Community work

Michael J. Crawley

Ecological experiments: Purpose, design and execution. By Nelson G. Hairston Sr. *Cambridge University Press: 1990. Pp. 370. Hbk £30, $53.50; pbk £15, $24.95.*

In his presidential address to the British Ecological Society in 1957, George Varley suggested that there were alternating modes of population regulation in successive trophic levels. If one trophic level, say plants, was limited by competition then the next trophic level (herbivores in this case) must be limited by natural enemies. At about the same time, but unaware of Varley's work, Nelson Hairston prepared a paper with Frederic Smith and Larry Slobodkin on the relative importance of competition and predation in different trophic levels. Their paper was rejected by *Ecology* and eventually appeared in *American Naturalist* in 1960, since when it has become one of the citation classics of community ecology.

Hairston *et al.* reasoned that plants, natural enemies and decomposers are all limited by competition for food, but that herbivores are kept scarce by natural enemies (they did not compete for food and have little impact on the abundance of plants). In brief, "the world is green and we're not making coal". The hypothesis was darwinian both in the breadth of its vision and in the fact that it derived from natural history observations rather than from controlled experiments.

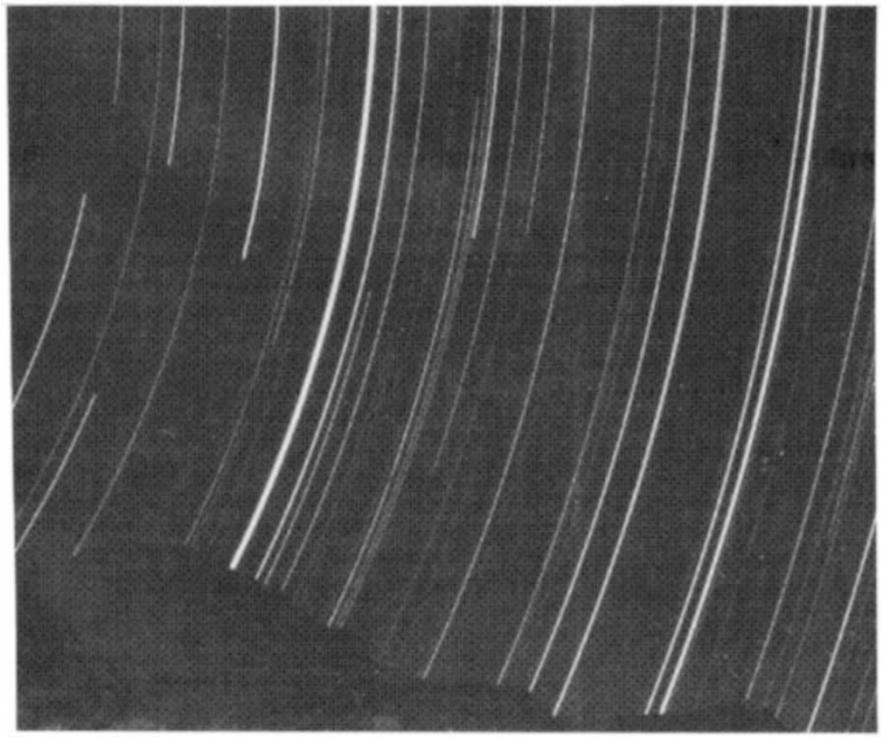
Despite repeated attacks during the intervening 30 years (the world is obviously not always green, herbivores sometimes do have important effects on plants, and predators do not always compete for resources), the hypothesis has stood the test of time remarkably well. As Hairston shows in his new book, there is no compelling evidence against any of the argument's central tenets.

Hairston's main theme here is that manipulative field experiments offer the best (perhaps the only) means of understanding ecological communities. He makes the important point that robust generalizations about the relative importance of competition and natural enemies are only likely to emerge if the outcome of experiments is considered one habitat at a time sessile animals compete directly with plants (for example, in rocky intertidal habitats where space is often the limiting resource whereas there is no equivalent process in muddy intertidal or in terrestrial habitats). To this end, he draws examples from forests, successional communities, deserts, fresh water and marine communities, and each chapter describes a selection of experiments that have been carried out on how populations of decomposers, plants, herbivores and predators are regulated.

Nature has no stake in being understood by ecologists, and even the simplest questions tend to have complicated answers. This has meant that good field tests of competing hypotheses about population regulation are few and far between. The result is that our detailed knowledge is hideously fragmentary (it is like having one or two pieces from lots of different jigsaws) and generalizations are inevitably based on case histories that derive from a wholly unrepresentative set of species (those that are reasonably easy to work with) and a somewhat esoteric collection of habitats (places where ecologists like to do their field work). In no case has population regulation been studied in simultaneous field experiments on all the components of the same ecosystem (plants, herbivores, carnivores and decomposers). The task of carrying out simultaneous, long-term, well-replicated, experimental studies on all the important components of any real ecosystem would be the ecological equivalent of sequencing the human genome.

One of Hairston's aims is to inspire better ecological experiments. He does this by describing examples of both good and bad designs, and he pulls few punches in exposing the shortcomings of the ill-designed studies (one extreme case, published in the *Journal of Animal Ecology* in 1972, had no control, no replication, no randomization and no statement of the initial conditions). Although it is true that ecologists have never been renowned for the quality of their experimental designs (for example, the high frequency of 'pseudoreplication' exposed by S. H. Hurlbert in 1984), it should be said that contemporary experimental ecologists, brought up in the post-Hurlbert era, are much better informed on matters of experimental design (most of Hairston's examples of poor design come from studies published before 1985).

Like most advocates, Hairston could be accused of over-selling his product. For example, he has little time for observational studies (comparative surveys or 'natural experiments') and the contributions of ecological theory get short shrift. Thus, while you would be unlikely to choose him as your guide to the strengths of the comparative method or as an advocate for theoretical ecology, when it comes to writing about ecological experimentation Hairston is unbeatable. This is the best ecology book to appear in several years. It is instructional, entertaining and unmatched in the breadth and distinction of its scholarship. □



Time-exposed star trails over the barren Cabeza Prieta Mountains (1985), reproduced from *Desert Heart* by W. K. Hartmann. The volume charts both the natural history and cultural history of the Sonoran Desert, southwest United States. Published by Fisher, price $35.

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