

Preface

*"If you can look into the seeds of time, and say which grain will grow
and which will not, speak then to me."*

Banquo, from Shakespeare's Macbeth

Perhaps this book is my attempt to hold a conversation with Banquo? He would be a fierce critic of the scientific stature of plant ecology, judging from this quote, and I doubt that I could get him to speak at all. He demands, not only predictive ability, but a very fine-grained level of predictive ability. In this book I attempt to develop a predictive theory of plant community assembly. By "predictive" I mean that the theory should be able to quantitatively tell us the relative abundance of each species in the local community under natural field conditions and based on information that can be collected in practice. By "theory" I mean a formal method of both performing such predictions and also of being able logically to deduce why such predictions actually hold in nature based on known biological processes – in this case, the process of natural selection.

I warn you at the outset that the predictive theory presented in this book would not satisfy Banquo even if it were to succeed. Such fine-scale predictive ability – being able to "say which grain will grow and which will not" – is likely forever beyond our grasp. The reason for this is explained in Chapter 2. We must remain forever mute before Banquo. However, this does not mean that macroscopic properties of plant communities must remain forever beyond our grasp. We might be able accurately to predict such aggregate properties as the relative abundance of various species even if we can never say what will happen with every seed. In fact, counterintuitive as this might sound, such inherent unpredictability at a fine scale might even help us to predict such macroscopic properties. This is the message of Chapters 4 to 7. On reflection then, my conversation cannot be with Banquo but rather with you, the reader.

So who are you? I find it easier to write if I can imagine the person to whom I am speaking and then simply write down the conversation. Let me tell you who I imagine you to be. You are a graduate student of ecology, or perhaps an advanced undergraduate student, who is interested in how ecological communities are formed. No? Then you are a more seasoned researcher in plant ecology who is looking for a new perspective on a question as old as our science. That's not you either? Then you are an animal ecologist, or maybe an ecologist without any taxonomic preference, who is looking for a *really* new perspective on the same old question. If this is who you are then I dearly hope that you will apply these ideas to your own subject area. Perhaps your interests are more theoretical? If so you will also find some new theoretical developments that might interest you. In case you are *not* a theoretical ecologist I hasten to add that explicitly mathematical developments have been separated from the main text by placing them inside boxes. You can certainly read the text – if you want – without wading through these boxes. You will have to endure some equations but you will not need any mathematics beyond basic algebra, some introductory calculus, and the rudiments of statistics. Although not a user's manual, you should find enough practical information (including some code in the *R* language) to be able to apply the ideas of this book to real field data.

Ideas are only scientific ones when they are made public. Public ideas (memes) are ones that travel from brain to brain. Each passage through some grey matter changes the idea, sometimes profoundly but usually only subtly, and this gradual change makes it very hard to say where an "idea" originates or even if two people are thinking about the same "idea". The ideas in this book are no exception. I am constantly surprised when I find one of my own apparently original ideas written, long before I ever thought it, in the writings of people who have influenced me. Properly chastened, such surprises remind me both of how much I owe to others and also of how few original ideas I actually have. I have tried to properly credit such borrowed ideas but, just to be sure, I want to acknowledge my debt to the following people who have each influenced my thoughts on the subject: Robert van Hulst, Paul Keddy, Rob Peters, Martin Lechowicz, Len Lefkovitch and Éric Garnier. Grégory Sonnier (a current PhD student) has been working hard to find new ways of empirically testing many of the ideas in this book. Some of his interesting results have not been included in this book since they have not yet been published, but they have undoubtedly influenced me as well. If anyone notices that I have not properly

acknowledged the ideas of others I can only ask that they let me know so that I can properly pay my debts.

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Analogy is a vital part of science because they help us to broaden our horizons with a success to that which we already understand. Although both scientists and philosophers have long recognized that scientists have to struggle with reality. The danger, where this happens, comes however when scientists "know something of nature in any other way. In medieval Europe, the reigning Aristotelian ecology was accepted as unquestionable. Science, however, as we now know to possess a life-cycle: birth, growth, old age and death. From now on, in the natural world were made intelligible in this way and were understood by comparison with definitions drawn (the "nature") of objects of nature. As we shall see, this is not the case. Why? Because the nature of objects is not in the nature of predators in fact. A stone falls to the ground not by flying up into the air. Why? Because it is in the nature of objects to fall, i.e. objects made of "earth" rather than "air" or other elements. The nature of a thing was to know the thing itself (Heraclitus). The "nature" was replaced in the seventeenth century, by people like Descartes, Galileo and Newton, with a new one: the analogy of nature as a machine. The word of a mechanical clock, down to modern times, the fact remains that it is "nature" to do so -- place the hand along on a table and it follows a line -- v. Rather than an inherent desire, the hand, when properly handled, moves because a spring turns a wheel that hits a cog. Sometimes during the early twentieth century Nature stopped being teleological and became a machine that was obeying physical causes. By the end of the twentieth century, the very meaning of "explanation" itself had changed from its original Aristotelian sense to the new mechanistic one: to know the cause-effect relationship was to know the thing.

What is new for great scientific ideas is also true of those derived from biology. There is no more easily grasped through analogy. As will be explained in chapter 2, the analogy used by ecologists to understand