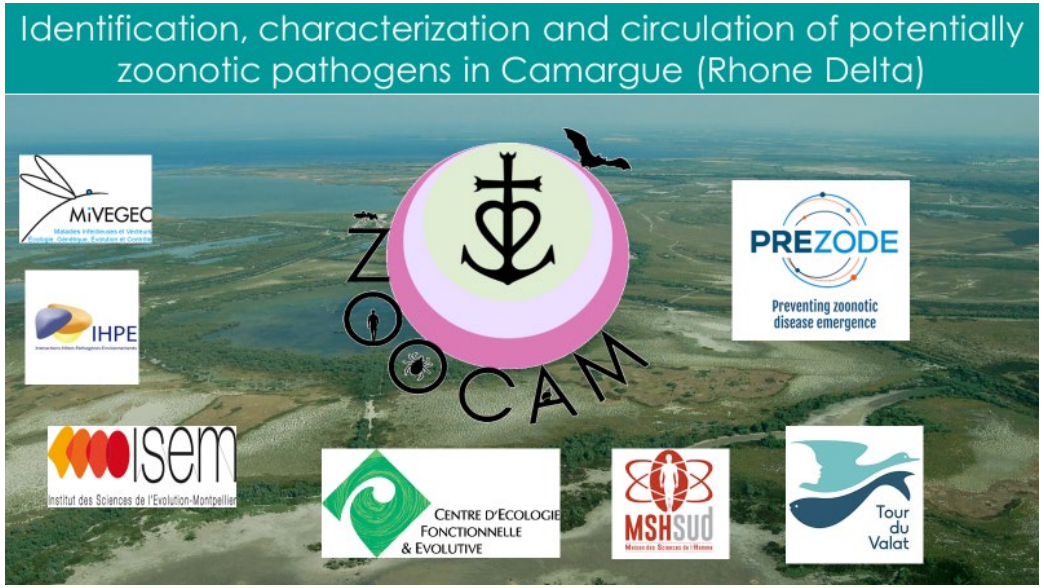
Zones Ateliers
LTSER FRANCE CAMARGUE

Comment prévenir les risques infectieux par une approche pluridisciplinaire ? Exemple du Projet ZOOCAM porté par ZACAM




Frédéric THOMAS


Nathalie BOUTIN-RICHTER

What is the international context ?



A few words about the ZACAM Zone Atelier



The ZOOCAM Project

What is the international context ?



A few words about the ZACAM Zone Atelier



The ZOOCAM Project

One World,One Health



The “One World - One Health” concept, created in 2004, recognizes the close connections between health of humans and that of other animals and our shared environment.

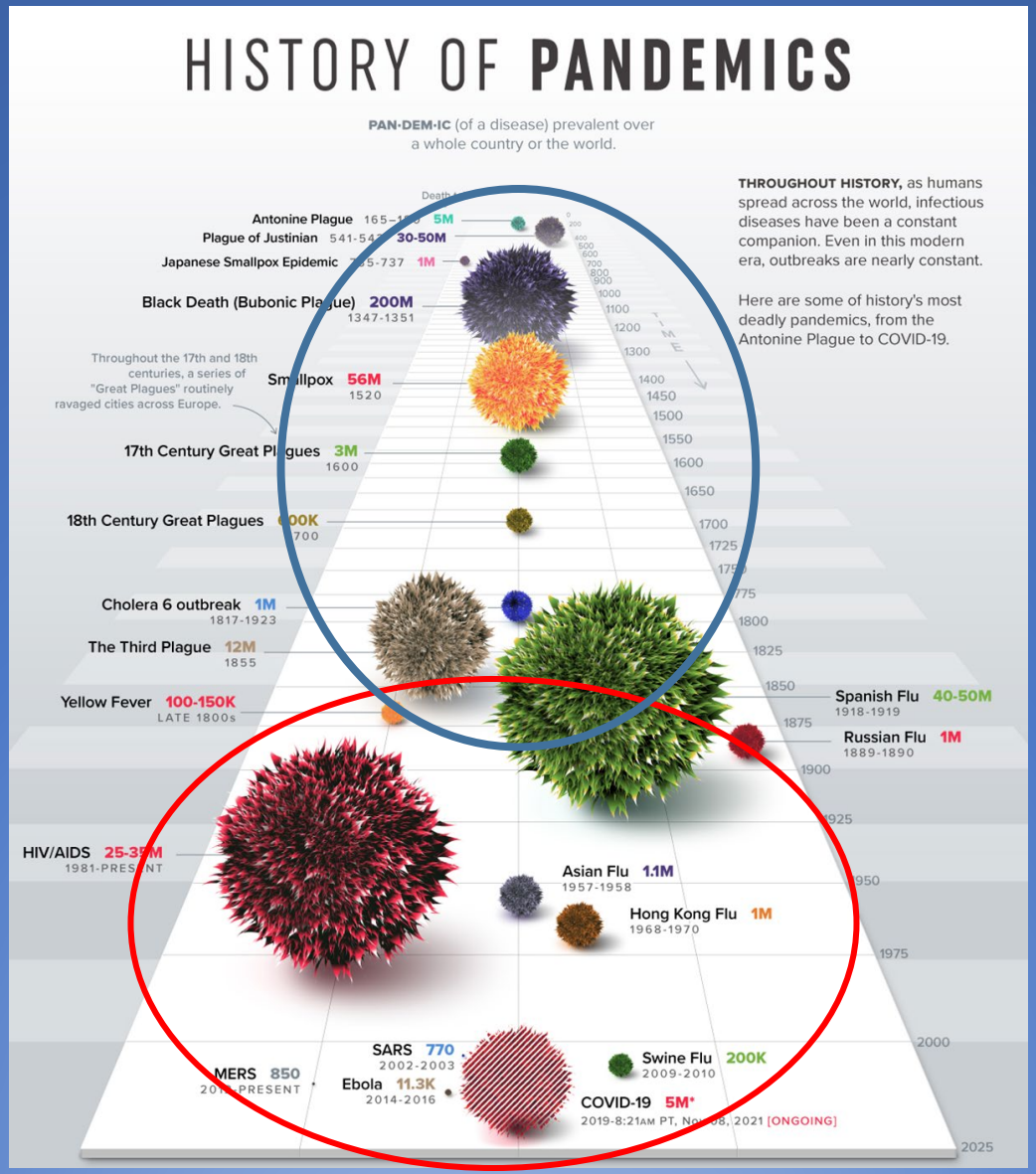


World Health Organization

Oie
WORLD ORGANISATION FOR ANIMAL HEALTH

Food and Agriculture Organization of the United Nations

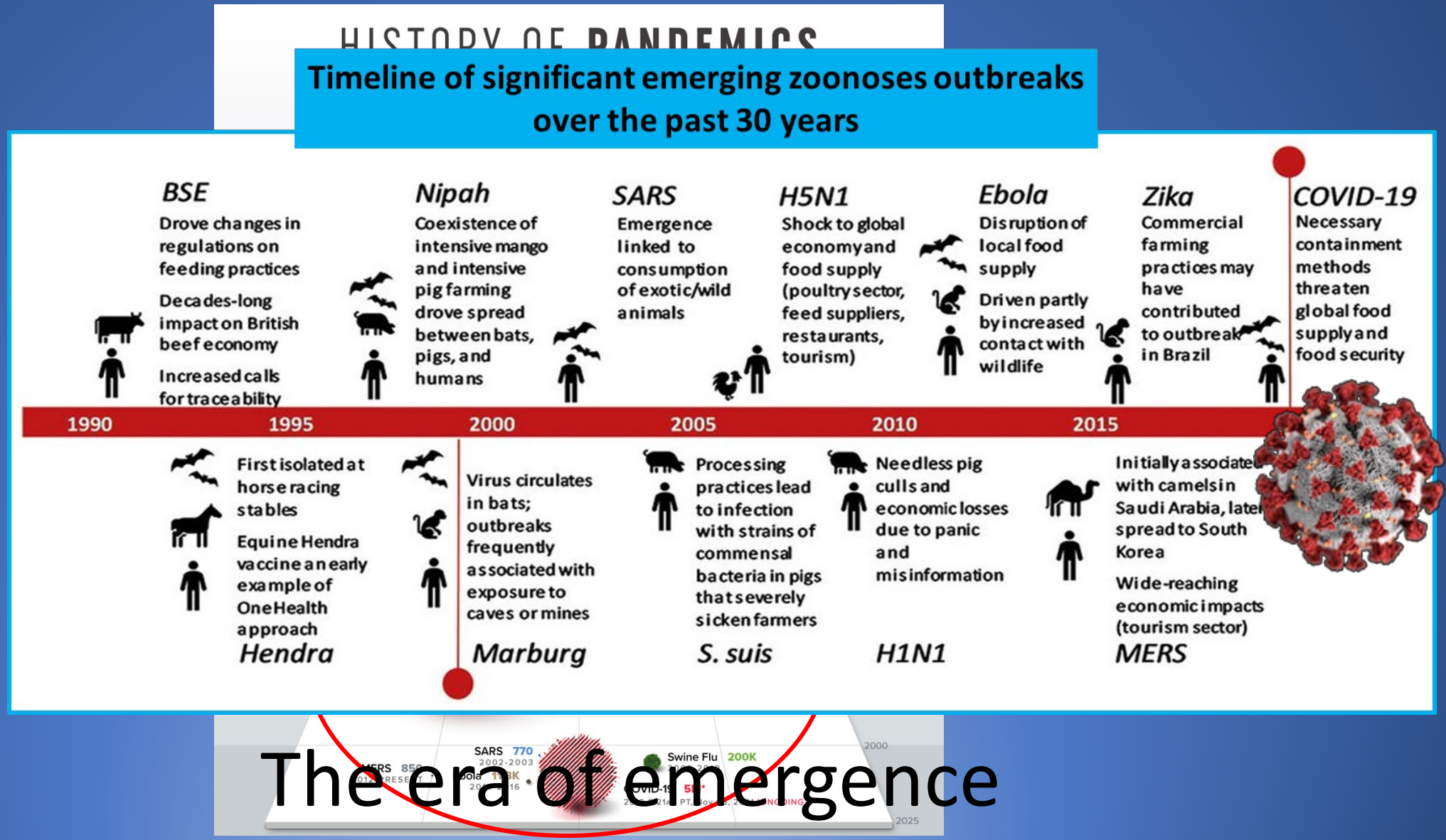
The importance of this concept is evidenced by the accelerated emergence or re-emergence of diseases over the last decades…



Before the 20 century, the world had a pandemic on average every 100 years

The sequence of emerging and re-emerging diseases seems to be clearly accelerating

The importance of this concept is evidenced by the accelerated emergence or re-emergence of zoonoses over the last decades…



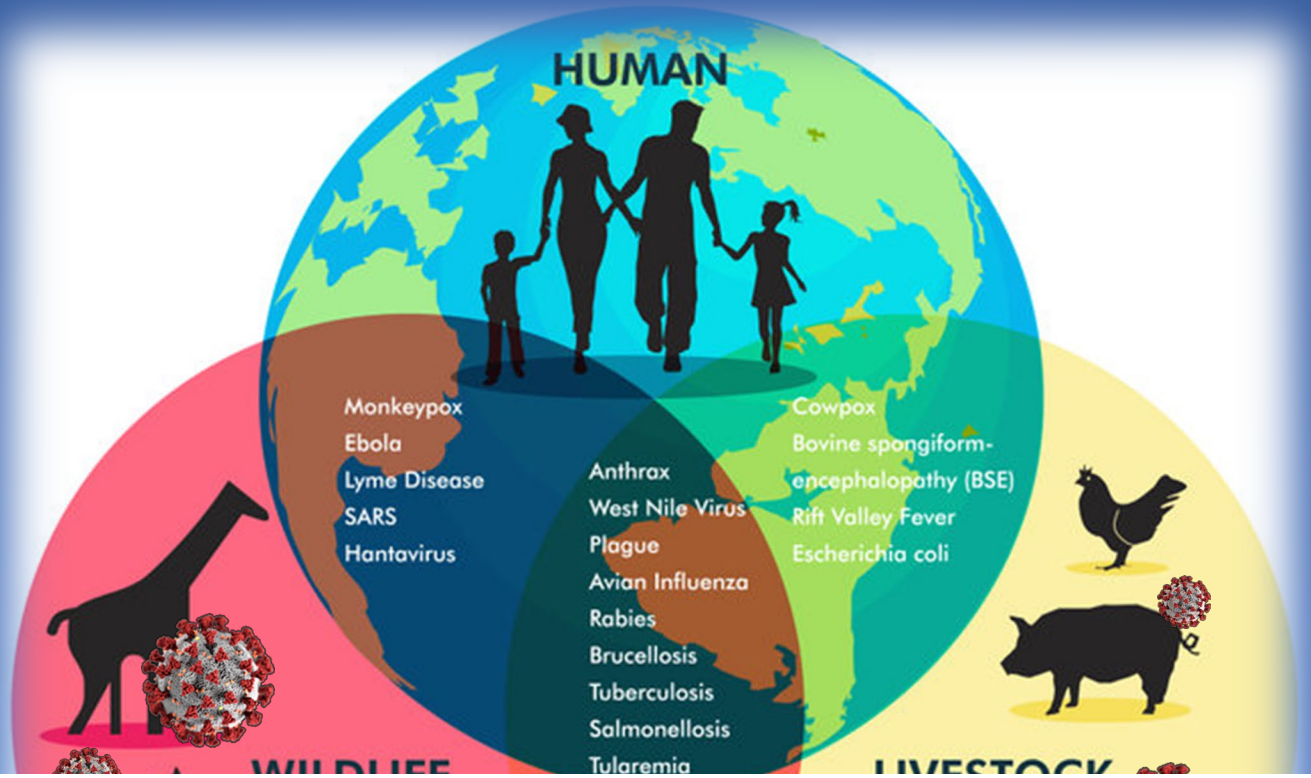
The era of emergence

Until now our approach, each time, was to control epidemics or pandemics once there, often in emergency… with more or less success.



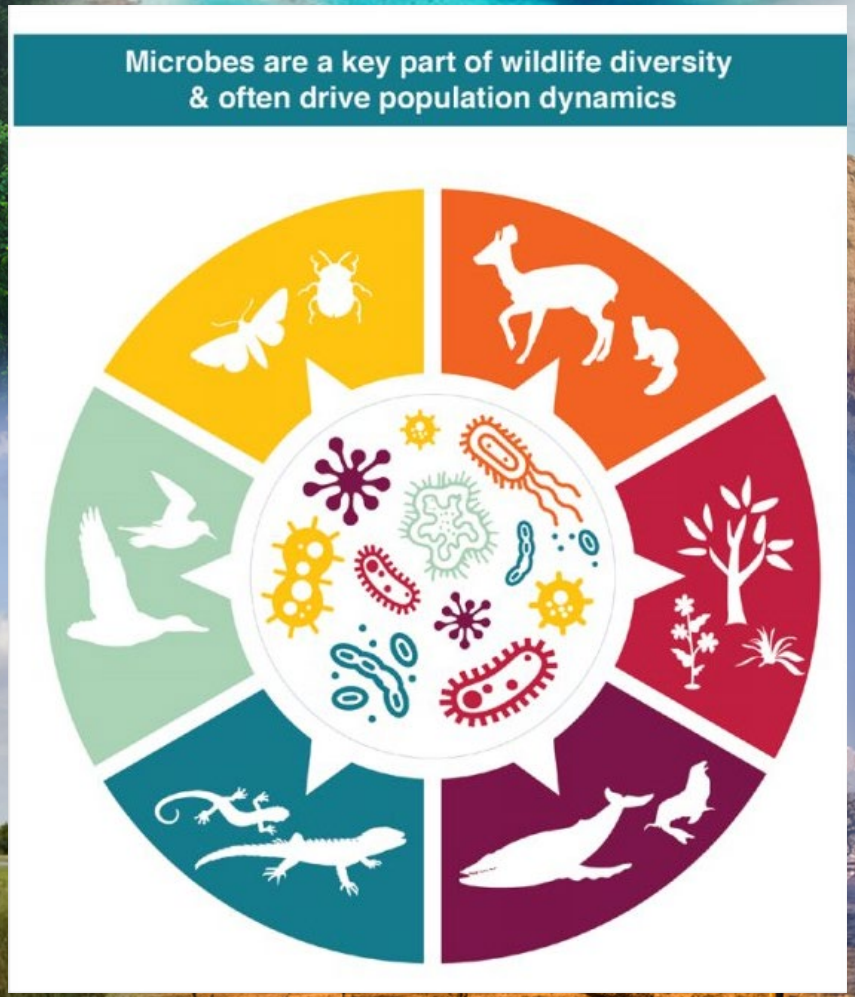

But what is the origin of these novel diseases?
They comprise:
60%
of all infectious diseases in humans
75%
of all emerging infectious diseases
Source:
UNEP Frontiers 2016 Report

We need to understand the processes that are responsible from these transfers to humans



Loss of biodiversity and pandemics: a growing concern…

Ecosystems rely on FRAGILE equilibria



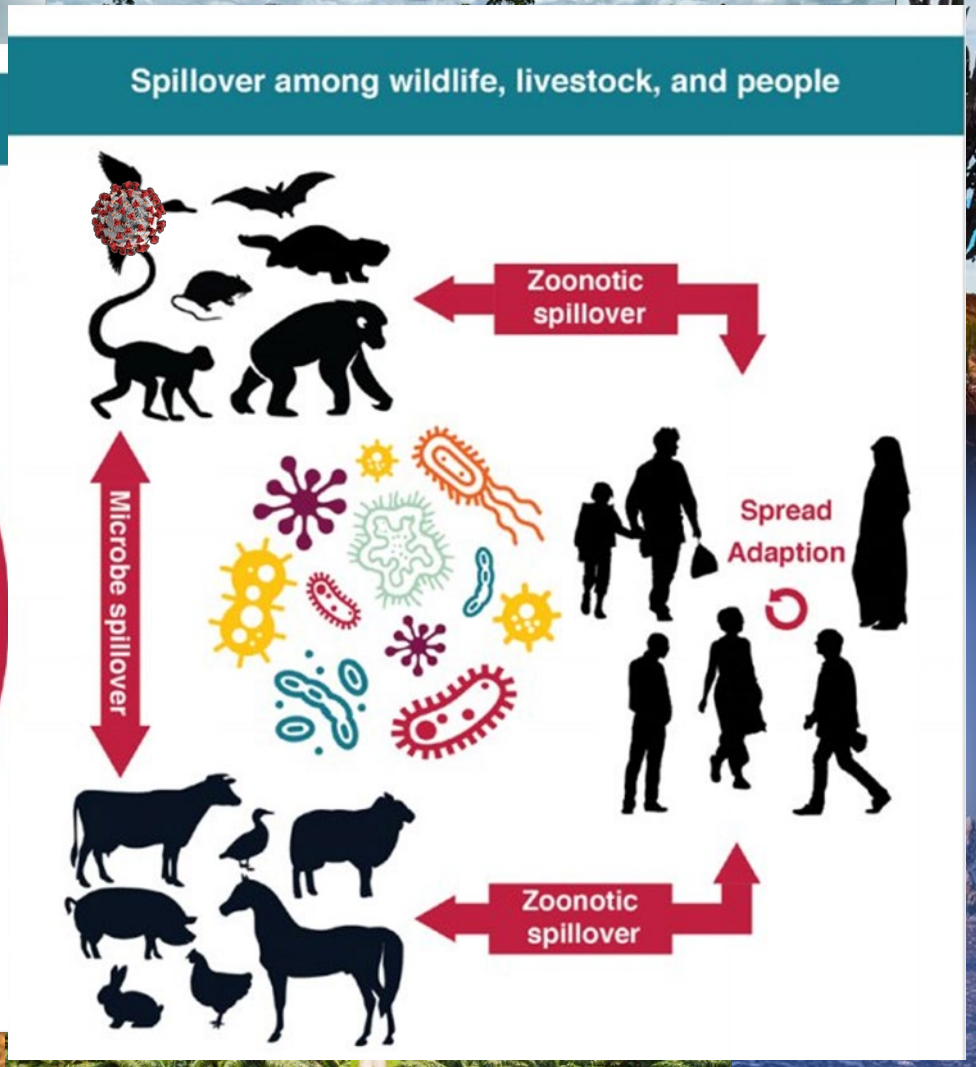
Regulation of populations

Structure of communities

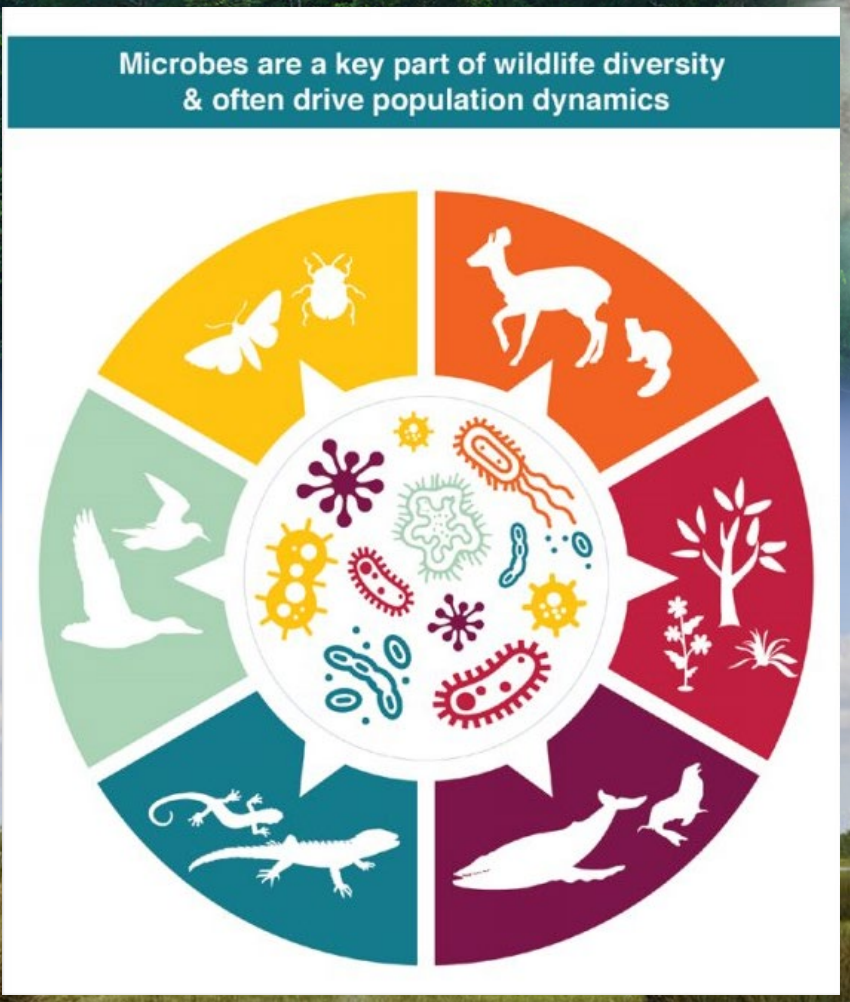
Ecosystems rely on FRAGILE equilibria



Humans alter the balance within ecosystems



Ecosystems rely on FRAGILE equilibria

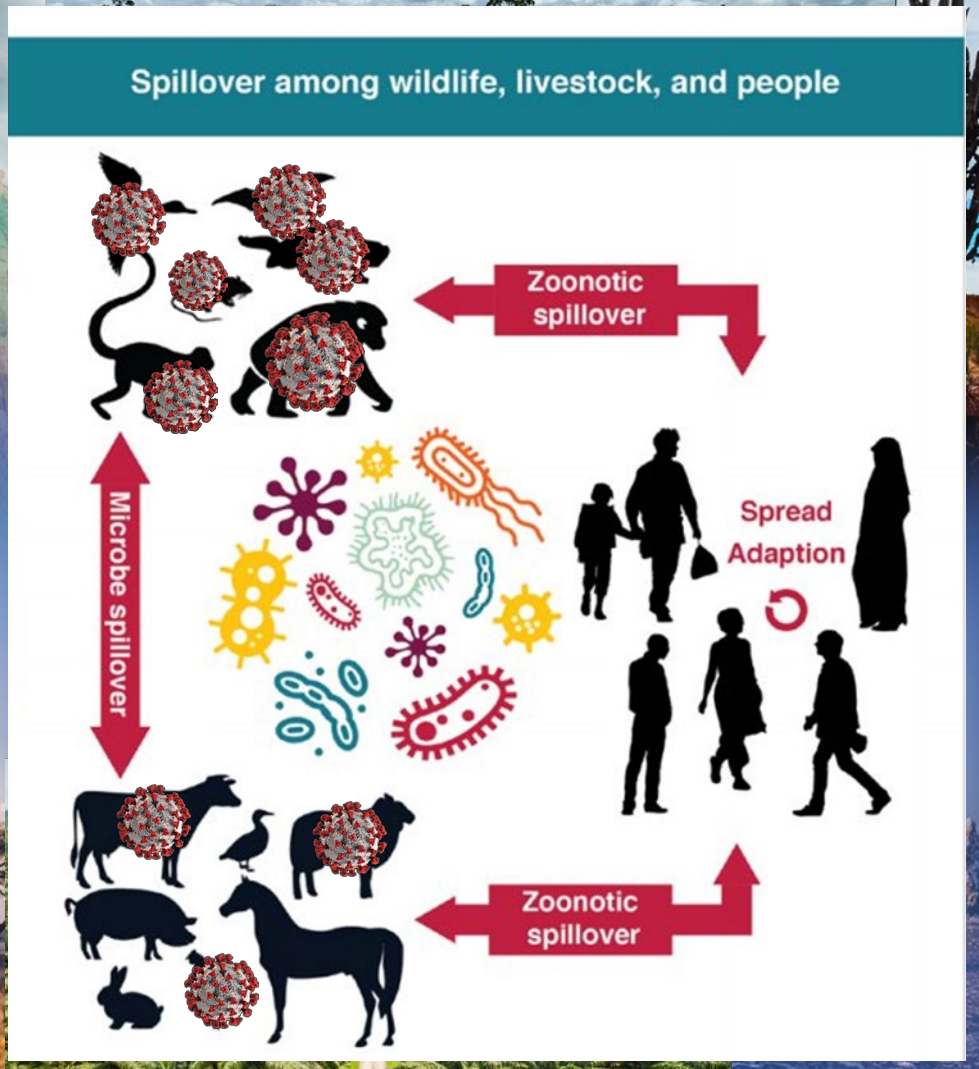


Humans alter the balance within ecosystems

Anthropogenic environmental changes

Land degradation → Microbe communities altered

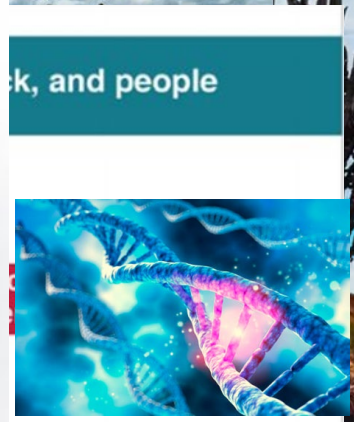
Habitat loss → Increased interaction among animals & species

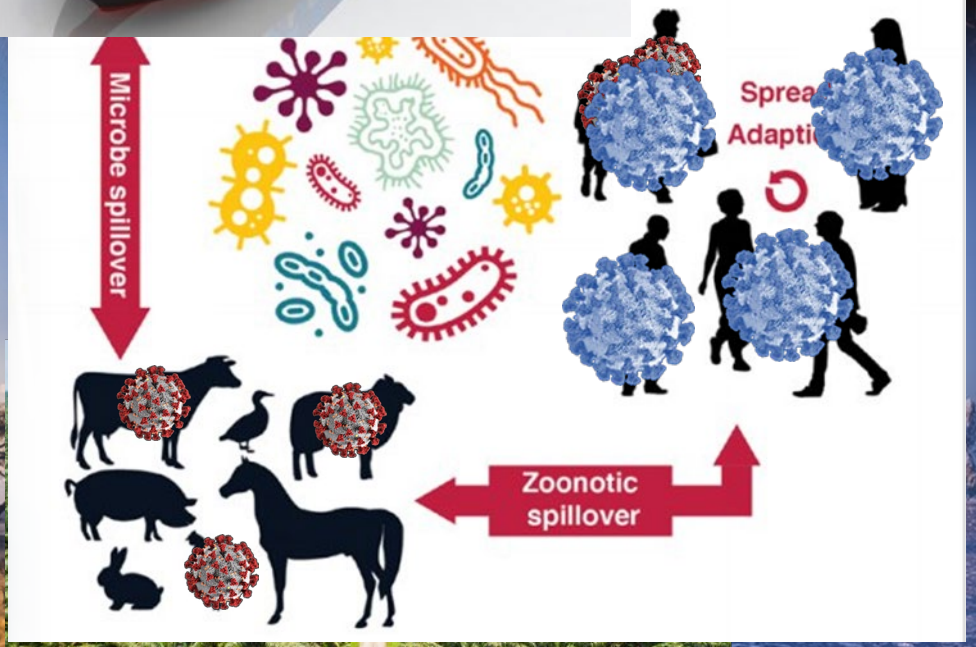


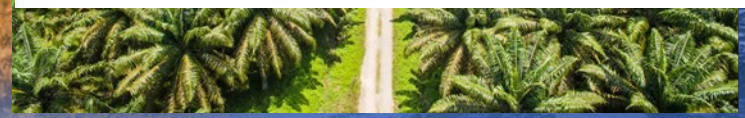
Ecosystems rely on FRAGII



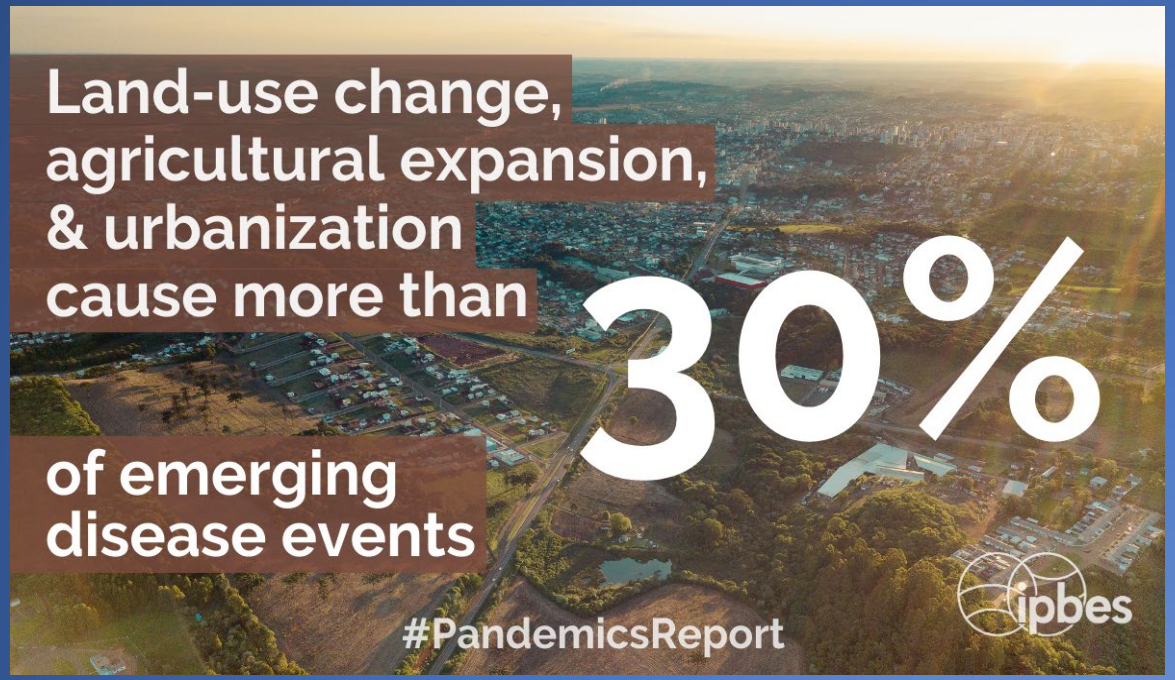








Recent syntheses indicate that several anthropic factors are crucial



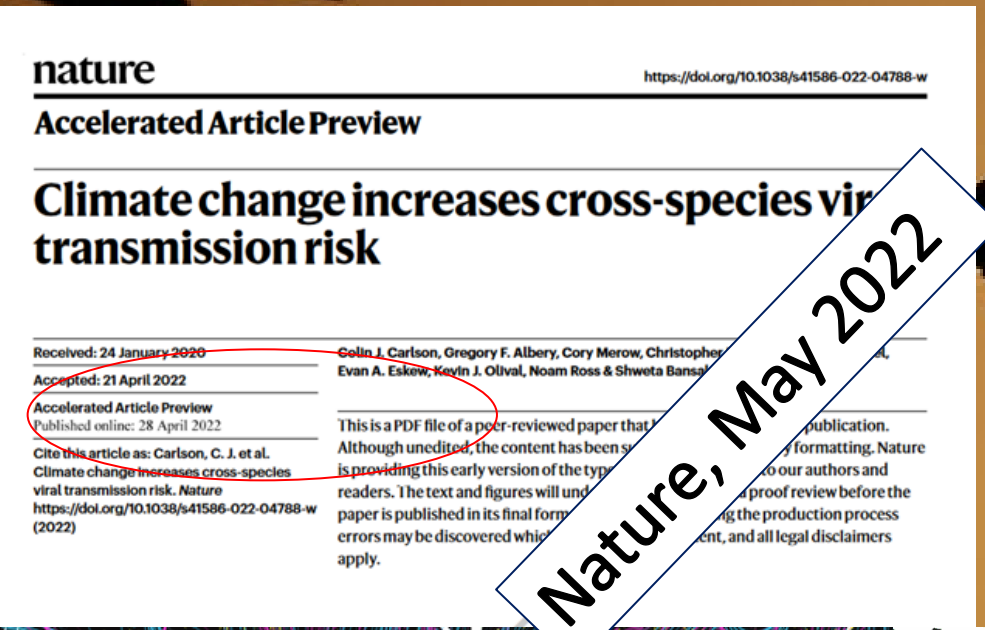
Recent syntheses indicate that several anthropic factors are crucial





Animals are likely to be more heavily infected, stressfull conditions impact their immunity, exchanges of pathogens between taxa, closer proximity to humans…

Climate change is forcing many animals to flee their natural geographic distribution



nature

https://doi.org/10.1038/s41586-022-04788-w

Accelerated Article Preview

Climate change increases cross-species vir transmission risk

Received: 24 January 2020

Accepted: 21 April 2022

Accelerated Article Preview
Published online: 28 April 2022

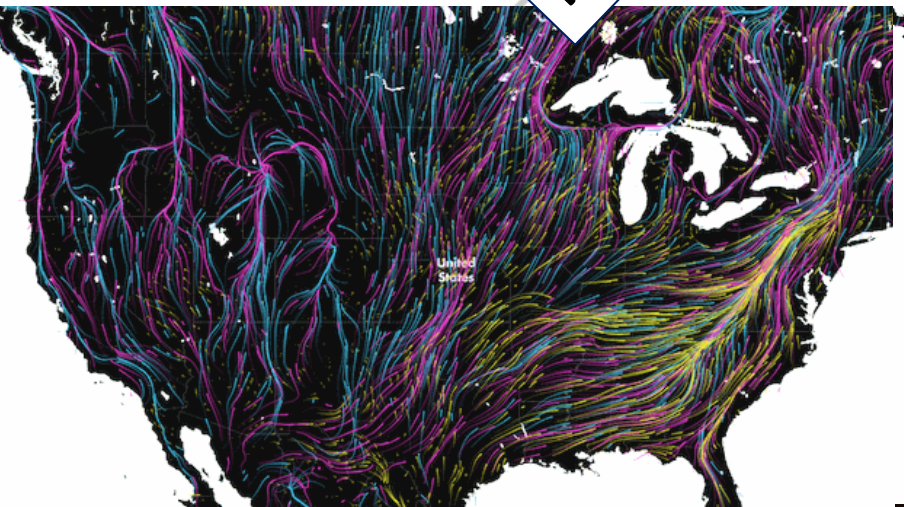
Cite this article as: Carlson, C. J. et al. Climate change increases cross-species viral transmission risk. *Nature* https://doi.org/10.1038/s41586-022-04788-w (2022)

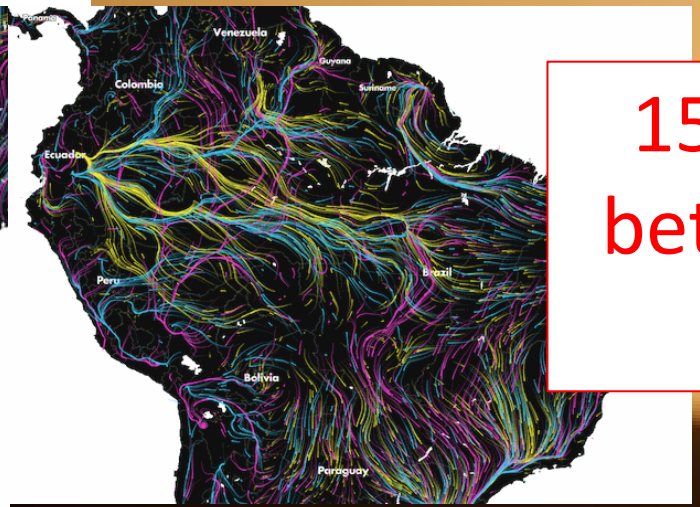
Colin J. Carlson, Gregory F. Albery, Cory Merow, Christopher … Evan A. Eskew, Kevin J. Olival, Noam Ross & Shweta Bansal …

This is a PDF file of a peer-reviewed paper that … publication. Although unedited, the content has been s… formatting. Nature is providing this early version of the typ… to our authors and readers. The text and figures will und… proof review before the paper is published in its final form… the production process errors may be discovered whic… nt, and all legal disclaimers apply.

Nature, May 2022

As a consequence, many species which usually do not interact together will suddenly do, and will transmit each other their pathogens





15 000 novel transmissions between species could occur before 2070 !

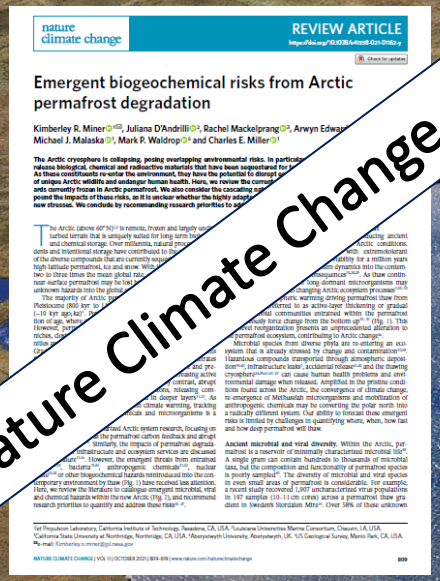
If the Arctic permafrost melts, the results could be catastrophic for the climate... But also as regard to pathogen emergences

2016: **Anthrax outbreak in Russia**



A heat wave is blamed for thawing a 75-year-old reindeer carcass, along with dormant spores of anthrax bacteria that infected it.

Permafrost thaw could release zombie bacteria and viruses


nature climate change

REVIEW ARTICLE

Emergent biogeochemical risks from Arctic permafrost degradation

Kimberley R. Miner, Juliana D'Andrilli, Rachel Mackelprang, Arwyn Edwards, Michael J. Malaska, Mark P. Waldrop and Charles E. Miller

Nature Climate Change, 2021



Dr Kimberley Miner from NASA Jet Propulsion Laboratory

"These microbes have coevolved with things like giant sloths or mammoths, and we have no idea what they could do when released into our ecosystems".

However, a good news: we can escape this era of emergence



Reducing anthropogenic global environmental change can reduce pandemic risk

ipbes

#PandemicsReport

Recommendations

We need a change of paradigm: **prevention is better than control**

Early detection
And surveillance

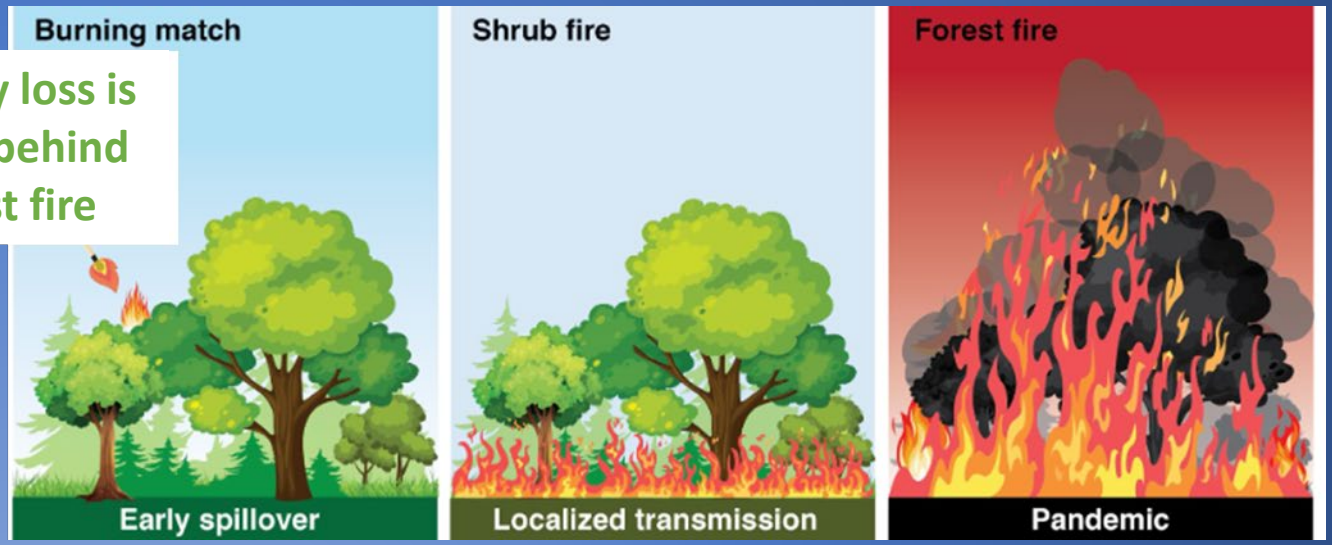


BUT ALSO

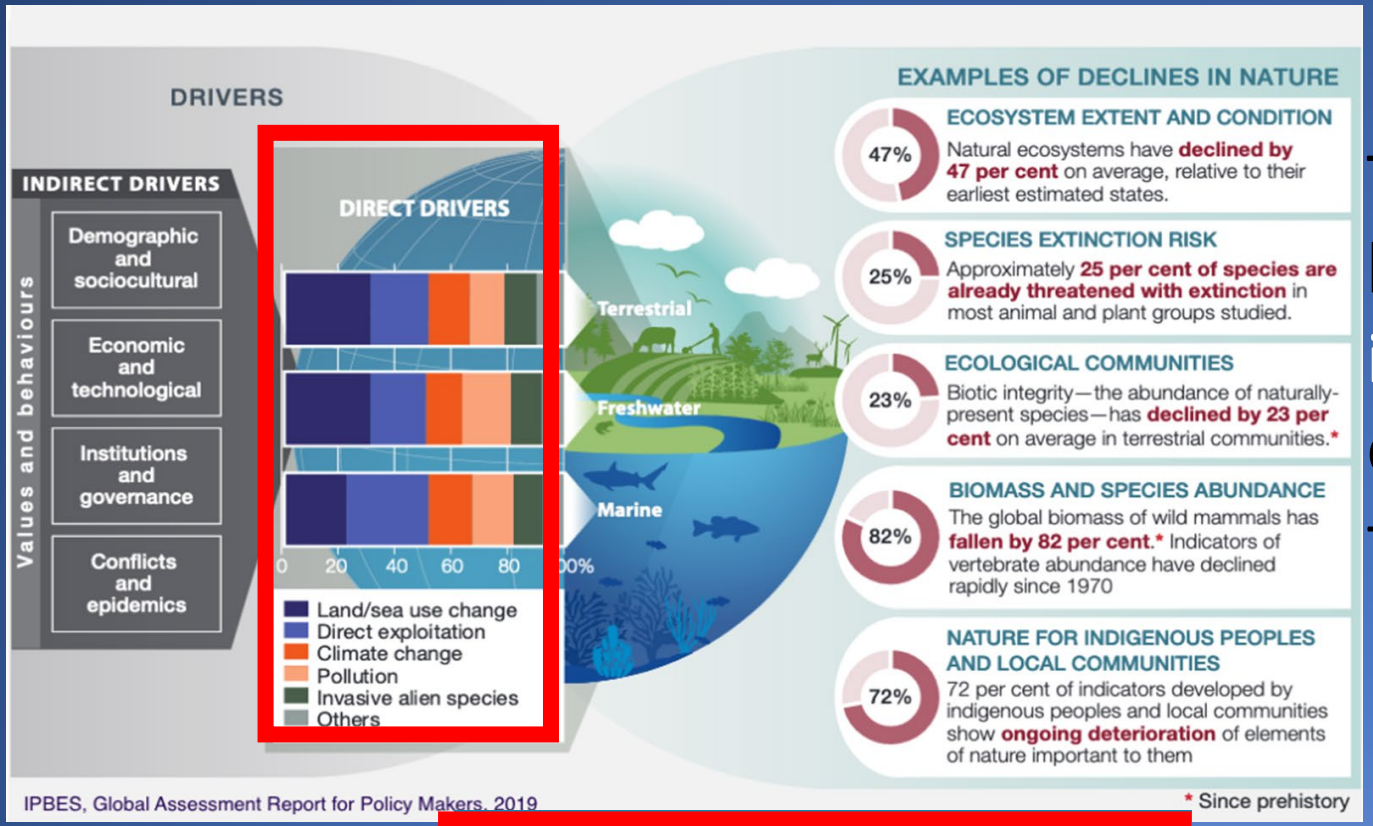
Management of ecosystems and socio ecosystems to Combine protection of the biodiversity, economic activity and reduced risk of emergences



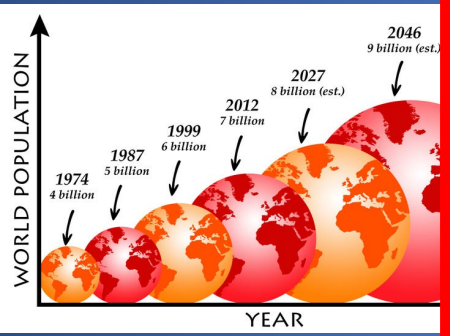
Biodiversity loss is the spark behind the forest fire

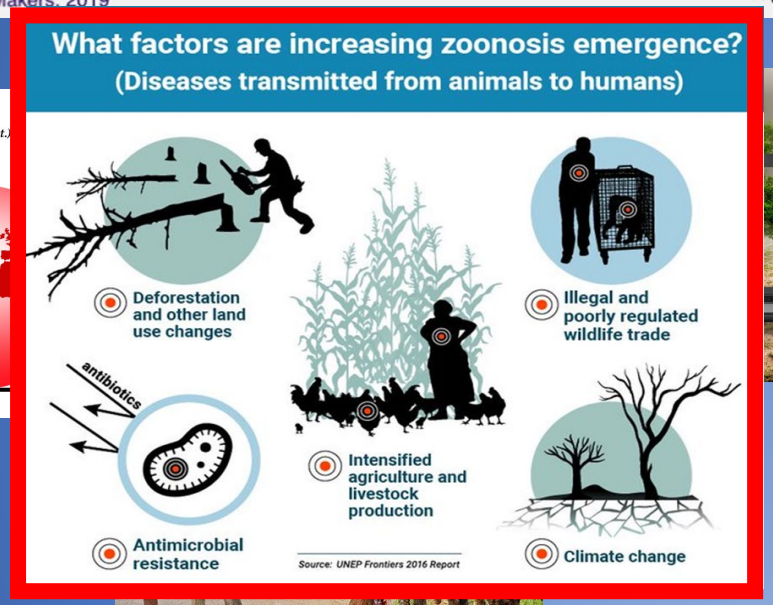


Prevention would be 100 times less costly than control !



The problem is however complex because drivers factors are often indirect… being for instance demographic, socio-cultural, economic, technologic, political, due to conflicts…











Recommendations on strengthening *One Health* approach

At the moment

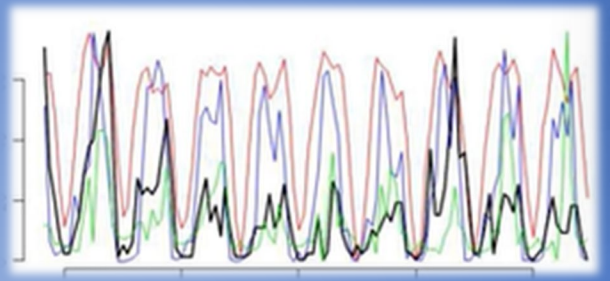
PREVENT - PREPARE- CONTROL



WE NEED TO DESIGN A SCIENCE-BASED PREVENTION STRATEGY ON THE LONG TERM

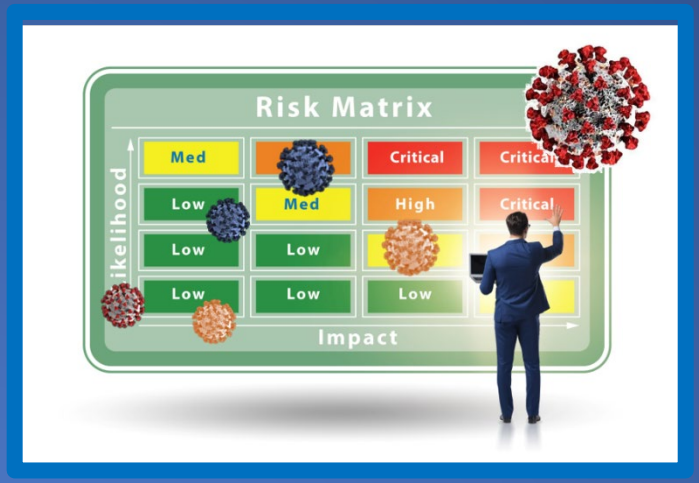


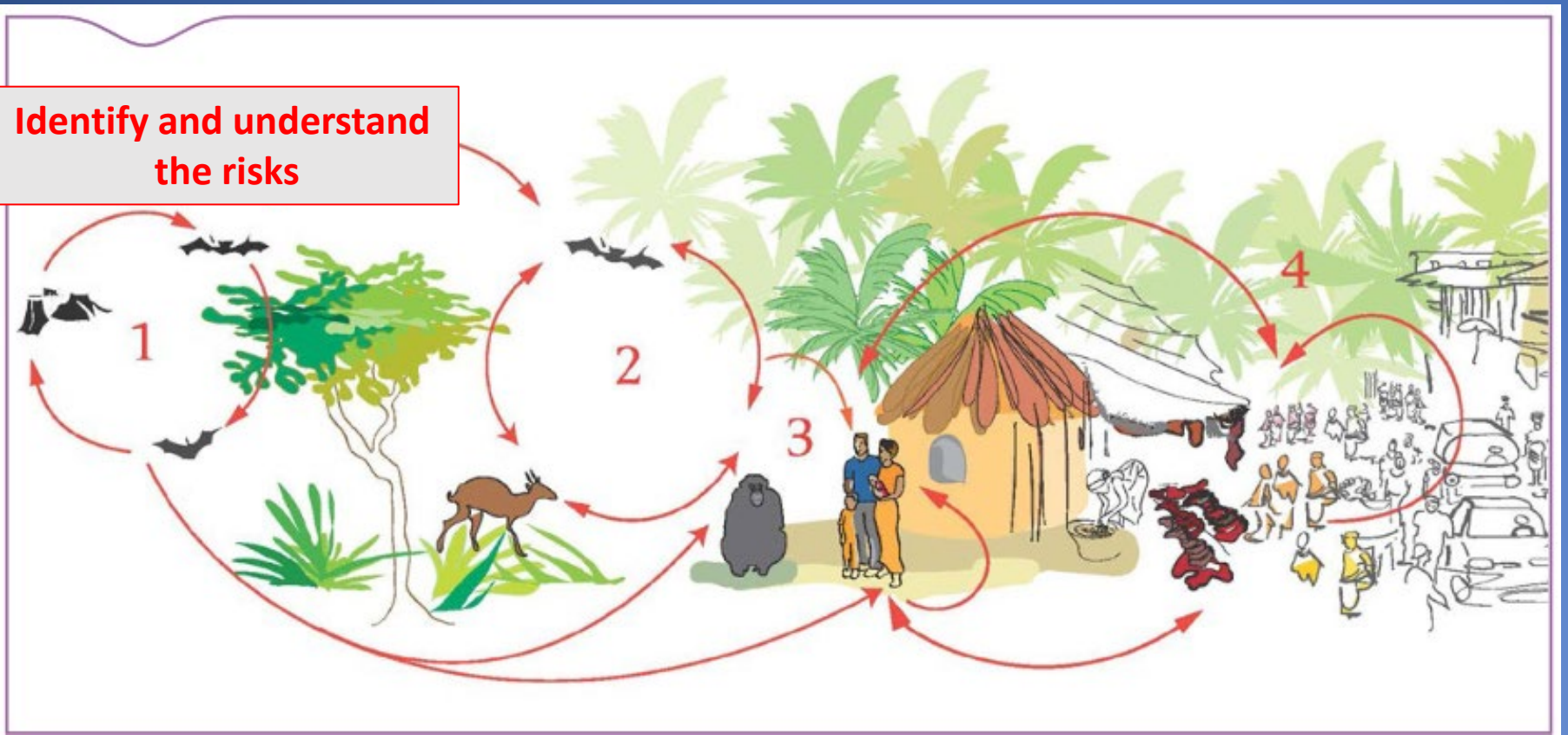
Without a preventive approach, emergence of novel diseases will be recurrent !



Recommendations

Identify and understand the risks,
Provide solutions to reduce them





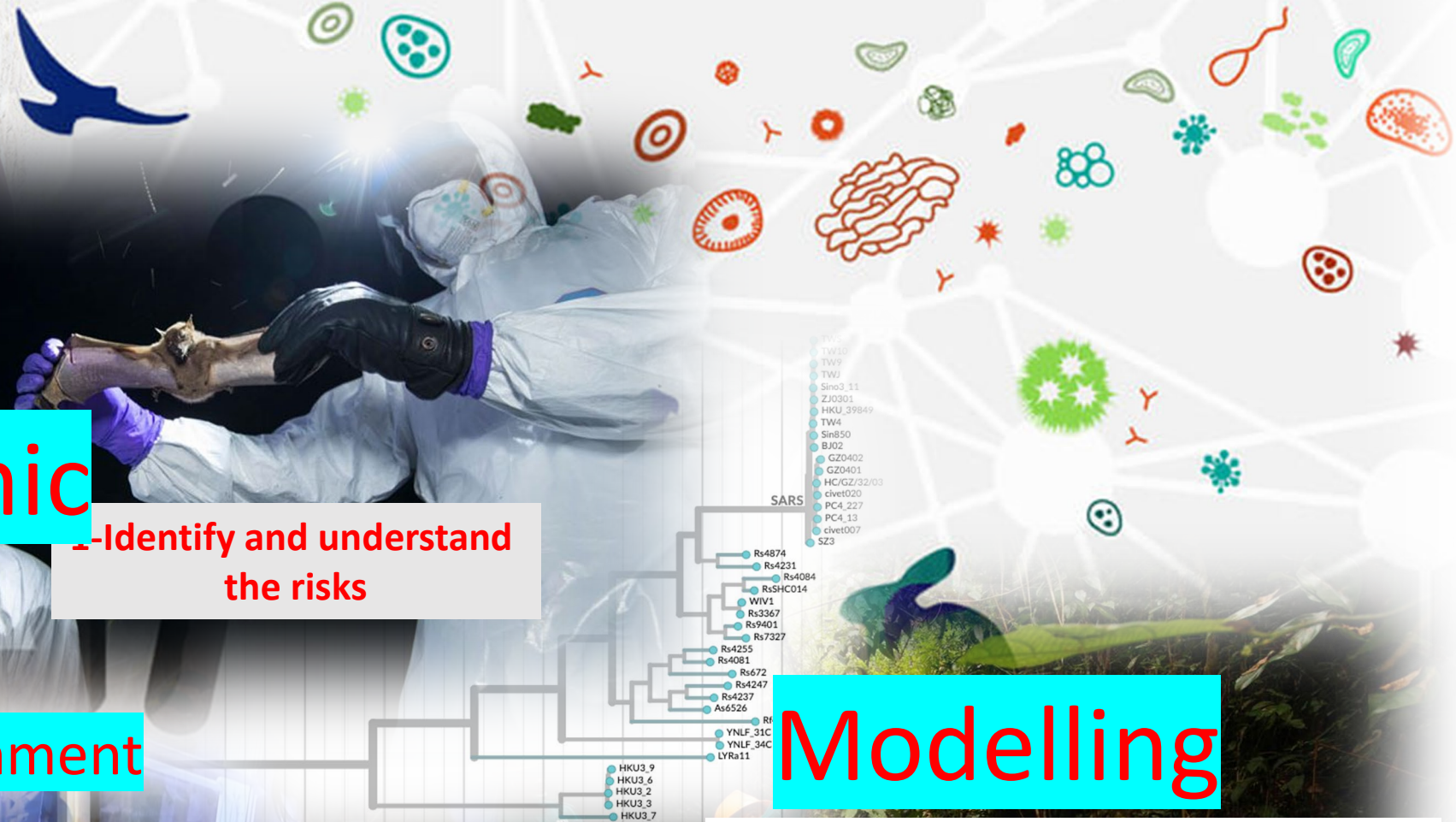
Deploy academic Research

1-Identify and understand the risks

Animals/Humans/Environment







Modelling



PHILOSOPHICAL TRANSACTIONS B

rstb.royalsocietypublishing.org

Review

Cite this article: Scoones I, Jones K, Lo Iacono G, Redding DW, Wilkinson A, Wood JLN. 2017 Integrative modelling for One Health:

Integrative modelling for One Health: pattern, process and participation

I. Scoones[1], K. Jones[2,3], G. Lo Iacono[4,5], D. W. Redding[2], A. Wilkinson[1] and J. L. N. Wood[4]

[1]STEPS Centre, Institute of Development Studies, University of Sussex, Brighton BN1 9RE, UK
[2]Centre for Biodiversity and Environment Research, Department of Genetics, Evolution and Environment, University College London, Gower Street, London WC1E 6BT, UK
[3]Institute of Zoology, Zoological Society of London, Regent's Park, London NW1 4RY, UK
[4]Department of Veterinary Medicine, Disease Dynamics Unit, University of Cambridge, Madingley Road, Cambridge CB3 0ES, UK
[5]Environmental Change, Public Health England, Didcot OX11 0RQ, UK

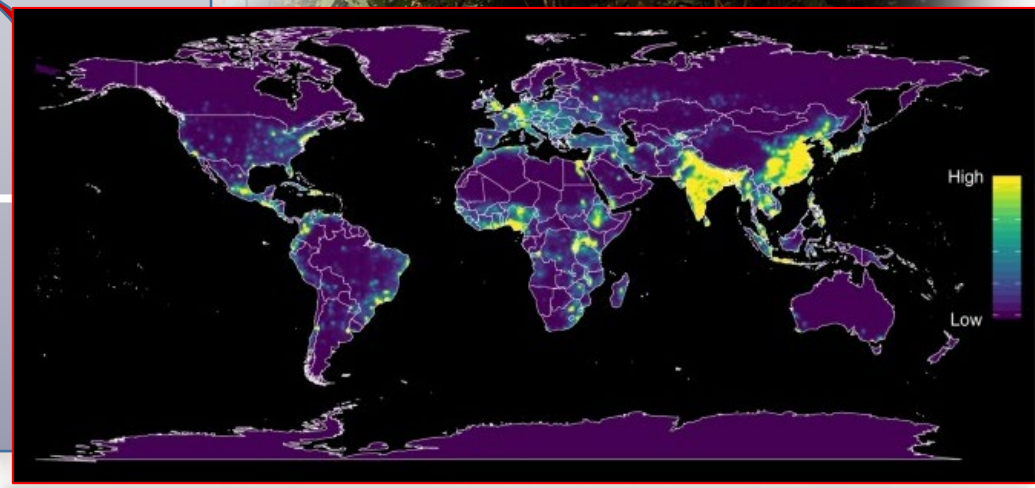
1-Identify and understand the risks

It is estimated that 1,7 millions of viruses are still unknown in mammals and birds, including 800000 potentially able to infect humans !







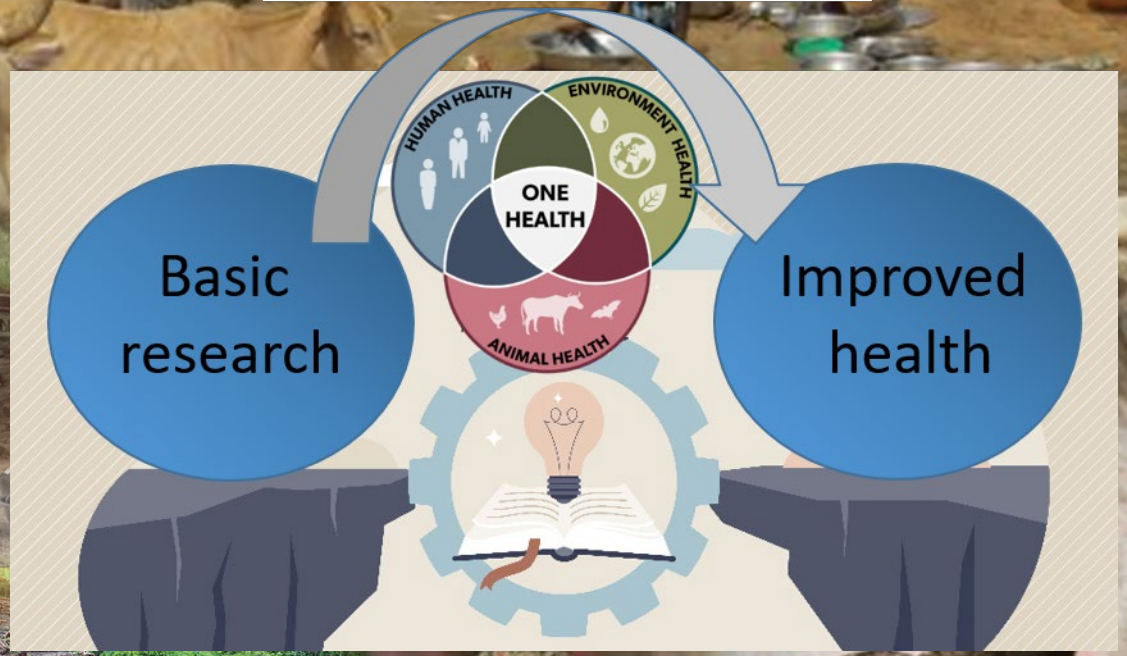


Recommendations on strengthening *One Health* approach

Identify and understand the risks,
Provide solutions to reduce them



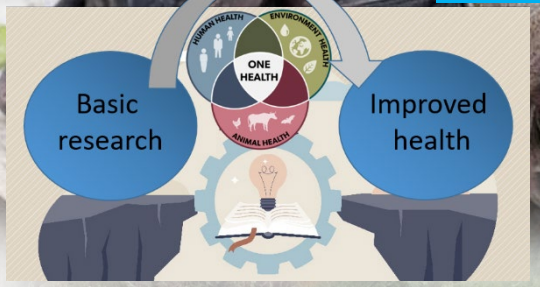
TRANSLATIONAL RESEARCH

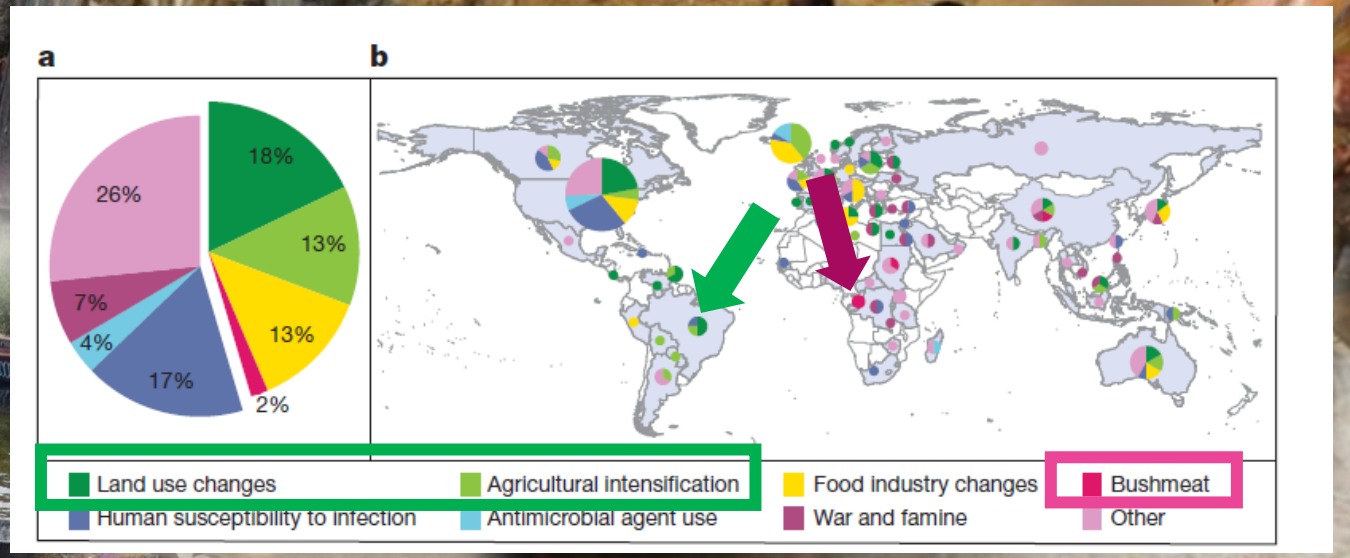


Reduce these risks

We need an **operational program**, to support and reinforce the implementation of sustainable prevention solutions against zoonoses, **adapted to local contexts** and environmental, climatic and social changes through a One Health approach. To be successful, programs must follow the pathways of sustainability, respect cultures, religions etc…

TRANSLATIONAL RESEARCH





Reduce these risks

We need an operational program, to support and reinforce the implementation of sustainable prevention solutions against zoonoses, adapted to local contexts and environmental, climatic and social changes through a One Health approach. **To be successful, programs must follow the pathways of sustainability for populations, respect their cultures, religions etc…**



A co-construction process

Reduce these risks

ONE HEALTH EDUCATION





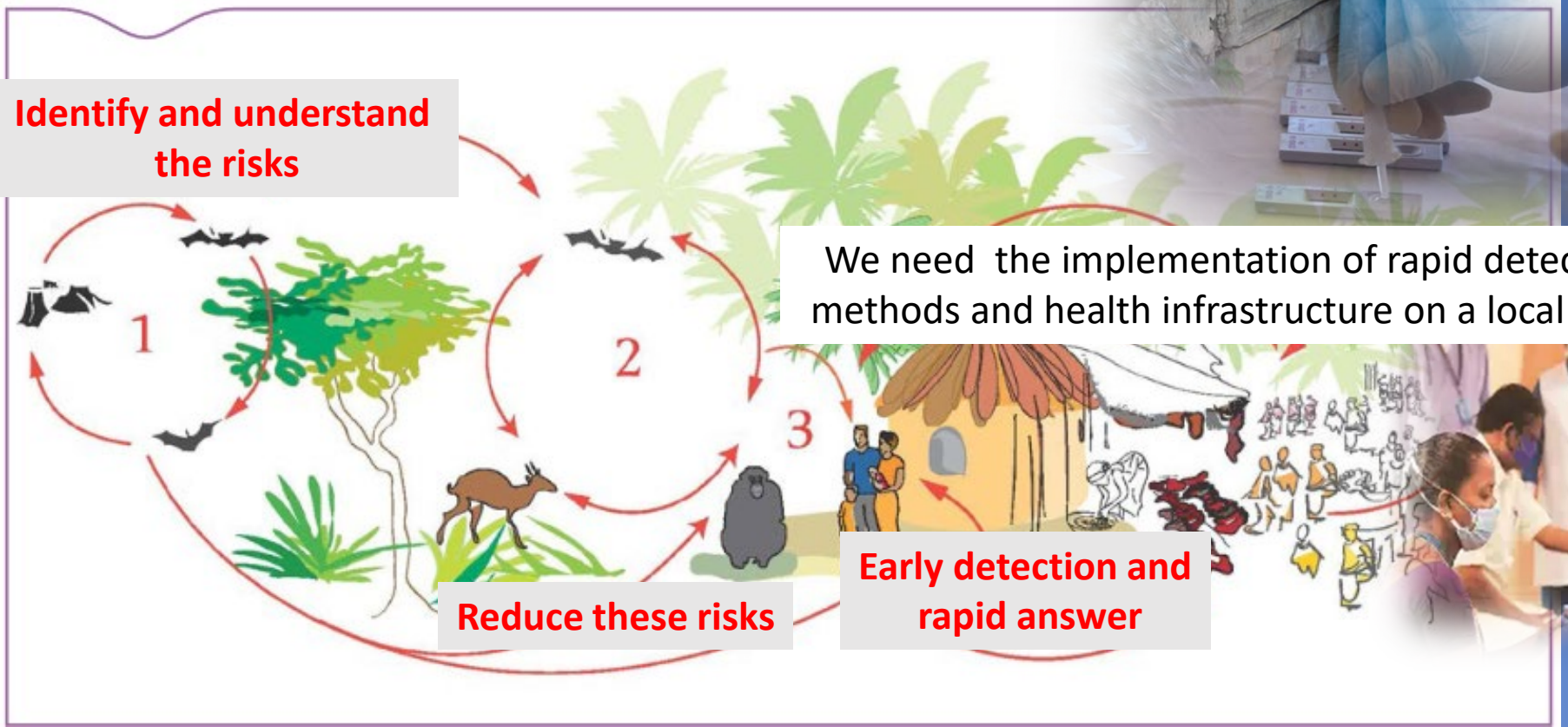




Prepare our students to be 1) critical thinkers who will inherently understand connections of human, animal and ecosystem health and 2) to be our future leaders and responsible citizens in our diverse, complex, and ever-changing world.

Recommendations

Identify and understand the risks,
Provide solutions to reduce them



We need the implementation of rapid detection methods and health infrastructure on a local scale



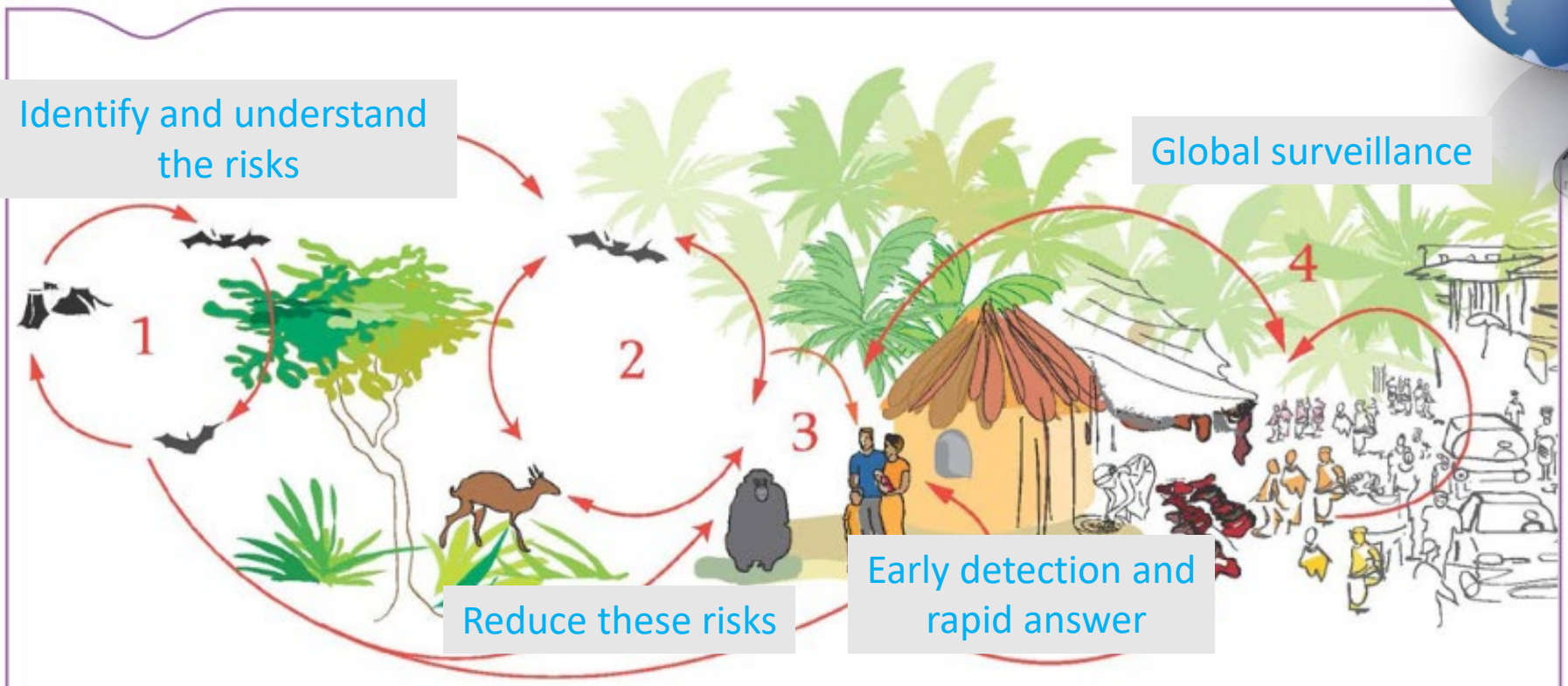


Recommendations

We need reinforce innovative surveillance systems, such as epidemiological surveillance platforms, surveillance of antimicrobial resistance in animals, early warning systems etc…

Reinforce early detection and surveillance on a global scale





Rapid response

We need scientists to work with other experts, from different sectors

- to share essential knowledge

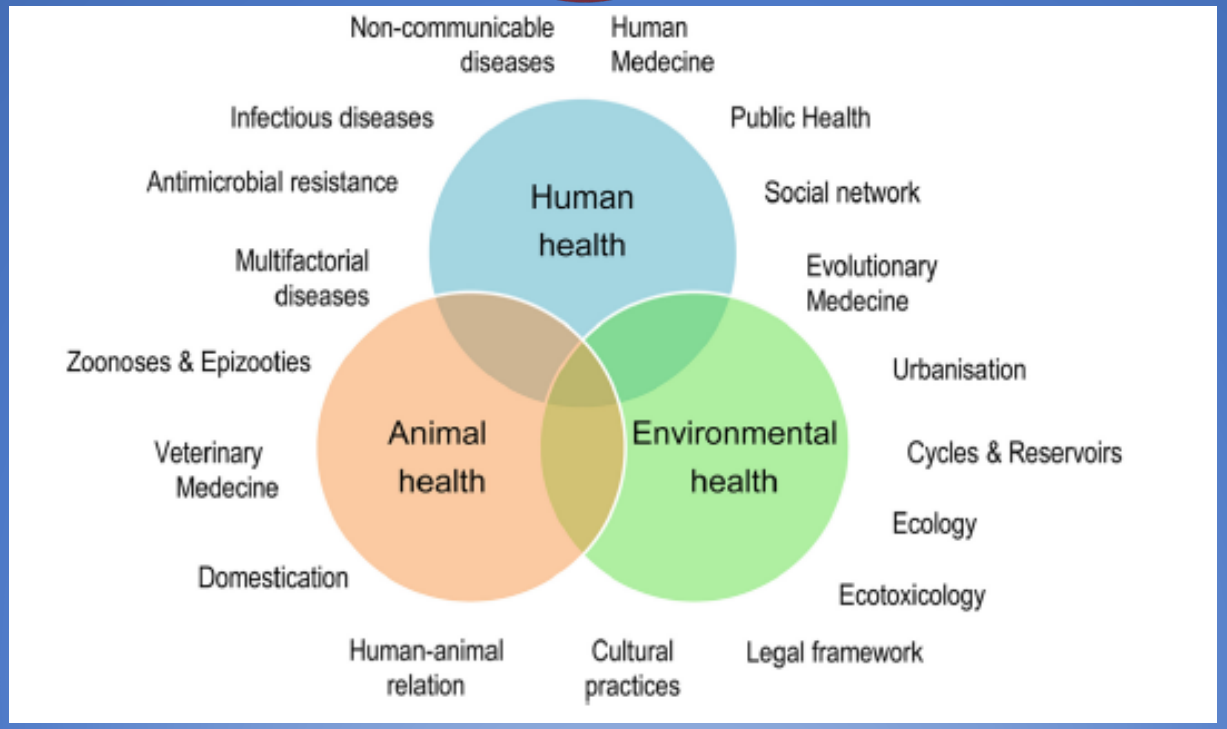
- to build a global network

- to design common response to global threats

The One Health approach proposes a HOLISTIC view of health, and it does

NOT consider only zoonotic and vector-borne diseases

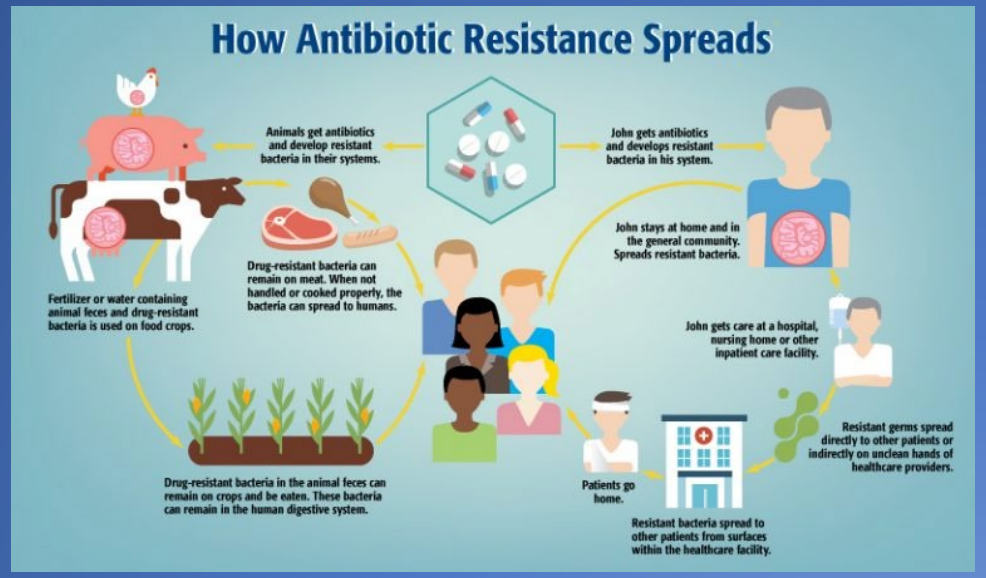




The One Health scope has broadened with the inclusion of other fields, like antimicrobial resistance (WHO, 2015), (eco)toxicology, health in urban environments (Destoumieux-Garzón et al., 2018), plant health and recently cancer (Dujon et al. 2021) .

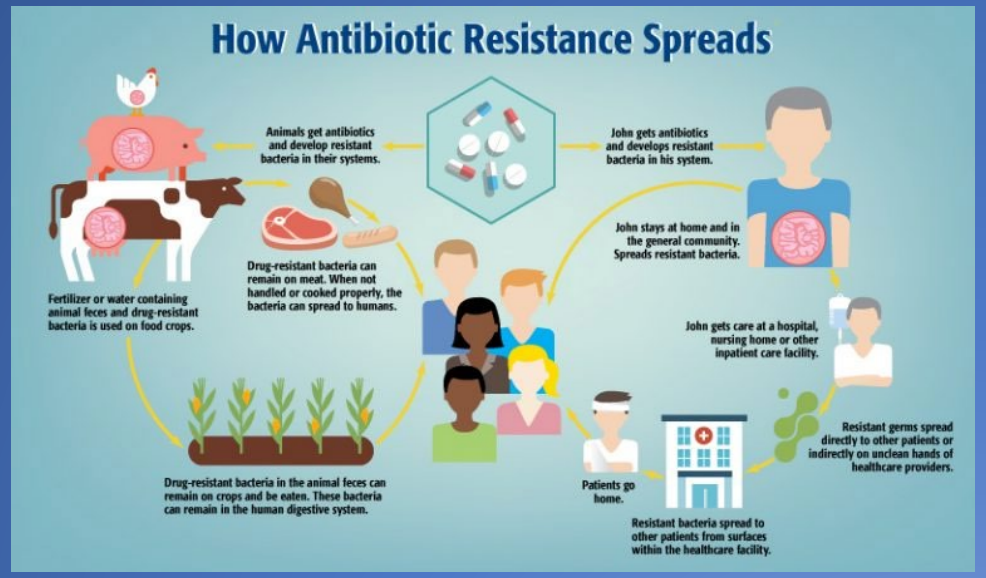
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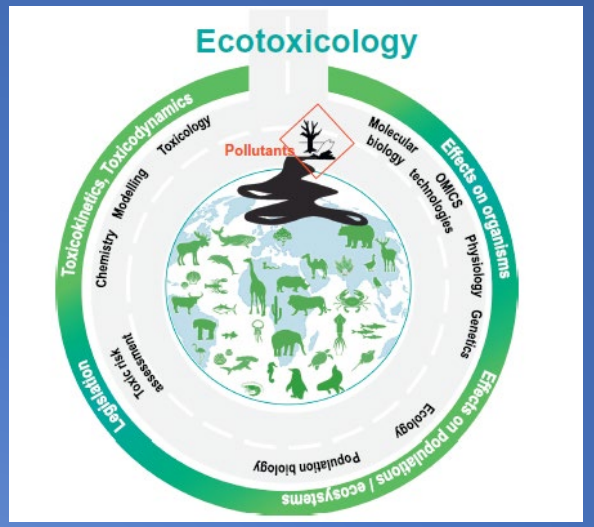




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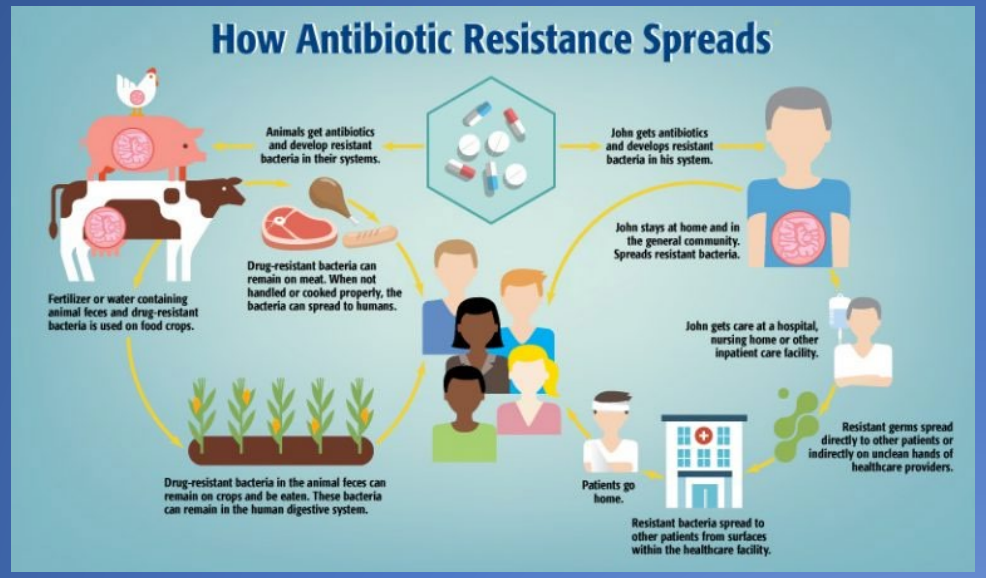


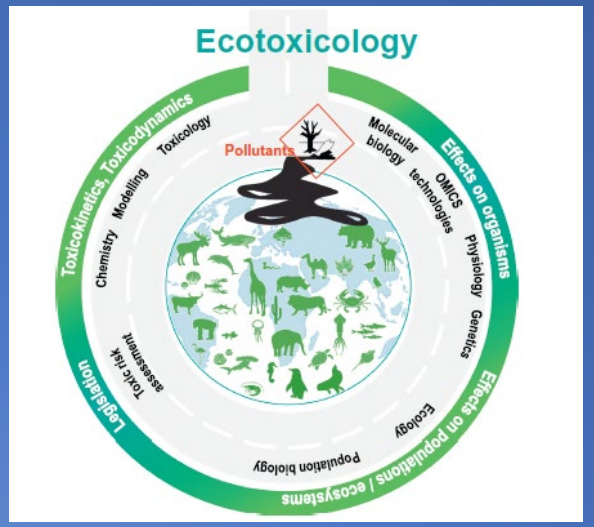




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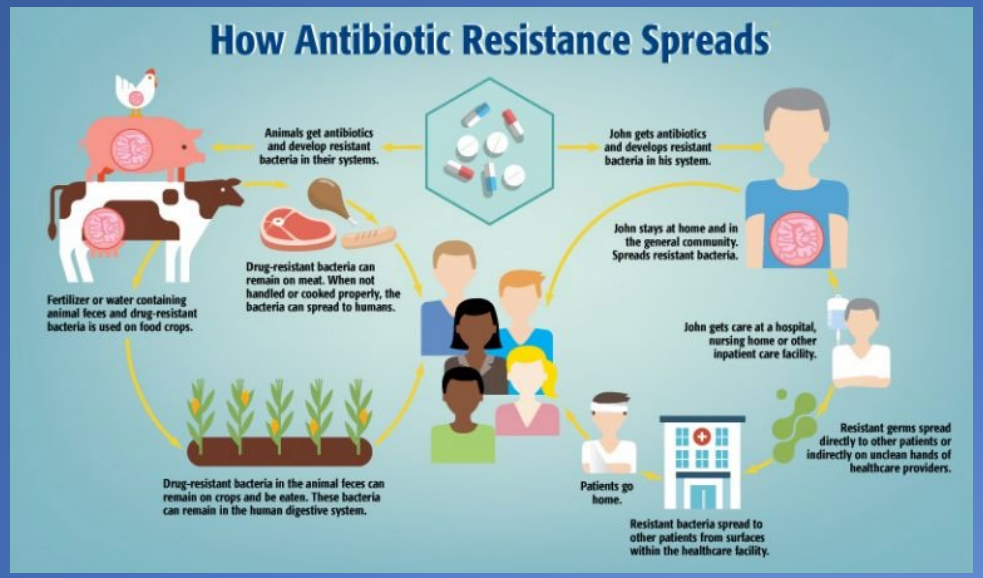


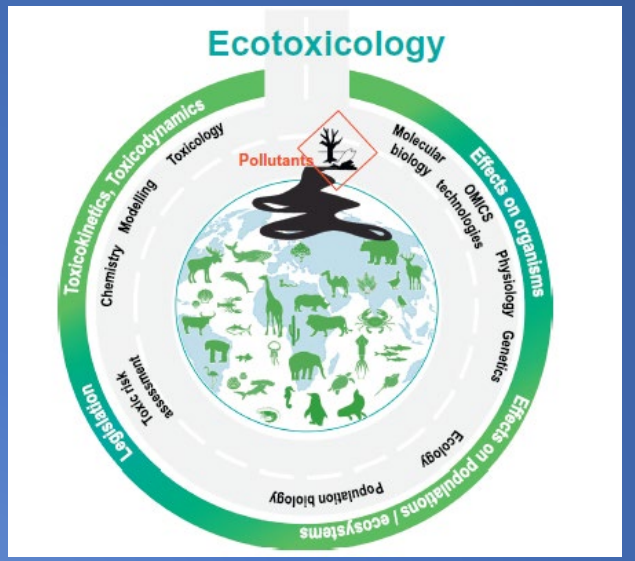




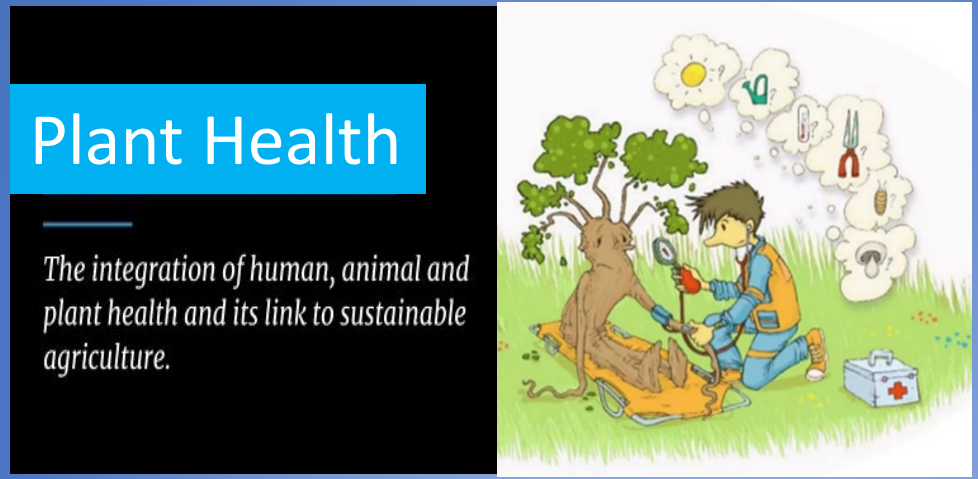
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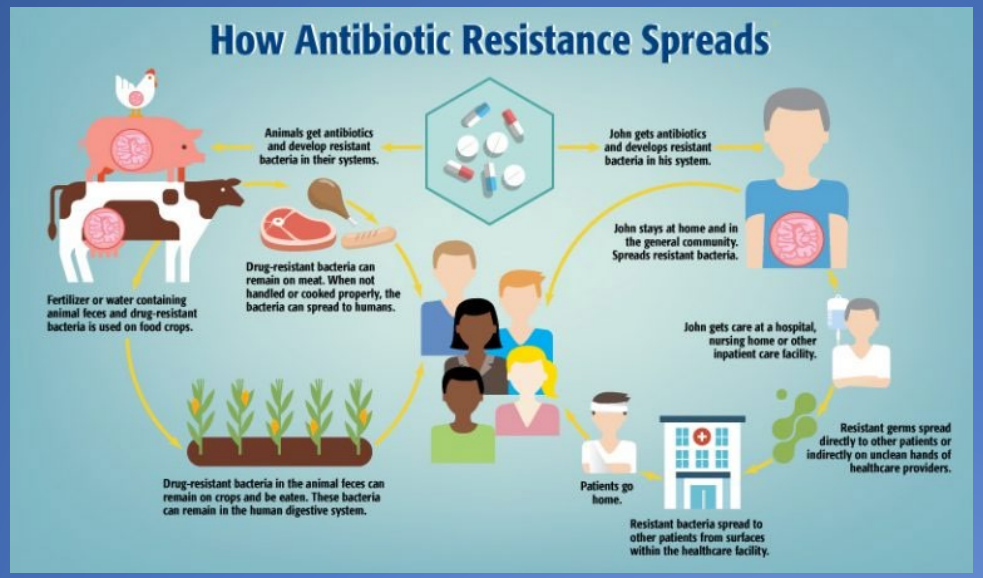


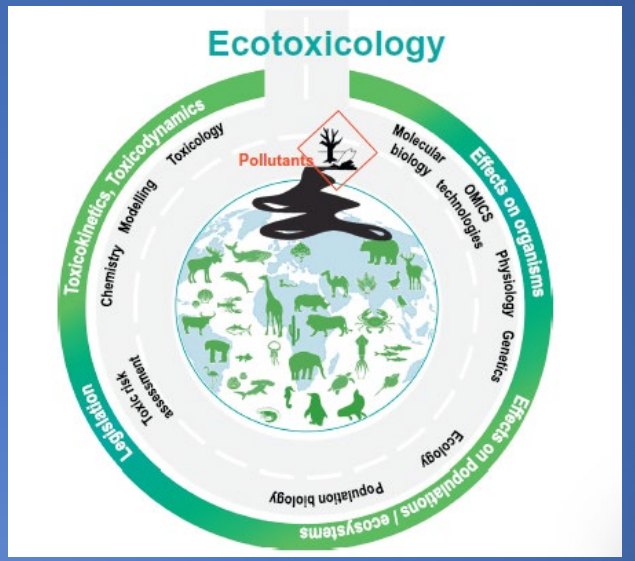




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BUILDING A HEALTHY URBAN ENVIRONMENT TOGETHER

ONE HEALTH

Plant Health

The integration of human, animal and plant health and its link to sustainable agriculture.





Received: 3 September 2021 | Revised: 10 September 2021 | Accepted: 12 September 2021
DOI: 10.1111/eva.13303

PERSPECTIVE

On the need for integrating cancer into the One Health perspective

Summary

Recent pandemics have highlighted the urgency to connect disciplines studying animal, human, and environment health, that is, the "One Health" concept. The One Health approach takes a holistic view of health, but it has largely

this bias are multiple, ranging from the fact that historically it has originated from a collaboration between human and veterinary medicines, and also because zoonotic diseases undoubtedly represent major health and economic threats to human societies. The scope has broadened with the inclusion of other fields, such as antimicrobial resistance (WHO, 2015), (eco)toxicology, and health in urban en-

Take-home messages



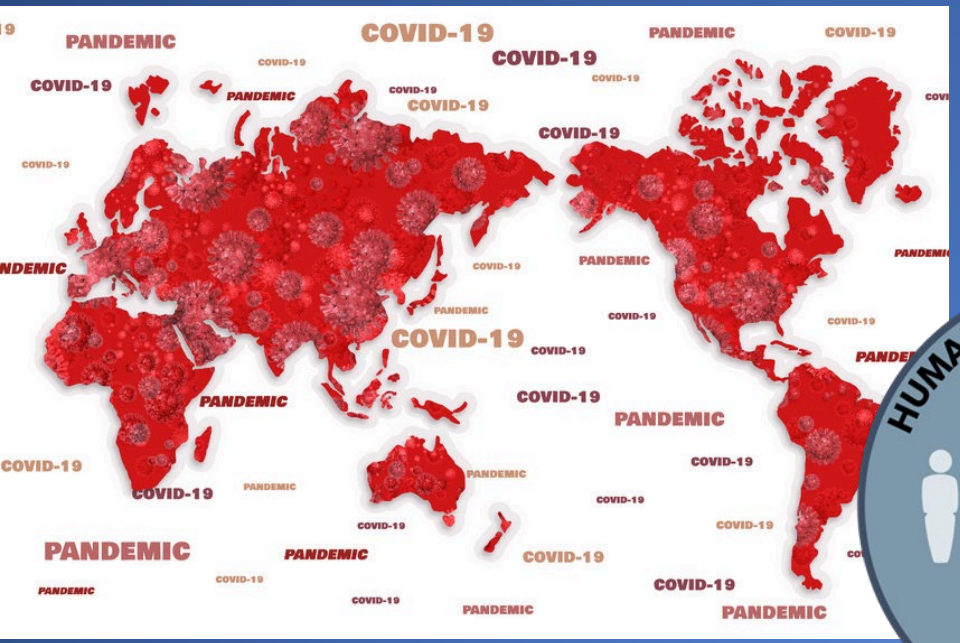
- It is not enough to control epidemics/pandemics, it would be much better to prevent them from ocurring

- We need to improve our understanding of the drivers and mechanisms of diseases' emergence at different scales

- We need to turn this knowledge into concrete strategies, easily adaptable by local stakeholders around the world

- A large collaboration and interdisciplinarian scope is key to the success of preventing pandemics

The Covid 19 pandemic has underlined the less than satisfactory integration of these issues…

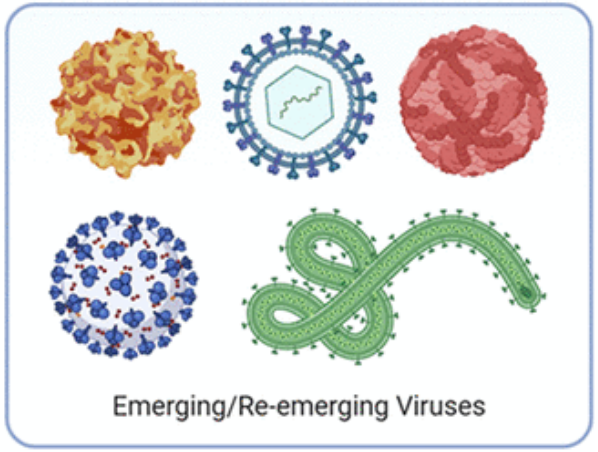


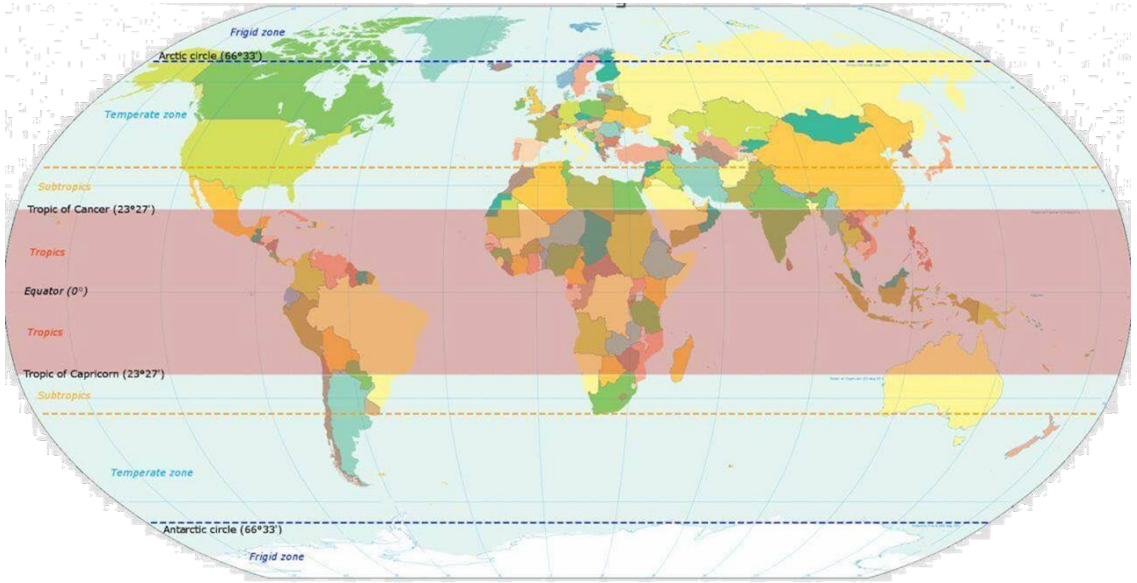




Despite considerable progress, One Health is still in its infancy and many major discoveries remain to be made. **For example, most of the work has been until now done in intertropical regions**, as these are important sources of infectious agents.





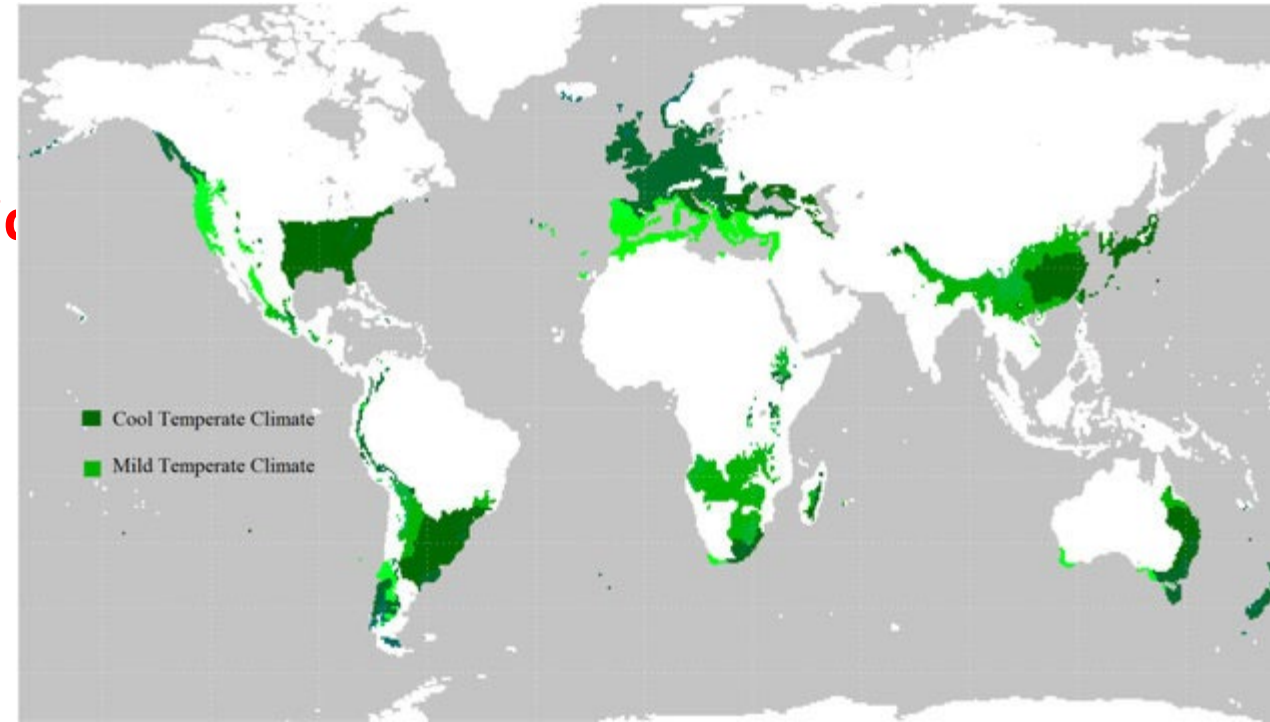


However, **some areas in temperate regions are theoretically very exposed to zoonotic risks**, due to the fact that they possess **hotspots of biodiversity, hosting many species of pathogens, reservoir hosts and vectors**, that they are intermingled with ecosystems partly occupied by different **human activities, coupled with the proximity to airports**, etc.

In such contexts, where the increasing effects of climate change are added, it becomes urgent to study those areas with an approach that integrates environmental, social-ecological and evolutionary research in health issues at the interface between humans, ecosystem and animals (both livestock and wildlife).

Camargue, the Rhone delta, is an emblematic spot of the south of France that typically corresponds to this situation.





What is the international context ?



A few words about the ZACAM Zone Atelier



The ZOOCAM Project

A few words about the ZACAM Zone Atelier



LTSER Network (Long-Term Socio-Ecological Research)



The Zones Ateliers (ZA) focus on a functional unit (a river and its watershed, landscapes - agricultural or urban - and biodiversity, from Antarctica to sub-Saharan Africa, or the coastline, or the environments characterized by chronic radiation of natural or enhanced natural origin) and develop a specific scientific approach based on observations and experiments on workshops sites, to conduct multidisciplinary research in the long term. A ZA is therefore, most often, a network of workshop sites.

An ongoing initiative… *16. ZA Santé-Environnement Camargue (ZACAM)*

1. ZA Alpes
2. ZA Arc Jurassien
3. ZA Armorique
4. ZA Bassin du Rhône
5. ZA Brest Iroise
6. ZA Environnementale Urbaine Strasbourg
7. ZA Hwange
8. ZA Loire
9. ZA Bassin de la Moselle
10. ZA Plaine et Val de Sèvre
11. ZA Pyrénées-Garonne
12. ZA Seine
13. ZA Antarctique
14. ZA Territoires Uranifères dans l'Arc Hercynien
15. ZA Environnementale Rurale

Qu’est-ce qu’une ZA ?

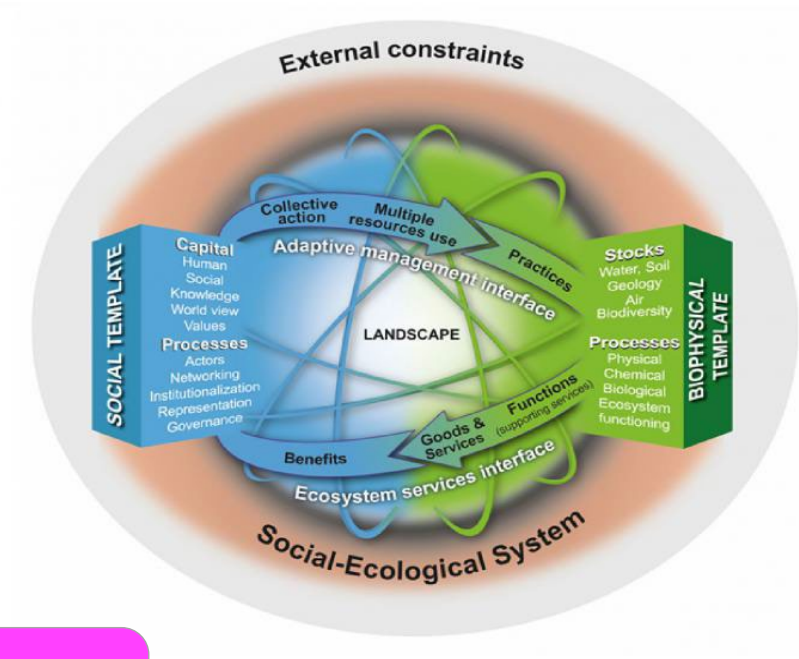
Dispositifs de recherche sur les socio-écosystèmes (SES)

Développent une recherche interdisciplinaire

Autour d’une unité fonctionnelle

Ancrés dans le temps long

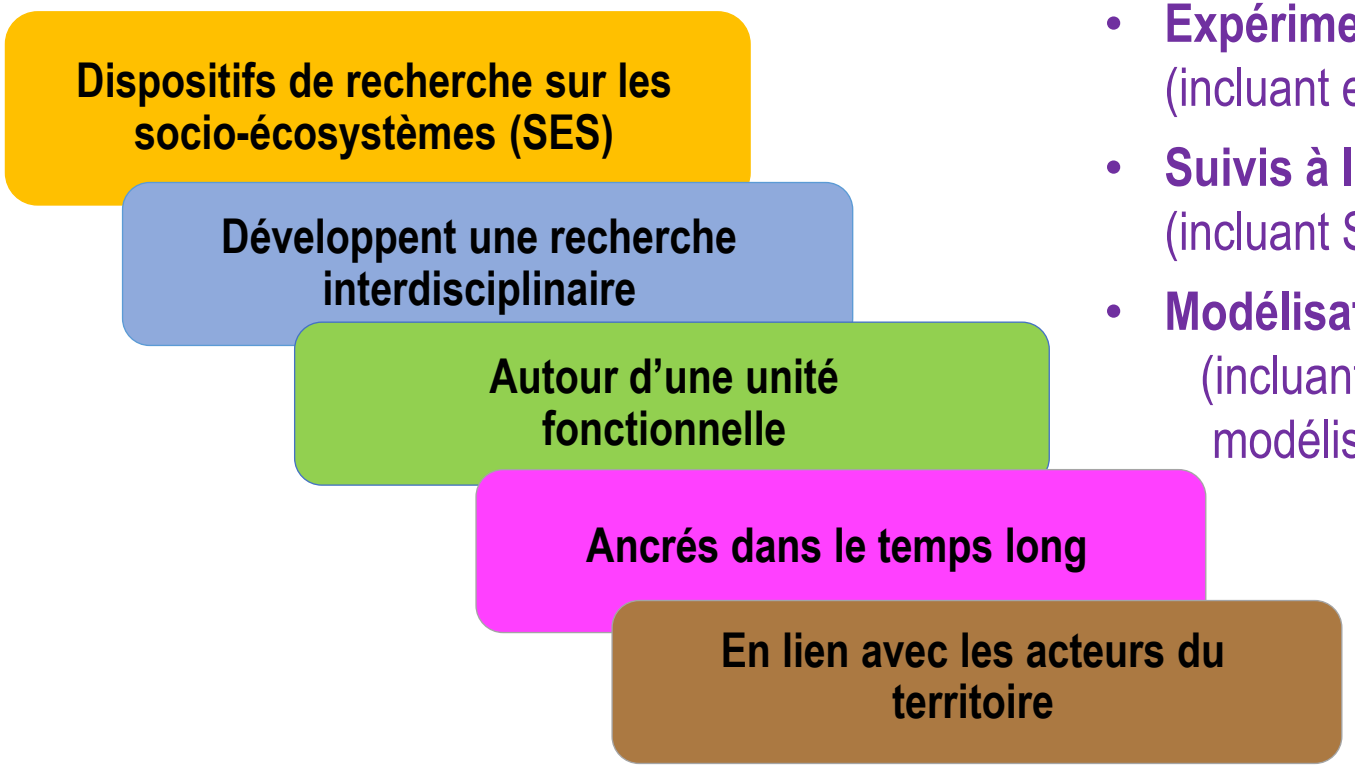
En lien avec les acteurs du territoire



Bretagnolle et al., 2019
Ecology and Society

Fonctionnement et évolution des SES

Une IR unique au plan national

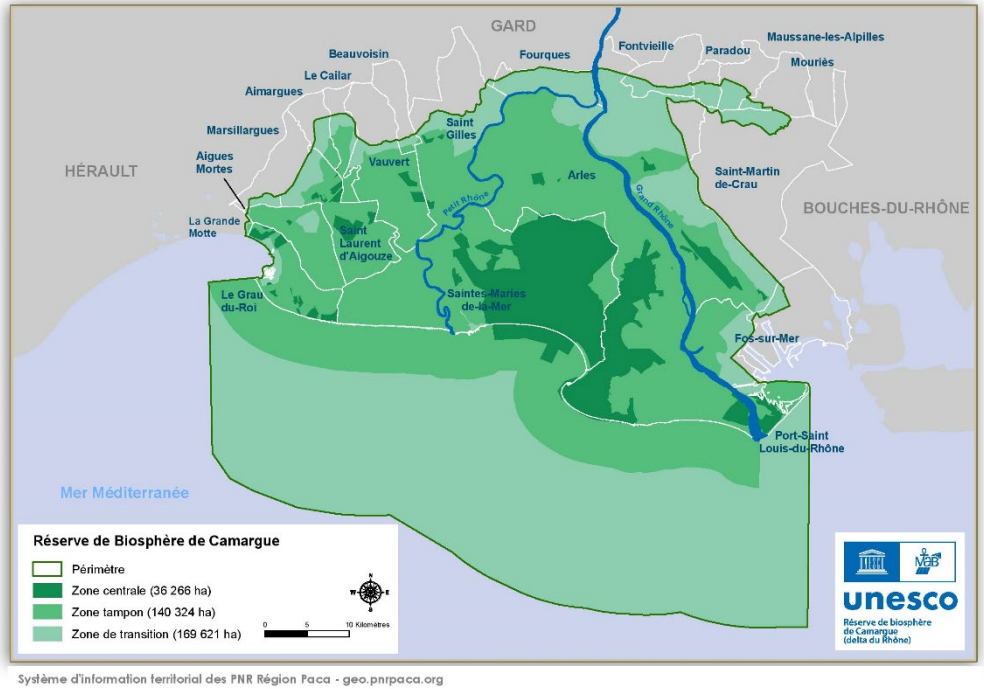


- **Expérimentation sur les SES** (incluant expé socio-écologiques)
- **Suivis à long terme** (incluant Sciences Participatives)
- **Modélisation, scénarisation** (incluant co-construction et modélisation d'accompagnement)

Aide à la décision

Perspective de transformation des territoires vers davantage de soutenabilité

The area :Camargue



Système d'information territorial des PNR Région Paca - geo.pnrpaca.org

The theme : socio-ecology of health



« full health » "that goes beyond One Health by explicitly integrating a questioning of the socio-economic and political systems to the interaction of the living, etc.

The approaches :

Parasitology, virology, bacteriology, hydrology, mathematics, conservation biology, ecotoxicology, chemistry, history, landscape ecology, geography, humanities and social sciences etc.

The scientists:

+ Multiple laboratories, universities and research organizations

Local actors :

The Regional Natural Park of Camargue, the National National Reserve of Camargue, the Tour du Valat, the community of communes, the farmers, hunters, associations...

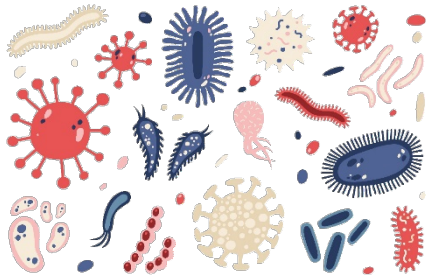
La labellisation de la ZACAM au sein du réseau

La ZA « Santé-environnement en Camargue » (ZACAM), labélisée en Janvier 2024 est :

- **La 16ème ZA du réseau**, proche géographiquement de la ZABR (Bassin du Rhône)*.
- **La 2ème ZA à l'interface Terre-Mer** après la **ZA Brest-Iroise**,
- **La 1ère spécifiquement inscrite sur le littoral Méditerranéen,**
- **La 1ère focalisée sur les questions de santé-environnement.**

** LA ZABR ne couvre pas le delta dans ses sites ateliers et qui ne traite pas non plus de problématiques d'écologie de la santé telles qu'envisagées dans la ZACAM*

4 health issues relevant to the Camargue



Zoonotic pathogens circulating and emerging



Antimicrobial resistance



Eco-toxicology



Eco-anxiety

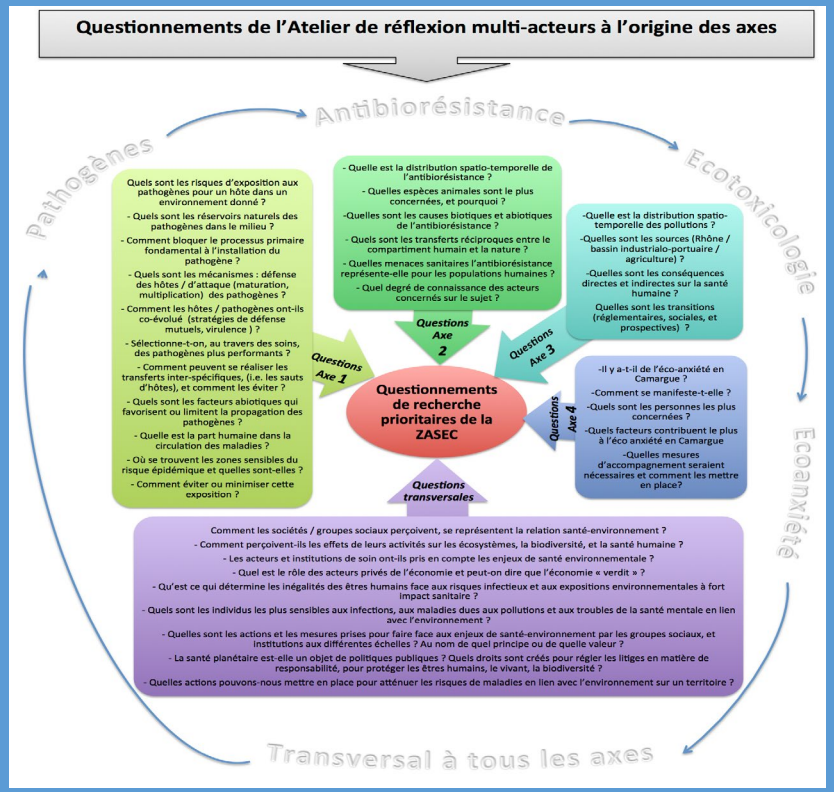
Two pillars to sustain to the 4 axes

Ecological health observatory: Scientific and citizen monitoring on impact of global change and human practices on health



Living lab:
Measuring the effects of a "full health" approach at the scale of the territory





Workshop 2 Décembre 2022
À la Tour du VALAT

Réunion SHS dans le cadre du montage de la ZA "Santé Environnement Camargue" 30 Mars 2023

(Salle 206 - Site Vauban – Université de Nîmes)

Zone Atelier « Health/Environment/Camargue »

OBJECTIVES

- Co-construct interdisciplinary research at the health x environment nexus in the Carmargue socio-ecosystem
- Characterize the operational links between humans and nature
- Addressing societal health issues in the Camargue
- To guide the Camargue socio-ecosystem towards resilience and sustainability in health
- To provide a knowledge base for decision-makers

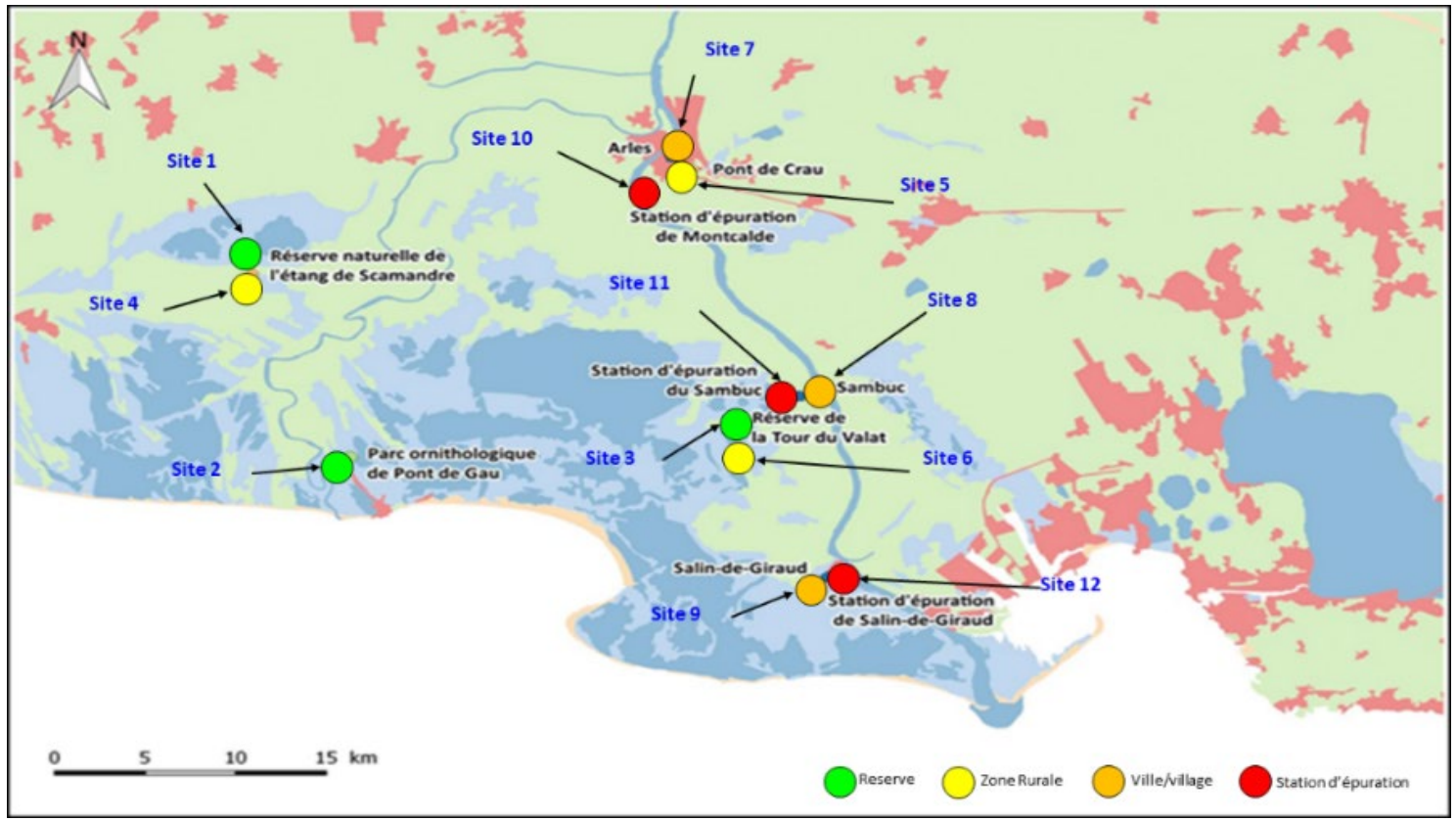
MEANS

- Long-term monitoring (including participatory science)
- Experiment innovative solutions with third parties within the Camargue socio-ecosystem
- Co-construction for the modeling and build scenarios of accompaniment
- Working groups on different health issues

A research on the
Health x Environment nexus
anchored in the
Camargue socio-ecosystem

Two key of challenges

Identification and instrumentation of workshop sites along urbanization gradients



Open-access and interoperability of health and environmental data



Partage / liens : Cat OPIDor, PNDB, GD4H, Promise, OBSTLAG, MESURHO, etc.

What is the international context ?



A few words about the ZACAM Zone Atelier



The ZOOCAM Project

Identification, characterization and circulation of potentially zoonotic pathogens in Camargue (Rhone Delta)



Projection du Clip ZOOCAM

French

Zones Ateliers
LTSER FRANCE CAMARGUE

Accueil | Présentation | Axes et initiatives | Données | Projets | Valorisation | Formation | Actualités



LA ZONE ATELIER SANTÉ-ENVIRONNEMENT CAMARGUE

La Camargue : un territoire de recherche

Façonnée par les eaux, la Camargue – au sens large, est un delta unique, foisonnant d'activités humaines et d'une biodiversité exceptionnelle. Ici, la préservation des patrimoines naturels et culturels se conjugue avec l'expérimentation du développement durable et l'adaptation au changement climatique


ZOOCAM
Thank you for your attention
cnrs
MITI
MISSION INTERDISCIPLINAIRE POUR LES INITIATIVES
PREZODE
Institut
exposUM
UNIVERSITÉ DE MONTPELLIER
horizon
europe

CLIP DE ZOOCAM

Lien vers le Clip du projet ZOOCAM

👉 **Découvrez la vidéo ici : https://youtu.be/_tkmQV85S60**

- Email / contact
- Frédéric Thomas : frederic.thomas2@ird.fr



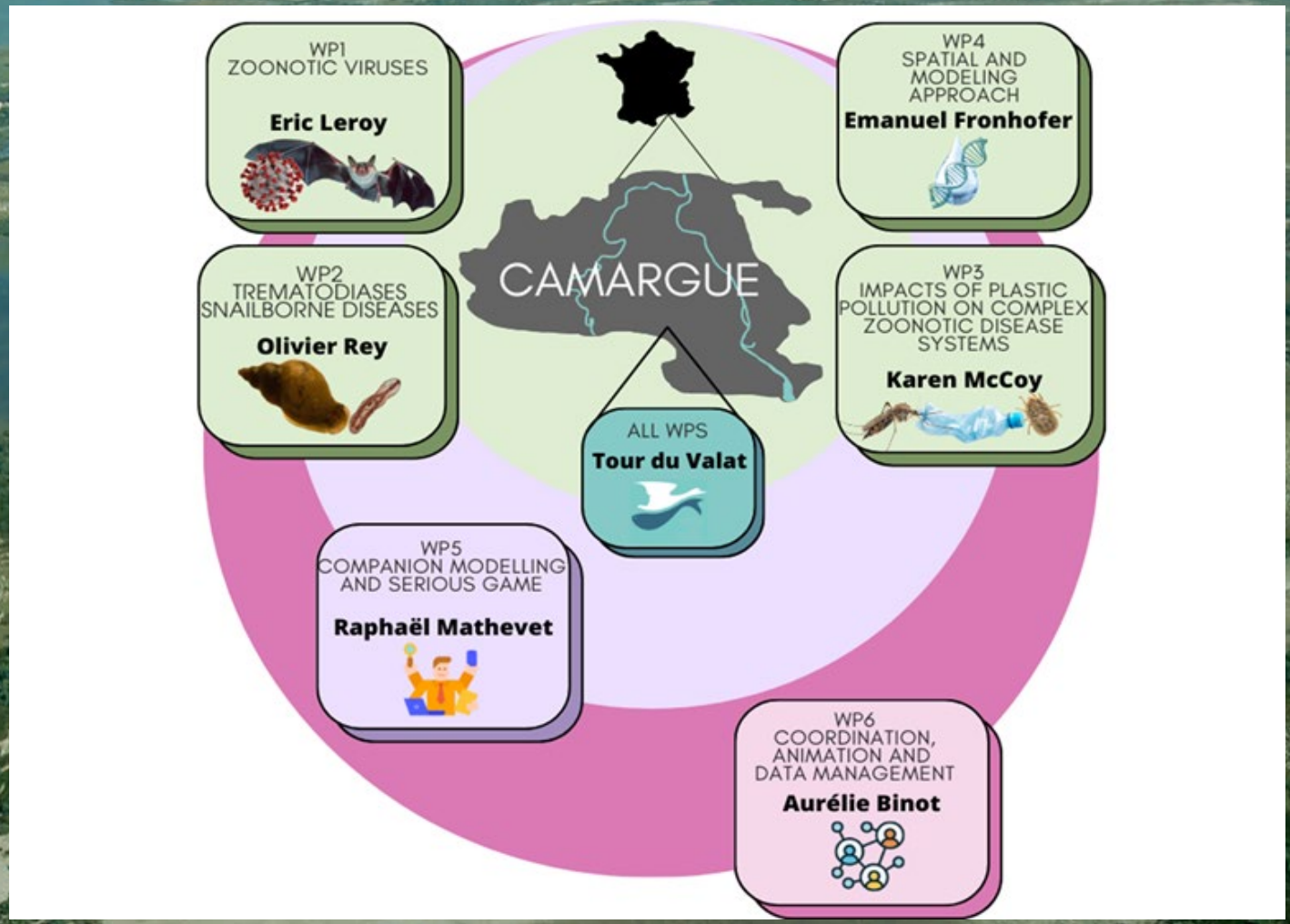
Suivre l'actualité du projet sur le site de la ZACAM

SLIDES SUPPLEMENTAIRES

ZOOCAM represents an exceptional springboard for developing research aimed at answering the following crucial and timely questions:

- **What are the dynamics of circulating and emerging zoonotic agents in the Camargue?**
- **What are human and environmental factors influencing the spread of zoonotic agents?**
- **Can current and emerging zoonotic risks be modeled and predicted?**
- **How are the risks perceived among local communities and stakeholders?**

Six Work Packages



WP1

Identification, caractérisation et circulation des virus potentiellement zoonotiques chez les mammifères sauvages de Camargue



- Rechercher les virus hébergés par les mammifères et susceptibles de se transmettre à l'Homme et de représenter un risque pour la santé publique
- Etudier la dynamique (prévalence et diversité) des virus identifiés au cours d'une année et la pondérer en fonction de critères d'intérêt
- Caractériser le génome des virus identifiés et identifier les traits évolutifs relatifs au franchissement de la barrière d'espèce
- Suivre l'évolution virale et l'évolution des communautés virales au sein de la zone d'étude



Porteurs : Frédéric THOMAS & Eric LEROY, MIVEGEC

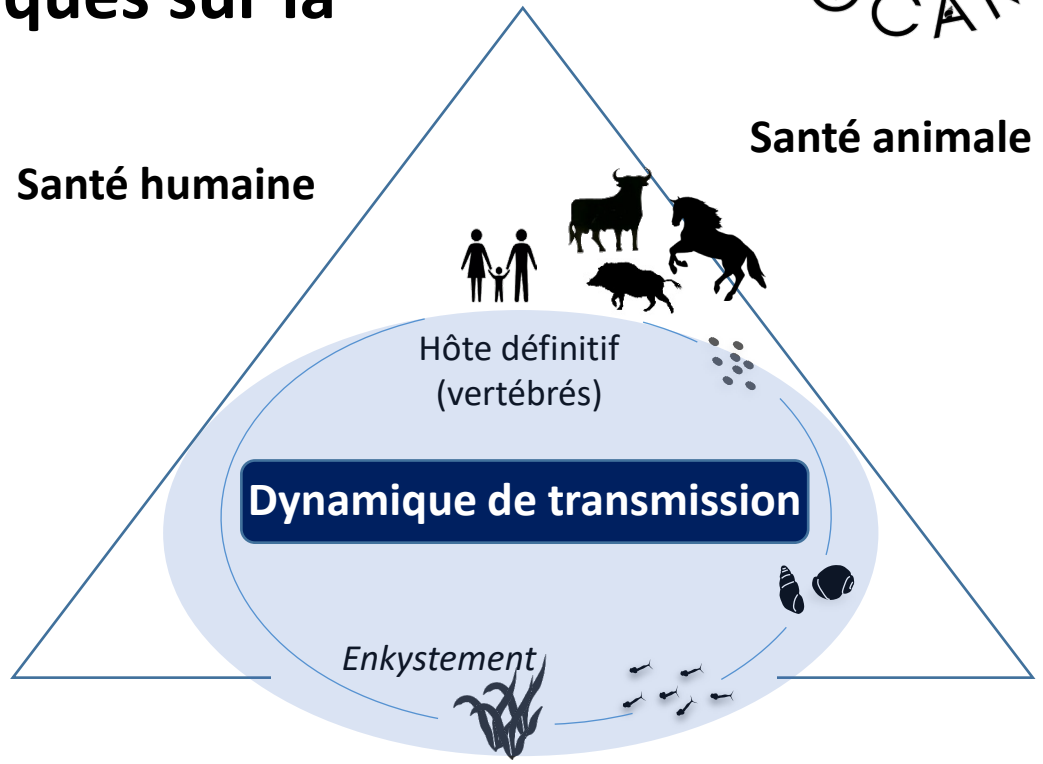
WP2

Impact des modifications des milieux aquatiques sur la dynamique de transmission de trématodes



Fasciola hepatica (pathogène zoonotique)
Calicophoron sp. (pathogène émergent)

- Caractériser les dynamiques spatio-temporelles de tous les trématodes associés aux écosystèmes aquatiques en Camargue. Cette tâche permettra une biosurveillance des trématodes entrant et potentiellement circulant en Camargue
- Identifier les facteurs biotiques et abiotiques, y compris ceux d'origine anthropique (polluants chimiques), qui influent sur la circulation des trématodes zoonotiques établis en Camargue
- Identifier les liens potentiels entre la tolérance des escargots aux polluants prédominants et leur compétence envers les trématodes zoonotiques





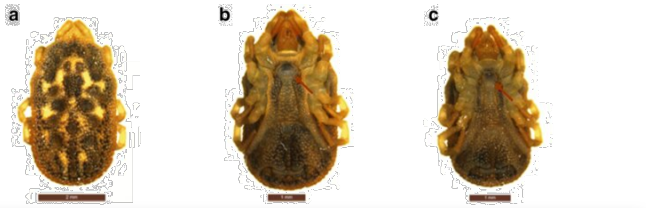
Porteur : Olivier REY, IHPE

WP3

Impacts de la pollution plastique sur des systèmes complexes de maladies zoonotiques

L’ objectif est d'étudier les conséquences de la pollution plastique sur la capacité vectorielle de trois espèces impliquées dans la transmission de pathogènes zoonotiques (parasites, virus, bactéries) : les tiques (*Ornithodoros maritimus*) qui transmettent la Babésie et des bactéries telles que les borrelies du groupe de la fièvre récurrente, les moustiques (*Culex pipiens*) qui transmettent le virus du Nil occidental, et les escargots d'eau douce (*Galba truncatula*) qui sont des hôtes intermédiaires clés de la fasciolose.









Évaluer les changements dans la capacité vectorielle implique deux composantes principales : 1) comprendre l'impact de la pollution plastique sur la démographie du vecteur, ce qui affecte la disponibilité du vecteur pour le pathogène, et 2) évaluer comment l'exposition affecte la capacité du vecteur à transmettre les pathogènes, c'est-à-dire la compétence vectorielle.

Porteur : Karen McCoy, MIVEGEC

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WP4

Approche spatiale et modélisation





Qu'est-ce qui détermine la présence des parasites et des agents pathogènes à différents endroits ? Existe-t-il des zones spécifiques dans un paysage qui abritent davantage ou moins de parasites, formant des zones chaudes et froides de diversité parasitaire ?

Comprendre les interdépendances entre l'incidence et la diversité des agents pathogènes/parasites, d'un côté, et la présence de vecteurs/hôtes et de variables écosystémiques, y compris des facteurs abiotiques mais aussi la santé et la stabilité de l'écosystème, de l'autre côté.

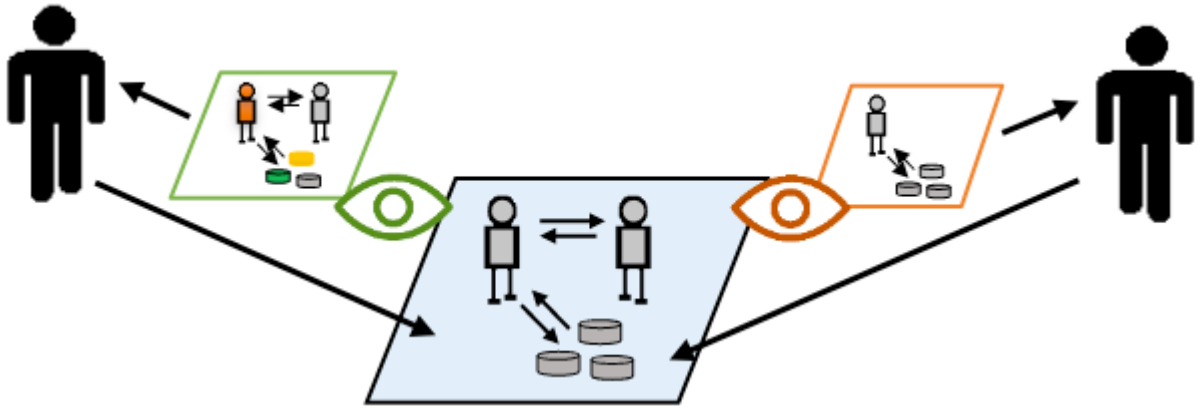
- la surveillance de la biodiversité dans l'espace et le temps
- la mesure du fonctionnement de l'écosystème dans l'espace et le temps
- la synthèse et l'intégration via la modélisation mathématique de la Camargue en tant que méta-écosystème hôte-parasite spatialement structuré

Porteur : Emanuel Fronhofer ISEM, CNRS

WP5

Modélisation compagnon et jeu sérieux

Sur la base des données générées par les précédents work packages, et dans le but de produire des connaissances et/ou de soutenir la réflexion collective sur la gestion des zoonoses, nous impliquerons les parties prenantes dans une approche de modélisation compagnon les amenant à co-construire une approche intégrée de gestion adaptative des zoonoses. **La modélisation compagnon consiste à mettre en place une approche de modélisation participative, itérative et continue. Cette approche de modélisation participative peut utiliser des outils de simulation à base d'agents et des jeux de rôle qui seront utilisés pour explorer l'émergence, la propagation et les impacts des zoonoses, ainsi que des scénarios de contrôle**. Ces outils pourraient être utilisés dans (1) la formation ; (2) des ateliers de sensibilisation et d'aménagement du territoire avec les parties prenantes ; (3) des ateliers multi-acteurs visant à améliorer les moyens de surveillance et d'évaluation des zoonoses

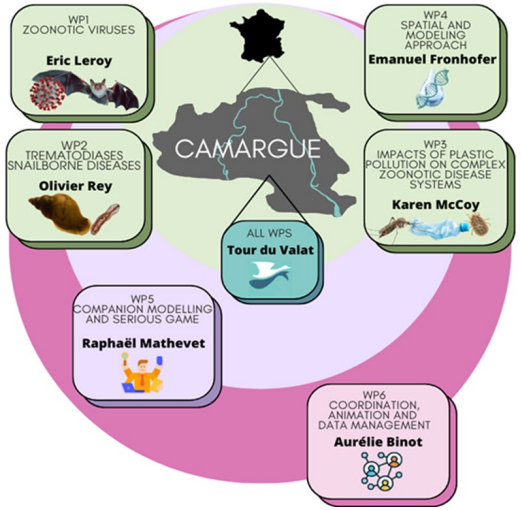


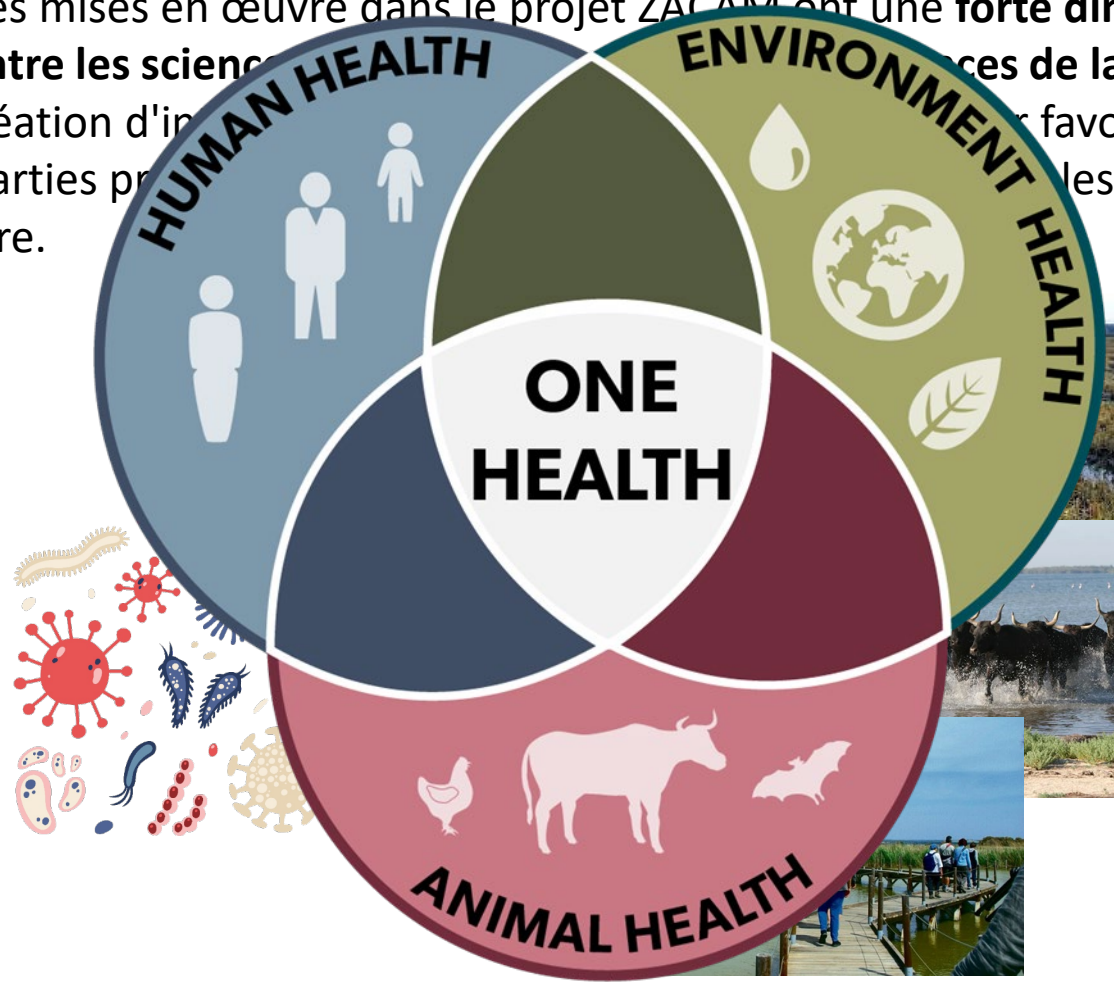
Porteur : Raphaël Mathevet

WP6

Coordination, animation et gestion des données

Étant donné que les activités mises en œuvre dans le projet ZACAM ont une **forte dimension interdisciplinaire, notamment à l'interface entre les scienc ces de la vie et de l'environnement**, elles impliquent également la création d'in favoriser l'émergence de processus de co-construction entre les parties pr les résultats de la recherche, dans une perspective transdisciplinaire.







Porteur : Aurélie Binot

ZOOCAM

Lien vers le Clip du projet ZOOCAM

👉 **Découvrez la vidéo ici :** https://youtu.be/_tkmQV85S60

Email / contact

Frédéric Thomas : frederic.thomas2@ird.fr



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