

Dinosaur National Monument & Canyonlands National Park

Project Brief

National Park Service
U.S. Department of the Interior

Natural Resource Condition
Assessment Program



Modeling Non-native Smallmouth Bass Population Dynamics in the Green River to Support Native Fish

Summary: Four federally endangered or threatened fish are native to the Green River and its tributaries, including areas in Dinosaur National Monument and Canyonlands National Park. Smallmouth bass, an important recreational sportfish but an invasive species in the Green River system, threatens these native fish. This study used long-term data on smallmouth bass captures and early life history to build a population model linking bass recruitment to variability in environmental conditions and mechanical removal of bass.

Researchers found that early life stages of bass were influenced by the timing of hatching, water temperature, and river/dam discharge. The model suggests that invasive-fish removal programs are a key management tool to keep populations in check. It also suggests that targeted high-flow events during smallmouth bass spawning and nesting, such as the recent releases out of Flaming Gorge Dam, effectively reduce bass reproductive success. Building these types of models can help test effects of management strategies and other conditions (e.g., hydrologic, climate), leading to better informed decision-making.

Background

The Green River and its tributaries in Utah and Colorado support populations of four Endangered Species Act-listed fish: humpback chub (*Gila cypha*), bonytail (*Gila elegans*), Colorado pikeminnow (*Ptychocheilus lucius*), and razorback sucker (*Xyrauchen texanus*). Much of the Green River system is crucial habitat for these species and considered vital for their recovery. This includes the Yampa and Green rivers in Dinosaur National Monument (NM) and Canyonlands National Park (NP). Both rivers are also inhabited by non-native fish such as smallmouth bass (*Micropterus dolomieu*). Because smallmouth bass threaten the recovery of the endangered/threatened fish, state and federal resource managers have conducted mechanical removals (via electrofishing) of bass in parts of the river sub-basin since 2003.

Flaming Gorge Dam is located on the upper Green River, upstream of the two parks (Figure 1). The Upper Colorado River Endangered Fish Recovery Program developed recommendations for the release of water and flows from the dam, with the most recent flow and temperature



The Green River in Dinosaur National Monument. NPS photo

recommendations described by LaGory et al. (2019). Long-term drought and increasing water demands have strained the Green River system, leading to emergency releases and changes in operations at Flaming Gorge Dam.

To help the National Park Service (NPS) understand how possible changes in flow regimes could affect native federally listed fish and non-native predatory fish in the parks, park managers sought partners to develop fish population response models.

Project Overview

Research partners started with existing smallmouth bass demographic models that included effects of density dependence and mechanical bass removal. They then expanded the models by including environmental drivers (hydrology and river temperature) and fitted the model to observed data. Their goal was to discern drivers of smallmouth bass population change and create a simulation model to investigate responses of smallmouth bass to management actions and future hydrologic conditions. The model that researchers developed was structured by bass age and included five age classes (ages 0 to 4+). Ages-1 and 2 were non-reproductive sub-adults, and ages-3+ were reproductive adults.

The geographical areas of focus for the modeling project were two lower reaches of the Yampa River (Lily Park and Yampa Canyon) and the middle section of the Green River downstream of Flaming Gorge Reservoir (see Figure 1). The latter area is affected by releases from the dam, as well as by the mostly unregulated Yampa River. The Green River reach has a long-term record of intensive smallmouth bass removal.



Figure 1. Map showing the locations of the Flaming Gorge Reservoir, the three river reaches studied, and Dinosaur NM. Note that Canyonlands NP is located approximately 140 miles southwest of Dinosaur (straight-line distance) and is therefore not shown on the map. The two parks are 260 river miles apart. Figure: Lindsey Bruckerhoff, Ohio State University

Key Findings

There were a number of findings from the modeling project. These include, but are not limited to:

- **The model worked.** It was successful at identifying fluctuations in observed catch of smallmouth bass based on hypothesized and estimated dynamics of recruitment, dispersal, survival, and bass removal. Additional information in some areas could make the model even stronger.
- **Reducing small-mouth bass populations is not a “one and done” effort.** Researchers estimated the proportions of smallmouth bass that dispersed upstream or downstream from each of the three river reaches. They estimated, for example, that 32% and 28% of sub-adults and adults, respectively, in Lily Park moved downstream to Yampa Canyon.
- **Sustained removal efforts work.** A simulation case study of bass removal efforts found that abundance of

sub-adults and adults would have increased in all three river reaches if no past effort was made to remove smallmouth bass. It was also determined that sustained maximum removal efforts could have resulted in bass densities 89% lower than those under observed removal levels.

- **Nature can help too.** Researchers found that early life stages of bass were influenced by timing of hatching and river/dam discharge. Recruitment (from age-0 to age-1) was low in years with later hatching periods, cooler water temperatures, and higher flows during the hatch. The model also estimated a negative effect of high flow events on bass spawning and nest success.
- **Using this information.** In the face of drought (meaning fewer high-water years) and increasing water demand, targeted dam operations could represent an option for management in the regulated Green River by releasing flow spikes during bass spawning and washing away their nests.

Conclusions: The model discussed here can be used for smallmouth bass management by testing the outcomes of varying management and climate scenarios. Different management scenarios might include conducting bass removal efforts in different river reaches, changing the timing of removal efforts, or varying the timing and/or frequency of releases from Flaming Gorge Dam that disrupt bass nests. The model could also be used to assess the risk of establishment of invasive smallmouth bass in river reaches without bass or with newly introduced populations. The risks of establishment grow as reservoir releases become warmer with lower reservoir levels.

Based on this and other work, current management tools for smallmouth bass include mechanical removal of bass, targeted flows, and working with other federal and state partners and stakeholders.

Literature Cited

La Gory, K.E., K.R. Bestgen, H. Patno, J. Wilhite, D.M. Speas, and M.A. Trammell. 2019. Evaluation and suggested revisions of flow and temperature recommendations for endangered fish in the Green River downstream of Flaming Gorge Dam, Flaming Gorge Dam flow and temperature recommendations—Final Report. Upper Colorado River Endangered Fish Recovery Program.

This Brief is Based on:

Bruckerhoff, L., C. Yackulic, D. Eppenhimer, K. Bestgen, M. Tildon Jones, and C. Michaud. 2025. [Estimating drivers and identifying uncertainties in smallmouth bass population dynamics in an invaded river network](#). Canadian Journal of Fisheries and Aquatic Sciences 82:1–24.