Constructing a post-classic ecology:
towards a theoretical framework from the complex system theory perspective

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In the last hundred years, the theoretical framework of ecology has been transformed several times. Some of the resultant framework leads to flourishing ecological subdisciplines with diverse research domains and methodologies. Such diversities have caused concerns among ecologists in recently years. Is such diversity a sign of the immaturity of the discipline? Or is it intrinsic to the nature of ecology? Responses to these questions from both ecologists and philosophers of ecology vary drastically. Although this paper does not intend to offer an answer to such question, however, the presention of an alternative theoretical framework from the complex system theory perspective shows that neither immaturity nor inherent diversity need apply and offers new insight into theoretical framework, methodology and research domain.

This paper will trace the historical development of the theoretical framework of ecology through examining the conception of ecosystem of a few milestone works. These works include: the pioneering work of Alfred G. Tansley; Raymond L. Lindeman imperial work on Cedar Bog Lake; and the mechanistic transformation of ecosystem ecology initiated by Eugene P. Odum and Howard T. Odum.

The paper will reveal the central role of complex dynamical systems concepts and principles through an analysis of two contemporary theoretical models, Ulanowicz's energy, material and information (EMI) flow pathway network model, and Pahl-Wostl's spatio-temporally differentiated EMI flow pathway network model. Based on the analysis of these two models, an alternative theoretical framework is constructed from recent developments in complex system theory. Four principles are suggested as the key concepts of the new framework's understanding of any ecosystem:

1. Reorganising principle: an ecosystem's organization often does not start from scratch. Instead, it is often the recombination of fragments of organizational connections among the ecosystem's components that survived destruction, or imported from its neighbour region by immigrant animals or plants, or the combination of the two.
2. Diversity principle: the diversity of individual organisms' biological characteristics and environmental heterogeneity are the essential conditions for EMI flow pathway networks to emerge.
3. Historicity principle: ecosystems are historical systems, which means two things: i) the response of an ecosystem to any disturbance or stimulus may often be highly unpredictable; ii) the impact from a disturbance or intervention is often strongly influenced by what happened to the system before the disturbance; iii) the timing and volume of the disturbance or intervention are crucial to its impacts.
4. Locality principle: the characteristic dynamics and organization of ecosystems are often strongly site-specific.

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