Pumpkin Creek Aquatic Species Monitoring Plan: addressing fish biologists' concerns

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Background

Low-tech, process-based restoration (LT-PBR) is known to be largely beneficial to fishes in the few instances where fish have been monitored (e.g., Bouwes et al. 2016). Relative to other regions however, LT-PBR has been virtually unmonitored in prairie streams, and implementation of projects is thought to be outpacing relevant research (Pilliod et al. 2018). While the intended outcomes of restoration would sustain habitats that native Pumpkin Creek fishes historically inhabited, the transition process or even restored system may create habitats that favor non-native species now present in the system (Figure 1). This potential outcome is especially concerning to fish biologists who are tasked with maintaining healthy populations of native and game species. Given the lack of research on fish assemblage response to LT-PBR and biologists' justifiable concern, we intend to implement a collaborative monitoring program (Bureau of Land Management and University of Wyoming) to begin addressing knowledge gaps and help inform future restoration projects.

Pumpkin Creek is known to contain fishes of 26 different species, 19 native and 7 non-native (Table 1; BLM *unpublished data*). Brassy Minnow (*Hybognathus hankinsoni*), Plains Minnow (*H. placitus*), Creek Chub (*Semotilus atromaculatus*), and Burbot (*Lota lota*) are listed as potential Montana Species of Concern due to suspected, but unverified population declines. The diverse species assemblage and presence of potentially sensitive species makes Pumpkin Creek an ideal research candidate for both short and long-term fish response to restoration.

Table 1. Native and non-native fishes found in Pumpkin Creek (2010-2018). Potential Montana Species-of-Concern are *italicized.*

Native		**Non-Native**
Bigmouth Buffalo	Longnose Dace	Black Bullhead
Brassy Minnow	Longnose Sucker	Common Carp
Burbot	*Plains Minnow*	Green Sunfish
Channel Catfish	River Carpsucker	Northern Plains Killifish
Creek Chub	Sand Shiner	Smallmouth Bass
Emerald Shiner	Shorthead Redhorse	White Crappie
Fathead Minnow	Stonecat	Yellow Perch
Flathead Chub	Western Silvery Minnow	
Goldeye	White Sucker	
Lake Chub		

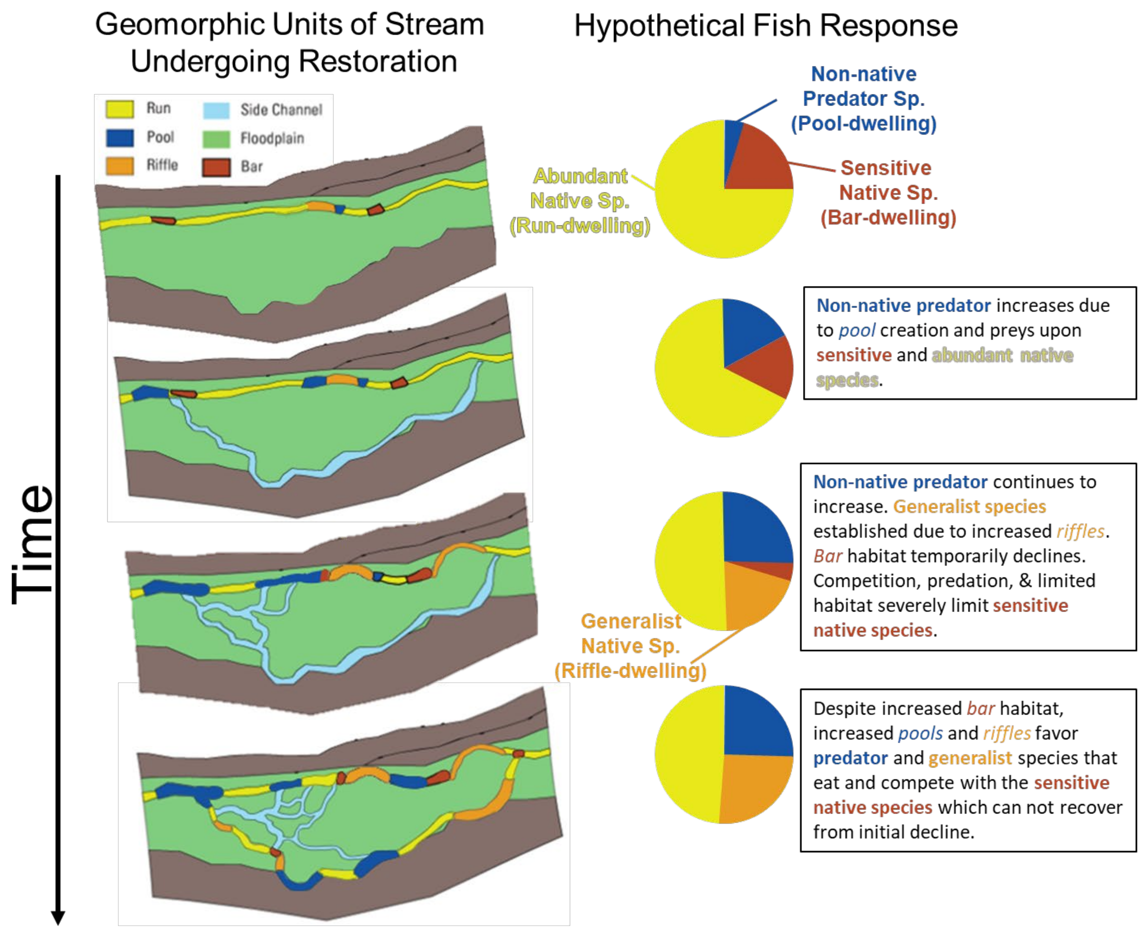

Figure 1. Hypothetical example of how stream restoration could induce geomorphic change (left) that favors generalist and non-native species at the expense of a sensitive native species (right). Please note that this is a completely hypothetical example. To the author's knowledge, such a scenario has not been reported for process-based restoration. Geomorphic unit map adapted from Bennett et al. 2019.

Proposed Monitoring

We propose both short- and long-term monitoring of the fish assemblage at 5 sites in Pumpkin Creek (Figure 2). Short-term monitoring will be completed by University of Wyoming personnel and last 3-4 years. Long-term, less-intensive monitoring will be completed by Bureau of Land Management personnel and last until the entire restoration reach is considered to have reached a new dynamic equilibrium (i.e., be restored).

Short-term monitoring and research

The objective of short-term monitoring is to **link restoration-induced habitat change to shifts in the relative abundance of fish species**. We will accomplish this by:

A) delineating mesohabitat types (e.g., riffles, pools) at five 100 m reaches (Figure 2) before and during restoration (at least once per year). We will use a custom, fish-centric modification of the Geomorphic Unit Tool and Wheaton Fluvial Taxonomy (Wheaton et al. 2015).

B) completing fish sampling via bag seine (Rabeni et al. 2009) and recording fish assemblage composition at every 20 m segment within the 100 m study reaches.

Both habitat and fish assemblage data at sites being restored will be compared to sites not being restored (i.e., control sites) in a before-after, control-impact (BACI) study design. Analysis and interpretation will focus on determining the trajectory of fish assemblage change in the system with special focus on potential species of concern (Table 1). Habitat types within each 20 m section will be compared to the fish assemblage in that section to determine species-habitat relationships.

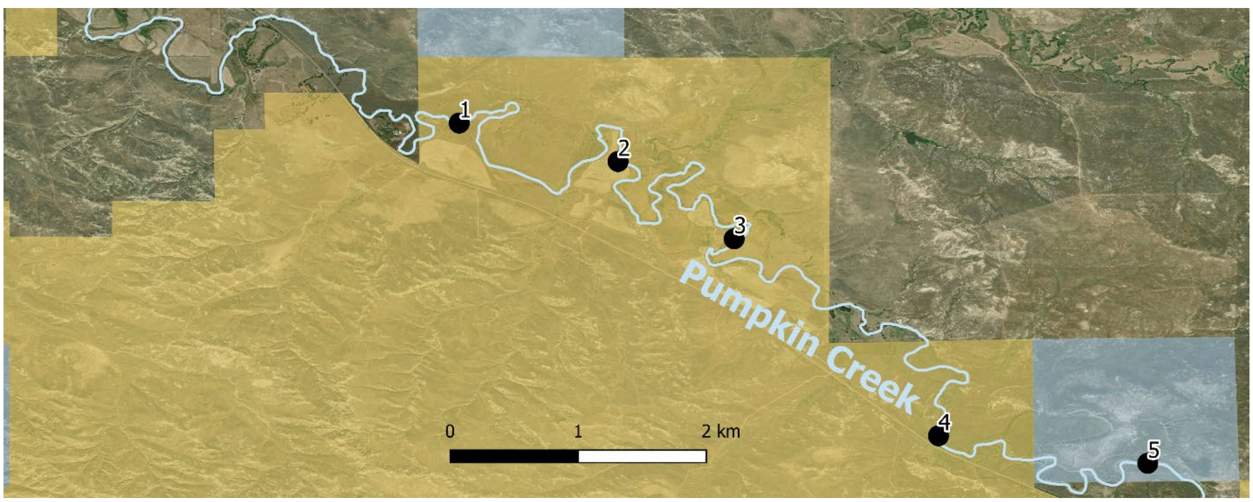

Figure 2. Map of the 5 monitoring reaches within the restoration area. Four of the sites (1-4) were chosen due to the availability of past BLM sampling data.

Long-term monitoring

The objective of long-term monitoring is to **determine which fish species benefited from restoration and which did not.** A secondary objective will be to compare the short-term trajectory of the fish assemblage to the long-term outcome. Upon completion of short-term monitoring, BLM will continue long-term monitoring via a staggered sampling design in which sites 1 and 3 are sampled during odd years and sites 2 and 4 during even years. If as expected, site 5 is not part of the stream restoration, it will be monitored every year to serve as a control site.

A bag seine will be used to sample fish in each 100 m reach in the same manner as short-term monitoring. However, intensive habitat sampling will not occur, and species composition will not be recorded by each 20 m section.

References

Bennett, S. N., J. M. Wheaton, N. Bouwes, C. E. Jordan, W. W. Macfarlane, J. D. Maestas, E. Portugal, and S. M. Shahverdian. 2019. Chapter 3 – Planning for low-tech process-based restoration. Pages 87 – 142 *in* J. M. Wheaton, S. N. Bennett, N. Bouwes, J. D. Maestas, and S. M. Shahverdian, editors. Low-tech process-based restoration of riverscapes: design manual. Utah State University Restoration Consortium, Logan, Utah.

Bouwes, N., N. Weber, C. E. Jordan, W. C. Saunders, I. A. Tattam, C. Volk, J. M. Wheaton, and M. M. Pollock. 2016. Ecosystem experiment reveals benefits of natural and simulated beaver dams to a threatened population of steelhead (*Oncorhynchus mykiss*). Scientific Reports 6: 28581.

Pilliod, D. S., A. T. Rohde, S. Charnley, R. R. Davee, J. B. Dunham, H. Gosnell, G. E. Grant, M. B. Hausner, J. L. Huntington, and C. Nash. 2018. Survey of beaver-related restoration practices in rangeland streams of the western USA. Environmental Management 61: 58-68.

Rabeni, C. F., J. Lyons, N. Mercado-Silva, and J. T. Peterson. 2009. Warmwater fish in wadeable streams. Pages 43-58 *in* S. A. Bonar, W. A. Hubert, and D. W. Willis, editors. Standard methods for sampling North American freshwater fishes. American Fisheries Society, Bethesda, Maryland.

Wheaton, J. M., K. A. Fryirs, G. Brierley, S. G. Bangen, and N. Bouwes. 2015. Geomorphic mapping and taxonomy of fluvial landforms. Geomorphology 248: 273-295.