Laws, Theories, and Patterns in Ecology

Author: Allen, Timothy F. H.

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A Last Hurrah for Modernist Realism in Ecology

Laws, Theories, and Patterns in Ecology. Walter K. Dodds. University of California Press, 2009. 256 pp., illus. $9.95 (ISBN 9780520260405 cloth).

This book, *Laws, Theories, and Patterns in Ecology,* attempts to address whether ecology has laws, and extensively lists candidates for ecological laws—although Walter K. Dodds looks more profitably at theories. The book finishes with a short, strong section dealing with patterns (wherein Steward Pickett, Daniel Simberloff, and I are handsomely cited). It is encyclopedic in its treatment, looking at organismal, population, community, and ecosystem views of ecological material. The wide scope of the book turns up some surprising gems; for instance, the respect it gives natural history. Dodds's book provides what is to my knowledge the largest collection of what might be laws between two covers. On the downside, it is a bit of a stamp collection—an arbitrary if systematic compendium. Many will like the conventional treatment of a recurring discussion on which I comment below. This book is likely to be used in graduate seminars; its references include many recent papers, so it is up to date. Even so, I still fear it will tend to entrench yet another generation of ecologists in a naive epistemology as to the modeling process.

At the outset we note that two great ecologists, Steward T. A. Pickett and Daniel Simberloff, think this is an excellent book that fills a need. On the dust jacket is a quote from Simberloff, stating the book is "an insightful exploration of long-standing controversies" and noting that Dodds discusses broad issues such as "neutral theory." Pickett says it is "significant," and "well laid out, coherently." He says it is all the more remarkable because it attempts to cover the breadth of ecology, and he goes on to say it will engender "deep and productive discussion of the conceptual structure of modern ecology."

Pickett's reference to "modern ecology" highlights the largest problem I have with this book, its modernist realism. Modernism must choose either to make levels in biology fundamentally real or to assert that we can know biology without invoking levels of analysis. Modernism says better science approaches reality more closely (Funtowicz and Ravetz 1992). The problem with modernism is that it invites the presumption of knowledge without levels of analysis. If modernism insists laws are to reflect the way nature really is, then laws must address the world independent of levels of analysis.

So long as one stays within a paradigm, naive realism does no harm. Many physicists are realists. Joel Cohen (1971) says biology has physics envy, and Dodds's book is another data point for Cohen. In physics, different levels, such as quarks versus subatomic particles, are separated by so many scalar orders of magnitude that although different levels of analysis may be present, they can be safely forgotten in universal acquiescence. By contrast, the models and codes inside biological systems (e.g., DNA, hormones, mating rituals) stabilize emergent phenomena, allowing for levels in biology to be closely packed with regard to scale. For instance, individual selection occurs at a scale close to that of group selection. There is no clean shot between selection at different levels—indeed, by the standards of physics there are no clean shots anywhere in biology. Failures of modernism matter in biology.

Dodds presents a suite of laws about evolution. One of his laws is that there is no spontaneous generation. We know what he means, because we are familiar with Pasteur's broth experiments. But that law shows how denying levels of analysis generates ambiguity. Dodds concedes the origin(s) of life as an exception, but that concession expands the scale and muddles the discourse. Levels of analysis intrude decisively on a time frame for life's origins, and again as one decides what life is, anyway. Are prion proteins alive? For sure, we do not see full-fledged bacteria spontaneously generated, but we can reasonably expect lots of spontaneous generation at different, lesser degrees of elaboration, each denying Dodds's law up to a point. Lesser elaborations of spontaneous generation heading toward something like life would usually not be detected, because full-fledged life consumes such generation before it is recognizable. Levels of emergence (generation) packed into proximate scales across biology invite many alternative analyses. In biology, laws are problematic because they are big ideas and cannot apply sufficiently generally without muddling alternative analyses across levels.

Dodds addresses very large notions that do not fit inside just one paradigm, and so the essential realism underpinning his laws does not offer requisite variety (Ashby 1956). Dodds appears to come from a school that is big on differential equations; the clue is that he explicitly refers to modern ecology as starting with MacArthur, May, and the usual suspects (I, on the other hand, would say that the quantification of ecology in the 1950s is the proper start). There is some reference to alternative paradigms, such as the ecosystem modeling at Oak Ridge National Laboratory, but Dodds is not fully conversant with that literature, and many big ecosystem players are absent. From Oak Ridge is the one properly replicated experimental paper that gives the lie to a diversity-stability relationship: Van Voris and colleagues (1980). This important study is unmentioned even in the ecosystem section.

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Dodds appears unfamiliar with landscape ecology, as Bruce Milne and Monica Turner are absent even in the fractal section. If anyone has ecological laws, they do. Diversity, with its "laws," causes the usual problems: It is a measurement still waiting for an idea; it remains a granfalloon (Vonnegut 1963), a group of issues capriciously related, like the chemistry of red things. Dodds's diversity laws (for example, diversity increases with area) often appear trivial: How could diversity go down in a larger area, since a species, once counted, cannot be uncounted in that place? Larger areas are often not more diverse than smaller ones when the comparisons are made in different places, so Dodds's law is either insignificant or full of holes—take your pick.

The book mistakes scale for type throughout. Dodds indicates that his laws apply to the organism, population, community, or ecosystem *scale* when he really means the *type* of entity in the foreground. This issue gets away from the author. The level of analysis, particularly in ecology, includes not just a ranking on scale (as will commonly suffice in physics) but also a ranking on the type of thing at given levels that are ranked by definition not size. The equivalence of organisms required in the definition of "population" is not a statement of size or scale (you are not equivalent to the mites on your body and so do not belong to their population, although you are an organism as are they, and you occupy the same space). Of necessity there are levels of analysis in science in general, but critically, in ecology, the pertinent levels will be different for each new time and place—any law will have lots of exceptions. The organisms that we model often have models of their own for themselves and the other organisms around them. Polanyi (1968) succinctly captured this notion in his classic article "Life's Irreducible Structure." It is the meaning in the models of the subjects and the observers that is irreducible. That "structure" requires recognition by a person observing at one level, and that makes the notion of law quite difficult.

Laws, Theories, and Patterns in Ecology has lots of citations to David Tilman but none to the superior work, with strong empirical backing, by Phil Grime. The omission of Grime is symptomatic, since Grime addresses diversity through strategies that are identified by an experienced observer with a clear level of analysis. Dodds also makes no acknowledgment of Rosen's (1991) modeling relation, which limits the book's sophistication. There is no distinction between formal coded models, such as allometric equations, and analog models, where experimental schemes rescale the phenomenon. Howard Pattee (1978) made some very helpful distinctions between laws and rules. Being a card-carrying physicist, Pattee is far more qualified to sort out the deeper meaning of the concept of law than are ecologists, who often just get befuddled, and will likely remain so, this book notwithstanding.

Most ecologists still defending a modernist view will not share my objections. Many reading this review will say, "What else but discovering reality is the proper reference for science?" My reply is that we have been to Oz and have discovered that the Wizard is in some sense only manipulating perception. In a postmodern world (Allen et al. 2001) it matters that we have data interpreted only through a level of analysis, not access to an essential external reality. Some may feel that all is lost without an approach to reality. Even so, the Lion gets his courage, the Scarecrow gets his brain, and the Tin Man gets his heart anyway. And Dorothy gets to go home, if not to Kansas, to Uncle Fred Clements in Nebraska. So all is not hopeless even if science provides only narratives and simply states powerful points of view. But it is better to face with a robust epistemology the necessity of having a point of view than to deny it. So read Dodds's book with a critical eye; while appreciating in positive terms what it attempts, understand where it fails.

TIMOTHY F. H. ALLEN
Timothy F. H. Allen (tfallen@wisc.edu) is a professor of botany and environmental studies at the University of Wisconsin in Madison.

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TO SEE THE FOREST THROUGH THE TREES

The Tangled Bank: An Introduction to Evolution. Carl Zimmer. Roberts and Company, 2010. 385pp., $59.95 (ISBN 978-0981519470 cloth).

Carl Zimmer takes the title of his book, *The Tangled Bank: An Introduction to Evolution*, from the last paragraph of Darwin's *Origin*: "It is interesting to contemplate a tangled bank…and to reflect that these elaborately constructed forms…have all been produced by laws acting around us." Like Darwin, Zimmer chooses to write in a style that is understandable for any educated reader. What better way is there to inform the general reader of Darwin's theory than to provide a lucid