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Lack of High-Quality Nurseries Is Not Just a Human Problem: Nonnative Fish Densities in Backwater Nurseries of the San Juan River, NM, CO, UT

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Introduction

The Razorback Sucker (*Xyrauchen texanus*) and Colorado Pikeminnow (*Ptychocheilus lucius*) are federally-endangered species occurring in the San Juan River of NM, CO, and UT (Fig. 1). These species have shown little natural recruitment in this system (Schooley and Marsh 2007), with a lack of high-quality nursery habitats being one potential explanation for this phenomenon. The young-of-year of both species prefer backwaters, including those that form in secondary channels or in association with islands (Farrington et al. 2016). Unfortunately, many nonnative fishes that compete with and prey upon these imperiled species also reside in backwaters (Brandenburg and Gido 1999). Many of these nonnative fishes (e.g., Red Shiner *Cyprinella lutrensis*; Western Mosquitofish *Gambusia affinis*) in the San Juan River are small-bodied generalists with rapid life cycles and high reproductive effort, allowing them to quickly achieve high densities in their introduced ranges (Moyle 2002; Herrington 2004). However, it is presently unknown how nonnative fish densities vary between secondary channel and island backwater nurseries of the San Juan River during the critical post-spawning window of July-September.

Methods

Our goal was to assess variation in nonnative fish densities in backwater habitats along a 55-river mile reach of the San Juan River in between Shiprock, NM and Montezuma Creek, UT (Fig. 1). Nonnative fishes were sampled using a 4.6 m wide X 1.8 m tall seine with 3.2 mm mesh. We seined 50 m reaches within 20 backwater habitats, including 10 secondary channel and 10 island sites. Each site was sampled five times at two-week intervals between July-September 2021. All fish species captured were identified to species, measured for total length, and released back into the sample reach. Nonnative densities were calculated by dividing the total number of individuals captured across all nonnative species encountered at a site by backwater sample area (m²). The estimated results are displayed in #/100m².

Data Analysis

We examined differences in nonnative fish densities between backwater types (secondary channel and island) and among our five sample trips. Prior to analysis, data was $\log_{10}(x+1)$ transformed to meet normality and homoscedasticity assumptions. Mean differences were tested using one-way analysis of variance (ANOVA) and Fisher's least significant difference (LSD) post hoc analyses. $\alpha = 0.05$ was used for all analyses.

Results

We collected 13,016 nonnative fishes in 85/91 sites. Mean densities of nonnative fish were 115% greater in secondary channels compared to islands ($F_{1,89} = 11.98$, $p = 0.008$; Fig. 2). We also found that mean nonnative fish densities significantly varied among the sample trips ($F_{4,84} = 2.71$, $p = 0.035$; Fig. 3), with trip #2 having significantly lower mean density than trips 1, 3, and 4, but not compared to trip #5.

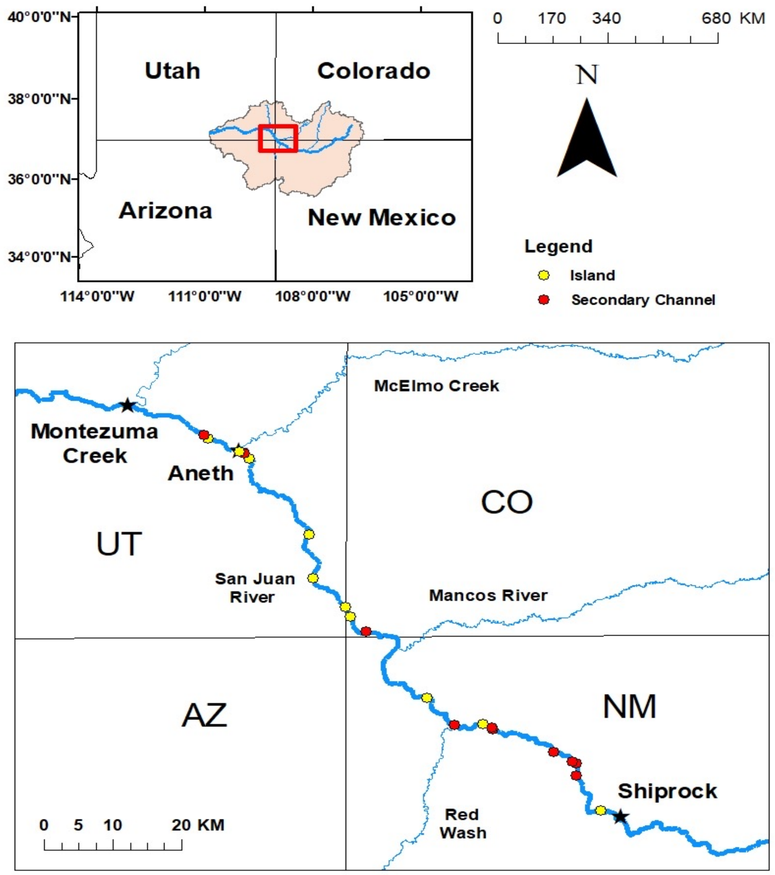

Figure 1. Map of the San Juan River with secondary channel and island backwater sample sites indicated.

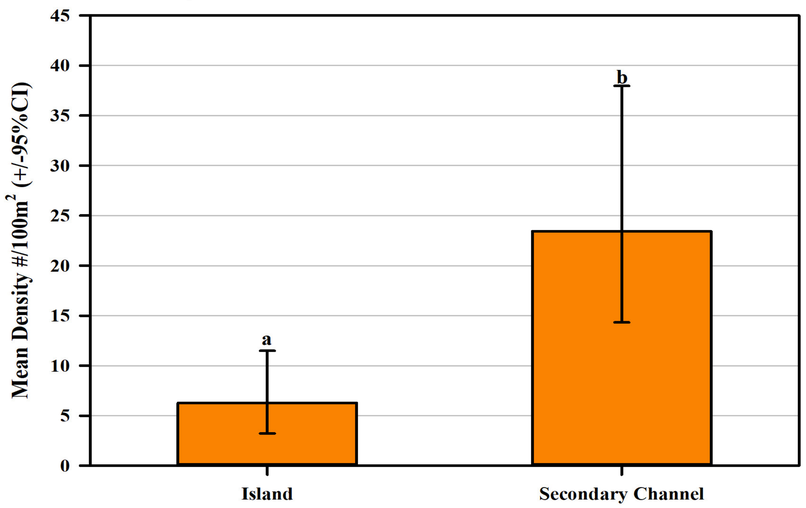

Figure 2. Mean nonnative fish density differences between island and secondary channel backwaters on the San Juan River. Letters denote significance ($\alpha = 0.05$).

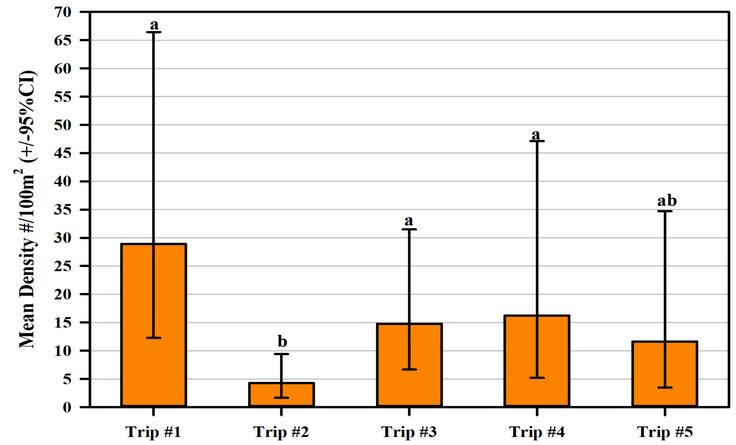

Figure 3. Mean nonnative fish density differences among five sample trips conducted in backwaters of the San Juan River during July-September 2021. Letters denote significance ($\alpha = 0.05$).

Conclusion

It appears that overall nonnative fish densities are greater in secondary channel backwaters compared to islands (Fig. 2), indicating secondary channel backwaters might provide poorer nursery habitat for imperiled native fishes. This pattern was generally consistent throughout the post-spawning season, as only 1/5 sample trips significantly differed in nonnative density (Fig. 3). If native fishes prefer secondary channel backwaters for nurseries because of their environmental characteristics, competition and predation pressure from nonnatives may be a potential factor contributing to the lack of recruitment by imperiled fishes of the San Juan River.

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