It’s a Wonderful Gift

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It is not often that mathematical theory is tested by a machine gun. In 1981, Dave Kelleyhouse, a wildlife biologist employed by the state of Alaska, submitted a purchase requisition for an automatic rifle to shoot wolves from aircraft in order to increase moose hunter success. If removing wolves was the management goal, it seemed to make sense to accomplish this as efficiently as possible. “Machine-gun Kelleyhouse” didn’t reckon that public opinion would play a role and that, once the public weighed in, his supervisors would be displeased (1).

It is doubtful that elegant math was really on the wildlife biologist’s mind. But 11 years later, when the “experimental results” of killing wolves entered the scientific literature, it was packaged as a field test of a theory based on very seductive mathematical equations and graphs. The idea was that, if wolves and the general result of temporary, intensive wolf kill rates could be brought to a very low level, predators represent a “conversion” of biomass from their prey, so logically one would expect a proportional relationship. It would be a vast understatement to say that predator-dependent models based on Lotka-Volterra dynamics are the entrenched, major-Itt view, for they are the foundation of most of the scientific literature on predation over the past century. Never mind that the outcome of the basic Lotka-Volterra model is very sensitive to initial conditions; that the only model outcome, if the parameters are carefully adjusted, is an everlasting predator-prey cycle; and that no serious student of predation believes the model suitably depicts the real world. For over two decades, Arditi and Ginzburg have picked away at the reigning paradigm, all the while championing their alternative ratio-dependent model. Amassing compelling evidence from mathematics, logic, field data, and experimental studies, they have gradually gained support.

Only dedicated specialists will have closely followed the debate over ratio dependence. The present book usefully distills the theory in a grand narrative, albeit one written by the challengers to prevailing opinion. Arditi and Ginzberg have studied carefully the arguments of their critics and respond with a hypothesis based on “gradual interference” along a gradient of predator density. By this notion, predators that exist at moderate to high density interfere or indirectly compete with one another, leading to a “reduction in consumption rate due to sharing available prey with their neighbors.” Perhaps satisfyingly, gradual interference accommodates both prey-dependent and ratio-dependent perspectives, each operating in pure form at the extremes of predator density.

After a career in field biology that’s led to an appreciation for the inherent complexity of predator-prey dynamics, I admit to being impressed by the immediate usefulness of viewing predation through ratio-dependent glasses. Elegant mathematics that describes the essential core dynamic is a “wonderful gift” to our understanding of the natural world, which physicist Eugene Wigner said “we neither understand nor deserve” (10). Imagine reaching the following insights through mathematics and critical thinking: Whereas the presence or absence of predators greatly affects prey numbers, annual variation in predator density does not. Killing a wolf will not likely improve moose-, elk-, or deer-hunting success for humans. Improving habitat will increase prey numbers more successfully than will controlling predators. Biological control of insect pests can actually work, even in a (mainly) ratio-dependent world. The mutual dependency of predator and prey is fundamentally asymmetrical—prey matter to predator populations far more than vice versa.

In reviewing the progress in scientific understanding of predator-prey systems, Arditi and Ginzburg decry the gap that exists between theory and application. Microbiologists quickly confirmed and accepted the basics of consumer-resource dynamics, but many applied ecologists (e.g., in my own field of wildlife management) have an unfortunate phobia for all things mathematical. Readers...
who do not fully understand the equations of Arditi and Ginzburg will not appreciate all of the elegance and evidence in *How Species Interact*. Yet all ecologists will certainly gain by grasping the conclusions and philosophy found in the book.

**References**


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