INTEGBI 114 – Infectious disease dynamics (4 units)

INSTRUCTOR: to be determined
GSI: to be determined

INSTRUCTOR INFORMATION

The instructor believes that a quantitative understanding of the ecology and evolution infectious disease is critical in their management and that infectious disease provides a uniquely well-understood context to teach these quantitative approaches.

COURSE FORMAT

Two lectures/discussions (1.5h each) per week and one hour of study section focused on understanding readings, current epidemics and the major project of research on a particular disease.

PREREQUISITES

Bio 1A and Bio 1B or equivalent required, Ecology or Evolution course suggested.

FULL COURSE DESCRIPTION AND AIMS

Many of the challenges of managing infectious disease are essentially ecological and evolutionary problems. Disease follows the rules of species interactions as it spreads through host populations while resistance to antibiotics occurs through the rules of evolutionary biology. The key aim of the module is to teach ecological and evolutionary principles in the light of infectious diseases affecting human populations and societies as well as agriculture and wildlife. This is applied ecology and applied evolution writ large.

There is a large body of successful theory and more data in disease interactions than in any other ecological interaction. We aim to show how this combination of theory and data has been used to understand (1) the processes that determine population dynamics, (2) how we can successfully intervene in medical and conservation contexts (for example how many individuals should we vaccinate?), (3) how we can understand parasite virulence in the light of evolution and (4) how we can manage the impact of evolution on medical interventions.

INTENDED LEARNING OUTCOME

- Understanding the role of infectious disease in natural populations and communities
- Understand the role of disease in shaping human agriculture and societies
- Describe how infectious disease may be important in conservation

- Discuss when parasite virulence makes sense in the light of evolution
- Explain how to apply ecological and evolutionary principles to the treatment and control of infectious
- Present a scientific poster on the evidence for coevolution between a pair of species.

TEXTBOOK

No required textbook

ASSESSMENT: (% of Final Grade, Due date)

Midterm (15%, 3/2/17): Multiple choice

Poster (on species interaction of your choice; 25%, 4/6/17)

Participation in weekly discussion (10%, throughout term)

Quizzes on readings, case studies and disease of the week (15%, throughout term)

Final exam (35%, Finals week): Multiple choice.

ABSENCES

Each student can miss up to 3 class sessions without penalty, no need to contact me. If these absences are not used, students can drop the lowest 1 to 3 (depending on absences taken) scores they have on quizzes/participation.

COURSE SCHEDULE

Classes will consist of approximately 45 minute lecture on a major conceptual topic in the dynamics of infectious disease. In addition in the first session each week, I will present either a case study a particular reading in detail or discuss the impact of a key disease biologist. As a group we will choose a 'disease of the week' that we will read about and on which I will lead an interactive discussion in the second session. If (when!) there is a current important epidemic in the world we will discuss this. We will teach a familiarity with disease modeling and forecasting techniques using hands on web based modeling tools.

Discussion sections will (1) go over questions about the lectures, esp. as there is no text, (2) discuss the readings, (3) give homework exercises/readings, and (4) later in the course it will help you with the major project (research on a particular disease). Instructions on all these things will be given during discussion. The general format of a discussion section will be: (a) Quiz or materials to be handed in (b) Any questions from lecture (c) Discussion of readings, of exercises, of homework (d) Assignments for the following week. Later in the semester, the discussion sections will introduce you to how to conduct library and data base searches on a specific disease, and how to present the results as posters. **Your discussion leader is PRIMARILY YOUR MENTOR!! Contact them with questions about lecture, etc.** If you e-mail questions to them or to me, we may share answers by e-mail with the rest of the class – rarely is something you are uncertain about unique to you. Nor is uncertainty or curiosity any kind of indictment of your abilities – quite the reverse – it means you are thinking and participating!!

Required reading

Hudson, P. J., Dobson, A. P., and Newborn, D., Prevention of population cycles by parasite removal *Science* 282 (5397), 2256 (1998)

Kilpatrick, A. M. and Altizer, S., Disease Ecology. *Nature Education Knowledge* 1 (11), 13 (2010).

Ferguson, N. M., Cummings, D. A. T., Fraser, C., Cajka, J. C., Cooley, P. C., and Burke, D. S., Strategies for mitigating an influenza pandemic *Nature* 442 (7101), 448 (2006).

Galvani, A. P., Reluga, T. C., and Chapman, G. B., Long-standing influenza vaccination policy is in accord with individual self-interest but not with the utilitarian optimum *Proceedings of the National Academy of Sciences of the United States of America* 104 (13), 5692 (2007).

1/17/17	Introduction to the Ecology and Evolution of Infectious Disease
1/19/17	Lecture 1: Why infectious disease matters – the historical context: Case study – Yellow Fever in the Americas
1/24/16	Lecture 2: Why infectious disease matters now and how to predict it (Koskella): Case study – Malaria
1/26/17	Lecture 3: Vectorborne disease (Koskella)
1/31/17	Lecture 4: Sexually transmitted infections: Case study – HIV (Koskella)
2/2/17	Lecture 5: Disease impacts on wildlife population dynamics (Koskella); Reading - Hudson, P. J., Dobson, A. P., and Newborn, D., Prevention of population cycles by parasite removal *Science* 282 (5397), 2256 (1998)
2/7/17	Lecture 6: Modeling Disease dynamics:
2/9/17	Lecture 7: Foundations of disease modeling - Case Study - Measles

2/14/17	Lecture 8: Modeling childhood disease:
2/16/17	Lecture 9: “Rnought” - Case Study - Influenza
2/21/17	Lecture 10: Disease and communities:
2/23/17	Lecture 11: Population structure and the spread of disease: Disease biologist Florence Nightingale
2/28/17	Lecture 12: Vaccination: Case study – Small pox
3/2/17	MIDTERM EXAM
3/7/17	Lecture 14: Evolution of disease virulence: Case study Myxomatosis
3/9/17	Lecture 15: Rapid evolution of disease
3/14/17	Lecture 16: Evolution of host defense: resistance: Disease Biologist: Frank Fenner
3/16/17	Lecture 17: Evolution of host defense: tolerance
3/21/17	Lecture 18: The Evolution of antibiotic resistance: Reading - Kilpatrick, A. M. and Altizer, S., Disease Ecology. *Nature Education Knowledge* 1 (11), 13 (2010).
3/23/17	Lecture 19: Evolutionary implications of disease interventions
3/28/17	SPRING BREAK
3/30/17	SPRING BREAK
4/4/17	Lecture 20: Management in the face of evolution
4/6/17	POSTER SESSION
4/11/17	Lecture 21: Disease Emergence: ecology and evolution: Ferguson, N. M., Cummings, D. A. T., Fraser, C., Cajka, J. C., Cooley, P. C., and Burke, D. S., Strategies for mitigating an influenza pandemic *Nature* 442 (7101), 448 (2006).
4/13/17	Lecture 22: Management in the face of an epidemic
4/18/17	Lecture 23: Disease in conservation: Disease Biologist: Ronald Ross
4/20/17	Lecture 24: Lessons from Ebola
4/25/17	Lecture 25: Socio-economic determinants of disease: Galvani, A. P., Reluga, T. C., and Chapman, G. B., Long-standing influenza vaccination policy is in accord with individual self-interest but not with the utilitarian optimum *Proceedings of the National Academy of Sciences of the United States of America* 104 (13), 5692 (2007).
4/27/17	Lecture 26: this years epidemic
5/2/17	RRR WEEK
5/4/17	RRR WEEK
5/8-5/12	FINAL EXAM