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# General Laws of Ecology: Thermodynamics and the ten-percent rule

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## Abstract

Ecology is a relatively young science compared to other traditional subjects such as physics, chemistry, biology, geology, even botany, zoology, ornithology, e.g., and other "ologies" in the biological sciences pre-date it. One criticism of the field is that it lacks fundamental theory and is largely a science of contingencies. Relatedly, it builds on theory and laws in physics and chemistry, particularly thermodynamics and stoichiometry, but it is more than simply an extension or new application of those fields. It clearly has something unique to offer that is not housed in those other disciplines, which has to do with the self-organization and maintenance of complex adaptive systems. Shortly after Sir Arthur Tansley coined the term ecosystem, whole ecosystem studies were conducted using Lindeman's trophic-dynamic concepts. The idea being that general patterns of ecosystems emerge along this standardized approach. One such outcome was the so-called ten-percent rule of trophic transfer efficiency. However ingrained this rule is in the field of ecology today and introductory biology textbooks, there is not a clear understanding of where this number originated. In this presentation, I review the historical and empirical evidence that led to this rule and put it in context of other current thermodynamic principles. Notably, the ten-percent rule stemmed from early work by Patten and Slobodkin in the late 1950s and early 1960s. Remarkably, in spite of the paucity of evidence that spawned this numeraire, it probably is a reasonably correct value for many ecological conditions.

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