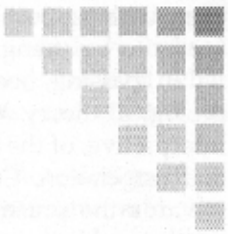

Preface

Biology as a whole is changing. New evidence becomes available daily, from observations that span the entire gamut of possible scales. Recent paleontological insights, for example, have been as influential as those associated with molecular techniques. Accordingly, general perceptions of biological systems have shifted dramatically, and these developments reflect the interplay between theory and new evidence. Advances of this kind represent the most exciting aspect of science, for they radically change the way in which we see the world.

Ecologists, too, have adjusted to new evidence in their primary quest of explaining the distribution, abundance and diversity of species. In general, though, the adjustments to ecological theory have proved rather superficial relative to the implications of the new findings from disciplines not traditionally associated with ecological theory, despite their relevance being widely acknowledged. The paleontological data provide a good example (Walter and Paterson 1994). A more fundamental shift is therefore needed if ecology is to remain in line with the developments in biology as a whole. In ***Autecology***, we develop and justify such realignment to ecological theory. Chapter one explains the basis of what we have done and provides an overview of the structure and place of autecological theory. The points made are expanded through the rest of the book and a glossary with an autecological focus is included.

Autecological research of the nature we recommend has been conducted by many researchers, many of them with applied ecology interests. Clearly, we do not claim novelty in this regard. What we do offer as new is the synthesis of this approach into a general methodology and theory that, together, provide a coherent and comprehensive alternative to the approach and interpretations of demographic ecology (which is represented chiefly by population and community ecology). Such an alternative, with the novel insights it generates, has never been available, not even in the thesis of Andrewartha and Birch (1954), for they could not reconcile their approach with any available evolutionary theory. Although demographic ecology

theory has been subject to severe criticism for some time, it has retained its dominance. Its determinism and associated promise of accurate prediction, even with respect to future evolutionary trajectories, has an appeal that seems to be strengthened by want of an alternative.

In passing, we ask the reader to consider the ultimate purpose of ecological theory. We accept it is a generalization, both organizational and interpretive, of the observed patterns of organismal distribution, abundance and association. Consider this in the light of tendencies to divert theory towards the practical aspirations of the observer, whether that is spatial analysis with the aid of satellite-assisted technology or the conservation of organisms. Convenience, although desirable in a theory, should not force the theory to contradict the very nature of the systems it is meant to explain. Drury's (1998) warning, in his *Ecology for Conservationists*, reminds us that most ecologists now probably learn ecological theory before getting the chance to experience organisms in nature to any deep extent. Although this might be an inevitable consequence of our urbanization and institutional existence, the organisms in their own environment should be foremost in our minds when trying to interpret the living world.

The subject matter of ***Autecology*** is designed to penetrate to the heart of ecology and encourage scrutiny of the basic workings of the discipline. It justifies the introspective reconsideration of the basic direction of ecology and therefore poses questions about current practice that are uncompromising to some extent. This synthesis nevertheless represents an open and honest attempt to demonstrate that at least one sound and workable alternative general approach to the present system of ecological investigation and interpretation of distribution, abundance and diversity is available. The alternative we canvas should not be mistaken as an equivalent to the alternative hypotheses commonly presented in ecological writings, where alternative interpretations are advanced to justify a scientific test or explain a set of observations. Instead, we present a fully articulated alternative framework for the whole of ecological theory and practice. The message can therefore be judged only once fully assimilated so that it is understood as a whole. Interim judgments of components of the overall argument are necessary, but the overall argument should not be dismissed simply because existing theory or a new sub-discipline is seen to cope with that particular component or sub-discipline. Such superficial dismissal is likely to be precipitated if too little attention is paid to terminology. Terms and concepts require careful attention, for they are frequently used in subtle ways that imply meaningful differences. Such everyday terms as "species", "population" and "competition" already suffer from such misuse. Unless meanings are specific, precise and used consistently, ecology will not improve as a science.

The theory presented in ***Autecology*** has been designed as a replacement for demographic theory, which was developed to explain the numerical stability of organisms in local situations. This is the view that underpins Darwinian natural selection, to its detriment according to Brady (1982).

For demographic ecology to achieve its original goal, a suite of associated assumptions had to be made as a platform. These premises were generally poorly articulated and thus remained cryptic to most ecologists (Cooper 2001). During the past few decades, various observations have helped expose these assumptions, encouraged their scrutiny and specified what an alternative ecological framework must accommodate (and what it, in turn, assumes).

For example, demographic theory was simply not designed to accommodate the spatio-temporal dynamics of organisms and the "idiosyncrasy" of species. Efforts to overcome these problems have commonly been discussed, ecological theory has been adjusted in various ways and several new sub-disciplines have been developed. Spatial ecology, metapopulation dynamics and macroecology, for example, are intended corrections to problems revealed in the foundations of demographic ecology. Developments like these, although significant and welcome, are still not entirely satisfactory as they are still only *ad hoc* adjustments to relatively peripheral aspects of ecological theory. They do not deal with the problems at the heart of demographic theory and they thus work against the formulation of an integrated theory for the discipline. In other words, they do not do full justice to the problems they should have overcome. Is it sufficient simply to add such *ad hoc* interpretations to old theory? Or is a complete reorganization required to cope with the knowledge that the fundamentals of the discipline are flawed to the extent that research, interpretation and application are all influenced negatively? We justify the latter approach otherwise logical disjunction will inevitably attend interpretation, compromise understanding, and affect the practice of ecology.

Autecological theory has the advantage of generalizing at a level that accommodates the problematic "idiosyncrasy" that species present to demographic ecology and is consistent with the associated "individualistic" spatio-temporal dynamics of species. Among the strengths of this theoretical replacement for demographic ecology is its logical connection to a species concept and model of adaptation that explains the spatio-temporal distribution of species' properties. Neither does it deal with the ecology of organisms primarily in relation to the resource use of other organisms, as in community ecology. All autecological interpretation is specified in relation to the adaptations of individual organisms and their interactions with their immediate environment, and it explains the spatio-temporal adjustment of organisms in relation to environmental dynamics at its various scales. To this end, it does not bisect the environment into its abiotic and biotic components, but deals with the environment as the organisms themselves confront it.

Autecology encourages ecologists to think of ecological processes primarily in terms of individual organisms, their adaptations, and their interactions with the environment and its dynamics. It is here that the foundational assumptions of autecology lie, and they are specified and

justified later. The properties of organisms must be considered in relation to their mode of inheritance and the associated process of recombination. They thus have their origins in the species gene pool of their provenance. Ultimately, the origin of such characters relates back to the process of adaptation and this informs how species must be dealt with in ecological theory and interpretation, and has implications for understanding adaptation and speciation (which are also spelled out). Such a readjustment in thought is liable to affect, to some extent at least, all the endeavors of ecologists.

An ancillary aim of ***Autecology*** is to help free biology from an idealism that is increasingly accepted, albeit unconsciously or unintentionally. The imposition of determinism on biological information spans biology at all scales, from the molecular upwards. Although it is relatively easy to demonstrate that deterministic interpretation, and therefore theory, is inappropriate for biology, the development of a well-articulated alternative is not so straightforward, and has proved elusive. Rose (1997) presented an alternative that copes very well with phenomena at the level of the organism and below. His proposal, a return to the multidimensional and interactive nature of development, and the maintenance and reproduction of organisms, is an instructive and refreshing change in emphasis from genetic determinism. Above the organism level, however, we find we are at slight odds with Rose, so ***Autecology*** is our attempt to do for the biology of whole organisms what he has done for the processes that take place within them.

Numerous colleagues and friends have contributed to the development of our ideas and the production of this book. Our collaborations with other scientists and research students have, in particular, been as enriching in this respect as they have been enjoyable. The intellectual stimulation generated by the challenges and insights of all of these people, going back decades, has helped substantially in formulating our interpretation and synthesis, and we wish to express our deep gratitude to them all. Several colleagues have read portions of the manuscript and their comments have been extremely useful in tightening our arguments and smoothing our presentation – we thank Tony Clarke, Greg Daglish, Lindsay Popple, Lauren Kaye, Renee Rossini and Andrew Ridley. Hugh Paterson, Raghu Sathyamurthy, Chris Pavey and James Hereward kindly found time to work through the entire manuscript, to its immense benefit. We are sorry we could not follow all of the suggestions as far as we would have liked. We had to draw a line at some point despite the many interpretations to follow. Many figures had to be redrawn and the perceptive talents of Iman Lissone have worked amazing changes in rendering elegant clarity from complexity. Finally, we thank Anantanarayanan Raman and Phoebe Coulon-McIntosh for their support during this project.

GIMME H. WALTER
ROB HENGEVELD