Metacommunities: Spatial Dynamics and Ecological Communities

M. Holyoak, M. A. Leibold and R. D. Holt (eds). University of Chicago Press, Chicago, 2005. 513 pp. Price US$38. ISBN: 0 226 35064 9.

This book is a resoundingly thorough exploration of metacommunity concepts to date. *Metacommunities* has four main sections including core concepts, empirical evidence, theoretical perspectives and emerging areas. Each section has a stimulating introduction that puts the forthcoming chapters into a broader theoretical context, and compels you to read on.

The key concepts underlying most chapters are four models of metacommunity dynamics. The models, previously referred to as paradigms (Leibold *et al.* 2004), are thankfully reduced to conceptual models or perspectives in this book. The models include the Patch Dynamic concept, where prey species or poor competitors survive in a patchy landscape by colonizing patches faster than predators or superior competitors; the species-sorting model, in which all species can reach all patches, but the community that develops in a patch is determined by local environmental conditions; the mass-effects perspective in which substantial dispersal leads to species occurring in locations where their natural rate of increase is less than one; and the neutral model where species are ecologically equivalent, and community composition is determined by a random sampling process, coupled with dispersal and speciation. Most authors use these concepts as either a framework or a point of reference, providing a consistent theme throughout the book.

Chapter 14, authored by nearly all of the key metacommunity protagonists, summarizes a range of predictions under the four metacommunity models and may be especially valuable for designing field tests of these theories. For example, under the neutral model local diversity should increase with increasing migration rates (reduced distance between patches). In contrast, under the species-sorting model, local diversity should be unrelated to migration rates because species composition is determined by local conditions. However, unravelling the relative importance of these models in real systems will be challenging, because similar spatial patterns are predicted by more than one model. Chase *et al.* (Chapter 14) warn that several patterns need to be examined to distinguish among models.

Although these metacommunity models are relatively new, many of the concepts that they describe incorporate or redescribe existing theory. Metapopulation theory is acknowledged as a primary source of origin for metacommunity ideas (Chapter 1), particularly the two-species models of predator–prey dynamics in patchy environments (Chapter 2). The intermediate–disturbance hypothesis incorporates a colonization–competition trade-off, just as in patch dynamic models (Chapter 10). Also in Chapter 10, Mouquet *et al.* describe how the species-sorting model has already been explored using classic Lotka–Volterra models and lottery models. For example, Chesson's spatial and temporal storage effects are kinds of species-sorting dynamics, where all species have access to all patches, but only appear when conditions are suitable (Chapter 10). Furthermore, through reading *Metacommunities* I discovered that Mass Effects have been invented five times, and are also know as 'spatial subsidies' in the food-web literature (Chapter 3), as source-sink effects, edge effects (Chapter 2), and the rescue effect (Chapter 5).

Holyoak *et al.* (Chapter 1) convincingly explain why metacommunity theory is important from an applied perspective, pointing out that metacommunity processes are crucial to determining the outcome of habitat loss and fragmentation. However, when applied aspects are revisited in the concluding chapter (Chapter 20), Holt *et al.* failed to bring together the rich source of preceding examples and theory that emphasized applied outcomes. For example, in Chapter 2, Hoopes *et al.* discuss the colonization/competition trade-off and suggest that poorly dispersing good competitors may be the first species to disappear with increasing habitat loss. Theoretical results (Chapter 3) predict that niche specialization leads to a stronger species–area relationship, meaning specialist species have smaller population sizes and will be more vulnerable to extinction in the face of habitat loss. This prediction was supported by empirical results in Chapter 9. Shurin and Srivastava (Chapter 17) argued that the saturation of local communities is only likely relative to a small regional pool; species from further away may still be able to invade. The implication is that even the most intact and species-saturated native community may be readily invaded by exotic species. Although the strength of *Metacommunities* is its theoretical exploration, it takes very little imagination to extend these ideas to many applied conservation problems.

Most chapters make reference to areas of future research, and the final chapter is devoted to the topic. The field is rife for exploration. This includes obtaining a better understanding of the way behaviour influences dispersal; especially important given the simplifying assumptions about dispersal incorporated into nearly all metacommunity models. For example, animal behaviour, such as habitat selection (Chapter 16) wasn't considered by the four metacommunity models, but may alter the mechanisms determining community composition. Another key area of research is to understand the degree of openness of communities, and the way species with different dispersal abilities interact in different trophic layers of communities (Chapter 20).

Although the independent chapters are in the form of journal articles, some don't have the efficiency of a good journal piece. My only substantial quibble with the book is that some chapters could have been more scrupulously edited to improve their impact. Nevertheless, *Metacommunities* is an exciting and valuable compilation of ideas that will strengthen this rapidly growing field.

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REFERENCES

Leibold M. A., Holyoak M., Mouquet N. *et al.* (2004) The metacommunity concept: a framework for multi-scale community ecology. *Ecol. Lett.* **7**, 601–13.