Testing the Generality of Elton's Rule: Comparing Aquatic and Terrestrial Ecosystems Across Environmental Conditions

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Research goals

1. Identify empirical and methodological bottlenecks that slow progress of systematic comparison between (especially aquatic and terrestrial) ecosystems,
2. Develop a metric to characterise 'size structuredness' across ecosystems,
3. Collate available data and test the generality of size structuredness and its relation with abundance distributions and energy flow.

Rationale for the research

In his book *"Animal Ecology"*, published in 1927, Elton introduced the concept of the *"pyramid of numbers"*, whereby "*animals form food-chains in which species become progressively larger or, in the case of parasites, smaller in size*" and "*the animals at the base of the food-chain are relatively abundant, while those at the end are relatively few in numbers, and there is a progressive decrease in between the two extremes*". Hence, extending Elton's view to larger, more complex levels of biological organisation, body size should hold a central role in structuring food webs and ecosystems, *i.e.*, the entity of biota which are linked though feeding interactions could be described in terms of it's 'size-structuredness'. Lindeman (1942) synthesised Elton's organismal based concept into his descriptions of energy flows between trophic levels (producers, primary consumers, secondary consumers, *etc*.) within ecosystems. He expanded Elton's pyramid of numbers to a pyramid of biomass and productivity, which he integrated within his consideration of energetics and food cycles. In addition Lindeman recognised systematic differences between ecosystem types in terms of biomass partitioning, energy flow and trophic efficiency; and he identified major differences between marine, freshwater and terrestrial systems. We are still only able to make tentative assertions in relation to testing Elton's Rule, especially when comparing systems that appear to follow rather different "rules" with respect to body-size and abundance relations.

Anticipated output

Definitions of methods and metrics.
Standardised (where possible) datasets of size-based predation matrices (with, where possible, biomass information), across ecosystems and environmental conditions.
Results of a comparison of size-structuredness of aquatic versus terrestrial systems, incorporating environmental variables; comparisons of energy flow structures (and simple derivations of stability properties) based on biomass information.
Development of new hypotheses on the "sizestructuredness" of ecosystems.

Provisional list of Participants

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