Size-Frequency Distribution of Perennial Herbaceous Communities

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Abstract

The inverse relationship between body size and abundance is a well-documented ecological pattern that holds true across many diverse ecosystems. In plant stands, the relationship is driven by the balance between the recruitment and growth of small individuals and competitive exclusion and individual mortality. In many forest communities, the scaling exponent describing the decline of abundance with mass is proposed to be -11/8. In this experiment, we apply the forest-based scaling theory to a perennial herbaceous community in the Brown Family Environmental Center (BFEC). Two perennial communities were surveyed, a wetland and prairie. These communities were also compared to a forest community also surveyed at the BFEC. While the size distributions of the prairie, wetland, and forest ecosystems did not exactly match the proposed exponent of -11/8, they were all very similar to one another. This shows that even across three very different communities, there is a common pattern in the size-frequency distribution.

Introduction

•A general pattern in ecology in both plant and animal communities is the inverse relationship in between body mass and abundance (White et al., 2007)
•The scaling exponent describing the decline of abundance with mass is documented as -11/8 across many diverse forest communities (Stegen and White, 2008). While this phenomenon is well studied in forests, it has not been extended to herbaceous communities.
•These ecosystems present a unique perspective since size distributions arise from differential growth after the plant community dies back to ground level during the winter. Therefore, functional traits of different species play a key role in the size distribution in the community.

Methods

Study Site
- Brown Family Environmental Center wetland, prairie, and forest ecosystems

Wetland and Prairie Protocol
- In 1.2 x 1.2m plots, the above ground biomass of each individual plant was harvested and weighed

Forest Protocol
- The diameter breast height of all trees in a 2 hectare plot were measured
- Biomass was calculated using allometric scaling as described in Jenkins et al. 2003

Before and after harvesting of a wetland plot at the BFEC

Results and Discussion

- Maximum likelihood estimates (White et al., 2008) of the size-distribution data showed very similar exponents between the three communities.
- The measured exponent values were consistently larger than the literature value proposed by Stegen and White.
- A reason for this discrepancy between the could be the tendency to under sample the smallest plants in a community.
- The tradeoff between plant size and density is caused by competition for resources and space

System	Size Distribution Exponent
Literature Value	-11/8 (-1.375)
Prairie Plot 1	-1.20
Prairie Plot 2	-1.28
Prairie Plot 3	-1.15
Forest 2011	-1.19
Forest 2006	-1.22
Wetland Plot 1	-1.29

Table 1. Scaling exponents of number of individuals to mass using maximum likelihood estimate (White et al. 2008).

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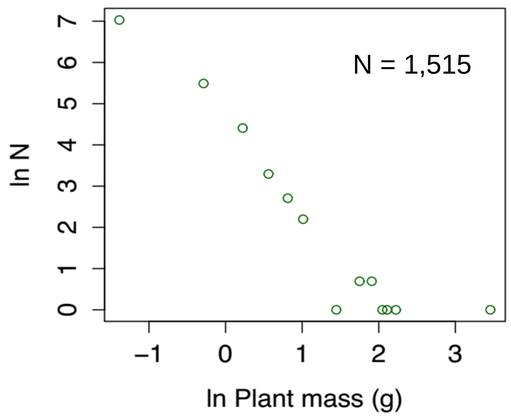

Figure 1. Relationship between number and mass (g) of plants in Wetland Plot 1. Logarithmic axes.

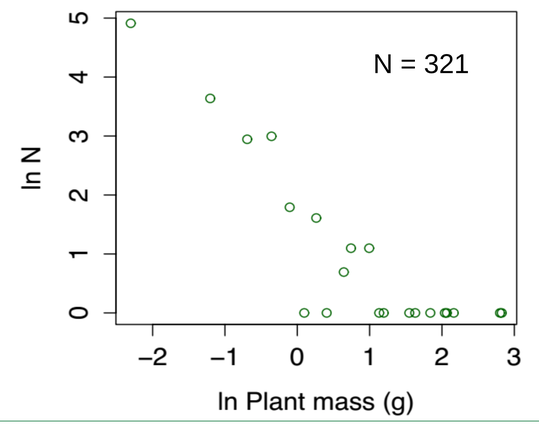

Figure 2. Relationship between number and mass (g) of plants in Prairie Plot 2. Logarithmic axes.

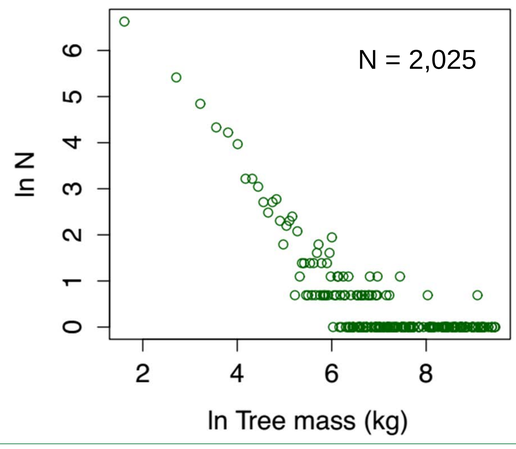

Figure 3. Relationship between number and mass (kg) of trees in Forest Plot in 2011. Logarithmic axes.

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