

**Anthropology 177/Human Biology 114
Environmental Change and Emerging Infectious Disease**

Fall 2013

Instructors:

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Course Description:

This is a lecture course on the changing epidemiological environment, with particular attention to the ways in which anthropogenic environmental changes are altering the ecology of infectious disease transmission, thereby promoting their re-emergence as a public health threat. Organized by case studies of environmental change at (roughly) local to global scales, we focus on the role that environmental changes (such as deforestation and land-use conversion, urbanization, human migration, international commerce, and climate change) play in contemporary disease transmission. The diseases affected by these environmental changes include SARS, Avian Flu, Malaria, Dengue Fever, Chagas disease, Lyme, Influenza, Cholera, Hantavirus, BSE/vCJD, and West Nile Virus.

Expectations:

Attendance at lecture and discussion sections is mandatory. There is an in-class midterm for both the 3- and 5-credit options. For the 3-unit option, there is also an in-class final. For the 5-unit option, there is a 15-page research paper and no final. The research paper may be on any course-related topic that is *approved by the instructors*. Paper proposals will be due during week 5 of the course (details TBA). Collaborative papers are welcome, subject to the requirement of roughly 15 pages per author. Please consult the paper guide available on Coursework.

Students registered for 4 credits follow the rules for the 5-credit options. No exceptions to this rule will be granted.

Students registered for the graduate section of this class (Anthro 277) must write a research paper, which is expected to be a more involved research paper than for the undergraduate class. While 277 enrollees are allowed to register for three credits to accommodate credit limits, you cannot receive graduate credit for this course without writing a full research paper.

Prerequisites:

One of the following: HUMBIO 2A & 2B, the Bio Core, the Earth Systems Core, or permission of the instructors.

Sections:

Discussion sections will meet for one hour weekly starting the second week of the course. Locations TBA. Sections are a required part of the class.

Grading:

Grades for 5-unit enrollment will be based the midterm (40%), section (10%), and the 15-page paper (50%). Grades for 3-unit enrollment will be based on the midterm (40%), section (10%), and final (50%).

Readings:

Quammen, D. 2012. *Spillover: Animal Infections and the Next Human Pandemic*. New York: Random House.

In addition to this semi-popular book, we will use readings from the primary scientific literature throughout the quarter. Class reading assignments average between two and three journal articles per meeting. The reading load is thus quite light and the material in these readings is fair game for testing, so the prudent student will read all the assigned materials. All articles will be available on Coursework.

Course Outline (Provisional)

Lectures are on Tuesday and Thursday from 11-12:30 in Building 380-380C.

Readings Subject to Change

Week 1. Introduction: EIDs and

- 09.24 SARS & Avian Flu: A Taste of the Future? (Jones)
Readings: Jones et al. (2008); Mills et al. (2006); Gauthier-Clerc et al. (2007)
- 09.26 Epidemiology Meets Ecology: Some Tools (Jones)
Readings: Jones lecture notes; Wilson (2001); Woolhouse et al. (2005); Janes et al. (2012)

Week 2. Local Deforestation and Disease: Frontier Malaria in Rondônia

- 10.01 Colonization in Rondônia: How not to Change R_0 (Durham)
Readings: Charnley & Durham (2010); Paaijmans et al. (2009)
- 10.03 Vectors of Change and Vectorial Capacity (Durham)
Readings: Singer & Castro (2001); Sounza-Santos et al. (2008)

Week 3. National & International Change: Viral Encephalopathies on the Move

- 10.08 Dropping Like Crows: West Nile Virus in North America (Durham)
Readings: LaDeau et al. (2008); Kilpatrick et al. (2006); Reiter (2008); Kilpatrick (2011)
- 10.10 Paper or Plastic? Climate Change, Human Migration, and Urban Refuse as Drivers of Epidemic Dengue Fever (Jones)
Readings: Stoddard et al. (2009); Morrison & Scott (2010)

Week 4. Devastatingly Slow Infections

- 10.15 The Origins of HIV: Primate Lentiviruses and Bushmeat Hunting (Jones)
Readings: Gao et al. (1999); Hahn et al. (2000); Keele et al. (2009)
- 10.17 Origins of HIV: Migration, Globalization, and How Local Infections Go Global (Jones)
Readings: Rudicell et al. (2010); Sousa et al. (2010)

Week 5. Bound by the Food Chain: Prions

- 10.22 Careful What You Eat: The Tragic Case of Kuru (Durham)
Readings: Collinge 2006; Alpers (2008), Durham (2008); Gajdusek (2008)
- 10:24 How Now Mad Cow: Environmental Influences on the TSE's (Durham)
Readings: Belay & Schonberger (2005); Mead et al. (2009)

Week 6. El Niño, Cascades, and Vortices (Oh My!): Hantavirus and Plague

- 10.29 Death in the Southwest: Hantavirus Pulmonary Syndrome (Jones)

Readings: Engelthaler et al. (1999); Yates et al. (2002)

- 10.31 Is Plague Caused by “Trophic Cascades”? and How Can Ecology Help? (Jones)
Readings: Duplantier et al. (2005); Osfeldt & Holt (2004); Collinge et al. (2005)

Week 7. Global Environmental Change: Climate and Cholera

- 11.5 Environment and Endemism in South Asia: The Case of Cholera (Durham)
Readings: Lobbitz et al. (2000); Faruque et al. (2005)

- 11.7 Coping with Copepods: The Peruvian Cholera Epidemic (Durham)
Readings: Rodo et al (2002); Gil et al. (2004); Martinez-Urtaza et al. (2008)

Week 8. The Challenge of Chagas: Who’s the Guinea Pig?

- 11.12 *In-Class Midterm (NOTE: covers material through 11/7)*

- 11.14 American Trypanosomiasis: Disease of Poverty (Durham)
Readings: Moncayo & Silveiro (2009), Franco-Paredes et al. (2007); Cohen & Gürtler (2001); Rassi et al. (2010)

Week 9. Disruption of Community Processes and Disease Emergence

- 11.19 *Changes in the Land: Deflected Succession and the Emergence of Lyme Disease in Eastern Woodlands* (Jones)
Readings: LoGiudice et al. (2003); Keesing et al. (2006)

- 11.21 The Dilution Effect (Jones)
Readings: Ogden & Tsao (2009); Wood & Lafferty (2013); Salkeld et al. (2013)

11.25-11.29 Thanksgiving Break: NO CLASS

Week 10. Wrap-Up: Humanity’s Changing Epidemiological Environments

- 12.03 Evolution and Control: Designing Evolution-Proof Interventions
Readings: Galvani (2003), Read et al. (2009); Read et al. (2011)

- 12.05 Lessons for Control: How Can Human Ecology Help? (Jones & Durham)

- 12.12 *Final Exam (for 3 units): 3:30 to 6:30 pm*

Papers Due (for 5 units): 6:30 pm, paper copy due in classroom; email copy to all course staff

Readings (Full Reading List to Follow)

- Cohen, J. E., and R. E. Gürtler. 2001. [Modeling Household Transmission of American Trypanosomiasis](#). *Science*. 293:694-698.
- Collinge, S. K., W. C. Johnson, C. Ray, R. Matchett, J. Grensten, J. F. Cully, K. L. Gage, M. Y. Kosoy, J. E. Loye, and A. P. Martin. 2005. [Testing the Generality of a Trophic-cascade Model for Plague](#). *Ecohealth*. 2 (2):102-112.
- Engelthaler, D. M., D. G. Mosley, J. E. Cheek, C. E. Levy, K. K. Komatsu, P. Ettestad, T. Davis, D. T. Tanda, L. Miller, J. W. Frampton, R. Porter, and R. T. Bryan. 1999. [Climatic and environmental patterns associated with hantavirus pulmonary syndrome, Four Corners region, United States](#). *Emerging Infectious Diseases*. 5 (1):87-94.
- Galvani, A. P. 2003. [Epidemiology meets evolutionary ecology](#). *Trends in Ecology & Evolution*. 18 (3):132-139.
- Gao, F., E. Bailes, D. L. Robertson, Y. L. Chen, C. M. Rodenburg, S. F. Michael, L. B. Cummins, L. O. Arthur, M. Peeters, G. M. Shaw, P. M. Sharp, and B. H. Hahn. 1999. [Origin of HIV-1 in the chimpanzee *Pan troglodytes troglodytes*](#). *Nature*. 397 (6718):436-441.
- Gauthier-Clerc, M., C. Lebarbenchon, and F. Thomas. 2007. [Recent expansion of highly pathogenic avian influenza H5N1: a critical review](#). *Ibis*. 149 (2):202-214.
- Hahn, B. H., G. M. Shaw, K. M. De Cock, and P. M. Sharp. 2000. [AIDS as a zoonosis: Scientific and public health implications](#). *Science*. 287 (5453):607-614.
- Janes, Craig R., K. K. Corbett, J. H. Jones, and J. Trostle. 2012. [Emerging infectious diseases: the role of social sciences](#). *The Lancet*. 380 (9857):1884-1886.
- Jones, K. E., N. G. Patel, M. A. Levy, A. Storeygard, D. Balk, J.L. Gittleman, and P. Daszak. 2008. [Global trends in emerging infectious diseases](#). *Nature*. 451 (7181):990-993.
- Keele, B. F., J. H. Jones, K. A. Terio, J. D. Estes, R. S. Rudicell, M. L. Wilson, Y. Li, G. H. Learn, T. M. Beasley, J. Schumacher-Stankey, E. Wroblewski, A. Mosser, J. Raphael, S. Kamenya, E. V. Lonsdorf, D. A. Travis, T. Mlengeya, M. J. Kinsel, J. G. Else, G. Silvestri, J. Goodall, P. M. Sharp, G. M. Shaw, A. E. Pusey, and B. H. Hahn. 2009. [Increased mortality and AIDS-like immunopathology in wild chimpanzees infected with SIVcpz](#). *Nature*. 460 (7254):515-519.
- Keesing, F., R. D. Holt, and R. S. Ostfeld. 2006. [Effects of species diversity on disease risk](#). *Ecology Letters*. 9 (4):485-498.
- Kilpatrick, A. M. 2011. [Globalization, Land Use, and the Invasion of West Nile Virus](#). *Science*. 334 (6054):323-327.
- LoGiudice, K., R. S. Ostfeld, K. A. Schmidt, and F. Keesing. 2003. [The ecology of infectious disease: Effects of host diversity and community composition on Lyme disease risk](#). *Proceedings of the National Academy of Sciences, USA*. 100 (2):567-571.

- Mills, C. E., J. M. Robins, C. T. Bergstrom, and M. Lipsitch. 2006. [Pandemic influenza: Risk of multiple introductions and the need to prepare for them](#). *PLoS Medicine*. 3 (6):e135.
- Ogden, N. H., and J. I. Tsao. 2009. [Biodiversity and Lyme disease: Dilution or amplification?](#) *Epidemics*. 1 (3):196-206.
- Ostfeld, R. S., and R. D. Holt. 2004. [Are predators good for your health? Evaluating evidence for top-down regulation of zoonotic disease reservoirs](#). *Frontiers in Ecology and the Environment*. 2 (1):13-20.
- Paaijmans, K. P., A. F. Read, and M. B. Thomas. 2009. [Understanding the link between malaria risk and climate](#). *Proceedings of the National Academy of Sciences, USA*. 106 (33): 13844-13849.
- Rassi, A., A. Rassi, and J. A. Marin-Neto. 2010. [Chagas disease](#). *The Lancet*. 375 (9723): 1388-1402
- Read, Andrew F., Troy Day, and Silvie Huijben. 2011. [The evolution of drug resistance and the curious orthodoxy of aggressive chemotherapy](#). *Proceedings of the National Academy of Sciences*. 108 (Supplement 2):10871-10877.
- Read, A. F., P. A. Lynch, and M. B. Thomas. 2009. [How to Make Evolution-Proof Insecticides for Malaria Control](#). *PLoS Biology*. 7 (4):e1000058.
- Salkeld, D. J., K. A. Padgett, and J. H. Jones. 2013. [A meta-analysis suggesting that the relationship between biodiversity and risk of zoonotic pathogen transmission is idiosyncratic](#). *Ecology Letters*. 16 (5):679-686.
- Scott, T. W., and A. C. Morrison. 2010. [Vector Dynamics and Transmission of Dengue Virus: Implications for Dengue Surveillance and Prevention Strategies](#) *Vector Dynamics and Dengue Prevention*. In *Dengue Virus*, edited by A. L. Rothman, pp. 115-128. New York: Springer.
- Singer, B. H., and M. C. De Castro. 2001. [Agricultural colonization and malaria on the Amazon Frontier](#). *Annals of the New York Academy of Sciences*. 954:184-222.
- Sousa, J. D. d., V. Müller, P. Lemey, and A.-M. Vandamme. 2010. [High GUD Incidence in the Early 20th Century Created a Particularly Permissive Time Window for the Origin and Initial Spread of Epidemic HIV Strains](#). *PLoS ONE*. 5 (4):e9936.
- Stoddard, S. T., A. C. Morrison, G. M. Vazquez-Prokopec, V. P. Soldan, T. J. Kochel, U. Kitron, J. P. Elder, and T. W. Scott. 2009. [The Role of Human Movement in the Transmission of Vector-Borne Pathogens](#). *PLoS Neglected Tropical Diseases*. 3 (7). e481.
- Wilson, M. L. 2001. Ecology and Infectious Disease. In *Ecosystem Change and Public Health: A Global Perspective*, edited by J. L. Aron and J. Patz. Baltimore: Johns Hopkins University Press.

Wood, C. L., and K. D. Lafferty. 2013. [Biodiversity and disease: a synthesis of ecological perspectives on Lyme disease transmission](#). *Trends in Ecology & Evolution*. 28 (4): 239-247.

Woolhouse, M. E. J., D. T. Haydon, and R. Antia. 2005. [Emerging Pathogens: The Epidemiology and Evolution of Species Jumps](#). *Trends in Ecology & Evolution*. 20 (5):238-244.

Yates, T. L., J. N. Mills, C. A. Parmenter, T. G. Ksiazek, R. R. Parmenter, J. R. Vande Castle, C. H. Calisher, S. T. Nichol, K. D. Abbott, J. C. Young, M. L. Morrison, B. J. Beaty, J. L. Dunnum, R. J. Baker, J. Salazar-Bravo, and C. J. Peters. 2002. [The Ecology and Evolutionary History of an Emergent Disease: Hantavirus Pulmonary Syndrome](#). *Bioscience*. 52 (11):989-998.