

# Forests and public health: food, nutrition and diseases

Why forests matter...



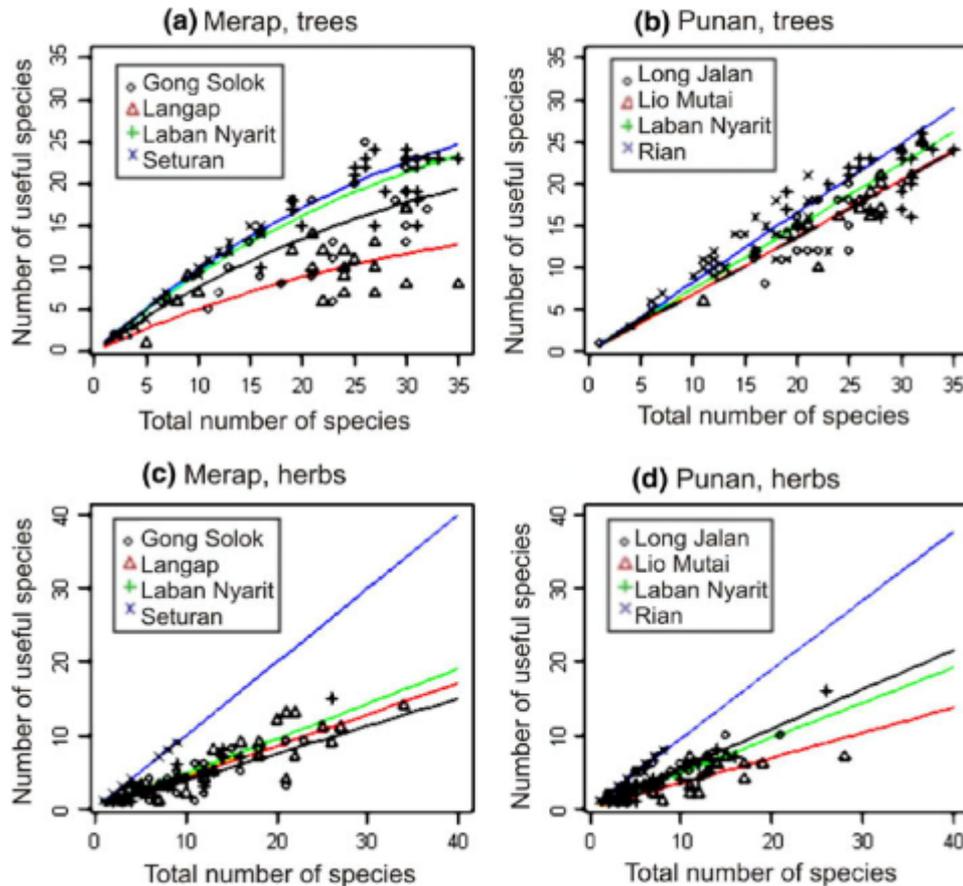
R. Nasi, J. E. Fa Brussels, Feb 2017



# Foods from the forests



# Useful (and non substitutable) species



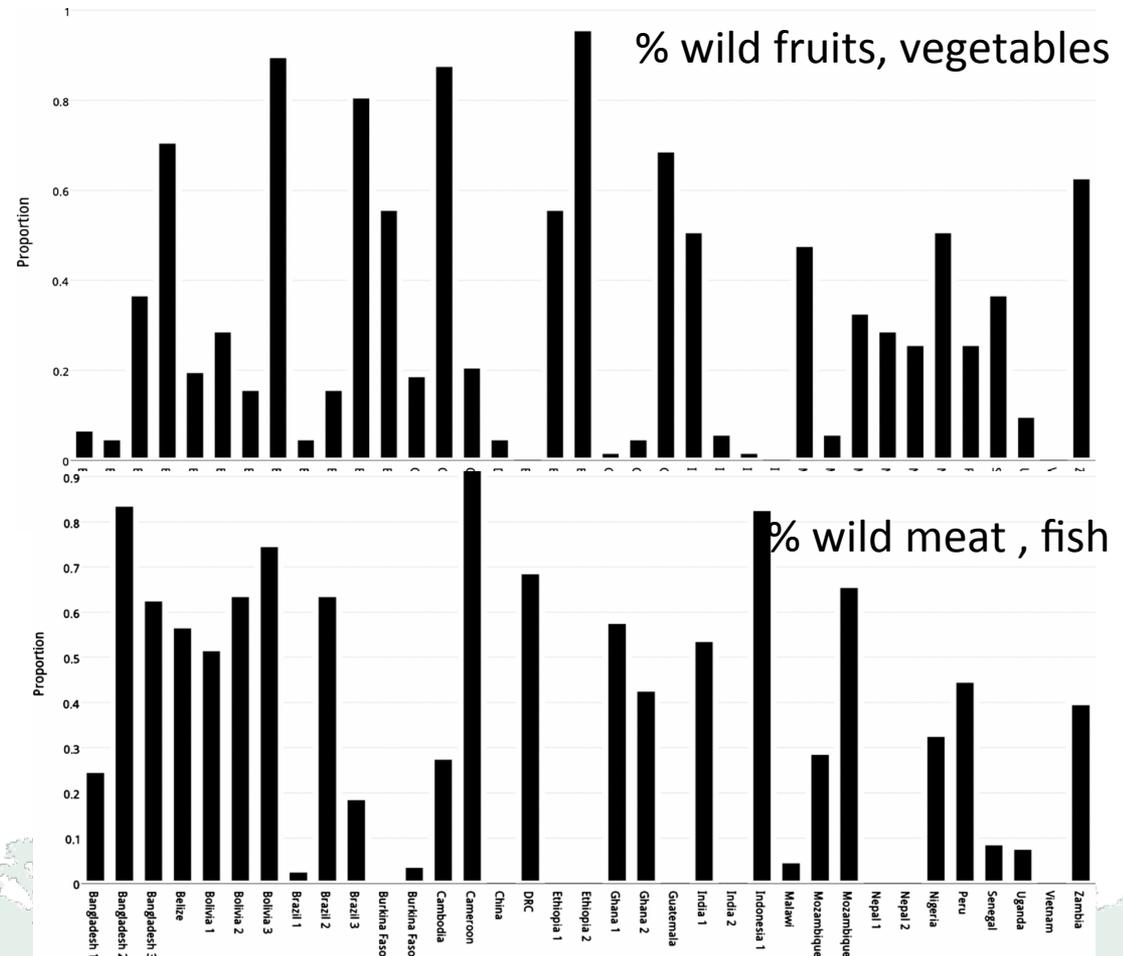
Number of useful species (excluding fuelwood) as a function of total number of species in forests in Kalimantan (Indonesian Borneo) - (Sheil and Salim, 2012)

# Forest foods and healthy diets: quantifying the contributions



- top quartile 14.8% of recommended amounts of fruits and vegetables, and 106% of meat and fish from forests.
- 13 sites, % of meat/fish from forests greater than from livestock/aquaculture,
- 11 sites, % fruits and vegetables from forests more than from agriculture

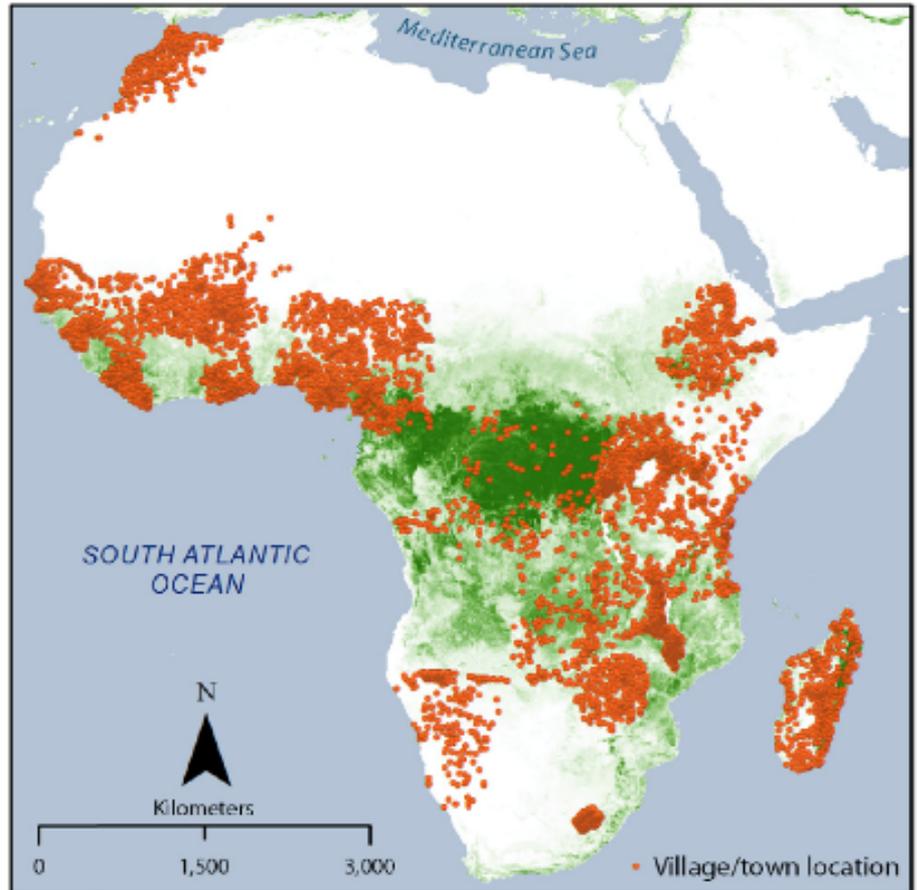
Rowland et al. 2016



# Dietary quality and tree cover

- There is a statistically significant **positive** relationship between % tree cover and **dietary diversity**
- **Fruit and vegetable consumption** first increases and then decreases with tree cover (peak tree cover is ca. 45%)
- There is **no** statistically significant relationship between tree cover and **animal source foods**

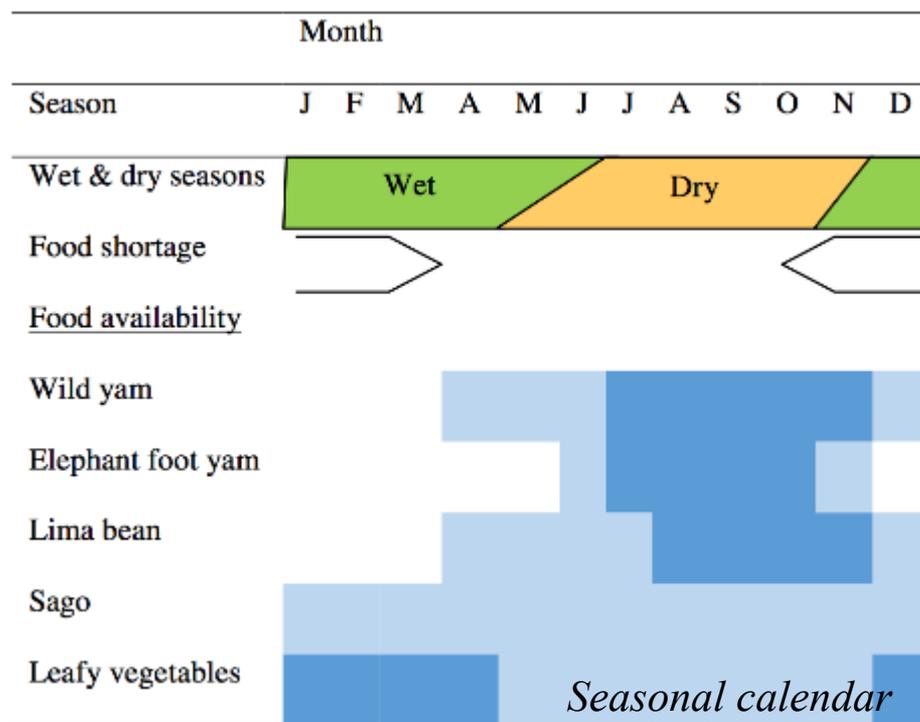
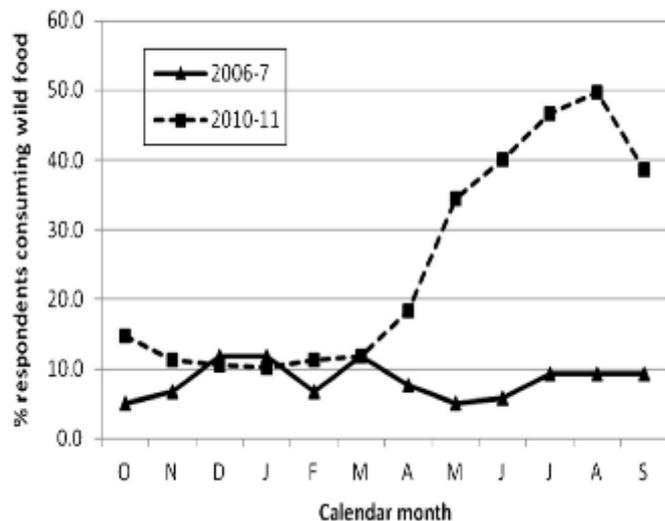
(Ickowitz et al. 2014 Global Environmental Change)



Location of study communities

# Coping Strategies

Wild food consumption



Example: Timor-Leste



## Wild animals as food





# What is so special about bushmeat?

- Economically significant
- Socially acceptable
- Largely non substitutable
- Gender differentiated
- Regulated but not controlled
- Poor's people businesses

## **BUT**

- Unsustainable
- Resource base is degraded or capital depleted
- State has no revenues
- Corruption reigns

→ **LOSE-LOSE situation, everyone lose!**

## Size of the issue



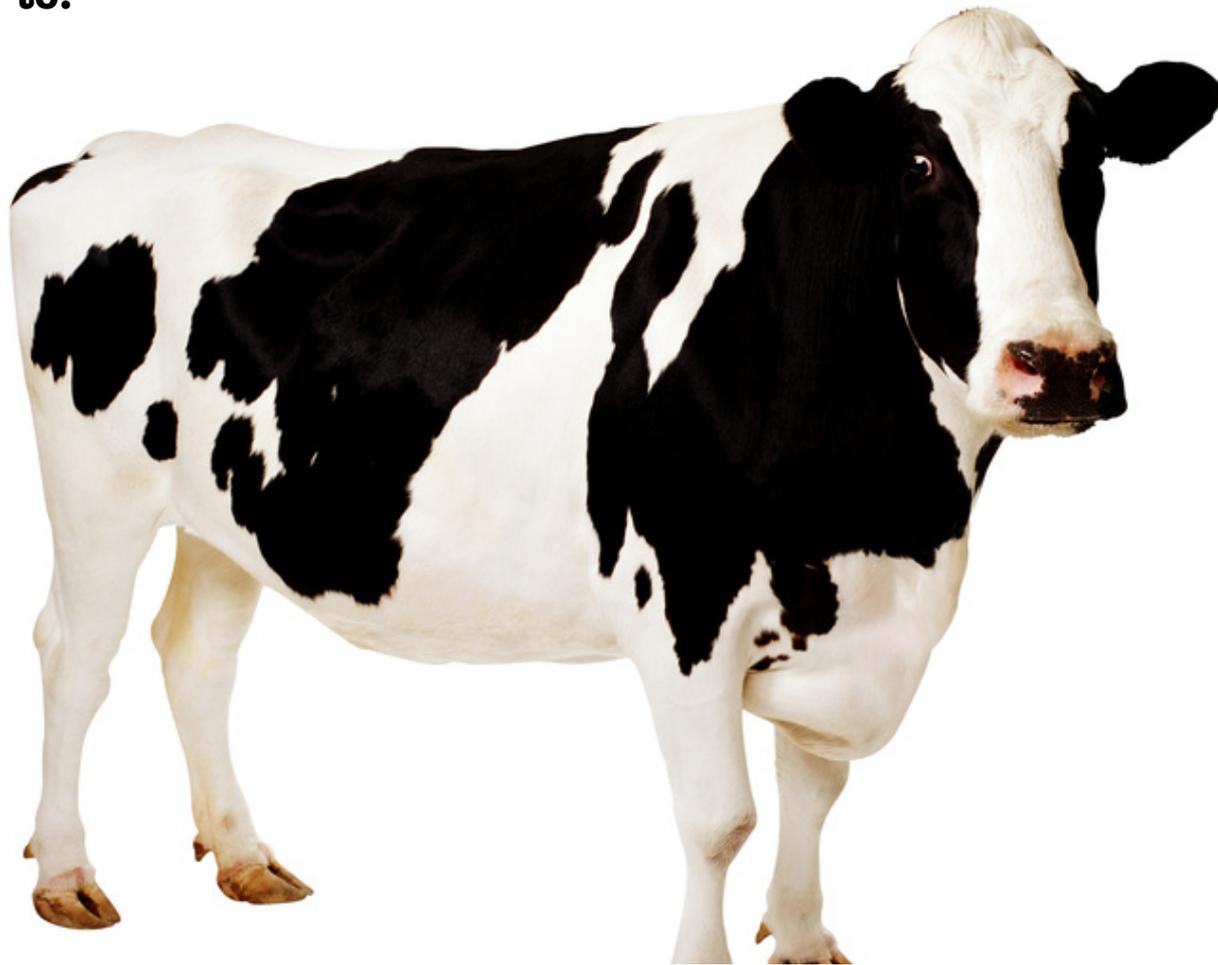
K. Ammann

In tonnes/meat/year

	Consumption	Extraction
Amazon	909,000	<b>1,299,000</b>
Congo	3,198,000	<b>4,569,000</b>

From Nasi et al. (2011)

**5 million tonnes/year of bushmeat in the Congo Basin is equivalent to:**

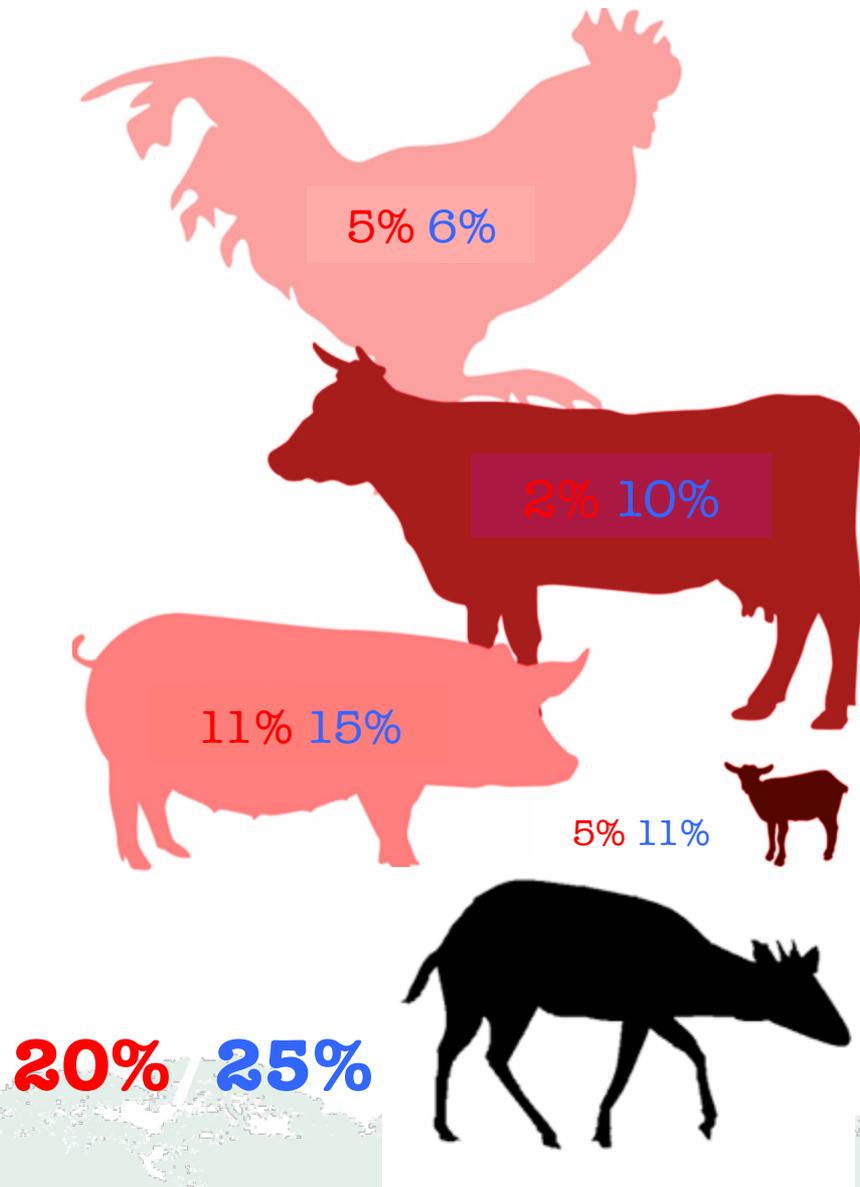


**15-20 million**



**2-2.5 billion**

## Bushmeat is regularly eaten often in low but significant quantities



**Example:** rural and urban children in Kisangani, DRC, report higher consumption of bushmeat than any other meat.

Rural/Urban

From: Van Vliet et al. (2012)

A broader view and understanding of the nutritional contribution made by wild meat and of the implications to humans and environment is necessary.

**“Realistically, if changes in attitude do not occur soon...a fitting epithet for the loss of [Sulawesi] endemic mammals and birds may be 'they tasted good'” (O'Brien & Kinnaird)**

**“You have to have at least one square meal a day to be an environmentalist” (Borlaug)**



**But**, what are the consequences on **food security** and **human nutrition** if wild meat resources are depleted?



## A protein gap?

Sustainable protein supply from bushmeat in the Congo Basin:

**6.5 - 13.0g/person/day** now

**0.4 - 0.8g/person/day** in 2050  
(given deforestation & population growth)

Overall protein supply will fall from about **85g** to **41g**/person/day by 2050, due to reductions in bushmeat availability. **This is 79% of the WHO recommended minimum of 52g/person/day.**



## A fat gap?

The suggestion from a study in Ecuador is that if wild meat and fish availability decreases, the most immediate and serious effect would not be a **reduction** in protein intake, but in **fat intake**.

Wild meat provides fat as well as protein. Fat is energy-rich, and contains vitamins. Dietary fat should supply at least 15-20% of the energy intake.



## A micronutrient gap?

In a study of children under 12 y of age in rural northeastern Madagascar, **consuming more wildlife** was associated with significantly **higher haemoglobin concentrations**.

Removing access to wildlife would induce a **29% increase** in the numbers of children suffering from anemia and a tripling of anaemia cases among children in the poorest households.

# Gender issues

- Plays a disproportionately important role in the livelihoods and well-being of women (and children)
- Women play an important role in the different value chains of these products and derive crucial income from the sales
- Women generally invest back their income into household food and wellbeing; men more into non essential goods



# Pygmy – non Pygmy issues

## Pygmies

HR

$20.4 \pm 23.2$  ind.  $P^{-1} Yr^{-1}$

$376.3 \pm 515.1$  kg  $P^{-1} Yr^{-1}$

ER

$87.9 \pm 109.9$  ind.  $H^{-1} Yr^{-1}$

$1646.6 \pm 2095.7$  kg  $H^{-1} Yr^{-1}$



## Non-Pygmies

HR

$39.5 \pm 66.9$  ind.  $P^{-1} Yr^{-1}$

$307.0 \pm 450.6$  kg  $P^{-1} Yr^{-1}$

ER

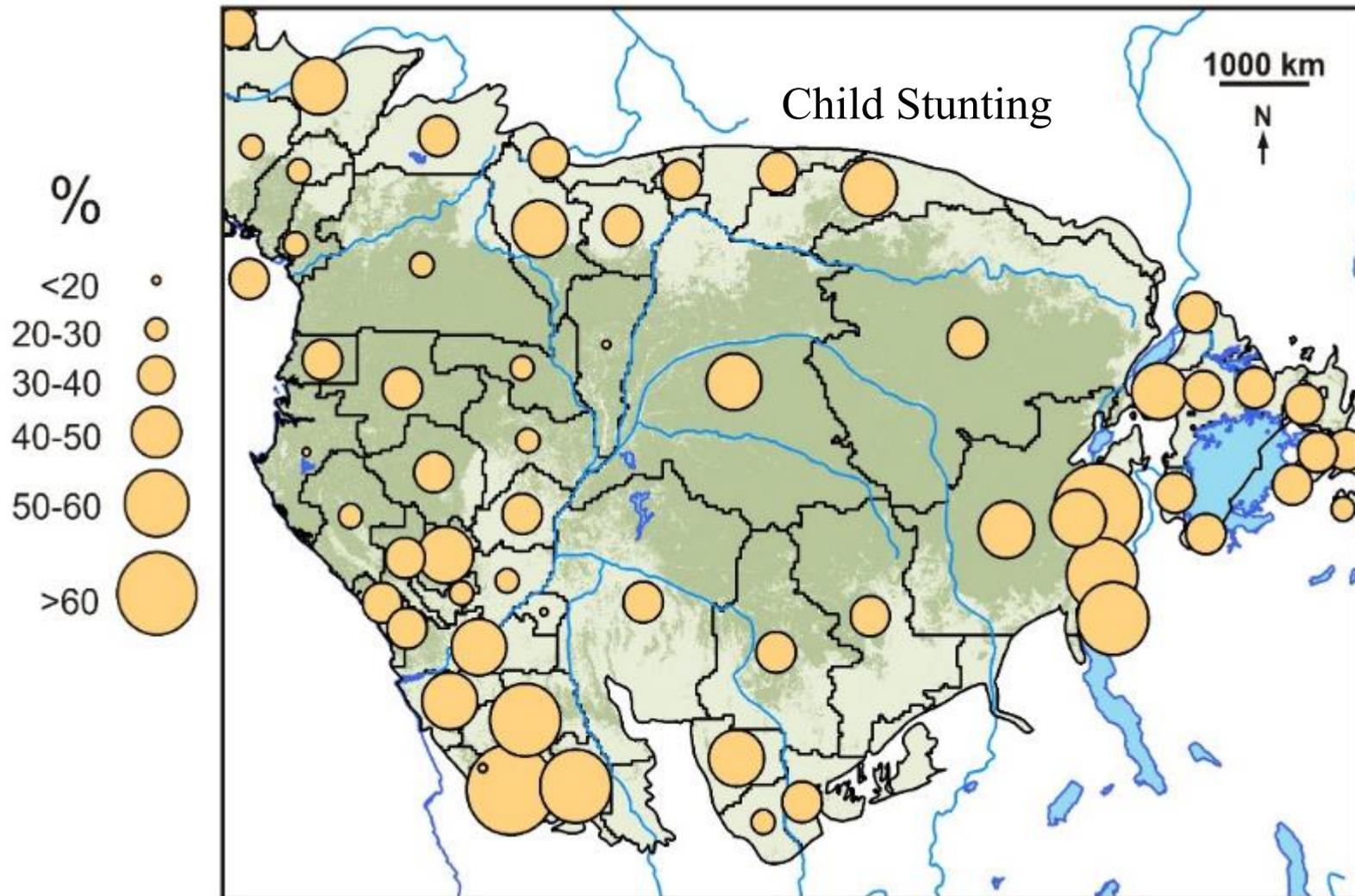
$162.0 \pm 123.6$  ind.  $H^{-1} Yr^{-1}$

$1283.9 \pm 1004.2$  kg  $H^{-1} Yr^{-1}$

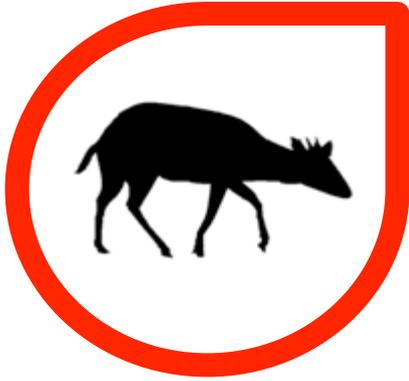
H = Hunter  
P = Person

From Fa et al. (2016)

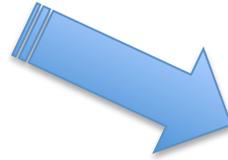
# Bushmeat and Malnutrition



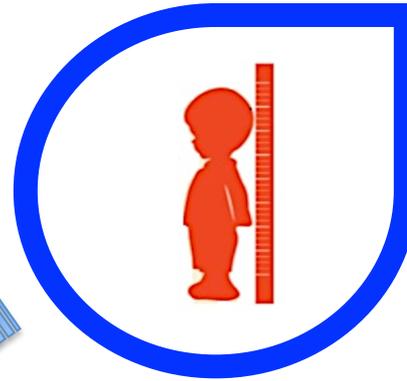
Source: Fa et al. i2015, *Scien. Repor.*



Areas of high bushmeat extraction/impact



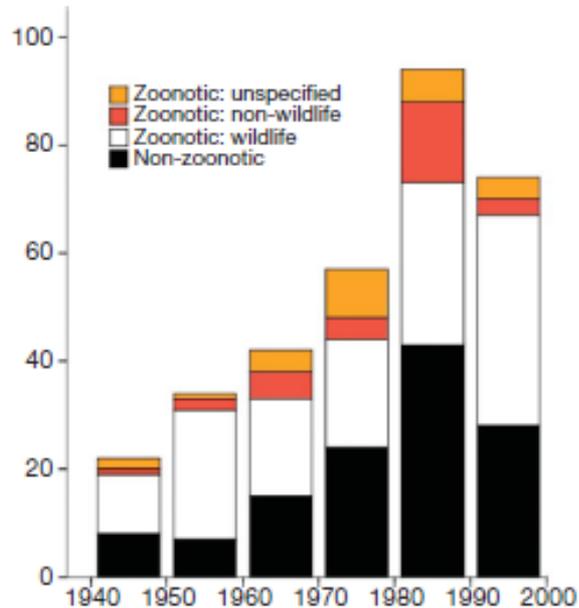
Stunting is higher in children



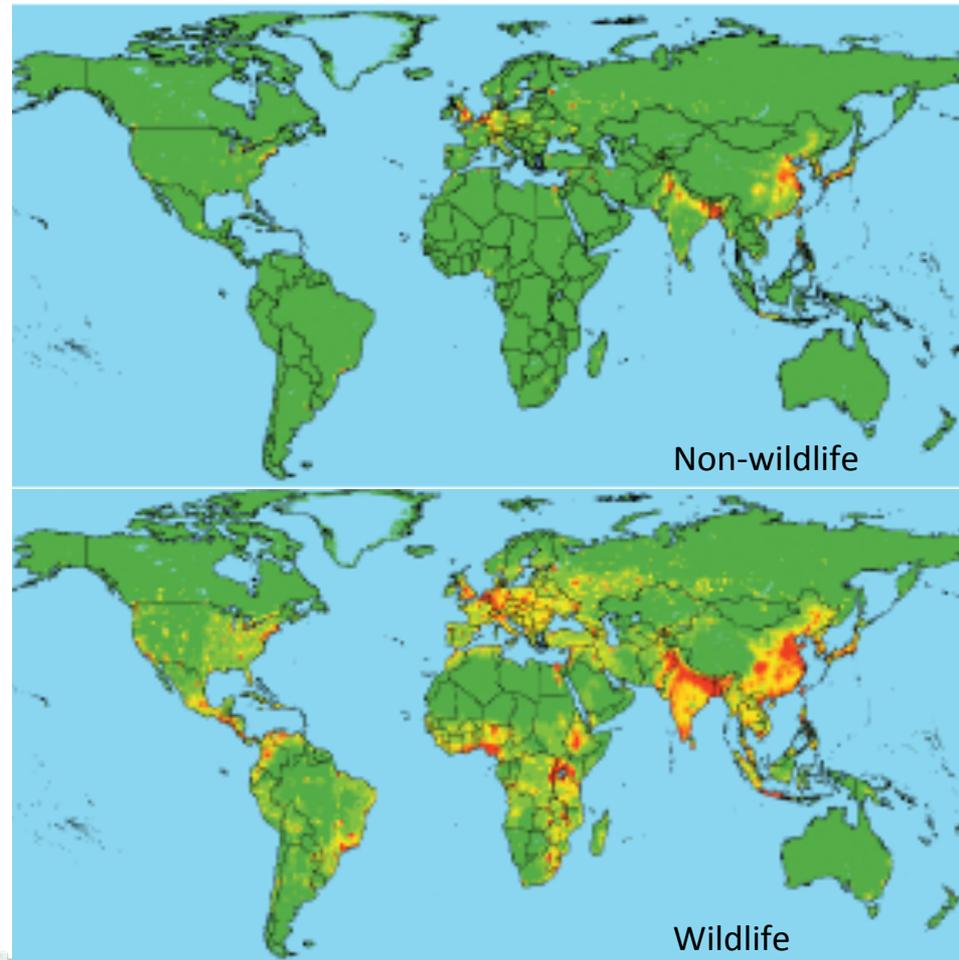
Areas with more bushmeat extraction, more food insecurity are also the areas most likely to be affected by Ebola in central Africa.

## Public health links

# Emerging Infectious Diseases

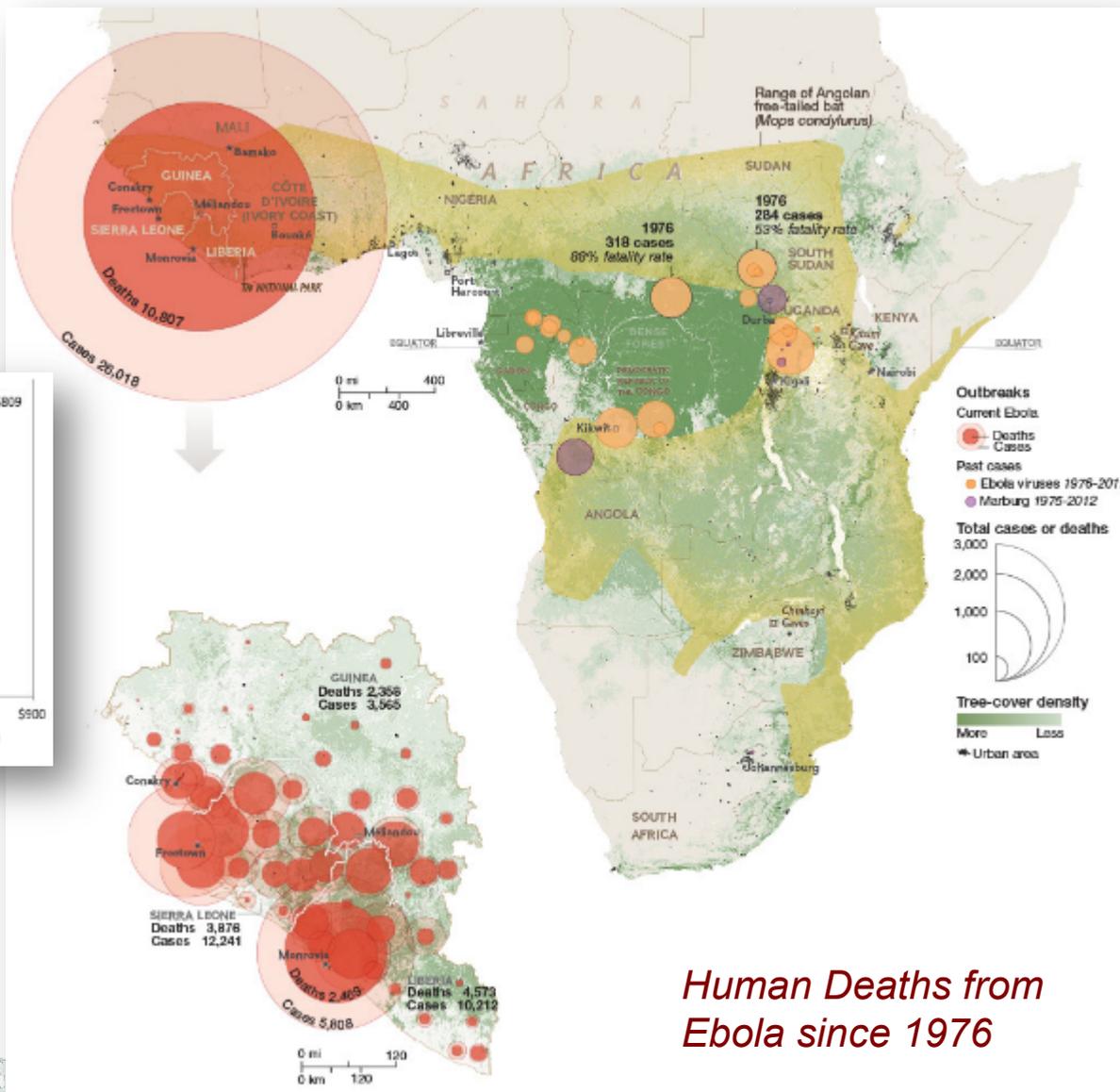
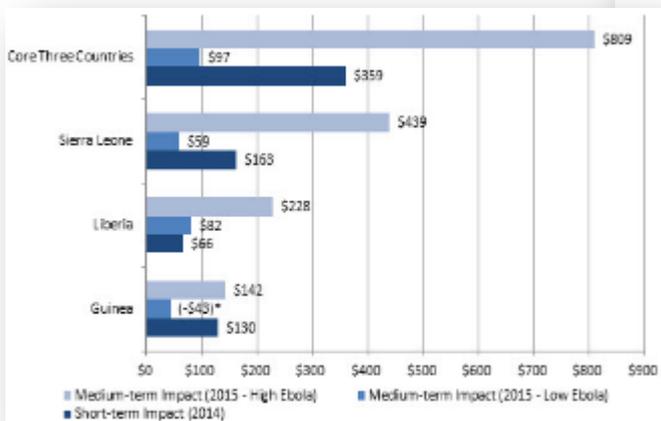


Number of EID events per decade



Global distribution of relative risk of an EID event

Estimates of GDP lost due to Ebola Outbreak in \$US millions



Human Deaths from Ebola since 1976

**Enzootic Cycle**

New evidence strongly implicates bats as the reservoir hosts for ebolaviruses, though the means of local enzootic maintenance and transmission of the virus within bat populations remain unknown.

**Ebolaviruses:**  
 Ebola virus (formerly Zaire virus)  
 Sudan virus  
 Tai Forest virus  
 Bundibugyo virus  
 Reston virus (non-human)



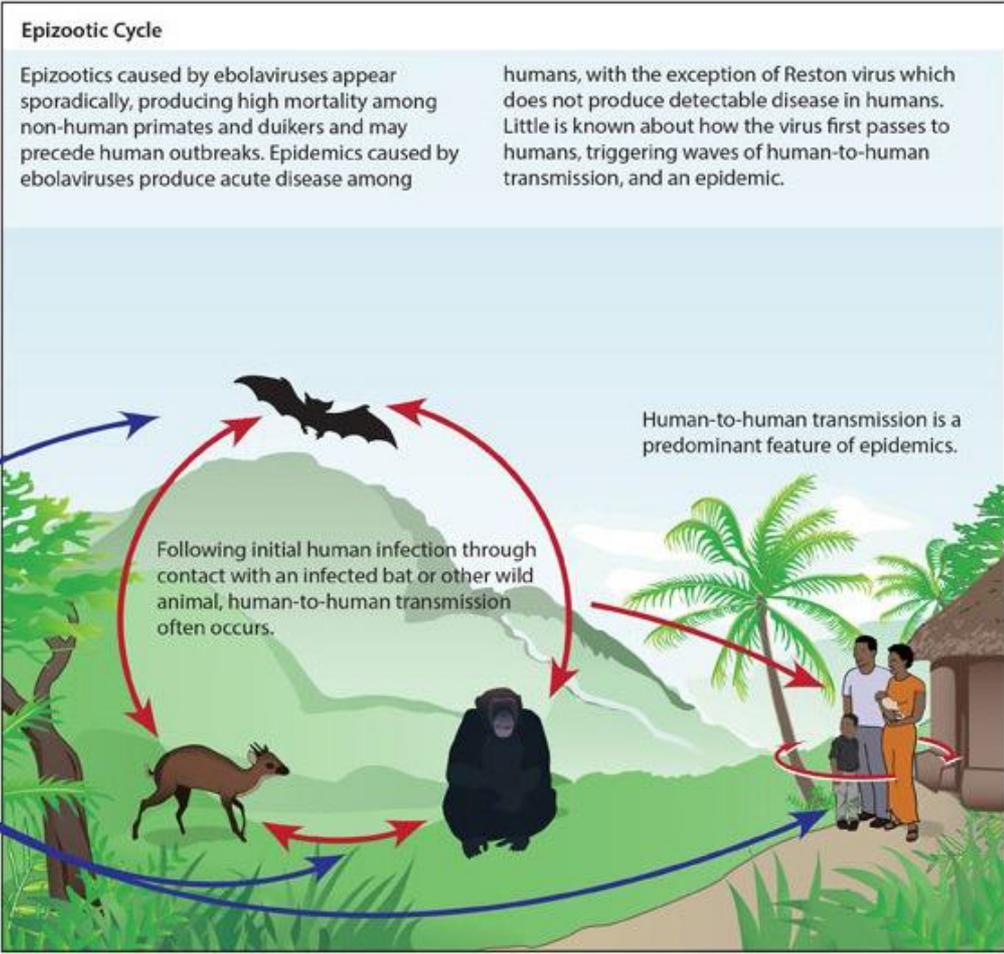


**Epizootic Cycle**

Epizootics caused by ebolaviruses appear sporadically, producing high mortality among non-human primates and duikers and may precede human outbreaks. Epidemics caused by ebolaviruses produce acute disease among humans, with the exception of Reston virus which does not produce detectable disease in humans. Little is known about how the virus first passes to humans, triggering waves of human-to-human transmission, and an epidemic.

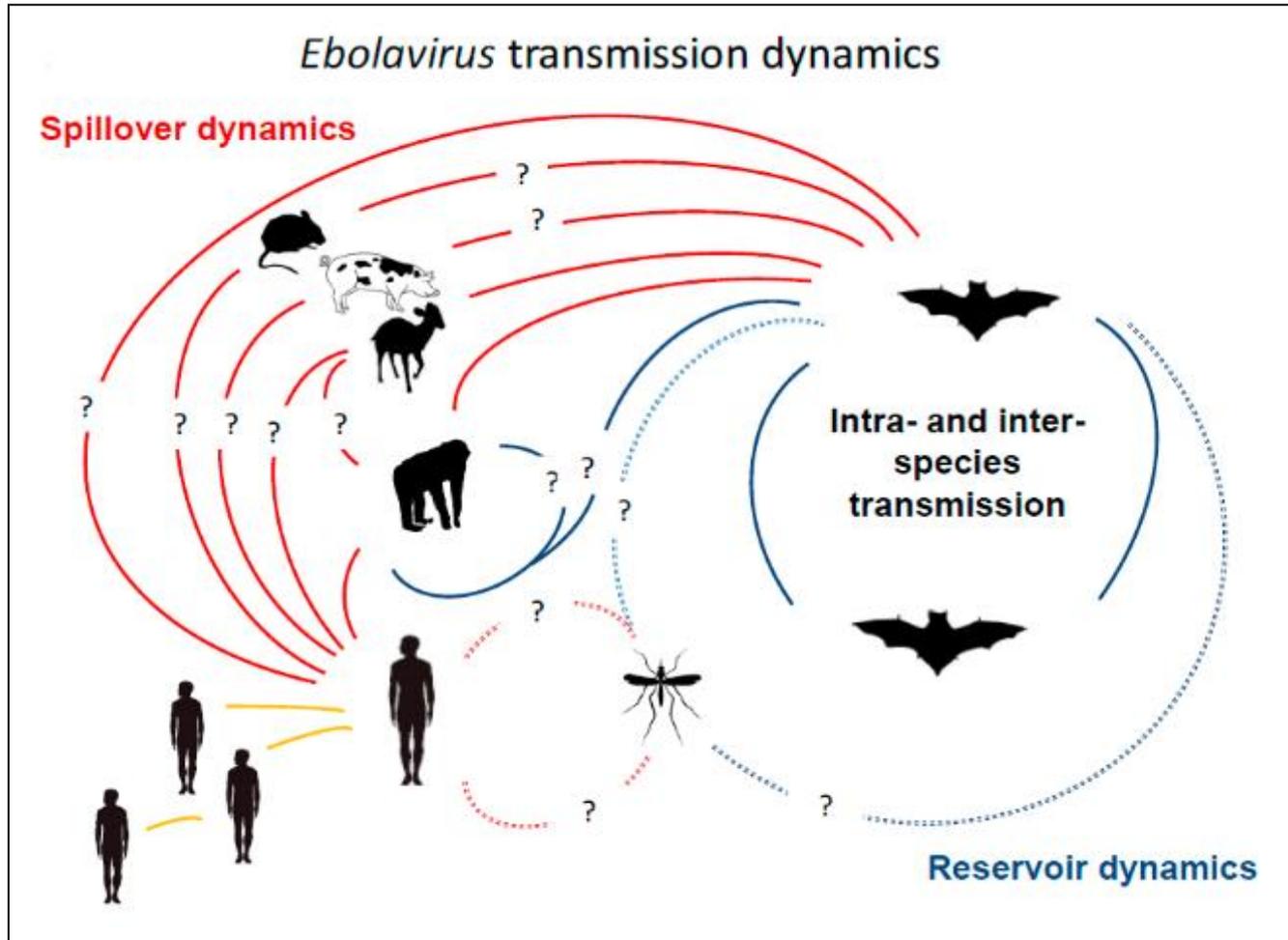
Human-to-human transmission is a predominant feature of epidemics.

Following initial human infection through contact with an infected bat or other wild animal, human-to-human transmission often occurs.



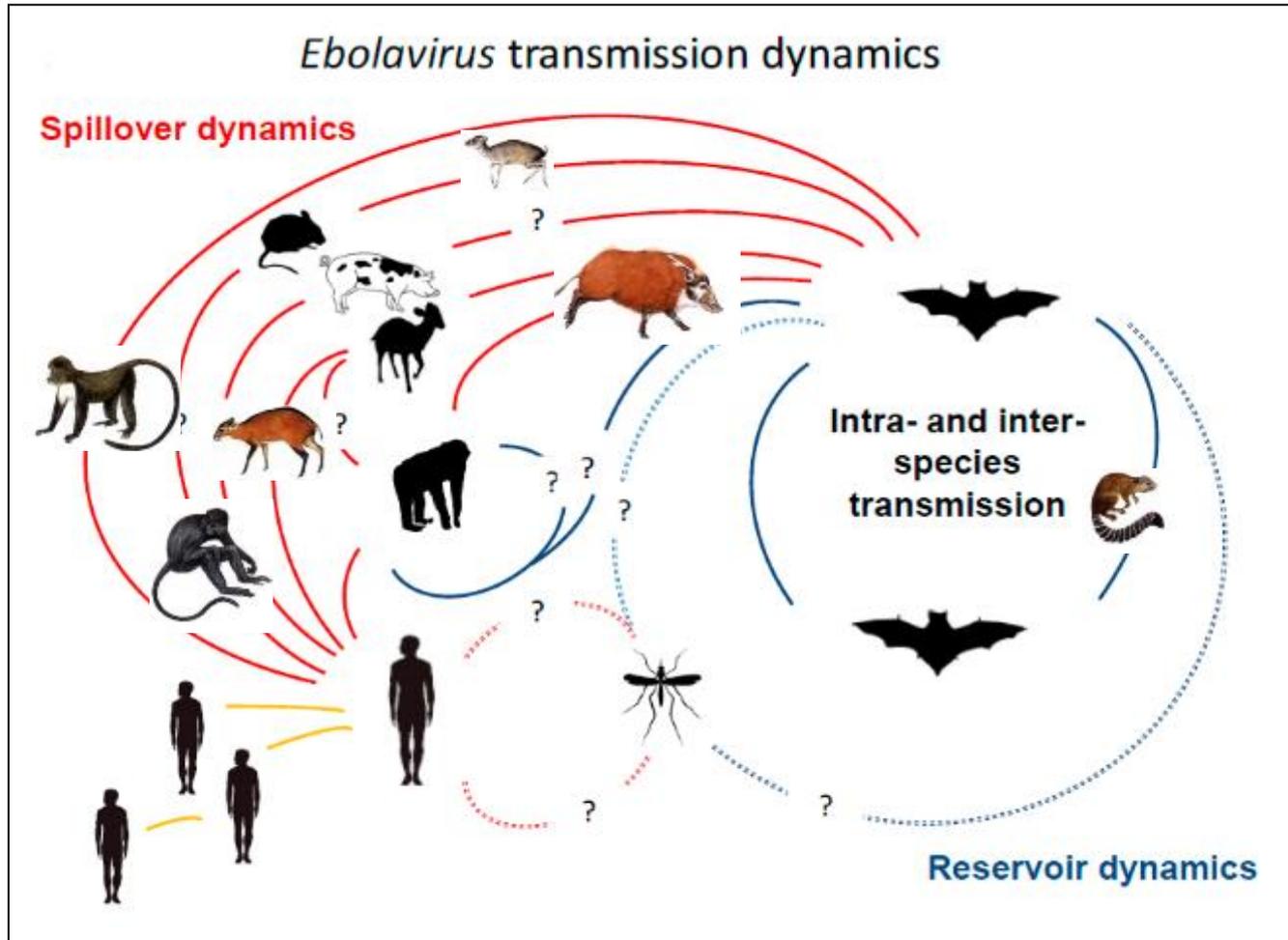
# Modelling the Ebola-virus distribution

The EVD is a zoonosis



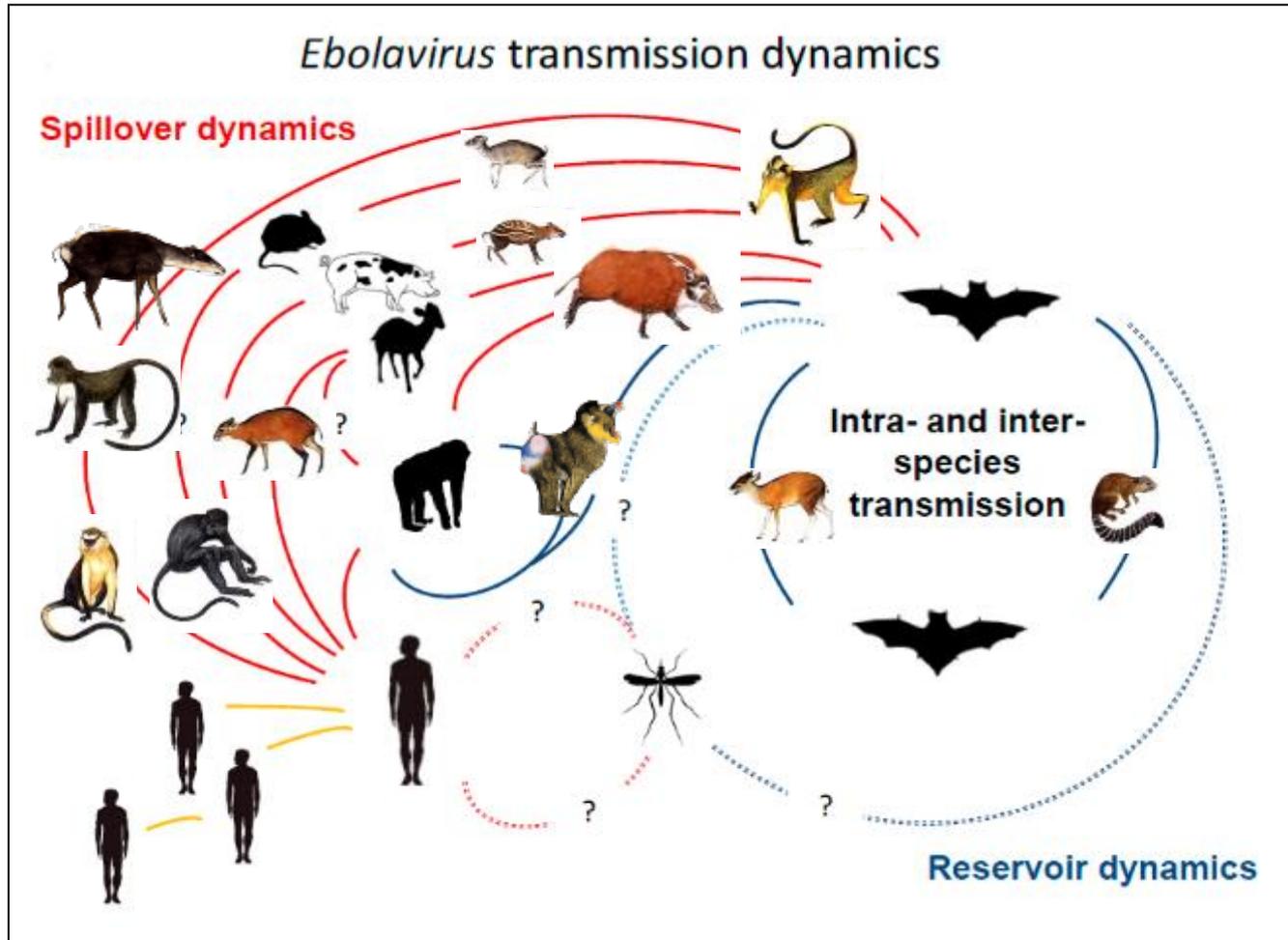
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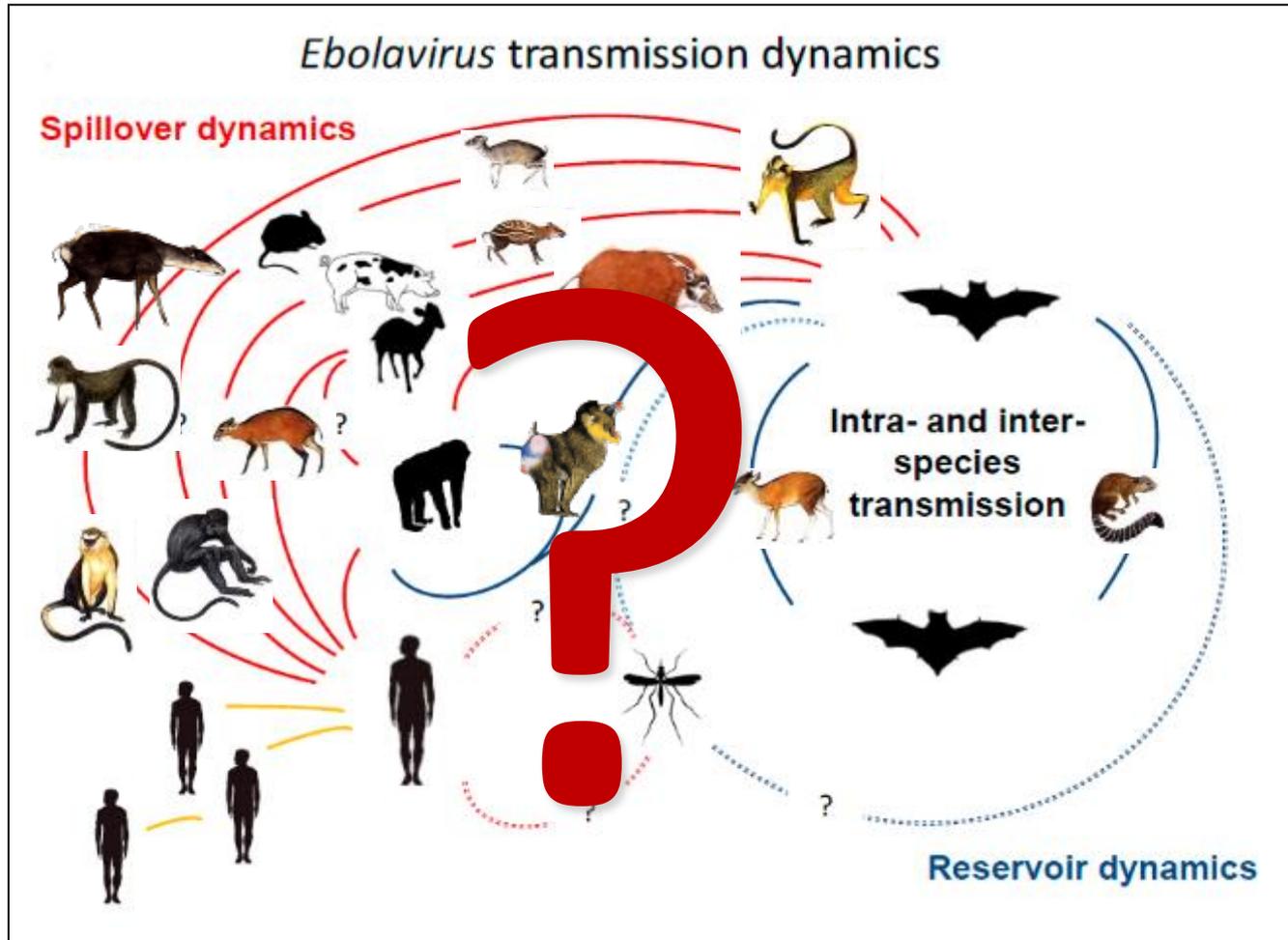
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The EVD is a zoonosis



# Modelling the Ebola-virus distribution

The EVD is a zoonosis



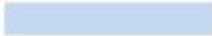
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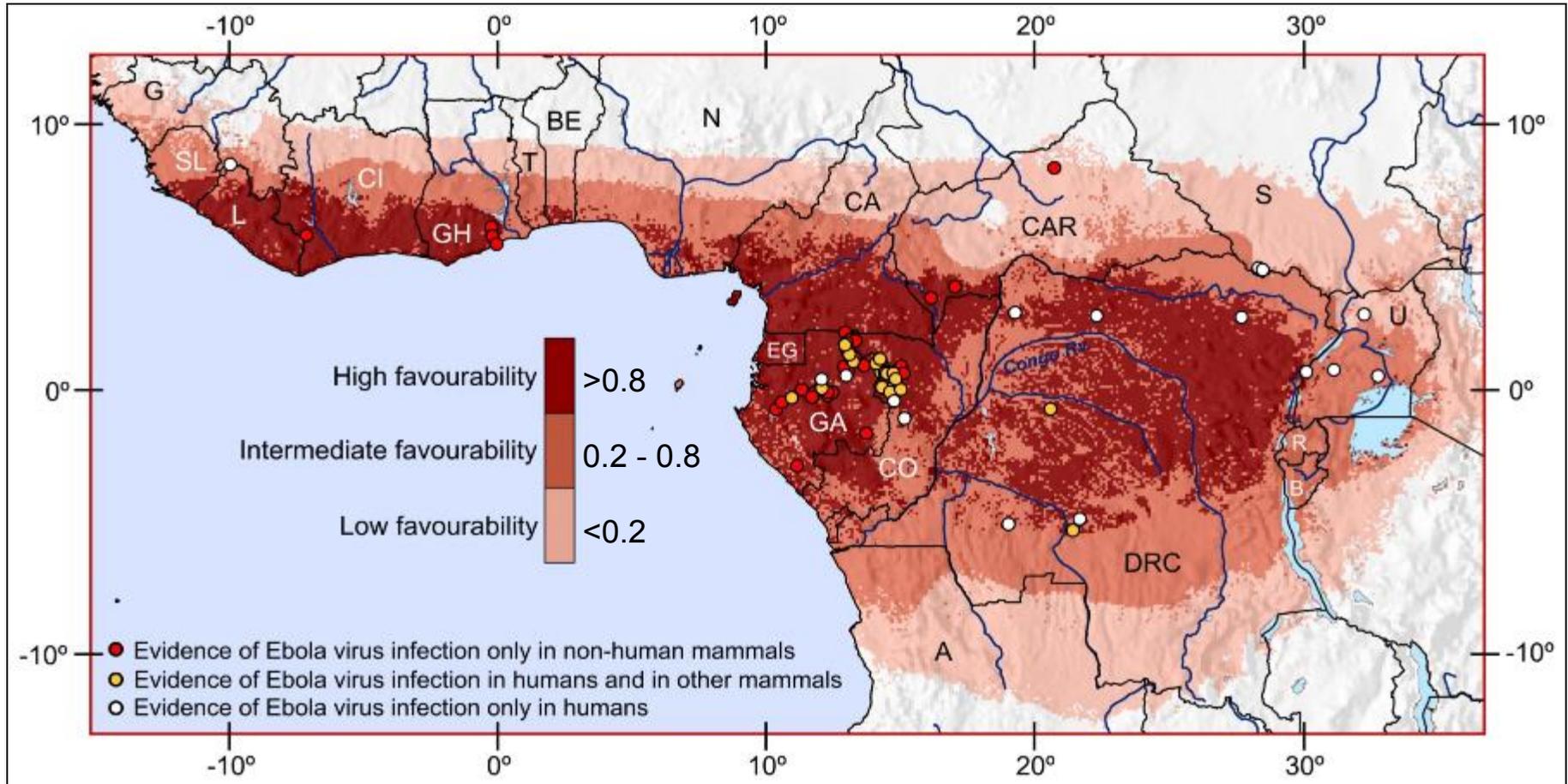
# Modelling the Ebola-virus distribution

Order	Family	Species	
	Hominidae	<i>Gorilla gorilla</i>	
		<i>Pan troglodytes</i>	
	Cercopithecidae	<i>Colobus satanas</i>	
		<i>Colobus guereza</i>	
		<i>Mandrillus sphinx</i>	
		<i>Mandrillus leucophaeus</i>	
		<i>Papio anubis</i>	
		<i>Cercopithecus neglectus</i>	
		<i>Cercopithecus nictitans</i>	
		<i>Cercopithecus cephus</i>	
Rodentia	Muridae	<i>Mus setulosus</i>	
		<i>Praomys sp.</i>	
	Hystricidae	<i>Atherurus africanus</i>	
	Erinaceomorpha	Soricidae	<i>Sylvisorex ollula</i>
	Pteropodidae	<i>Eidolon helvum</i>	
		<i>Epomophorus gambianus</i>	
		<i>Epomops franqueti</i>	
		<i>Hypsignatus monstrosus</i>	
		<i>Micropteropus pusillus</i>	
		<i>Myonycteris torquata</i>	
		<i>Rousettus aegyptiacus</i>	
		<i>Tadarida condylura</i>	
	Molossidae		
	Carnivora	Viverridae	<i>Civettictis civetta</i>
	Cetartiodactyla	Suidae	<i>Potamochoerus porcus</i>
	Bovidae	<i>Tragelaphus spekii</i>	
		<i>Cephalophus callipygus</i>	
		<i>Cephalophus dorsalis</i>	

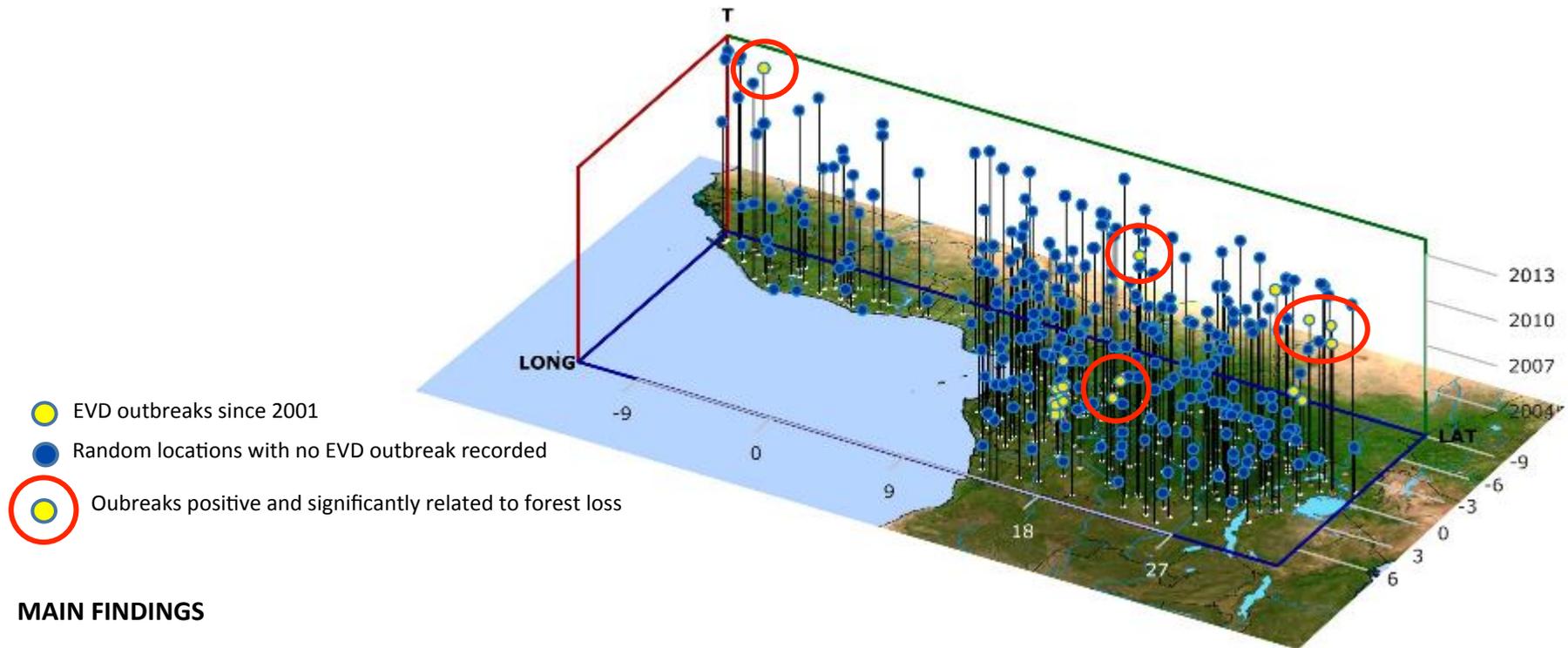
 Serological or PCR positivity of Ebola virus  
 Increased mortality attributed to EVD

- Morvan et al. (1999) *Microbes and Infection* 1
- Huijbregts et al. (2003) *Oryx* 37
- Leroy et al. (2004) *Science* 303
- Leroy et al. (2004) *J. Infectious Diseases* 190
- Leroy et al. (2005) *Nature* 438
- Rouquet et al. (2005) *Emerg. Infect. Dis.* 11
- Lahm et al. (2007) *Tr.Roy.Soc.Trop.Med.Hyg.* 101
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- Pourrut et al. (2007) *J. Infectious Diseases* 196
- Pourrut et al. (2009) *BMC Infectious Diseases* 9
- Hayman et al. (2010) *Plos ONE* 5
- Hayman et al. (2012) *Emerging Infectious Dis.* 18
- Olival & Hayman (2014) *Viruses* 6
- Sáez et al. (2015) *EMBO Molecular Medicine* 7

# What does the model suggest?



# Disease and Deforestation



## MAIN FINDINGS

- There is a **significant correlation** between EVD outbreaks and episodes of forest loss
- This correlation involves forest loss episodes **less than 3 years prior** to the EVD outbreak
- Significant correlations only apply to outbreaks located at the **margins of the rainforest domain**, corresponding to 78% of the cases recorded **after 2005** (see red ellipses above)
- In this area, road and rural population densities are positively related to EVD outbreaks, and human index cases are not related to contacts with bovinds and great apes (Olivero et al. 2017)

THANK YOU

BUSHMEAT

[WWW.CIFOR.ORG/](http://WWW.CIFOR.ORG/)

Pictures CIFOR, N. van Vliet



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