EEB 315/ ENVIRON 315 (3 credits)
Ecology and Evolution of Infectious Diseases
Instructors: Mercedes Pascual and Johannes Foufopoulos
GSIs: Stephanie Gervasi and Luis Fernando Chaves

Course Outline

Class meeting times:
Lectures: Tu, Th 10-11am, Chemistry Rm 1300 (MP & JF)
Discussion:

Wednesday	8:30-10 a.m.	Rm 1145 Natural Science Building (LFC)
	10-11:30 a.m.	Rm 1145 Natural Science Building (SG)
	1-2:30 p.m.	Rm 2008 Modern Languages Building (LFC)
	2:30-4 p.m.	Rm 2004 Modern Languages Building (SG)

Computer/Wet Labs:
Computer and wet labs will meet at the same lab times, but at **alternate locations** noted below:
Computer labs: Rm 1720 Science Learning Center, Chemistry
Wet labs: Rm 1556 Dana Hall
Office Hours:
Stephanie Gervasi (G573 Dana Hall; sgervasi@umich.edu)- Mon. 11-12 pm
Luis Fernando Chaves (2041 Natural Science; lfchaves@umich.edu) Mon. 12:30-1:30 pm
Johannes Foufopoulos (G568 Dana Hall; jfoufop@umich.edu)- by appointment
Mercedes Pascual (2045 Natural Science; pascual@umich.edu)- by appointment

Prerequisites: BIOL 100 for non-majors or BIOL 162 for EEB majors
Readings: Course reader, available at Michigan Union's bookstore. Additional reading materials will be on reserve at the UM Science Library.

Course Description:

This course will provide an introduction to the ecological and evolutionary processes observed in parasites and other disease-causing organisms. You will be introduced to the wonderfully bizarre world of malaria, measles, fleas, tapeworms, HIV and anthrax. Topics examined will include the evolution of various life histories in human and wildlife parasites, spatial patterns of disease, host-parasite co-evolution and the role of disease throughout human history. Quantitative models for the temporal patterns of infectious diseases will be presented. The course will also focus on the various manners in which pathogens overcome of evade the host's immune system, and how they manipulate host behavior to facilitate transmission. In the last part of the course, we will examine the environmental factors leading to the emergence of new pathogens such as Lyme disease, Ebola and West Nile Encephalitis, as well as the importance of pathogens for wildlife conservation.

Student Evaluation

First Exam	February 23rd	25%
Second Exam (Partially cumulative)	April 18th	35%
Class/Lab Participation (including pop quizzes and a brief group presentation)		20%
Laboratory Reports		20%
Total:		100%

Academic Standards information: available at http://lsa.umich.edu/saa/standards/acadjudic.html

Reserve Reading List (available at UM Science Library):

- Brooks, D.R. 1993. *Parascript: parasites and the language of evolution*. Smithsonian Institution Press: Washington.

- Bush, A.O. et al. 2001. *Parasitism: the diversity and ecology of animal parasites*. Cambridge University Press: Cambridge, New York.
- Cheng, T.C. 1986. *General Parasitology.* Academic press College Division: Orlando, Fla.
- Ewald, P.W. 1994. *Evolution of infectious disease*. Oxford University Press: Oxford New York.
- Hudler, G.W. 1998. *Magical mushrooms, mischievous molds*. Princeton University Press: Princeton, N.J.
- Kennedy, C.R. 1975. *Ecological animal parasitology*. New York.
- Moore, J. 2002. *Parasites and the behavior of animals*. Oxford University Press: Oxford, New York.
- Schmidt, G.D. 1985. *Foundations of Parasitology*. Times Mirror/Mosby College Pub.: St. Louis.
- Wills, C. 1996. *Yellow fever, black goddess: the coevolution of people and plagues*. Addison-Wesley Pub.: Reading, MA.
- Zimmer, C. 2000. *Parasite Rex: Inside the bizarre world of nature's most dangerous creatures*. Touchstone Pub.: New York, NY.

EEB 315/ENVIRON 315
Ecology and Evolution of Infectious Diseases

Schedule of Lectures: 2006

You are expected to have read these materials (from your Course Reader or from materials on reserve in the Science Library) *before* each lecture.

JF-Johannes Foufopoulos; **MP**-Mercedes Pascual; **SG**-Stephanie Gervasi; **LFC**-Luis Fernando Chaves.

JANUARY

5/1 **Introduction** (SG & LFC)
Presentation of film on infectious diseases.

10/1 **General Lecture on Diversity of Microparasites** (JF)
See Parasitology notes on reserve in Science Library

12/1 **General Lecture on Diversity of Macroparasites** (JF)
- Hotez PJ, and Pritchard DI. 1995. Hookworm Infection. Scientific American June: 68-74.

17/1 **Introduction to Population Regulation and Models** (MP)
- Scott and Dobson. 1989. The role of parasites in regulating host abundance. Parasitology Today, 5(6): 176-183.

19/1 **Morbilliviruses (measles, rinderpest, canine distempter)** (JF)

24/1 **Microparasite models, herd immunity and vaccination** (MP)
- Roberts and Heesterbeek. 1993. Bluff your way in epidemic models. Trends in Microbiology, 1(9): 343-348.

26/1 **Morbilliviruses, seasonal dynamics-Measles I** (MP)
- Keeling. 1997. Modeling the persistence of measles. Trends in Microbiology, 5 (12): 531-518.

31/1 **Spatial Dynamics, heterogeneous transmission-Measles II** (MP)

FEBRUARY

2/2 **Vector Transmitted Pathogens I: Malaria, trypanosomes, and others** (JF)
- Ostfeld. 1997. The ecology of Lyme-disease risk. American Scientist, 85: 338-346.
- Rogers et al. 2002. Satellite imagery in the study and forecast of malaria. Nature, 415: 710-715.

7/2 **Vector Transmitted Pathogens II: Transmission models** (MP)

- Gupta, S. and Day, K.P. 1994. A strain theory of malaria transmission. Parasitology Today, 10(12): 476-481.
- Gupta, S. et al. 1994. Parasite virulence and disease patterns in *Plasmodium falciparum* malaria. Proc. Natl. Acad. Sci. USA, 91: 3715-3719.

9/2 **Sexually Transmitted Diseases** (JF)
See Parasitology notes on reserve in Science Library

14/2 **Retroviruses, HIV/AIDS** (JF)

- Gao et al. 1999. Origin of HIV-1 in the chimpanzee *Pan troglodytes troglodytes*. Nature, 397: 436-441.
- Weiss and Wrangham. 1999. From *Pan* to pandemic. Nature, 397: 385-386.

16/2 **Waterborne Pathogens: Schistosomiasis and others** (JF)
See Parasitology notes on reserve in Science Library

21/2 **Cholera and the Role of Environmental Reservoirs** (MP)

23/2 **First Exam**

MARCH

7/3 **Macroparasite models: Red grouse-interplay of predation and parasitism** (MP)

- Dobson and Hudson. 1994. The interaction between the parasites and predators of Red grouse *Lagopus lagopus scoticus*. Ibis, 137: S87-S96.
- Hudson et al. 1998. Prevention of population cycles by parasite removal. Science, 282: 2256-2258.

9/3 **Avian Parasitism** (JF)

- Winfree. 1999. Cuckoos, cowbirds and the persistence of brood parasitism. TREE, 14(9): 338-343.

14/3 **Parasites and Host Behavior Manipulation** (JF)

- Moore. 1984. Parasites that change the behavior of their host. Scientific American, 250: 108-115.

16/3 **Evolution of Virulence** (MP)

- Ebert, D. and Herre, E.A. 1996. The evolution of parasitic diseases. Parasitology Today, 12(3): 96-101.
- Ebert. 1998. Experimental evolution of parasites. Science, 282: 1432-1435

21/3 **Evolution of Antibiotic Resistance** (JF)

- Levy, 1998. The challenge of antibiotic resistance. Scientific American 46-53.

23/3 **Insect Pathogens/ Biocontrol** (JF)

- Myers JH. 1993. Population Outbreaks in Forest Lepidoptera. American Scientist 81: 240-251.

28/3 **Biodiversity and Disease** (MP)

- Dobson AP. 2005. What Links bats to emerging Infectious Diseases?. Science, 310:628-629.
- Le Roy EM et al. 2005. Fruit bats as reservoirs of Ebola virus. Nature. 438 575-576.
- Pin Koh L et al. 2004. Species Coextinctions and the biodiversity crisis. Science. 305: 1632-1634

30/3 **Emerging Diseases in Wildlife, Domestics, and Humans** (JF)

- Earn DJD, Dushoff J and Levin SA. 2002. Ecology and Evolution of the flu. TREE. 17(7): 334-340.
- Webby RJ and Webster RG. 2001. Emergence of influenza A Viruses. Phil. Trans. R. Soc. Lond B. 356, 1817-1828
- Nathanson et al. 1993. The evolution of virus diseases: Their emergence, epidemicity, and control. Virus Research, 29: 3-20.
- Daszak et al. 2000. Emerging diseases in wildlife-threats to biodiversity and human health. Science, 287: 443-449.

APRIL

4/4 **Emerging Diseases in Marine Ecosystems** (MP)

- Harvell et al. 1999. Emerging marine diseases-climate links and anthropogenic factors. Science, 285: 1505-1510.
- Harvell et al. 2002. Climate warming and disease risk for terrestrial and marine biota. Science, 296: 2158-2162.

6/4 **Impact of Infectious Disease on Nature Conservation** (JF)

- Torchin, M.E. et al. 2003. Introduced species and their missing parasites. Nature, 421: 628-630.

11/4 **Disease and Global Climate Change** (Guest Lecture: Mark Wilson)

13/4 **Review**

18/4 **Second Exam**

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Schedule of Labs: Winter 2006

You are expected to have read these materials *before* each lab/discussion.

JANUARY

10/1 Micro/Macro Parasites Diversity

Lab will meet on room 1556 Dana blg (SNRE)--
You will examine a diverse array of parasite specimens.

18/1 Population Regulation and Models

This is a discussion—come prepared to talk about the main concepts of these readings:.

- Dobson and Carper. 1996. Infectious diseases and human population history. *Bioscience*, 46(2): 115-125.
- Scott and Dobson. 1989. The role of parasites in regulating host abundance. *Parasitology Today*, 5(6): 176-183.

25/1 Microparasite models

Lab will meet in the Sciences Learning Center on Chemistry blg.--
In this lab you will be introduced to the program Populus and will do simulations with frequency and density dependent models of disease transmission.
Readings:

- Roberts and Heesterbeek. 1993. Bluff your way in epidemic models. *Trends in Microbiology*, 1(9): 343-348.

Further material will be sent by email

FEBRUARY

1/2 Morbilliviruses

Lab will meet in the Sciences Learning Center on 1720 Chemistry blg.--
During this lab you will estimate model parameters with real world data. Excel will be used.

8/2 Vector Transmitted Pathogens: Malaria and the Sickle Cell Allele

Lab will meet in the Sciences Learning Center on 1720 Chemistry blg.--
During this lab you will explore the relationship between the sickle cell allele and malaria in Africa.

A notebook will be sent by email when appropriate

15/2 Sexually Transmitted Diseases

This is a discussion—come prepared to talk about the main concepts of these readings:.

- Holmes. 1994. Human ecology and behavior and sexually transmitted bacterial infections. *Proc. Natl. Acad. Sci. USA*, 91: 2448-2455.
- Smith and Dobson. 1992. Sexually transmitted diseases in animals. *Parasitology Today*, 8(5): 159-166.

22/2 Review for the 1st exam

MARCH

8/3 Macroparasite of fishes

Lab will meet on room Dana blg (SNRE)--
During this lab we will dissect fish to look for their micro and macroparasites.

15/3 Ectoparasites of Fishes

Lab will meet in the Sciences Learning Center on 1720 Chemistry blg.--
During this lab you will examine the patterns of aggregation of macroparasites within a population of fish hosts. Excel will be used.

Further materials will be sent by email when appropriate.

22/3 Evolution of Virulence

This is a discussion—come prepared to talk about the main concepts of these readings:

- Ebert, D. and Herre, E.A. 1996. The evolution of parasitic diseases. *Parasitology Today*, 12(3): 96-101.
- Ebert. 1998. Experimental evolution of parasites. *Science*, 282: 1432-1435.

- Herre. 1993. Population structure and the evolution of virulence in nematode parasites of fig wasps. *Science*, 259: 1442-1445.

29/3 Evolution of Sex/Sexual Selection

This is a discussion—come prepared to talk about the main concepts of these readings:

- Clayton. 1991. The influence of parasites on host sexual selection. *Parasitology Today*, 7(12): 329-334
- Lively CM. 1996. Host-parasite coevolution and sex-Do interactions between biological enemies maintain genetic variation and cross-fertilization? *BioScience*, 46(2): 107-113.

APRIL

5/4 Environmental drivers of Disease

This is a discussion—come prepared to talk about the main concepts of these readings:

- Jackson JBC. 2001. What was natural in the coastal oceans? PNAS, 98: 5411-5418.
- Patz JA et al. 2005. Impact of regional climate change on human health. Nature. 438: 310-317.
- Lindblade KA. et al. 2000. Land use change alters malaria transmission parameters by modifying temperature in a highland area of Uganda. *Trop. Med Intl Health*. 5: 263-274.

12/4 Impact of Infectious Disease on Nature Conservation

This is a discussion—come prepared to talk about the main concepts of these readings:

- Morell. 1999. Are pathogens felling frogs? *Science*, 284: 728-731.
- Ostfeld RS and Keesing F. 2000. Biodiversity and Disease Risk: the case of Lyme Disease. *Conservation Biology* 14(3): 722-728.