Population Dynamics for Bioinformatics

I. Introduction

What is Population Dynamics, a branch of Ecology. Applications and role in the management of biological resources.

II. Exponential growth

Goals:

1. Recognize geometric and exponential population growth.
2. Distinguish between seasonal and continuous breeders.
3. Given a time series of population abundance (N_t), know how to measure variation (absolute, relative, mean ...).
4. Understand the finite rate of increase (λ) versus the instantaneous rate of increase (r) and how they determine population abundance.
5. Understand the consequences of unregulated population growth
6. Understand what a biomathematical model is. Distinguish between parameters and variables.

Summary

Measures of population variation. Finite rate of increase (λ). Geometric growth. Seasonal and continuous breeders. Rates of survival and mortality in continuous breeders. Instantaneous variation. Instantaneous rate of growth (r).Exponential growth. Consequences of unregulated growth: the case of human population.

Lab Class: Numerical exercises and simulation with Populus

Readings:

Akçakaya H., M Burgman and L Ginzburg. 1999. Applied Population Ecology – Chapter 1. Population Growth, pp. 1-31

III. Regulated growth in continuous time: The logistic equation

Goals

1. Recognize the need for regulation factors of population growth and identify major groups of such factors.
2. Understand the following concepts in population ecology: density-dependent population regulation, c*arrying capacity* (K), non-trivial equilibrium, stable equilibrium, logistic growth.
3. Understand the non-linear nature of regulated population dynamics.
4. Understand difficulties in recognizing density-dependent regulation in field populations (lab class).

Summary:

Regulation factors in Population Dynamics. Concepts of equilibrium, stability, carrying capacity (K). The logistic equation of continuos breeders and its geometry. *Per capita* growth.

Lab Class: Simulation with a computer spreadsheet

Readings:

Roughgarden, J. 1979. *Theory of Population Genetics and Evolutionary Ecology: An Introduction*. MacMillan Publ, NY. Chapter 16.

IV. Variability and demographic stochasticity

Goals:
1. Distinguish sources of variability and uncertainty in population dynamics
2. Understand what demographic stochasticity (DS) is and the risk of extinction for random reasons even when $\lambda>1$.
3. Distinguish between deterministic and stochastic models.
4. Learn what risk is and how to draw risk curves.
4. Learn how to simulate demographic stochasticity in computer spreadsheets (Lab session)

Summary
Variability and uncertainty in population dynamics: environmental and non-environmental factors: a brief review. Demographic stochasticity (DS) and how to simulate it. Deterministic versus stochastic models. Advantages of stochastic models. Pseudo-random generators. Risk curves and their interpretation.

Lab Class: Simulation with a computer spreadsheet

Readings:
Akçakaya H., M Burgman and L Ginzburg. 1999. Applied Population Ecology – Chapter 2: Variation.

Literature

Akçakaya, HR, MA Burgman, LR Ginzburg. 1999 (2nd Ed) *Applied Population Ecology. Principles and Computer Exercises*. Sinauer, Sunderland Mass. Chapters 1, 2, 3.

Roughgarden, J. 1979. *Theory of Population Genetics and Evolutionary Ecology: An Introduction*. MacMillan Publ, NY. Chapter 16.