[Conservation Medicine]
Surveillance and early detection at the interface: getting off the beaten path

SABIO
Sanidad y Biotecnología
Health and Biotechnology

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CSIC

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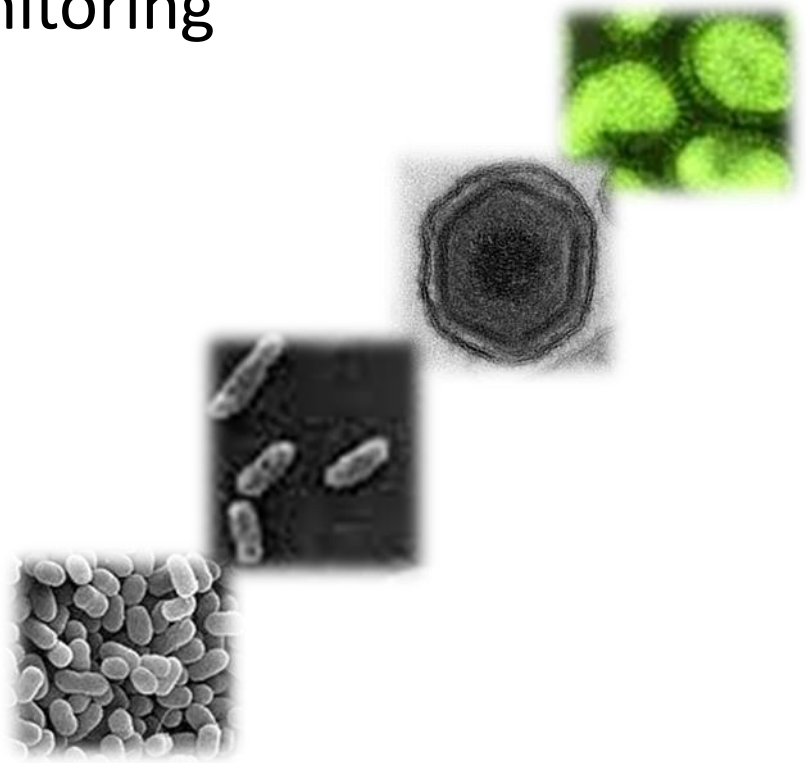
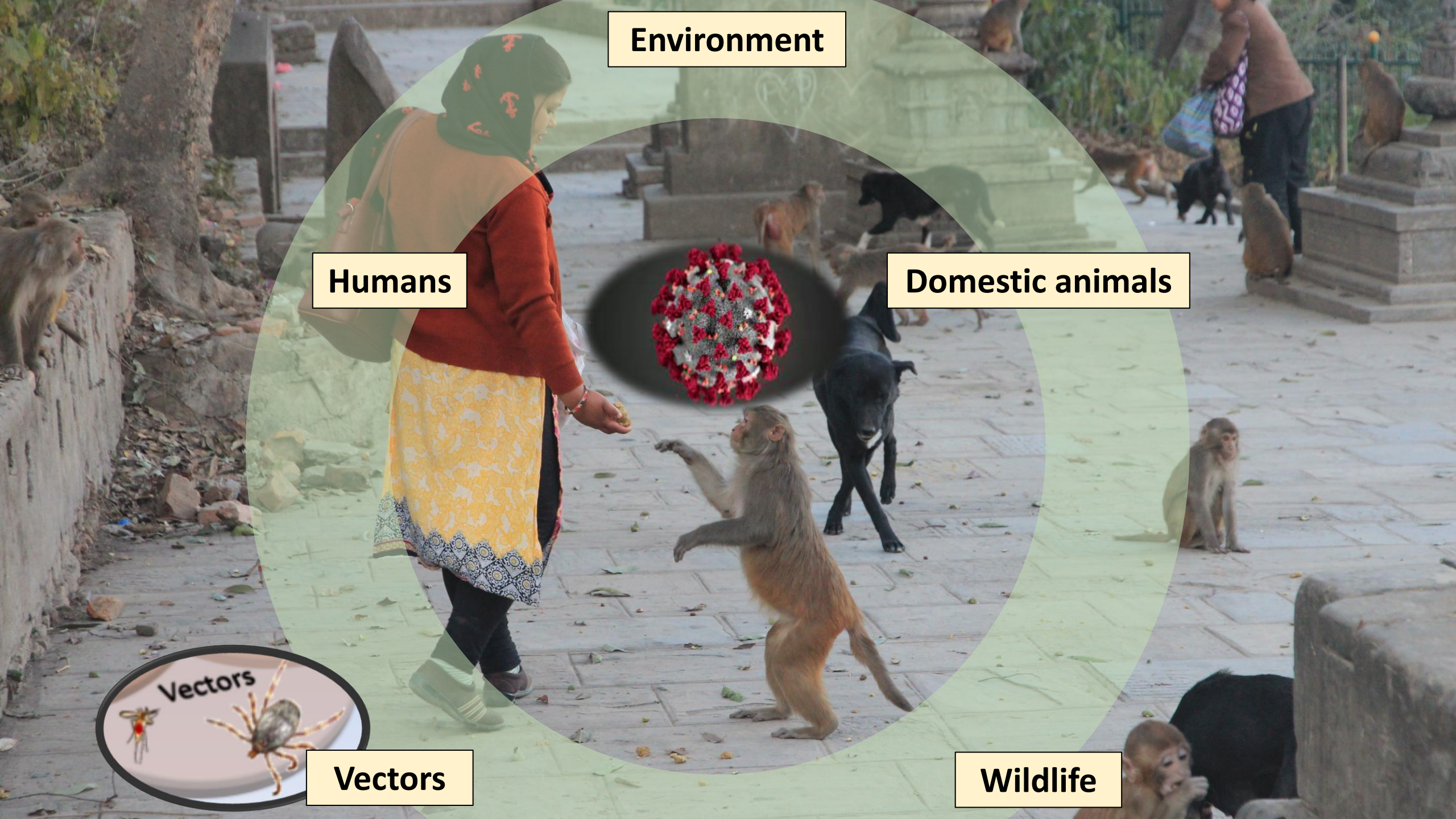
CSIC - UCLM - JCCM
IREC

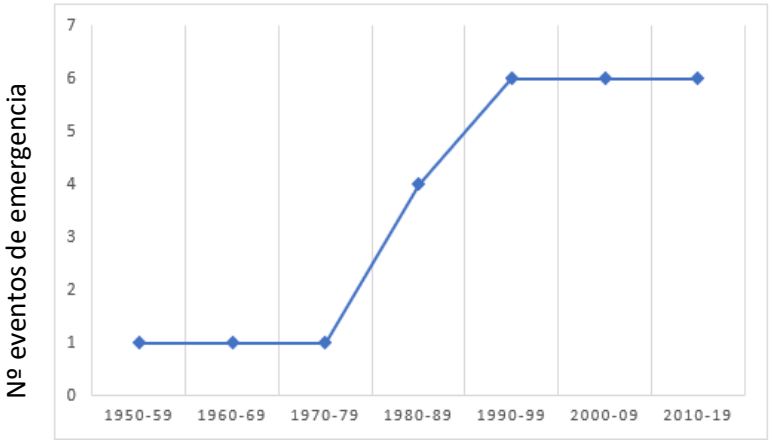
- **SaBio** (Health & Biotechnology) group at **IREC**
- Universidad de Castilla La Mancha & CSIC

Contents

- The interface and the role of wildlife
- Host communities, biodiversity, and the reservoir concept
- Surveillance, early detection, and integrated monitoring
- Environmental nucleic acid detection – ENAD
- Outlook




Environment
Humans
Domestic animals
Vectors
Vectors
Wildlife



Mixomatosis

Peste porcina africana

Enfermedad de Lyme

Queratoconjuntivitis

Tuberculosis

Enfermedad hemorrágica del conejo (GI.1)

Sarna sarcóptica

Morbillivirus

Pasteurelosis septicémica

Tularemia

Pestivirus

Hepatitis E

Lengua azul

Leucemia felina

Sarna

Leishmaniosis

Louping ill

Schmallenberg

Fiebre hemorrágica de **Crimea-Congo**

Enfermedad hemorrágica GI.2

Adenovirus canino 1

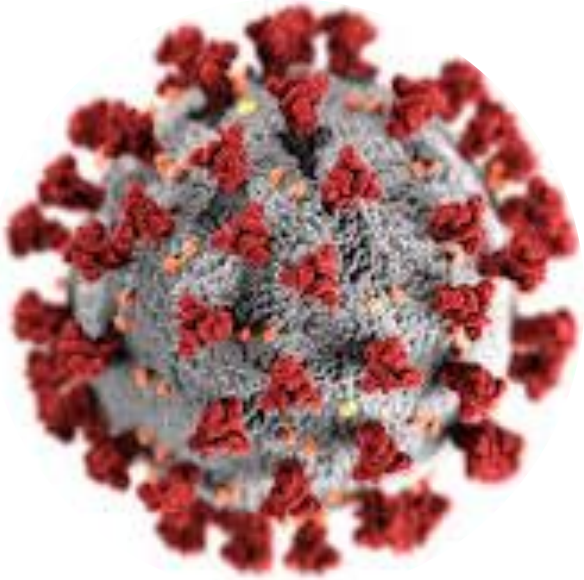
Mixomatosis recombinante

Enfermedad hemorrágica epizoótica

1950 1960 1970 1980 1990 2000 2010 2020

- → 15 virus, 4 bacteria, 2 parasites… 8 are zoonotic.
- → Incomplete list - dates indicate first reference.
- → Can emerge in several species (mange) or show species jumps (myxomatosis).
- → Some others (not shown) are not strictly emerging but cause periodic local outbreaks: CDV, Q fever…

Emerging pathogens



Challenging to control

Global distribution

Multi-host

THE CONVERSATION

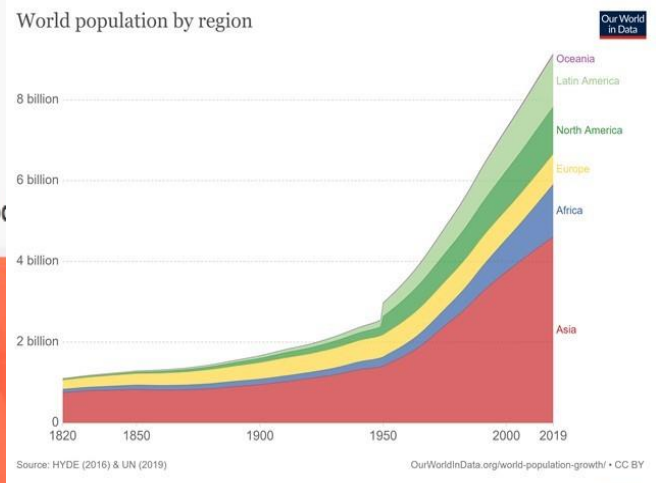
Rigor académico, oficio periodístico

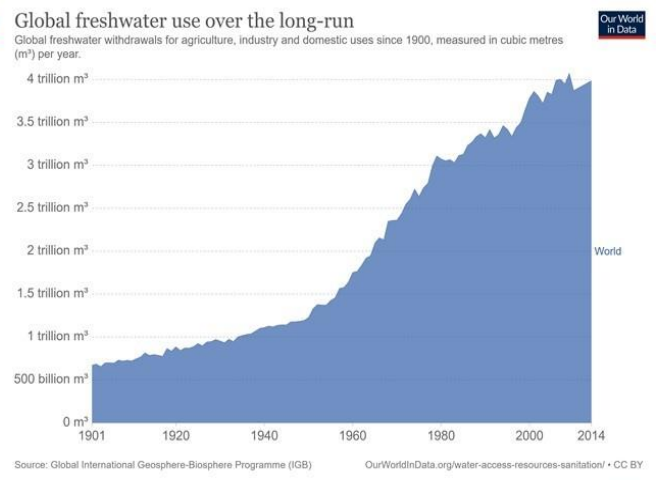
COVID-19 Ciencia + Tecnología Cultura Economía Educación Medicina + Salud Medioambiente + Energía Política + Soc

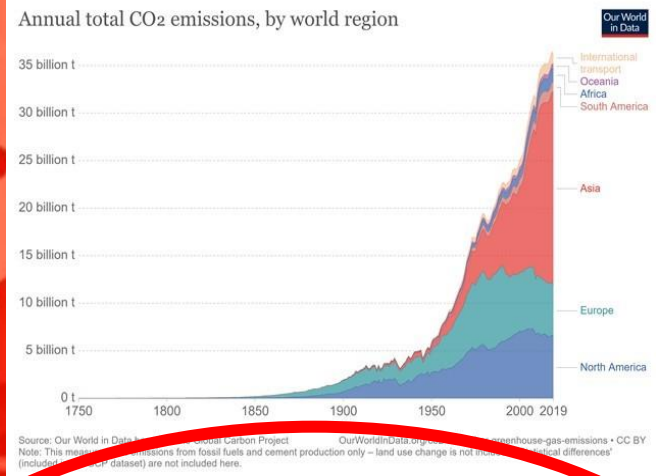
A global crisis

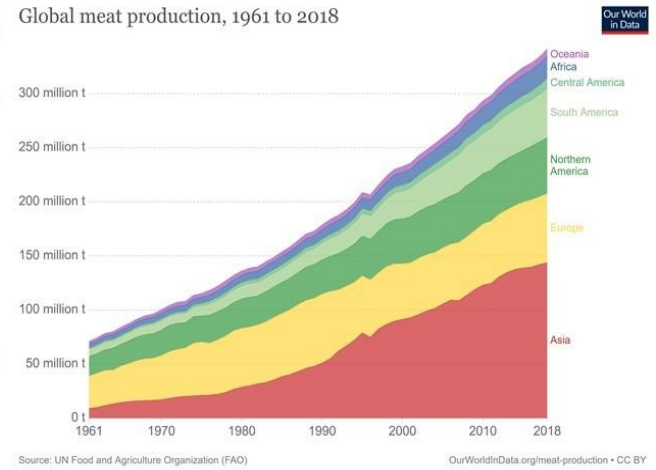
Población, agua, biodiversidad, energía y alimentación: los pilares de una crisis global

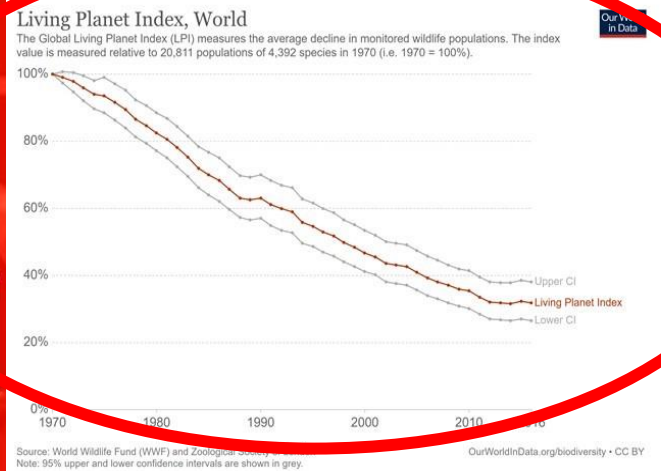
19 agosto 2021 21:49 CEST











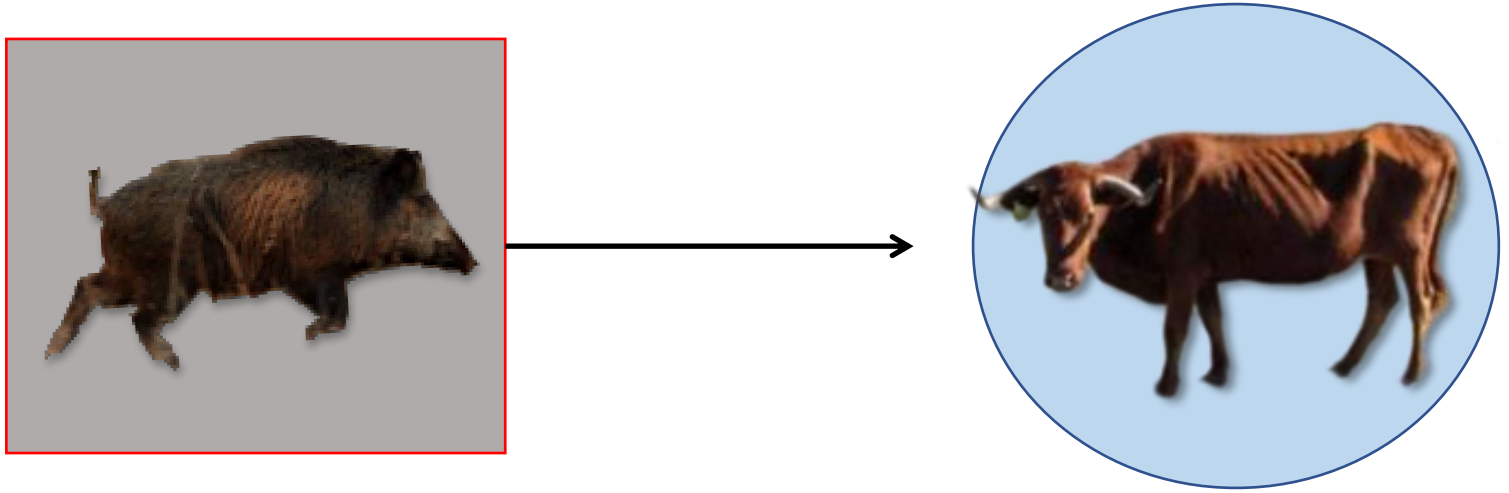
Indicadores globales sobre: Población por región del mundo (A); Consumo total de agua dulce (B); Emisiones de CO2 por región del mundo (C); Producción de carne por región del mundo (D); y pérdida media de poblaciones de fauna (E). Obsérvese que la escala temporal varía entre gráficos. Fuente: Our World in Data.

Measuring biodiversity

- GBIF & online info
- AI-based sound ID (bats, birds)
- Transects (mammal signs, birds)
- Camera traps (random & risk points)
- E-DNA
- (…)

Pathogen transmission & maintenance

Reservoir



Reservoir

Target

Pathogen transmission & maintenance

Reservoir

Reservoir

Target

Pathogen transmission & maintenance

Reservoir | **Maintenance community**

Reservoir


R3A1
R3A2
R3A3
R3A4
R3B1
R3B2
R3B3
R3B4
R3C1
R3C2
R3C3
R3C4
R3D1
R3D2
R3D3
R3D4
1 0 1 2 3 km


Ltl Acorn 050F 010C 10/12/2016 09:27:10


Ltl Acorn 055F 013C 10/12/2016 17:18:34

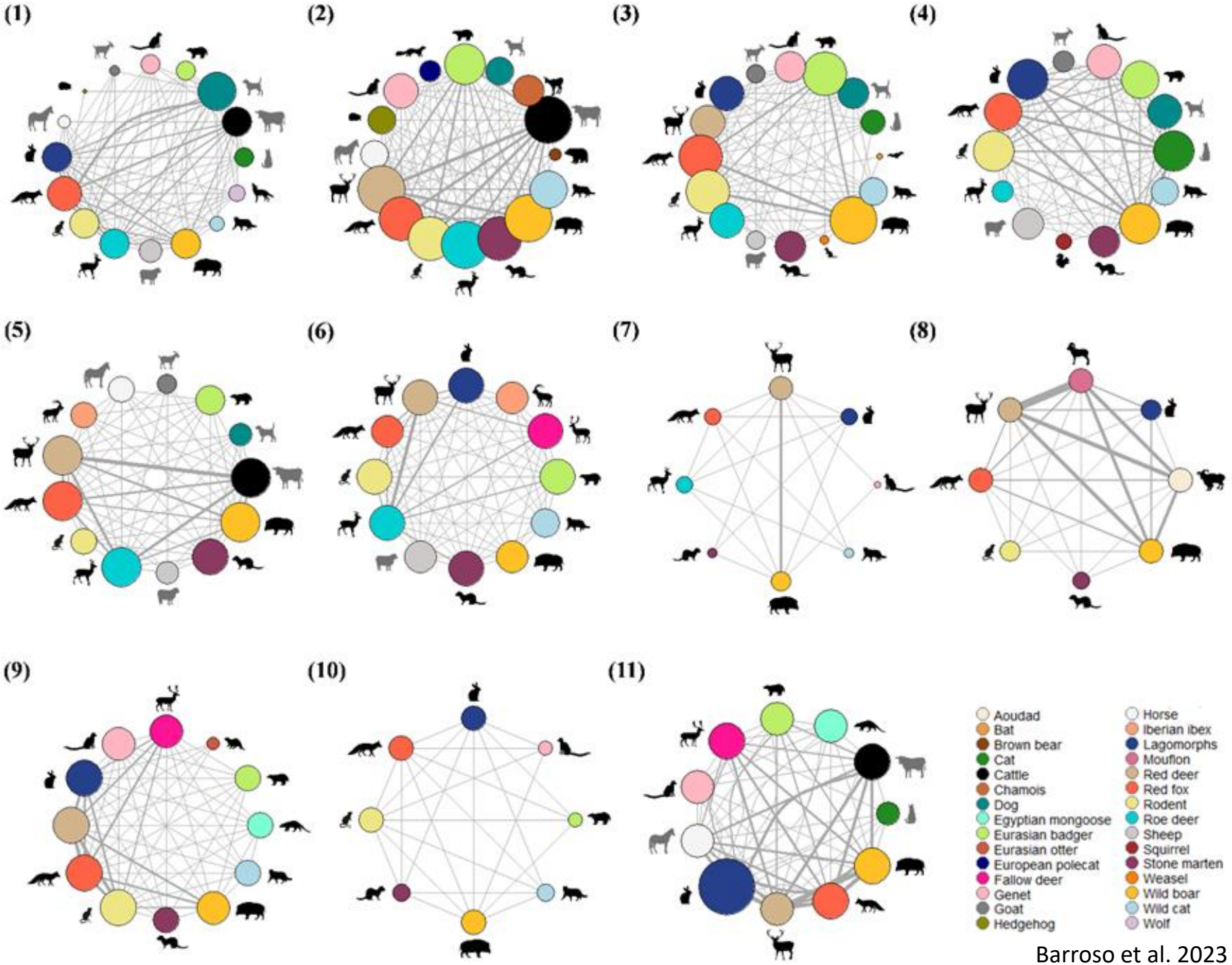

Ltl Acorn 044F 007C 10/11/2016 00:05:17


Ltl Acorn 053F 012C 10/02/2016 02:55:53


Ltl Acorn 051F 011C 09/16/2016 20:58:02


Ltl Acorn 055F 013C 09/25/2016 20:05:02

Maintenance communities



Barroso et al. 2023

Maintenance communities

One Health 16 (2023) 100479

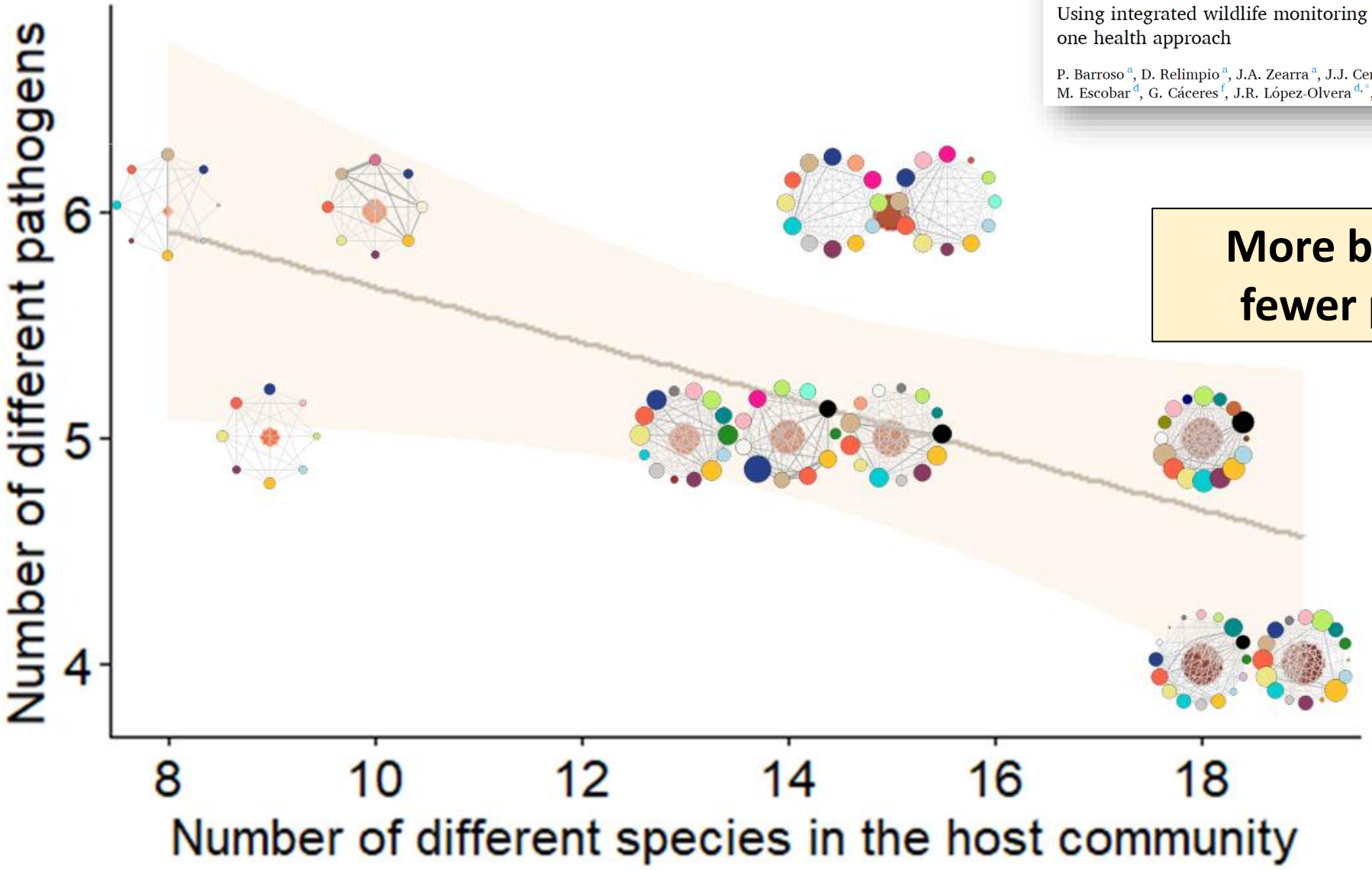
Contents lists available at ScienceDirect

One Health

journal homepage: www.elsevier.com/locate/onehlt

Using integrated wildlife monitoring to prevent future pandemics through one health approach

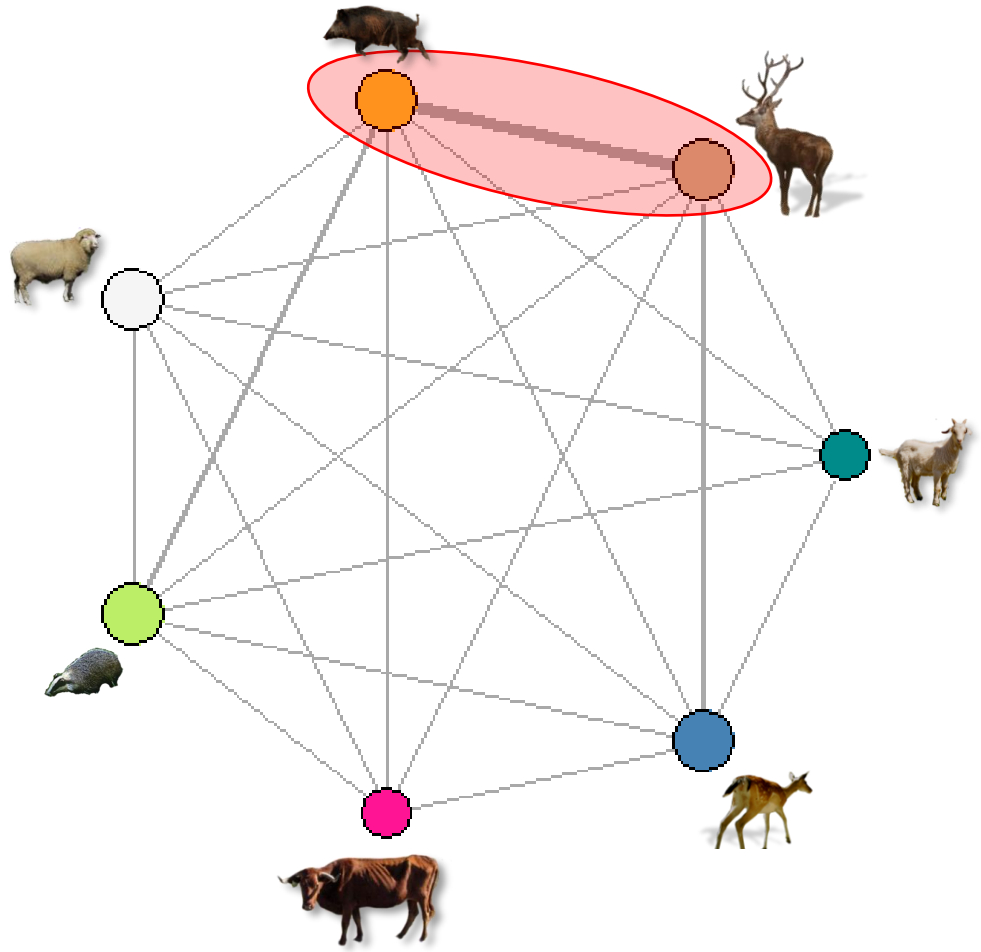
P. Barroso [a], D. Relimpio [a], J.A. Zearra [a], J.J. Cerón [b], P. Palencia [a,c], B. Cardoso [a,e], E. Ferreras [a], M. Escobar [d], G. Cáceres [f], J.R. López-Olvera [d,*], C. Gortázar [a]

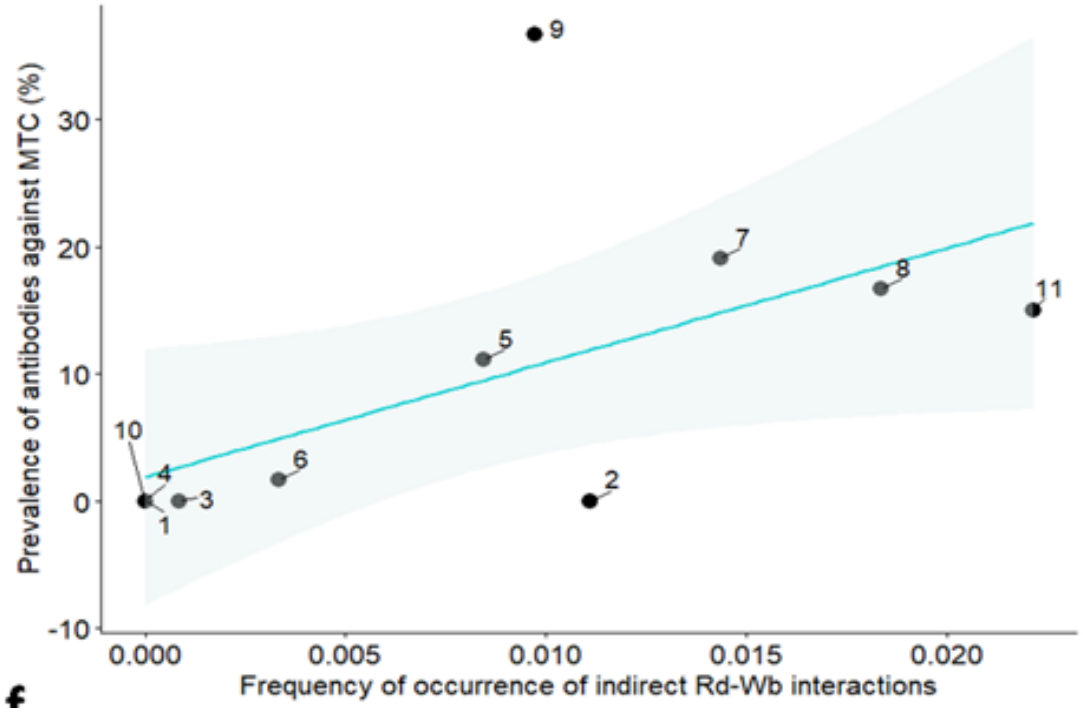


More biodiversity, fewer pathogens

Barroso et al. 2023

Maintenance communities

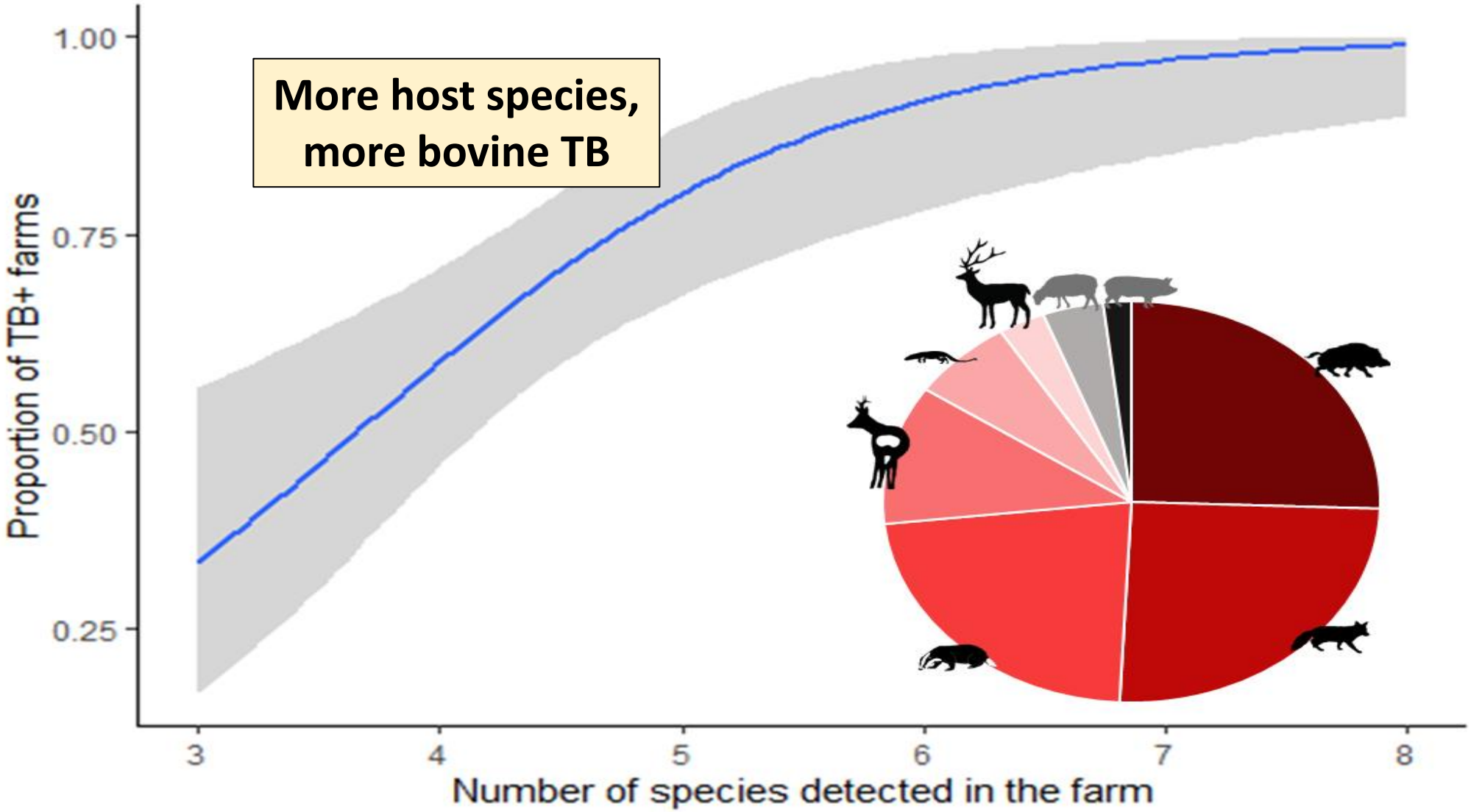




More RD-WB interactions, more TB

Barroso et al. 2023

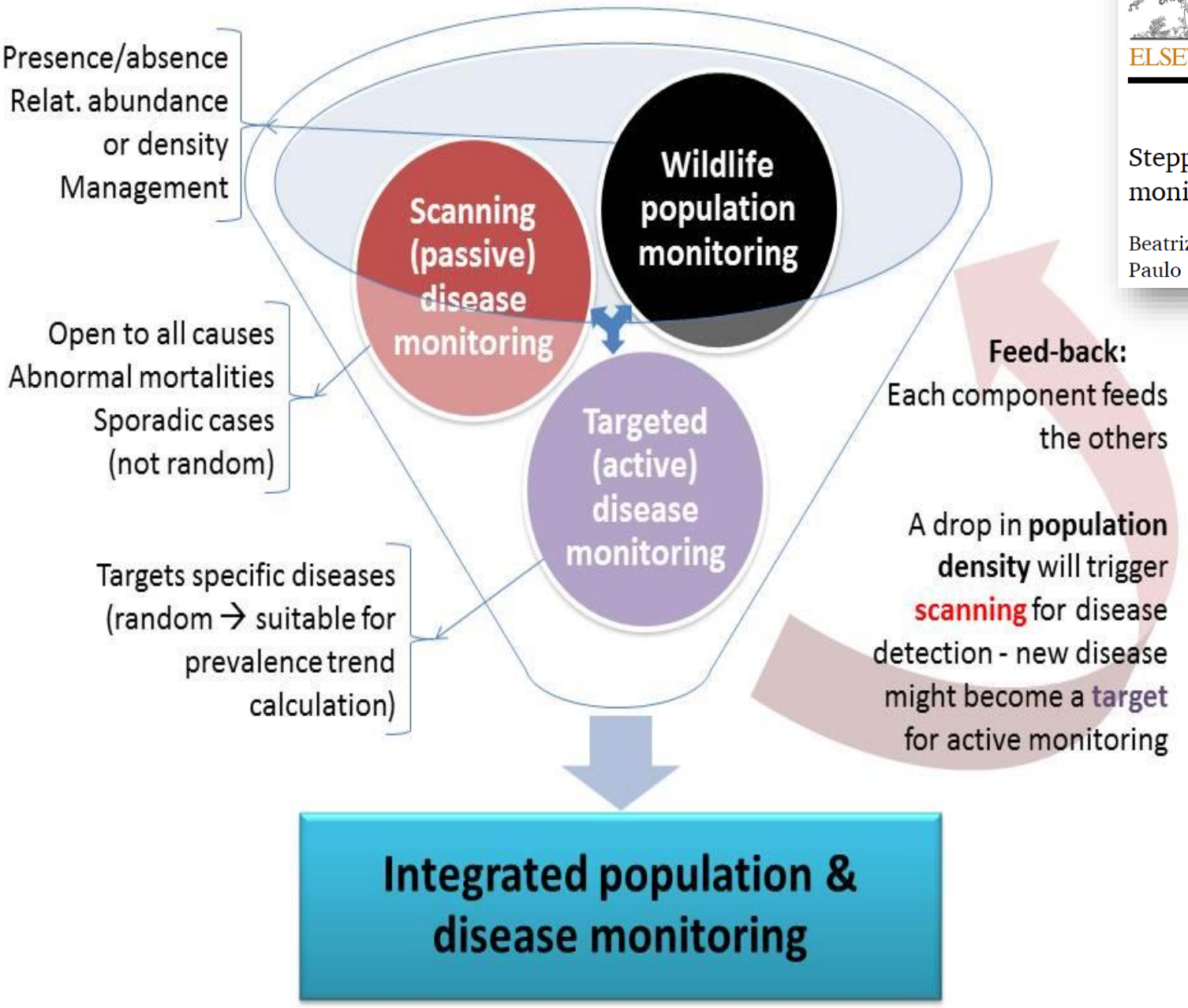
Maintenance communities



% of TB positive cattle farms in Salamanca (Spain) by n^{er} of host species.

Herrero et al. submitted


Early detection & diagnosis
How many cases
Prevalence
Trends
Effects on population



Contents lists available at ScienceDirect

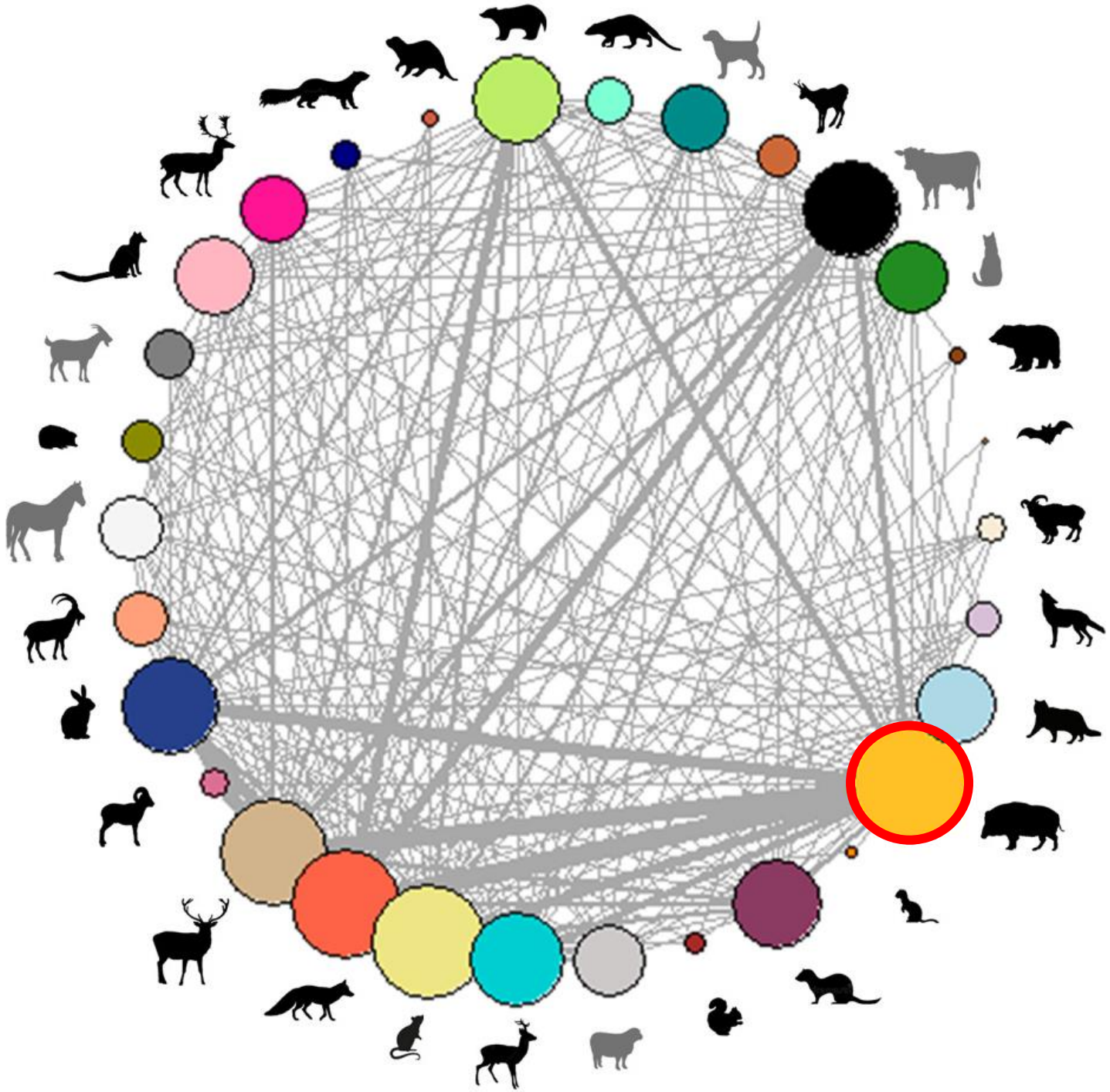
Research in Veterinary Science

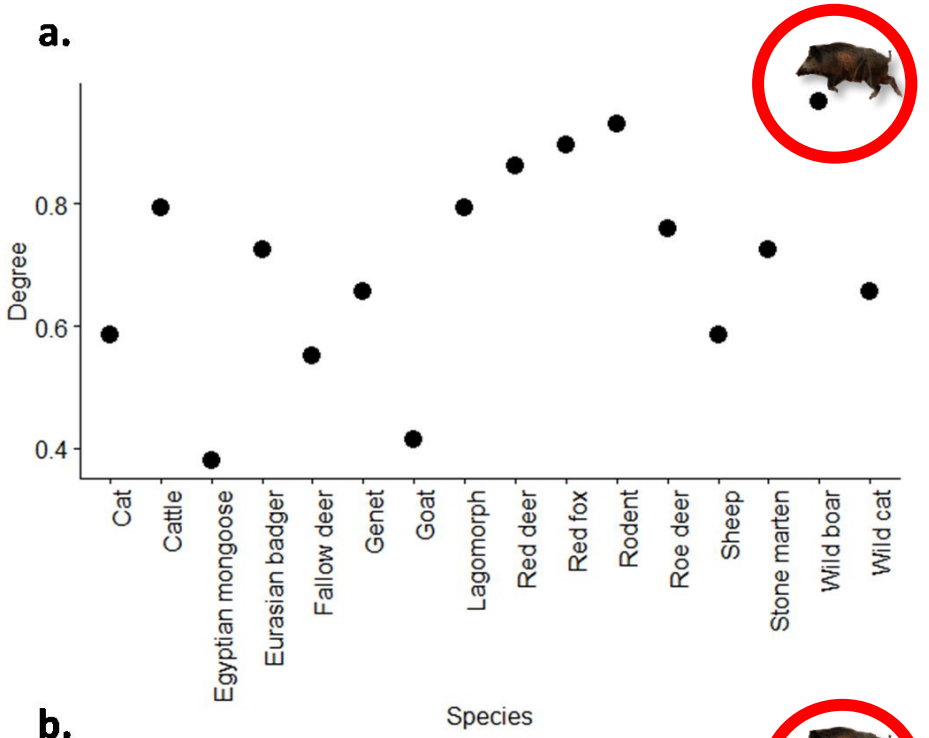
journal homepage: www.elsevier.com/locate/rvsc

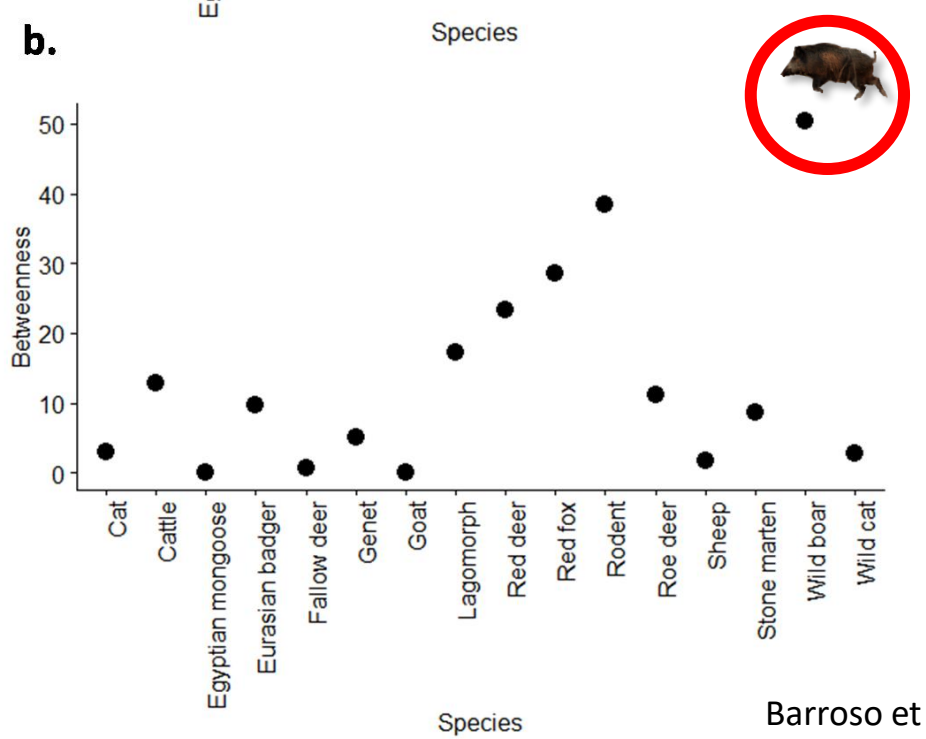
Stepping up from wildlife disease surveillance to integrated wildlife monitoring in Europe

Beatriz Cardoso [a,b,c,d,*], Ignacio García-Bocanegra [e], Pelayo Acevedo [b], Germán Cáceres [f], Paulo C. Alves [a,c,d], Christian Gortázar [b]

- Broad **early detection** (passive/scanning)
- Choose host(s) & diseases for **targeted monitoring**
- Monitor representative host species' **populations**







Barroso et al. 2023

Indicator species wild boar:

- Ancestor of the pig
- Common and widespread
- Game species (accessible)
- Prone to produce antibodies

Pig & wild boar pathogens

- Aujeszky's disease V
- PCV2
- *Mycoplasma hyo.*
- *Brucella* sp
- Influenza V

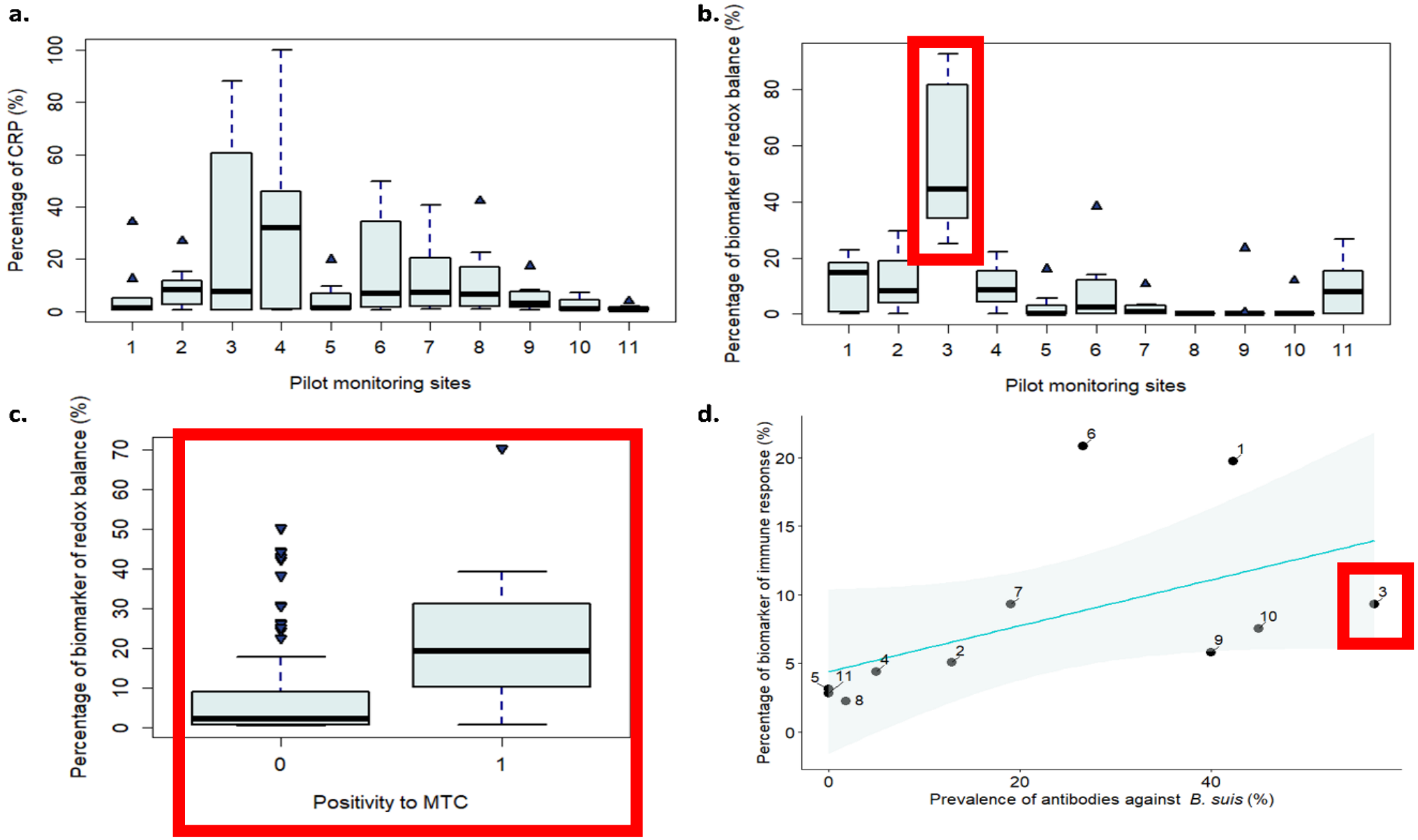
Multi-host pathogens

- HEV
- *M. tuberculosis* complex
- *Coxiella burnetii*
- CCHFV

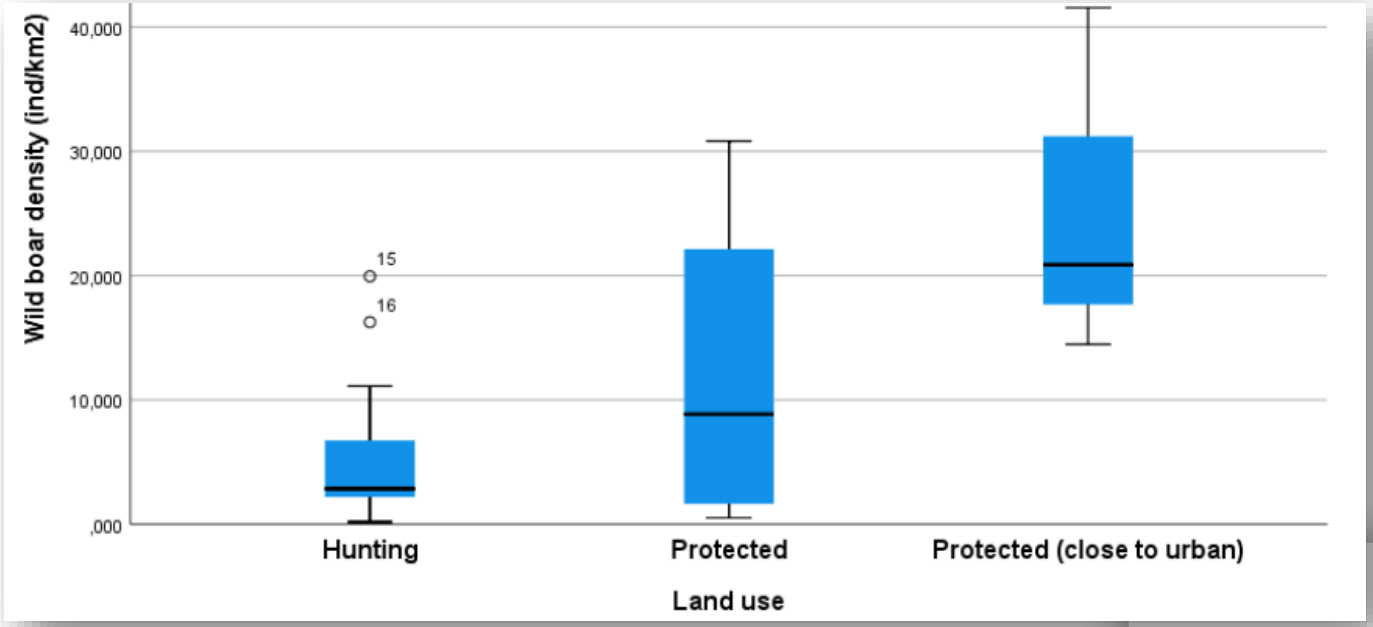
Other pathogens (!)

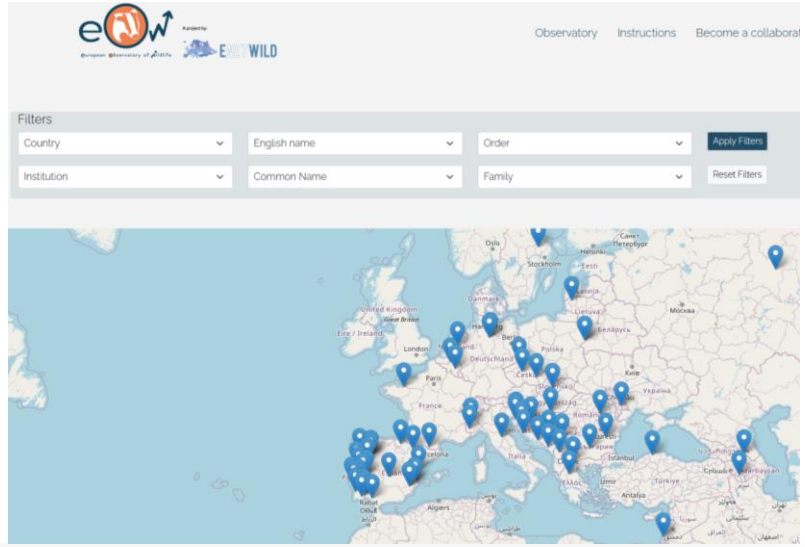
- *Toxoplasma gondii*
- *Erysipelothrix rhusiopathiae*
- Epizootic Haemorrhagic Disease V
- Canine Distemper V

What about using non-specific markers?



Population monitoring: local, regional, continent-wide





EXTERNAL SCIENTIFIC REPORT

ENETWILD

APPROVED: 15 February 2023
doi:10.2903/sp.efsa.2023.EN-7892

Wild ungulate density data generated by camera trapping in 37 European areas: first output of the European Observatory of Wildlife (EOW)

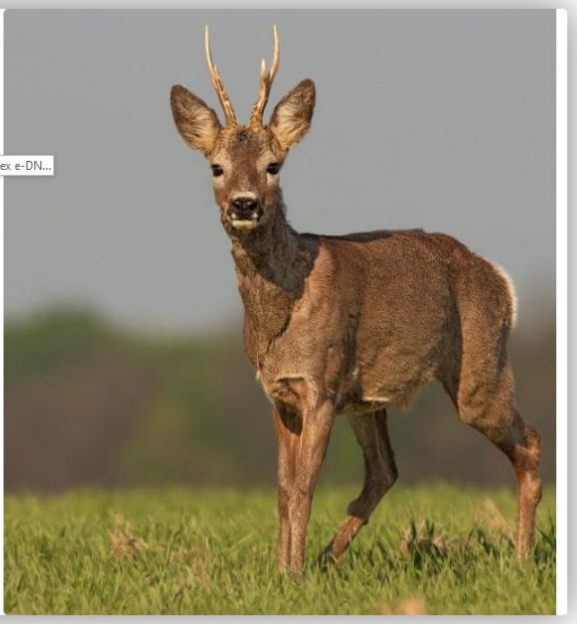
ENETWILD-consortium[1], Tancredi Guerrasio, Pelayo Acevedo P, Marco Apollonio, Amir Arnon, Carlos Barroqueiro, Olgirda Belova, Oskar Berdión, José Antonio Blanco-Aguiar, Hanna Bjil,

eow

european observatory of wildlife

A network of "observation points" provided by collaborators from all European Countries capable to monitor wildlife population at European level. It is funded by the European Food Safety Authority (EFSA) through the project ENETWILD.

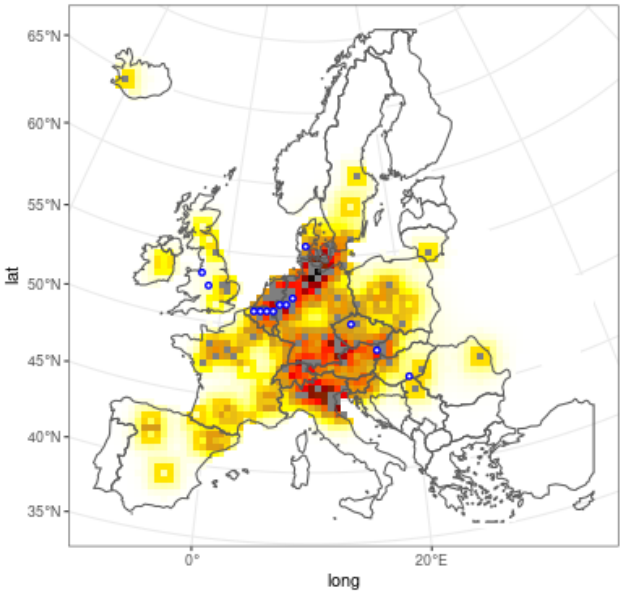
VISIT EOW WEBSITE



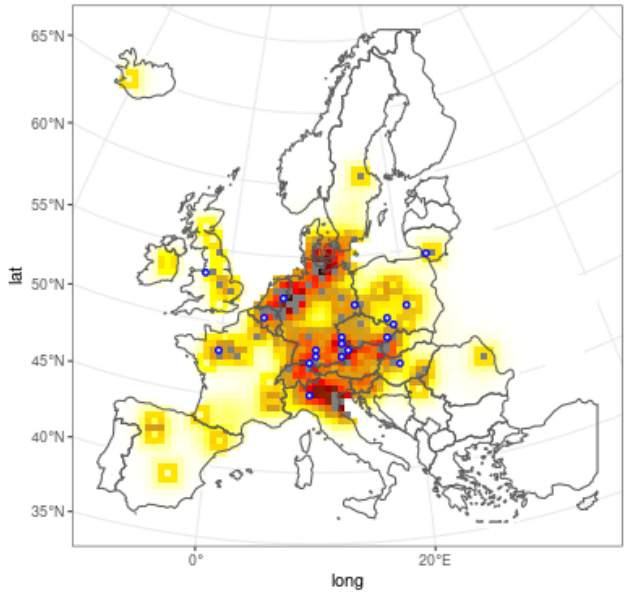
EFSA's Bird Flu Radar

Early warning of highly pathogenic avian influenza (HPAI) in the EU

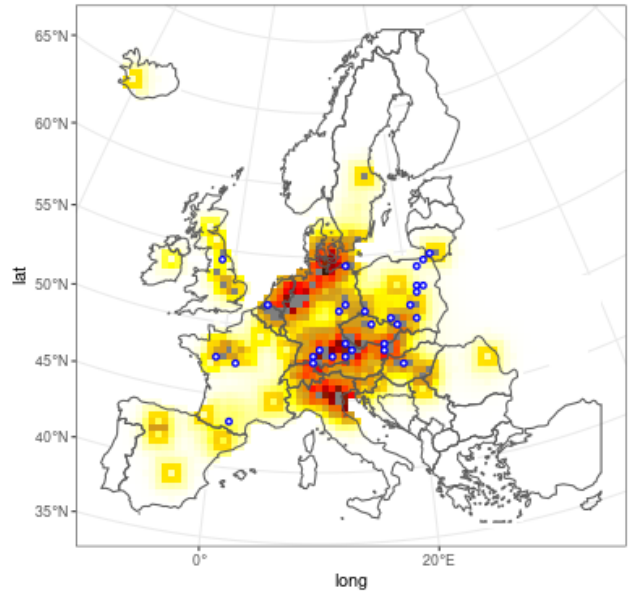
Year 2023 - Week 15



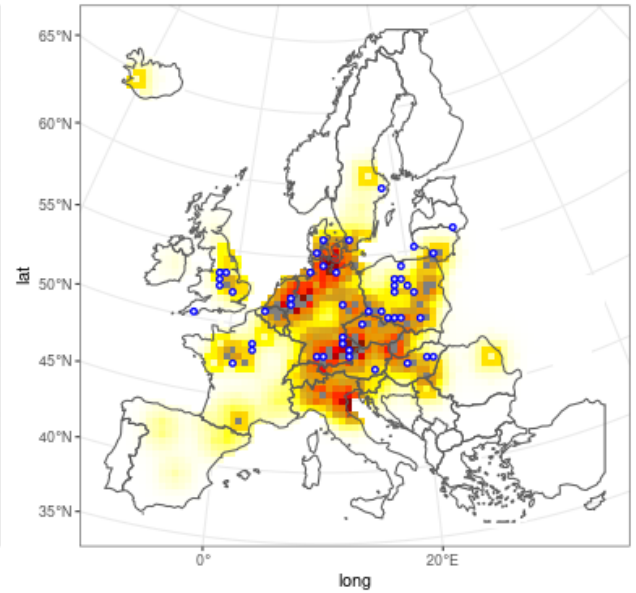
Year 2023 - Week 16



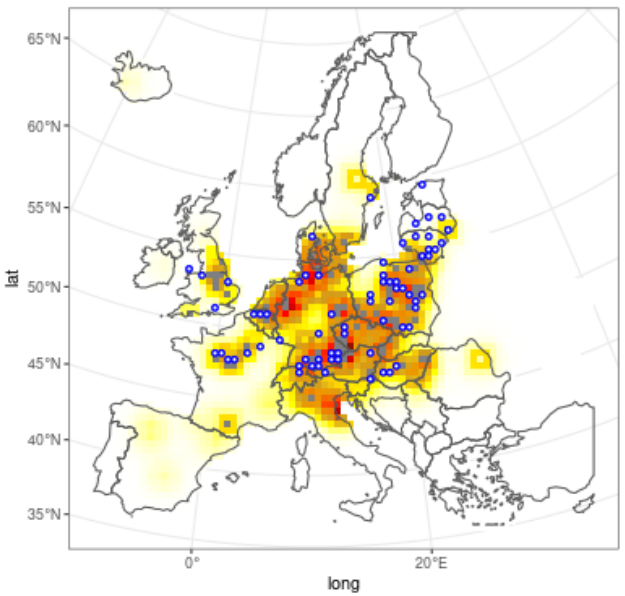
Year 2023 - Week 17



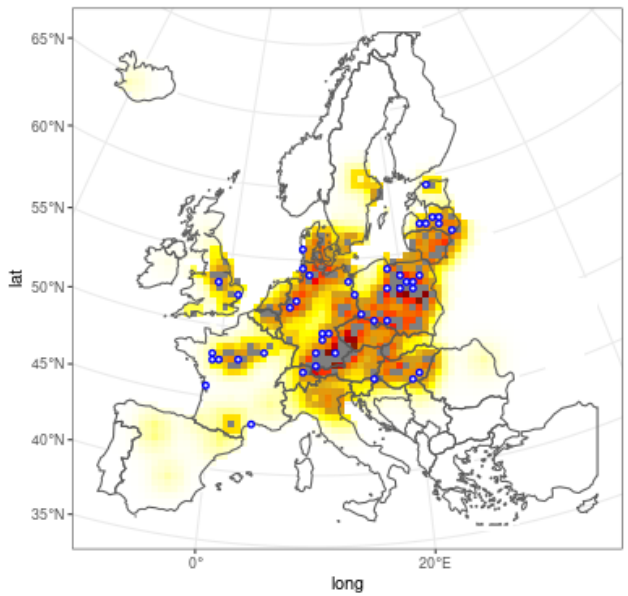
Year 2023 - Week 18



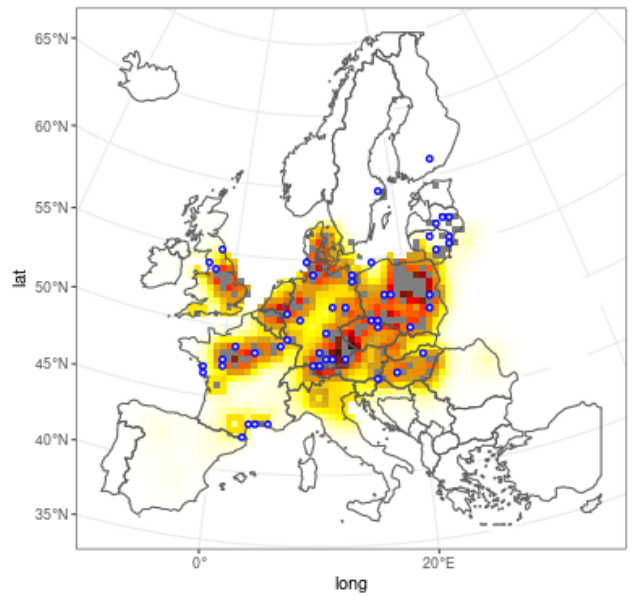
Year 2023 - Week 19



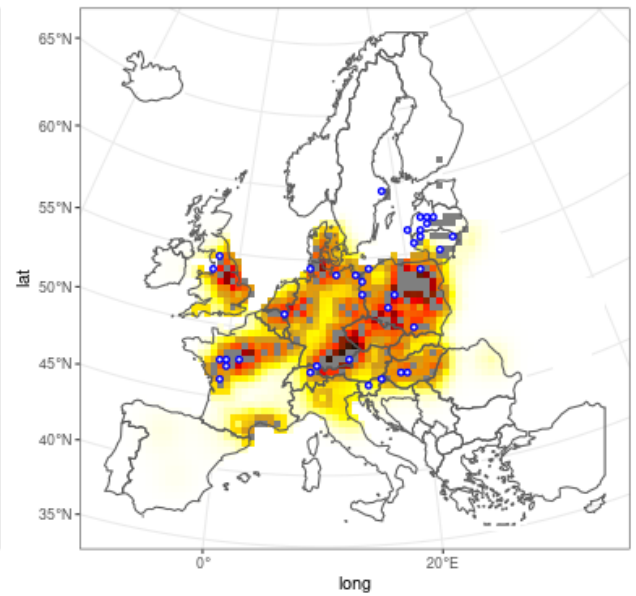
Year 2023 - Week 20



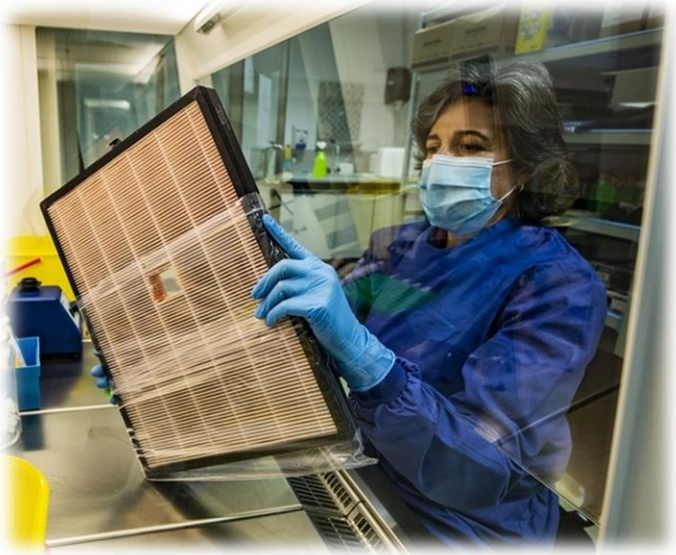
Year 2023 - Week 21



Year 2023 - Week 22



ENAD: noninvasive pathogen surveillance



INDOOR AIR
International Journal of Indoor Environment and Health

ORIGINAL ARTICLE | Open Access

HEPA filters of portable air cleaners as a tool for the surveillance of SARS-CoV-2

Isabel G. Fernández de Mera, Carmen Granda, Florentina Villanueva, Marta Sánchez-Sánchez, Alberto Moraga-Fernández, Christian Gortázar, José de la Fuente

First published: 18 September 2022 | https://doi.org/10.1111/ina.13109

PLOS ONE

RESEARCH ARTICLE

Environmental DNA: A promising factor for tuberculosis risk assessment in multi-host settings

Jordi Martínez-Guijosa[1☯*], Beatriz Romero[2☯], José Antonio Infantes-Lorenzo[2,3], Elena Díez[4], Mariana Boadella[5], Ana Balseiro[6], Miguel Veiga[1], David Navarro[4], Inmaculada Moreno[7], Javier Ferreres[1], Mercedes Domínguez[7], Cesar Fernández[4], Lucas Domínguez[2,3], Christian Gortázar[1]

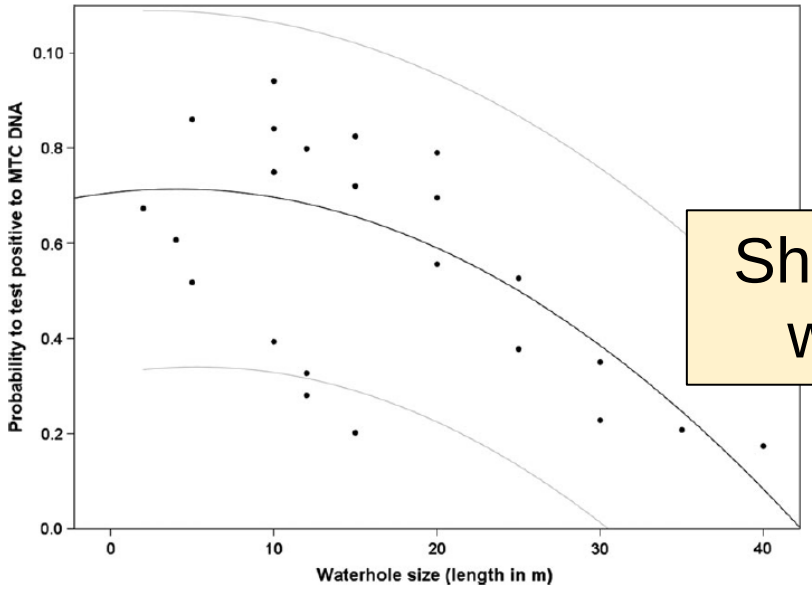
ORIGINAL ARTICLE

Transboundary and Emerging Diseases WILEY

Detection of environmental SARS-CoV-2 RNA in a high prevalence setting in Spain

Isabel G. Fernández-de-Mera[1] | Francisco J. Rodríguez del-Río[2] | José de la Fuente[1,3] | Marta Pérez-Sancho[4] | Dolores Hervás[2] | Inmaculada Moreno[5] | Mercedes Domínguez[5] | Lucas Domínguez[4] | Christian Gortázar[1]

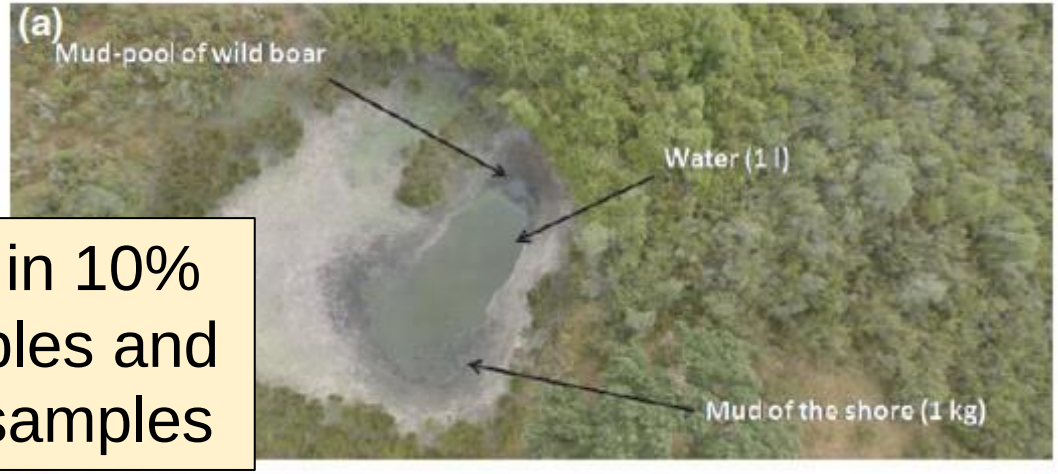
eDNA targeting MTC



MTC DNA in 10% water samples and 50% mud samples

Shallow and small waterholes (+)

Visibly sick animals at (+) waterholes



Transboundary and Emerging Diseases

Transboundary and Emerging Diseases

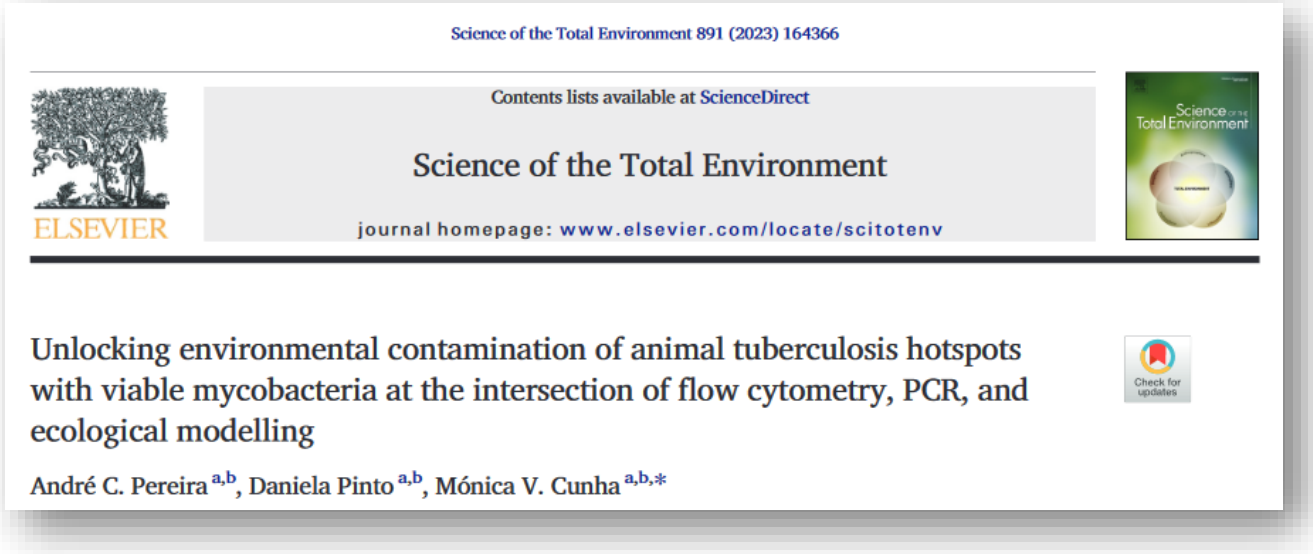
ORIGINAL ARTICLE

Environmental Presence of *Mycobacterium tuberculosis* Complex in Aggregation Points at the Wildlife/Livestock Interface

J. A. Barasona[1], J. Vicente[1], I. Díez-Delgado[1,2], J. Aznar[3,4], C. Gortázar[1] and M. J. Torres[3]

MTC e-DNA detection is relevant

- Pereira et al. (2023) assessed the burden and viability of environmental MTBC cells by FLOW-FISH-FACS and qPCR.
- In an endemic TB setting, most natural substrates contained viable or dormant MTBC cells, with higher burden in mud.
- Load of viable MTBC cells in the environment > minimum infective dose.


Science of the Total Environment 891 (2023) 164366

Contents lists available at ScienceDirect

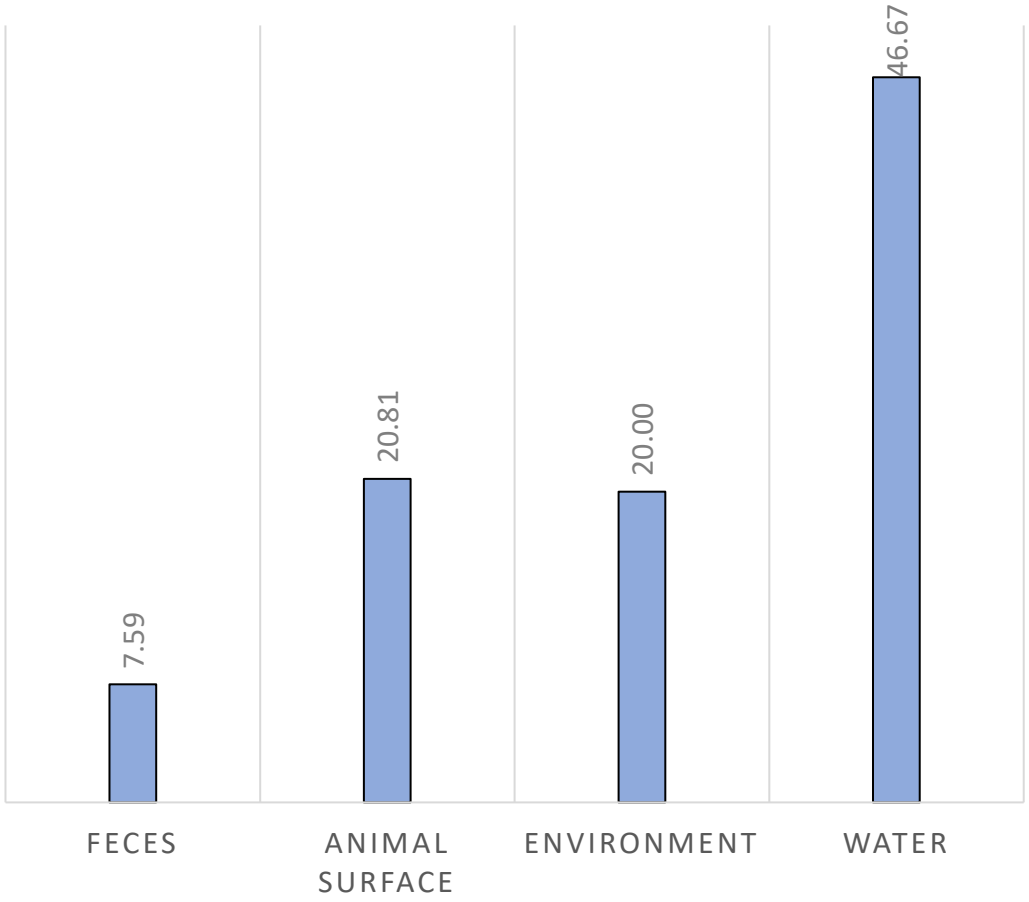
Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

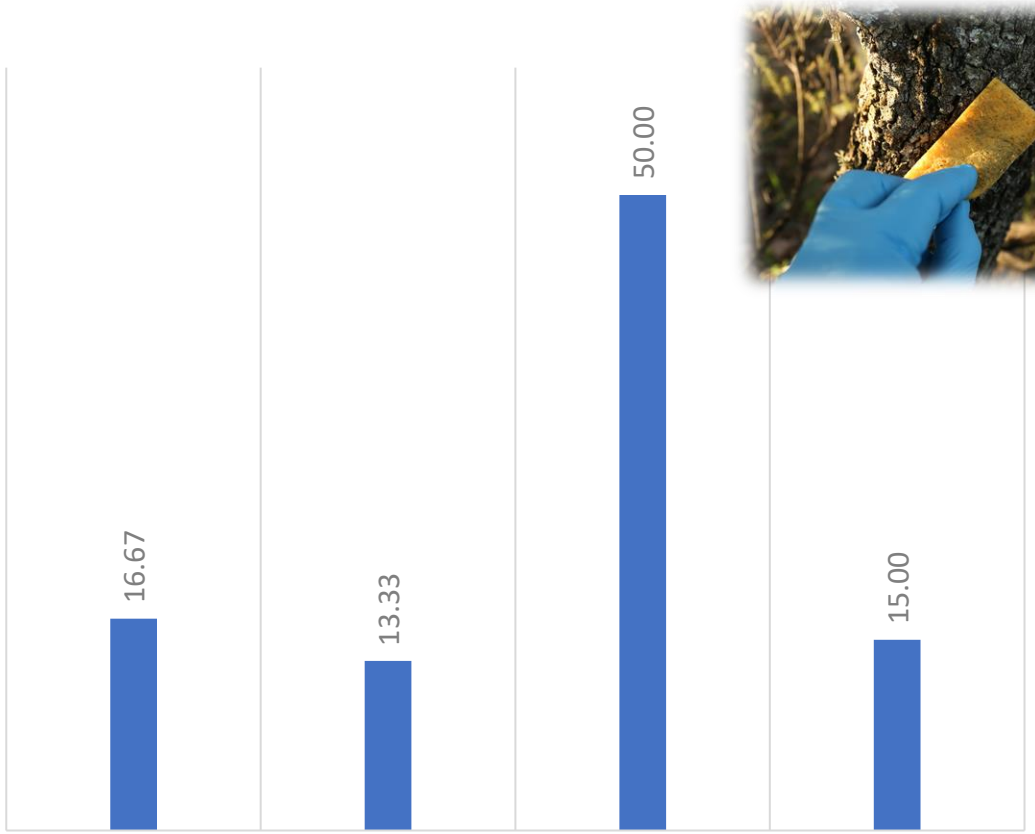
Unlocking environmental contamination of animal tuberculosis hotspots with viable mycobacteria at the intersection of flow cytometry, PCR, and ecological modelling

André C. Pereira [a,b], Daniela Pinto [a,b], Mónica V. Cunha [a,b,*]

M. tuberculosis complex e-DNA in open air farms



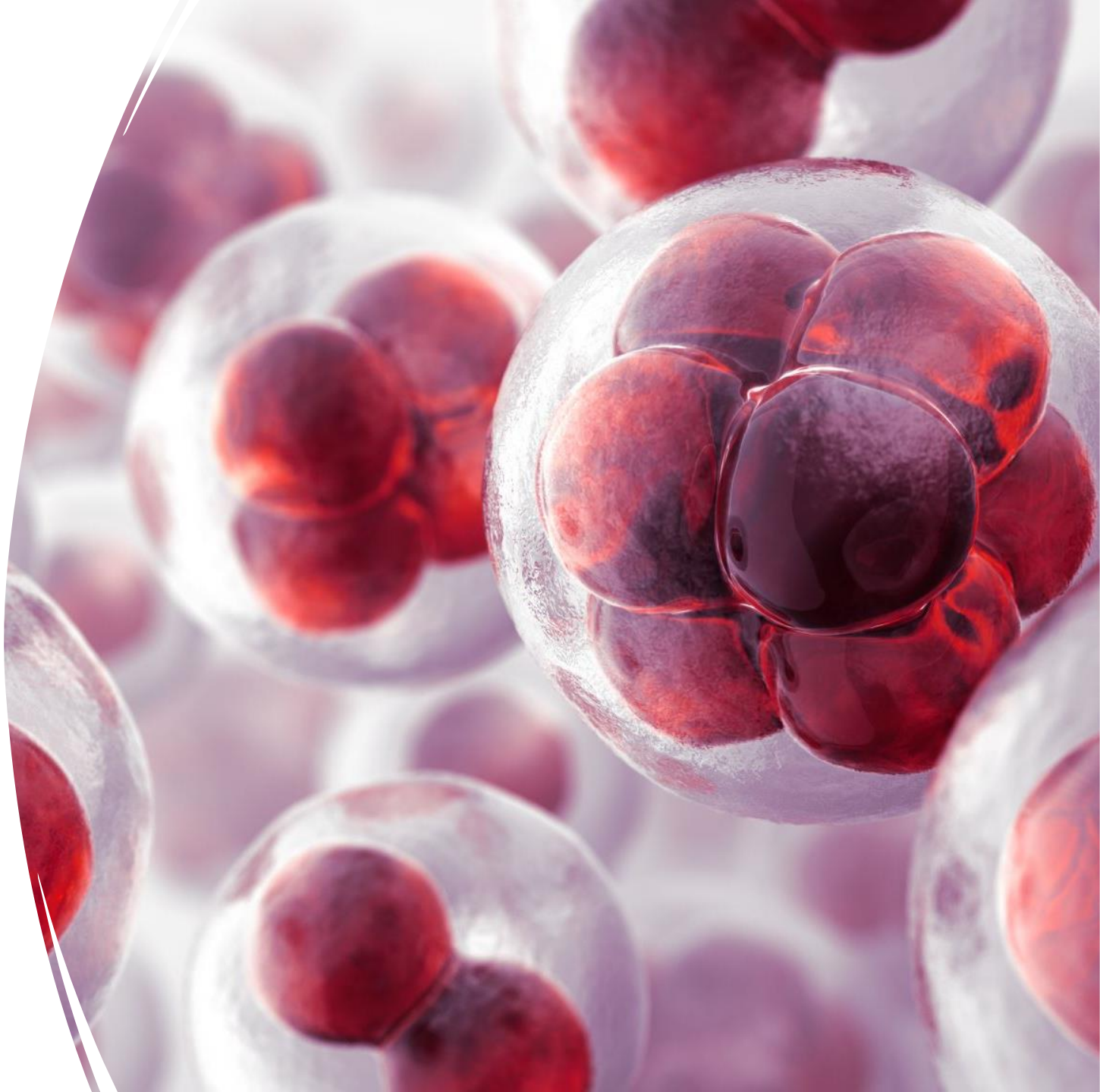
% of positive samples by type



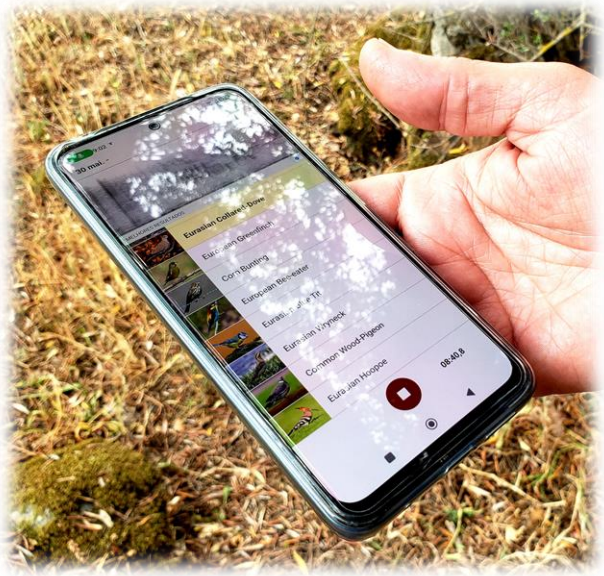
% of positive environmental samples

What can we detect in environmental samples?

- RNA viruses such as SARS-CoV-2
- DNA viruses such as ASFV
- Bacteria such as CMT
- AMR markers
- Parasites such as *Toxoplasma gondii*
- You name it!



Outlook: integrating all tools & more



CT networks:
- Host abundance
- Species diversity
- Interactions

Signs, sounds (AI):
- Host abundance
- Species diversity
- ENAD samples

Indicator sp:
- Prevalence
- Non-specific
- Inv. samples

ENAD:
- Pathogens
- Species diversity
- (…)

Scale up from local pilot sites to continent-wide schemes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