







Biodiversity and pandemics: how envisioning sustainable prevention strategies?

Benjamin Roche

Je n'ai pas de conflit d'intérêts en lien avec le sujet traité.

What do we observe?

The current context (a)

- Number of emerging disease outbreaks is increasing since decades
- Human mobility is also increasing since decades
- All ingredients are here to observe new pandemics during the next years





The era of emergence



of existing human infectious diseases are zoonotic of emerging infectious diseases of humans (including Ebola, HIV, and influenza) have an animal origin



new human diseases appear every year. Three are of animal origin



of agents with potential bioterrorist use are zoonotic pathogens



CORONAVIRUS

The era of emergence





Plowright et al, Nat. Rev. Mic. 2017

The era of emergence



Understanding the whole ecosystem to prevent emergence in a sustainable way





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Reasons of viral emergences from wildlife

- Generally linked to global changes, especially deforestation (IPBES, 2020)
 - Biodiversity reduction (dilution effect, etc...)
 - Changes in contact patterns with human populations (exposure increase)



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- Deforestation is also linked to economic growth
 - Agriculture development
 - Urban expansion



Biodiversity conservation as a prevention strategy against zoonoses emergence?

Impact of conservation strategies on pathogen circulation in wildlife

Conservation strategies		Consequences on pathogens communities on the ecosystem A	Consequences on pathogens	
Several Small Reserves		Communities on the ecosystem B Banid pathogen adaptation: high pathogen transmission within each reserve		
Maximize regional diversity by combining small patches with several different species		which may lead to different pathogen adaptation within each patch (local speciation)		
		Slow pathogen adaptation: hot and cold spots of transmission and adaptation		
		Strong genetic drift effects may limit adaptation if interconnectivity between patches is strong		
Intermediate Strategy Maximize the time to population extinction		Medium level of transmission. Determine the ideal patch size could be considered by looking at the pathogen communities		
Single Large Reserves Larger areas contain more species than smaller areas (species-area relationship theory and equilibrium theory of island biogeography)	Classic Reserves	More pathogens species but less transmission (dilution effect)	More pathogens species and more transmission (amplification effect)	
Decrease the probability of species extinction	Biodiversity Hotspots	More pathogens species but less transmission (dilution effect)	More pathogens species and more transmission (amplification effect)	
	Key Biodiversity Areas (KBAs)	Host communities being heterogeneous between KBAs, it is difficult to extrapolate for pathogen communities		

(Perhaps) not the good question...



What can we do?

The International Joint Laboratory ELDORADO

Ecosytems, Biological Diversity, habitats modifications, and risk of emerging pathogens and Diseases in MexicO



Directors: Gerardo Suzan, Benjamin Roche

Our goal



How to link biodiversity and emerging diseases?

ECOLOGY LETTERS

Viewpoints 🛛 🙃 Free Access

Was the COVID-19 pandemic avoidable? A call for a "solutionoriented" approach in pathogen evolutionary ecology to prevent future outbreaks

Benjamin Roche 🔀, Andres Garchitorena, Jean-François Guégan, Audrey Arnal, David Roiz, Serge Morand, Carlos Zambrana-Torrelio, Gerardo Suzán, Peter Daszak ... See fewer authors

Designing SUSTAINABLE conservation strategies that:

- PROTECTS human populations from virus emergence
- DOES NOT impact negatively economic growth at short term







- Yucatan has lost 50% of its jungle
- Mexico has more endangered species than any other countries on earth
- Always been considered as current and future hotspot for zoonoses emergence



- The peninsula is connected to Mexico City with almost 10 flights/day
- With its 25 million inhabitants and 22 millions annual passengers at the international airport, Mexico City is considered as one of the most plausible source of pandemics



Our field study



Characterizing pathogen circulation in wildlife



Characterizing pathogen circulation in wildlife



Characterizing pathogen exposure in humans



Characterizing pathogen circulation in wildlife



Anthropological factors for human exposure



Characterizing pathogen exposure in humans



Characterizing pathogen circulation in wildlife



Anthropological factors for human exposure



Characterizing pathogen exposure in humans



Identifying the best (and plausible) scenarios for the management of Yucatan









ELDORADO

How to link biodiversity and emerging diseases?



CAPACITY BUILDING







Our actions -Interface with policy

- Close collaboration with the state and federal government to help Yucatan becoming the first territory with a OneHealth prevention strategy against zoonosis emergence
- Articulation at an international scale through the PREZODE initiative



Preventing zoonotic disease emergence

GOBIERNO DE MÉXICO





Mexico et Paris coopèrent pour prévenir les risques pandémiques Le Mexique devient ainsi le premier pays d'Amérique latine à adhérer à l'initiative internationale Prezode que le président Emmanuel Macron ... & lemonde.fr



Preventing zoonotic disease emergence



PREZODE: A COMMON FRAMEWORK TO FOSTER COLLABORATION AND IMPACT

To take up the challenge of preventing pandemics, the initiative was launched in January 2021 during the One Planet Summit, with the support of the European Commission and the Quadripartite (FAO, WHO), WOAH and UNEP).



THE LANCET

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PREZODE: preventing zoonotic disease emergence

Marisa Peyre → Gwenaël Vourc'h → Thierry Lefrançois → Yves Martin-Prevel → Jean-François Soussana → Benjamin Roche 🖂



PREZODE AIMS



 A common framework to implement and coordinate research projects, surveillance systems, operational projects to maximize their impact



• A platform for data sharing

 A resource center for decision making, to support evidence based choices and policies to implement to reduce the risk of emerging zoonosis





VISION AND OBJECTIVE





PREZODE MEMBERS



24 Member countries and

Overseas territories

2

https://prezode.org/Who-we-are/Members







First concrete actions



PREACTS's geography

AFRICAM

- Senegal
- Guinea
- Cameroon
- Madagascar
- Cambodia

ASAMCO

- Mexico/Costa Rica/Haiti
- Democratic Republic of Congo
 - Lao/Thailand

PREZODE WHO/PREZODE Working Group Quantitative indicators of the risk of anization the emergence of zoonotic diseases

• Co-chairs: Maria Van Kerkhove (WHO) and Benjamin ROCHE (IRD/PREZODE)

Team: Alice Simniceanu (WHO), Sophie vonDobschütz (WHO), Manon Lounnas (IRD/PREZODE)



Escaping « Panic and neglect »

Combine control, preparation and prevention

- Today there is a lot of attention to control and preparation.
 - There are numerous tools (including quantitative ones)
 - But every emergence is different...
- Much less focus on prevention
- Despite higher efficiency and better return on investment
- It is not just an academic question. The tools are not enough



How to link biodiversity and emerging diseases?



Preventing zoonotic disease emergence









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