Factors Contributing to the Reliability of Data in Odonata Citizen Science

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Objectives

1. Evaluate the **reliability** of citizen science surveys in documenting odonate diversity
2. Integrate citizen science and direct field observation to **model** richness, abundance, and composition of odonates
3. Evaluate **differences in accuracy** between citizen science reports and expert sampling regarding odonate diversity

Introduction

Odonates (dragonflies and damselflies) belong to an ancient order of aquatic insects that shape food webs as predators during all life stages. The *when* and *where* of their life history has been linked extensively to external cues, notably temperature and photoperiod, making this taxon especially sensitive to changing environments and climate change. **Understanding this relationship presents a crucial challenge for conservation decisions.**

However, high-resolution data needed for modelling is often lacking or unavailable for many taxa. Fortunately, a worldwide hobbyist following has formed around these charismatic insects, providing over 1,500,000 open-sourced citizen science observation records through websites like iNaturalist.

Likewise, citizen science has not gone uncriticized. Inequalities in sampling effort, data storage and mobilization create inherent bias through overrepresentation and data gaps. As such, we ask:

Are Odonata citizen science records reliable in capturing biodiversity trends?

Methodology

Study Design: Five sites were chosen, covering OH, WV, KY, and VA. This transect represented both highly-reported regions and areas with lower rates of citizen science participation, as well as varied elevation and longitudinal aspects. Citizen science data was compiled for this region from iNaturalist and Odonata Central.

Surveying: This transect was sampled once monthly during June, July, and August, representing the peak odonate flight season for this region during 2019. For each sampling period, the number of odonates visible was counted per species.

Modelling: Biodiversity metrics, incl. richness, Shannon diversity and net abundance, were computed for each site, sampling period and sampling method. Model selection was used to determine if an interaction occurred between sampling type and site for any metric or time period. NMDS was used to compare composition of observed species between both methods.

Are Odonata citizen science records reliable in capturing biodiversity trends?

Not always.

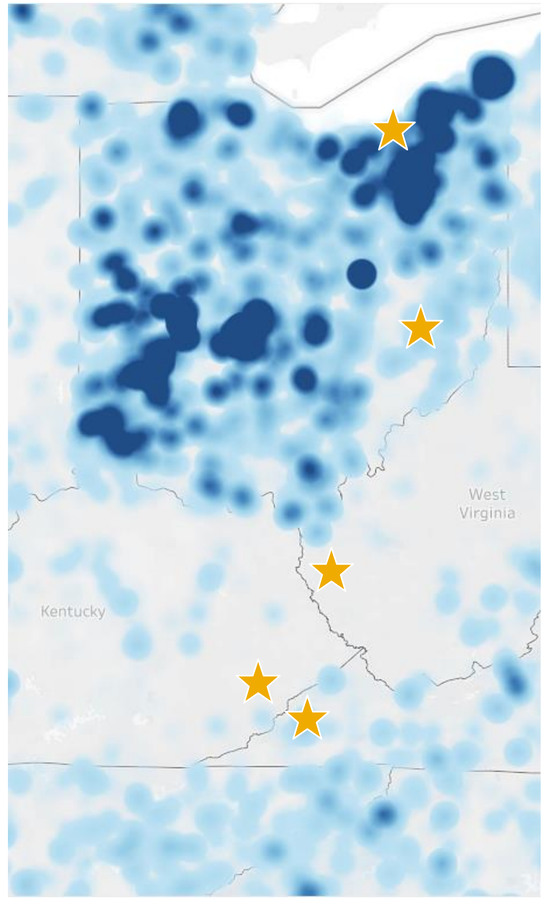

Figure 1: A Tableau map of approximately 155,000 odonate observations in the eastern United States, formed from citizen science databases, iNaturalist and Odonata Central. Sampling locations are designated with stars.

Results

Richness - Analysis of species richness revealed that the model with an interaction effect provided a better fit (AIC: 186.59) than the model without (AIC: 200.75), suggesting that that there are different patterns occurring between sites by sampling method. In the interaction model, there was a significant difference in reported richness between methods ($p = 0.004$).

Abundance – Similar to richness, models with the interaction effect provided a better fit (AIC: 251.54) than the model without (AIC: 262.14). In the interaction model, there was a significant difference in reported abundance between methods ($p = 0.007$).

Composition – Differences in community composition were evaluated using Adonis and found to be significant ($p = 0.046$). Composition was visualized using NMDS (below).

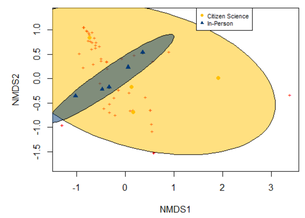

Figure 2: NMDS visualizing odonate composition by source. Yellow corresponds to citizen science observations while green corresponds to in-person observations.