Ecology of Insect Host-Parasitoid Communities

Competition may be the most vital factor in the structure and function of these systems.

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"Ecology" is a remarkable word. In recent years it has come to denote a startling variety of things to a variety of people. We keep hearing that our very survival as human beings depends on how well we understand our ecology and what we are willing to do for it. Apparently the essence of this plea is: How can we stop polluting our environment, overpopulating our earth, and overusing our resources? But the term ecology was first used with somewhat simpler and purer connotations. Ecological studies originally dealt with natural history, and with the tolerances of plants and animals (excluding human beings) to physical conditions in their environments. Attempts were made to determine the effects of temperature, humidity, and other physical factors on various organisms and their distribution. In later studies, the trend was toward more nebulous things—such as finding out the effects of competition, trophic structure, or species diversity on organisms and their organization. We were trying to understand how natural environmental factors affect the distribution and abundance of species, other than man, on this earth. Perhaps this form of the science should be called "classical ecology" to distinguish it from the newer, more human-oriented form.

Over the past two decades, classical ecologists have become more interested in studying number dynamics in groups of single species and in the puzzling and entertaining things that happen when groups of several species attempt to live together. Such studies, known as population and community ecology, have attracted a surprisingly large number of investigators, possibly because the data that can be collected are often so complex as to be almost overwhelmingly difficult to analyze, and thus they present an irresistible challenge. In any event, the endeavors of these investigators have provided the basis for some of the most profound and heated controversies science has ever known.

Not long ago, population ecologists spent much time arguing whether "density dependent" or "density independent" factors regulate natural population numbers. Fortunately, after several years the controversy somewhat subsided when a close scrutiny of the various positions showed that frequently the opponents were saying very much the same thing only in a different way. Some ecologists, with perhaps more insight than others, concluded that there were often no valid means of differentiating density dependent from independent factors. Nevertheless, the debate was thought-provoking and allowed time for the gathering of more evidence which, after some analysis, began to indicate what probably should have been realized from the beginning—that no two populations are necessarily regulated or even influenced by the same kinds of factors. Colinvaux (*1*) has written a lucid and penetrating account of this position.

There have been other hotly debated issues in population and community ecology; issues that may be a long time in their resolving. Reasons for the regular cycling in numbers of some animal species have never been agreed upon. Indeed, there is still controversy over the question of whether the cycles are real or not. The importance of predators, weather, and diseases in population dynamics is still largely undetermined. Why are some species in a community relatively rare and others common? Is it a fact that populations are more stable in tropical than in temperate areas, and if so, why? There are even some issues that have been considered closed, but that could benefit from reinvestigation; ecological succession is one such issue (*2*). All in all, it is apparent that there are many mysteries in classical ecology yet to be solved. It is also apparent that these mysteries will not be solved entirely by simulated computer studies nor from long-winded debate. The issues will be resolved ultimately from long-term, in-depth studies of natural populations and communities under both field and laboratory conditions. This task will not be easily nor quickly accomplished.

Since 1966, I have been studying an aggregate of insect species that I perfer to call a community. Others might like to call it a segment of a community, a species complex, or something else, and this attitude is understandable according to various definitions of a community. This particular community consists of a tiny midge *Rhopalomyia californica* Felt (Diptera: Cecidomyiidae) that forms galls on the plant *Baccharis pilularis* De Candolle (coyote brush), and a number of parasitic wasp species (parasitoids) (Hymenoptera) that attack the midge, each other, or both (*3*). All members of this community are endemic to the northern and central coastal region of California and extend inland to the Sierra Nevada foothills in limited areas. There are both primary parasitoids (attacking only the host insect, the midge) and facultative hyperparasitoids (attacking either the midge or another parasitoid) present in the community. *Rhopalomyia* has altogether perhaps a dozen species of parasitoids, some of which are very common and appear in most samples, and others which occur sporadically and even very infrequently. I have studied intensively the six species that are most consistent in their presence within the coastal area observed; the other species seem to be so sporadic in occurrence that they must have much less effect on the community.

Although very few of them have

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