Understanding Pesticide and Salt Effects on Developmental Neuroplasticity in Amphibians

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This study looked at the effect of very low doses (trace amounts) of pesticides and salt on amphibian developmental neuroplasticity.

- 10 tadpoles were placed in small pools (mesocosms) to mimic their natural environment.
- Each mesocosm was given a certain combination of pesticide and/or salt.

The goal of the study is to understand what effect, if any, do certain pesticides, road salts, and their interactions have on the growing brains of tadpoles, so that a better understanding of the environmental impact of pesticide and road salt runoff can be constructed.

We used various techniques to compare group means to each other to understand if there was any difference between the group means and specifically what the difference was between them. We also took into account other potential factors, like person or mesocosm, that might have impacted the measurements or the tadpoles that were not directly related to the pesticides and/or salt. Level of significance (alpha) = 0.05

- Main methods: ANOVA, MANOVA, Tukey, Post-hoc Analysis, Mixed-Effect Models

ANOVA: The mean body mass across mesocosms is equal.
MANOVA: The mean brain measurements across mesocosms are equal.

**Experiment 1:** Pesticide and Salt Effects

- N = 56 mesocosms (16 + 40 shared with Ex. 2), each with 10 tadpoles
- Do pesticides alter brain shape?

**Experiment 2:** Pesticide and Salt Effects

- N = 120 mesocosms (80 + 40 from Ex. 1), each with 10 tadpoles
- Road salt will alter relative brain shape
- Road salt will exacerbate the effects of pesticides on brain shape

**Methods**

- 10 tadpoles were placed in small pools (mesocosms) to mimic their natural environment.
- Each mesocosm was given a certain combination of pesticide and/or salt.

**Results**

- Experiment 1 Post-hoc Test Result:
- Experiment 2 Post-hoc Test Result:
- Experiment 1 MANOVA:
- Experiment 2 MANOVA:

**Conclusion**

- Mixed effect Model: Test to see whether there are significant effects of Mesocosm and Person who collected data on our model?

ANOVA on Mixed Effect Models versus Simple Linear Model

- There might be random effect on Mesocosm for experiment 2, but it is negligible

**Data Pre-Processing**

**Background & Introduction**

- Water
- Ethanol
- Permethrin
- Imidacloprid
- Pesticides

**Experiment 1**

- ANOVA: Significant impact of pesticides on body mass
- MANOVA: Each brain measurement differed in which variable had a significant impact on it
- Tadpoles with Mal has significantly smaller mean body mass than the Ethanol Control group

**Experiment 2**

- ANOVA: All environmental variables had a significant impact on body mass except the pesticide concentration
- MANOVA: Each brain measurement differed in which variable had a significant impact on it, but all were impacted by the introduction of environmental factors

**Tables**

<table>
<thead>
<tr>
<th>Pesticide</th>
<th>Concentration</th>
<th># of mesocosms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malathion (Mal)</td>
<td>Hi/Low</td>
<td>4, 4</td>
</tr>
<tr>
<td>Chlorpyrifos (Chlor)</td>
<td>Hi/Low</td>
<td>4, 4</td>
</tr>
<tr>
<td>Cypermethrin (Cy)</td>
<td>Hi/Low</td>
<td>4, 4</td>
</tr>
<tr>
<td>Permethrin (Per)</td>
<td>Hi/Low</td>
<td>4, 4</td>
</tr>
<tr>
<td>Ethanol</td>
<td>Control</td>
<td>4, 4</td>
</tr>
<tr>
<td>Water</td>
<td>Control</td>
<td>4, 4</td>
</tr>
</tbody>
</table>

**Graphs**

- EDA: Spread of bodymass for each pesticide group (exp. 1) & pesticide/salt combination group (exp. 2)