(3 credits)

Lecturer: Itamar Giladi

Weekly Lecture Hours	Exercise	Laboratory	Field Trip
3			

Course description and objectives:
Dispersal is a key life-history transition with numerous and significant ecological and evolutionary consequences, which directly affect individual fitness, and thus, dispersal-linked traits are under considerable selection pressure. While in mobile organisms, dispersal events can occur and reoccur throughout an individual's life time, in sessile organisms (e.g. most plants, many marine invertebrates), dispersal is a once in a lifetime event that has major consequences for future success. The course will take a broad look at dispersal in different taxa and different life forms. The course will cover the mechanisms, consequences and evolution of dispersal, as well as the various theoretical and empirical approaches for studying all aspects of dispersal ecology and evolution.

Course structure:
The course will be taught weekly in a 3 hours lecture.

The course is a graduate level course offered to M.Sc. and PhD students.
Assessment of students and structure of final grade:
Participation in class and discussion 10%
Assignments 40%
Final exam 50%

The course includes 4 modules, each addressing one facet of dispersal research. In each module there will be 3-4 lectures and one assignment. The four modules are:
a. Quantifying and modeling dispersal
b. Causes and consequences of dispersal
c. Evolution of dispersal
d. Dispersal and conservation

Module a - Quantifying and modeling dispersal: The first module will cover the various methods for quantifying dispersal and for modeling dispersal. It will include analytical, mechanistic, statistical and phenomenological approaches for providing a quantitative description of dispersal.
Module b - Causes and consequences of dispersal: This module will deal with the causes and drivers for dispersal as well as the consequences of dispersal at the individual, population and community levels.
Module c – Evolution of dispersal: This module will focus on the evolutionary processes that select for different dispersal strategies. It will start with the evolution of dispersal rate and will expand to the evolution of mixed-dispersal strategies, the evolution of dispersal distances and the evolution of dispersal kernels. It will deal with context-dependent dispersal as well.
Module d – Dispersal and conservation biology: This module will focus on the ecology and evolution of dispersal in a fast changing world. In this module I will demonstrate how the methodology and theory covered in the previous modules are

applied to conservation problems. I will include topics on dispersal and climate change, dispersal in fragmented landscapes and dispersal and species invasions.

Detailed description of course units:

1. General introduction: Definitions and basic terms, history of studying dispersal.

Module a - Measures and modeling of dispersal

2. Methods for estimating dispersal probabilities, dispersal parameters and long-distance dispersal.
3. Quantifying dispersal: Genetic tools for measuring dispersal – combination of direct observations and genetic tools for estimating dispersal, pros, cons and limitations.
4. Modeling dispersal – constructing dispersal models and incorporating them into demographic, landscape and evolutionary models.

Assignment 1: Inverse modeling

Module b – Causes and consequences of dispersal

5. Dispersal mechanisms, dispersal-related traits and dispersal syndromes.

Discussion: A critical look on Janzen-Connell models.

6. Habitat selection, ideal-free distribution and dispersal.
7. The genetic basis of dispersal: Dispersal, local competition, kin-competition and kin-facilitation. Inbreeding, outbreeding and dispersal.
8. Condition-dependent dispersal - plasticity in dispersal.

Assignment 2: Simulation of condition-dependent dispersal and long-term consequences.

Module c – Evolution of dispersal

9. Why disperse? Advantages and disadvantages of dispersal - key paper – Johnson and Gaines, 1990. Evolution of dispersal - Annual review of Ecology and Systematics.
10. History of modeling evolution of dispersal. Hamilton and May model, evolution of dispersal rates and evolution of dispersal distances.
11. Evolution of dispersal in spatially and temporally heterogeneous environments, predator-prey and parasite-host systems. Multiple causes for the evolution of dispersal.

Assignment 3: A critical review of models addressing the evolution of dispersal distance in general and of long-distance dispersal in particular.

Module d – Dispersal and conservation biology

12. Dispersal in fragmented landscapes – dispersal and metapopulation.
13. Population spread and dispersal – introduced species, invasive species and climate change.
14. Dispersal and climate change - ecological and evolutionary perspectives. Dispersal at the edge of population expansion.

Assignment 4: Analytical models of population spread. Reaction-diffusion and Integro-difference spread models.

Reading materials:

Text books:

Dispersal Ecology and Evolution. Clobert J., Baguette M., Benton T.G. & Bullock J.M. (2012). Oxford University Press, Oxford.

Dispersal. Clobert J., Danchin E., Dhondt, A.A. & Nichols, J.D. (2001). Oxford University Press, Oxford.

In addition, we will read and discuss some of the classic papers on dispersal, as well as the most recent literature.