

Long-term Ecological Monitoring Plots as Sentinel Sites for Emerging Infectious Disease

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Team Members: Peter Daszak, Executive Director, Consortium for Conservation Medicine, New York, NY; Robert Wirtz, Chief, Entomology Branch, Division of Parasitic Diseases, National Center for Zoonotic, Vector-Borne and Enteric Diseases, Centers for Disease Control and Prevention, Atlanta, GA; Stuart Davies, Director, Center for Tropical Forest Science, Smithsonian Institution Global Earth Observatory Network, Panama City, Panama; Jeff Bender, Co-Director, Center for Animal Health and Food Safety, University of Minnesota, St. Paul, MN; Daniel Brooks, Professor of Ecology and Evolutionary Biology, University of Toronto, Canada; Kimberly Lindblade, Director, CDC Emerging Infectious Disease Program in Central America and Panama, Guatemala. Jonathan Epstein, Senior Research Scientist, Consortium for Conservation Medicine, New York, NY.

Justification and Specific Goals and Objectives: Over 70% emerging pathogens come from animals. Wild animals serve as a major reservoir for many emerging pathogens. Moreover, recent research suggests that rates of disease emergence correlate with developing nations experiencing heavy anthropogenic impacts in regions of high biodiversity. Thus, disturbance of intact ecosystems contributes to emergence of disease, particularly in the tropics, regions of high biodiversity and rapid environmental change. Indeed, Ebola virus, human immunodeficiency virus, SARS virus and Nipah virus among many others all have origins in tropical forests. In addition, many diseases of concern to public health are intimately tied to tropical forest ecosystems either through wildlife hosts or through disease vector ecology including leishmaniasis, Chagas disease, leptospirosis, and Yellow Fever. To better understand and predict emerging infectious disease it will be critical to improve understanding of wildlife host and disease interactions in intact tropical forest ecosystems. Unfortunately, research in intact tropical forests and wildlife is difficult, resource intensive and requires specialized skills that are not widely available. A more efficient approach would be to integrate wildlife and vector disease work into ongoing ecological research programs. We propose that long-term ecological research sites could be an important resource for studying wildlife and disease in intact ecosystems. The Smithsonian's Global Earth Observatory (SIGEO) network has 22 established global dynamic forest plots that have been systematically monitored with standardized protocols as long-term ecological monitoring sites for up to 25 years. This international network of large-scale plots in 16 countries is currently monitoring 3.5 million trees of 6,500 different species. Many of these plots are located in regions of particular interest for disease surveillance (Fig 1). The advantages of working within the SIGEO sites are many. They are already organized into a collaborative network with an explicit priority for fostering research. Each site, at a minimum, has a Principal Investigator, a scientist who coordinates research activities in the site, on-site managers and, in most cases, a field station. However, incorporating systematic disease monitoring and research into long-term ecological protocols has never been attempted and will require novel approaches that integrate ecology, genomics, epidemiology, entomology, virology, microbiology and tie to related work in nearby human and domestic animal populations. **Specific objective** of this proposal is to hold a trans-institutional meeting involving partners from federal agencies (the Smithsonian Institution, the Centers for Disease Control and Prevention), non-profit organizations (the Consortium for Conservation Medicine) and academia (University of Minnesota, University of Toronto) to establish the SIGEO network as strategic monitoring and research sites for global emerging disease. **Goals** of the meeting will be to: 1) identify key sites of interest for emerging and endemic disease research and monitoring; 2) brainstorm novel strategies for emerging and endemic disease surveillance and detection; 3) develop long-term monitoring protocols for improving understanding of the link between environmental change, pathogen evolution and disease emergence; and 4) establish key collaborative partnerships among

workshop participants and others to ensure the implementation of strategic preliminary emerging disease research projects with the goal of seeking funding through a competitive grant process (R01, R21).



Figure 1. Map showing 22 established SIGEO sites in black (black dots) and 12 candidate sites in blue (red dots). [CRC = Smithsonian Institution Conservation & Research Center; SERC = Smithsonian Environmental Research Center]. Interactive website: <http://biogeodb.stri.si.edu/bioinformatics/sigeo/>

Strategy for Achieving Goals and Long-Range Strategy for Maintaining Partnerships: The proposed workshop will convene a diverse group of scientists from the public, private and academic sectors to brainstorm the most effective monitoring and research program for emerging disease in intact forest ecosystems. This workshop will establish partnerships that will add value to each participating institution and agency. The Smithsonian Institution will gain partners to establish long-term disease monitoring to their SIGEO network of forest plots, the CDC and Universities will be able to partner with a federal agency with an extensive network of international partners and long term ecological monitoring sites. The proposed expansion of the SIGEO network into disease surveillance is particularly timely. In 2007, SIGEO ran a series of workshops to expand their focus to include vertebrate, pathogen, and invertebrate monitoring. Several recommendations and projects emerging from these workshops have relevance to developing disease surveillance and disease ecology research programs in the forest plot system. In particular, the implementation phase of the vertebrate and invertebrate workshop includes performing systematic inventories of select invertebrates and vertebrates along with their parasites and microbiota on select forest plot sites over the coming years. This will involve sending teams of researchers to forest plot sites, training local forest managers in invertebrate, vertebrate and pathogen monitoring techniques and performing a systematic survey of select vertebrate microbiota. The protocols emerging from the workshop will be able to capitalize on this inventory to expand monitoring to disease vectors and pathogens at reduced costs. Preliminary data emerging from the inventory can then be used to pursue competitive grants and promote the partnership for non-competitive funding.

What Success Will Look Like: This grant will help fund a 3 day workshop for 20 participants in Panama focused on developing emerging disease research and surveillance in the SIGEO network. Outcomes of this workshop will include: 1) a workshop report to share with SIGEO network partners and interested parties outlining recommendations for incorporating disease into the long-term monitoring and research protocols; 2) a plan for initiating pilot research in the plots; 3) identification of key partners to accomplish the plan; and 3) a funding plan identifying potential future funding sources and strategies to obtain them.

Detailed Budget:

Requested From One Health Leadership Fund:

Item	Method of Calculation	Total Cost
Hotel Accommodations	15 out-of-town participants x 3 nights x \$120/night	\$5,400
Food for conference	\$50/day x 3 days x 20 participants	\$3,000
Administrative costs	Administrative support for travel and workshop arrangements	\$1,000
Supplies	Name tags, folders, pens etc.	\$600
TOTAL		\$10,000

Provided by Participating Institutions:

Item	Method of Calculation	Total Cost
Travel	15 out-of-town participants x roundtrip airfare x \$1500/trip	\$22,500
Conference venue	\$100/day x 3 days	\$300
TOTAL		\$22,800

Principal Investigator/Program Director (*Last, first, middle*):

Pelican, Katharine M.

NAME Katharine M. Pelican, D.V.M., Ph.D.			
EDUCATION/TRAINING (<i>Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.</i>)			
INSTITUTION AND LOCATION			
Wesleyan University, Middletown, CT		POSITION TITLE Reproductive Health Scientist	
University of Minnesota, Saint Paul, MN			
University of Maryland, College Park, MD			
	DEGREE (<i>if applicable</i>)	YEAR(s)	FIELD OF STUDY
Smithsonian's National Zoological Park	B.A.	1988-1992	Pre-Veterinary Medicine

Professional Experience

1997-2002	Post-doctoral Fellow, Department of Reproductive Sciences, National Zoological Park
1997-date	Guest Scientist, Veterinary Resources Program, National Center for Research Resources, National Institutes of Health
2002-date	Research Fellow, National Institutes of Health Fellowship, Special Emphasis Research Career Award, National Zoological Park
2002-date	Guest Researcher, The Thailand Zoological Parks Organization and the Thailand Department of National Parks, Wildlife and Plant Conservation
2004-date	Captive Breeding Consultant and Researcher, Iberian Lynx Captive Breeding Program, Spain.
2006-date	Leader, Smithsonian Amphibian Working Group, Smithsonian Institution, Washington, DC
2007-date	Adjunct Professor, University of Minnesota School of Public Health, Minneapolis, MN
2007	Head, Department of Environmental Change and Species Survival, Center for Species Survival, Smithsonian's National Zoological Park, Washington, DC
2007-date	Vertebrate Working Group Coordinator, Smithsonian Institution Global Earth Observatories, Smithsonian Institution, Washington DC.
2007-date	Assistant Professor of Ecosystem Health, Department of Veterinary Population Medicine, College of Veterinary Medicine, University of Minnesota, St. Paul, MN

Peer-Reviewed Papers:

1. Pukazhenth, B.S., K.M. Pelican, D.E. Wildt and J.G. Howard. 1999. Sensitivity of domestic cat (*Felis catus*) sperm from normospermic versus teratospermic donors to cold-induced acrosomal damage. *Biol Reprod* 61:135-141.
2. Pukazhenth, B.S., E. Noiles, K.M. Pelican, A.M. Donoghue, D.E. Wildt and J.G. Howard. 2000. Osmotic effects on feline spermatozoa from normospermic versus teratospermic donors. *Cryobiology* 40:139-150.
3. Ottinger, M.A., J. Wu, K.M. Pelican. 2002. Neuroendocrine regulation of reproduction in birds and clinical applications of GnRH analogues in birds and mammals. *Semin Avian Exot Pet Med* 11: 71-79.
4. Pelican, K.M., M.A. Ottinger, J.L. Brown, D.E. Wildt and J.G. Howard. 2005. Short term ovarian suppression in the domestic cat using levonorgestrel versus antide. *Gen Comp Endocrinol* 144: 110-121.
5. Pelican, K.M., D.E. Wildt, B. Pukazhenth and J.G. Howard. 2006. Ovarian control for assisted reproduction in the domestic cat and wild felids. *Theriogenology* 66 (1): 37-48.
6. Pelican, K.M., D.E. Wildt, and J.G. Howard. 2006. The GnRH agonist Lupron® (leuprolide acetate), prevents ovulation following gonadotropin stimulation in the clouded leopard (*Neofelis nebulosa*). *Theriogenology* 66: 1768-1777.
7. Pukazhenth, B.S., D. Laroe, A.E. Crosier, L.M. Bush, R. Spindler, K. Pelican, M. Bush, J.G. Howard and D.E. Wildt. 2006. Challenges in cryopreservation of clouded leopard (*Neofelis nebulosa*) spermatozoa. *Theriogenology* 66: 1790-1796.
8. Pukazhenth, B.S., K.M. Pelican, and D.E. Wildt. 2007. 'Appendix A: Genome Resource Banking.' Eds. C. Gascon, J. Collins, R. Moore, D. Church, J. McKay, and J. Mendelson. Amphibian Conservation Action Plan. The World Conservation Union (IUCN), Gland Switzerland. Pp. 38-39.
9. Pelican, K.M., M.A. Ottinger, D.E. Wildt and J.G. Howard. 2008. Ovarian suppression with the progestin levonorgestrel but not the GnRH antagonist antide induces a consistent response to gonadotropin stimulation in the domestic cat. *Dom Animal Endocrinol* 34: 160-175.

ROBERT A. WIRTZ, Ph.D.

Centers for Disease Control and Prevention (CDC), Atlanta, GA (1997-present)
Chief, Entomology Branch, Division Parasitic Diseases, National Center for Zoonotic, Vector-borne & Enteric Diseases. Direct Branch activities to reduce the threat of arthropod-borne diseases to humans, with a focus on the control of the vectors of malaria, lymphatic filariasis and Chagas disease; insecticide resistance; analytical analysis of insecticides and anti-malaria drugs; and implementation and evaluation of insecticide treated bed net and indoor residual spraying programs. Coordinate technical assistance and oversight for malaria vector control activities in 15 sub-Saharan African countries in support of the President's Malaria Initiative, a five year \$1.2 billion program with the goal of reducing malaria mortality in vulnerable populations by 50%. Supervise four World Health Organization (WHO) Collaborating Centers, and the vector component of the Malaria Research and Reference Reagent Repository. Coordinate public health entomology among the CDC, US Agency for International Development (USAID), Departments of Defense (DOD) and Agriculture (USDA), the Carter Center and other organizations.

Walter Reed Army Institute of Research (WRAIR), Washington, DC (1982-96)
Department of Entomology Assistant Chief; manager/co-investigator for projects on: Rapid Diagnostics, Arthropod Repellents, Vector Suppression, Vector-Parasite-Host Biology, Malaria Vaccine Development, Lyme Disease and Chemical Defense.

EDUCATION: Ph.D. Entomology Kansas State University 1976
 M.S. Entomology Kansas State University 1973
 B.S. Microbiology Kansas State University 1971

ACADEMIC ASSOCIATIONS: Adjunct professor/advisor: Uniformed Services University of the Health Sciences (USUHS) (1988-present); Univ. MD School of Medicine-Baltimore (1990-present); Univ. MD-College Park (1991-96). Invited lecturer (last five years): Auburn, Emory, Harvard, KSU, ISU, USUHS, LSU and GSU.

CONSULTANT: Consultant/instructor for the use of diagnostic tests in entomological research on over 70 occasions in 25 countries for the DOD, International Irrigation Management Institute, NAS, Pan American Health Organization, USAID and WHO.

ADDRESS: Robert A. Wirtz, Entomology Branch, CDC – F42, 4770 Buford Highway, NE, Atlanta, GA 30341-3724. Phone: 770-488-4240; fax: 770-488-4258; E-mail: rwirtz@cdc.gov

PUBLICATIONS: Over 260 publications, including nine book chapters, on medical entomology, arthropod repellents, insect physiology, toxicology, allergies to arthropods, molecular biology, immunology and malaria vaccine development.

Daniel Rusk Brooks, Professor of Ecology & Evolutionary Biology, University of Toronto
Education: BS with Distinction (1973), MS (1975) (University of Nebraska-Lincoln), PhD (1978) (University of Mississippi)

Specialist in evolution and ecology of tropical biodiversity, especially of parasite-vertebrate systems.

Honors: Henry Baldwin Ward Medal, American Society of Parasitologists (1985); Gold Medal, Centenary of the Instituto Oswaldo Cruz, Brazil (2000); Robert Wardle Award, Canadian Society of Zoologists (2001); Fellow, Royal Society of Canada (National Academy of Science) (2004); PhD *honoris causa*, Stockholm University (2005); DSc, University of Nebraska-Lincoln (2007)

More than 300 scientific publications, including

Foundations of evolutionary theory

Brooks, D.R. and E.O. Wiley. 1988. *Evolution as Entropy: Toward a Unified Theory of Biology*. Chicago: Univ. Chicago Press, Chicago. 2nd ed.

Phylogenetic systematics

Wiley, E.O., D. Siegel-Causey, D.R. Brooks, and V.A. Funk. 1991. *The Compleat Cladist: A Primer of Phylogenetic Procedures*. Univ. Kansas Museum of Natural History Press, Lawrence.

Phylogenetic comparative studies

Brooks, D.R. and D.A. McLennan. 1991. *Phylogeny, Ecology and Behavior: A Research Program in Comparative Biology*. Univ. Chicago Press, Chicago.

McLennan, D.A. and D.R. Brooks. 2002. *The Nature of Diversity: An Evolutionary Voyage of Discovery*. Univ. Chicago Press, Chicago.

Systematics and evolution of parasites and host-parasite associations

Brooks, D.R. and D.A. McLennan. 1993. *Parascript: Parasites and the Language of Evolution*. Smithsonian Inst. Univ. Press.

Tropical biology, natural history and biodiversity: www.parasitesrus.com

Dr. Kim Lindblade is the director of the CDC's International Emerging Infections Program in Central America and Panama (IEIP-CAP). The IEIP-CAP mission is to assure a rapid and effective response to emerging infectious disease threats in Central America and Panama by contributing to the capacity of the ministries of health (MOH) and academic institutions of the region to recognize emerging infections and prevent, control and treat important infectious diseases. To this end, IEIP-CAP is involved in four main activities: generation of incidence and etiology data for disease syndromes of regional and international importance; evaluation of public health programs; strengthening of MOH skills in surveillance, research, laboratory diagnostics and analysis; and responding to outbreaks of diseases. Dr. Lindblade has significant experience at the intersection of ecology and epidemiology: in both Uganda and Kenya, she spent several years in highland areas investigating how environmental change affects malaria transmission. For more than 4 years she was the Chief of the Malaria Epidemiology Section of the CDC field station co-located with the Kenya Medical Research Institute in Kisumu, Kenya, and from 2004-2007 she headed the Onchocerciasis Elimination Program for the CDC office in Guatemala. Currently, the IEIP-CAP is working on surveillance for meningitis, encephalitis, pneumonia and diarrhea, and is soon to begin human and animal surveillance for arboviruses, rickettsioses and leptospirosis. The IEIP-CAP is working with the CDC Division of Vector-Borne Infectious Diseases to conduct joint human and animal surveillance for West Nile virus in Guatemala. Dr. Lindblade has an MPH and a PhD in epidemiology from the University of Michigan and is the author or co-author of more than 25 publications on infectious diseases.

Highlighted publications:

- Cohen JM, KC Ernst, KA Lindblade, JM Vulule, CC John, ML Wilson (*submitted*) Land-cover and land-use are associated with household-level malaria incidence in two western Kenya highland communities. *Malaria Journal*.
- Gonzalez RJ, N Cruz-Ortiz, N Rizzo, J Richards, G Zea-Flores, A Dominguez, M Sauerbrey, E Catú, O Oliva, FO Richards, KA Lindblade. (*Submitted to the PLoS Neglected Tropical Diseases.*) Successful interruption of transmission of *Onchocerca volvulus* in the Escuintla-Guatemala focus, Guatemala.
- Cohen JM, KC Ernst, KA Lindblade, JM Vulule, CC John, ML Wilson (2008) Topography-derived wetness indices are associated with household-level malaria risk in two communities in the western Kenyan highlands. *Malaria Journal*. 7:40.
- Lindblade KA, B Arana, G Zea-Flores, N Rizzo, CH Porter, A Dominguez, N Cruz-Ortiz, TR Unnasch, GA Punkosdy, J Richards, M Sauerbrey, J Castro, E Catú, O Oliva and FO Richards Jr. 2007. Elimination of *Onchocerca volvulus* transmission in the Santa Rosa focus of Guatemala. *American Journal of Tropical Medicine and Hygiene*. 77: 334-341.
- Lindblade KA, JE Gimnig, L Kamau, WA Hawley, F Odhiambo, G Olang, FO ter Kuile, JM Vulule, L Slutsker (2006). Impact of sustained use of insecticide-treated bednets on malaria vector species distribution and culicine mosquitoes. *Journal of Medical Entomology* 43:428-32.
- Lindblade KA, Walker ED, Onapa AW, Katungu J, Wilson ML (2000) Land use change alters malaria transmission parameters by modifying air temperature in a highland area of Uganda. *Tropical Medicine and International Health* 5:263-274.
- Lindblade KA, Walker ED, Wilson ML (2000) Anopheline (Diptera: Culicidae) sampling strategies for early warning of malaria epidemics in African highlands. *Journal of Medical Entomology* 37: 664-674.
- Lindblade KA, Walker ED, Onapa AW, Katungu J, Wilson ML (1999) Highland malaria in Uganda: Prospective analysis of an epidemic associated with El Niño. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 93: 480-487.
- Lindblade KA, Carswell G, Tumuhairwe JK (1998) Mitigating the relationship between population growth and land degradation: Land use change and farm management in southwestern Uganda. *Ambio* 7: 565-561.
- Lindblade K (1997) Discrepancies in understanding historical land use changes in Uganda. *PLA Notes* 28:59-63.

STUART J. DAVIES is the Director of the Center for Tropical Forest Science. This program coordinates a global network of 20 large-scale tropical forest research plots in 15 countries. The goals of the CTFS program are to: (i) to monitor representative biodiverse tropical forests of the world through a network of large long-term plots; (ii) to conduct research on the origin and maintenance of diversity in tropical forests, (iii) to understand the function of tropical forests and how tropical forests and their biodiversity can best be conserved, managed, and used in sustainable ways for human benefit; and (iv) to develop opportunities in training, capacity building, education and international collaborative studies in tropical forest science.

Davies received his PhD. from Harvard University in 1996. Prior to becoming the Director of the CTFS, Davies coordinated the Asia Program of CTFS which is cosponsored by the Arnold Arboretum of Harvard University. Before joining CTFS, he was a Senior Research Associate at the Center for International Development at Harvard University (2001-2003), Associate Professor at the Institute for Biodiversity and Environmental Conservation, University of Malaysia Sarawak (1997-2001), and a Predoctoral Research Fellow at the University of Brunei Darussalam (1993-1994).

Selected Recent Publications:

1. Russo, S.E., M. Irwin, S.J. Davies, S. Tan. (2008) Interspecific demographic trade-offs and edaphic niche specialization of tree species along resource gradients. *Journal of Ecology* 96, 192–203.
2. Chave, J., R. Condit, . . . S.J. Davies, et al. (2008) Assessing evidence for a pervasive alteration in tropical tree communities. *PLoS Biology* 6: 1-8.
3. Baltzer JL, Davies SJ, Bunyavejchewin S, Noor NSM (2007) The role of desiccation tolerance in determining tree species distributions along the Malay-Thai Peninsula. *Functional Ecology* 22: 221-231.
4. Feeley, K.J., S.J. Davies, P.S. Ashton, S. Bunyavejchewin, M.N. Nur Supardi, A.R. Kassim, S. Tan & J. Chave (2007) The role of gap-phase processes in the long-term biomass dynamics of four old-growth tropical forests. *Proceedings of the Royal Society UK* 274, 2857–2864.
5. Baltzer, J.L., S.J. Davies, M.N. Nur Supardi, A.R. Kassim & J.V. LaFrankie (2007) Geographical distributions in tropical trees: can geographical range predict performance and habitat association in co-occurring tree species? *Journal of Biogeography* 34, 1916–1926.
6. Feeley, K.J., S.J. Wright, M.N. Nur Supardi, A.R. Kassim & S.J. Davies (2007) Decelerating growth in tropical forest trees. *Ecology Letters* 10, 461-
7. Quek, S.P., S.J. Davies, P.S. Ashton, T. Itino & N.E. Pierce (2007) The geography of diversification in mutualistic ants: a gene's-eye view into the Neogene history of Sundaland rain forests. *Molecular Ecology* 16: 2045-2062.
8. Shono, K., S.J. Davies and Y.K. Chua (2007) Performance of 45 native tree species on degraded lands in Singapore. *Journal of Tropical Forest Science* 19: 25-34.
9. Shono, K., S.J. Davies and Y.K. Chua (2006) Regeneration of native plant species in restored forests on degraded lands in Singapore. *Forest Ecology and Management*, 237: 574-582.
10. Baillie, I.C., P. S. Ashton, S.P. Chin, S.J. Davies, P.A. Palmiotto, S.E. Russo & S. Tan (2006) Spatial associations of humus, nutrients and soils in mixed dipterocarp forest at Lambir, Sarawak, Malaysian Borneo. *Journal of Tropical Ecology*, 22: 543-553.
11. King, D.A., S.J. Davies, M.N. Nur Supardi & S. Tan. (2006) The role of wood density and stem support costs in the growth and mortality of tropical trees. *Journal of Ecology*, 94: 670-680.
12. Condit, R., P. Ashton, S. Bunyavejchewin, H.S. Dattaraja, S. Davies, S. Esufali, C. Ewango, R. Foster, I.A.U.N. Gunatilleke, C.V.S. Gunatilleke, P. Hall, K.E. Harms, T. Hart, C. Hernandez, S. Hubbell, A. Itoh, S. Kiratiprayoon, J. LaFrankie, S. Loo de Lao, J.-R. Makana, M.N. Supardi Noor, A.R. Kassim, S. Russo, R. Sukumar, C. Samper, H.S. Suresh, S. Tan, S. Thomas, R. Valencia, M. Vallejo, G. Villa, T. Zillio. (2006) The importance of demographic niches to tree diversity. *Science* 313:98-101.
13. Davies, S.J. & H. Semui (2006) Competitive dominance in a secondary successional rain forest community in Borneo. *Journal of Tropical Ecology*, 22: 53-64.
14. Wills, C., K.E. Harms, R. Condit, D. King, J. Thompson, F. He, H.C. Muller-Landau, P. Ashton, E. Losos, L. Comita, S. Hubbell, J. LaFrankie, S. Bunyavejchewin, H. S. Dattaraja, S. Davies, S. Esufali, R. Foster, N. Gunatilleke, S. Gunatilleke, P. Hall, A. Itoh, R. John, S. Kiratiprayoon, S. Loo de Lao, M. Massa, C. Nath, M.N. Supardi Noor, A. Rahman Kassim, R. Sukumar, H.S. Suresh, I-F. Sun, S. Tan, T. Yamakura & J. Zimmerman (2006) Nonrandom Processes Maintain Diversity in Tropical Forests. *Science*, 311, 527-531.

NAME Jonathan H. Epstein	POSITION TITLE Senior Research Scientist Veterinary Epidemiology, Emerging Zoonoses
eRA COMMONS USER NAME Jepstein14	

EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, and

INSTITUTION AND LOCATION	DEGREE (if applicable)	YEAR(s)	FIELD OF STUDY
Brandeis University, MA	BA	1996	Biology
Tufts University, Sch. Vet. Med., Grafton, MA	DVM	2002	Wildlife Med., Intl. Med.
Tufts University, School of Medicine, Boston, MA	MPH	2002	Epidemiology
Tufts University, Sch. Vet. Med., Grafton, MA	Cert Intl Med	2002	Zoonotic Diseases

A. Positions and Honors

Positions and Employment

2003- Senior Research Scientist, Consortium for Conservation Medicine, Columbia University, NY

B. Peer-reviewed publications (in chronological order) * indicates corresponding author

1. McCall, B.J., **Epstein, J.H.** & Annette, N., Potential human exposure to Australian bat Lyssavirus, Queensland, 1996-1999. *Emerging Infectious Diseases* 2000; 6: 259-264
2. Kaufman, G.E., Else, J., Bowen, K., Anderson, M. & **Epstein, J.H.** Conservation medicine in the veterinary curriculum. *EcoHealth* 2004; 1: S43-S49.
3. Daszak, P., Tabor, G.M., Kilpatrick, A.M., **Epstein, J.** & Plowright, R. Conservation Medicine and a new agenda for emerging diseases. *Annals of the New York Academy of Sciences* 2004; 1026: 1-11
4. Patz, J.A., Daszak, P., Tabor, G.M., Aguirre, A.A., Pearl, M., **Epstein, J.**, Wolfe, N.D., Kilpatrick, A.M., Foutopoulos, J., Molyneux, D., Bradley, D.J. & Members of the Working Group Land Use Change and Disease Emergence. Unhealthy Landscapes: Policy Recommendations on Land Use Change and Disease Emergence. *Environmental Health Perspectives* 2004. 112: 1092-1098
5. Newman SH, **Epstein JH**, Schloegel LM. The nature of emerging zoonotic diseases: ecology, prediction, and prevention. *Medical Laboratory Observer* 2005 37:10-19.
6. Li W, Shi Z, Yu M, Ren W, Smith C, **Epstein JH**, Wang H, Crameri G, Hu Z, Zhang H, Zhang J, McEachern J, Field H, Daszak P, Eaton BT, Zhang S & Wang L-F Bats are natural reservoirs of SARS-like coronaviruses. *Science* 2005; 310: 676-679.
7. Pulliam J, Field H, Olival KJ & the Henipavirus Ecology Research Group (**Epstein**). An alternative explanation of Nipah virus strain variation. *Emerging Infectious Diseases*. 2005; 11: 1978-1979
8. Daszak, P., Plowright, R., **Epstein, J.H.**, Pulliam, J., Abdul Rahman, S., Field, H.E., Smith, C.S., Olival, K.J., Luby, S., Halpin, K., Hyatt, A.D. & the Henipavirus Ecology Research Group (HERG). The emergence of Nipah and Hendra virus: pathogen dynamics across a wildlife-livestock-human continuum. In: Collinge, S.K. & Ray, C. (Eds.), *Disease Ecology: Community Structure and Pathogen Dynamics* Oxford University Press 2006; pp 186-201.
9. **Epstein, J.H.***, Field, H.E., Luby, S., Pulliam, J., and Daszak, P. Nipah Virus: Impact, Origins, and Causes of Emergence. *Current Infectious Disease Reports* 2006; 8: 59-65.
10. **Epstein, J.H.***, Rahman, S.A., Zambriski, J.A., Halpin, K., Meehan, G., Jamaluddin, A.A., Hassan, S.S., Field, H.E., Hyatt, A.D., Daszak, P. & HERG. Feral cats (*Felis catus*) as possible vectors for Nipah virus. *Emerging Infectious Diseases*. 2006; 12: 1178-1179.
11. Breed, A.C., Field, H.E., **Epstein, J.H.**, Daszak, P. Emerging henipaviruses and flying foxes - conservation and management perspectives. *Biological Conservation* 2006;131: 211-220.
12. **Epstein, J.H.***, McKee, J., Shaw, P., Hicks, V., Micalizzi, G., Daszak, P., Kilpatrick, A.M. & Kaufman, G. The Australian white ibis (*Threskiornis molucca*) as a reservoir of zoonotic and livestock pathogens. *EcoHealth*. 2006; 3: 290-298.
13. Halpin, K., Hyatt, A.D., Plowright, R.K., **Epstein, J.H.**, Daszak, P., Field, H.E., Wang, L., Daniels, P., and the Henipavirus Ecology Research Group. 2007 Emerging viruses – coming in on a wrinkled wing and a prayer. *Clinical Infectious Diseases* 2007; 44: 711-17.
14. McLaughlin, A.B., **Epstein, J.H.***, Prakash, V., Smith, C.S., Daszak, P., Field, H.E., and Cunningham, A.A. Plasma biochemistry and hematological values for wild-caught flying foxes (*Pteropus giganteus*) in India *Journal of Zoo and Wildlife Medicine*. 2007. 38 (3). Pp. 446-452.

Peter Daszak

Consortium for Conservation Medicine, 460 W. 34th St. New York, NY 10001
E-mail: daszak@conservationmedicine.org

Professional Preparation

Bangor University, UK	Zoology	BSc (honors)	1988
Univ. of East London, UK	Parasitology	Ph.D	1994

Appointments

Executive Director, Consortium for Conservation Medicine	2001 – current
Faculty Research Scientist, University of Georgia	1999 – 2001
Guest Researcher, Centers for Disease Control and Prevention (CDC)	1999
Faculty Research Scientist, Kingston University, UK	1993 – 1998
Research Assistant, University of East London	1989 – 1992

Publications (out of 106 peer-reviewed papers and chapters); * = corresponding author

Five most closely related to proposed project

Daszak, P., Cunningham, A.A. & Hyatt, A.D. (2000). Emerging infectious diseases of wildlife - threats to biodiversity and human health. **Science** 287: 443-449

Kilpatrick, A.M., Daszak, P., Goodman, S.J., Rogg, H., Kramer, L.D., Cedeño, V. & Cunningham, A.A. (2006). Prediction of Pathogen Introduction: West Nile virus and the Galapagos. **Conserv. Biol.** 20: 1224-1231.

Kilpatrick, A.M., Chmura, A.A., Gibbons, D.W., Fleischer, R.C., Marra, P.P. & Daszak, P. (2006). Predicting the global spread of H5N1 avian influenza. **PNAS** 103: 19368-19373.

Jones, K.E., Patel, N.G., Levy, M.A., Storeygard, A., Balk, D., Gittleman, J.L. & Daszak, P.* (Corresp. Author) (2008). Global trends in emerging infectious diseases. **Nature** 451:990-994.

Pulliam JR, Epstein JH, Dushoff J, Rahman SA, Meehan G, Bunning M, HERG, Jamaluddin AA, Hyatt AD, Field HE, Dobson AP & Daszak P* (Corresp. Author). Agricultural intensification, epidemic enhancement and the emergence of new lethal zoonoses from wildlife. **Nature** in review.

Five other relevant publications

Ekbom, A., Daszak, P., Kraaz, W. & Wakefield, A.J. (1996). Crohn's disease after *in utero* measles virus exposure. **Lancet** 348: 515-517.

Berger, L., Speare, R., Daszak, P., *et al.* (1998). Chytridiomycosis causes amphibian mortality associated with population declines in the rain forests of Australia and Central America. **PNAS** 95: 9031-9036.

Li, W., Shi, Z., Yu, M., Ren, W., Smith, C., Epstein, J.H., Wang, H., Crameri, G., Hu, Z., Zhang, H., Zhang J., McEachern, J., Field, H., Daszak, P., Eaton, B.T., Zhang, S. & Wang, L.-F. (2005). Bats are natural reservoirs of SARS-like coronaviruses. **Science** 310: 676-679.

Kilpatrick, A.M., Kramer, L.D., Jones, M.J., Marra, P.P. & Daszak P. (2006). West Nile virus epidemics in North America are driven by shifts in mosquito feeding behavior. **PLoS Biol.** 4: 606-610

Rodríguez, J.P., Taber, A.B., Daszak, P., Sukumar, R., Valladares-Padua, C., Padua, S., Aguirre, L.F., Medellín, R., Acosta, M., Aguirre, A.A., Bonacic, C., Bordino, P., Bruschini, J., Buchori, D., González, S., Mathew, T., Mendez, M., Mugijca, L., Pacheco, L.F., Dobson, A.P., Pearl, M. (2007). The globalization of conservation: A view from the South. **Science** 317: 755-756.

NAME Bender, Jeffrey	POSITION TITLE Associate Professor
eRA COMMONS USER NAME	

EDUCATION/TRAINING (<i>Begin with baccalaureate or other initial professional education, such as nursing, and</i>)			
INSTITUTION AND LOCATION	DEGREE (if applicable)	YEAR(s)	FIELD OF STUDY
California Polytechnic University, San Luis Obispo, CA	B.S.	1985	Biology
University of MN, St. Paul, MN	DVM	1989	Veterinary Medicine
University of MN, St. Paul, MN	M.S.	1995	Epidemiology/Vet Med

A. Positions and Honors.

Positions and Employment

2007 – present	Co-Director of the Center for Animal Health and Food Safety, University of Minnesota
2006 – present	Associate Professor, Veterinary Population Medicine, College of Veterinary Medicine, University of Minnesota, St. Paul, MN
2002 - present	Adjunct Assistant Professor, Environmental and Occupational Health, School of Public Health, University of Minnesota
2000 - 2006	Assistant Professor, Veterinary Population Medicine, College of Veterinary Medicine, University of Minnesota, St. Paul, MN
1997 – 2000	State Public Health Veterinarian, Minnesota Department of Health
1995 – 2000	Infectious Disease Epidemiologist; Foodborne, Vectorborne and Zoonotic Unit, Minnesota Department of Health

B. Selected peer-reviewed publications (in chronological order).

1. Sannes MR, Belongia EA, Kieke B, Smith KE, Vandermause M, **Bender J**, Clabots C, Winokur P, Johnson JR. Predictors of antimicrobial-resistant *Escherichia coli* in the feces of vegetarians and newly hospitalized adults in Minnesota and Wisconsin. *J Infect Dis*, 2008;197:430-434.
2. Cho S, Diez-Gonzalez F, Fossler C, Wells SJ, Hedberg CW, Kaneene JB, Ruegg P, Warnick L, **Bender JB**. Antimicrobial susceptibility of Shiga toxin producing *Escherichia coli* isolated from organic dairy farms, conventional dairy farms, and county fairs in Minnesota. *Foodborne Pathogens & Disease*, 2007;178-186.
3. Steinmuller N, Demma L, **Bender JB**, Eidson M, Angulo FJ. Outbreaks of enteric disease associated with animal contact: Not just a foodborne problem anymore. *Clin Infect Dis*, 2006;43:1596-1602.
4. Cho S, Diez-Gonzalez F, Fossler C, Wells SJ, Hedberg CW, Kaneene JB, Ruegg P, Warnick L, **Bender JB**. Prevalence of shiga toxin-encoding bacteria and shiga toxin-producing *Escherichia coli* isolates from dairy farms and county fairs. *Veterinary Microbiology*, 2006;118:289-298.
5. Medus C, Smith K, **Bender J**, Besser J, Hedberg C. Salmonella outbreaks in restaurants in Minnesota, 1995-2003: Evaluation of the role of infected foodworkers. *J Food Protection*, 2006;69:1870-1878.
6. Griggs JP, **Bender JB**, Jacob JP. Microbial safety of chickens raised without antibiotics. *J Appl Poult Res*, 2006;15:475-482.
7. **Bender JB**, Hueston W, Osterholm MT. Recent animal disease outbreaks and their impact on human populations. *J of Agromedicine*, 2006;11:5-15.
8. Cho S, **Bender JB**, Diez-Gonzalez F, Fossler CP, Hedberg CW, and Wells SJ. Prevalence and Characterization of *Escherichia coli* O157 Isolates from Minnesota Dairy Farms and County Fairs. *J Food Protection*, 2006;69:252-259.
9. Liesener A, Smith K, Davis R, **Bender J**, Danila R, Neitzel D, Forsman S, Nordquist G, Scheftel J. Circumstances of Bat Encounters and Knowledge of Rabies among Minnesota Residents Submitting Bats for Rabies Testing. *J Vector and Zoonotic Diseases* 2006;6:208-215.
10. Lopes VC, Wedel SD, **Bender JB**, Smith KE, Leano FT, Boxrud DJ, Lauer DC, Velayudhan BT, Nagaraja KV. Emergence of antimicrobial resistant *Salmonella* enterica serotype Newport in Minnesota. *Clin Inf Dis* 2006;43:210-3.
11. Wünschmann A, Shivers J, **Bender J**, Carroll L, Fuller S, Saggese M, van Wettene A, Redig P. Pathological and immunohistochemical findings in goshawks (*Accipiter gentilis*) and great horned owls (*Bubo virginianus*) naturally infected with West Nile virus. *Avian Diseases* 2005;49:252-259.