

DISEASE ECOLOGY AND CONSERVATION

EVPP 427-001/BIOL 417-002

EVPP 527-001/BIOL 507-002

3 Credit Hours

Fall Semester 2019

Lecture: 4:30–7:10 p.m. Tuesdays

Innovation 133

Instructor: Prof. Esther Peters
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Prerequisite(s): *Undergraduate students:* EVPP 301 OR BIOL 308 and 60 credit hours; or Instructor's permission.

Graduate Students: Courses on Evolution, Ecology, Zoology and Conservation Biology or Instructor's permission.

Sign up for Mason Alert (e.g., weather closings, emergencies) at <https://alert.gmu.edu>

Syllabus

Course Description

Conservation of biological diversity faces multiple challenges. The relationship of humans to impacts on terrestrial and aquatic organisms has been recognized, but conservation strategies traditionally have not included investigations of the symbioses and linkages among all organisms and the continuum of environment and health to frame protection policies and educate the public. In the 1990s, conservation medicine emerged as a transdisciplinary field that studies the relationships between human, animal, and ecosystem health and environmental conditions. Biomedical sciences are combined with conservation biology and other disciplines to trace the environmental sources of pathogens and pollutants, develop an understanding of the ecological causes of changes in human, biotic, and ecosystem health and address the consequences of diseases to populations and ecological communities. This advanced course will provide a framework in which to examine the connections between condition of the planet and health of all species. It will also challenge students in the ecological sciences, health sciences and the natural sciences to think about new, collaborative ways to address ecological health. Understanding infectious and noninfectious diseases, pathogens, processes, impacts, and how to maintain

healthy populations of species—and the ecosystem services the species provide—is the key to conservation.

Course Objectives and Student Learning Outcomes

The course will examine health issues from various standpoints, including the emergence and resurgence of infectious disease agents and how they are investigated; the effects of global climate change on health; the increasing impacts of toxic chemicals and hazardous substances and the health implications of habitat fragmentation, degradation, and loss of biodiversity. Students will participate in individual and team assignments to be able to:

- Explain the difference between health and disease;
- Discuss biotic and abiotic agents causing diseases, the paradigm of disease, factors controlling diseases and how they are investigated;
- Define terms pertaining to health, disease, epidemiology, ecology and medicine;
- Analyze diverse readings on conservation medicine and its role in conserving species and ecosystems;
- Collect examples of diseases occurring in terrestrial and aquatic organisms;
- Evaluate recent reports on emerging diseases in wildlife, domestic animals and humans and their effects on ecosystems; and
- Explain how disease investigations can improve conservation projects.

Course Expectations

Each session will combine lectures, class exercises, occasional guest speakers and student discussion. As with any cross-listed course (undergrad/grad) offering, ***this will not be an easy course***. The successful student **must read assignments, study supporting materials, and prepare assignments outside of class**. Self-directed study skills are important. Students need to organize material logically and communicate well orally and in writing.

Class Preparation

“He who hesitates is lost...” Reading, research, and assignments are detailed on the following class outlines. Any concerns about keeping up with assignments should be discussed with Prof. Aguirre. More students are juggling work, research, internships, shadowing, and families. Please note: “Although many students must work to meet living expenses, employment must not take priority over academic responsibilities. Students employed more than 20 hours a week are strongly urged not to attempt a full-time academic load. Students employed more than 40 hours a week should attempt no more than 6 credits per semester. Students who fail to observe these guidelines may expect no special consideration for academic problems arising from the pressures

of employment.” (University catalog, section AP.1.2. Academic Load, see: <http://catalog.gmu.edu/content.php?catoid=27&navoid=5365#attendance>). Please consider your responsibilities and interests and plan accordingly to protect your health and GPA!

Class Participation

Students should come to class ready to participate in all activities (assignments completed prior to class). They should behave in a mature and professional manner and abide by the GMU honor code. **Please turn off cell phones before class begins.**

Absenteeism should be limited to illness or emergencies, or discuss concerns with the instructor.

Students should notify the instructor before class if they must miss a class. **Multiple missed classes will affect student grades** as class exercises are given in almost every lecture. PowerPoint TEXTS will be posted so you have the highlights of each lecture. However, you need to make every effort to attend. Students should contact classmates to obtain lecture notes and assignments as quizzes and exams will be based from the lectures, PPTs and other reading materials.

Students may record the lectures (sound), but may not take photographs or videos. Instead, they should take notes, which will help them study for the quizzes. If using electronic devices (such as laptops, notebooks, tablets) please be respectful of your peers and instructor and do not engage in activities unrelated to class. Such disruptions show a lack of professionalism and can affect your grade.

If you are a student with a disability and you need academic accommodations, please notify the instructor and contact the Office of Disability Services (ODS) at 993-2474. All academic accommodations must be arranged through the ODS.

E-mail Communications

Prof. Peters will send e-mail messages only to your GMU e-mail account. Students must use their Mason email accounts— “MASONLIVE” account—to receive important University information, including messages related to this class. See <http://masonlive.gmu.edu> for more information. Please be sure you check it often and keep your mailbox from getting “over quota” (filled up so you won’t get any)! If you are not getting messages (e.g., MasonLive issues), please give an alternate e-mail address.

Required Textbook

Aguirre, A. A., R. S. Ostfeld and P. Daszak. 2012. *New Directions in Conservation Medicine: Applied Cases of Ecological Health*, Oxford University Press, New York, 646 pp.

Course Assignments

Definitions of Terms

Each student is expected to identify 100 common terms related to infectious disease ecology and submit them *written by hand*. This is a way to expose you to common terminology used in conservation medicine, and to help you remember some of these definitions while writing them. Terms must be selected from class materials and may not be copied from internet word searches. Terms must be numbered and written legibly on lined paper (notecards will not be accepted). Terms are not required to be in alphabetical order, but if they are not in alphabetical order they must demonstrate organizational thought such as grouped by theme (e.g. types of surveillance, emerging infectious diseases, disease and translocation) or field (i.e. disease ecology, conservation, climate change, fragmentation). If you choose to define THEORIES, HYPOTHESES or POSTULATES, you MUST cite the original publication, AND thoroughly explain the premise.

Written Assignments

In addition to reading and studying the textbook, other books, and journal papers, **undergraduates will prepare one written assignment and graduate students will prepare two written assignments** of 400 words not including references drafted as commentaries, comparing, contrasting, or critiquing a technical (scientific) article recently published (2017 or later) on a disease ecology issue (i.e., anthrax outbreak in bison; dolphins stranding in the Virginia coast; global Ebola outbreak; Zika virus spreading in the Americas), in the style of *Letters to Science* <http://www.sciencemag.org/site/collections/online/eletters/guidelines.xhtml>

YOU MUST ATTACH THE PAPER YOU ARE REVIEWING TO YOUR SUBMISSION

Attachments can be .doc, .pdf, or other downloadable files. Attachments may NOT be in the form of a hyperlink.

Identify *specific* issues/critiques you have with **an article of your choice from a refereed journal**. This can be something that you found problematic, interesting, ridiculous, missing, etc. Compare and support your arguments with other sources in the literature. You are **encouraged** to search articles from all sources. Use Web of Science or other journal databases to do additional literature searches.

Make your critiques **explicit and clear**, e.g.: “I find three main critiques in the way this argument was presented.” ... paragraphs 1, 2, 3. Preferable to critique is a piece of **primary** literature, popular magazine or even a TV news report, not a review paper or chapter.

Do not spend too many words describing the intro, methods, conclusions, etc., of the article or report that you are critiquing. Try to give a very **brief** overview of the important points or methods and spend the rest of your paper giving **your own** “two-cents”! A good idea is to end with what you think needs to be done in the future based on your critique. **Don’t be repetitive** with your points, you only have up to 400 words, therefore be concise and clear. Make every word count (this may be one of the big challenges of the assignments and will train you for real manuscript writing with editor-imposed word limits).

Proofread: Review your spelling and grammar before handing your work in! Avoid run-on or ambiguous sentences.

Each paper should be neatly prepared and proofread, especially checking for consistency, completeness, and correctness (Help: The Writing Center, OWL/On-line Writing Lab). Many online grammar resources are now available. This book might help when writing:

Ross-Larson, B. 1996. *Edit Yourself: A Manual for Everyone Who Works With Words*. W.W. Norton & Co., New York, NY.

All statements of fact in your paper need to be referenced to the original research. You can of course access that material electronically, BUT the use of web sites as a primary source of information is discouraged. You should be using primary literature (e.g., peer reviewed journal articles) and reports for your authority. Limit web citations to no more than about 25% of the total. Full references (all author names) should be provided in the Literature Cited section of your paper. As for citation style, use *Letters to Science*, but include all authors in the Literature Cited portion of the paper. Footnotes are reserved for limited explanatory material only. In the body of the text use numbers with an alphabetized Literature Cited section. Please use Zotero or EndNote as your reference manager as this will be very useful in your future research.

Use **proper reference structure**, author-year, e.g., “AbuBakar *et al.* (2011) isolated Nipah virus from pigs” or numbered reference (if you want to save words), e.g. “Nipah virus was isolated from pigs [1]”.

References:

1. AbuBakar, S., L.-Y. Chang, A.R.M. Ali, S.H. Sharifah, K. Yusoff, and Z. Zamrod, *Isolation and molecular identification of Nipah virus from pigs*. *Emerging Infectious Diseases*, 2004. **10**(12): p. 2228-2230.

Please use Word (either .doc or .docx files only) and email your paper to me at the due date.

Final PowerPoint Presentation

Not for Undergrads!

Graduate students are required to give a 10–12-min presentation (+5 min Q&A) via PowerPoint slides on a *contemporary* issue/topic relevant to *Disease Ecology and Conservation*. **This assignment is optional for undergraduate students to improve their grades.** These presentations are worth *20% of your grade*. The issues/topics (*but not the contents*) for the presentations are not limited to those covered in the textbook. *Choose your favorite infectious disease, in a terrestrial or marine species or ecosystem from a newspaper, magazine article, or scientific journal article.* In your presentation, provide a brief background of the problem; describe the impacts of this disease to wildlife, domestic animals, humans and ecosystems and concerns from an economic, cultural, environmental, and conservation medicine perspective. Impacts can be considered from species to ecosystems and from molecular to global. Management implications may include discussion of mechanisms of control, prevention measures and proactive intervention to control impacts of the pathogen. Presentations will be **15 minutes total**.

The slide presentation “rule of thumb” is 1 slide per minute, so plan accordingly. Your 1st slide should be a title slide with your name and title of the talk. Next should be an introduction & overview to the topic followed by more specifics. Next you should discuss the implications of your infectious disease and management issues related to conservation medicine. Finally, you should provide conclusions and highlight the main points.

Presentations will be graded on the clarity of the presentation, the professionalism of the slides, the content of the material presented and your ability to answer questions posed by classmates and instructor.

Each topic below will get a score ranging from **1** (poor), **2** (good), **3** (very good) **4** (excellent).

Literature Review- Scope of information gathering.

Scientific knowledge- How accurate is the information presented.

Management Implications- all presentations should address *at least* 3 of the following areas:

- a) Effects of an infectious disease in species and ecosystems from the molecular to the global, including human health.
- b) Economic perspectives.
- c) Cultural perspectives.
- d) Socioeconomic perspectives.
- e) Environmental policy angle.
- f) Perspectives from both the development, agriculture and conservation.
- g) Public health angles.
- h) Solutions to the problems outlined.

Conclusions-Conclusions are sound and supported by data.

Slides-Slides are well organized, logical, and easy to read and to interpret.

Style-Delivery is clear, audible, with proper elocution and eye contact with audience.

Time-Speaker adheres strictly to time limit.

Undergrads will listen to the presentations and participate in the Q&A session for each talk.

Grading Criteria

The total grade received for this course will be based on the following assignments and assessments:

Activity	EVPP427/BIOL435 %Contribution to Total Grade	EVPP527/BIOL507 %Contribution to Total Grade
Definitions of Terms	10%	10%
Class participation	8%	5%
Extra readings	-	5%
Written commentaries:	20% (one only)	20% (10% each)
4 Surprise quizzes: 5 given	40% (10% each)	20% (5% each)
Mid-term Exam:	20%	20%
PowerPoint presentation:	2% (listen, question)	20%
TOTAL	100%	100%

The final grade for undergraduate students will be based on this scale: A = 100–93%, A- = 92–90%, B+ = 89–86%, B=85–83, B- = 82–80%, C = 79–70%, D = 69–60%, F < 59%.

The final grade for graduate students will be based on this scale: A= 100–90%, B= 89–80, C = 79–70%, D= 69–60%, F < 59%.

A CURVE WILL NOT BE APPLIED.

Academic Integrity

GMU is an Honor Code university; please see the University Catalog for a full description of the code and the honor committee process. The principle of academic integrity is taken very seriously and violations are treated gravely. What does academic integrity mean in this course? Essentially this: when you are responsible for a task, you will perform that task. When you rely on someone else's work in an aspect of the performance of that task, you will give full credit in the proper, accepted form. Another aspect of academic integrity is the free play of ideas. Vigorous discussion and debate are encouraged in this course, with the firm expectation that all aspects of the class will be conducted with civility and respect for differing ideas, perspectives, and traditions. When in doubt (of any kind) please ask for guidance and clarification. Students are expected to complete the work on their own or as a team, depending on the assignment.

All exams will be completed by individuals in the classroom or as a team outside the classroom (those registered for the course).

Unless otherwise noted, these assessments will be taken without the use of study aids, memoranda, textbooks, other books, data, or other information available.

It is important to note that materials produced for this course, particularly for the research paper, require creativity in organization and presentation, but that the information presented within the

paper or other product must be properly acknowledged as to its source. Statements of a general nature or that synthesize information from several sources need not be attributed to a specific source; however, statements of specific details or direct quotations (“between quotation marks”) from books, journals, newspaper or other media articles, Internet web pages, or other authorities must be identified with the name of the author and year in the text and the full citation provided in a literature cited section at the end of the paper. The instructor will provide the format for citations.

Other Useful Campus Resources

WRITING CENTER: Robinson Hall B213; 703-993-1200; <http://writingcenter.gmu.edu>

UNIVERSITY LIBRARIES: “Ask a Librarian” <http://library.gmu.edu/mudge/IM/IMRef.html>

COUNSELING AND PSYCHOLOGICAL SERVICES (CAPS): 703-993-2380;
<http://caps.gmu.edu>

LEARNING SERVICES: 703-993-2999; <http://caps.gmu.edu/learningservices/>; offer many good study skills workshops!

ACADEMIC COUNSELING PROGRAM: 703-993-2380;
<http://caps.gmu.edu/learningservices/academiccounseling.php>

UNIVERSITY POLICIES

The University Catalog, <http://catalog.gmu.edu>, is the central resource for university policies affecting student, faculty, and staff conduct in university academic affairs. Other policies are available at <http://universitypolicy.gmu.edu/>. All members of the university community are responsible for knowing and following established policies.

Course Schedule*

<i>Week</i>	<i>Date</i>	<i>Book Chapters</i>	<i>Topic</i>
1	08/27	Foreword, Preface	Introductions. Syllabus. Course expectations. General concepts & definitions
		Chapter 1	Conservation Medicine: Ecological Health in Practice
2	09/3		Health and Disease Concepts & Models
3	09/10	Chapter 37	Eco-epidemiological approaches to infectious disease
4	09/17	Chapter 6	Disease, biodiversity and species extinction
5	09/24	Chapter 10	Habitat fragmentation/loss and disease ecology
		Chapter 5	Lyme disease and the dilution effect
6	10/1	Movie night:	" <i>Contagion</i> "
7	10/8	Chapter 15	Principles of emerging infectious diseases (EIDs)
8	10/15	<i>No class</i>	Columbus Day Recess
9	10/22		<i>Written Commentary 1</i>
		Chapters 16 & 23	EIDs: terrestrial and marine ecosystems
10	10/29		<i>Take Home Midterm Exam</i>
11	11/5	Chapters 20 & 21	Disease ecology of plants & invertebrates
12	11/12		<i>Take Home Midterm Exam Due</i>
13	11/19	Chapter 29**	Disease ecology, bioterrorism and environmental security
14	11/26	Chapters 11 & 12	The wildlife trade, bushmeat and the spread of disease
			<i>Written Commentary 2 due</i>
15	12/3	Chapter 42	Prediction and prevention of the next epidemic
16	12/10		Final PPT Presentations

* In addition to the chapters for each session, ALL graduate students are required to read *extra preselected, refereed papers/chapters* listed below that will be discussed in class.

** Chapter 29 from Aguirre et al. 2002 will be provided as a PDF.

Required Readings for Graduate Students:

Week 1:

Textbook: Chapters 2 & 3

Week 2:

Textbook: Chapter 38

DeCandia A.L., A.P. Dobson and B.M. vonHoldt. 2018. Toward an integrative molecular approach to wildlife disease. *Conservation Biology* 32:798-807.

Week 3:

Textbook: Chapter 9

Burge C. A., C. M. Eakin, C. S. Friedman, B. Froelich, P. K. Hershberger, E. E. Hofmann, L. E. Petes, K. C. Prager, E. Weil, B. L. Willis, S. E. Ford, and C. D. Harvell. 2014. Climate change influences on marine infectious diseases: implications for management and society. *Ann Rev Mar Sci* 6:249-277.

Rohr J.R., A.P. Dobson, P.T.J. Johnson, A.M. Kilpatrick, S.H. Pauli, T.R. Raffel, D. Ruiz-Moreno, and M.B. Thomas. 2011. Frontiers in climate-change-disease research. *TREE* 26:270-277.

Week 4:

Heard M.J, K.F. Smith, K.J. Ripp, M. Berger, J. Chen, J. Dittmeier, M. Goter, S.T. McGarvey, and E. Ryan. 2013. The threat of disease increases as species move towards extinction. *Conservation Biology* 27:1378-1388.

Keesing, F., L.K. Belden, P. Daszak, A. Dobson, C.D. Harvell, R.D. Holt, P. Hudson, A. Jolles, K.E. Jones, C.E. Mitchell, S.S. Myers, T. Bogich, and R.S. Ostfeld. 2010. Impacts of biodiversity on the emergence and transmission of infectious diseases. *Nature* 468:647-652.

Week 5:

Randolph, S.E., and A.D.M. Dobson. 2012. Pangloss revisited: a critique of the dilution effect and the biodiversity-buffers-disease paradigm. *Parasitology* 139(7):847-863. doi: dx.doi.org/10.1017/S0031182012000200

Ostfeld, R.S. 2013. A Candide response to Panglossian accusations by Randolph and Dobson: biodiversity buffers disease. *Parasitology* doi:10.1017/S0031182013000541

Week 6:

No readings. Movie night.

Week 7:

No Class

Week 8:

Chapter 28

Tompkins, D.M., S. Carver, M.E. Jones, M. Krkošek, and L.F. Skerrat. 2015. Emerging infectious diseases of wildlife: a critical perspective. *Trends in Parasitology* 31:149-159.

Week 9:

Chapter 18

Aguirre, A. A. and E. S. Weber III. 2012. Living Ocean, an Evolving Oxymoron. *In* R.A. Meyers (ed.), *Encyclopedia of Sustainability Science and Technology*, Springer, New York, pp. 6179-6202.

Peters E. C. 2015. Diseases of coral reef organisms. *In* C. Birkeland (ed.). *Coral Reefs in the Anthropocene*. Springer Science+Business Media, Dordrecht DOI 10.1007/978-94-017-7249-5_8.

Week 10:

The *Journal of Invertebrate Pathology* is an excellent resource for information on insect diseases. Select 2 articles from the list below:

Anderson, P.K., A.A. Cunningham, N.G. Patel, F.J. Morales, P.R. Epstein, and P. Daszak. 2004. Emerging infectious diseases of plants: Pathogen pollution, climate change and agro technology drivers. *Trends in Ecology and Evolution* 19(10):535-544.

Boyd, I.L., P.H. Freer-Smith, C.A. Gilligan, and H.C.J. Godfray. 2013. The consequence of tree pests and diseases for ecosystem services. *Science* 342: 1235773

Manley R., M. Boots and L. Wilfert. 2015. Emerging viral disease risk to pollinating insects: ecological, evolutionary and anthropogenic factors. *Journal of Applied Ecology* 52:331-340.

Sweet M.J. and K.S. Bateman. 2015. Diseases in marine invertebrates associated with mariculture and commercial fisheries. *Journal of Sea Research* 104:16-32.

Week 11:

Chapter 28

Altizer, S., R. Bartel, and B.A. Han. 2011. Animal migration and infectious disease risk. *Science* 331:296-302.

Pruvot M., M. Lejeune, S. Kutz, W. Hutchins, M. Musiani, A. Massolo and K. Orsel. 2016. Better alone or in ill company? The effect of migration and interspecies comingling on *Fascioloides magna* infection in elk. *PLoS ONE* 11(7): e0159319. doi:10.1371/journal.pone.0159319

Week 12:

Blancou J. and J.E. Pearson. 2003. Bioterrorism and infectious animal diseases. *Comp Immunol Microbiol Inf Dis* 26:431-443.

Robinowitz P., Z. Gordon, D. Chudnov, M. Wilcox, L. Odofin, A. Liu and J. Dein. 2006. Animals as sentinels of bioterrorism agents. *Emerg Infect Dis* 12:647-652.

Week 13:

Gomez, A. and A.A. Aguirre. 2008. Infectious diseases in the illegal wildlife trade. *Animal Biodiversity and Emerging Diseases*. N.Y. Acad. Sci.1149:16-19.

Smith, K.F., Behrens, M.D., Schloegel, L.M., Marano, N., Burgiel, S. and Daszak, P. 2009. Reducing the risks of the wildlife trade. *Science* 324: 594-595.

Week 14:

Gortazar C., L.A. Reperant, T. Kuiken, J. de la Fuente, M. Boadella, B. Martínez-Lopez, F. Ruiz-Fons, A. Estrada-Peña, C. Drosten, G. Medley, R. Ostfeld, T. Peterson, K. C. VerCauteren, C. Menge, M. Artois, C. Schultsz, R. Delahay, J. Serra-Cobo, R. Poulin, F. Keck, A.A. Aguirre, H. Henttonen, A.P. Dobson, S. Kutz, J. Lubroth and A. Mysterud. 2014. Crossing the interspecies barrier: opening the door to zoonotic pathogens. *PLoS Pathogens* 10(6): e1004129. doi:10.1371/journal.ppat.1004129.

Suzán G., G. E. García-Peña, I. Castro-Arellano, O. Rico, A. V. Rubio, M. J. Tolsá, B. Roche, P. R. Hosseini, A. Rizzoli, K. A. Murray, C. Zambrana-Torrel, A. A. Aguirre, P. Daszak, A.-H. Prieur-Richard, J. N. Mills, and J.-F. Guégan. 2015. Metacommunity and phylogenetic structure determine wildlife and zoonotic infectious disease patterns in time and space. *Ecology and Evolution* doi: 10.1002/ece3.1404