

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors in the order listed on Form Page 2.

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NAME: Peter Daszak		POSITION TITLE President & Chief Scientist	
eRA COMMONS USER NAME: daszak			
EDUCATION/TRAINING			
INSTITUTION AND LOCATION	DEGREE	MM/YY	FIELD OF STUDY
Bangor University (UK)	BSc. (hons)	07/86	Zoology
University of East London (UK)	Ph.D	03/93	Infectious Diseases

A. Personal Statement

I am President and Chief Scientist of EcoHealth Alliance, a US-based organization that conducts research and outreach programs on global health, conservation and international development. My 20+ years of research has focused on understanding the causes of disease emergence in wildlife, livestock and people, particularly viral zoonotic diseases. My work has included identifying the bat origin of SARS, the causes of Nipah and Hendra virus emergence, producing the first ever global emerging disease 'hotspots' map, identifying the first case of a species extinction due to disease, coining the term 'pathogen pollution', and discovering the disease chytridiomycosis as the cause global amphibian declines. I am a member of the IOM's Forum on Microbial Threats, the NRC Committee to Advise the USGCRP, the Supervisory Board of the One Health Platform, the One Health Commission Council of Advisors, and the DHS-funded CEEZAD External Advisory Board. I have served on the IOM Committee on global surveillance for emerging zoonoses, the NRC committee on the future of veterinary research, the International Standing Advisory Board of the Australian Biosecurity CRC; and have advised the Director for Medical Preparedness Policy on the White House National Security Staff and the Director of the OST on global health issues. I am the EHA institutional lead for USAID-EPT-PREDICT and PREDICT-2, and serve on the Editorial Board of *Conservation Biology*, *One Health*, and *Transactions of the Royal Society of Tropical Medicine & Hygiene*, and am Editor-in-Chief of *Ecohealth*. I have authored over 300 scientific papers on emerging diseases.

B. Positions and Honors**Positions and Employment**

1993-8 Senior Faculty Research Scientist, Kingston University
 1998 Guest Researcher, Centers for Disease Control and Prevention (CDC)
 1999-2001 Faculty Research Scientist, University of Georgia
 2001- Adjunct Faculty, Tufts Univ. Sch. Veterinary Med.; Univ. Georgia; Columbia Univ.
 2001-9 Executive Director, Consortium for Conservation Medicine, EcoHealth Alliance, New York
 2009- President & Chief Scientist, EcoHealth Alliance New York.

Other Experience and Professional Membership

Keynote speaker Merieux Foundation Conference on Emerging paramyxoviruses, France (2000); UN Millenium Ecosystem Assessment: Lead Author, human infectious diseases (2006); NIH: ad hoc member, ZRG1 IDM-G 90 study section: Virology, Biodefense & Emerg. Diseases (2003-5); Editorial Board, *Conservation Biology* (Blackwell); Founding Co-Editor *EcoHealth* (Springer) (2004-10); NAS – Committee Member, Future Needs in Veterinary Research (2004-5); DIVERSITAS (UNESCO-ICSU): Member of Scientific Committee (2004-11; Treasurer 2007-11); NIAID: Steering Committee, workshop on virus-host shifts & emergence of new pathogens (2005); Australian Biosecurity Cooperative Research Center: International Standing Advisory Committee (2005-10); NIH: ad hoc member, ZRG1 IRAP-Q study section (infectious diseases, epidemiology) (2005-7); International EcoHealth Association: Founding board of directors, Treasurer (2006-11); CDC: ad hoc member, ZCD1 SGI, 09PAR07-231, R36 Research Dissertation Awards (2007); European CDC: Keynote speaker, future infectious disease threats (2008); NAS-IOM Committee Member, Global capacity for EID surveillance (2008-9); Scientific Advisory Board, NIAID Center of Excellence, avian influenza (CRISAR), UCLA (2008-9); Reviewer IOM report on Infectious Disease Movements in a Borderless World (2009); NIAID: Steering Committee, workshop on viruses from bats (2009); NAS-IOM Participant, workshop on H1N1, Committee on Emerging Microbial Threats (2009); NIH: ZRG1 IRAP-Q Review panel ARRA Challenge grants (2009); Organizing Committee, 1st International One Health Symposium, Australia

(2010); Member, Council of Advisors One Health Commission (2010-); Editor-in-Chief, *EcoHealth* (2010-); Scientific Advisory Board, Oxford Univ. Clinical Research Unit, Vietnam (2010-); Member of IOM Forum on Microbial Threats (2010-); External Advisory Board, CEEZAD (Center of Excellence for Emerging & Zoonotic Animal Diseases) – Dept. Homeland Security, Science & Technology Center of Excellence, Kansas State Univ. (2010-); Steering Committee, NIAID Workshop on Arboviruses (2011); Organizer IOM Forum on Microbial Threats briefing on MERS-CoV (2013); Chair, Scientific Steering Committee, Future Earth ecoHEALTH project (2014-); Editorial Board, *Transactions of the Royal Society of Tropical Medicine and Hygiene* (2014-); Member NRC Advisory Committee to advise the US Global Change Research Program (USGCRP) (2014-); Supervisory Board, One Health Platform (2015-); Senior Fellow, Center for Development Research (ZEFc), University of Bonn (2015-); NSF/NIH Ecology & Evolution of Infectious Diseases review panel (2015); Ed. Board *One Health* (2015-).

Honors

Meritorious service award, CDC (1999); CSIRO silver medal for collaborative research (2000); Honored by the naming of a new species of centipede, *Cryptops daszaki* (*J Nat Hist* 2002; 36: 76-106) (2002); ISI Fast-breaking paper (2002); CBS 60 Minutes documentary on Nipah virus research; 6th Annual Lecturer, Medicine & Humanities, Texas A&M (2003); Editor's choice, *Science* (2006); Zayed International Prize for the Environment (2nd) (2006); Finalist, Director's Pioneer Award (2007); Discovery Channel documentary on Nipah virus research, Bangladesh (2008); Presidential Lecturer, University of Montana (2008); Elected member of the Cosmos Club 2012; Honored by the naming of a new species of parasite, *Isospora daszaki* (*Parasitol. Res.* 2013; 111:1463-1466) (2012); Awarded the Hsu-Li Distinguished Lectureship in Epidemiology (2013); Robert Leader Endowed Lecture in Food Safety, Michigan State Univ. (2015).

C. Contribution to Science (Note: * = Corresponding Author)

Studies of wildlife ecology to understand emerging zoonoses. It's been known for a long time that many emerging diseases are zoonotic with wildlife origins (e.g. HIV, Hantavirus pulmonary syndrome, West Nile virus). In the 1990s, new collaborations among ecologists studying wildlife population dynamics and medical scientists began to show that understanding disease dynamics in wildlife can allow better forecasting of disease risk in people, and ultimately help combat emerging pathogens. I was one of the leaders in this field, with a paper highlighting similarities between emerging diseases in people and wildlife that we published in *Science* (Daszak *et al.* 2000). I have continued this work with review papers on the linkages among biodiversity and health (Keesing *et al.*, 2010) and environmental change and health. Over the past 20 years, I have applied this approach to understand how the ecology of West Nile virus in birds can explain risk to people (e.g. Kilpatrick *et al.*, 2006), and how zoonotic diseases such as Nipah virus will likely alter their ecology in the future (e.g. Daszak *et al.*, 2013), as well as a range of studies to identify the ecological underpinnings of disease emergence.

- Daszak P, Cunningham AA, Hyatt AD (2000). Emerging infectious diseases of wildlife - threats to biodiversity and human health. **Science** 287: 443-449
- Keesing F, Belden LK, Daszak P, Dobson A, Harvell CD, Holt RD, Hudson P, Jolles A, Jones KE, Mitchell CE, Myers SS, Bogich T & Ostfeld RS. (2010). Impacts of biodiversity on the emergence and transmission of infectious diseases. **Nature** 468:647-652.
- Kilpatrick, A.M., Kramer, L.D., Jones, M.J., Marra, P.P. and Daszak, P. (2006). Host heterogeneity dominates West Nile virus transmission. **Proc Roy Soc B** 273: 2327-2333.
- Daszak P, Zambrana-Torellio C, Bogich TL, Fernandez M, Epstein JH, Murray KA, Hamilton H (2013). Interdisciplinary approaches to understanding disease emergence: The past, present and future drivers of Nipah virus emergence. **PNAS** 110: 3681-3688

Discovery that diseases can cause extinction of species. Biodiversity loss is one of the key threats to our planet, and one of the grand challenges cited by the National Academies of Science. Before the 1990s, it was known that diseases can cause outbreaks and sometimes smallscale population declines in wildlife. However, the role of diseases in largescale declines or even extinctions was controversial and widely disputed. Working with a veterinary colleague I was able to identify the first ever definitively-proven case of extinction of a species by an infectious agent (in *Partula* snails – Cunningham & Daszak, 1998). As one of the key members of a series of collaborations among veterinarians and ecologists, I identified a new fungal disease causing global declines and extinctions in amphibians (Berger *et al.*, 1998). I won the 2000 CSIRO Collaborative Research Medal for this work, and it has now led to a major focus of research in wildlife disease ecology which we summed up in a paper in *Science* in 2006 (Mendelson *et al.*, 2006).

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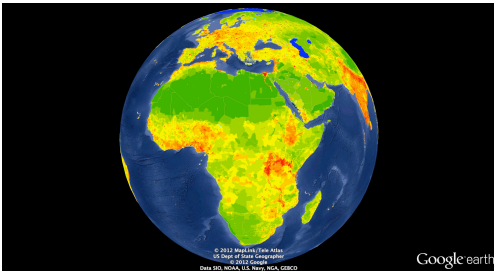
- Cunningham, A.A. & Daszak, P. 1998. Extinction of a species of land snail due to infection with a microsporidian parasite. **Conservation Biology** 12: 1139-1141.
- Berger L, Speare R, Daszak P, Green DE, Cunningham AA, Goggin CL, Slocombe R, Ragan MA, Hyatt AD, McDonald KR, Hines HB, Lips KR, Marantelli G, Parkes H (1998). Chytridiomycosis causes amphibian mortality associated with population declines in the rain forests of Australia and Central America. **PNAS** 95: 9031-9036.
- Mendelson JR, Lips KR, Gagliardo RW, Rabb GB, Collins JP, Diffendorfer JE, Daszak P et al.(2006). Confronting amphibian declines and extinctions. **Science** 313: 48.

Research on the bat origins of SARS and Nipah virus. The majority of EIDs are zoonotic in origin, with the majority of these originating in wildlife. Therefore, to prevent future disease emergence, it is critical that we better understand the wildlife origins of recent important zoonoses such as SARS and Nipah virus. As PI on three R01s my work has shown that SARS-CoV evolved from SARS-like CoVs in bats (Li *et al.*, 2005) and, by virus isolation, that giant fruit bats are the reservoir of Nipah virus (Rahman *et al.*, 2010). Collaborating with virologists in China, we have now isolated and characterized SL-CoVs from bats that use the same human host cell receptor (ACE-2) as SARS-CoV (Ge *et al.*, 2013). This work provides critical reagents and resources that now led to advances in viral understanding and ultimately will contribute to vaccine development by other groups. Our work has also identified why Nipah virus emerged in Malaysia (Pulliam *et al.*, 2012) and in Bangladesh, and the likely causes of Hendra virus emergence in Australia.

- 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 (2005). Bats are natural reservoirs of SARS-like coronaviruses. **Science** 310: 676-679.
- Rahman SA, Hassan SS, Olival KJ, Mohamed M, Chang L-Y, Hassan L, Saad NM, Shohaimi SA, Mamat ZC, Naim MS, Epstein JH, Suri AS, Field HE, Daszak P & HERG (2010). Characterization of Nipah virus from naturally infected *Pteropus vampyrus* bats, Malaysia. **EID** 16: 1990-1993
- Ge X-Y, Li J-L, Yang X-L, Chmura AA, Zhu G, Epstein JH, Mazet JK, Hu B, Zhang W, Peng C, Zhang Y-J, Luo C-M, Tan B, Wang N, Zhu Y, Crameri G, Zhang S-Y, Wang L-F, Daszak P*, Shi Z-L* (Co-Corresponding Authors) (2013). Isolation and characterization of a bat SARS-like Coronavirus that uses the ACE2 receptor. **Nature** 503: 535-538.
- Pulliam JRC, Epstein JH, Dushoff J, Rahman SA, Bunning M, HERG, Jamaluddin AA, Hyatt AD, Field HE, Dobson AP & Daszak P* (Corresponding Author) and the Henipavirus Ecology Research Group (HERG). (2012). Agricultural intensification, priming for persistence, and the emergence of Nipah virus: a lethal bat-borne zoonosis. **J Roy Soc Interface** 9:89-101

Analyzing drivers of emerging diseases to produce predictive EID ‘hotspots’ maps and models.

Emerging infectious diseases are one of the biggest threats to global health. However, their emergence is sporadic, complex, and seemingly unpredictable. In the early 2000s I started to use ecological analytical approaches to see if there are patterns in disease emergence, and if these are predictable. By collating a database of all known prior EID events, identifying their point origins, and correcting for reporting biases, I published the first ever predictive ‘hotspots’ maps of where disease emergence is most likely (Jones *et al.*, 2008; Fig 1.). I have continued this approach, publishing predictive maps of H5N1 spread (Kilpatrick *et al.*, 2006), analyses of the likely dimensions of unknown viral diversity in mammals (Anthony *et al.*, 2013), maps



and predictive models of pandemic spread and a series of other papers analyzing EID risk (reviewed in Morse *et al.*, 2012).

Fig. 1. Heatmap showing the most likely sites of future disease emergence (for zoonotic diseases of wildlife origin). Red = highest risk, Green = lowest risk. The high risk regions have a combination of high human population density and high wildlife biodiversity – both correlate significantly with EID presence, corrected for reporting bias (from Jones *et al.*, 2008).

- Jones KE, Patel NG, Levy MA, Storeygard A, Balk D, Gittleman JL, and Daszak P*. (2008). Global trends in emerging infectious diseases. **Nature** 451:990-993
- Kilpatrick AM, Chmura AA, Gibbons DW, Fleischer RC, Marra PP & Daszak P (2006). Predicting the global spread of H5N1 avian influenza. **PNAS** 103: 19368-19373.

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- Anthony SJ, Epstein JH, Murray KA, Navarrete-Macias I, Zambrana-Torrel CM, Solovyov A, Ojeda-Flores R, Arrigo NC, Islam A, Ali Khan S, Hosseini P, Bogich TL, Olival KJ, Sanchez-Leon MD, Karesh W, Goldstein T, Luby SP, Morse SS, Mazet JAK, Daszak P*, Lipkin WI. (2013). A strategy to estimate unknown viral diversity in mammals. **MBio** 4(5): e00598-13.
- Morse SS, Mazet JAK, Woolhouse M, Parrish CR, Carroll D, Karesh WB, Zambrana-Torrel C, Lipkin WI, Daszak P* (2012). Prediction and prevention of the next pandemic zoonosis. **Lancet** 380:1956-1965.

Developing the field of ‘One Health’ and ‘EcoHealth’ in research and policy. Throughout my career I have worked collaboratively across medical, veterinary and ecological disciplines. During the last couple of decades, I’ve tried to solidify this approach by becoming very active in the fields of ‘One Health’ and ‘EcoHealth’. I’ve written a series of book chapters and reviews on these issues, serve on national and international committees for both fields, am an editor of the journal *One Health* and Editor-in-Chief of the journal *EcoHealth*, and am the CEO of the EcoHealth Alliance. I have begun to work with economic modelers to assess how efficient One Health approaches could be in global efforts to deal with emerging diseases (e.g. Pike *et al.*, 2014; Castillo-Chavez *et al.*, 2015). My aim is to use these analyses, and wealth of other published work to influence health and environmental policy so that the One Health approach is adopted widely for the benefit of public health and conservation. To help solidify this, I’ve been very active on the boards of, or working with national and intergovernmental agencies for health (IOM Forum on Microbial Threats; International EcoHealth Society; One Health Commission; One Health Platform) and Conservation (IUCN, CBD, DIVERSITAS, Future Earth). I have also published extensively on the policy implications of this work (e.g. Smith *et al.*, 2009; Rodriguez *et al.*, 2007).

- Pike J, Bogich TL, Elwood, SE, Finnoff DC, Daszak P* (2014). Economic optimization of a global strategy to address the pandemic threat. (2014). **PNAS**.111:18519-18523.
- Castillo-Chavez C, Curtiss R, Daszak P*, Levin SA, Patterson-Lomba O, Perrings C, Poste G, Towers S. (2015). Beyond Ebola: lessons to mitigate future pandemics. **Lancet Global Health** 3: e354-355.
- Smith KF, Behrens M, Schloegel LM, Marano N, Burgiel S, Daszak P* (2009). Reducing the risks of the wildlife trade. **Science** 324:594-595.
- Rodríguez JP, Taber AB, Daszak P, Sukumar R, Valladares-Padua C, Padua S, Aguirre LF, Medellín R, Acosta M, Aguirre AA, Bonacic C, Bordino P, Bruschini J, Buchori D, González S, Mathew T, Mendez M, Mugijca L, Pacheco LF, Dobson AP, Pearl M (2007). Policy Forum: The globalization of conservation: A view from the South. **Science** 317: 755-756.

D. Research Support

Ongoing Research Support

USAID EPT PREDICT-2	Mazet (PI)	10/01/14 – 09/30/19
Conducting surveillance for novel pathogens in wildlife, livestock and people; characterizing human risk behavior; modeling risk of novel disease emergence; identifying mitigation strategies		
Amount: \$35 Million subcontract from a \$100 Million award		
Role: PI on Subcontract		

1R01AI110964	Daszak (PI)	06/01/14 – 05/31/19
NIAID: Understanding the Risk of Bat Coronavirus Emergence		
Bat ecological, human risk behavioral and virological studies to understand the risk of bat coronavirus emergence		
Role: PI		

NSF DEB 1414374	Perrings (PI)	10/15/14 - 10/14/17
NSF-NIH-USDA EEID, joint UK BBSRC BB/M008894/1		
US-UK Collab: Risks of Animal and Plant Infectious Diseases through Trade (RAPID Trade)		
Role: Co-Investigator		
NSF	Daszak (PI)	07/01/10-06/30/15
EcoHealthNet - a Research Coordination Network		
Funding for student exchange and workshops to fuse veterinary science, ecology and human medical sciences		
Role: PI 1R01GM100471	Perrings (PI)	09/15/11-06/30/15

HDTRA1 Huff (PI) 04/15/15 - 04/14/17
Office of Naval Research, Defense Threat Reduction Agency
Rapid identification of undiagnosed EID Events
Role: Co-Investigator

Completed Research Support

USAID EPT PREDICT-1 Mazet (PI) 10/01/09 – 09/30/14
Modeling hotspots for disease emergence and conducting surveillance in wildlife in hotspots for new emerging zoonoses
Amount: \$18 million subcontract on a \$75 million award
Role: PI on Subcontract

2 R01TW005869 Daszak (PI) 09/01/08 – 08/31/13
NIH Ecology of Infectious Diseases (Fogarty International Center)
The Ecology, Emergence and Pandemic Potential of Nipah virus in Bangladesh
To conduct mathematical modeling and fieldwork to understand the dynamics of Nipah virus in Bangladesh
Role: PI

NIAID Non-Biodefense Emerging Infectious Diseases
Risk of viral emergence from bats.
To model hotspots for bat viral diversity, identify & characterize new bat viruses & understand their pathology
Role: PI

NSF BCS 0826779 Daszak (PI) 10/01/08 – 03/31/12
NSF Human and Social Dynamics
AOC - HSD – Collaborative Research: Human-related factors affecting emerging infectious diseases
To analyze how socio-economic and environmental drivers predict risk of EIDs
Role: PI on lead proposal

R01TW005869 - supplemental Daszak (PI) 09/01/08 – 08/31/11
NIH EID (Fogarty International Center)
Supplemental funding: Predicting the risk of global H5N1 spread
This project will involve mathematical modeling and fieldwork in Bangladesh and China to understand risk of H5N1 spread.
Role: PI

NSF EF-062239 Kilpatrick (PI) 09/01/06 - 08/30/11
NSF/NIH: Ecology & Evolution of Infectious Diseases
Predicting spatial variation in West Nile virus transmission
Study interaction among WNV vector, reservoir host populations across an urban-to-rural gradient.
Role: Co-PI

R01 TW05869 Daszak (PI) 08/01/02 - 05/31/07
NIH/Fogarty International Center
Anthropogenic change & emerging zoonotic paramyxoviruses
To identify the cause of emergence of Nipah and Hendra viruses in Malaysia and Australia.
Role: PI

HSD 0525216 Daszak (PI) 10/15/05 - 10/14/06
National Science Foundation: Human and Social Dynamics
Collaborative Research: Socio-Economic and Environmental Drivers of Emerging Diseases
To analyze patterns of disease emergence globally and produce a broad risk assessment.
Role: PI