Yes, Ecology Is Hard


It would be difficult to argue that Homo sapiens has not known about trophic cascades at least since the Neolithic Revolution—ancient Chinese farmers, for example, are known to have understood that when birds eat coccinellid beetles, the latter’s control over the aphids that affect crops is diminished. Such observations of trophic cascades are recorded in archeological sites the world over, reflecting the fact that the idea has been around for a long time. Consequently, understanding the concept within traditions of Western science is a historically complicated subject, yet it offers important lessons for contemporary ecologists. Three intersecting lines of development are clearly recognizable in recent history.

First, there is a rich base in historical natural history study that should not be bypassed. Citing Darwin’s humble bees (as I frequently do) consecrates the idea as ordained by the master, yet humble farmers and humble hunters and gatherers before them undoubtedly took as a matter of course the notion that an enemy of my enemy is my friend. Indeed, one can hardly think about predators and their prey or herbivores and their plant food without casting one’s thoughts in this evident framework.

Second, a rich base in experimental ecology has developed, demonstrating that action at one trophic level may have indirect consequences at some other level. Again citing the master, Darwin’s famous experiments showing that his lawn mower (well, the equivalent) could have an effect on the competitive interactions among the plants attacked by that artificial herbivore were perhaps the first systematic demonstration of a trophic cascade, although one could imagine that ancient Chinese farmer killing a few birds and watching the aphids decline, thus being ecology’s true master. Since the 1960s, experimental ecology has acquired its own imprimatur as the methodological imperative of modern research, and the experimental documentation of trophic cascades has been a major theme.

The third line of historical development is clearly much more recent. In the mid-1920s, Lotka and Volterra independently wrote down two very simple equations that demonstrated the profound truth that predators and their prey must oscillate with respect to one another. Although those ancient farmers may have realized this fact, it is not as obvious as the ecological shibboleth that my enemy’s enemy is my friend. Furthermore, it is not so much the initial insight gained from these two equations, which many ecologists today would claim as independently obvious, but the enormous amount of theoretical ecology that has emerged from their detailed study. This fact is especially important since, as a result of the pioneering work of MacArthur and Levins, theoretical ecology is now a field unto itself, growing in mathematical sophistication even if it is a bit lacking in empirical grounding.

Today, we stand at the threshold (perhaps we are always there) of a quantum jump in our understanding about community ecology. A Venn diagram illustrating the intersection of these three trends would, I believe, guide us to the brink of making that jump. Unfortunately, these three trends seem to have generated the perception of a continuum rather than an intersection. Community ecologists are frequently thought of as existing on a continuum ranging from natural history, through experimental ecology, to theoretical ecology, with the normative value increasing along that continuum for the theoreticians but decreasing for the natural historians and being bell-shaped for the empiricists. But the problem, in my view, is not a prejudicial evaluation of which point on the continuum represents an ideal point of reference; rather, the problem is in the framework itself. These trends are not, and should not be thought of as, a continuum. They should be visualized as the overlapping set of a Venn diagram. The creative intersection of natural history, experimental ecology, and theoretical ecology is where the truth will be found.

A wonderful example of the inspiration that comes from the natural history set can be found in Cristina Eisenberg’s The Wolf’s Tooth: Keystone Predators, Trophic Cascades, and