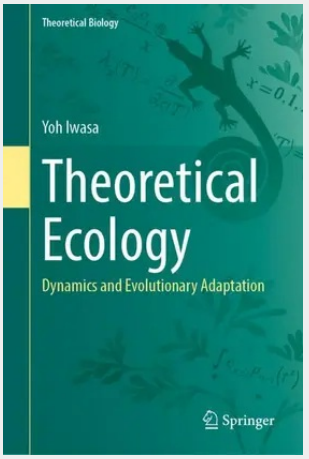
Iwasa

Theoretical Ecology

Dynamics and Evolutionary Adaptation



This textbook introduces essential mathematical concepts and techniques through concrete examples for those studying biology and related fields. It aims to convey the fascination of using mathematical models to understand living systems while providing the foundational skills needed to analyze such models.

In recent years, mathematical modeling has become increasingly important for understanding biological phenomena. Such models now play crucial roles in fields ranging from neuronal electrical activity and the molecular mechanisms of muscle contraction to the formation of morphological patterns during development and the study of brain function. Advances in modeling ecological and social behavior, as well as evolutionary processes, have further established mathematical modeling as an indispensable tool in theoretical and mathematical biology.

Mathematical models clarify logical structures, uncover unexpected patterns, and reveal commonalities across seemingly different disciplines. They also enable quantitative predictions that allow hypotheses to be tested against experimental and observational data.

Chapters in this book cover topics such as population dynamics, adaptive strategies, and principles of coexistence. Readers are introduced to dynamic optimization, control theory, and game theory, along with stochastic modeling techniques based on Markov and diffusion processes.

The purpose of this book is to present mathematical ideas in an intuitive and accessible way, helping biology students appreciate the fascination of mathematical modeling while acquiring essential analytical skills. With a focus on ecological contexts, it provides the background knowledge and core concepts needed to show how simple models can clarify underlying logic and unify diverse biological phenomena.

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