Assessing the impact of lake expansion on adjacent stream amphibian diversity and density

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Abstract and/or Background

Amphibians are in decline globally likely due to hydrology impacts (Mathwin et al., 2020). Anthropogenic alterations to natural water are one of the top contributing factors to this catastrophic issue (Kupferberg et al, 2009; Mathwin et al, 2020). Observing the expansion at a lake in Lynchburg, VA (Lake Hydaway), the construction of a new dam can have effects on amphibian biodiversity. Previous literature is lacking in the effects of lake expansion and dam construction on amphibian ecology in comparison to the amount of data found on fish and macroinvertebrates (Denton & Richter, 2013). Amphibians are often good indicators of environmental quality due to their aquatic and terrestrial nature, making the lake expansion an ideal opportunity to monitor amphibian biodiversity in response to the construction. (Eskew et al., 2012; Brannon and Purvis, 2007) The objective of the study is to do a biodiversity and density assessment of amphibians in opossum creak, which feeds into Hydaway lake. We plan to collect data at three sampling sites. The first will be located 1170m upstream from the new dam and act as a control site. The other two sites will be located at varying distances downstream from the new dam. Site 2 is located 75m below the new dam, where we expect to observe the most impact. Site three will be located 285m below the new dam into a wooded area where recovery is to be expected. (Eskew et al., 2012; Kirchberg et al., 2016) Three sample 2m^2 quadrants will be surveyed (20 min each) within each site by carefully flipping rocks by hand and using small nets to capture amphibians in each quadrant. After the sampling period, photo vouchers will be taken to identify each individual as well as measuring their snout-vent-length (SVL) using digital calipers. Sediment will be measured using a basic sedimentation method. With the expected decline in amphibian population and density, we can determine how much of Opossum Creek is affected by the lake expansion, leading to more effective management strategies to preserve biodiversity. This study can have implications for other aquatic systems affected by dam construction and lake expansion.

Figure _. Cricket Frog (*Acris crepitan*) photo by Cheyenne Brooks

Figure _. N. Dusky salamander (*Desmognathus fuscus*). Photo by Cheyenne Brooks

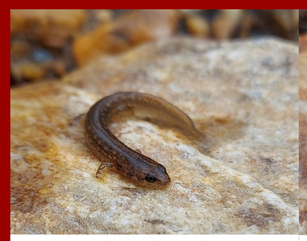

Figure _. Larval S. Two-lined salamander *(Eurycea cirrigera)* photo by Cheyenne Brooks

Figure _. Larval Red salamander (*Pseudotriton ruber*) photo by Cheyenne Brooks

Introduction and/or Research Question

Opossum creek is a second order stream that pours into the James River (*Opossum Creek Topo Map*, 2024). The creek is located in Cambell County, Virginia at an elevation of 482 feet (*Opossum Creek Topo Map*, 2024). The creek originates from rainwater high up and flows downstream draining into king fisher pond and lake Hydaway (Figure 1). Preceding from the lakes historic dam, the opossum creek continued to flow until meeting the James River (Figure 1).

However, in April of 2021, an expansion project began on the Hydaway lake which disrupted the original flow out of the lake (Boyer, 2021). The expansion entailed removing the old dam, building a new dam, and expanding the lake from 6 acres to 31 acres (Boyer, 2021). They also rerouted half a mile of camp hydaway road to accommodate the lake expansion (*Camp Hydaway Lake Expansion*, 2024).

Amphibian species are known to inhabit opossum creek, especially salamanders (Unpublished). During a survey in 2016, The northern dusky salamander (*Desmognathus fuscus*) was the most prominent salamander found by far (Unpublished). Other species found include the Southern two-lined salamander (*Eurycea cirrigera*) and the red salamander (*Pseudotriton ruber*) (Unpublished). Since dams have been seen to affect stream salamander density (Kirchberg et al., 2016) it is important to evaluate whether this new dam construction is affecting the amphibian species of opossum creek.

Methods

Field Collection

- Dipnetting in 2m^2 zones (Fig. 2)
- Flipping rocks in the stream
- Measure SVL using digital calipers (Fig. 4)
- Visual identification
- Substrate assessment

Field Sites

- Site 1: Reference site 1170m upstream from the dam
- Site 2: Immediately downstream from the dam (75m)
- Site 3: 285m downstream with comparable habitat to the reference site (Fig. 1)

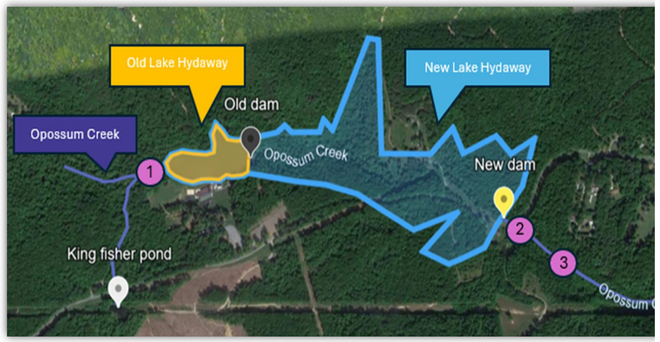

Figure 1. Overview of study site. Orange color represents the previous lake prior construction (6 acres) and blue represents new lake after construction (31 acres) and purple represents Opossum creek. Pink circles represent the 4 study sites numbered accordingly. Map taken from google maps on March 4, 2024.

Figure 2. Red flags used to mark the 2m^2 zones surveyed withing each site. Photo by Cheyenne Brooks.

Figure 4. Measurement of SVL using a Ziplock bag and digital calipers. Photo by Cheyenne Brooks

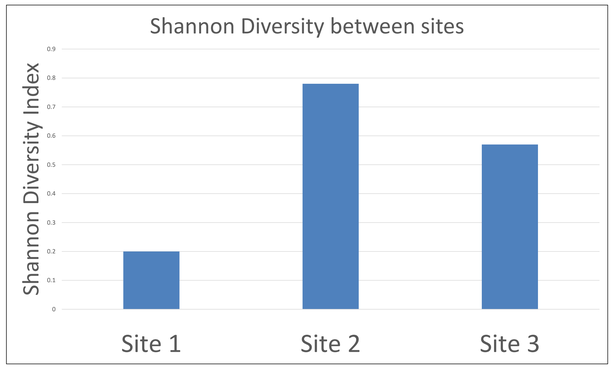

Figure 3. Measure of expected Shannon Diversity Index at the three sites.

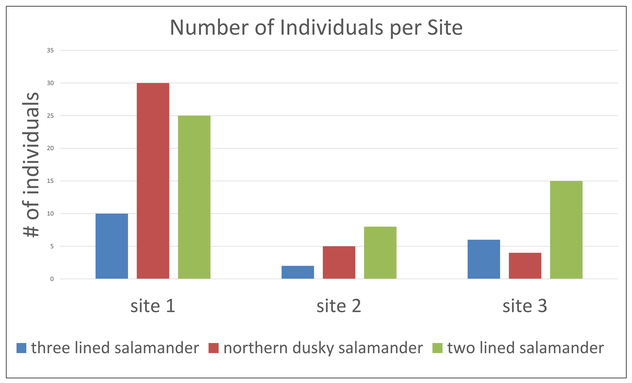

Figure 5. Expected population of the Three lined salamander (*Eurycea guttolineata*), N. Dusky salamander (*Desmognathus fuscus*), and the Two-lined salamander (*Eurycea cirrigera*) at the three sites.

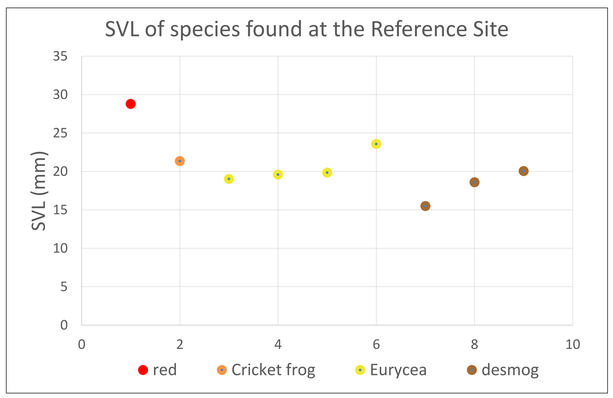

Figure 6. Preliminary data of species found at the Reference Site (Site 1) and their SVL's

Expected Results

- Biodiversity will be highest at the reference site
- Population levels at Site 2 and 3 will be negatively impacted (Fig. 5)
- Site 2 and 3 will have significantly lower diversity (Fig. 3) in comparison to the reference site.

Discussion

We expect from this study to see a decrease in body condition, population , and density downstream from the dam. This will be due to increased sedimentation and timbering as a result of dam construction. Site 2, directly downstream from the dam is a timbered area with very little canopy cover in addition to the sedimentation from the dam, creating a suboptimal habitat. Site 3 has a comparable habitat in terms of stream size and canopy coverage, but we expect to still see the effects of the dam in this area.

Future Work

1. Continued survey as the lake fills.
2. Management practices – habitat building to increase biodiversity.

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