Preface

This book originated from a working group established at the National Center for Ecological Analysis and Synthesis (NCEAS) at the University of California, Santa Barbara. The problem confronted was the contrasting dynamics shown by populations of large mammalian herbivores in recent decades. Some of these populations had declined abruptly in abundance, most notably in certain protected areas in Africa. Others had become so abundant as to threaten plant populations and forest regeneration, especially in parts of Europe and North America. Conventional models emphasizing population regulation around some steady state seemed inadequate to explain these divergent trends. Hence, the specific aims of the group were to challenge the prevalent models using existing data sets, and develop alternative models capable of accommodating the complexity of environmental influences operating at different spatial and temporal scales.

The group met annually over 3 years, 2001–2003. Much shared understanding was gained, and several joint-authored publications appeared in journals. Numerous other papers have subsequently been published relating to the dynamics of large ungulate populations. At the same time, population ecology has been undergoing a phase of theory maturation, evidenced by the appearance of several books (e.g. Lande, Engen and Saether 2003, Turchin 2003, Cuddington and Beisner 2005) as well as numerous papers in ecological journals. A "balance of nature" perspective is no longer the prevalent paradigm (Cooper 2003), and new approaches provide greater recognition of disequilibrium processes, nonlinear responses, and the consequences of spatial structure, enabled by expanded computational capacity to accommodate this complexity (Owen-Smith 2002, Ellner and Guckenheimer 2006, Clark 2007).

Studies on large herbivores have been making a substantial contribution to this theoretical reassessment. New insights have been provided by the opportunities to follow changes in certain ungulate populations in demographic or even individual detail, revealing response mechanisms that

generally remain cryptic for small mammal or insect populations. Being directly dependent on vegetation as a food resource, herbivore populations respond sensitively to patterns of plant growth, and hence to changing climatic and human influences on vegetation dynamics. Complications arise from the additional effects of predation and hunting on some of these populations, as well as from fragmentation of the spatial context within which they exist.

It is time to take stock of the new knowledge that has been gained from these large herbivore studies. In particular, there is a need to assess what revision of theory, expressed through models of population dynamics, is needed to represent and explain the causes of change, looking beyond the expected density-dependent feedbacks that have apparently been ineffective in some circumstances.

Accordingly, this book is aimed at filling this need through (i) reconciling theoretical models with empirical findings on the population dynamics of large mammalian herbivores, and (ii) developing appropriate models for identifying the factors and processes causing changes in abundance. It is structured as follows.

Chapter 1 summarizes findings from a set of long-term studies on herbivore populations that have been especially influential in revealing the processes contributing to changes in abundance. Chapter 2 outlines the suite of modeling approaches representing prevalent theory and concepts. The following chapters then explore particular aspects more comprehensively. Chapter 3 is concerned with identifying local and broad-scale climatic influences on population dynamics, as well as the modifying effects of predation and hunting, structured as a temperate–tropical comparison. Chapter 4 considers the demographic processes that generate changes in abundance, as illuminated by individual-based studies. Chapter 5 identifies circumstances that may lead to irruptive oscillations in abundance. Chapter 6 examines how spatial heterogeneity modifies the influences of temporal variation in conditions on population processes. Finally, Chapter 7 outlines an alternative paradigm for accommodating the effects of spatial and temporal variability in resources and conditions on population dynamics.

All chapters were subject to outside review before being accepted for publication, initially individually and then by the two reviewers of the complete book. Chapters were revised and re-submitted in the light of critical comments. We are indebted particularly to John Fryxell for providing very incisive suggestions for final improvement of all of the chapters. We are also indebted to the various people, both members of the NCEAS

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