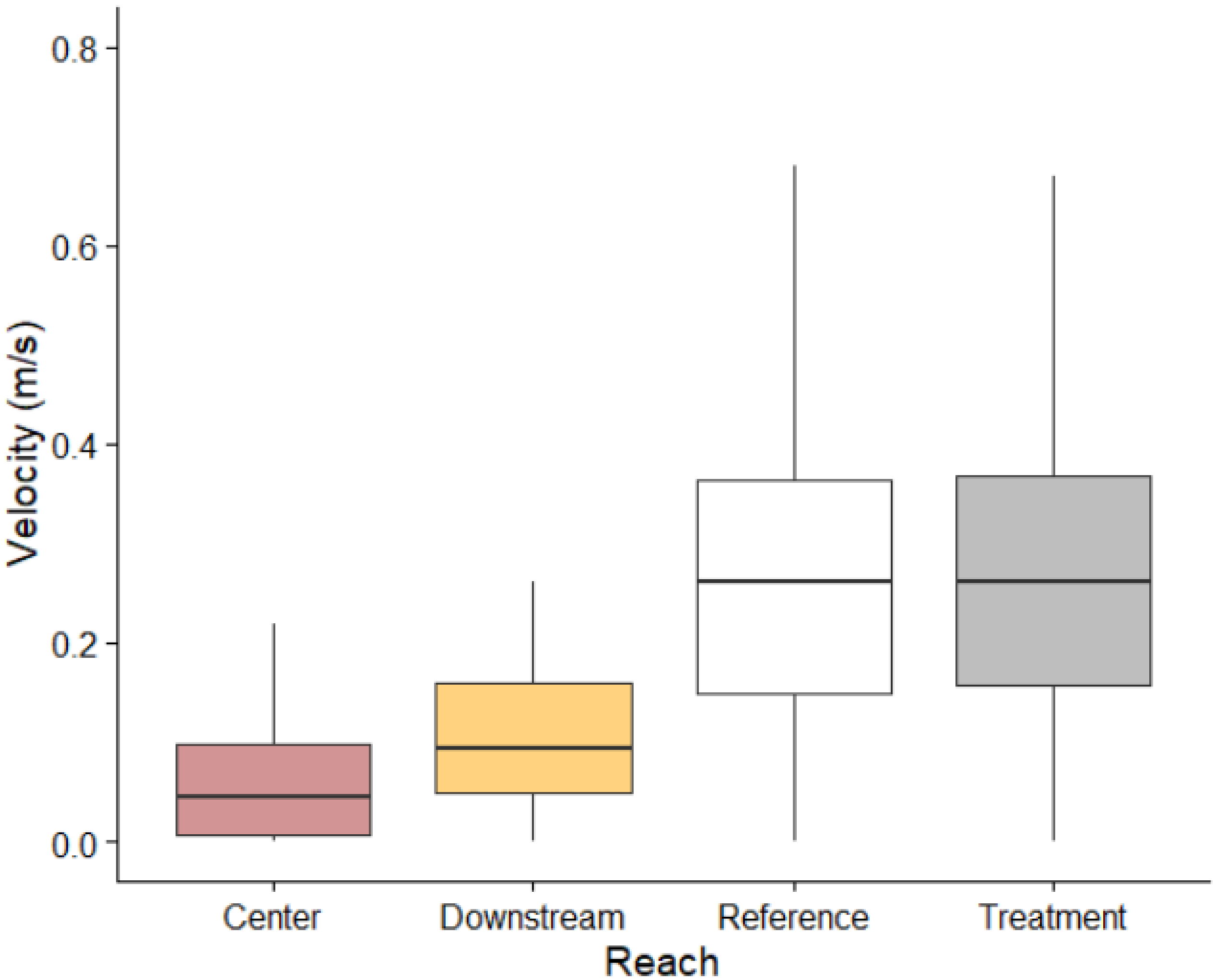


Figure 7: Boxplots of velocity measured across transects in experimental reaches (Reference, Treatment) and within and directly downstream of woody structures (Center, Downstream). Box dimensions represent the 25^{th} and 75^{th} percentile ranges, the bold horizontal line represents the 50^{th} percentile, and the whiskers extend from the box edges to the smallest and largest value no further than 1.5x the interquartile range.