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Session A, 2017 Third Place: The Effects of Anthropogenic Noise Disturbances on Anuran Mating Calls

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The Effects of Anthropogenic Noise Disturbances on Anuran Mating Calls

By Alyssa Dugan, Mary Schwartzmyer, Alivia Sheffield
Significance

• Anuran communication facilitates reproduction, provides information on individual identity, status, mood and intentions (Laiolo, 2010).

• When acoustic signals and extraneous sounds overlap in frequency, there is potential for auditory masking to occur (Bee and Swanson, 2007).

• Among the consequences of auditory masking are impaired recognition of signals and decreases in the ability of receivers to discriminate among different types of signals (Bee and Swanson, 2007).

• It is well-established that individual reproductive success is directly proportional to calling effort in numerous frog species (Sun and Narins, 2005).
Hypotheses

**Hypothesis 1:**
\( H_0 \): The intensity of frog calls will not be different in response to anthropogenic noise disturbance at varying decibel intensities.

\( H_A \): The intensity of frog calls will decrease in response to an increase in anthropogenic noise disturbance.

**Hypothesis 2:**
\( H_0 \): The period of time it takes for anurans to return to their control intensity will not vary between decibel levels played.

\( H_A \): The period of time it takes for anurans to reach their control intensity will increase as anthropogenic noise disturbance in decibels increases.
Anurans of Cranberry Lake

Spring Peeper (*Pseudocris crucifer*) *

American Bullfrog (*Lithobates catesbeianus*) *

Green Frog (*Lithobates clamitans*) *

Pickerel Frog (*Lithobates palustris*)

Wood Frog (*Lithobates sylvatica*)

American Toad (*Anaxyrus americanus*)

Mink Frog (*Lithobates septentrionalis*)

Northern Leopard Frog (*Lithobates pipiens*)

Gray Tree Frog (*Hyla versicolor*) *

* Frogs recorded during our study
Methods

• Four study sites were tested twice over a period of four nights.

• Recorded the average call intensity using Decibel 10 for 2 minutes – our control.

• Then played a motorcycle revving recording at one of three noise intensities (50 dB, 70 dB, and 90 dB).

• Recorded the immediate frog call intensity after the noise stimulus and the time it took to return to their initial call intensity.

• We used regression analyses to measure the relationships among the stimulus intensity and the dependent variables (mating call intensity change and length of time before returning to control intensity)
Beaver Meadow
Whoosh Pond
Beaver Pond
Pigs Ear Flow

Northern portion of the pond was sampled. Wetland/bog habitat.

The south-east portion of the pond was sampled. Pond habitat.

Southern end of the pond was sampled. Beaver formed wetland habitat.

Northern end of the bay was sampled. Marsh habitat.
Experimental & Sampling Units

Experimental Units: 8  Per 3 Treatments
Sampling Units: 16
Hypothesis 1 Results

The change in mating call intensity from before and after the disturbance stimulus was played. Data recorded from June 4th to June 7th 2017.

\[ y = 0.3239x - 7.2318 \]

\[ R^2 = 0.34 \]

\[ p < 0.001 \]

\[ F = 23.3 \]
Hypotheses 2

Results

The overall time taken for anuran species to return to the control mating call level after each noise disturbance treatment in seconds. Data recorded from June 4th - June 7th 2017.

\[ y = 2.9469x - 89.427 \]

\[ R^2 = 0.20 \]

\[ p = 0.002 \]

\[ F = 11.27 \]

\[ n = 8 \]
Ecological Relevance

• Human transformed ecosystems have the potential to greatly impact vocally-reliant populations and thus has great conservation significance.

Other studies found;

• That females have an increase in response latency and decreased orientation to male frog calls in the presence of traffic noise (Bee and Swanson, 2007).

• That calling males decrease during the noise and after, similar to ours. They also found that less-dominant species increased during this quiet time (Sun and Narins, 2005).

• That males were not able to adjust their temporal or frequency over a noise stimulus (Lengange, 2008).
Errors & Follow up Studies

• There were occasional natural lulls in the chorus creating deviation in some of our data points.
• The Decibel 10 App may have picked up non-targeted noises.
• We did not take into account how well sound travels across water.

Futures studies should consider:
• Testing the experiment over the breeding season of all 9 anuran species present in the Cranberry Lake region.
• Utilizing different types of anthropogenic noise (construction, highway noise, plane flyover, etc.).
• Utilizing higher tech equipment.
Conclusion

• Our research found that frog mating calls decreased in decibels respectively with increasing levels of anthropogenic noise.

• Our research also supports that higher levels of anthropogenic noise create longer delays in mating calls for anurans.

• Thus, human induced noise pollution affects reproductive behavior of anurans.
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• Dr. Fierke, Dr. McGee, and Keith Bowman for research advice and direction

• Devan Wade and Shane Currey for assisting us in the field at night (and protecting us from bears and VERY irritated beavers)
Literature Cited


Photos Cited

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Questions?