Bushmeat infections
a manifold wildlife conservation argument

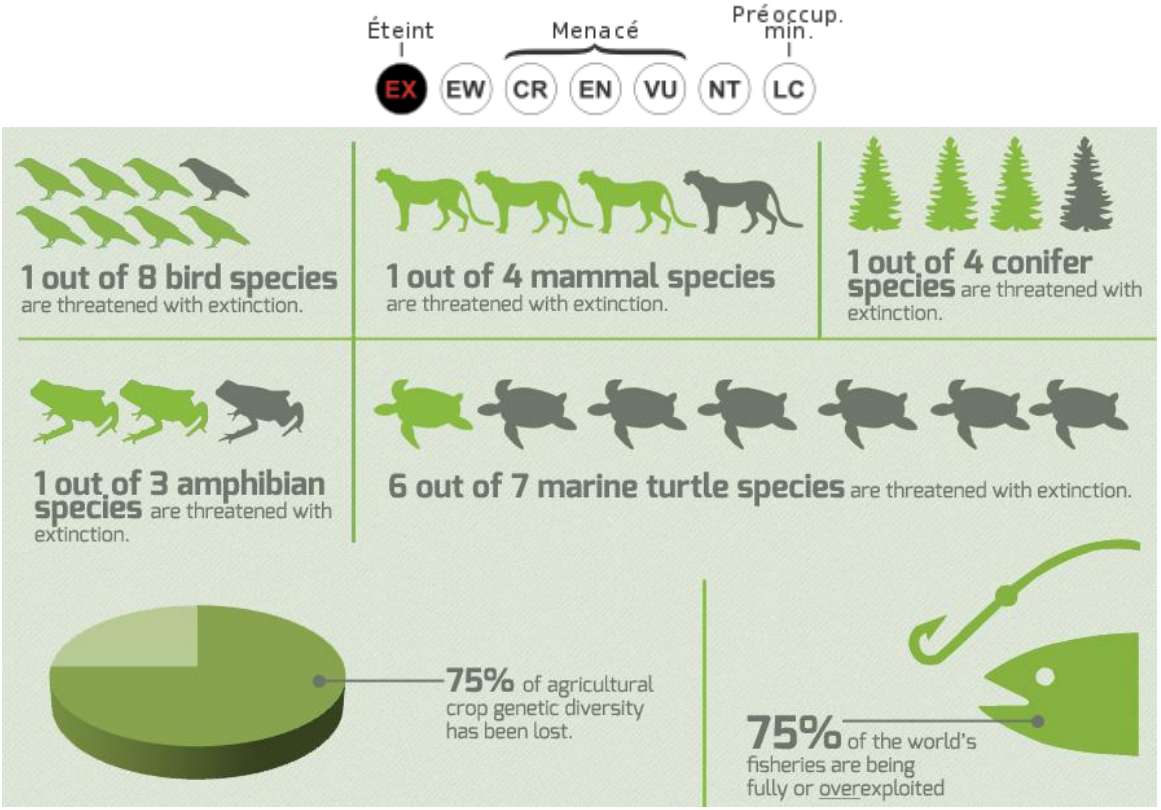
DR ANNE LAUDISOIT

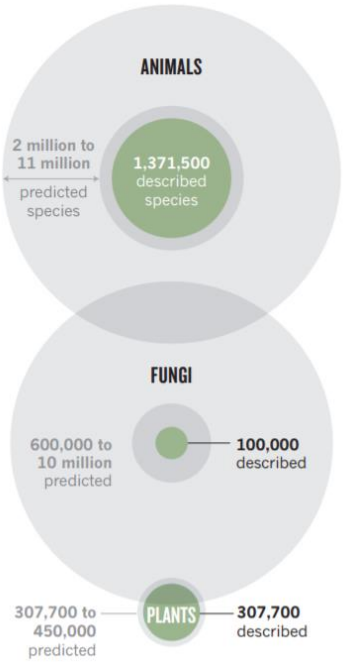
“If we could deal
with the trade in wildlife and deforestation
we wouldn’t need to stop an outbreak,
we would have already dealt with it.”

Peter Daszak, Ecohealth Alliance president

Biodiversity loss…
towards a 6th mass extinction ?

Since 1500, estimated 800 extinct





A mass extinction is estimated to cause 75% species to disappear

Monastersky, 2014. Nature reports.

SPECIES EXTINCTION#1

Steller's Sea Cow (*Hydrodamalis gigas*)

We cannot deny we dit it…oh, yes we can…

Let's blame it on sea urchins…mmm, it is us anyway.

Giant dugongid sirenian (750 cm, 4500–5900 kg)

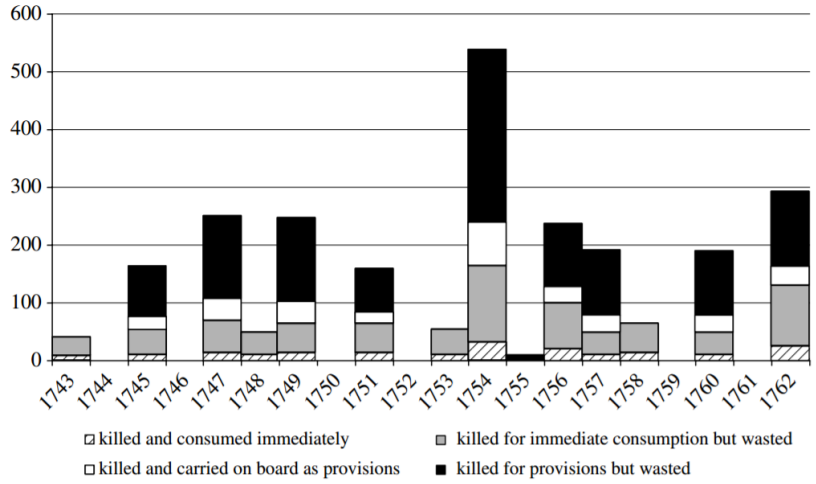
Discovered in 1741 after a ship wreck,
Estimated 1500-2000 specimen left

EXTINCT by 1768

27 YEARS of hunting for meat and fur

Associated with sea otter hunting for fur…

(Estes et al, 2016)



Turvey and Risley (2006)

We triggered the loss of interactions associated with keystone species.

SPECIES EXTINCTION#2

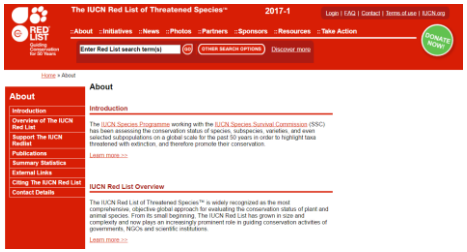
In case you don't care yet
tomorrow, maybe no fries…
It happened to others before….

The Great Potato Famine in Ireland is a prime example of the importance of genetic variety and biodiversity.

The famine devastated Ireland's population and economy between **1845** and **1852**.

one in eight Irish people died of starvation in three years during the Great Famine

The Irish depended on a single variety of potato, **"lumper"**, for most of their diet. A single infestation was able to spread quickly and wipe out large percentages of their food supply because of this lack of biodiversity within their crops.



Classical RED LIST

Theoretical use and trade regulation of listed species by the CITES

Global approach for evaluating the conservation status of plants and animals

SPECIES classified along a scale

Unassessed ➔ usually small, unfashionable species….

Data deficient (DD) ➔ should do, should do,…

Least concern (LC) ➔ assessed and doing well, widespread

Near threatened (NT) ➔ assessed…could do better…

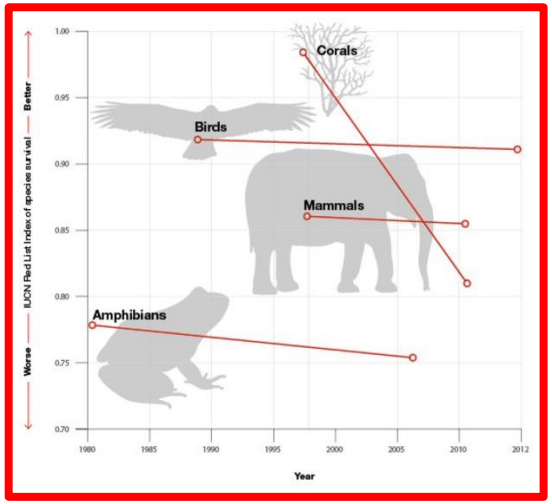
Vulnerable (VU) ➔ assessed and facing troubles

Endangered (EN) ➔ assessed and facing big troubles

Endangered (CR) ➔ assessed and facing very big troubles

Extinct in the wild (EW) ➔ nearly too late…

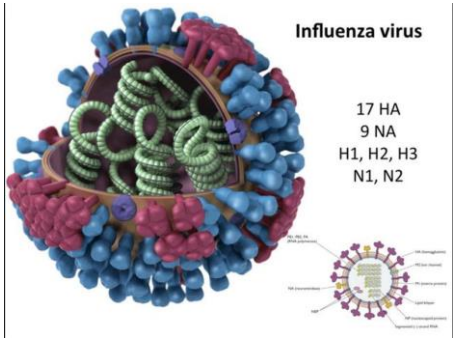
Extinct (EX) ➔ nope, too late…



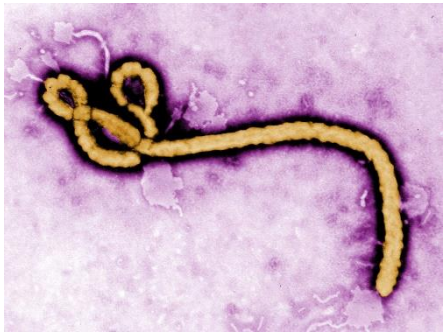
Another RED LIST ?

What about the diversity of pathogenic agents ?

LEAST CONCERN



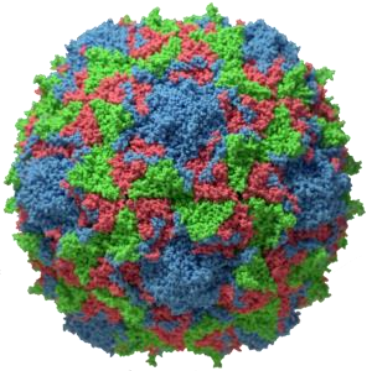
DATA DEFICIENT



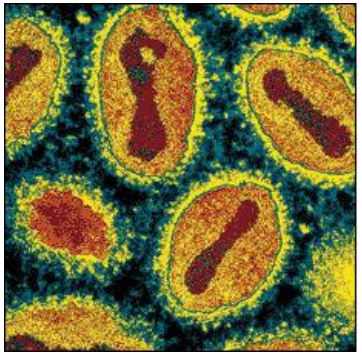
VULNERABLE

NEAR THEATENED

CRITICALLY ENDANGERED

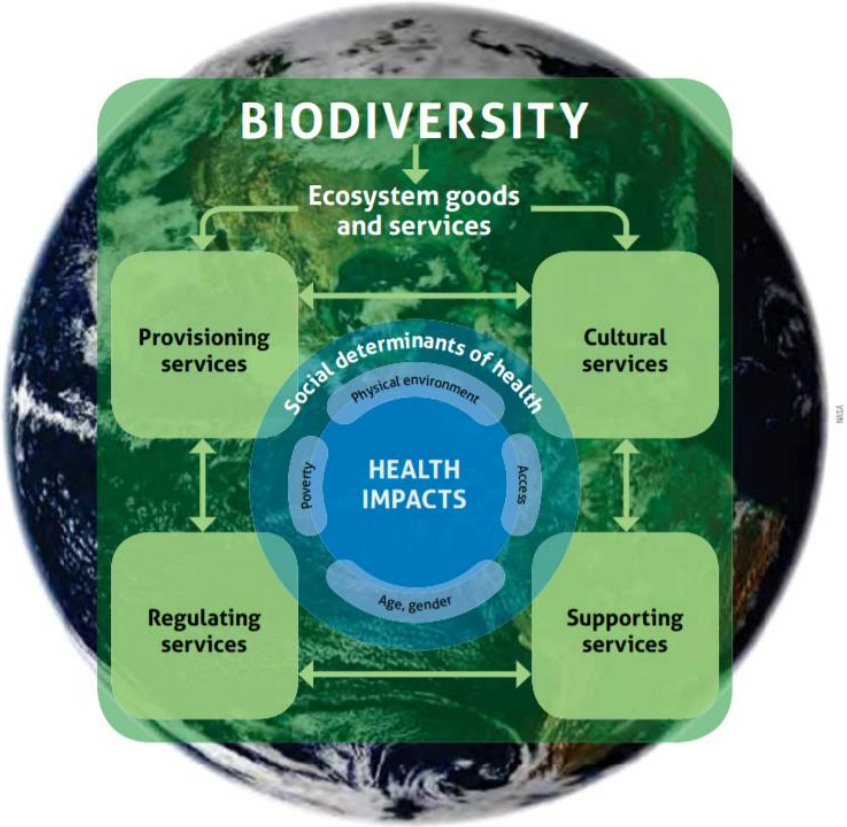


EXTINCT IN THE WILD



Ecosystem services

direct and indirect benefits yielded by biodiversity to ecosystems that support human and societal needs



WE decide to PROTECT ELEPHANTS
WE decide to EAT or NOT a SPECIES
WE decide to KILL MOSQUITOES
WE decide to ERADICATE a MICROORGANISM

WE DECIDE WHAT IS GOOD FOR US !

➔ **SPATIAL AND TEMPORAL SCALES…**

WE ASSESS THE USEFULNESS OF SPECIES

and HABITATS WORTH PRESERVING…

ANTHROPOCENTRIST APPROACH !!!

PUBLIC HEALTH ORIENTED ?

ECONOMY ORIENTED ?

Impact of EZD on wildlife

AESTETICAL and MORAL CONCERN

Do gorillas need the Ebola vaccine too? Virus has wiped out a THIRD of chimps and gorillas since the 1990s

- Virus is deadly for great apes, with mortality rates approximately 95 per cent for gorillas and 77 per cent for chimpanzees
- Current estimates suggest a third of the world's gorillas and chimpanzees have died from Ebola since the 1990s
- There are up to 100,000 left in the wild – so a single Ebola outbreak wipes out a considerable chunk of the world's gorilla population

Mass deaths of saiga antelope in Kazakhstan caused by bacteria

Almost total decimation of Betpak-Dala's population of 200,000 saiga antelopes in 2015 caused by pathogen that led to hemorrhagic septicemia, say scientists

Saiga antelope in 2011, before the mass deaths of 2015. Photograph: Anatoly Ustinenko/AFP/Getty Images

The mysterious mass deaths of about 200,000 saiga antelopes in Kazakhstan last year was caused by a bacterial infection.

As news emerged in May last year of the near-total decimation of the Betpak-Dala population of saiga antelope, there was plenty of speculation but few concrete

I - RESUME DE LA SITUATION

- Confirmation d'une épizootie de Monkeypox au Cameroun le 17/08/2016 dans le Parc National de la Mefou, Région du Centre ;
- Dernière flambée enregistrée en juin 2014 dans les villages de Mbinang et Minta, Région du Centre
- Au total 08 chimpanzés malades sur 23 dans le secteur SIVAN avec 02 décès, 02 guéris et 04 encore en cours de traitement;
- Aucun cas de contamination humaine détecté à ce jour ;
- 43 personnes exposées ont été suivies dont 37 sorties du suivi après 17 jours de post-exposition ;

Mass bird die-off observed off Florida Coast, sick birds found bleeding from the mouth

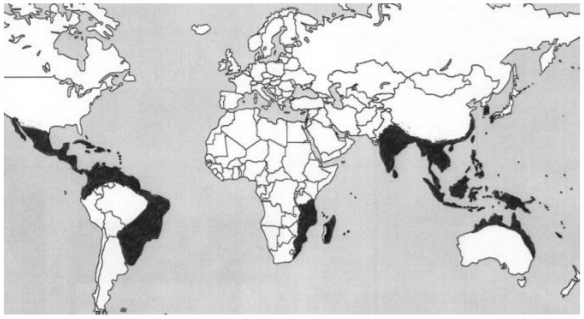
Thursday, May 25, 2017 by: Vicki Batts
Tags: bird deaths, Die Off, Florida, marine life

3,440 VIEWS

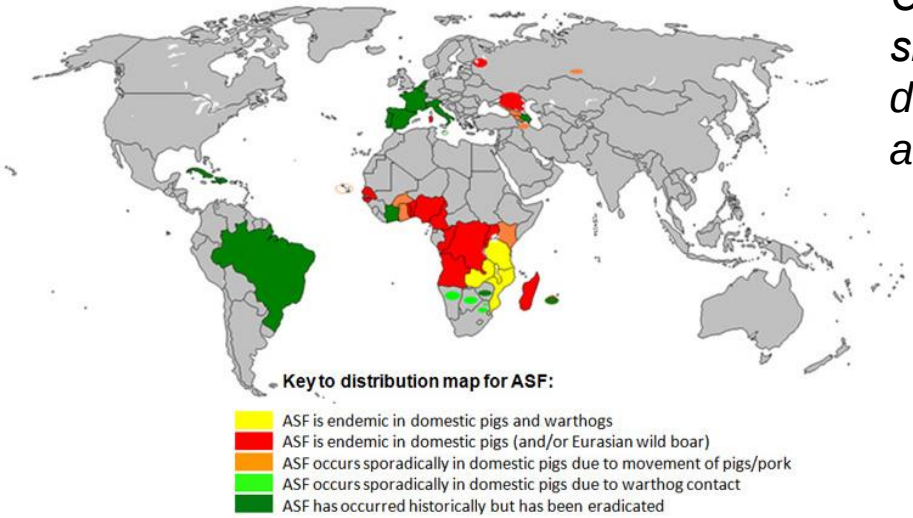
Protecting Black-Footed Ferrets and Prairie Dogs Against Sylvatic Plague

Once presumed to be extinct, a wild population of ferrets was discovered in 1981 in Wyoming. Unfortunately, this last colony succumbed to disease, but not before it provided a few animals to start a captive breeding effort that to date has produced over 7,000 young. Six facilities now maintain separate, intensively managed, captive ferret populations totaling around 290 animals.

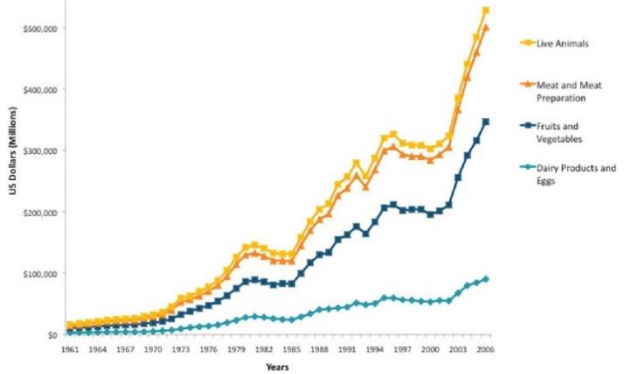
Impact of EZD on domestic animals
ECONOMICAL and POLITICAL CONCERN

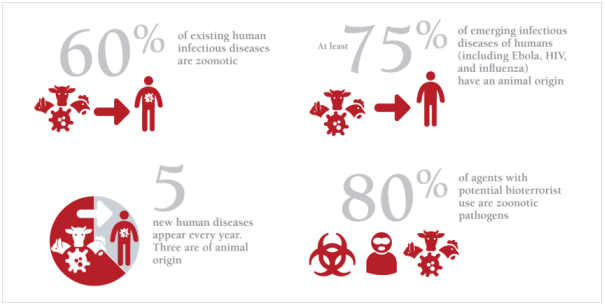


Babesia and Anaplasma
In ticks of import cattle
(Ripicephalus microplus)

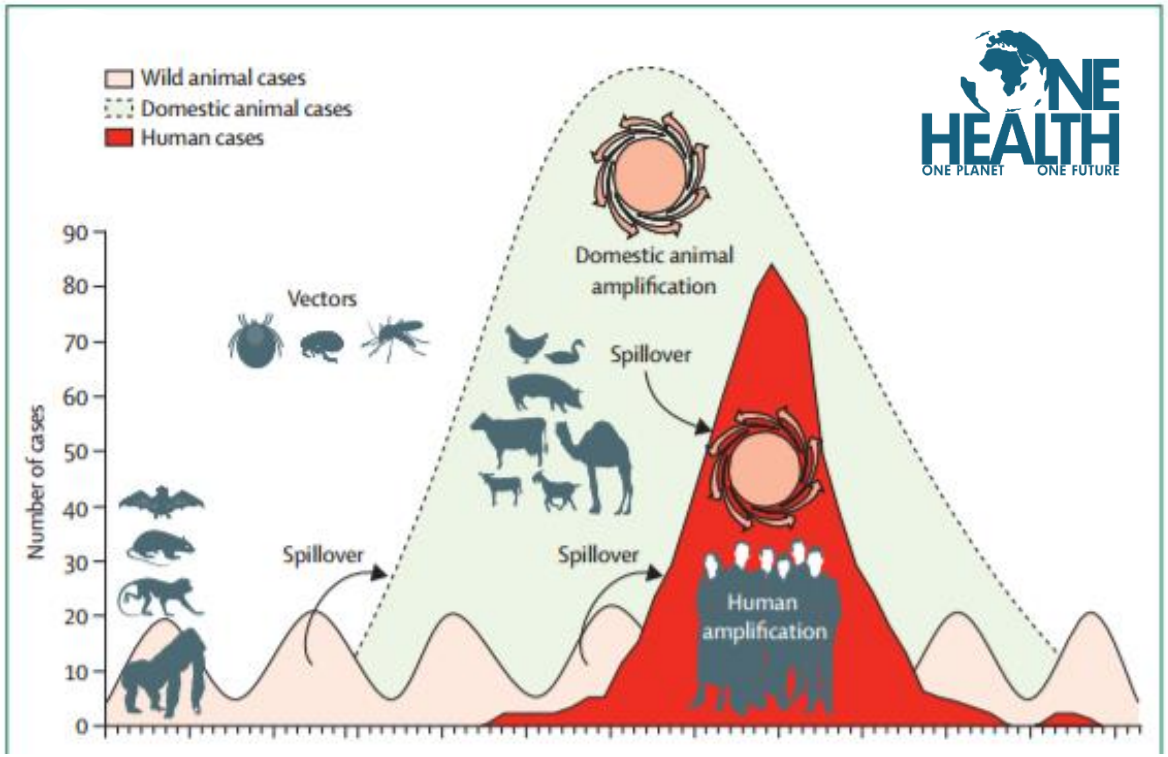


Coordinated interventions, including "test and slaughter," feed bans, mass vaccination of domestic animals and wildlife, health education and milk pasteurization





WE ARE ALL CONNECTED…



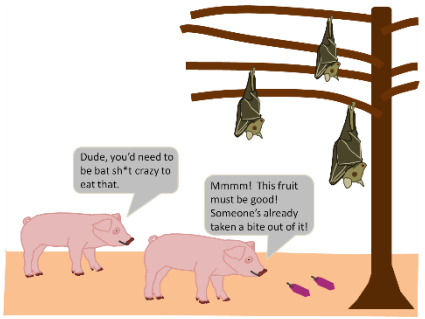
- Population growth
- (mono)Agricultural expansion
- Urban expansion
- Migration
- Pressure from export markets

DEFORESTATION
FOREST DEGRADATION
HABITAT CONVERSION
BIODIVERSITY LOSS
SPECIES RANGE SHIFTS

Karesh et al, 2005. EcoHealth

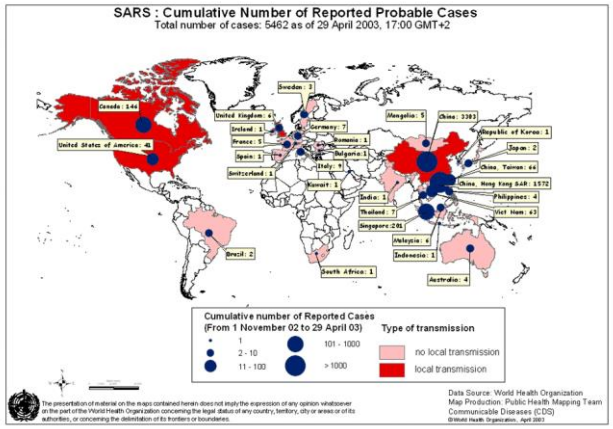
A LOCAL RISK CAN BECOME GLOBAL

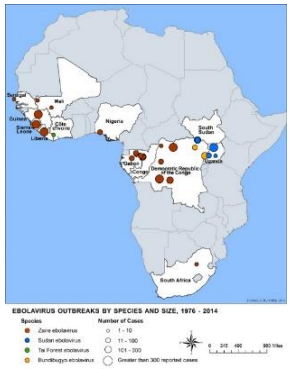
All concerned by future epidemics
even if they emerge from the far far bush

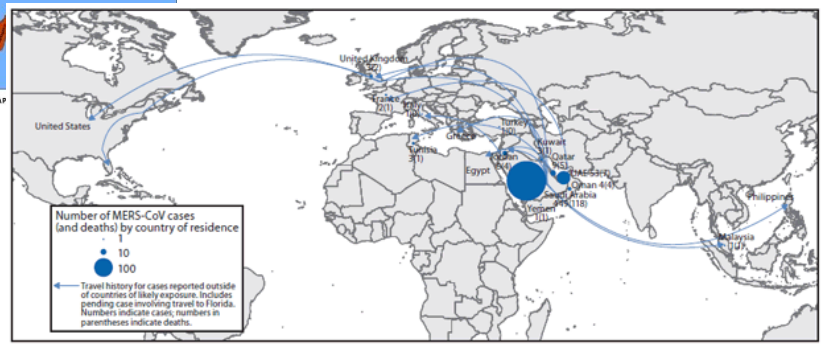


The WHO's top 8 list of diseases likely to cause severe epidemics

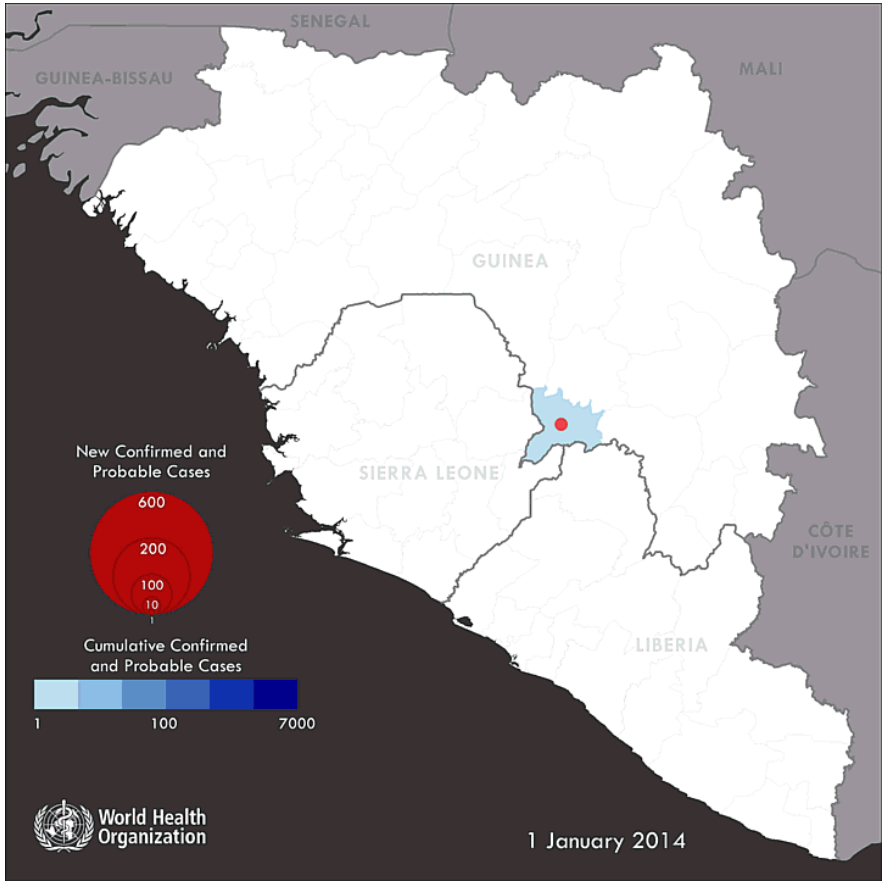
Crimean-Congo haemorrhagic fever
Ebola
Marburg
Lassa fever
MERS
SARS
Nipah
Rift Valley fever







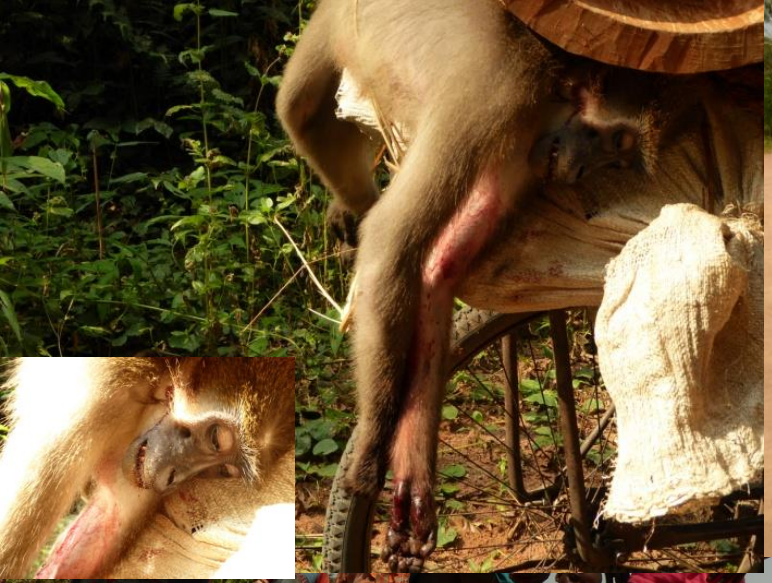
EBOLA 2014-2016
INTERHUMAN TRANSMISSION



" With a large expansion of the outbreak, and Ebola spreading to other countries in the region, children would lose their providers, households would suffer losses to their income, businesses would lose workers to death, illness, and fear, and industries like mining and agriculture would slow down significantly "

David Evans

Senior Economist at the World Bank and co-author of the report





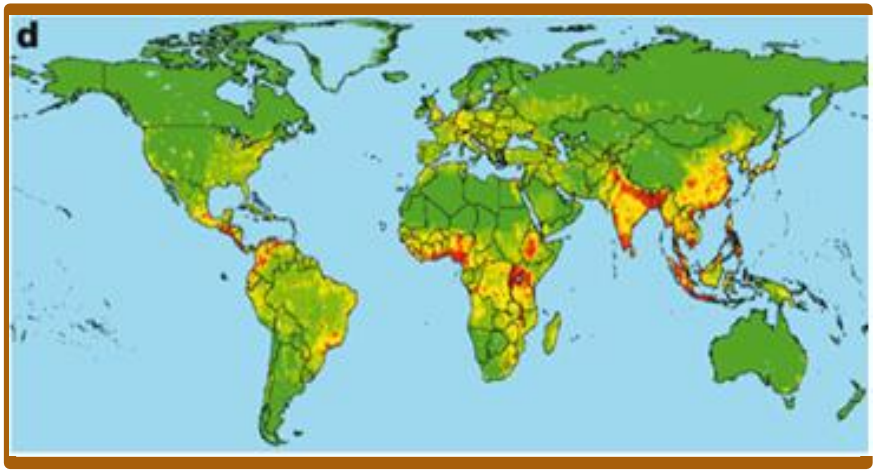

Global distribution of relative risk of an EZD event

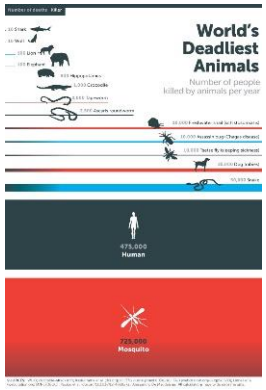
Proxy map of human activity (deforestation/landuse due to yield gaps)

Proxy map of initial pool and prevalence of pathogens in wildlife

Zoonotic pathogens from wildlife

Vector-borne pathogens



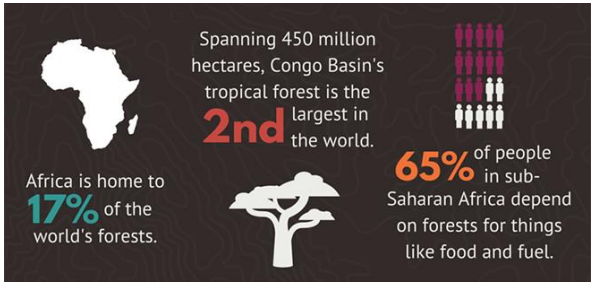


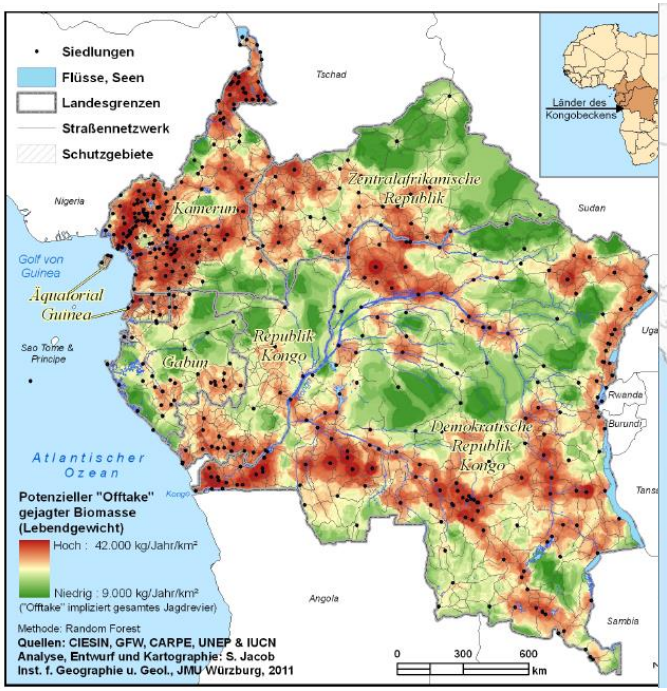
More likely to appear in lower-latitude developing countries

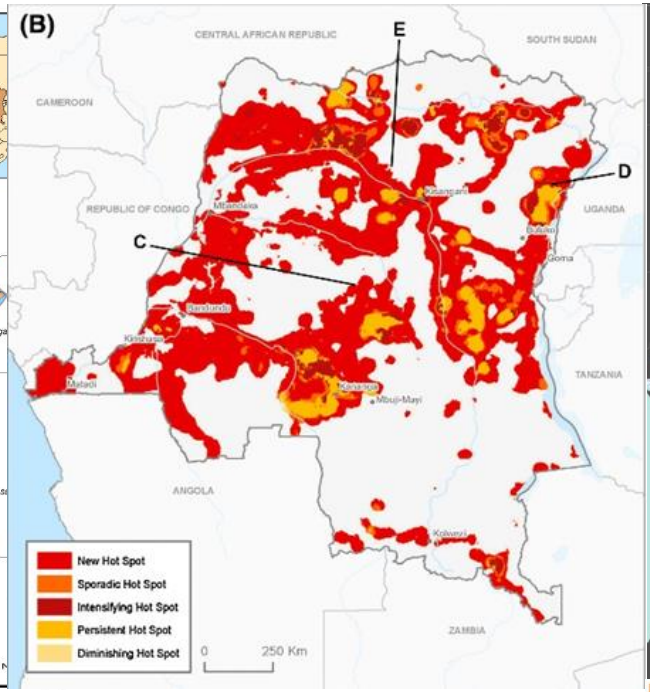
Jones et al, 2008. Nature.

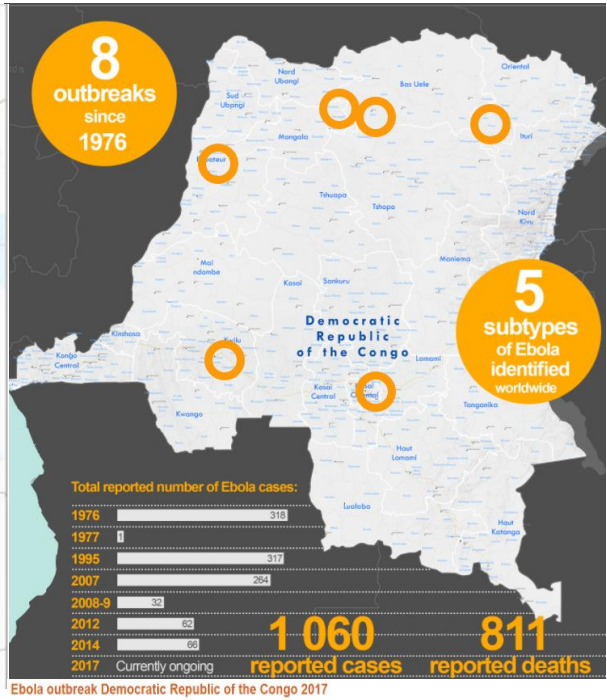
Deforestation and Fragmentation

50 millions forest fragments on earth
50 millions kilometer of edges
50 millions kilometer human-animal interface









Ebola outbreak Democratic Republic of the Congo 2017

Logging, bushmeat extraction and Ebola in the DRCongo

TRAFFIC

Trade Records Analysis of Flora and Fauna in Commerce

- **+++ increase in bushmeat consumption +++ urban demand**
- **Central Africa : 1–3.4 million tons /year**
- Legal trade of wildlife products **into the EU estimated** at €100 billion €/300 billion $US (2005)
  - ➔ exotic pets, skins, shells of non CITES-species

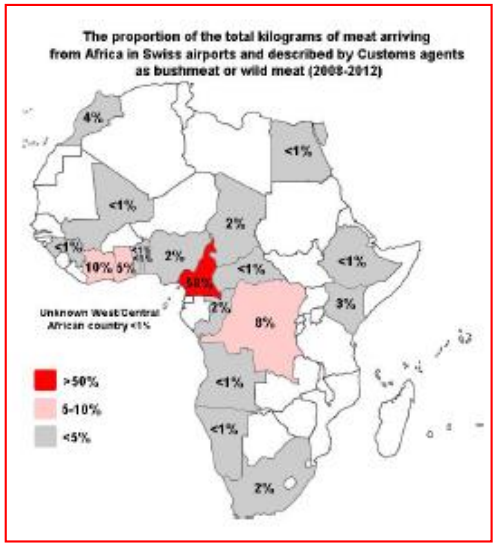
BUT +++ ILLEGAL … NOT really possible to assess…

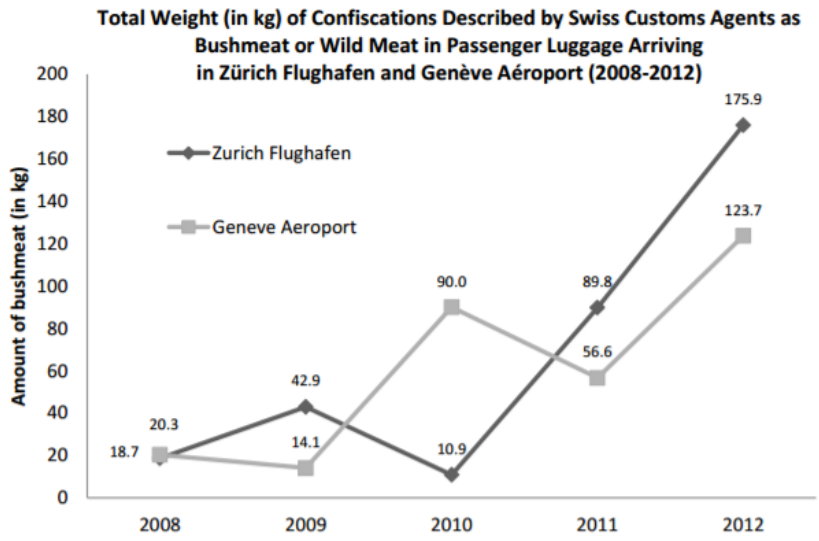
Estimated at 1/3 (33%) of legal traffic, so 30-100 billion $US

BUSHMEAT MUST BE ILLEGALY IMPORTED (smuggled) into Europe

➔ Cargo, Passenger luggage, Boat

Spatial and temporal nuance in the relationship between biodiversity loss, emerging zoonotic diseases (EZD) wildlife trade and bushmeat imports





+++ Cameroon (91.3%)
Bushmeat : *Cephalophus, Cercopithecus, Potamocherus*

In Switzerland , bushmeat imports are X2/year
In Paris, 273 tons/year !!!

ORIGIN : AFRICA +++ in Brussels, Switzerland, Paris, or the US airports.
DRCongo, Cameroon, Central African Republic, Ghana, Nigeria, Cameroon Ivory Coast, Togo

Spatial and temporal nuance in the relationship between biodiversity loss, emerging zoonotic diseases (EZD) transport, transit and travels…

PER DAY

- **around 80 0000 flights worldwide**
- **8 million people (=150 000 – 500 000 at any given time in the air)**
- **around 300 000 luggage lost (No, you're not the only one !)**

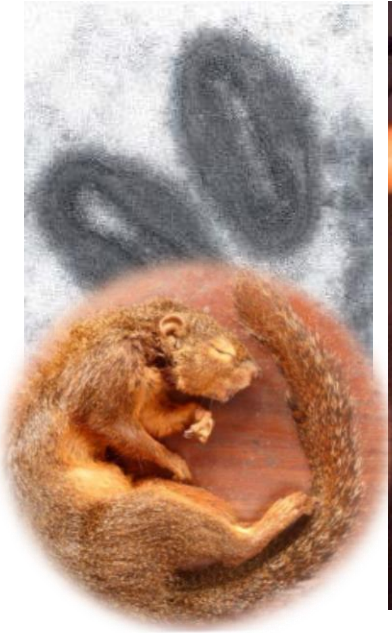
Brussels Airport-Zaventem

- major transit point of flights from Africa
- hub for the distribution of bushmeat inside Europe ?

WHY IS IS STILL POSSIBLE IN 2017 ? WHAT IS MISSING ?

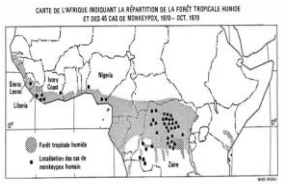
MONKEYPOX virus

A case study at various levels…

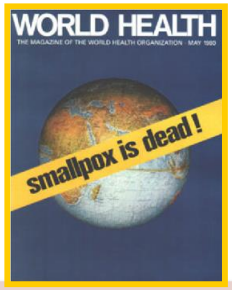


Discovery of Monkeypox virus and emergence of human monkeypox

1958
Monkeys



1977
Smallpox last case



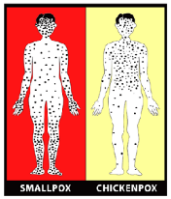
1985
Isolation Sick squirrel

1996-1997
EPIDEMIC
624 cases
VZV + MPX

1970
1st HMPX DRCongo
1970-79
59 cases,
6 countries

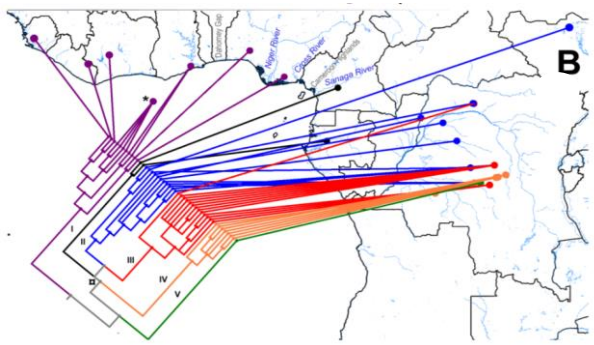
8 MAY1980
Surveillance of HMPX in DRCongo

1980-1986
404 cases
VZV + MPX
STOP surveillance



2005-2007
Active surveillance
760 cases

N cases : X250-fold



Nakazawa et al, 2015Viruses doi:10.3390/v7042168

N	COUNTRY	FIRST CASE	LAST CASE
1	Cameroon	1979	2016 (NHP)
2	Central African Republic	1984	2016
3	**Democratic Republic of Congo**	**1970***	**2016**
4	Gabon	1991	1991
5	Ivory Coast	1971	2012 (NHP)
6	Liberia	1970	1970
7	Nigeria	1971	1978
8	**Republic of Congo**	**(1982) 2003**	**2011 (IDP)**
9	Sierra Leone	1970*	1970
10	Soudan	2005	2005

**PDI : internally displaced people (refugees of DRCongo) ; NHP :non human primates*

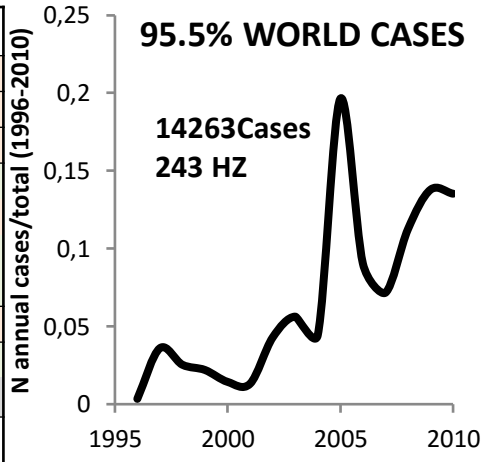
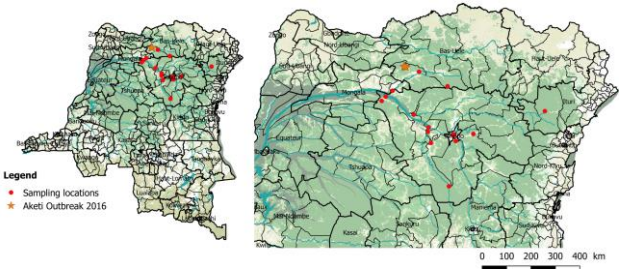


ILLUSTRATION
Neccessity to be « ONE HEALTH »
Monkeypox virus transmission



PRIMARY HOST
RESERVOIR ?
Still looking…

ACCIDENTAL HOST

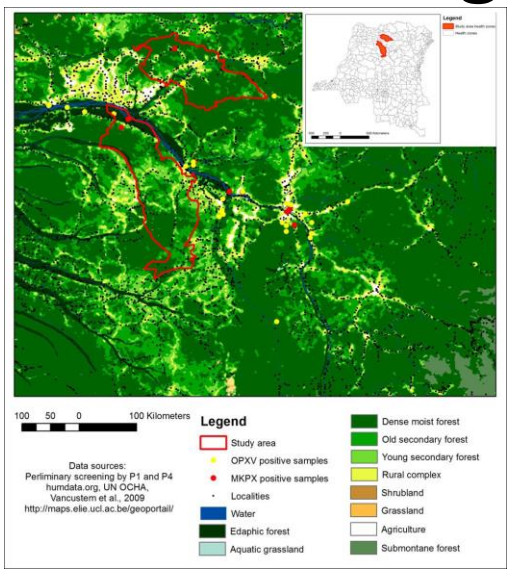
BUSHMEAT
HOME
MARKET
EXPORT

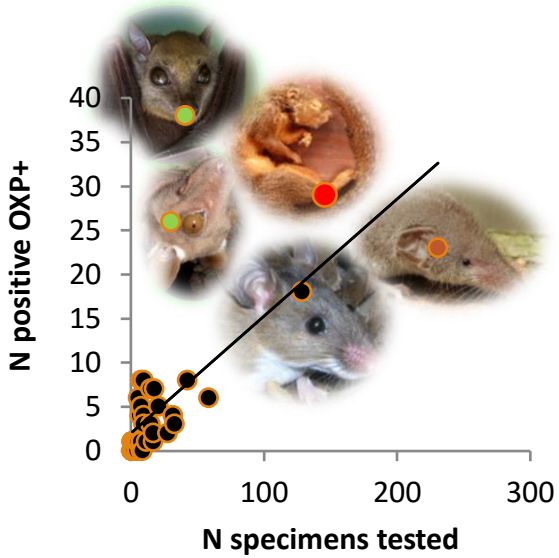
PRIMARY CASE

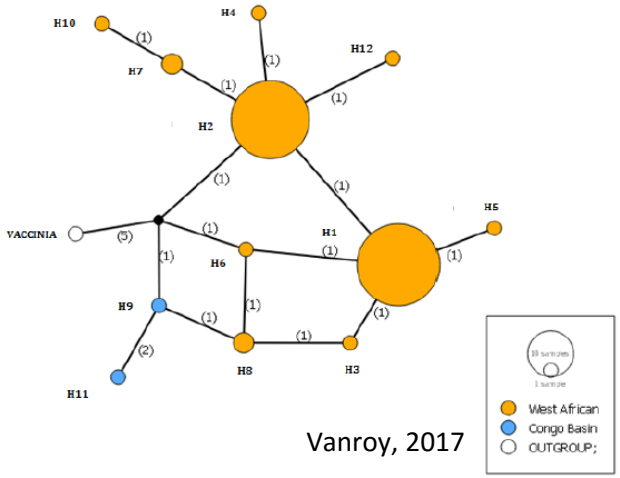
CO-PRIMARY

SECONDARY CASES

Current on-going Monkeypox research in the DRCongo (Laudisoit et al, in prep)







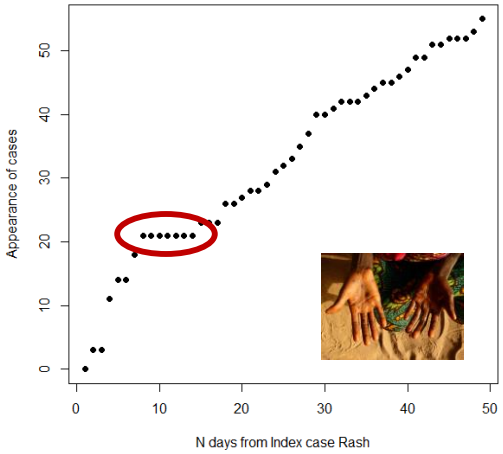
Vanroy, 2017

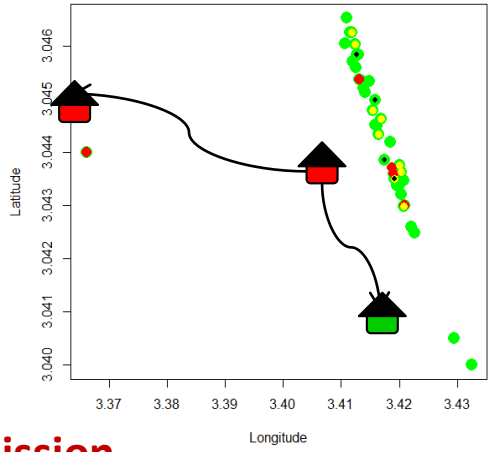
- ±10% MPX-HA POSITIVE (ADN)
- Wide host tropism :reservoirS ?
- Sympatric clades
- WA-clade

⇒ Sproadic cases

- CB-clade

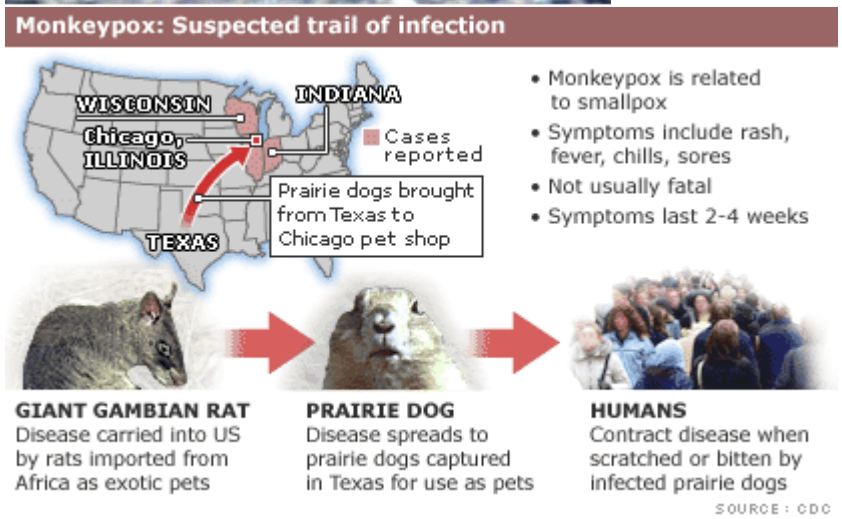
⇒ Epidemics ($R_0$1980=0.6-0.8 ➔ $R_0$2016=6-8)

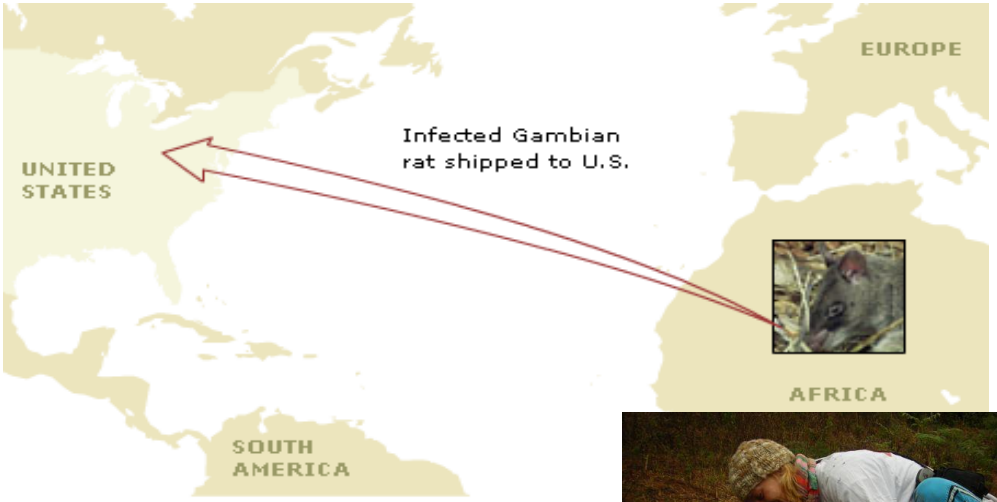




Longer chain of transmission

MONKEYPOX
USA, June 2003
71 cases

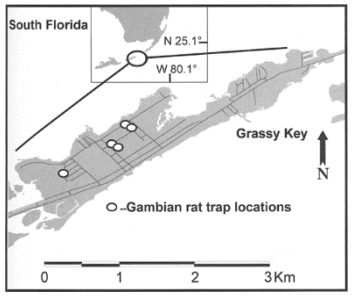




UNCONTROLLED PET TRADE

and INVASIVE SPECIES

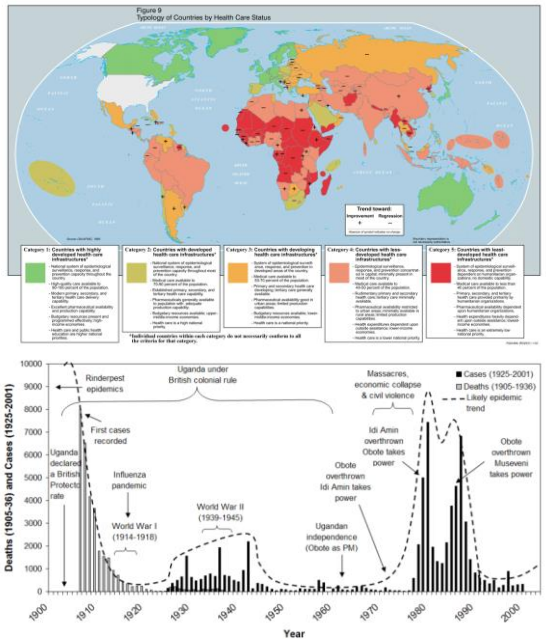
Cricetomys have now successfully colonized a limited area of Florida …

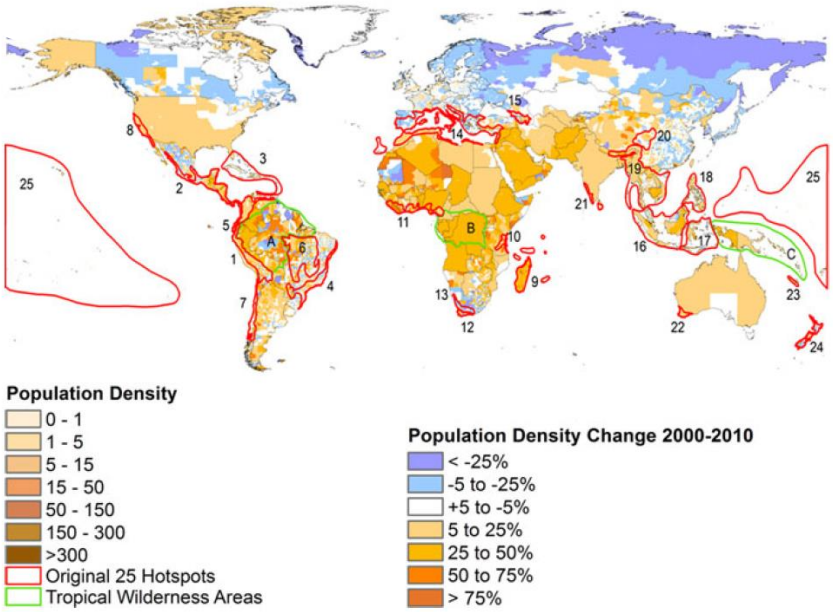


POPULATION GROWTH in BIODIVERSITY HOTSPOTS and WILDERNESS TROPICAL AREAS (WTA)

YEAR 1995 : 1 billion people = 19 % pop.
YEAR 2010 : 1.6 billion people = 23 % pop.

- **high growth,**
- **high density**
- **+++poverty**
- **armed conflict**
- **political instability**
- **poor health system**





➔ **Increase in vulnerability to emerging zoonotic infectious diseases…**

Williams, 2013. Popul Environ 34:510–523

MANIFOLD and GLOBAL

EZD from bushmeat should change a series of ways research is carried out and funded :

- Collaboration between MoH, research institutes, Universities
- Transdisciplinarity of research teams
- Public access to epidemiological data
- Broadcasting and vulgarization

- R&D of tools and equipment to monitor wildlife
- Different funding process : longterm studies required …

➔ Natural transport (phoresy) and travel (migration) of carrier species

- research capacities to generate baseline data

➔ What is the pool of pathogen in wildlife?

➔ What seasonality ?

MANIFOLD and GLOBAL

EZD from bushmeat affect the and are affected by not only the health of societies but also their

- public and veterinary health care and inspection policies
- preparedness to epidemics (detection and response)
- vaccines vs culling
- national and international demand in wildlife/wood products
- trade agreements (timber and wildlife) and crime

➔ **need to deal with the ILLEGAL NATURE OF THE TRADE**

CITES : focus on « TRADE »

➔ NEED FOR A MORE «ECOSYSTEM CENTERED» APPROACH

➔WHAT ABOUT THE SPECIES ENDANGERING the endangered…?

All the above are function of political and economic stability and more than anything else willingness…

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