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The Effects of Water Quality on the Habitat Use of Tiger Salamanders in Prairie Wetlands

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Introduction

The tiger salamander (*Ambystoma tigrinum*) is a wide-ranging amphibian of North America common to prairie wetlands. Nevertheless, little is known about their ecology. It is therefore unclear as to what conditions in wetland ponds are well suited for tiger salamanders and what effects human activity may have on established populations. Ponds in prairie wetlands can vary greatly in water quality parameters. Previous work suggests that higher dissolved oxygen levels are ideal (Noland and Ultsch, 1981; Rose and Crumpton, 2006). Similarly, Sugalski and Claussen (1997) suggest that salamanders prefer areas of high pH, being a limiting factor in microhabitat use. Conversely, nitrate and ammonia contamination can be lethal to amphibian communities (Rouse *et al*., 1999) and high nitrite levels may indicate sublethal conditions leading to future nitrate contamination (Griffis-Kyle, 2007). In this study, I assessed how these parameters effect salamander survival and microhabitat use in the prairie pothole region of Western Minnesota. My goal was to see if differences in water quality between ponds may indicate habitat preferences among these salamanders, and thereby, assist in predicting where populations may migrate in subsequent years.

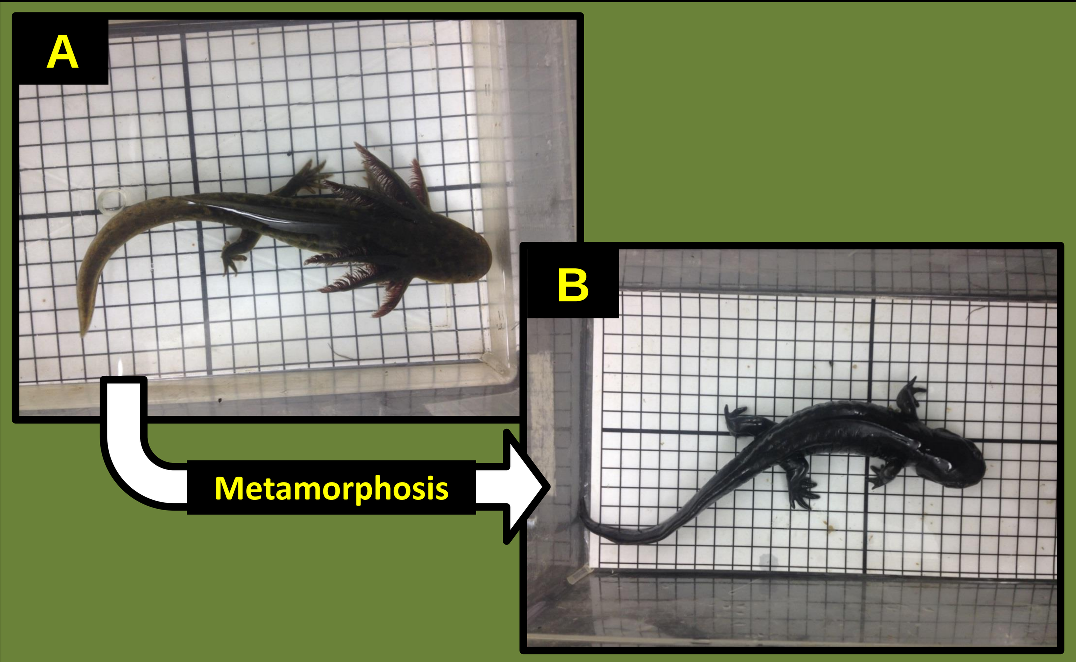

Figure 1. *A. tigrinum* specimens in the larval (A) form and metamorphosed (B) form photographed on a 1x1 cm grid. Photographs are of two different individuals.

Methods

- Field work was conducted for six weeks from late June to early August.
- Four ponds within the study site (Figure 2) were selected for intensive water quality and salamander population assessment. Ponds were selected based on proximity and preliminary water quality results.
- Minnow traps scattered around each pond were checked daily for captured amphibians.
- Water samples from each trap site were collected several times a week and tested for pH and phosphate, ammonia, and nitrite levels using a standard pond water kit. Additionally, dissolved oxygen was measured with a YSI® device.

Study Site

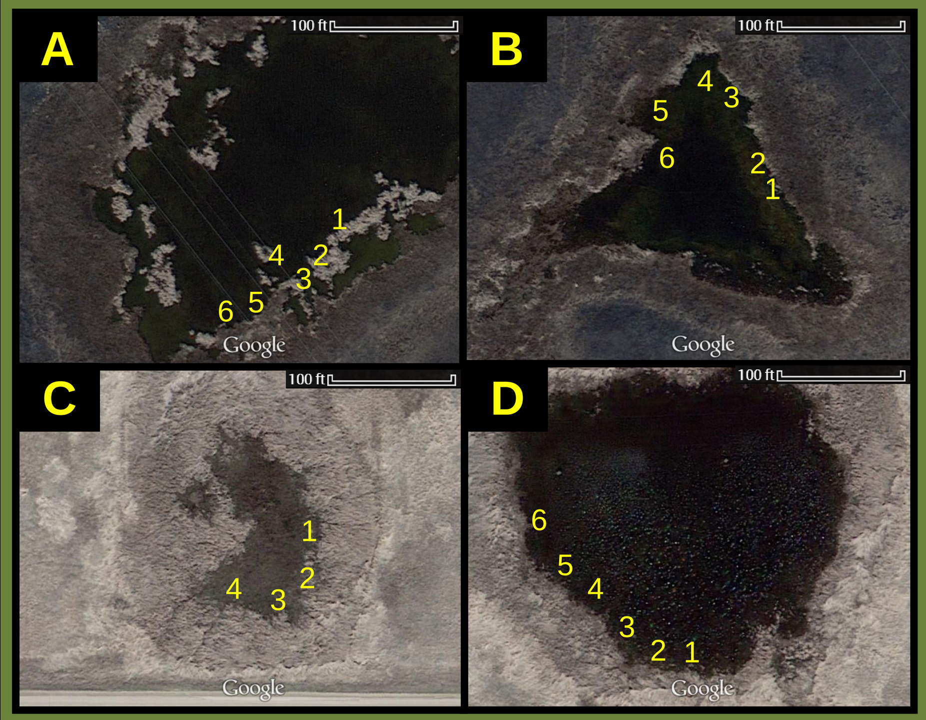

Figure 2. Study ponds within the Pepperton Waterfowl Production Area (PWPA). Trap sites are labeled from East to West. Pond A – a large, deep pond with stable water quality. Pond B – just south of A, selected for high dissolved oxygen. Pond C – a seasonal pond, selected for high phosphorous levels and very low dissolved oxygen. Pond D – just east of C, selected for high ammonia levels.

Results

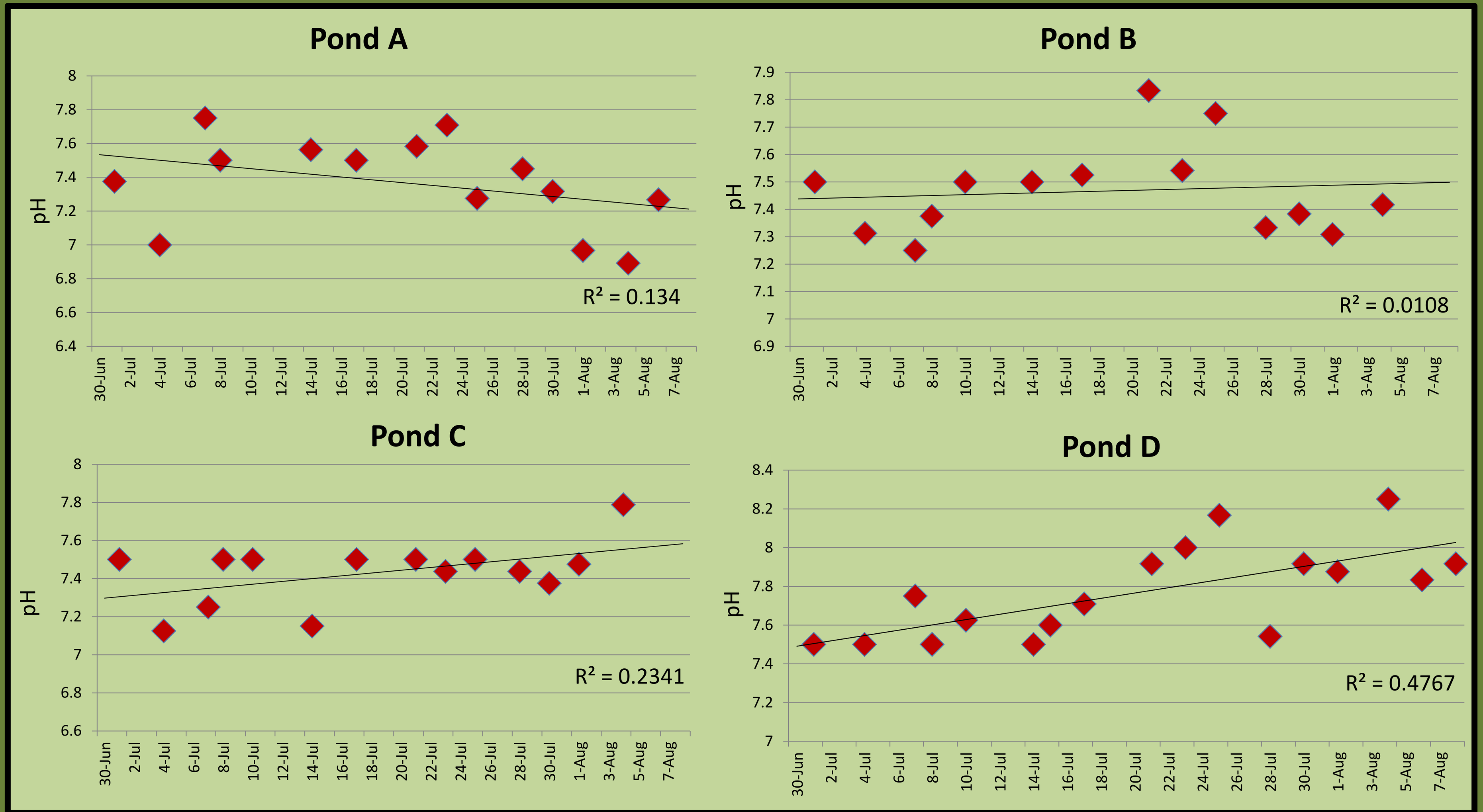

Figure 3. Average pH for each pond over time.

Although each water quality parameter varied between individual trap sites, no significant results in terms of pH were shown at this level of specificity. However, trends in the average pH over time are observable with regression analysis as shown in Figure 3. Ponds B, C, and D are shown to contain increasingly basic water over time whereas Pond A becomes slightly more acidic. Likewise, contaminants are better observed between ponds as opposed to within each pond. The average concentrations of each contaminant are shown in Figure 4. Phosphate levels in Ponds C and D are higher than that of A and B by an order of magnitude. Pond D exhibits greater ammonia levels than all other ponds. Nitrite levels were consistently measured to be 0 ppm in each pond.

Dissolved Oxygen levels between each trap site are shown in Figure 5. Pond B has a noticeably higher oxygen content than any other pond while Pond C shows the lowest amount. Ponds A and D contain roughly equal concentrations.

Salamanders where found in each of the four ponds, as summarized in Table 1. Significant differences in catch rate are observed both between and within certain ponds. Most individuals were caught in Pond D, particularly at Trap #1. Two adults were caught in Pond B, although no larvae were found to be present. In each pond, salamanders were caught disproportionally, with some traps catching no salamanders.

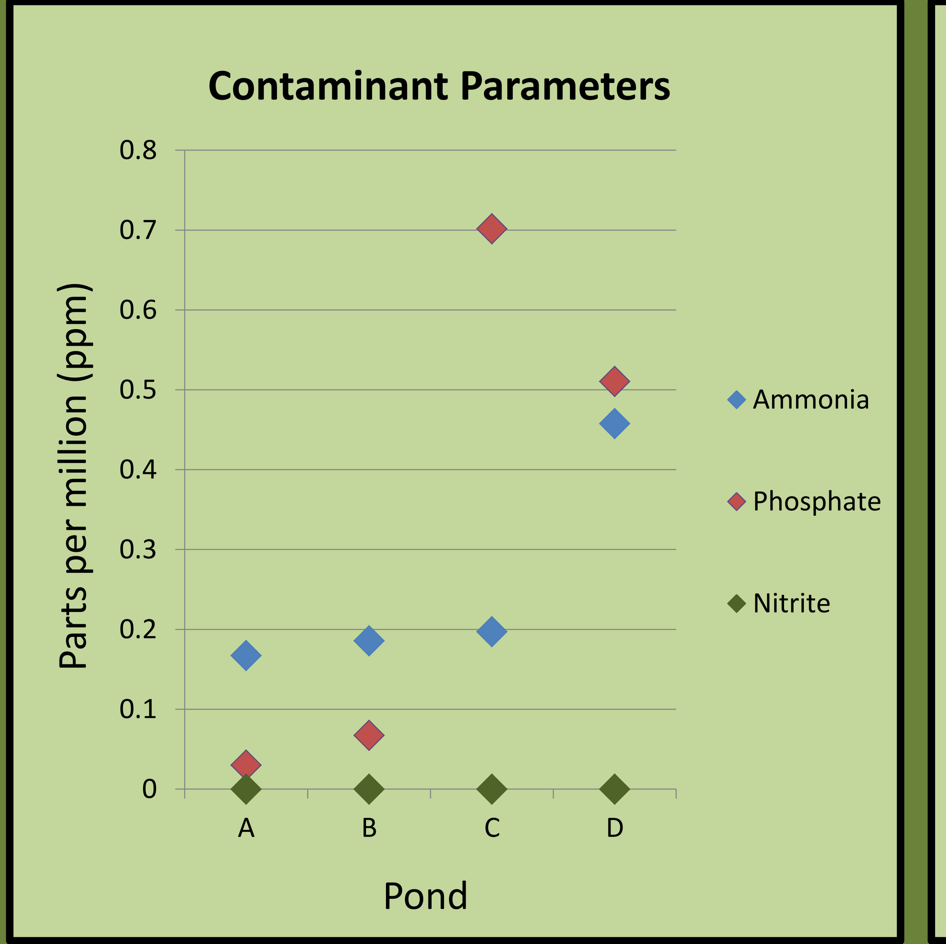

Figure 4. Average amounts of contamination of each pond.

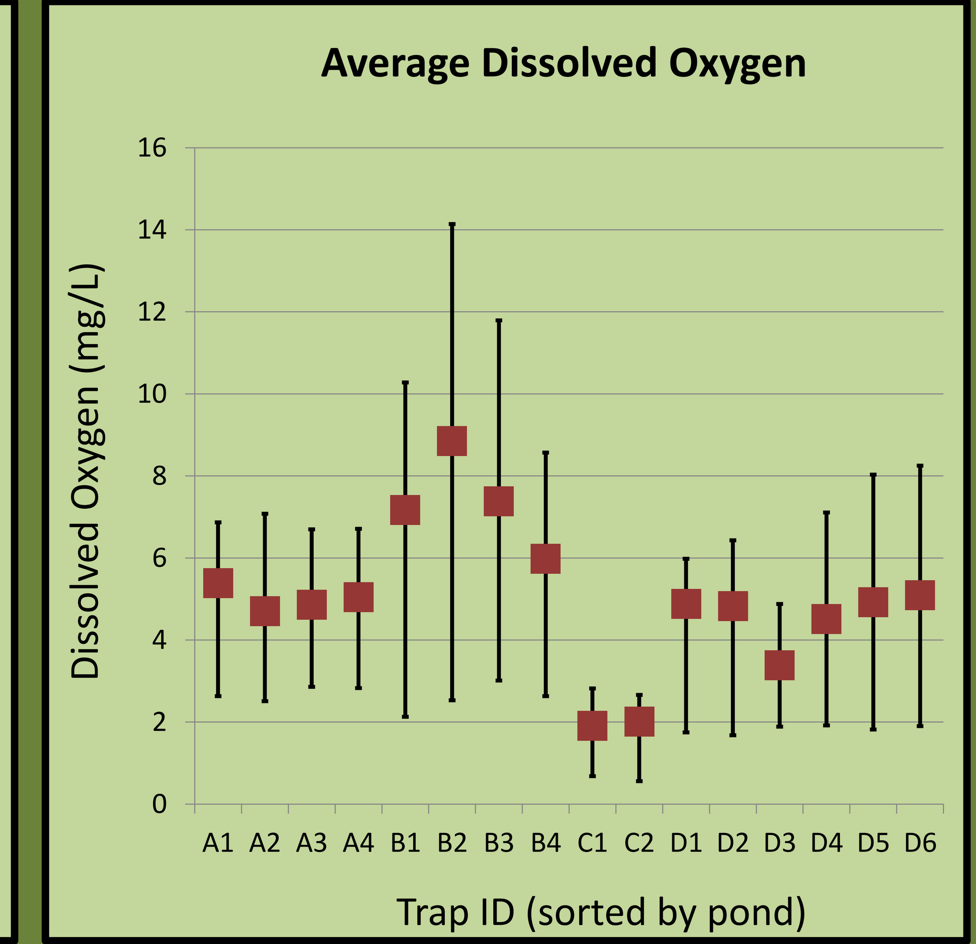

Figure 5. Average dissolved oxygen values at each trap site. Sites A5, A6, B5, B6, C3, and C4 are not included due to late trap deployment, and therefore, insufficient data.

Trap #	A		B		C		D	
1	**1**	1	**0**	0	**1**	1	**9**	1
2	**2**	0	**0**	0	**2**	0	**0**	0
3	**0**	0	**0**	0	**0**	0	**1**	0
4	**0**	0	**0**	2	**0**	0	**2**	0
5	**1**	1	**0**	0	-		**1**	0
6	**1**	0	**0**	0	-		**0**	0
Total	**5**	2	**0**	2	**3**	1	**13**	1

Table 1. Total number of larval and adult salamanders caught at each trap site. Larvae numbers are **bolded**. Pond C contained only 4 traps.

Discussion and Conclusions

Nitrite
- Current nitrite levels in the PWPA pose no threat to tiger salamander populations.

Phosphate
- While phosphate levels differ greatly between ponds, the data does not suggest that contamination levels affect salamander presence.

Ammonia
- Higher ammonia levels are correlated to Pond D. This may indicate that a higher population lives therein, producing higher amounts of nitrogenous waste.

pH
- Ponds C and D have become increasingly more basic over time. While salamanders prefer a higher pH (Sugalski and Claussen, 1997), it is unknown if these salamanders migrate within these ponds to areas of higher pH. Pond D, having the highest pH, had the most captures.

Dissolved Oxygen
- This study did not find a correlation between oxygen levels and salamander abundance. DO levels vary greatly between trap sites.

Nevertheless, tiger salamanders were caught disproportionally both between and within ponds, suggesting that a preference in microhabitat is present. It is therefore worthwhile to continue investigating these relationships in future studies.

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