European
OneHealth / EcoHealth
Workshop

Brussels, 6-7 October 2016

Biodiversity and Health

Serge Morand

dépasser les frontières

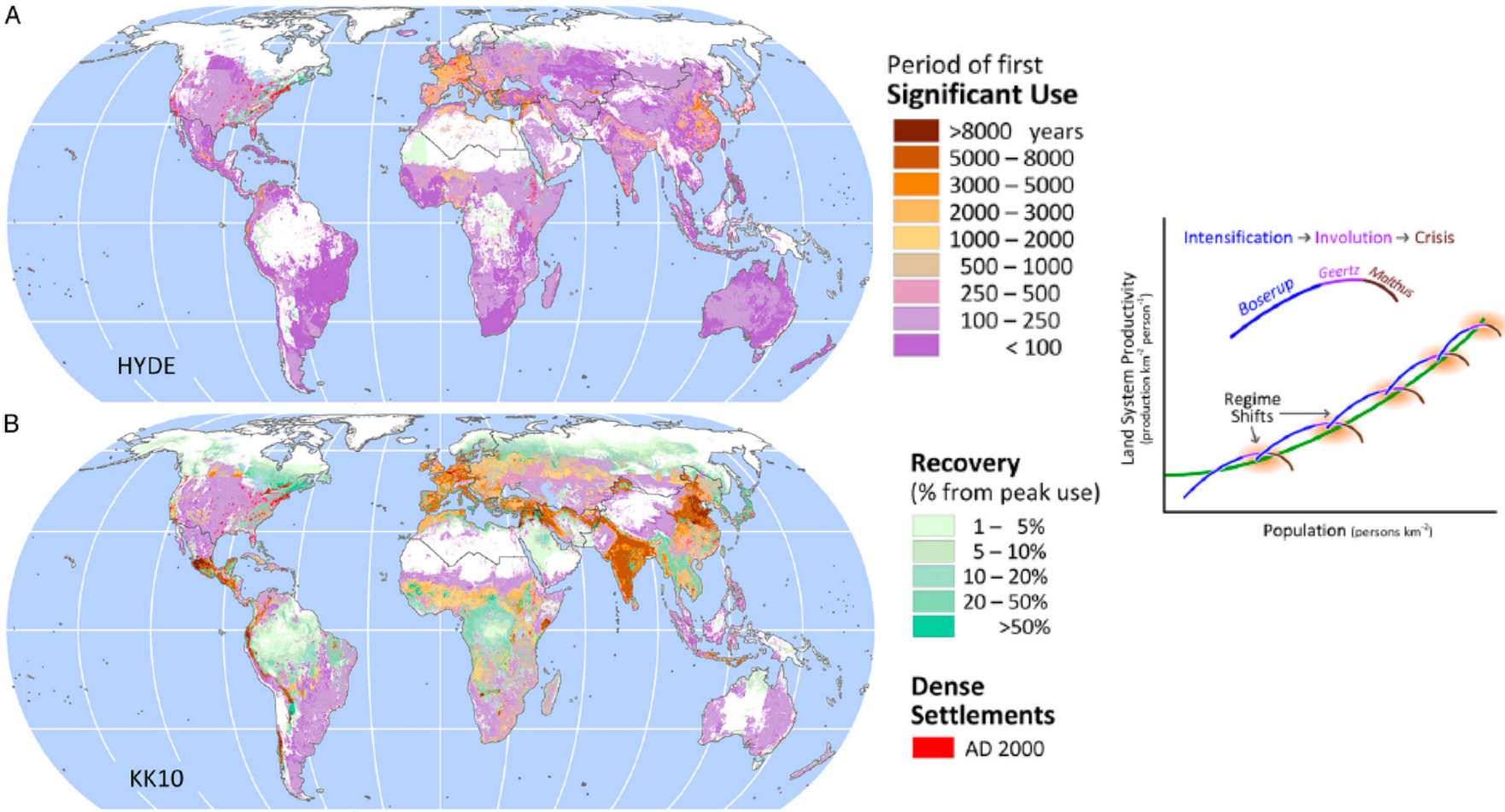
CENTRE D'INFECTIOLOGIE CHRISTOPHE MÉRIEUX DU LAOS

MAHIDOL UNIVERSITY *Wisdom of the Land*
Faculty of Tropical Medicine

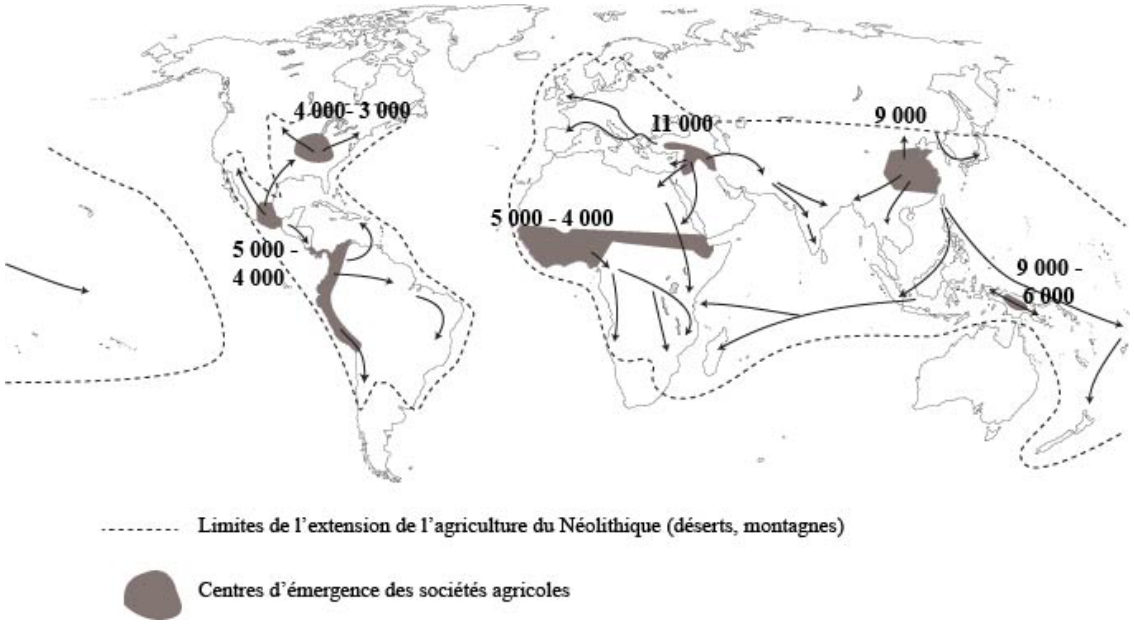
1. used planet

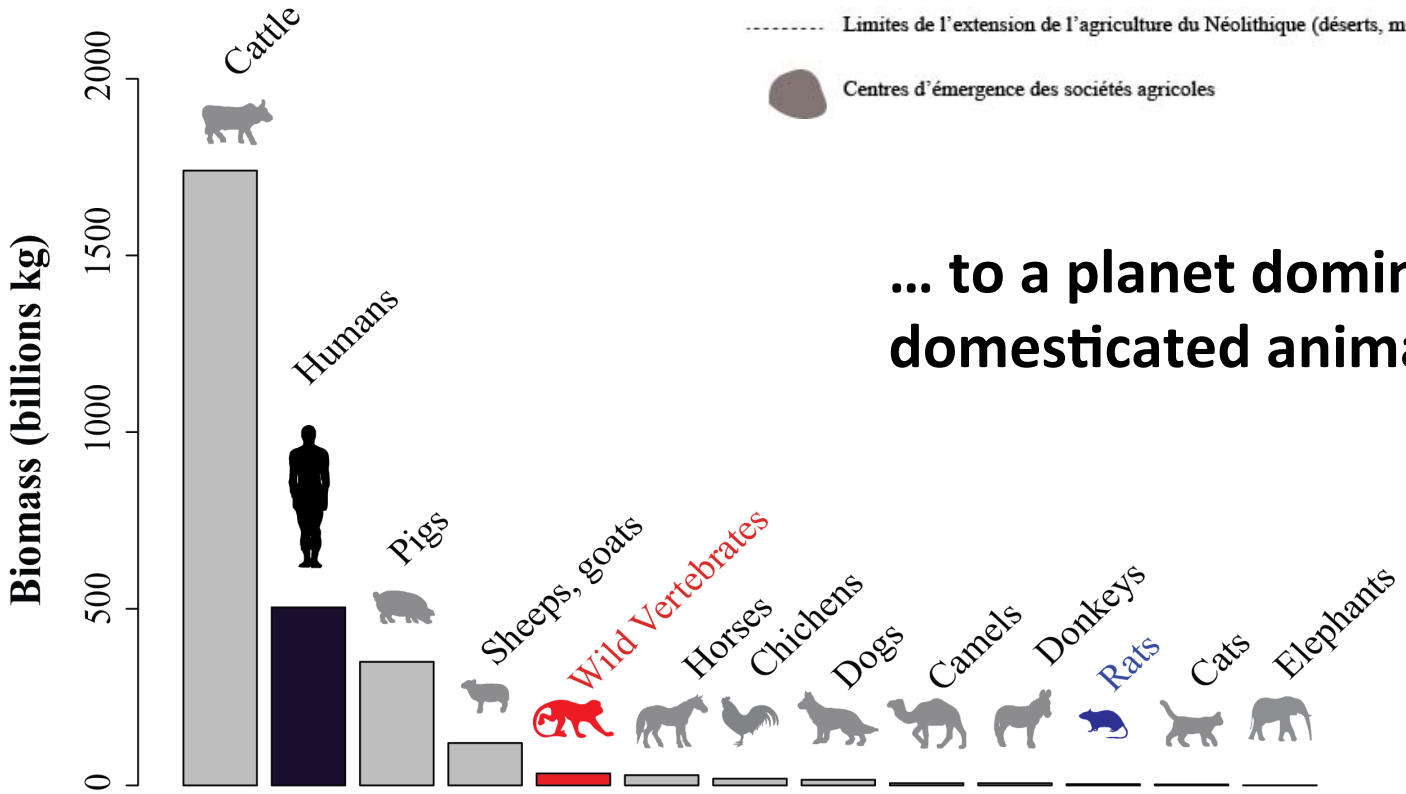
Used planet: A global history

Erle C. Ellis[a,1], Jed O. Kaplan[b], Dorian Q. Fuller[c], Steve Vavrus[d], Kees Klein Goldewijk[e], and Peter H. Verburg[f]



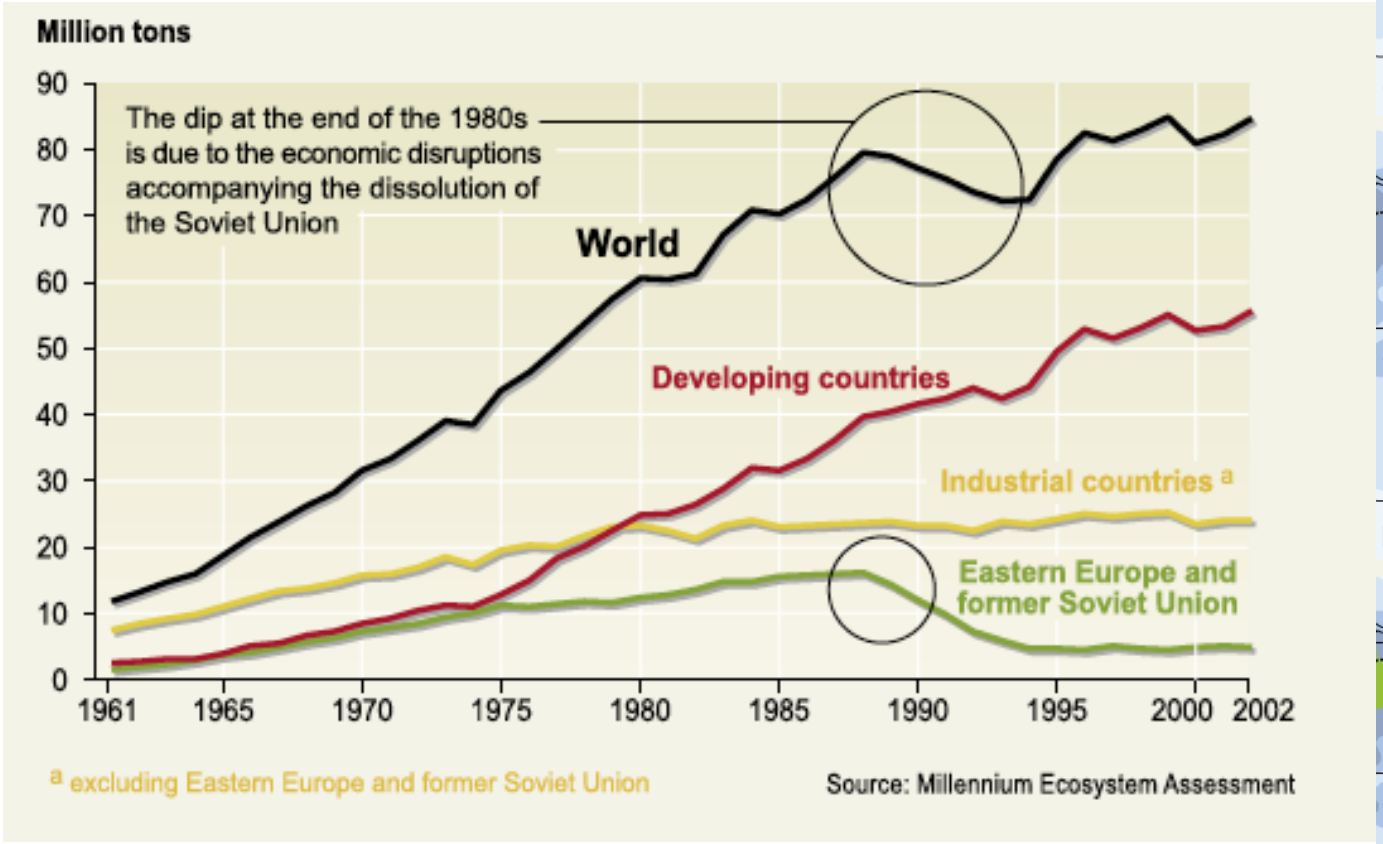
From the Neolithic revolution ….

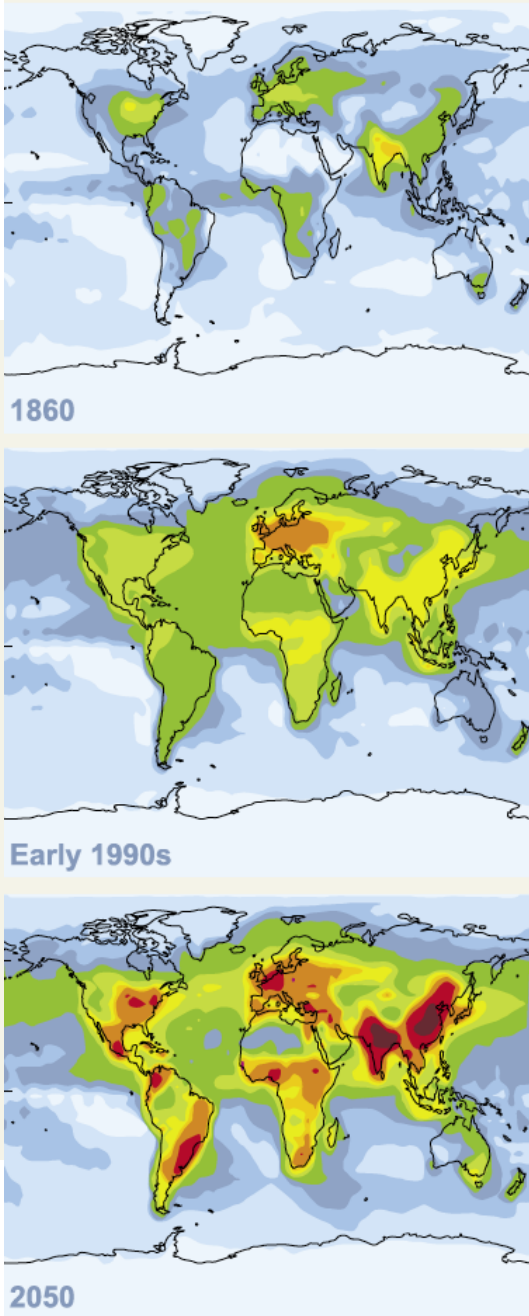




… to a planet dominated by domesticated animals

Trends in Global Use of Nitrogen Fertilizer, 1961–2001 (million tons) (S7 Fig 7.16)





Global trends in antimicrobial use in food animals

Thomas P. Van Boeckel[a,1], Charles Brower[b], Marius Gilbert[c,d], Bryan T. Grenfell[a,e,f], Simon A. Levin[a,g,h,1], Timothy P. Robinson[i], Aude Teillant[a,e], and Ramanan Laxminarayan[b,e,j,1]

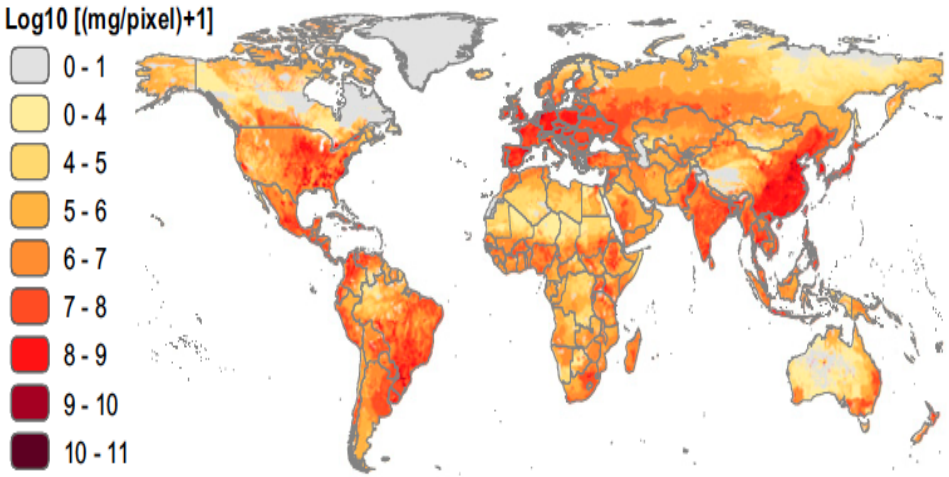


Fig. 3. Global antimicrobial consumption in livestock in milligrams per 10 km^2

PHARMACEUTICALS

China's lakes of pig manure spawn antibiotic resistance

Researchers begin to size up a public health threat from burgeoning pork production

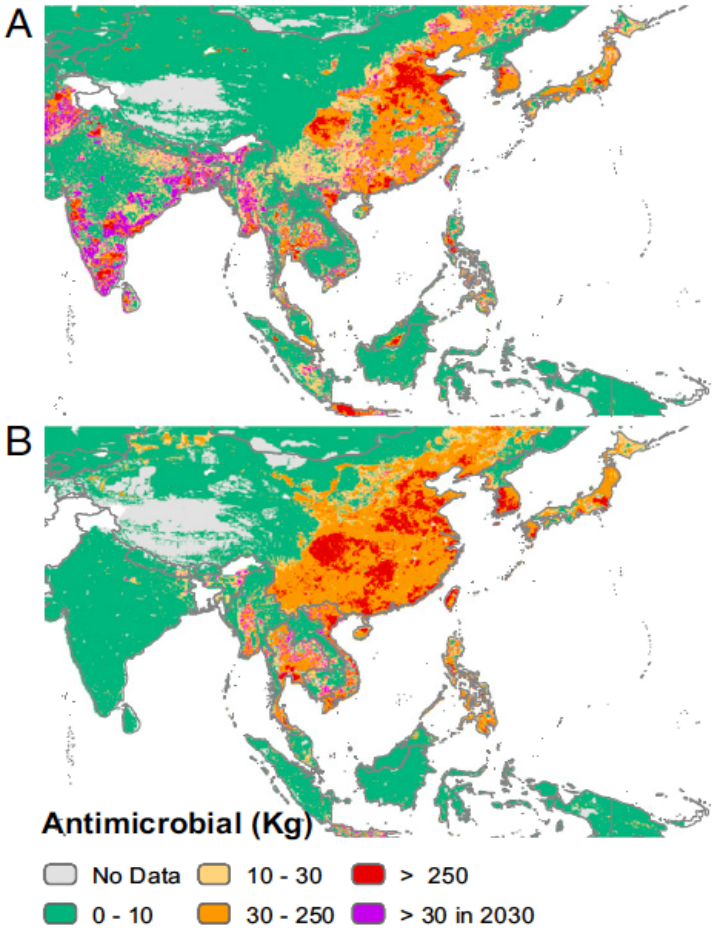


Fig. 4. Antimicrobial consumption in chickens (*A*) and pigs (*B*) in 2010. Purple indicates new areas where antimicrobial consumption will exceed 30 kg per 10 km^2 by 2030.

Pharmaceuticals in the environnement

Avian scavengers and the threat from veterinary pharmaceuticals

Richard J. Cuthbert[1,2], Mark A. Taggart[3], Vibhu Prakash[4], Soumya

The Daily Star Your Right To Know Sunday, October 26, 2014

Home NEWSPAPER Business Sports Wide Angle OP-ED ENTER

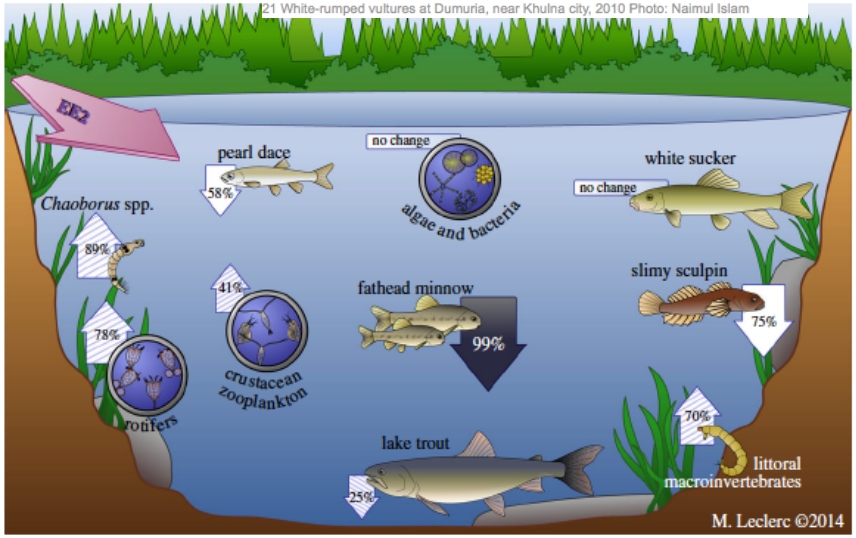
Saturday, September 29, 2012

Where have the vultures gone?

21 White-rumped vultures at Dumuria, near Khulna city, 2010 Photo: Naimul Islam

Bioaccumulation and trophic dilution of human pharmaceuticals across trophic positions of an effluent-dependent wadeable stream

Bowen Du[1,2], Samuel P. Haddad[1], Andreas Luek[5], W. Casan Scott[1,2],



Catastrophic Declines in Wilderness Areas Undermine Global Environment Targets

James E.M. Watson,[1,2,7,*] Danielle F. Shanahan,[1] Moreno Di Marco,[1,3] James Allan,[1] William F. Laurance,[4] Eric W. Sanderson,[2] Brendan Mackey,[5] and Oscar Venter[6]

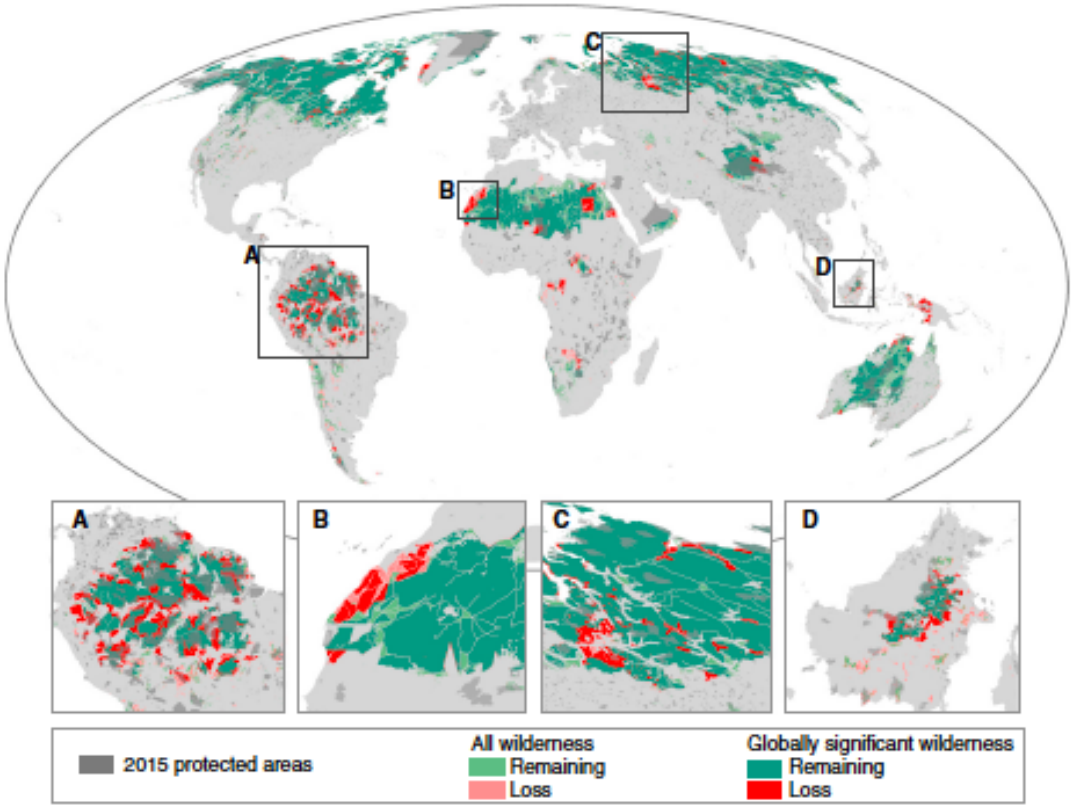
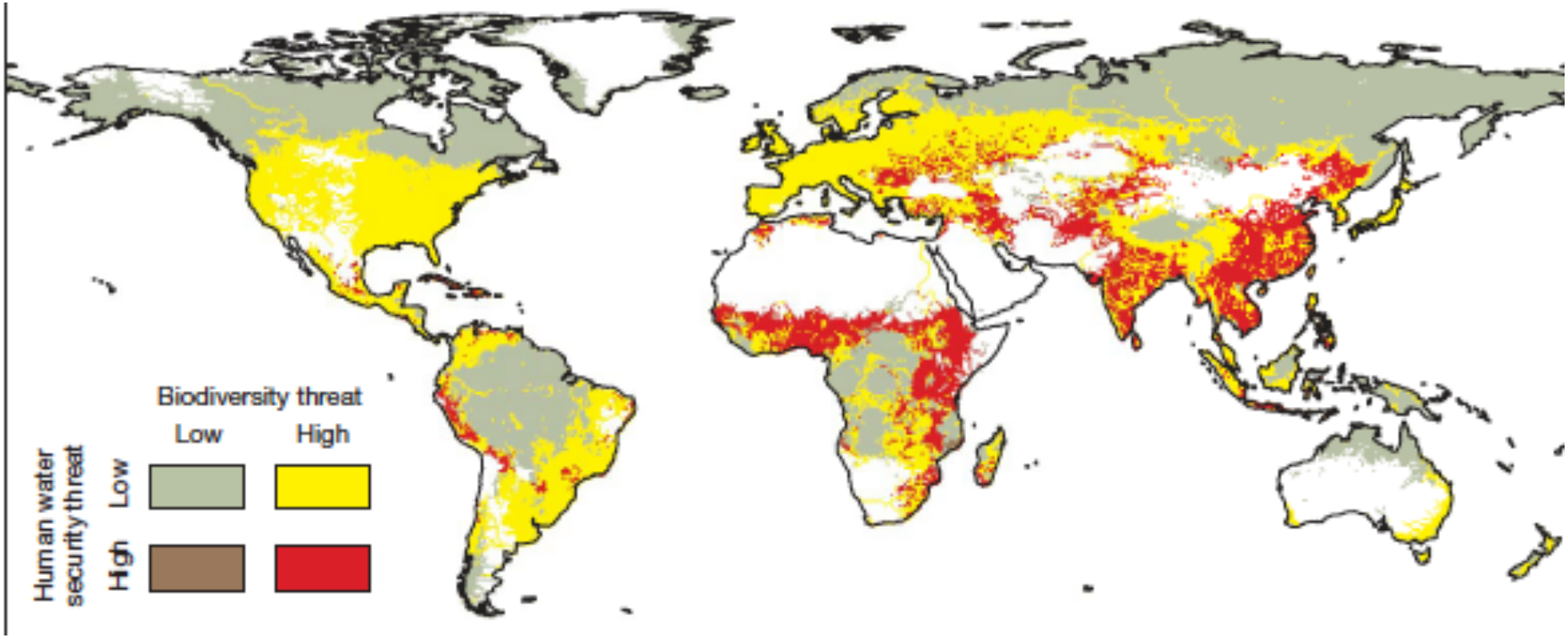


Figure 1. Change in the Distribution of Wilderness and Globally Significant Wilderness Areas since the Early 1990s

Global threats to human water security and river biodiversity

C. J. Vörösmarty[1]*, P. B. McIntyre[2]*†, M. O. Gessner[3], D. Dudgeon[4], A. Prusevich[5], P. Green[1], S. Glidden[5], S. E. Bunn[6], C. A. Sullivan[7], C. Reidy Liermann[8] & P. M. Davies[9]

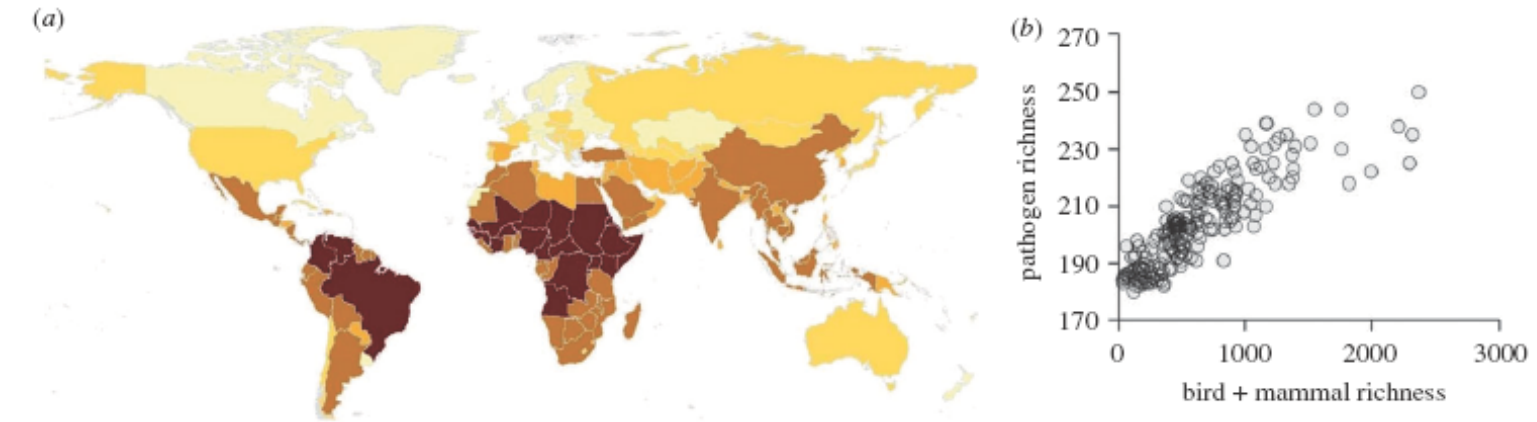


The developing world shows tandem threats to human water security and biodiversity

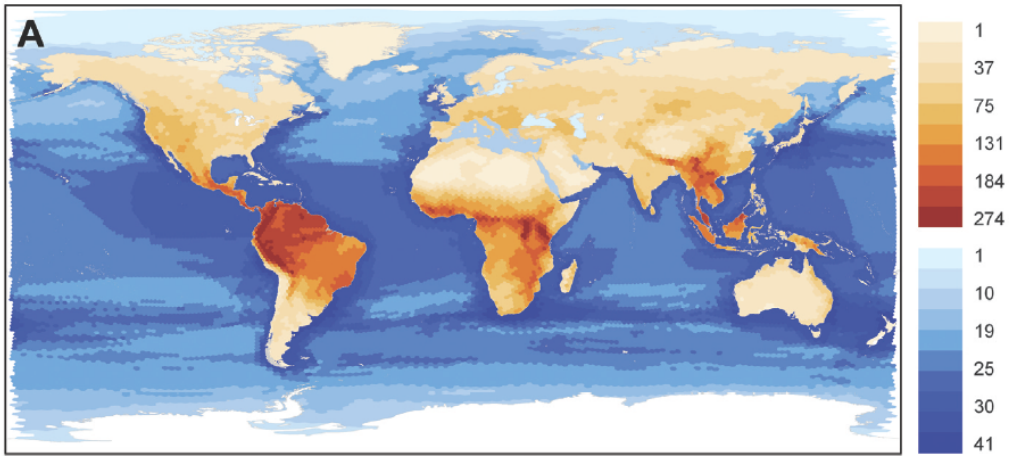
2. patterns

Biodiversity and richness in infectious diseases

Richesse en pathogènes

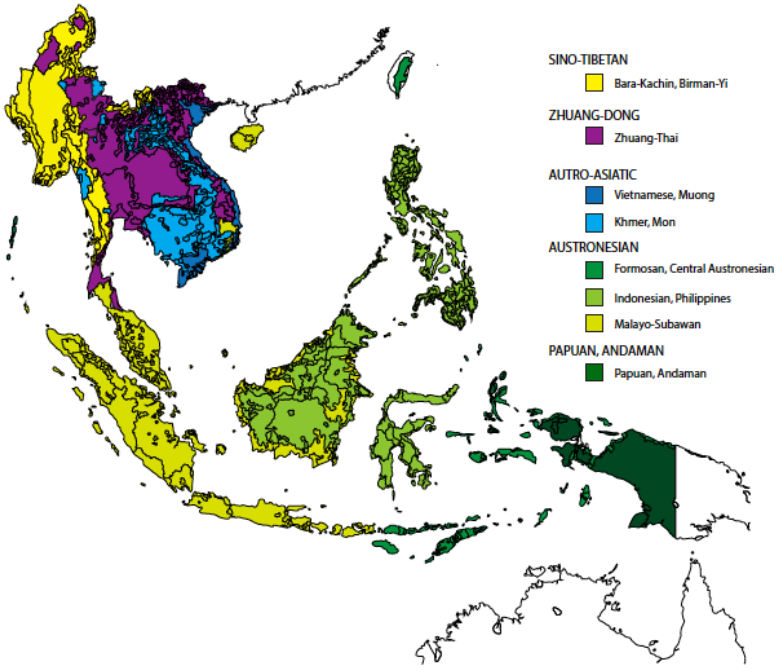


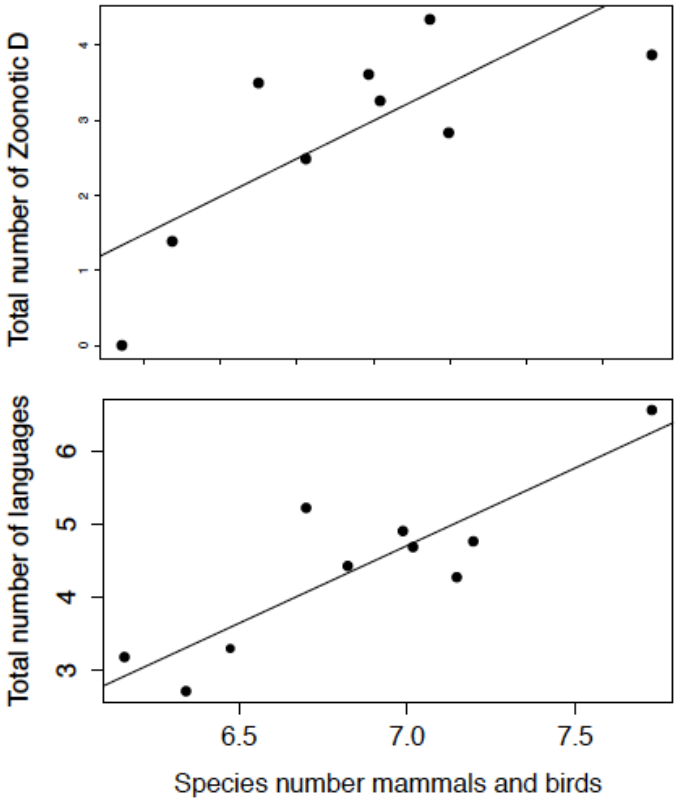
Richesse en mammifères

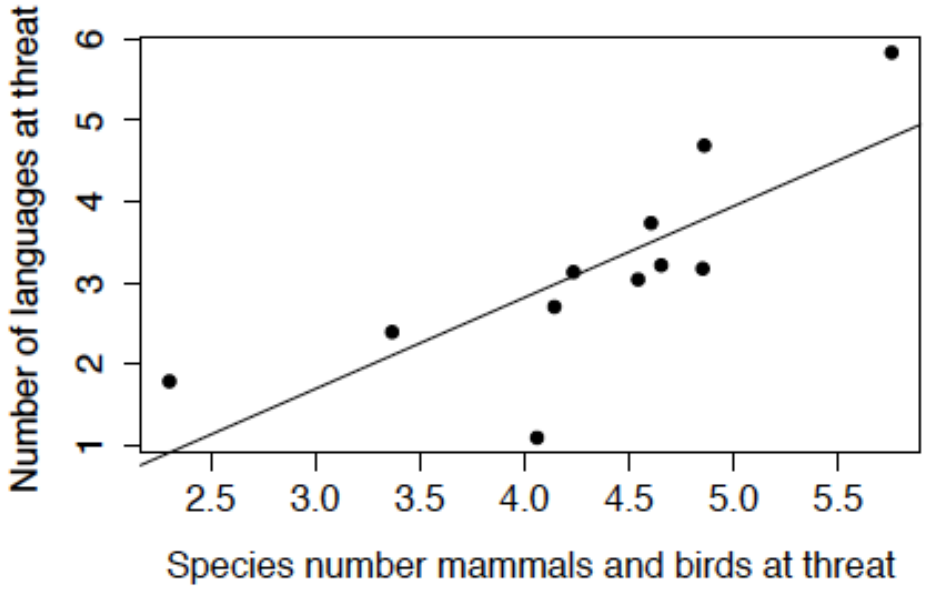


High richness in infectious diseases is associated with high biodiversity

Schipper et al. 2009. Nature







High richness in ID is associated with high cultural diversity

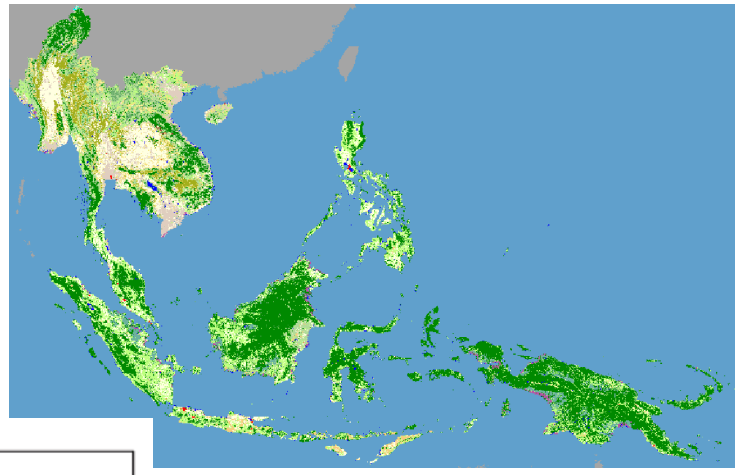
High threat in biodiversity is associated with high threat in cultural diversity

OPEN ACCESS Freely available online

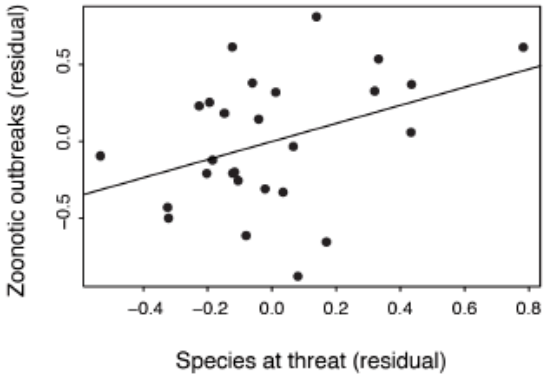
PLOS | ONE

Infectious Diseases and Their Outbreaks in Asia-Pacific: Biodiversity and Its Regulation Loss Matter

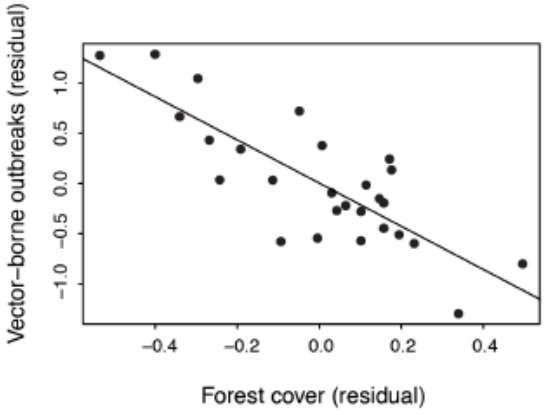
Serge Morand[1,2,3]*, Sathaporn Jittapalapong[4,5], Yupin Suputtamongkol[6], Mohd Tajuddin Abdullah[7], Tan Boon Huan[8]



Higher number of zoonotic outbreaks is linked with increasing biodiversity at threat



Higher number of vector-borne disease outbreaks is linked with low forest cover

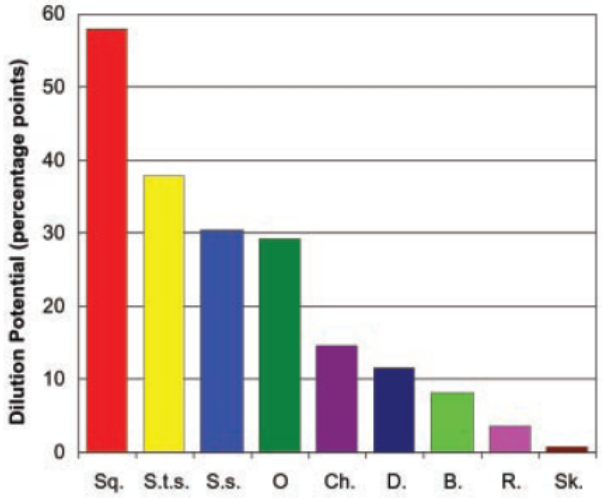


3. controversies

From Dilution Effect ….

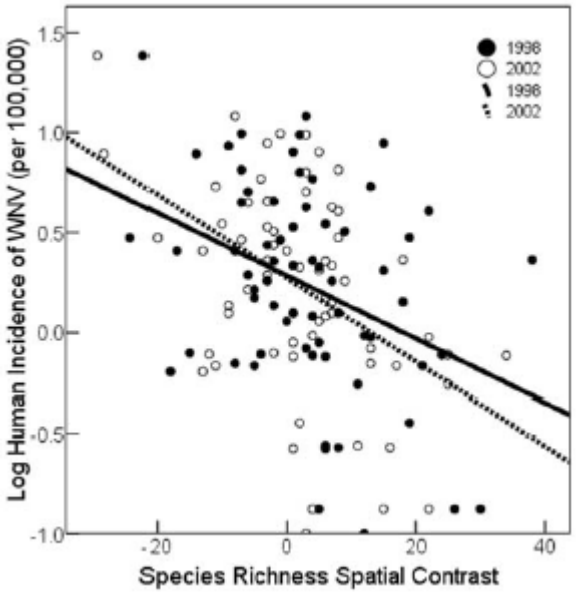
The ecology of infectious disease: Effects of host diversity and community composition on Lyme disease risk

Kathleen LoGiudice*†‡, Richard S. Ostfeld*, Kenneth A. Schmidt*§, and Felicia Keesing*¶



Increased Avian Diversity Is Associated with Lower Incidence of Human West Nile Infection: Observation of the Dilution Effect

John P. Swaddle[1,2]*, Stavros E. Calos[2]



… to refutation

Pangloss revisited: a critique of the dilution effect and the biodiversity-buffers-disease paradigm

S. E. RANDOLPH[1]* *and* A. D. M. DOBSON[1,2]

A meta-analysis suggesting that the relationship between biodiversity and risk of zoonotic pathogen transmission is idiosyncratic

Daniel J. Salkeld,[1,2]* Kerry A. Padgett[2] and James Holland Jones[1]

It's a myth that protection against disease is a strong and general service of biodiversity conservation: Response to Ostfeld and Keesing

Kevin D. Lafferty[1] and Chelsea L. Wood[2]

4. more difficulties

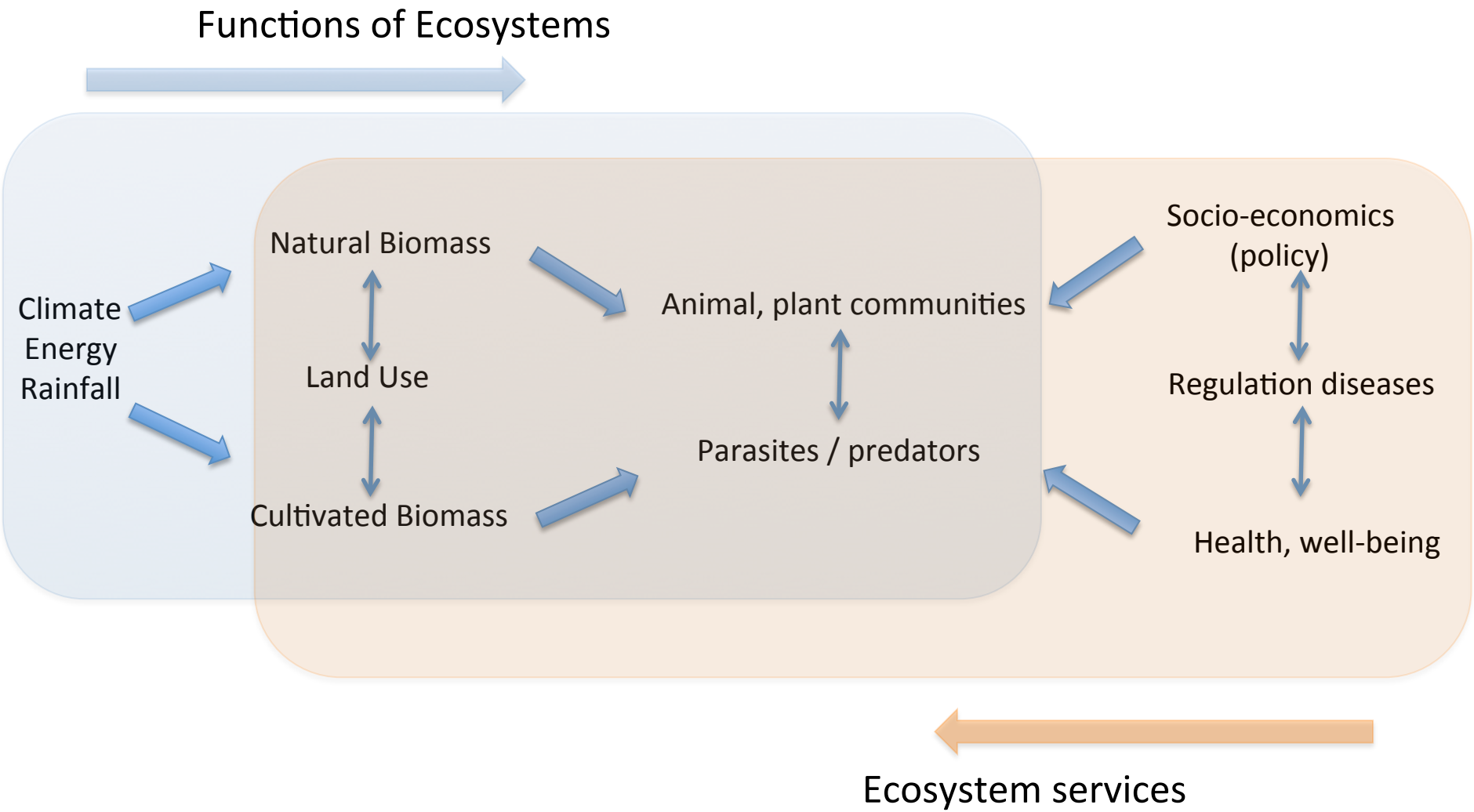
Biodiversity loss and its impact on humanity

Bradley J. Cardinale[1], J. Emmett Duffy[2], Andrew Gonzalez[3], David U. Hooper[4], Charles Perrings[5], Patrick Venail[1], Anita Narwani[1], Georgina M. Mace[6], David Tilman[7], David A. Wardle[8], Ann P. Kinzig[5], Gretchen C. Daily[9], Michel Loreau[10], James B. Grace[11], Anne Larigauderie[12], Diane S. Srivastava[13] & Shahid Naeem[14]

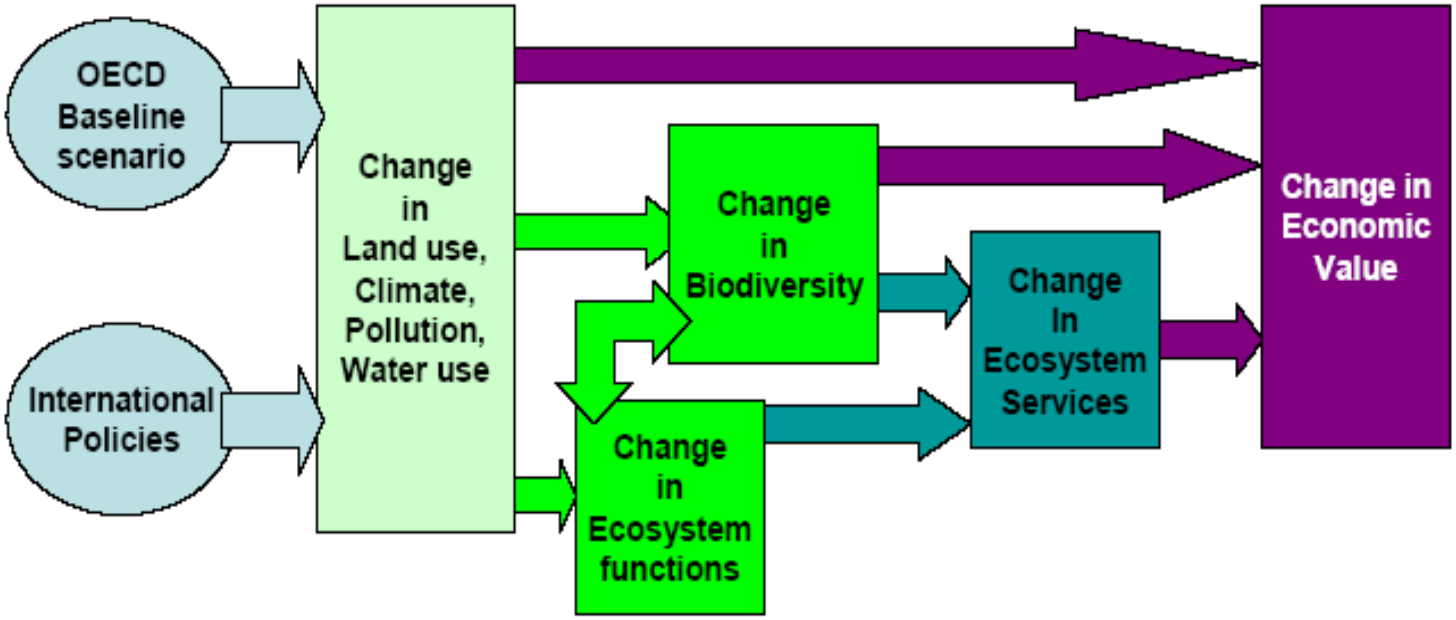
Table 1 | Balance of evidence linking biodiversity to ecosystem services

Category of service	Measure of service provision	SPU	Diversity level	Source	Study type	*N*	Relationship	
							Predicted	Actual
Regulating								
Biocontrol	Abundance of herbivorous pests (bottom-up effect of plant diversity)	Plants	Species	DS*	Obs	40		
		Plants	Species	DS†	Exp	100		
		Plants	Species	DS‡	Exp	287		
		Plants	Species	DS§	Exp	100		0
	Abundance of herbivorous pests (top-down effect of natural enemy diversity)	Natural enemies	Species/trait	DS*	Obs	18		
		Natural enemies	Species	DS†	Exp/Obs	266		
		Natural enemies	Species	DS‡	Exp	38		
	Resistance to plant invasion	Plants	Species	DS	Exp	120		
	Disease prevalence (on plants)	Plants	Species	DS	Exp	107		
	Disease prevalence (on animals)	Multiple	Species	DS	Exp/Obs	45		

What are ecosystem functions and services for health?



How to evaluate costs / benefits for health?



By the cost of inaction?

Benefits of globalization for health?

Is globalization healthy: a statistical indicator analysis of the impacts of globalization on health

Pim Martens[1,2*], Su-Mia Akin[1], Huynen Maud[1], Raza Mohsin[1]

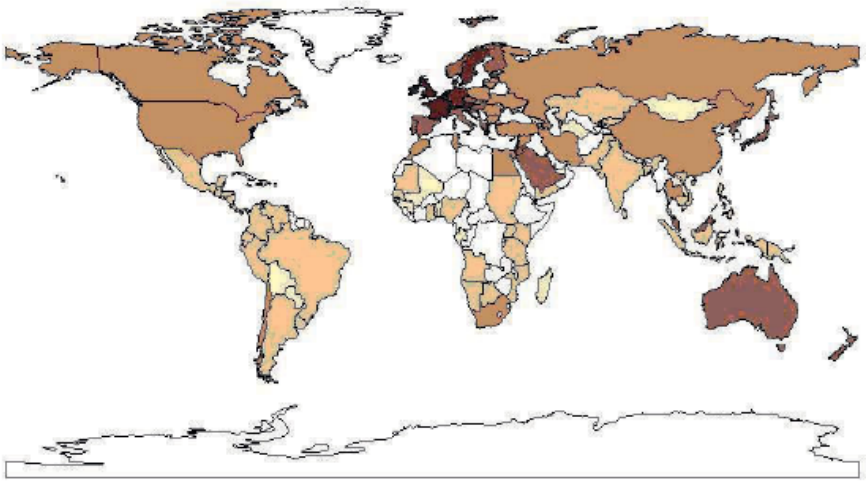
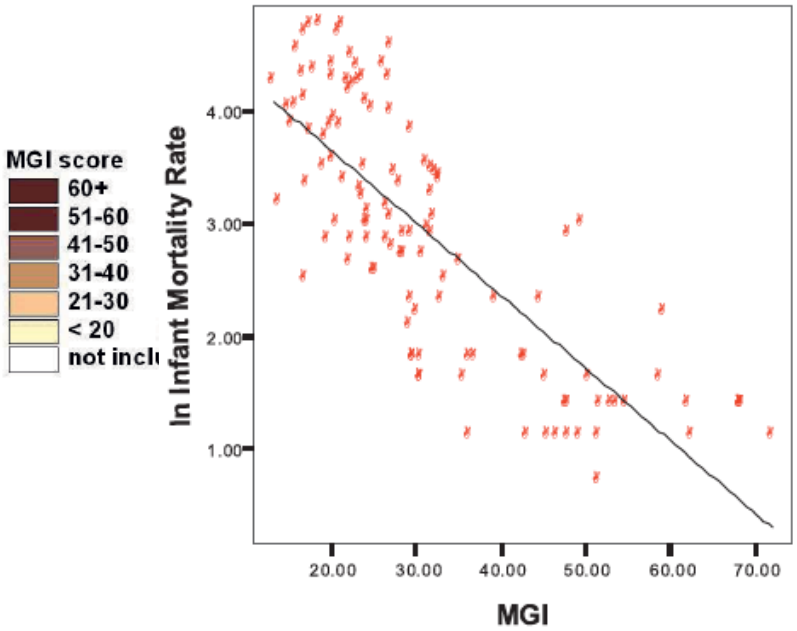


Figure 1 Map of the Maastricht Globalization Index (MGI) 2008 [27].



Positive association between globalization entre low infant mortality rate

5. Loss of cultural diversity and resources

VitalSites

The contribution of protected areas to human health

A research report by WWF and Equilibrium

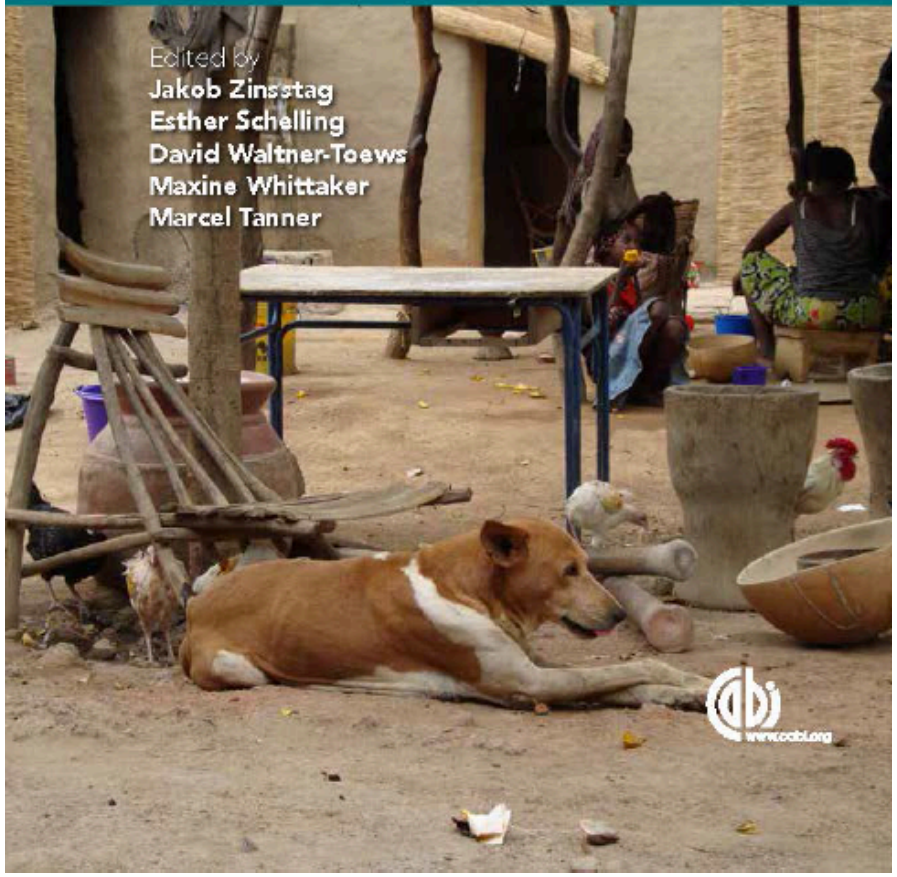
Local doctor prescribing traditional medicine to a patient in the Annapurna Conservation Area, Nepal

© Michel Gunther / WWF-Canon

EU-China Biodiversity Programme project area (*left*). Xian market (*right*) © WWF China

One Health

The Theory and Practice of Integrated Health Approaches



Edited by
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EcoHealth

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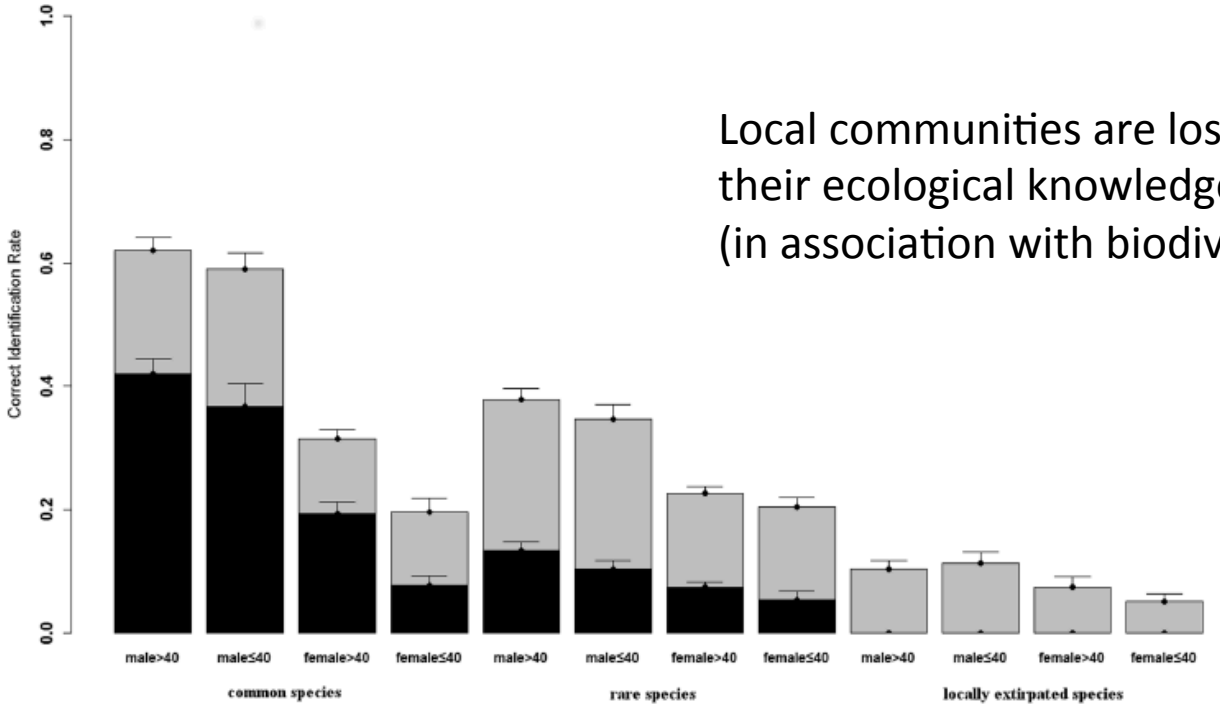
Springer

Shifting Baselines on a Tropical Forest Frontier: Extirpations Drive Declines in Local Ecological Knowledge

Zhang Kai[1,2], Teoh Shu Woan[1,3], Li Jie[1,4], Eben Goodale[5], Kaoru Kitajima[6], Robert Bagchi[7], Rhett D. Harrison[8,9]*



Local communities are losing their ecological knowledge (in association with biodiversity loss)

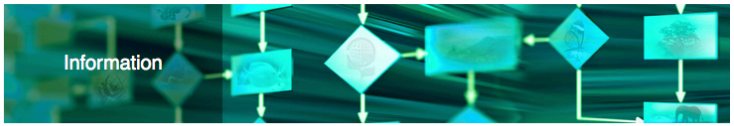
Figure 1. Proportion of bird species identified to group level (light grey) or identified to species level (dark grey) against respondent gender, respondent age, and species abundance (error bars = standard error). Note that for the statistical modeling respondent age was treated as a continuous variable.
doi:10.1371/journal.pone.0086598.g001

6. complexity

A COMPLEX GLOBAL GOVERNANCE ARCHITECTURE !!

Convention on Biological Diversity

The Convention | Cartagena Protocol | Nagoya Protocol | Programmes



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SBSTTA 18 Recommendation XVIII/14

XVIII/14. Health and biodiversity

futureearth
research for global sustainability

World Health Organization

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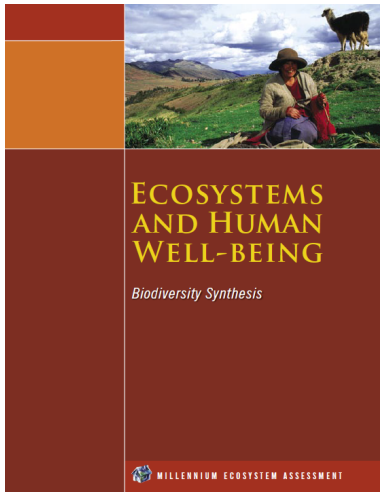
Climate change and human health

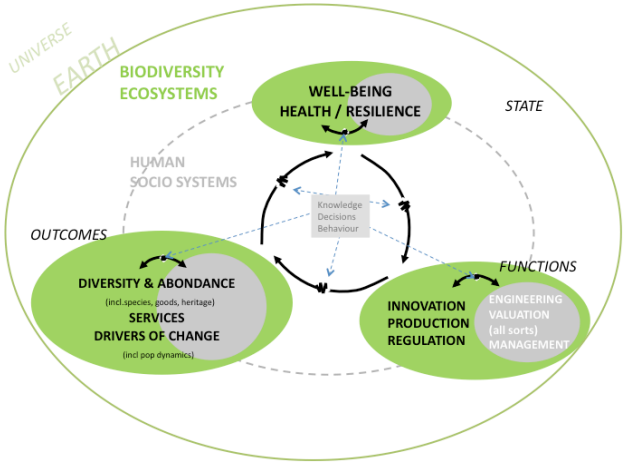
Biodiversity

What is biodiversity?

Biodiversity underpins life on Earth, and refers to the variety found in biota from genetic make up of plants an animals to cultural diversity.

What does biodiversity mean for human health?





Food and Agriculture Organization of the United Nations

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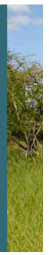
Biodiversity

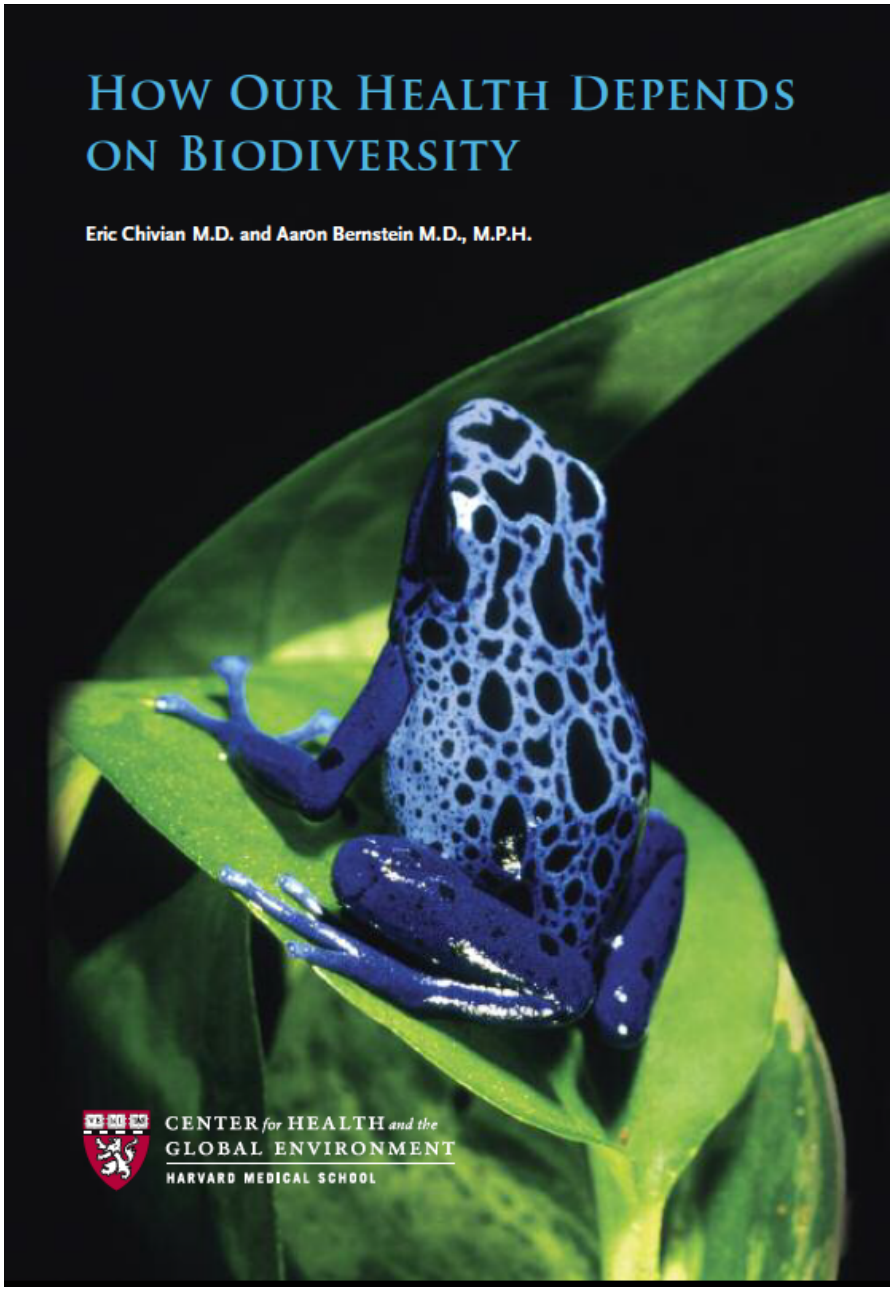
Biodiversity is essential for food security and nutrition. Thousands of interconnected species make up a vital web of biodiversity within the ecosystems upon which global food production depends.

With the erosion of biodiversity, humankind loses the potential to adapt ecosystems to new challenges such as population growth and climate change. Achieving food security for all is intrinsically linked to the maintenance of biodiversity.



7. representations

Biodiversity as seen by ecologists …



When bees go extinct…

Humans have to pollinate by hand (south of China)

… and as seen by epidemiologists

A walk on the wild side—emerging wildlife diseases

They increasingly threaten human and animal health

Pteropus alecto—the black flying fox—known t

The New York Times
SundayReview | The Opinion Pages

WORLD U.S. N.Y. / REGION BUSINESS TECHNOLOGY SCIENCE HEALTH SPORTS OPINION AUTOS

NEWS ANALYSIS

The Ecology of Disease

Olaf Hajek

By JIM ROBBINS
Published: July 14, 2012 | 114 Comments

7. same policy responses … and again

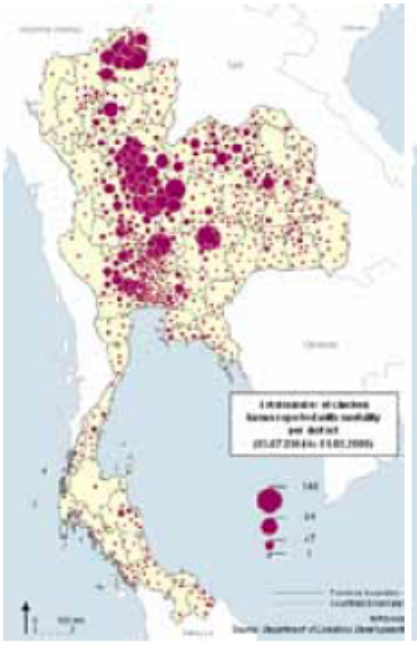
Impacts of Avian Influenza outbreaks on indigenous chicken genetic resources in Thailand

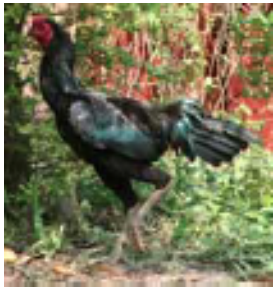
Monchai Duangjinda, Kreingkrai Choprakarn, Surachai Suwanlee, Panrapee Amnueysit
&
Olaf Thieme

GCP/RAS/228/GER Working Paper No. 13

The management of AI has impacted the genetic diversity of indigenous chickens:

- culling
- policy restricting restocking



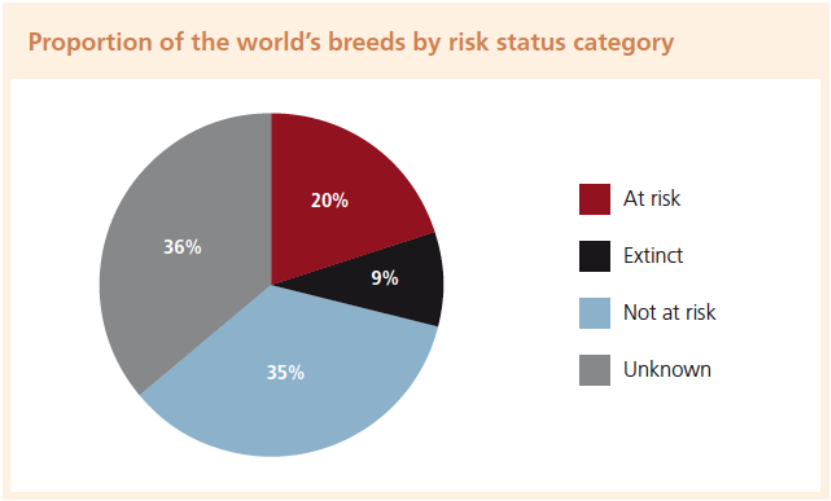


Where there is an ongoing loss of genetic resources…

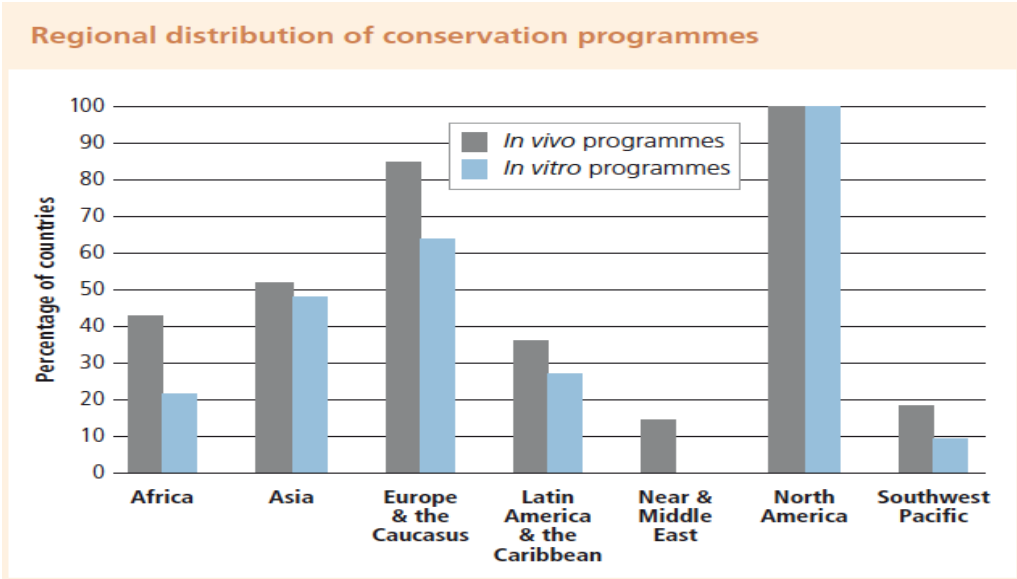
THE STATE
OF THE WORLD'S
ANIMAL GENETIC RESOURCES FOR FOOD AND AGRICULTURE

- This brochure presents key findings of the first global assessment of animal genetic resources.
- Sustainable management of the world's livestock genetic diversity is of vital importance to agriculture, rural development and the environment.
- This assessment has led to a process of policy development and a *Global Plan of Action for Animal Genetic Resources*.

COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE



.. and few conservation programmes in the domestication centres



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Brucellose: vers un abattage total à Bargy

ACTUALITE > FLASH ACTU Par lefigaro.fr avec AFP | Mis à jour le 30/09/2014 à 11:44 | Publié le 30/09/2014 à 11:43

L'AUTEUR

SUR LE MÊME SUJET

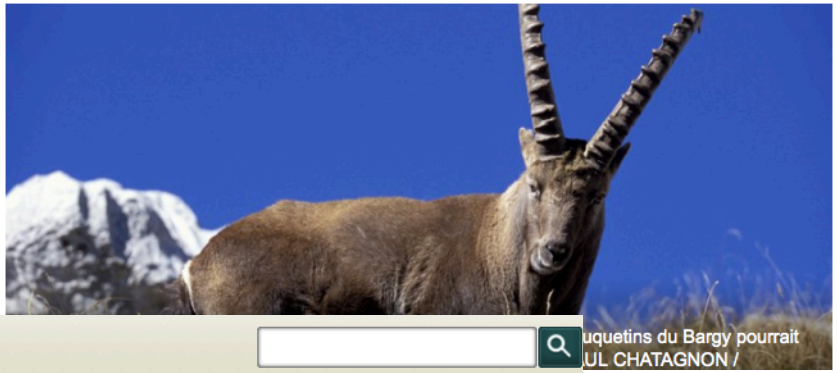
Le préfet de la Haute-Savoie va saisir le conseil national de protection de la nature (CNPN) d'une demande d'abattage total des 300 bouquetins du massif du Bargy, atteints de brucellose.

uetin : l'abattage
le massif du

ié le 30-09-2014 à 18h10
à jour le 01-10-2014 à 11h21

A+ A-

uer le troupeau pour
es scientifiques
avoriserait au contraire
se.



uquetins du Bargy pourrait
UL CHATAGNON /

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Mauritius must end unjustified mass cull of fruit bats

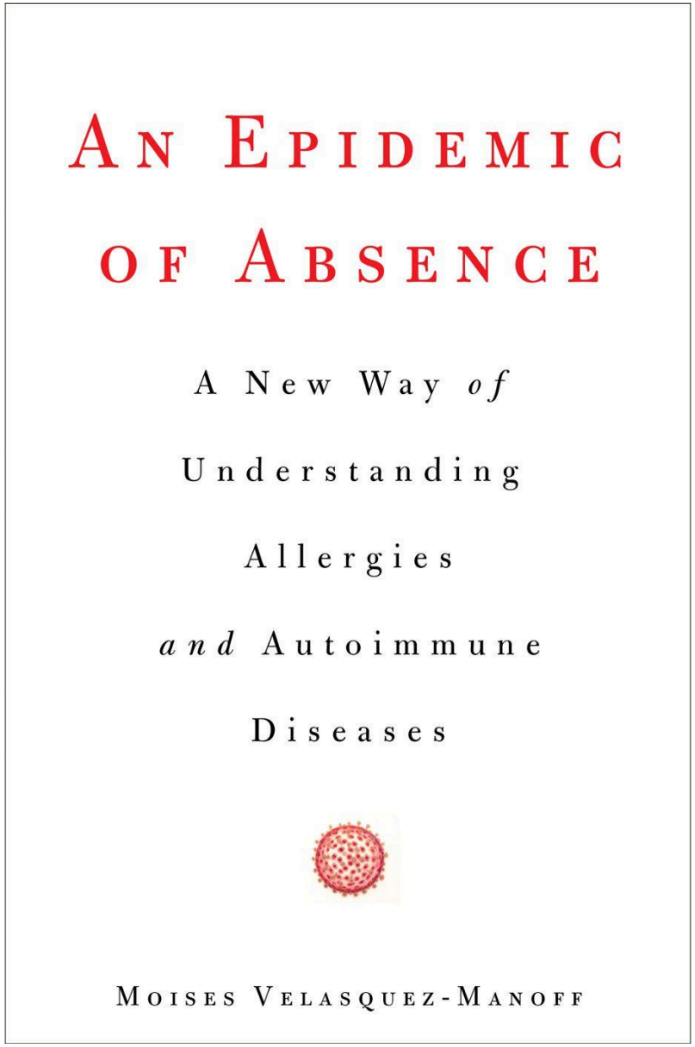
Posted on 17 November 2015

Despite a lack of scientific evidence and widespread public opposition, the government of Mauritius has embarked on the slaughter of thousands of Mauritius Fruit Bats, which is putting the future of the globally threatened species at risk, says a coalition of NGOs.

© Jacques de Speville

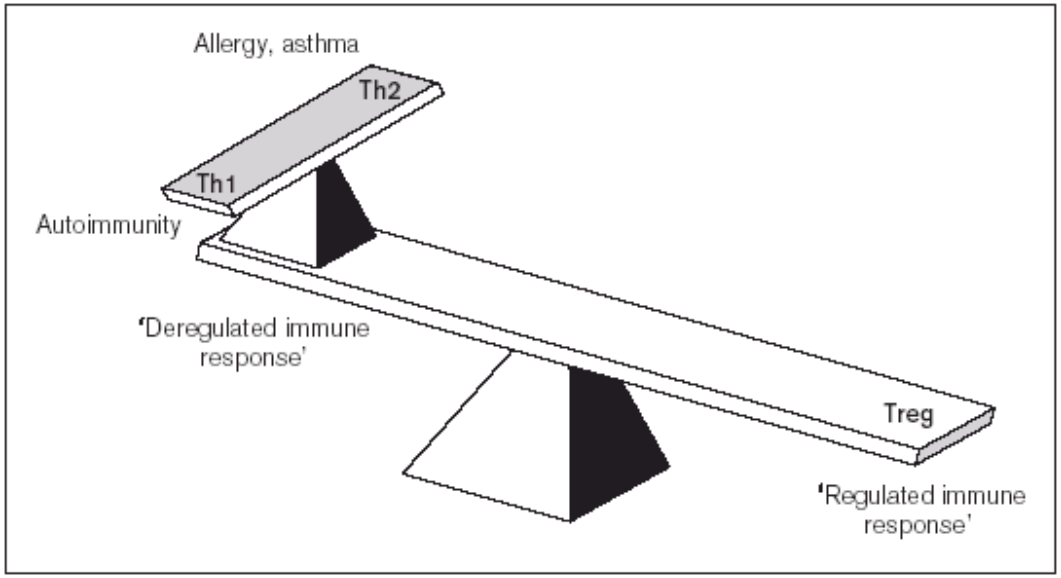
Enlarge

9. parasite loss matters



The loss of our old associates (helminths, protists) is associated with the increase of auto-immune diseases

Crohn disease, asthma, lupus erythematosus



Co-evolution, immunity

10. observatories “Biodiversity - Health - Societies”

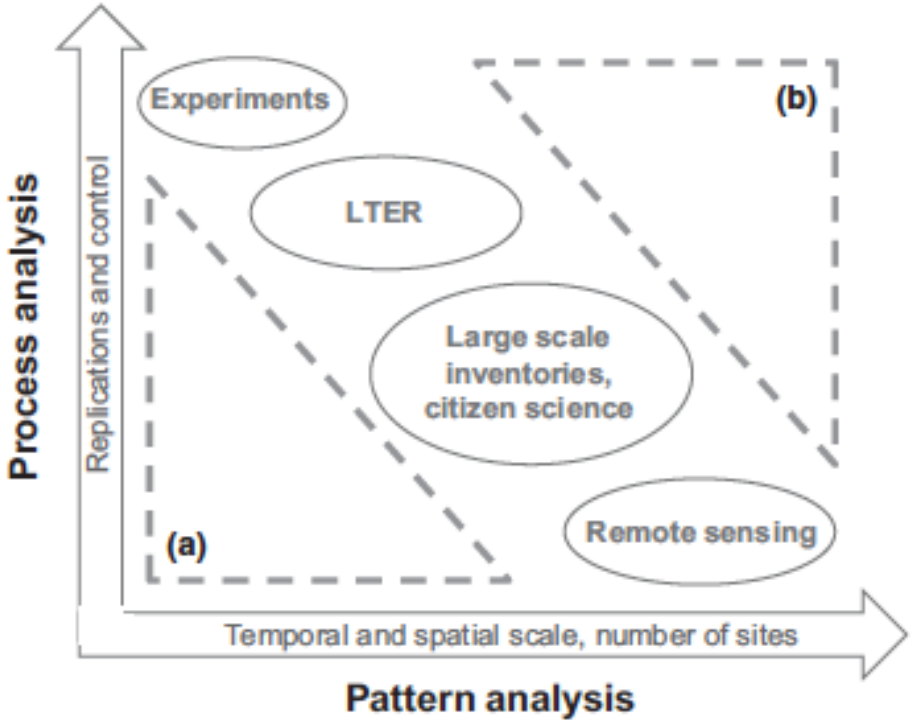
Journal of Applied Ecology

Journal of Applied Ecology 2015

REVIEW

Predictive ecology in a changing world

Nicolas Mouquet[1]*, Yvan Lagadeuc[2], Vincent Devictor[1], Luc Doyen[3], Anne Duputié[4], Damien Eveillard[5], Denis Faure[6], Eric Garnier[7], Olivier Gimenez[7], Philippe Huneman[8], Franck Jabot[9], Philippe Jarne[7], Dominique Joly[10,11], Romain Julliard[12], Sonia Kéfi[1], Gael J. Kergoat[13], Sandra Lavorel[14], Line Le Gall[15], Laurence Meslin[1], Serge Morand[1], Xavier Morin[7], Hélène Morlon[16], Gilles Pinay[2], Roger Pradel[7], Frank M. Schurr[1,17], Wilfried Thuiller[14] and Michel Loreau[18]



Towards and ethics of ecological prediction

Eubios Journal of Asian and International Bioethics 24 (July 2014)

Barcoding, biobanking, ebanking for "One Health" projects in South-East Asia: considering ethics and international law

- Claire Lajaunie[1], Serge Morand[2], Tan Boon Huan[3]

	Public Health (Medicine)	Animal Health (Veterinary Medicine)	Wildlife Conservation (Conservation Medicine)
Screening/barcoding	Gold standard test, reference laboratory WHO	OIE, reference laboratory OIE	Barcoding (BoL, Barcoding of Life)
Biobanking	Reference centers (international, national)	Institution initiatives	Natural History Museum, Institution initiatives
Ebanking	Reference centers	OIE, FAO	GBIF, BOLD, …
Ethics	WHO/CIOMS International Ethical Guidelines for Biomedical Research Involving Human Subjects	OIE Collaborating Centre for Animal Welfare Science and Bioethical Analysis National rules	National rules
International law and regulation	WHO International Health Regulations	OIE, WHO (zoonoses)	CDB, CITES*, CMS**

*CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora
**CMS: Convention on the Conservation of Migratory Species of Wild Animals

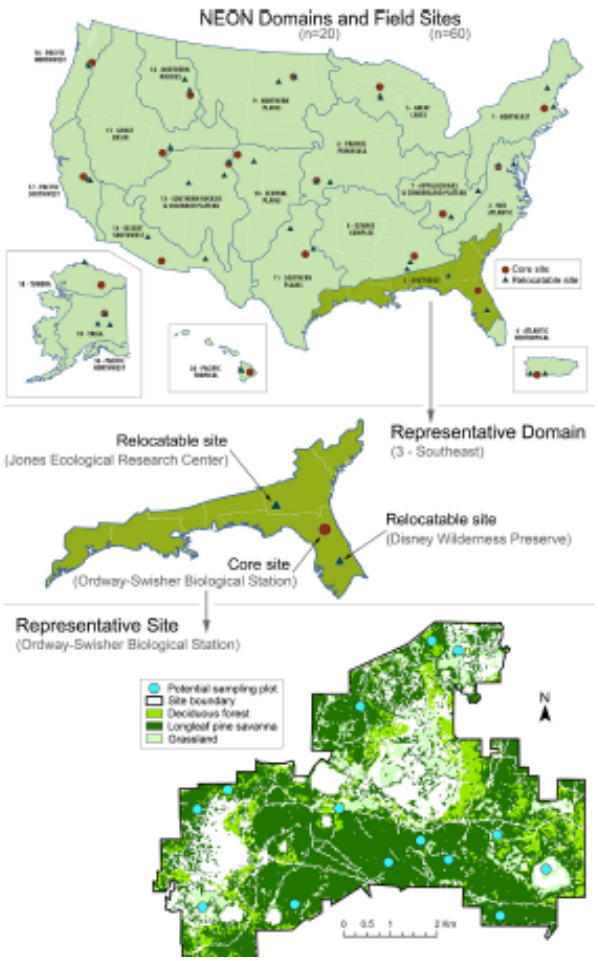
=> A gap between human health, animal health and wildlife

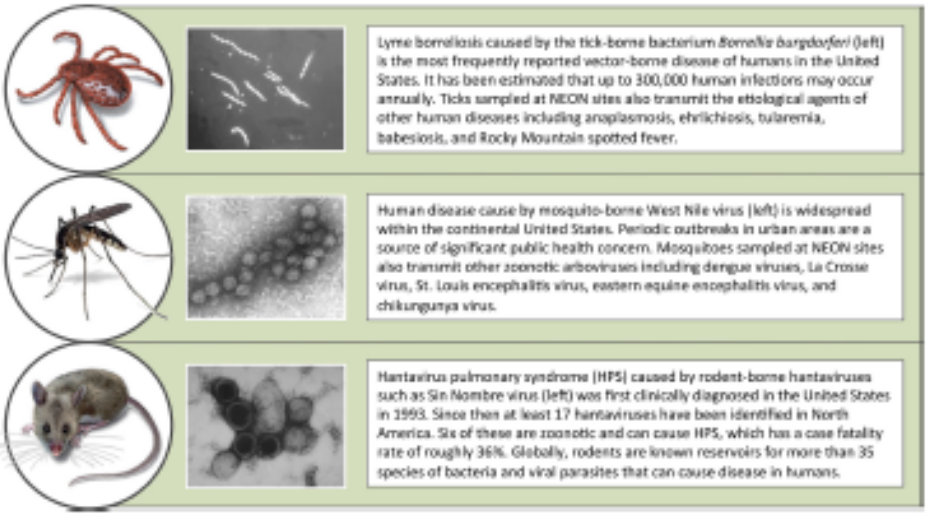
esa

ECOSPHERE

SPECIAL FEATURE: NEON DESIGN

Tick-, mosquito-, and rodent-borne parasite sampling designs for the National Ecological Observatory Network





Lyme borreliosis caused by the tick-borne bacterium *Borrelia burgdorferi* (left) is the most frequently reported vector-borne disease of humans in the United States. It has been estimated that up to 300,000 human infections may occur annually. Ticks sampled at NEON sites also transmit the etiological agents of other human diseases including anaplasmosis, ehrlichiosis, tularemia, babesiosis, and Rocky Mountain spotted fever.

Human disease cause by mosquito-borne West Nile virus (left) is widespread within the continental United States. Periodic outbreaks in urban areas are a source of significant public health concern. Mosquitoes sampled at NEON sites also transmit other zoonotic arboviruses including dengue viruses, La Crosse virus, St. Louis encephalitis virus, eastern equine encephalitis virus, and chikungunya virus.

Hantavirus pulmonary syndrome (HPS) caused by rodent-borne hantaviruses such as Sin Nombre virus (left) was first clinically diagnosed in the United States in 1993. Since then at least 17 hantaviruses have been identified in North America. Six of these are zoonotic and can cause HPS, which has a case fatality rate of roughly 36%. Globally, rodents are known reservoirs for more than 35 species of bacteria and viral parasites that can cause disease in humans.

The need to integrate social dynamics

Springer et al. 2016

Final conclusion

- Importance of domestic animals for Planetary Health
- Ecology and Evolution for « One Health »
- Share knowledge (and representations) for “better” political actions
- Observatories (local / global)

Thank you, merci !