

3-28-2014

Amphibian Occupancy and Habitat Use in a Restored Wetland

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Recommended Citation

Stulik, Emily, "Amphibian Occupancy and Habitat Use in a Restored Wetland" (2014). *2014 IPFW Student Research and Creative Endeavor Symposium*. Book 11.

http://opus.ipfw.edu/stu_symp2014/11

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Introduction

Amphibians are considered biological indicators of environmental health, but their populations have been declining due to habitat degradation and fragmentation. Efforts to restore wetland habitat can mitigate some aspects of habitat loss, but effective sampling techniques and suitable analytical approaches are needed to accurately measure the quality and functionality of the restored habitat. A relatively new approach, occupancy modeling, has shown promise as an innovative and advanced tool to measure presence, absence, and habitat use of various species.

Through the use of occupancy modeling with a bio indicator species, this research will be the first effort to assess and evaluate the suitability and functionality of Eagle Marsh Nature Preserve, a restored wetland located in Fort Wayne.



Both the Northern Leopard frog, *Lithobates pipiens*, (left) and the Northern Cricket frog, *Acris crepitans* (right), are declining in Indiana. The leopard frog is a Species of Special Concern while the cricket frog is considered rare in the Northern quarter of the state.

Objectives

- To measure and compare occupancy, habitat use, and reproductive success among anuran species and classes of wetlands.
- To gauge habitat suitability through characterization of the restored habitat and anuran habitat use.
- To use occupancy modeling to assess covariates that potentially influence and affect amphibian occupancy and detection probability.

Methods

A total of 30 wetland sites in Eagle Marsh, Fox Island County Park, and Arrowhead Marsh were systematically selected to represent a range of factors including size, chances of desiccation, spatial orientation, and degree of restoration.

Call surveys and tadpole surveys will be performed multiple times at each site to measure occupancy and detection probability. At each of these surveys water and air temperature, water pH, wind speed, humidity, date, and time of day are recorded. Habitat surveys measure water depths and percent vegetation in and around the wetlands to in order to measure habitat use and overall wetland quality.



Clockwise from left: Eagle Marsh Nature Preserve, showing I-69 and route 24 to the West and North. A Northern Leopard frog metamorph, caught during tadpole surveys. Three bullfrog tadpoles caught during tadpole surveys

Results

Call Survey Data

The gray tree frog, *Hyla versicolor*, had the highest rates of occupancy of the five species sampled. The Northern cricket frog had the lowest occupancy rate, although this was not significantly different from the fowler's toad, *Anaxyrus fowleri*.

Table 1: Occupancy rates and detection probability for 5 anuran species heard during call surveys.

| Scientific Name | Common Name | Occupancy (SE) | Detection probability (SE) |
|-------------------------------|-----------------------|----------------|----------------------------|
| <i>Hyla versicolor</i> | Gray tree frog | 0.79 (0.09) | 0.57 (0.06) |
| <i>Lithobates catesbeiana</i> | Bullfrog | 0.54 (0.10) | 0.59 (0.07) |
| <i>Lithobates clamitans</i> | Green frog | 0.36 (0.09) | 0.63 (0.09) |
| <i>Anaxyrus fowleri</i> | Fowlers toad | 0.16 (0.12) | 0.26 (0.20) |
| <i>Acris crepitans</i> | Northern cricket frog | 0.14 (0.09) | 0.32 (0.17) |

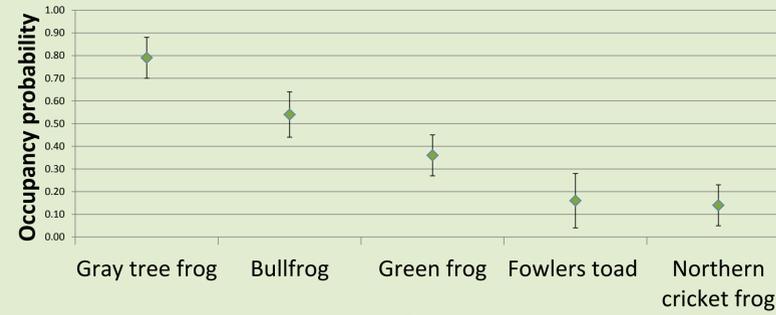


Figure 1: Occupancy probabilities with standard error for 5 anuran species heard during call surveys.

Tadpole Survey Data

Both the leopard frog and gray tree frog had significantly higher occupancy rates than the Northern cricket frog.

Table 2: Occupancy rates and detection probability for 4 species caught during tadpole surveys.

| Scientific Name | Common Name | Occupancy (SE) | Detection probability (SE) |
|---|-----------------------|----------------|----------------------------|
| <i>Lithobates pipiens</i> | Leopard frog | 0.83 (0.22) | 0.30 (0.09) |
| <i>Hyla versicolor</i> | Gray tree frog | 0.57 (0.12) | 0.42 (0.09) |
| <i>Lithobates catesbeiana/clamitans</i> | Bullfrog/Green frog | 0.70 (0.56) | 0.13 (0.12) |
| <i>Acris crepitans</i> | Northern cricket frog | 0.22 (0.17) | 0.22 (0.18) |

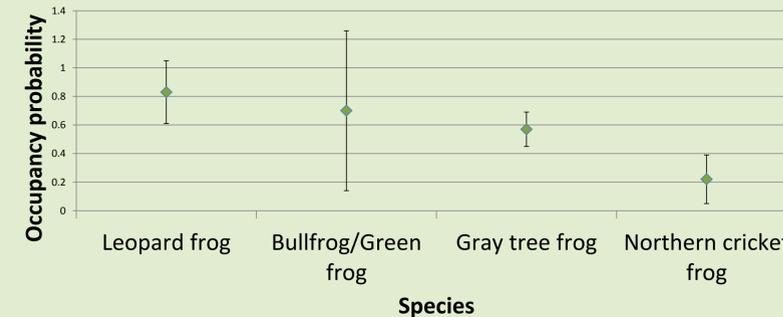
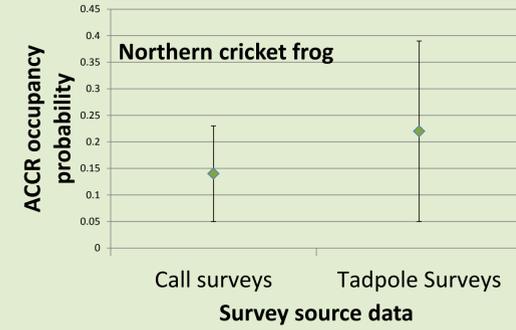
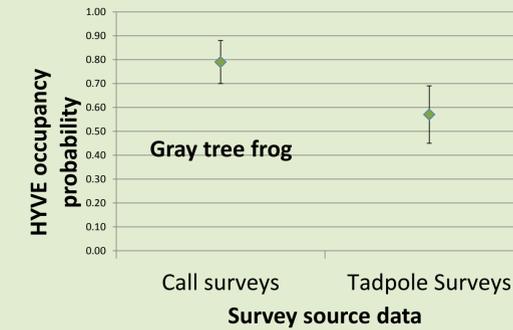


Figure 2: Occupancy probabilities with standard error for 4 species caught during tadpole surveys.

Comparing Survey Methods

Occupancy rates were significantly higher during call surveys than they were for tadpole surveys in the gray tree frog, but there was no significant difference in occupancy probability between survey methods for the Northern cricket frog.



Conclusions

The leopard frog, *Lithobates pipiens*, a species of special concern, showed high tadpole occupancy rates, at 0.83 (± 0.22). This species bred at 16 out of the 30 sites. The bullfrog, *Lithobates catesbeiana*, had relatively high occupancy rates for call surveys. Bullfrogs are becoming increasingly common in the Midwest, and there is some concern that they pose a threat to native species in areas where they are introduced. There was no clear difference between survey methods and overall occupancy probability. Call surveys may be a more effective survey to measure occupancy in the gray tree frog, but this was not the case for the Northern cricket frog.



A leopard frog tadpole

Future Directions

Multiple species, multiple season models will be generated with data from the second field season, beginning in March. Covariates affecting occupancy and detection probability, such as wetland type, size, degree of restoration, and humidity and temperature, will be modeled in PRESENCE. This will provide data on habitat use and suitability.

Findings from this research will provide future recommendations for land management and wetland restoration while preventing future declines of such vulnerable species.

Acknowledgements

- I would like to thank the Little River Wetlands Project and Fox Island County Park for their support and permission to conduct this research.
- To my field assistants Elizabeth Kunze, Kaylyn Sands, and Patrick Ewing for their hard work and help collecting data in the field.
- To the Fort Wayne Children's Zoo, who has generously donated funds to support the second season of data collection and field work.