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Abstract

Ecosystem network analysis (ENA) shows an apparatus of tools allowing a whole-system approach to the study of ecosystems. One of these indices is ascendancy (A) that combines growth (size) and development (flow organization) in a unique metric, being the product of the total system throughput (TST – sum of all the system flows) and the average mutual information (AMI – ranging from 0, when the system is completely connected, to a maximum corresponding to a linear chain topology).

The upper bound of ascendancy is typical for each ecosystem (depending on TST and flow structure) and is called development capacity (C). It is calculated as the product of TST by diversity of flow structure estimated using the Shannon information formula.

The development capacity has been shown as an important metric for the conceptual evolution of ecosystem ecology as well as for ecological applications such as those in ecosystem health and integrity. Its role and importance, both for conceptual development and applications, can be highlighted by analyzing its constitutive terms: ascendancy and overhead (Φ). The former quantifies the organized complexity, that is, the amount of medium which is exchanged through efficient connections, whereas the overhead components summarize the distance separating ascendancy from its theoretical maximum.

In this article, first, a brief sketch of information theory principles inspiring development capacity formulation is given, and the focus is on its importance as an ascendancy and overhead scaling factor. Then, an alternative way to define development capacity, relating to connectivity, role, and trophic position concepts is suggested, explaining, in this way, thermodynamic limits to ecosystem topologies. Finally, the author proposes some applications to real ecosystems.