Hablemos de

tuberculosis animal

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SABIO

Sanidad y Biotecnología

Health and Biotechnology

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CSIC - UCLM - JCCM

IREC

CSIC

Consejo Superior de Investigaciones Científicas

UCLM

Universidad de Castilla-La Mancha

Wild boar, lung

It is a nasty and selfish bug that slowly invades and destroys every tissue. Without intervention, it will spread to contaminate and corrupt in-contact organisms.

DISPATCHES

Tuberculosis-Associated Death among Adult Wild Boars, Spain, 2009–2014

Jose A. Barasona, Pelayo Acevedo, Iratxe Diez-Delgado, Joao Queiros, Ricardo Carrasco-García, Christian Gortazar, Joaquín Vicente

juveniles (12–24 months of age). In adults (>2 yea
observed proportion of wild boars with generalized
creases, suggesting some degree of TB-driven death
juveniles (*6*,*8*). TB is a sporadic cause of death amo

Health & Biotechnology
(**SaBio**)

SaBio research: Disease control – Reproductive biotechnology – Vector-borne infections – Wildlife management (…)

IREC

Wildlife Research Institute

UCLM
UNIVERSIDAD DE CASTILLA-LA MANCHA

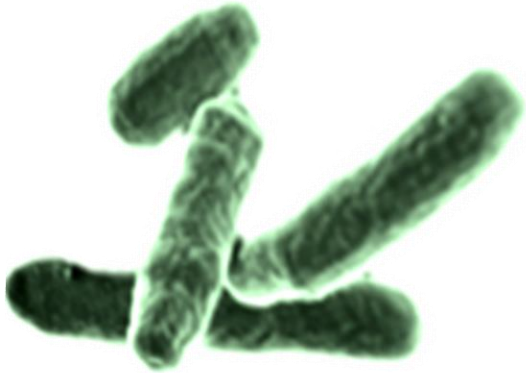
IREC

Ciudad Real - Spain

Reunión Ciencia & Txuletón 2024

Estructura de la presentación

- Situación actual de la TB animal
- Epidemiología: hospedadores y transmisión
- Análisis de riesgos y diagnóstico epidemiológico
- Herramientas de control
  - Pruebas y matadero en bovinos
  - Control de hospedadores no bovinos
  - Bioseguridad
  - Vacunación
- Cuatro mensajes clave



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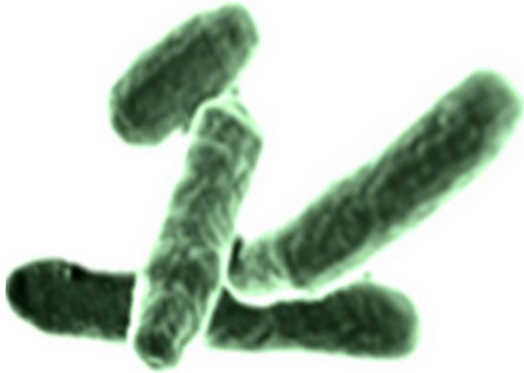
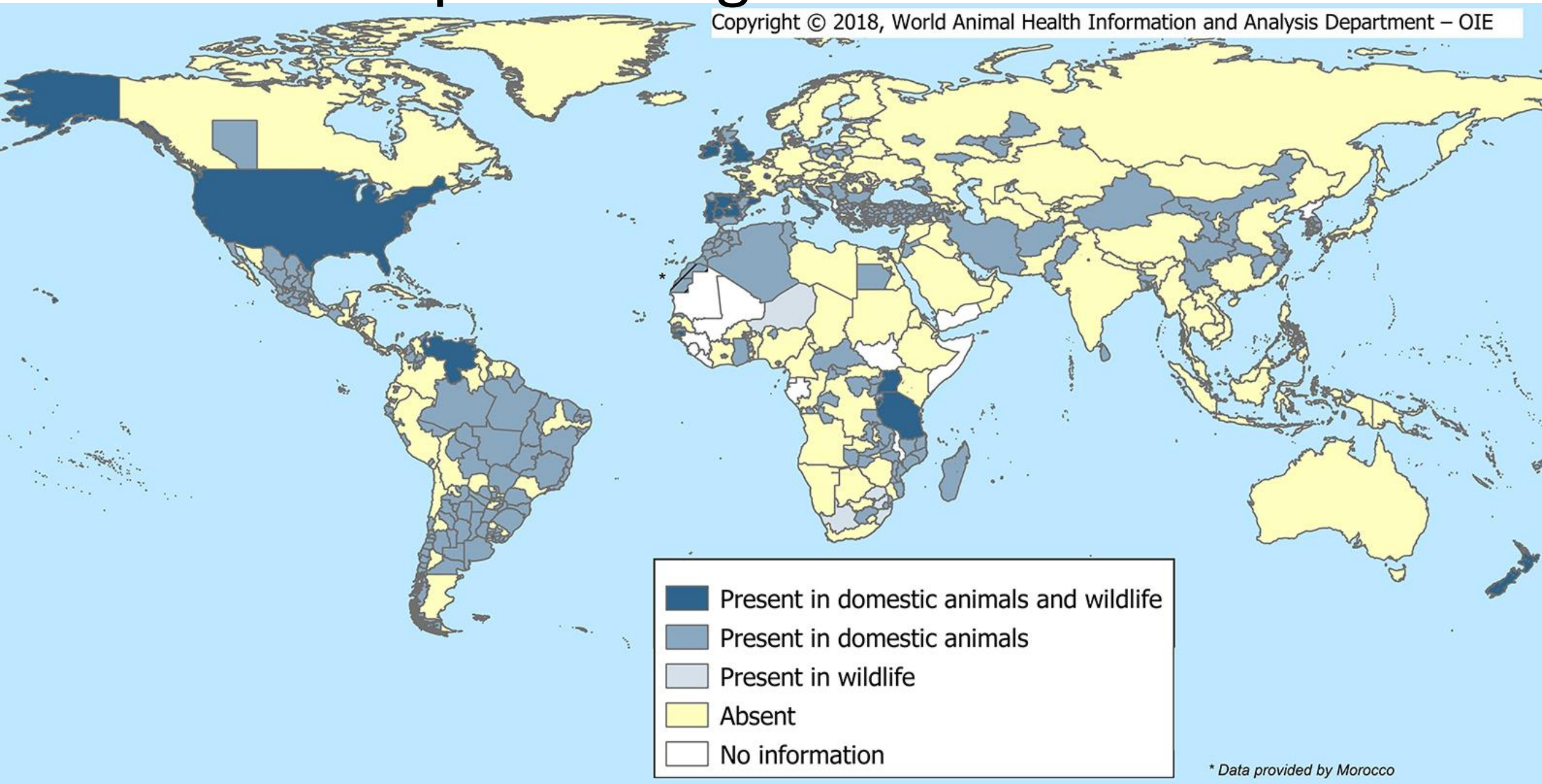


Situación epidemiológica mundial



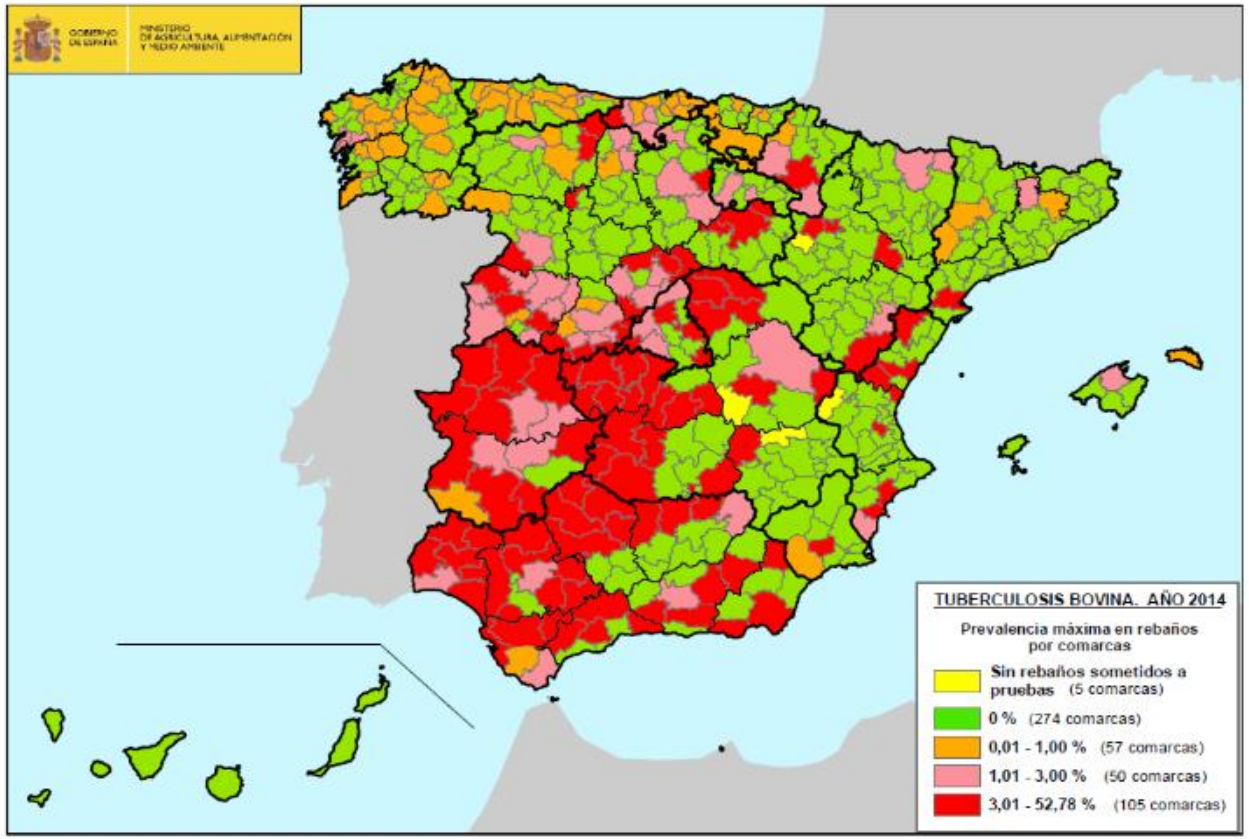
Age culling

- Rationale: remove older animals to slaughter to decrease the risk of TB breakdown, removing a source of infection for the younger animals
- Successfully used in Australia during TB eradication
- Applied to animals ≥8 years - where disease prevalence was high (3%), animals ≥ 5 years were removed

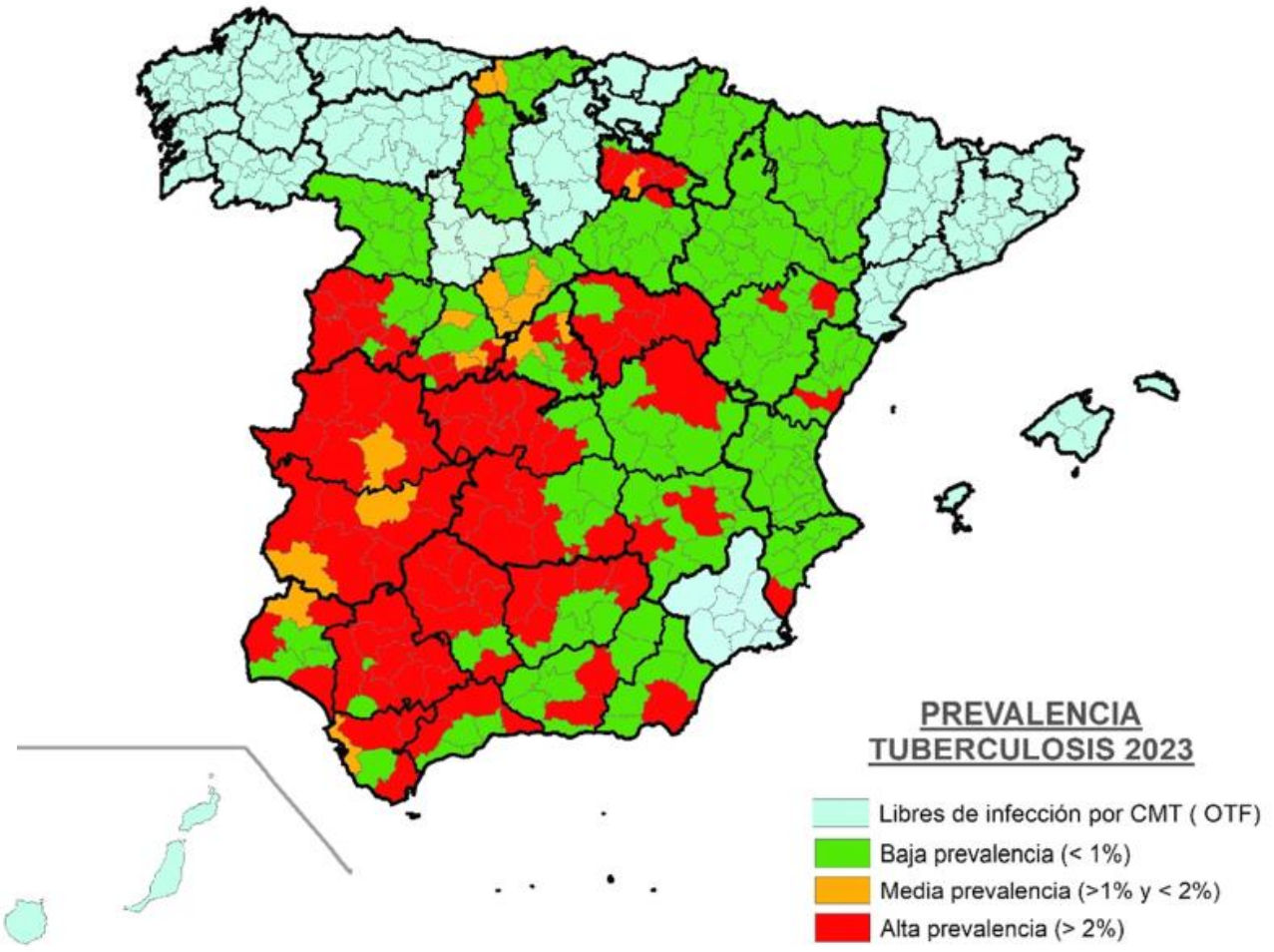
(Cousins and Roberts 2001)

TB bovina en España

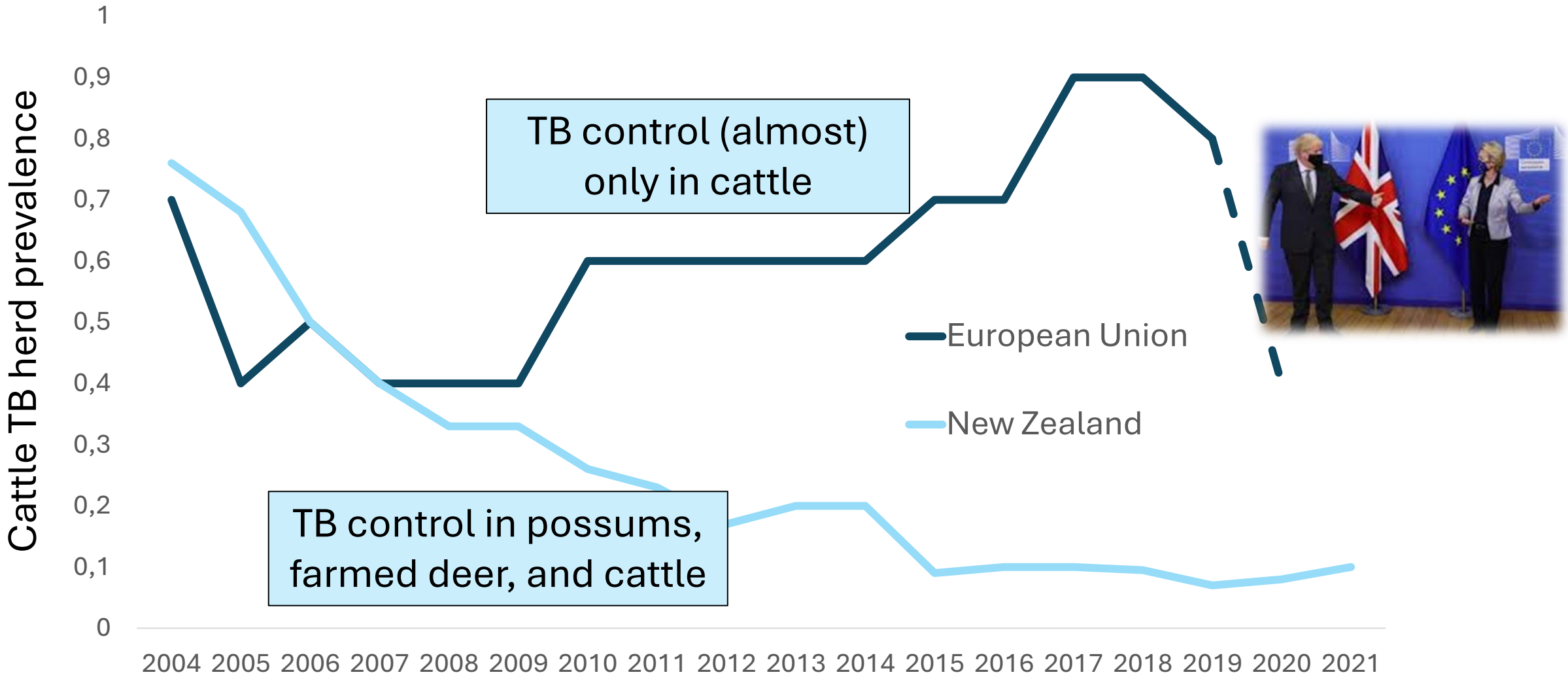
2014 – prev. rebaño 1.7%



2023 – prev. rebaño 1.6%



EU vs NZ


Cattle TB herd prevalence
1
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
TB control (almost) only in cattle
TB control in possums, farmed deer, and cattle
European Union
New Zealand

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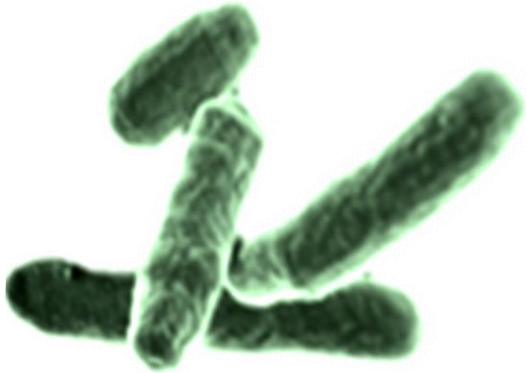
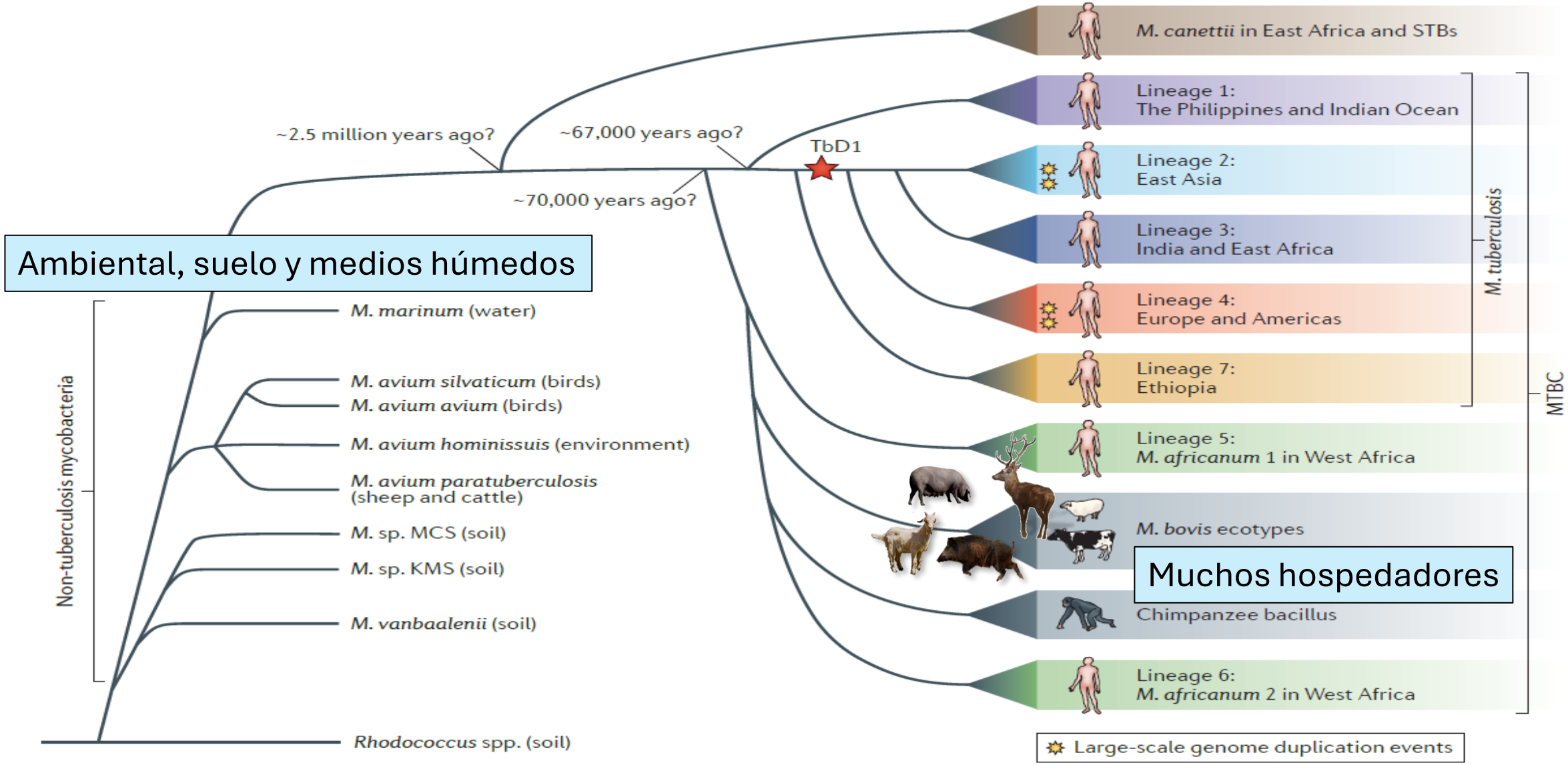


Intro: *Mycobacterium tuberculosis* complex



Genomic insights into tuberculosis

James E. Galagan

Dogma: “tuberculosis bovina”

Hospedadores domésticos no bovinos

2013

Short Communications

Veterinary Record doi:10.1136/vr.101347

Evidence of goats acting as domestic reservoirs of bovine tuberculosis

S. Napp, A. Allepuz, I. Mercader, M. Nofrarías, S. López-Soria, M. Domingo, B. Romero, J. Bezos, B. Pérez de Val

Hernández and others 1996). In 2000, in Asturias (Northern Spain), a 12 per cent (73 out of 600) of goats and a 92 per cent (23 out of 25) of goat herds were found positive to the gamma interferon test, while the prevalence on bovines and bovine herds was 0.1 per cent and 0.4 per cent, respectively (Balseiro and others 2001). However, in Spain, the testing of goat herds is only compulsory in mixed (cattle and goats) farms, or when they share pastures with cattle (Anonymous 2012a). Yet, some autonomous communities (Andalusia, Castile and Leon, Murcia, and the Canary Islands) have started implementing regional control and eradication programmes in goat herds.

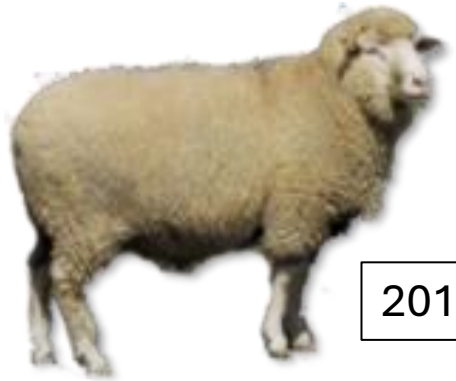
Even though a possible role of goats in bTB epidemiology in Spain has been proposed (Álvarez and others 2008, Bezos and others 2010, Rodríguez and others 2011), there are no published evidences of the spread of the bacteria from goats to cattle. The aim of the present

2012

JCM
Journals.ASM.org

Epidemiological Significance of the Domestic Black Pig (*Sus scrofa*) in Maintenance of Bovine Tuberculosis in Sicily

Vincenzo Di Marco,[a] Piera Mazzone,[b] Maria Teresa Capucchio,[c] Maria Beatrice Boniotti,[d] Vincenzo Aronica,[a] Miriam Russo,[a] Michele Fiasconaro,[a] Noemi Cifani,[e,f] Sara Corneli,[b] Elena Biasibetti,[c] Massimo Biagetti,[b] Maria Lodovica Pacciarini,[d] Monica Cagiola,[b] Paolo Pasquali,[f] and Cinzia Marianelli[f]



2016

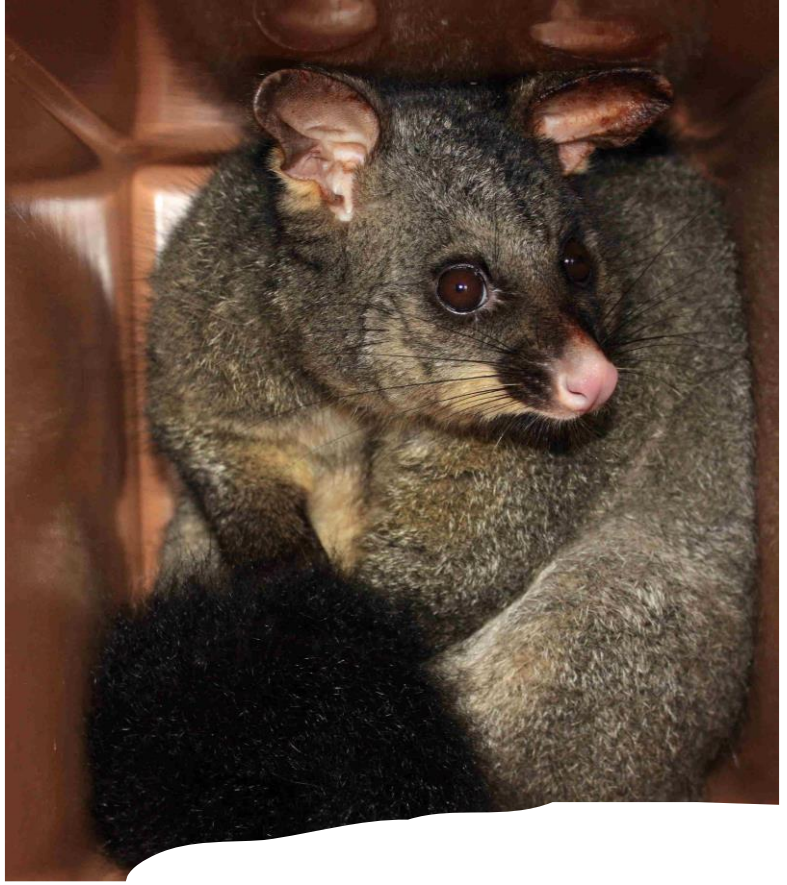
Transboundary and Emerging Diseases

Transboundary and Emerging Diseases

ORIGINAL ARTICLE

Sheep as a Potential Source of Bovine TB: Epidemiology, Pathology and Evaluation of Diagnostic Techniques

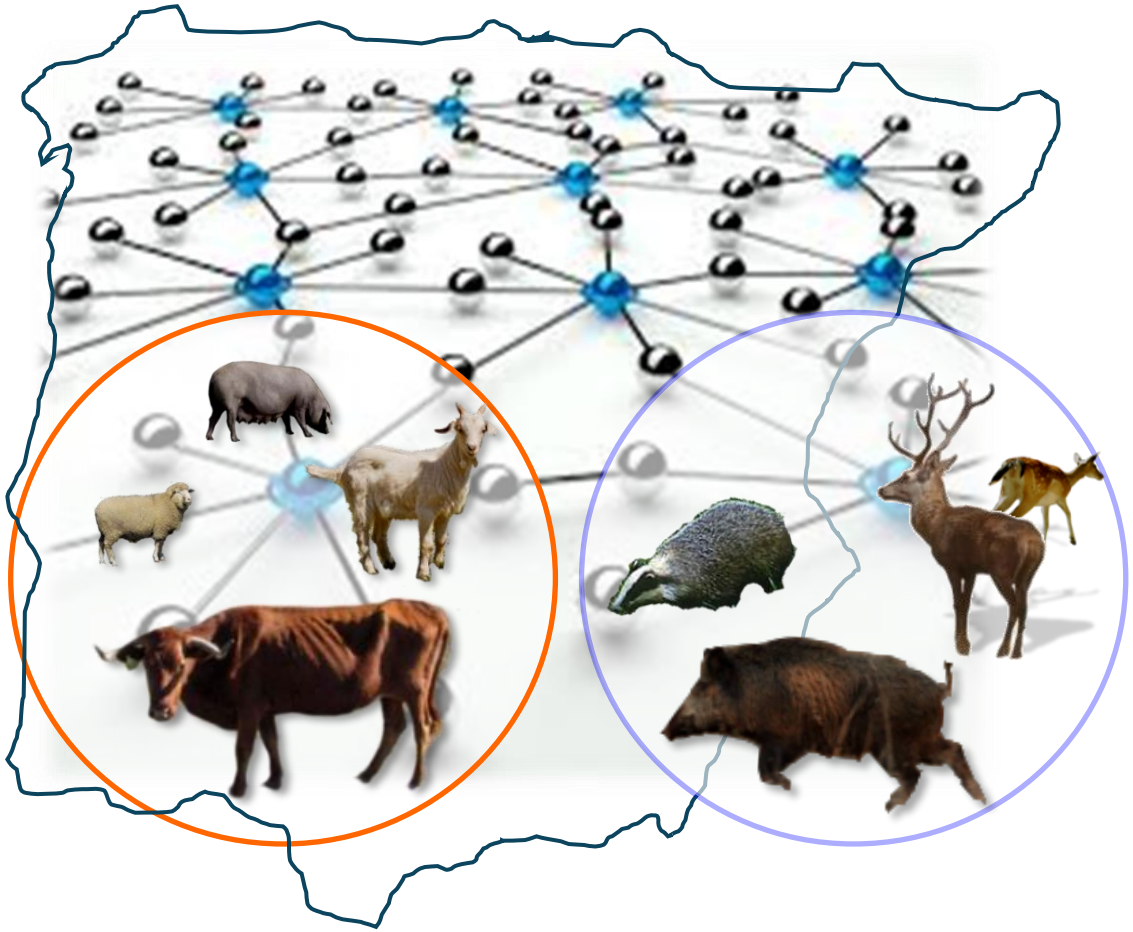
M. Muñoz-Mendoza[1], B. Romero[2], A. del Cerro[3], C. Gortázar[4], J. F. García-Marín[5], S. Menéndez[6], J. Mourelo[1], L. de Juan[2], J. L. Sáez[7], R. J. Delahay[8] and A. Balseiro[3]



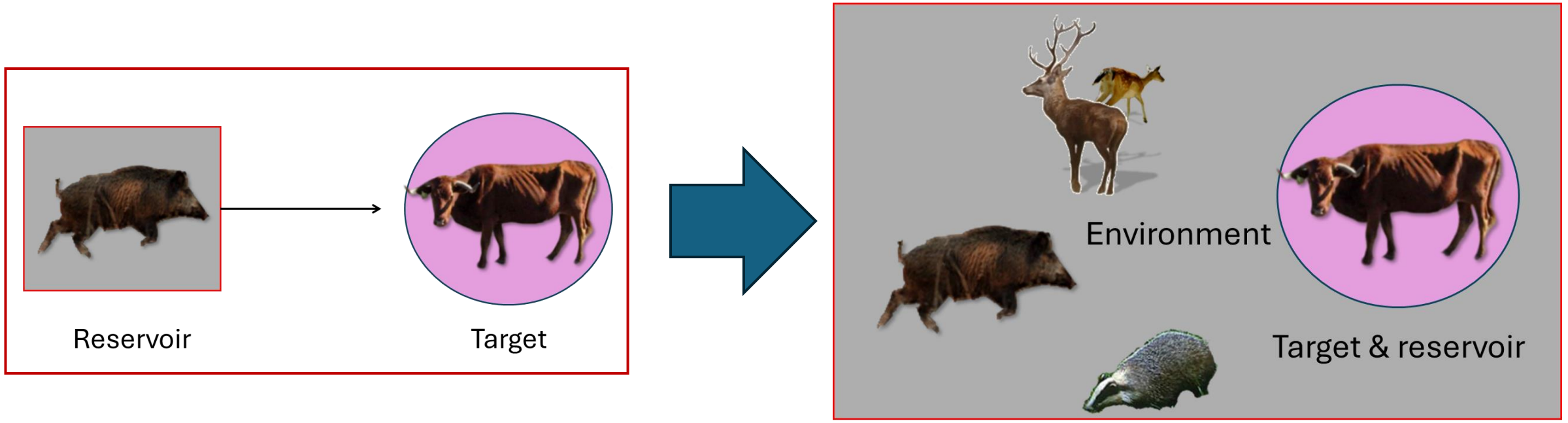
Wildlife hosts

Infección multi-hospedador

A más especies afectadas – mayor estabilidad del sistema



Episystems



"The set of biological, environmental, and epidemiological elements of an infection in defined geographic and temporal scales"

Haydon et al. 2002 EID; Tabachnick et al. 2010 J. Exp. Biol.


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

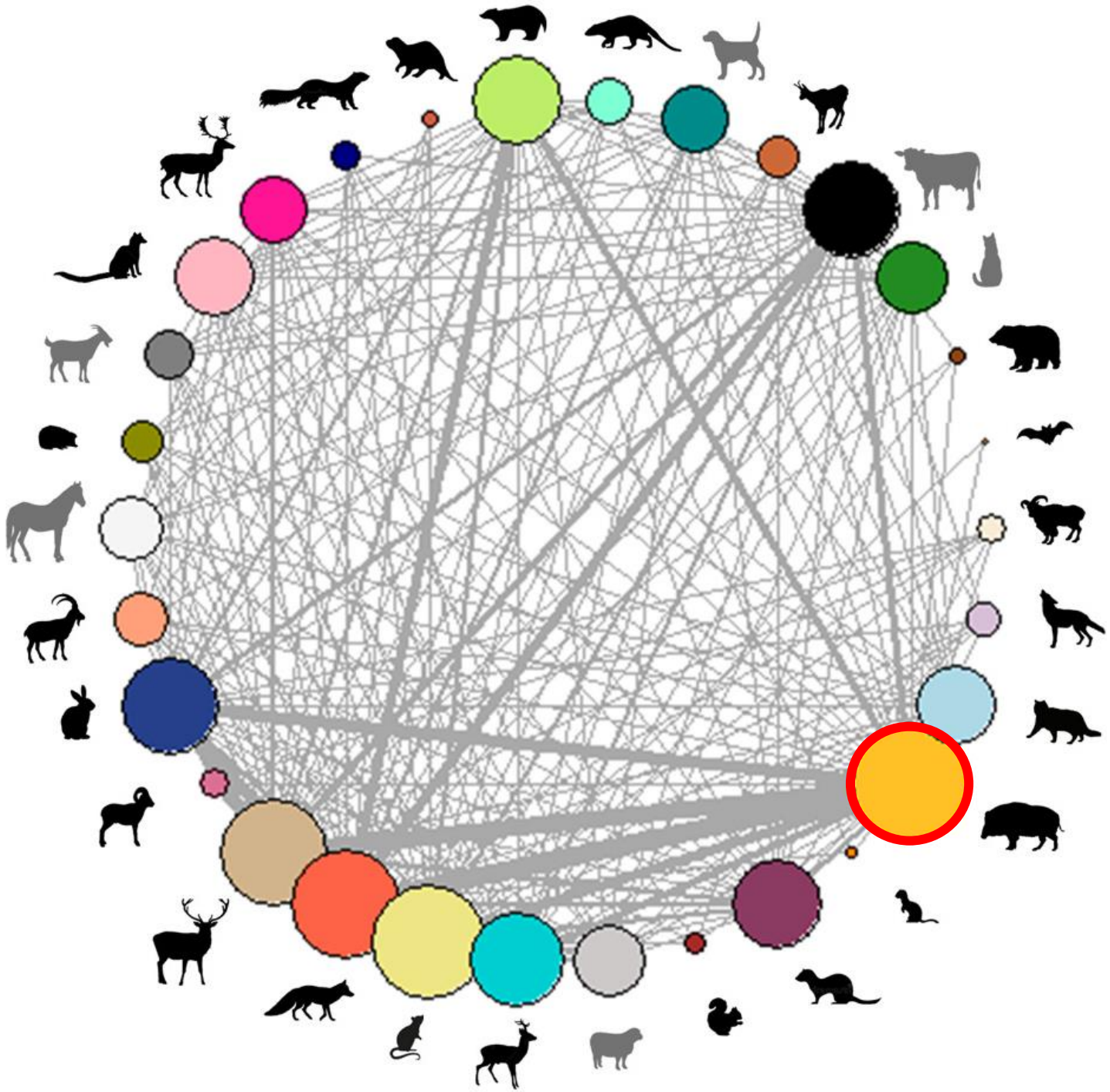

Ltl Acorn 055F 013C 10/12/2016 17:18:34

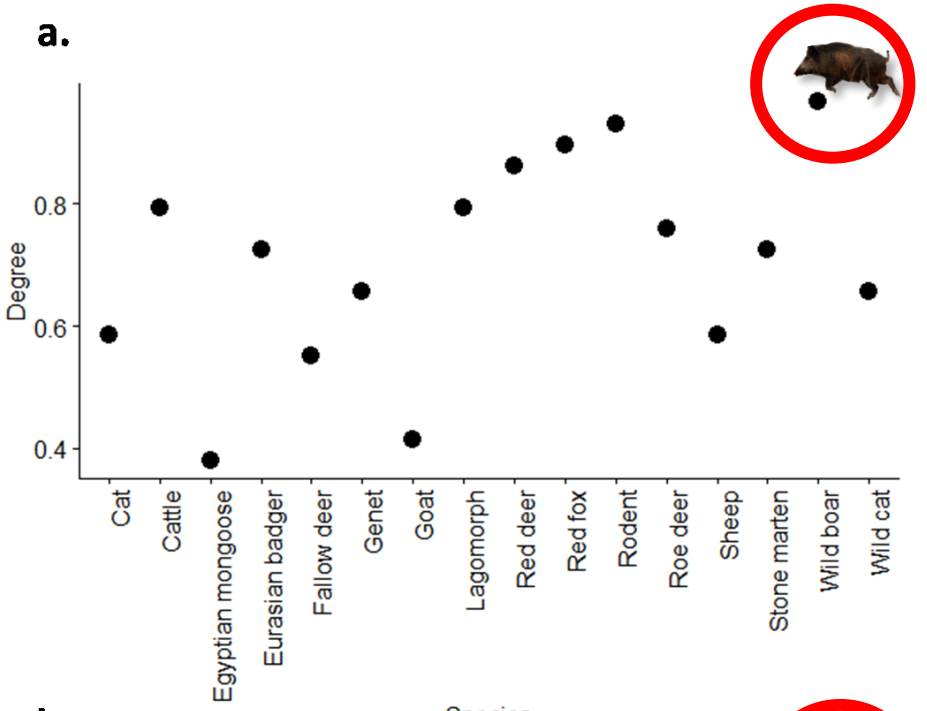

Ltl Acorn 044F 007C 10/11/2016 00:05:17

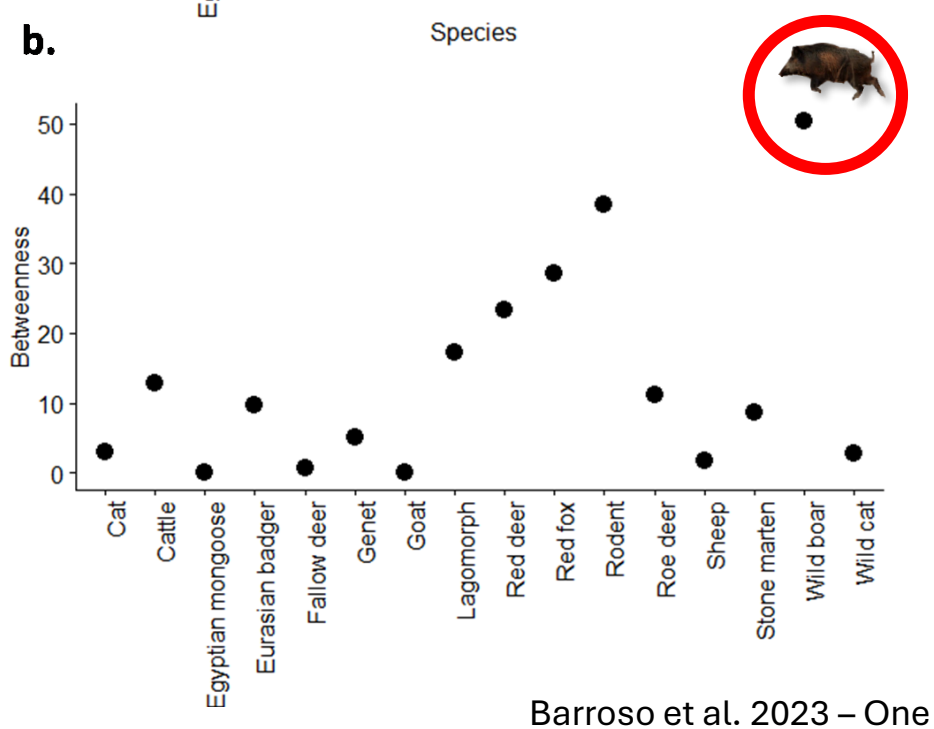

Ltl Acorn 053F 012C 10/02/2016 02:55:53


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


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

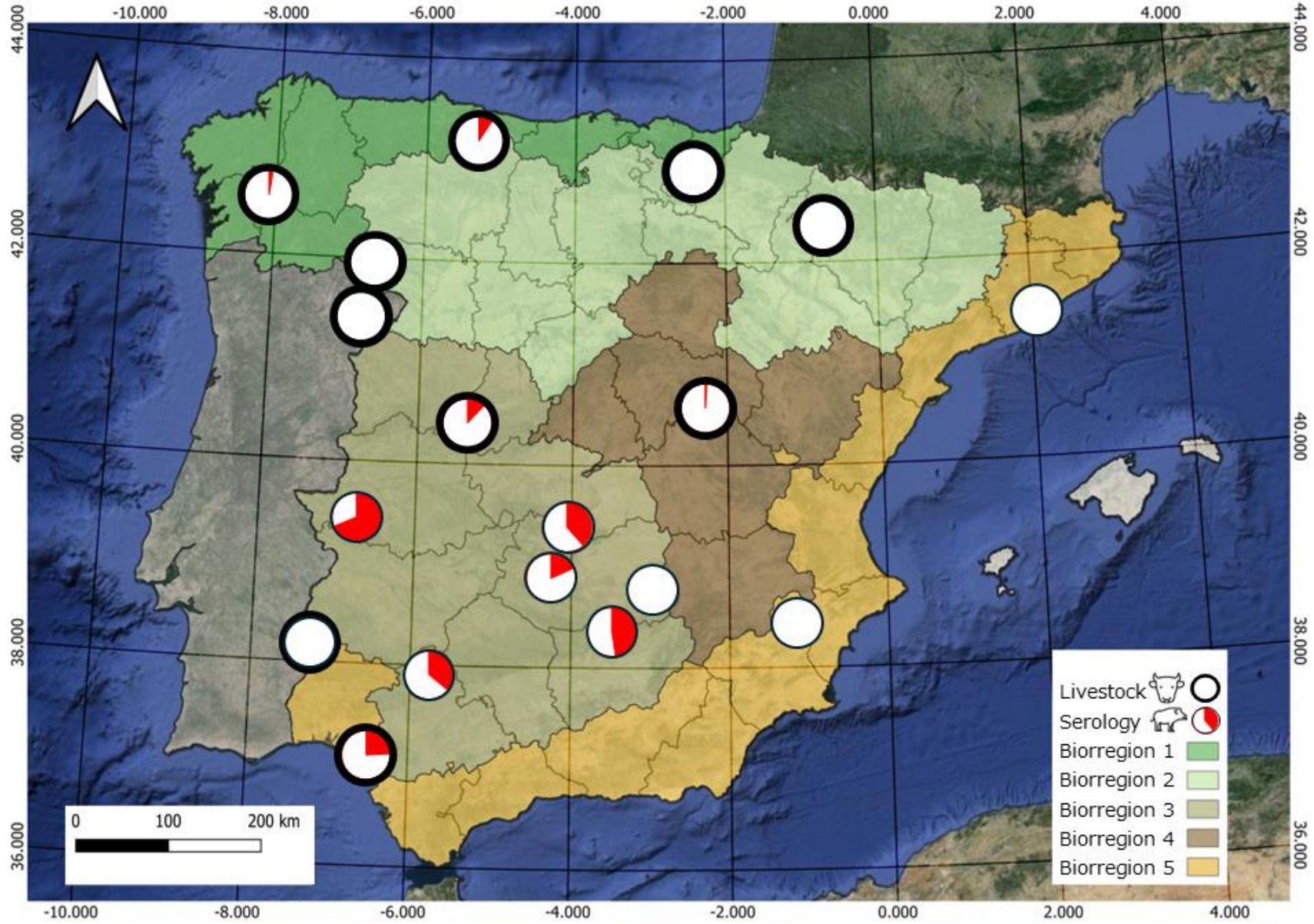


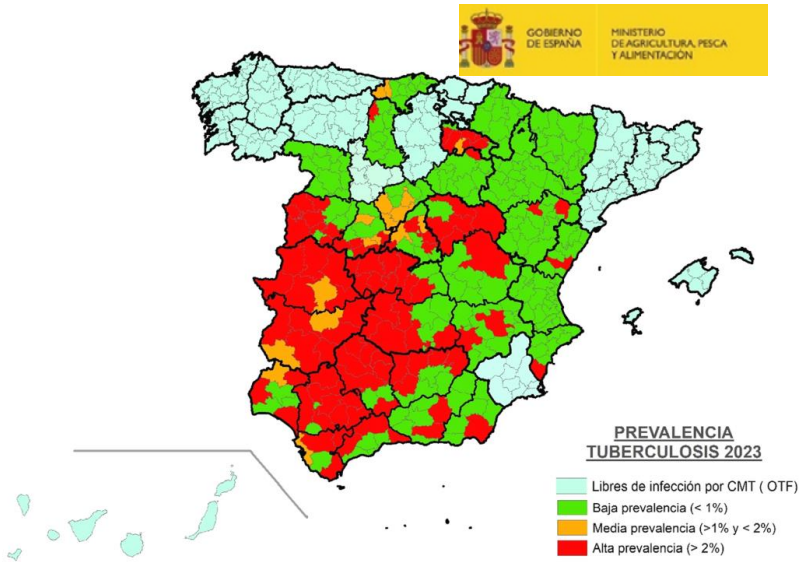




Barroso et al. 2023 – One Health

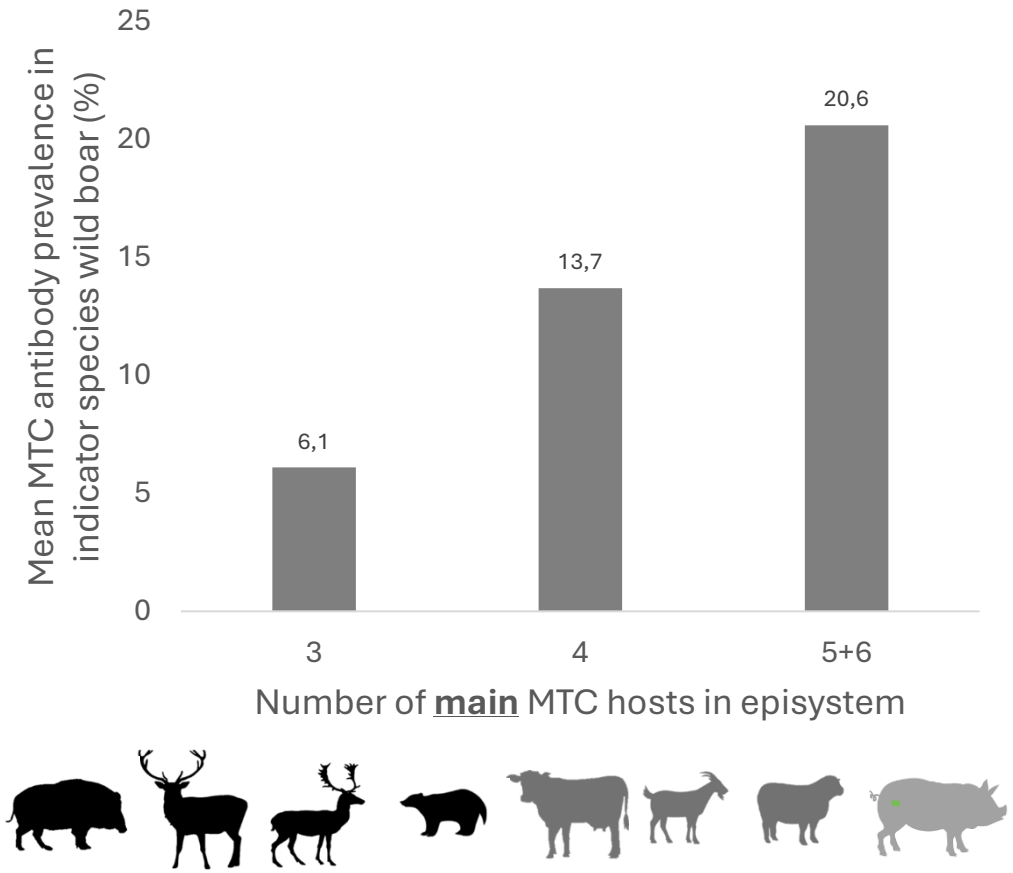
Results: TB distribution & prevalence

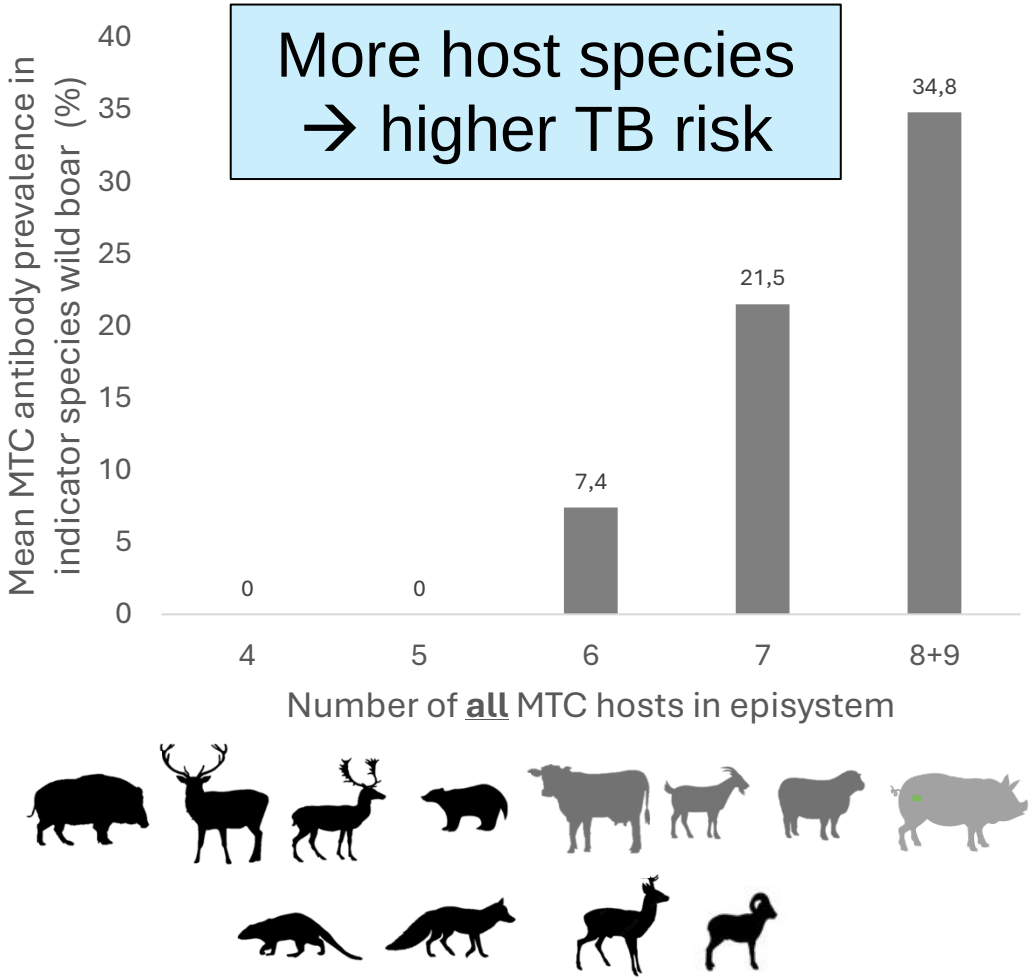




- TB detected in 4/5 biorregions (BRs)
- Mean prevalence 14% (range 0-68%)
- Highest prevalence in BR 3 (“Dehesa” region)

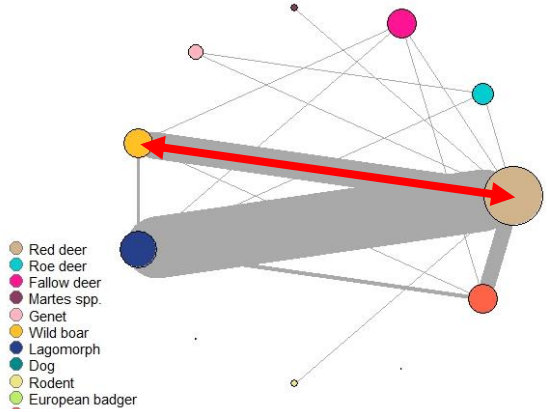
Results: more MTC host species → more TB

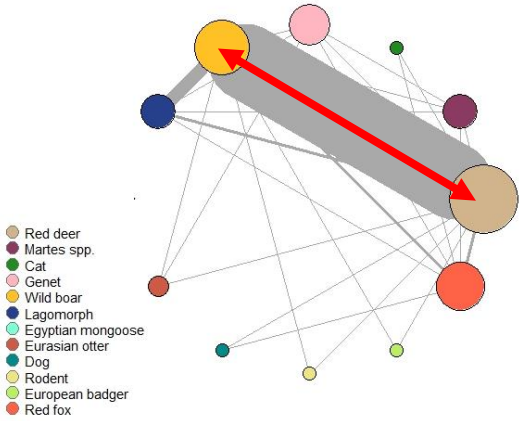


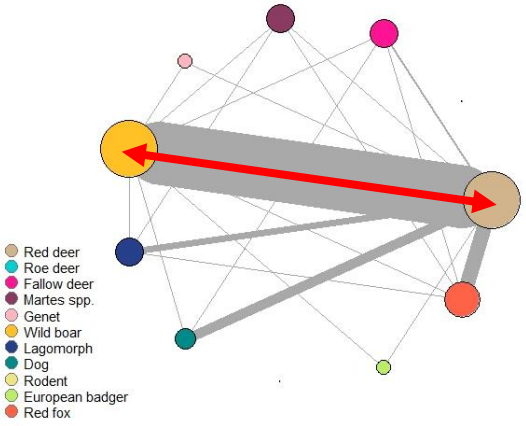


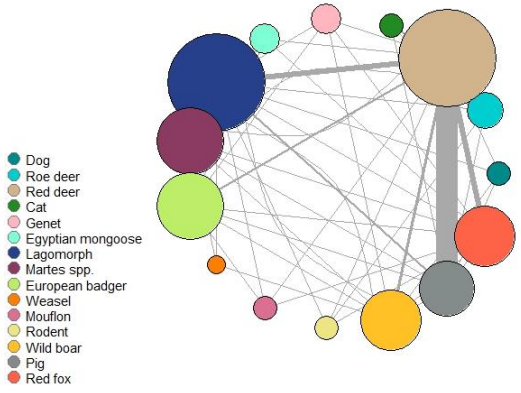
Results: Red deer weight correlates strongly with TB

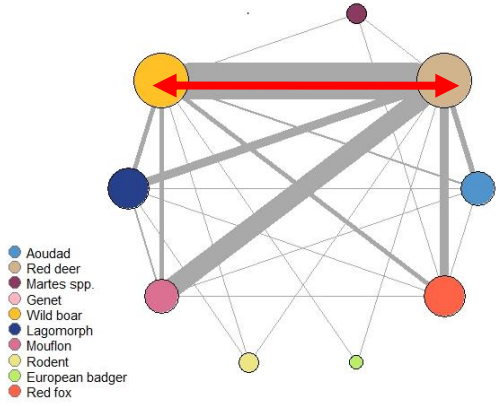
High TB prevalence host communities

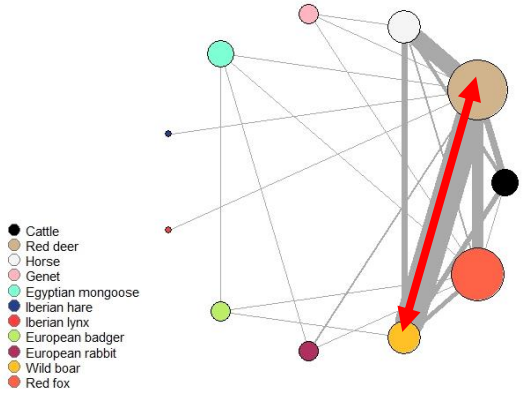




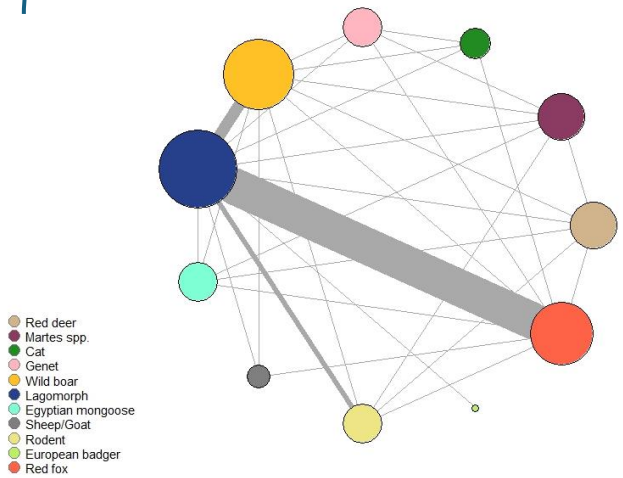


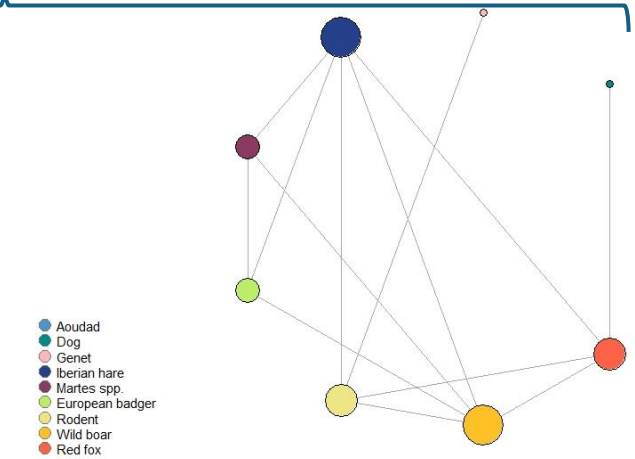


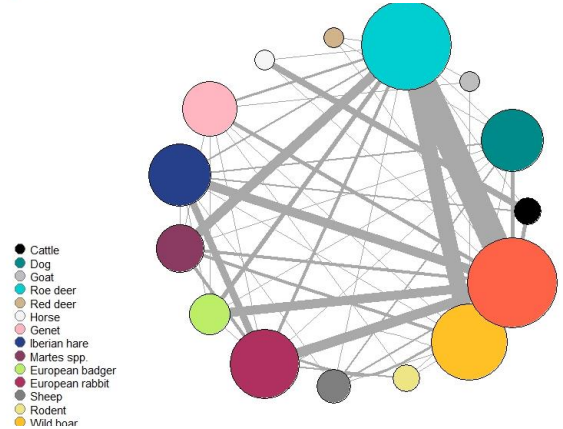


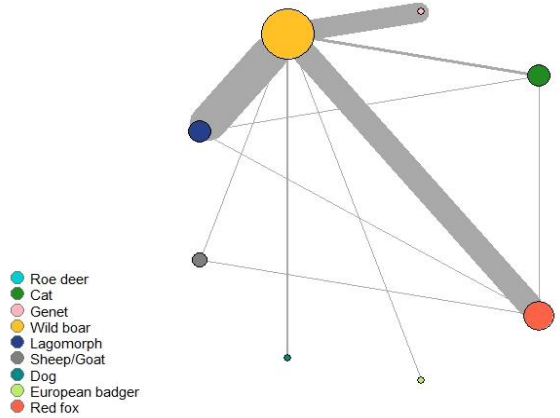


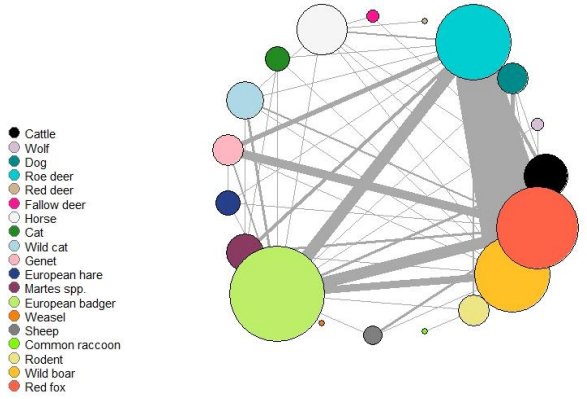
TB-free host communities

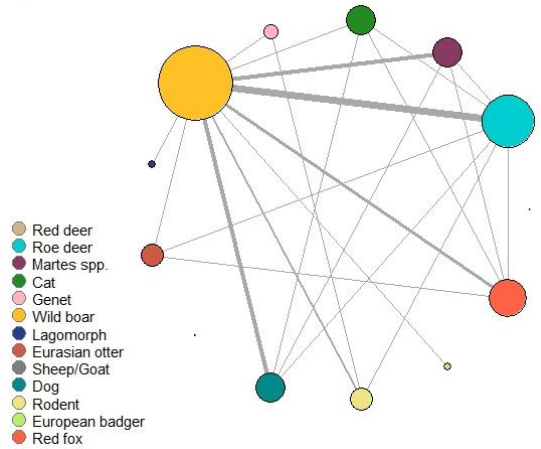


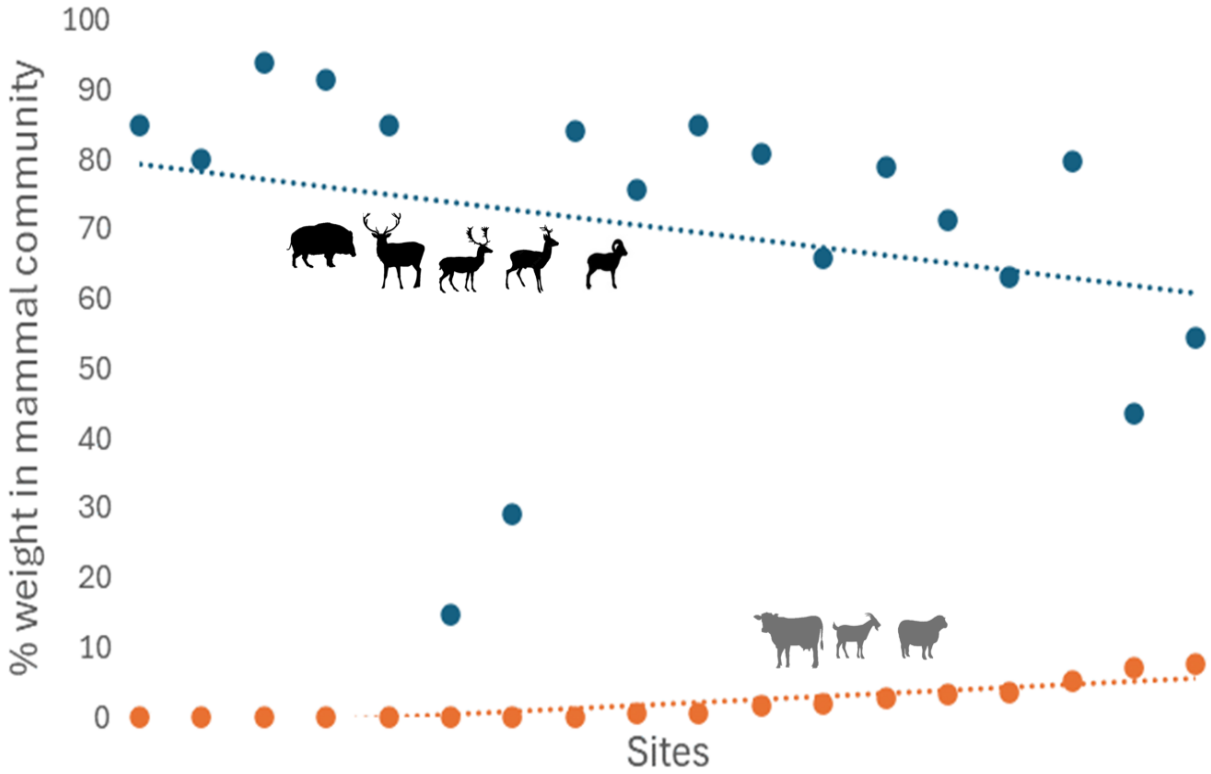


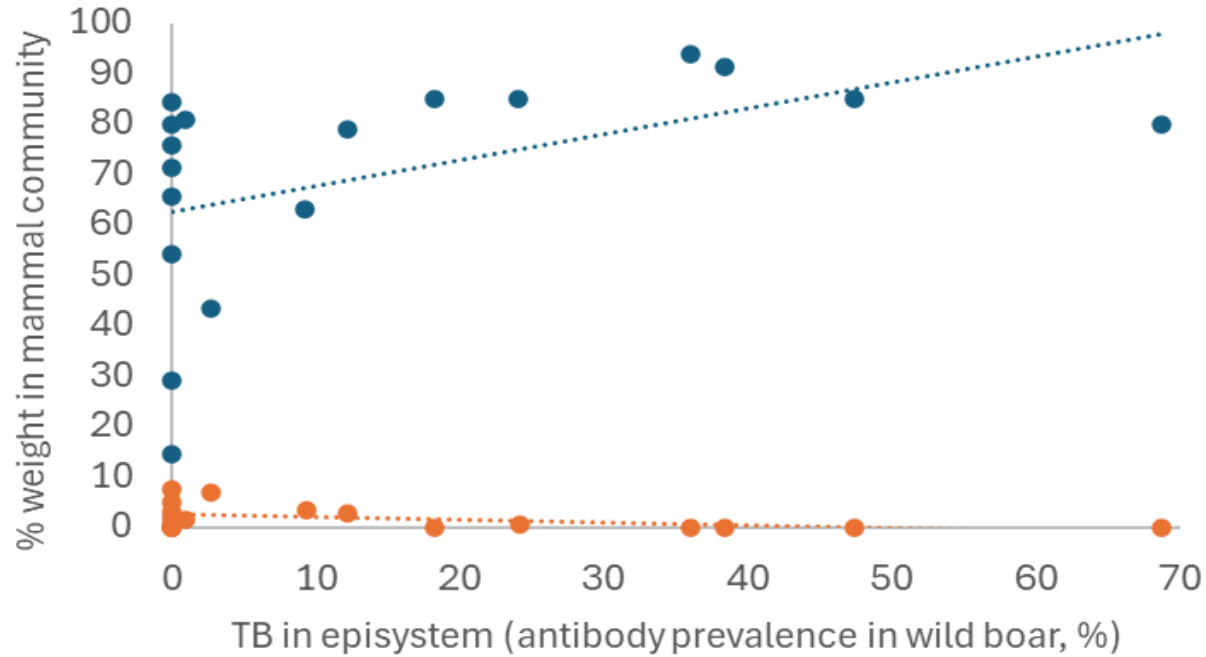









% weight in mammal community
100
90
80
70
60
50
40
30
20
10
0
Sites


% weight in mammal community
100
90
80
70
60
50
40
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20
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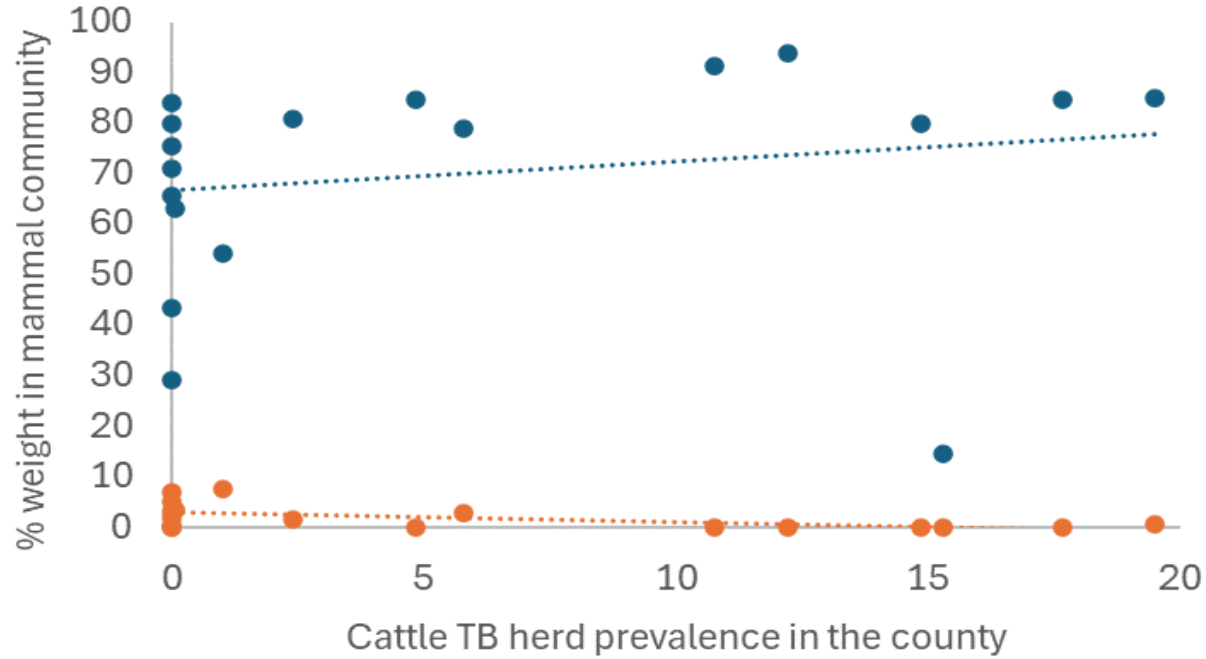
10
20
30
40
50
60
70
TB in episystem (antibody prevalence in wild boar, %)


% weight in mammal community
100
90
80
70
60
50
40
30
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0
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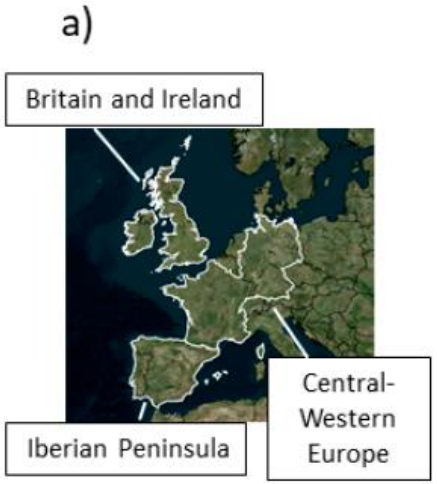
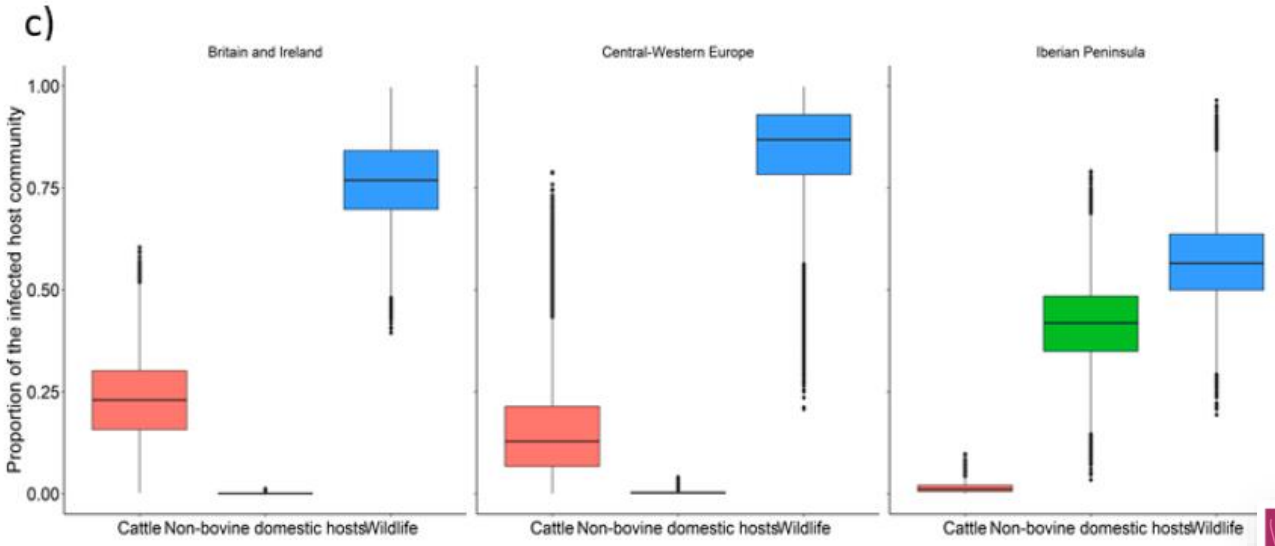
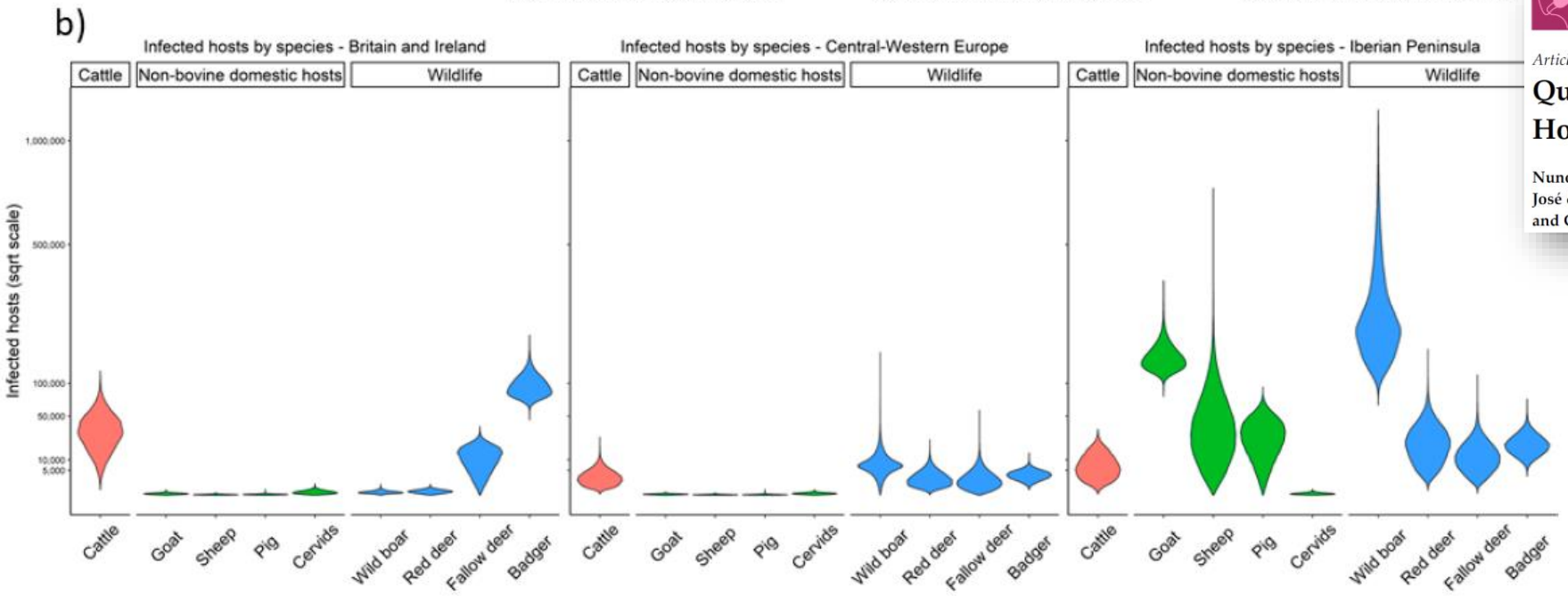
5
10
15
20
Cattle TB herd prevalence in the county

Are we targeting the right hosts?





Non-cattle >> Cattle



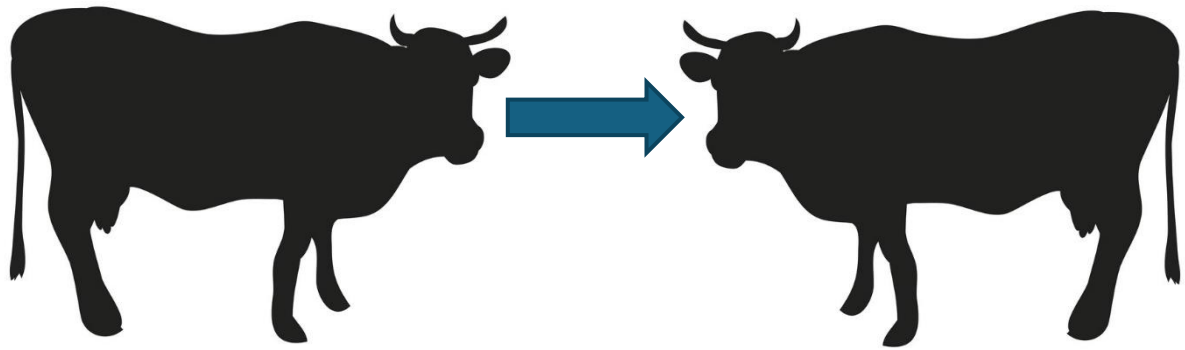
pathogens

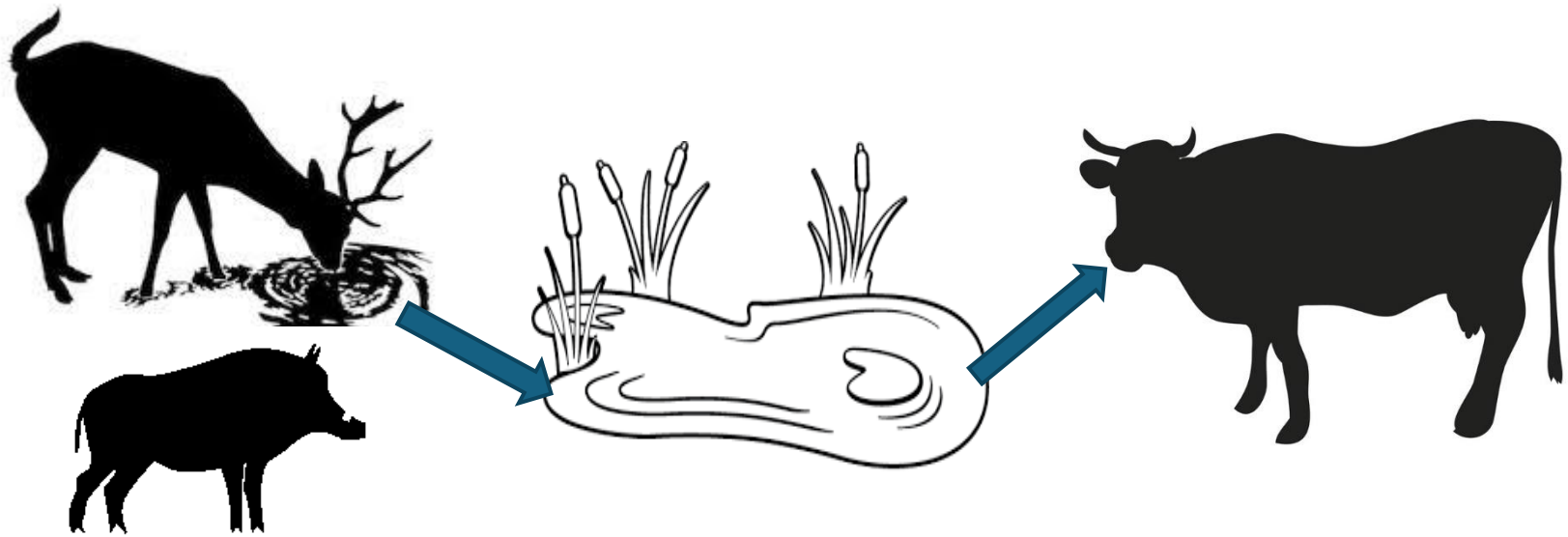
Article

Quantification of the Animal Tuberculosis Multi-Host Community Offers Insights for Control

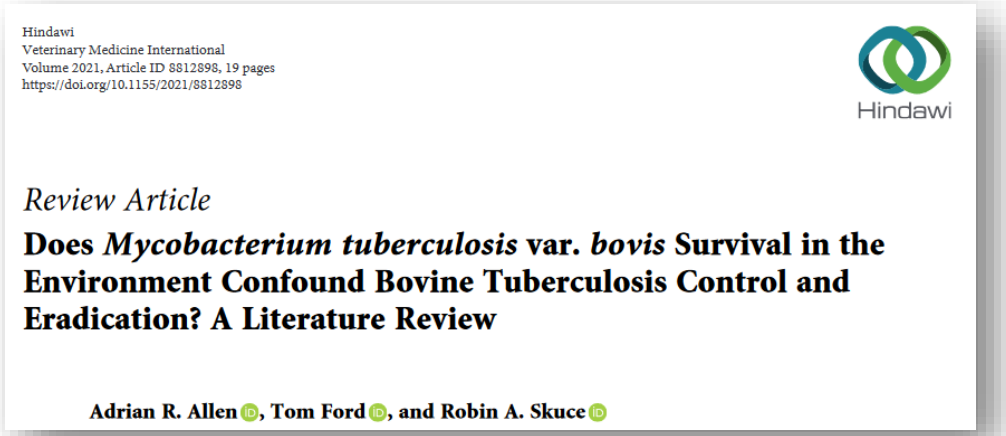
Nuno Santos [1,*], Céline Richomme [2], Telmo Nunes [3], Joaquín Vicente [4], Paulo C. Alves [1,5,6], José de la Fuente [4,7], Margarida Correia-Neves [8,9], María-Laura Boschiroli [10], Richard Delahay and Christian Gortázar [4]

Dogma: “contagio respiratorio”





Indirect transmission



Hindawi
Veterinary Medicine International
Volume 2021, Article ID 8812898, 19 pages
https://doi.org/10.1155/2021/8812898

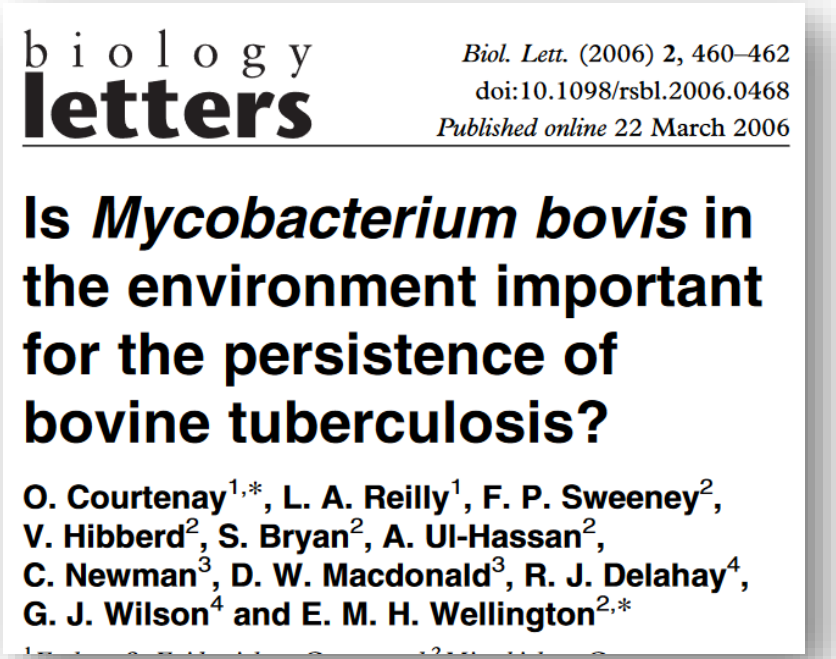
Hindawi

Review Article

Does *Mycobacterium tuberculosis* var. *bovis* Survival in the Environment Confound Bovine Tuberculosis Control and Eradication? A Literature Review

Adrian R. Allen, Tom Ford, and Robin A. Skuce

- *M. bovis* might be deposited by excretion and contaminate the environment
- *M. bovis* is relatively resilient in the environment, where it can infect a range of vertebrate and invertebrate hosts



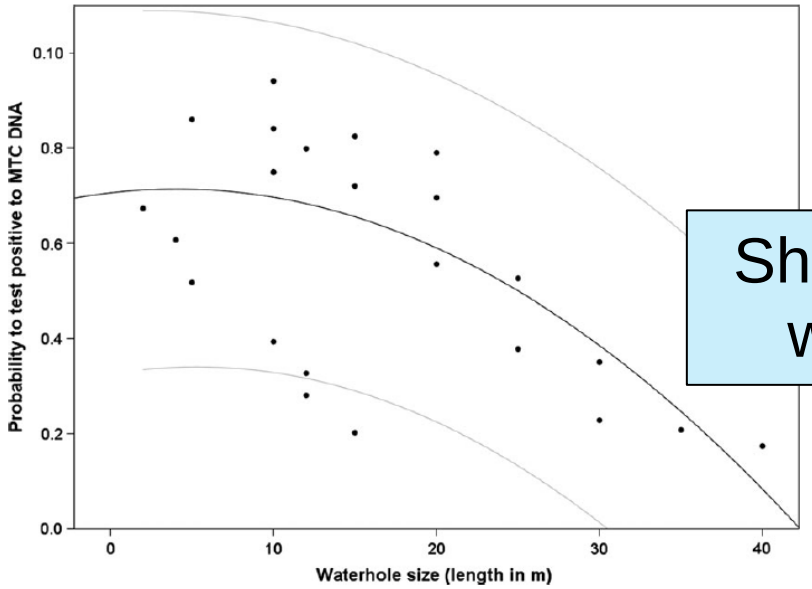
biology letters

Biol. Lett. (2006) **2**, 460–462
doi:10.1098/rsbl.2006.0468
Published online 22 March 2006

Is *Mycobacterium bovis* in the environment important for the persistence of bovine tuberculosis?

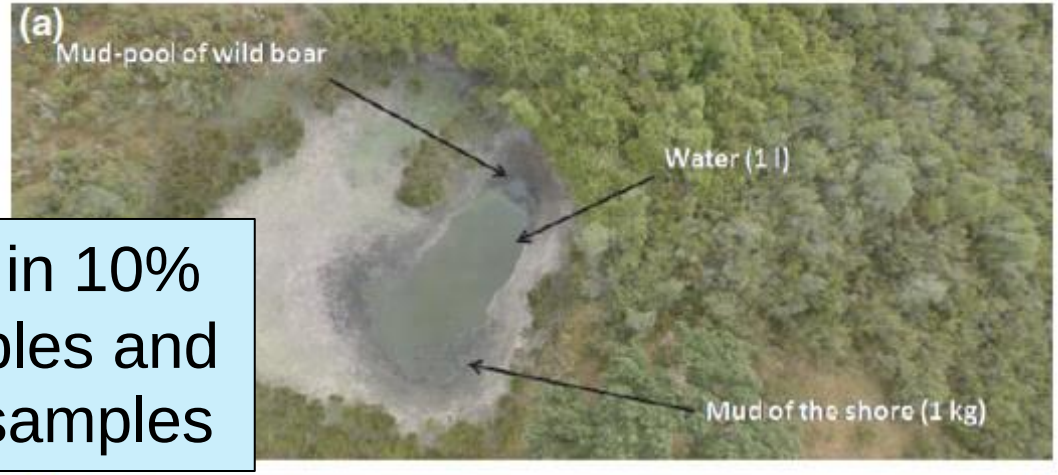
O. Courtenay[1,*], L. A. Reilly[1], F. P. Sweeney[2], V. Hibberd[2], S. Bryan[2], A. Ul-Hassan[2], C. Newman[3], D. W. Macdonald[3], R. J. Delahay[4], G. J. Wilson[4] and E. M. H. Wellington[2,*]

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

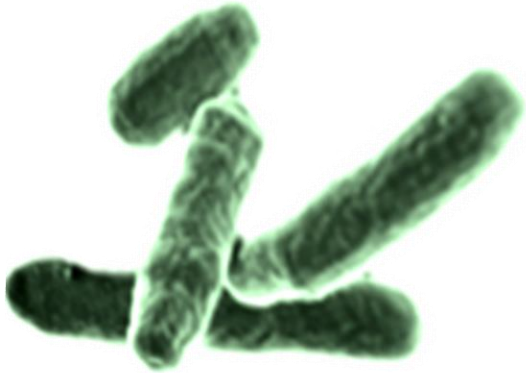
Environmental Presence of *Mycobacterium tuberculosis* Complex in Aggregation Points at the Wildlife/Livestock Interface

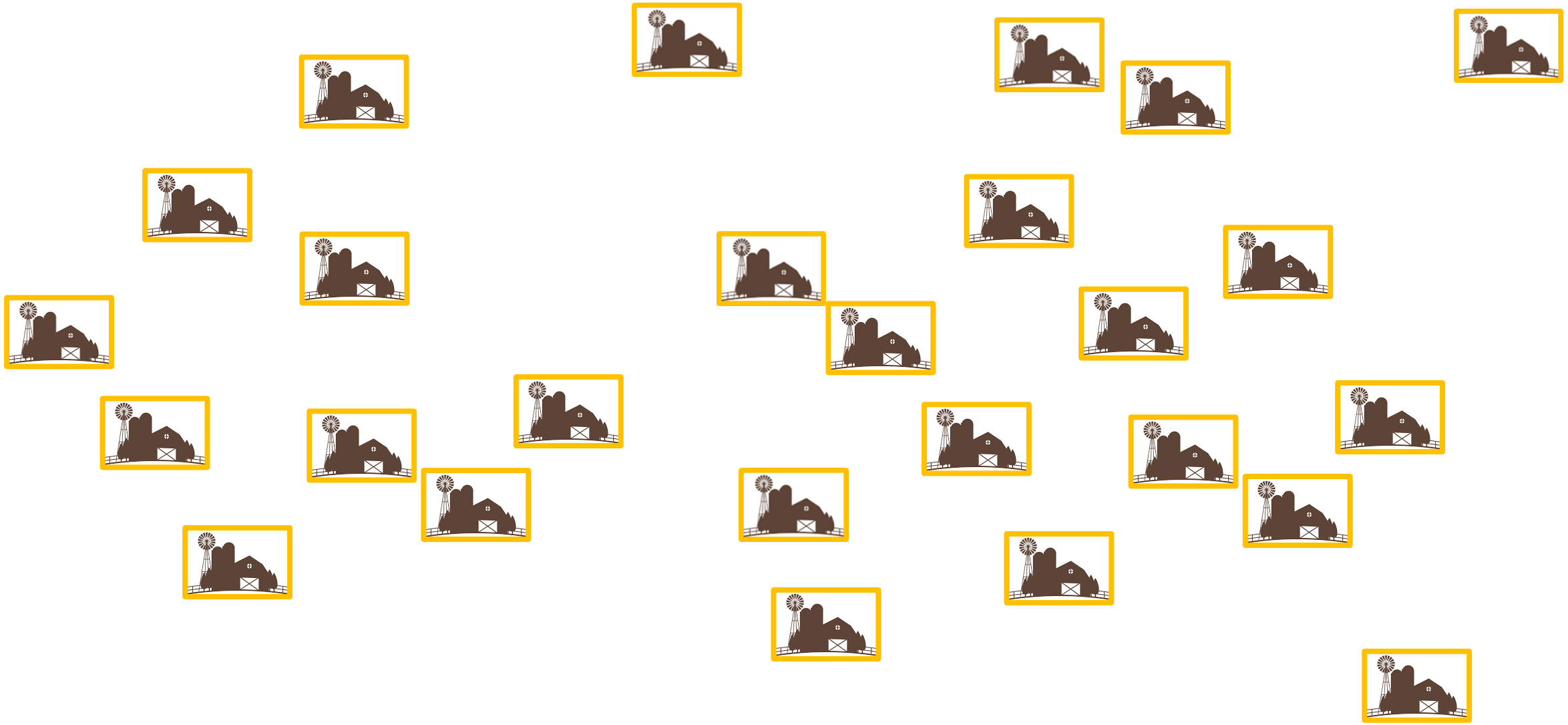
J. A. Barasona[1], J. Vicente[1], I. Díez-Delgado[1,2], J. Aznar[3,4], C. Gortázar[1] and M. J. Torres[3]

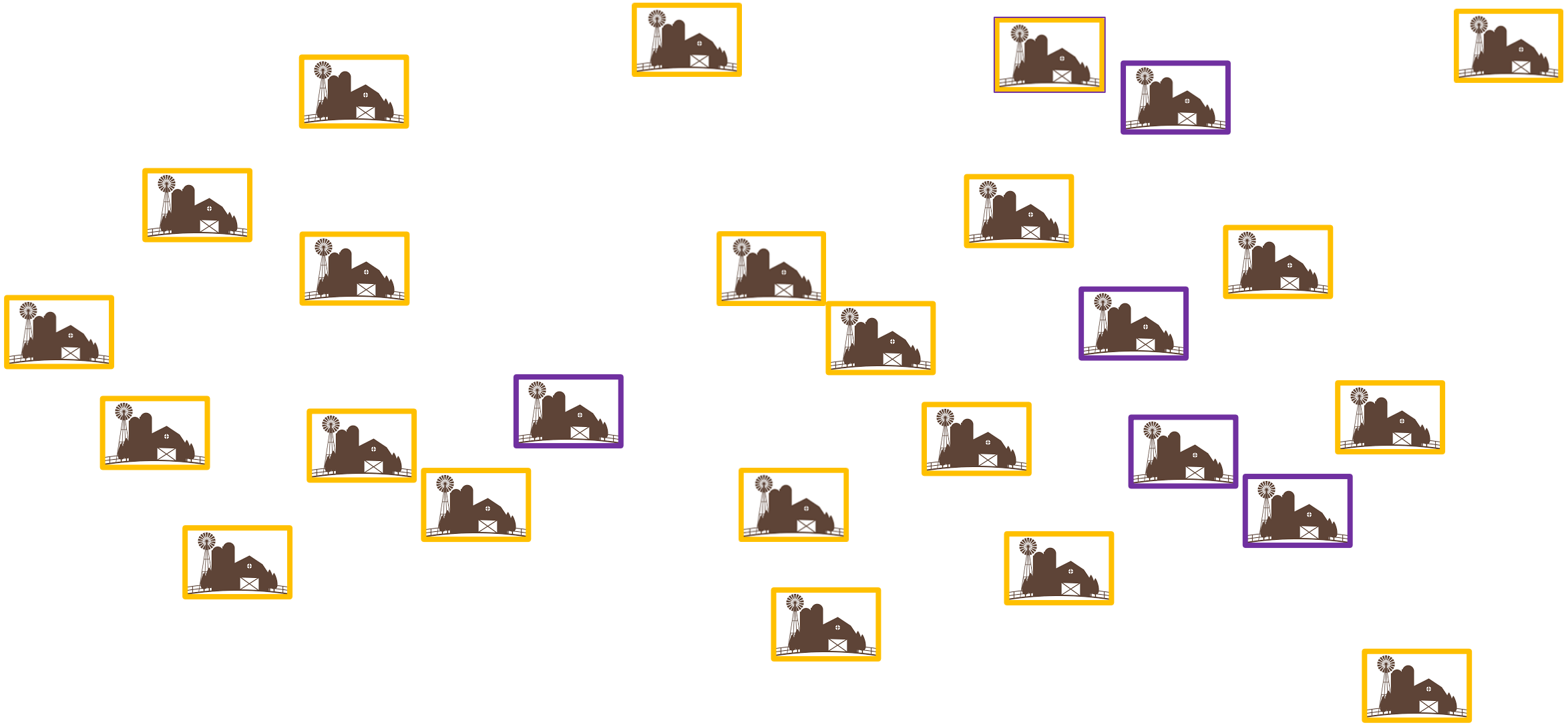
Transmisión entre especies es **indirecta**

Estructura de la presentación

- Situación actual de la TB animal
- Epidemiología: hospedadores y transmisión
- **Análisis de riesgos y diagnóstico epidemiológico**
- Herramientas de control
  - Pruebas y matadero en bovinos
  - Control de hospedadores no bovinos
  - Bioseguridad
  - Vacunación
- Cuatro mensajes clave







Gestión purines

Proximidad a bosque o matorral

Contacto rebaños bovinos

Contacto ciervo, gamo

Contacto jabalí

Saneamientos

Proximidad a maizal o afines

Almacenes de alimento

Densidad rebaños bovinos

Contacto gatos, perros

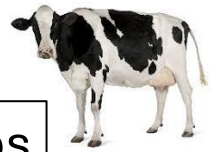
Contacto caprinos, ovinos, porcino extensivo…

Desinfección

Distancia rebaños próximos

Contacto tejón

Tamaño del rebaño



Proximidad a río

Comederos

Movimientos

Puntos de agua

Proximidad a coto de caza mayor

Cerramiento exterior

Movimientos

Saneamientos

Tamaño del rebaño

Contacto rebaños bovinos

Densidad rebaños bovinos

Distancia rebaños próximos

Puntos de agua

Almacenes de alimento

Comederos

Cerramiento exterior

Cerramiento zona novillas

Gestión purines

Contacto caprinos, ovinos, porcino…

Contacto gatos, perros

Proximidad a río

Proximidad a maizal o afines

Proximidad a bosque o matorral

Contacto tejón

Contacto jabalí

Contacto ciervo, gamo

Proximidad a coto de caza mayor

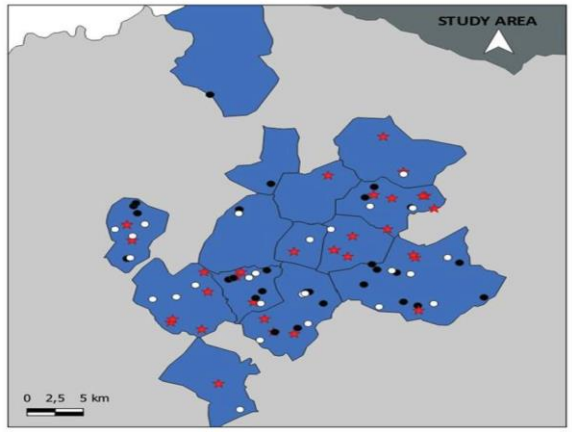
Ejemplo en ganaderías de carne: Salamanca, España

European Journal of Wildlife Research (2024) 70:81
https://doi.org/10.1007/s10344-024-01833-z

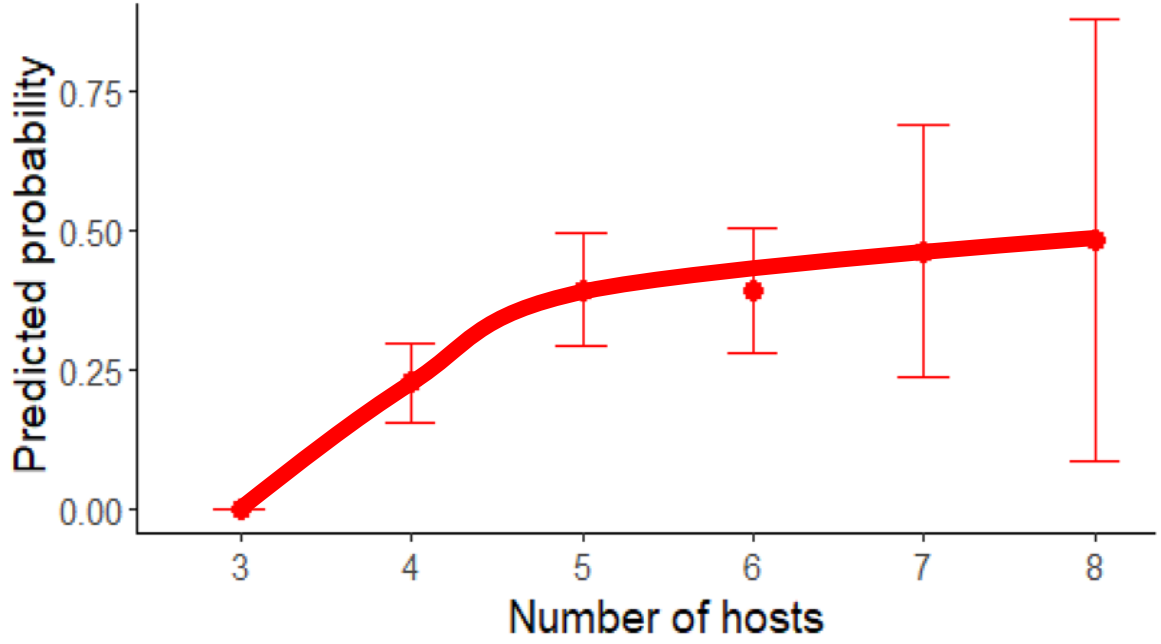
RESEARCH

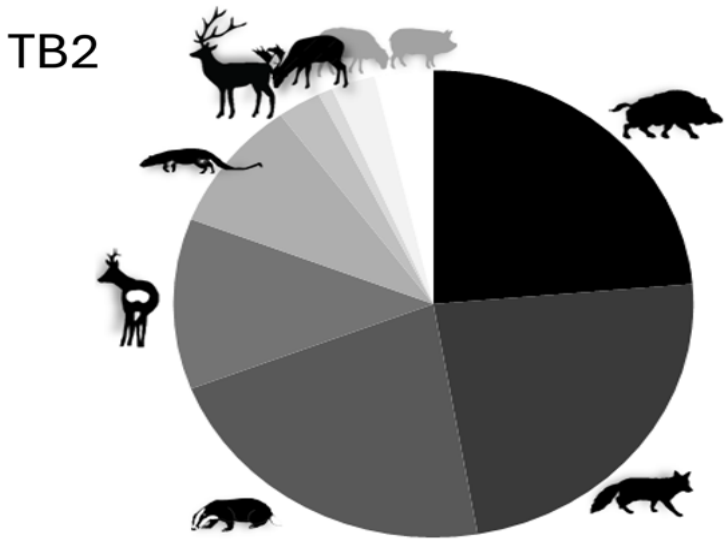
Farm management practices and host species richness associated with higher likelihood of tuberculosis positive farms in Western Spain

Gloria Herrero-García[1] · Rita Vaz-Rodrigues[2] · Pilar Pozo[2,3] · Patricia Barroso[1] · David Relimpio[2] · Jesús Nácar[4] · Anna Grau[4] · Olga Mínguez[5] · Alberto García-Rodríguez[1] · Ana Balseiro[1,6] · Christian Gortázar[2]



Gloria Herrero-García





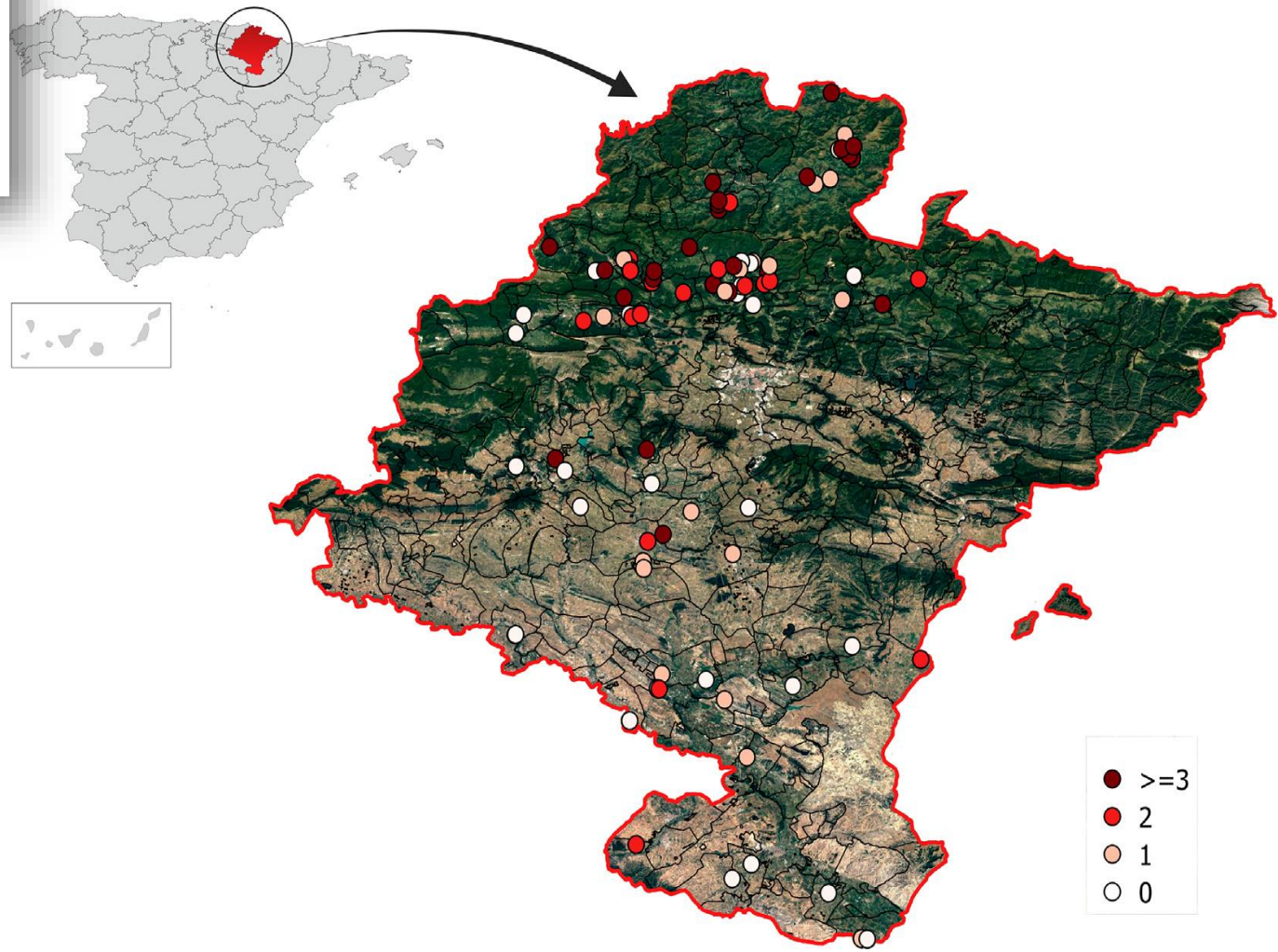
Ejemplo en ganaderías de leche: Navarra, España

Animal
The international journal of animal biosciences

Contribution of herd management, biosecurity, and environmental factors to the risk of bovine tuberculosis in a historically low prevalence region

P. Pozo [a,1,*], J. Isla [b,1], A. Asiain [c], D. Navarro [d], C. Gortázar [a]

Julio Isla
(Sabiotec)



Ejemplo en ganaderías de leche: Navarra, España

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Contribution of herd management, biosecurity, and environmental factors to the risk of bovine tuberculosis in a historically low prevalence region

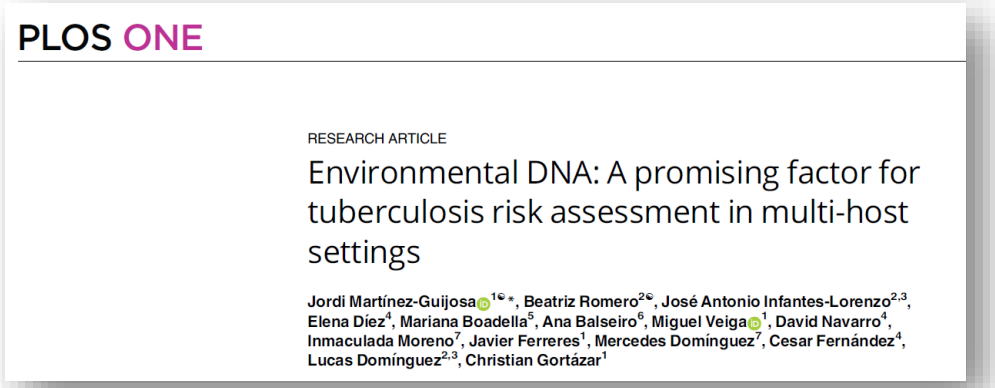
P. Pozo [a,1,*], J. Isla [b,1], A. Asiain [c], D. Navarro [d], C. Gortázar [a]

Principales factores de riesgo:

- Contacto con **ovinos**
- Presencia de **fauna** (tejón, jabalí)
- Ausencia **vallado** completo
- **Movimientos**

Variable	Level	Prevalence index 0	1	2	≥3	Total	%	OR Multivariable	95% Confidence interval 2.5%	97.5%	*P*-value[a]	*P*-value[b]
Leasing pastures for sheep flocks during Winter	No	25	15	16	11	67	71.3	NA	NA	NA	NA	0.05
	Yes	3	6	4	14	27	28.7	3.09	1.02	9.99	0.05	
Use of pastures	No	17	9	7	3	36	38.3	NA	NA	NA	NA	0.34
	Yes	11	12	13	22	58	61.7	1.99	0.48	8.47	0.34	
Frequency of badger sightings	0 (never)	21	10	9	6	46	48.9	NA	NA	NA	NA	0.03
	1 (sporadically)	6	9	8	13	36	38.3	3.03	1.12	8.51	0.03	
	>1 (monthly to daily)	1	2	3	6	12	12.8	4.34	1.13	17.48	0.03	
Solid fencing around farmyard	No	15	15	16	22	68	72.3	NA	NA	NA	NA	0.06
	Yes	13	6	4	3	26	27.7	0.42	0.16	1.04	0.06	
Movement to pastures	On foot	4	3	7	18	32	34.0	NA	NA	NA	NA	0.001
	None	17	9	9	4	39	41.5	0.57	0.12	2.74	0.48	
	Transport	1	2	2	1	6	6.4	0.49	0.08	2.89	0.42	
	Vehicle	6	7	2	2	17	18.1	0.09	0.02	0.31	0.001	
0 | 1	Intercept							0.43	NA	NA	0.33	
1 | 2	Intercept							1.56	NA	NA	0.61	
2 | ≥3	Intercept							6.09	NA	NA	0.04	

Ejemplo en ganaderías de carne: Navarra, España



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]

Jordi Martínez Guijosa

24 predios
20 variables

Se analiza la comunidad de hospedadores y se identifican como relevantes:

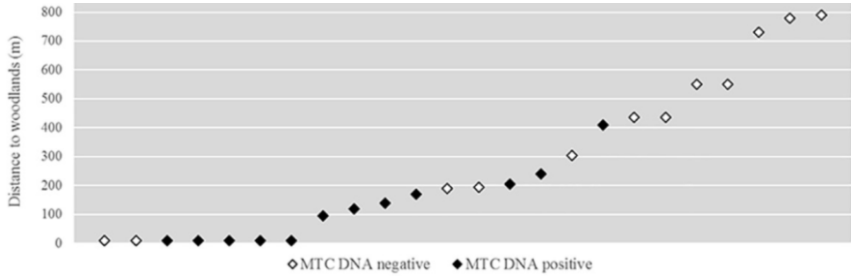
- Bovinos
- Jabalí
- Tejón
- Ovinos

Los predios se clasifican en (+) o (-) según se detecte ADN ambiental de CMT en esponjas.

Factores de riesgo principales:

- "uso de **pastos regionales**" (**ovino, jabalí**)
- "proximidad a bosques" (**jabalí, tejón**)

El muestreo de ADN ambiental mediante esponjas ayuda en análisis de riesgo



Esponjas para detectar TB

Esponja impregnada con líquido que destruye patógenos pero conserva su ADN y ARN

La esponja recoge ADN y ARN ambiental sobre superficies como comederos, bebederos o piel

La muestra se traslada al laboratorio para extraer ADN y ARN ambiental

RT PCR a tiempo real siguiendo protocolos en laboratorio acreditado

ORIGINAL ARTICLE

Transboundary and Emerging Diseases WILEY

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

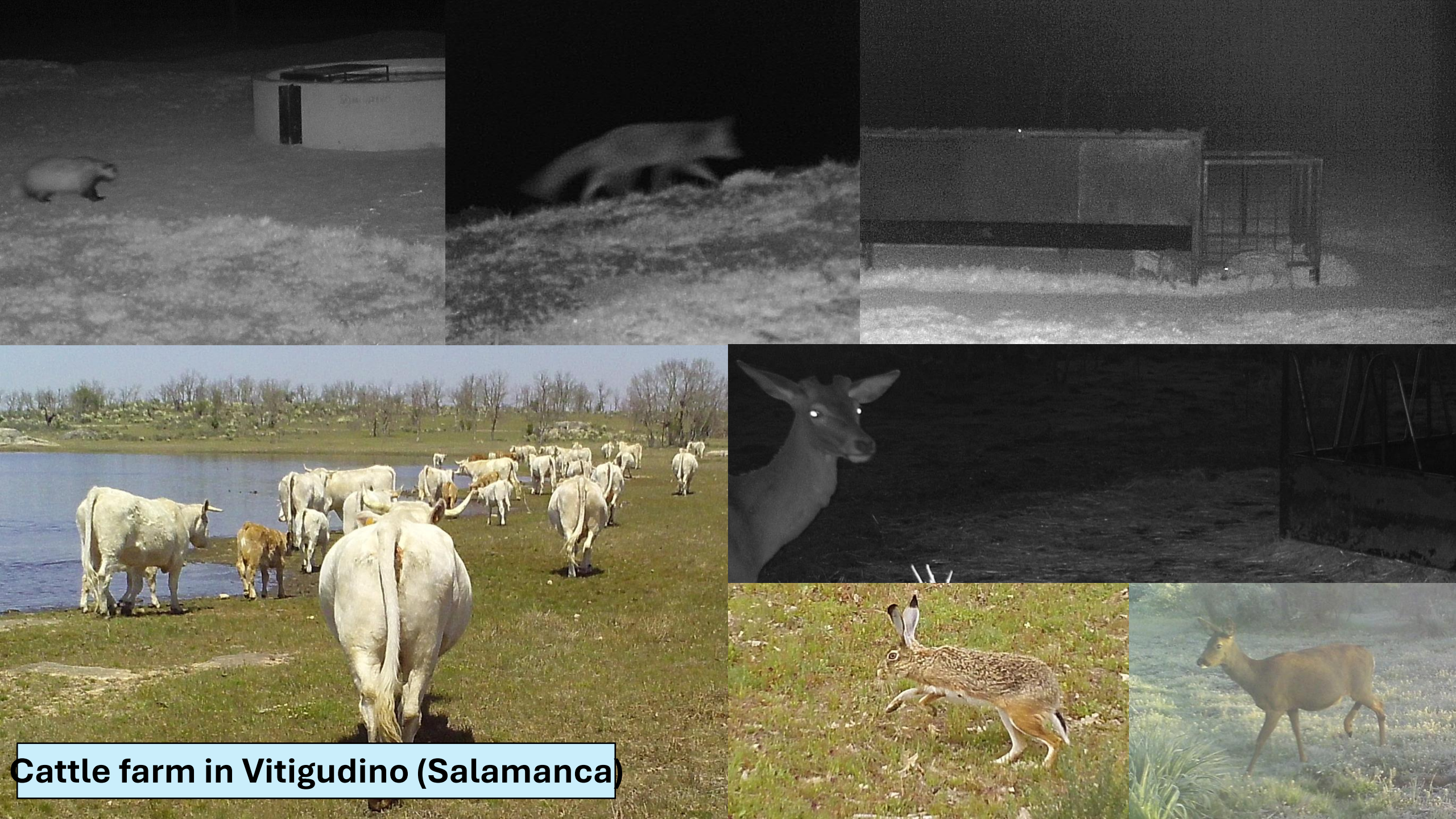
Isabel G. Fernández-de-Mera[1] | Francisco J. Rodríguez del-Río[2] | José de la Fuente[1,3] | Marta Pérez-Sancho[4] | Dolores Hervás[2] | Inmaculada Moreno[5] | Mercedes Domínguez[5] | Lucas Domínguez[4] | Christian Gortázar[1]

Proyecto ONE HEALTH FARMING

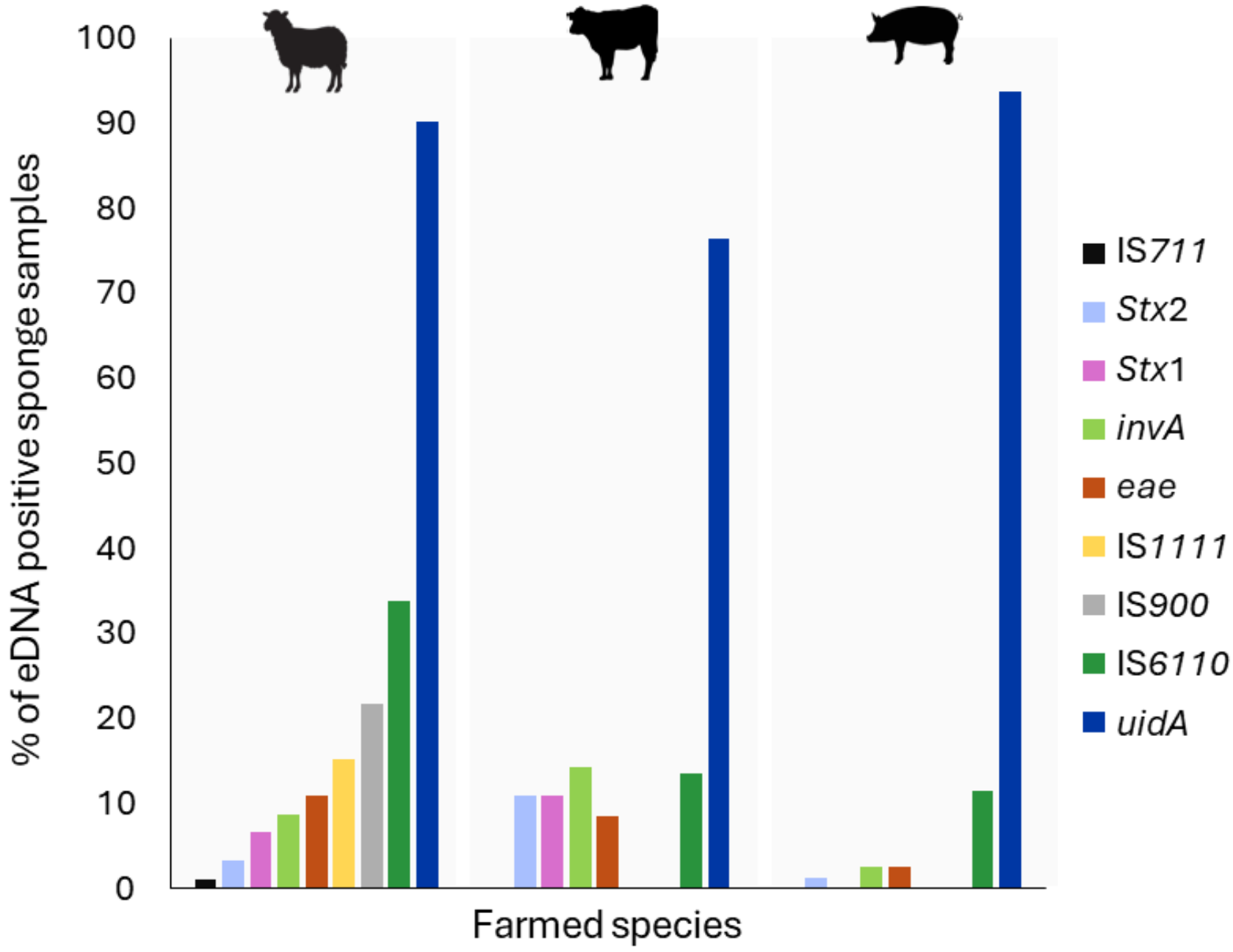
Vigilancia medioambiental y mitigación de riesgos para una producción alimentaria ganadera segura y sostenible y la conservación de la biodiversidad

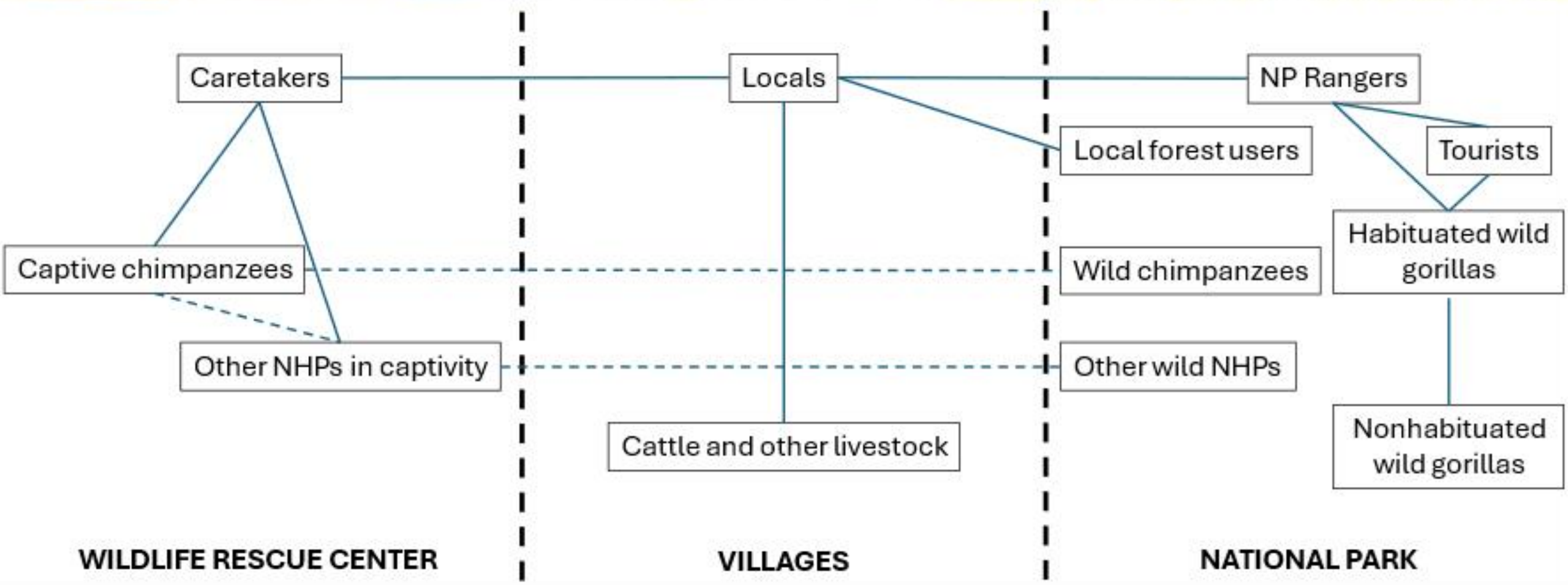
MINISTERIO DE CIENCIA E INNOVACIÓN
Financiado por la Unión Europea NextGenerationEU
Plan de Recuperación, Transformación y Resiliencia
AGENCIA ESTATAL DE INVESTIGACIÓN

Objetivo: mejorar la **bioseguridad** de las explotaciones extensivas para hacerlas más resistentes a las enfermedades emergentes, más competitivas y más sostenibles.



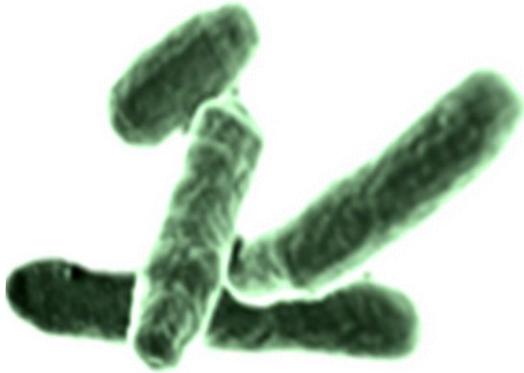
Cattle farm in Vitigudino (Salamanca)


100
90
80
70
60
50
40
30
20
10
0
% of eDNA positive sponge samples
Farmed species
IS711
Stx2
Stx1
invA
eae
IS1111
IS900
IS6110
uidA

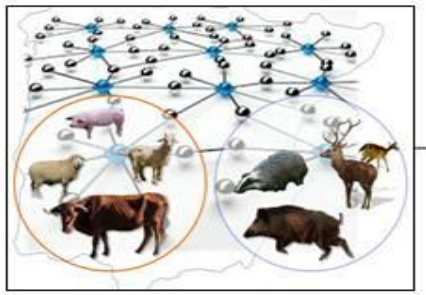

Caretakers
Locals
NP Rangers
Local forest users
Tourists
Habituated wild gorillas
Captive chimpanzees
Wild chimpanzees
Other NHPs in captivity
Other wild NHPs
Cattle and other livestock
Nonhabituated wild gorillas
WILDLIFE RESCUE CENTER
VILLAGES
NATIONAL PARK

Estructura de la presentación

- Situación actual de la TB animal
- Epidemiología: hospedadores y transmisión
- Análisis de riesgos y diagnóstico epidemiológico
- **Herramientas de control**
  - **Pruebas y matadero en bovinos**
  - **Control de hospedadores no bovinos**
  - **Bioseguridad**
  - **Vacunación**
- Cuatro mensajes clave



Control de TB



A.- No actuar ni desarrollar vigilancia sanitaria (desaconsejado)

B.- No actuar (coste>beneficio), pero realizar vigilancia sanitaria

C.- Actuar (coste<beneficio), siempre realizando vigilancia sanitaria

Vigilancia poblacional y sanitaria

Prevención y bioseguridad

Control de poblaciones

Vacunación

1. Diagnóstico epidemiológico

2. Decisión entre tres opciones

3. Intervención (control integrado)

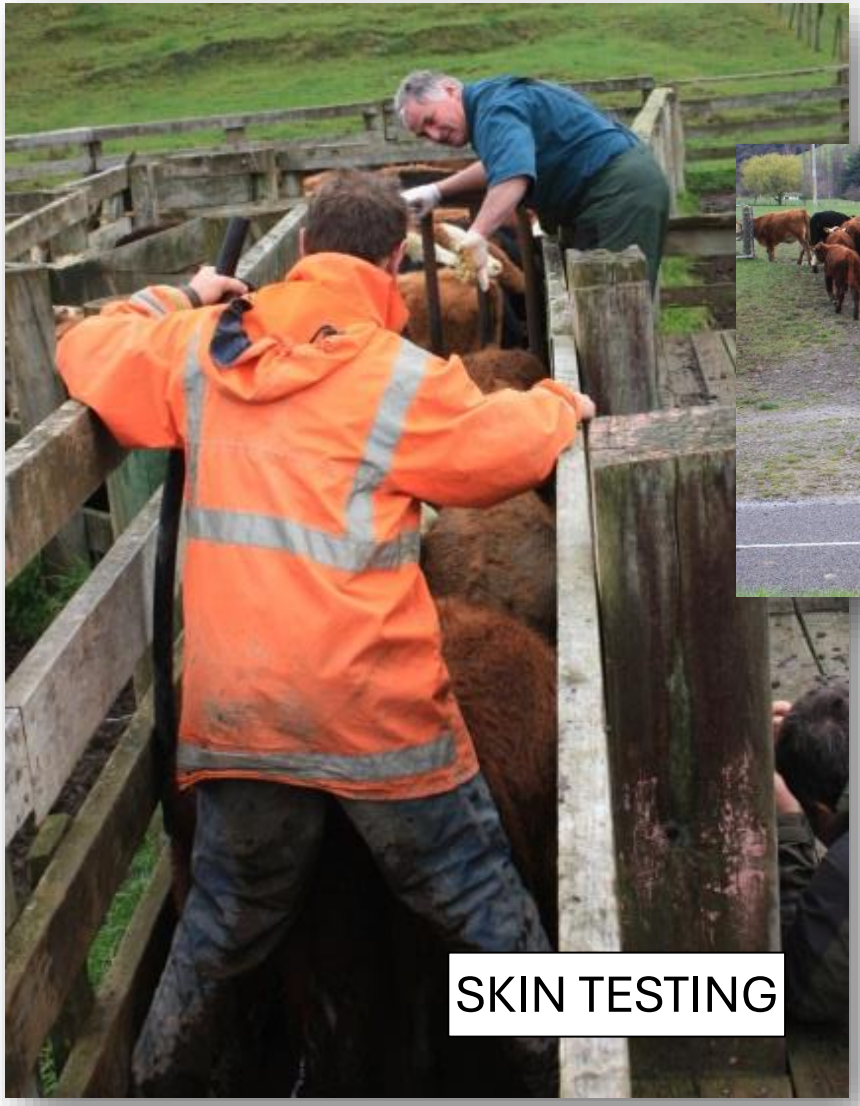
4. Valorar el efecto de la intervención y nueva decisión

MINISTERIO DE AGRICULTURA Y PESCA, ALIMENTACIÓN Y MEDIO AMBIENTE

PATUBES

Plan de **A**ctuación sobre **TUB**erculosis en **E**species **S**ilvestres

Standard TB control in cattle


SKIN TESTING


MOVEMENT CONTROL

These tools work

–

but are expensive

–

& limited to cattle

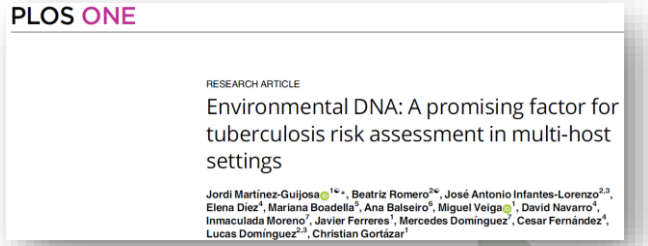
SLAUGHTER INSPECTION


(C)TOMI MARJO

Farm biosafety; Michigan (USA)

66% less bovine TB

Kurt VerCauteren, USDA


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]


Contents lists available at ScienceDirect

Preventive Veterinary Medicine

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

Spatially explicit modeling of animal tuberculosis at the wildlife-livestock interface in Ciudad Real province, Spain

Nathaniel P. LaHue[a,*], Joaquín Vicente Baños[b], Pelayo Acevedo[b], Christian Gortázar[b], Beatriz Martínez-López[a]


Contents lists available at ScienceDirect

Preventive Veterinary Medicine

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

Description and implementation of an On-farm Wildlife Risk Mitigation Protocol at the wildlife-livestock interface: Tuberculosis in Mediterranean environments

Jordi Martínez-Guijosa[a,*], Jose Francisco Lima-Barbero[b], Pelayo Acevedo[a], David Cano-Terriza[c], Saúl Jiménez-Ruiz[a,c], Jose Ángel Barasona[d], Mariana Boadella[b], Ignacio García-Bocanegra[c], Christian Gortázar[a], Joaquín Vicente[a]

Diagnóstico epidemiológico

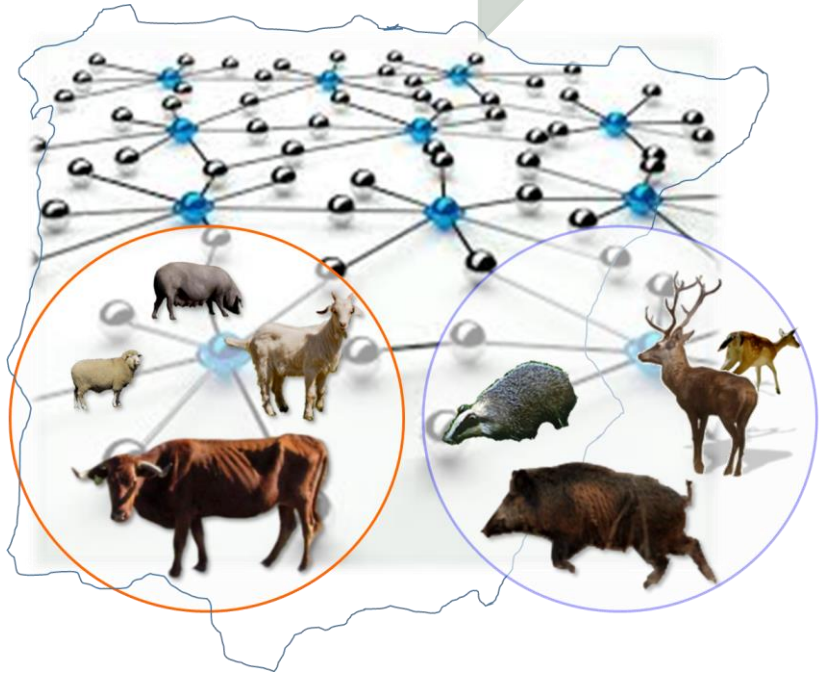
- Poblaciones
  *fauna
  *ganado
- Situación TB

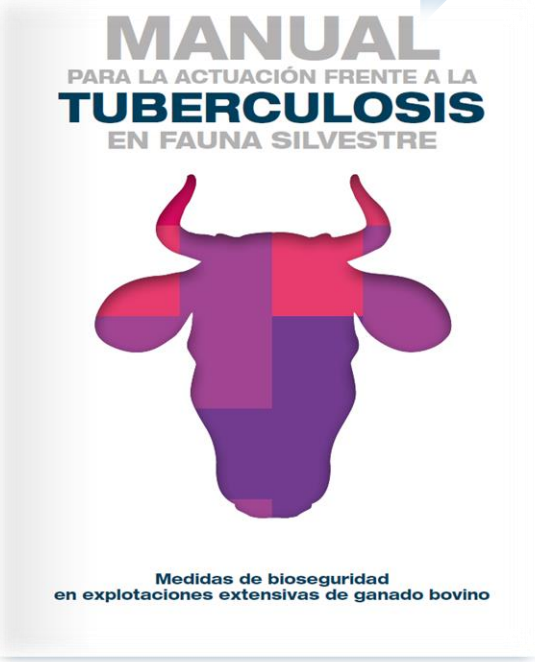
Análisis de riesgos

- Explotación
- Zona

Intervención

- Infraestructuras
- Manejo
- Animales



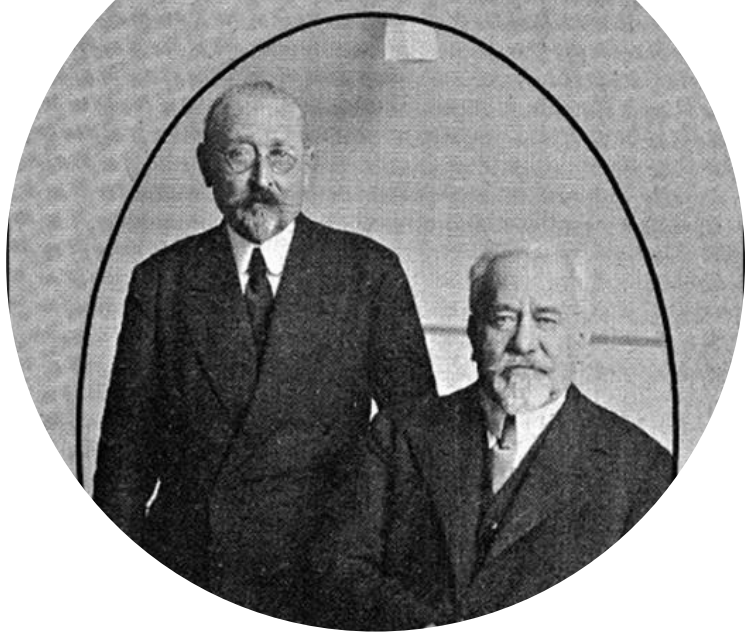


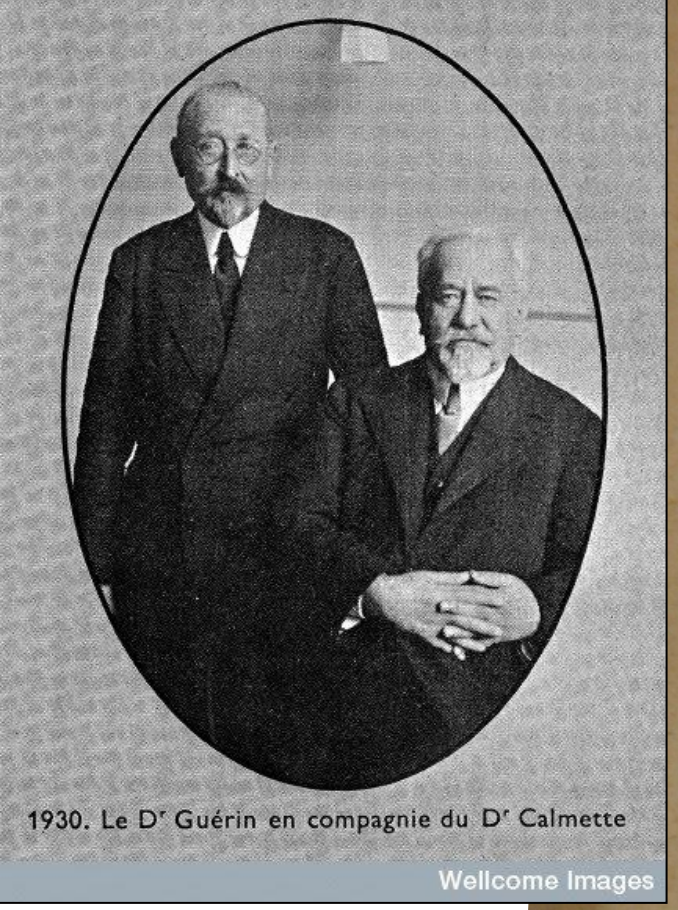
TB vaccines

- Bacillus Calmette Guerin (**BCG**)
  - 1920´s Institut Pasteur
  - Live, natural deletion mutant
  - *Mycobacterium bovis*
  - Causes cross-reaction with CMI tests
  - Survives in vaccinated – safety concerns

- **MtbVac** (UNIZAR-Zendal)
  - 2000's Carlos Martín, Zaragoza
  - Live, targeted deletion mutant
  - *Mycobacterium tuberculosis*
  - Causes cross-reactions
  - Human TB – safety concerns in animals

- **HIMB** (NEIKER-Sabiotec + Consortium)
  - 2010's Ramón Juste, NEIKER
  - Heat-killed field strain
  - *Mycobacterium bovis*
  - No cross-reaction by oral route
  - Heat-killed – no safety concerns




1930. Le Dr Guérin en compagnie du Dr Calmette

Wellcome Images

A. CALMETTE

Sous-Directeur de l'Institut Pasteur

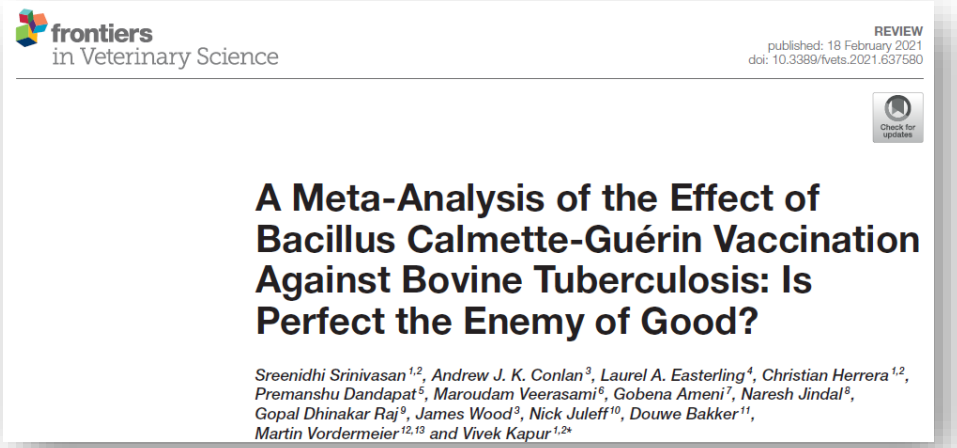
LA VACCINATION PRÉVENTIVE CONTRE LA TUBERCULOSE PAR LE "BCG"

AVEC LA COLLABORATION DE

C. GUÉRIN, A. BOQUET et L. NÈGRE

- Attenuated *M. bovis* mutant obtained after several re-cultures by Albert Calmette & Camille Guérin at Inst. Pasteur (Calmette 1927)
- BCG is still the most used TB vaccine (Franco-Paredes et al. 2006)

BCG in cattle



- Meta-analysis: 25% efficacy against infection
- Field studies only: 28-85% efficacy
- At low to moderate TB prevalence (<15%), BCG use can lead to OTF in 10 years

Database #	Authors	Location	BCG source	BCG route	BCG dose	Controls_n	Vaccinates_n	Reported efficacy
579	Ameni et al. (35)	Ethiopia	BCG Danish 1331	Subcutaneous	1–4 × 10^6 CFU	26	23	30%
1266	Ameni et al. (23)	Ethiopia	BCG Danish 1331	Subcutaneous	1 × 10^6 CFU	14	13	60%
1358	Nugent et al. (34)	New Zealand	BCG Danish 1331	Oral and Subcutaneous	1 × 10^8 CFU	531	644	67%
1373	Lopez-Valencia et al. (25)	Mexico	BCG Tokyo	Subcutaneous	1 × 10^6 CFU	66	65	60%
1410	Nugent et al. (36)	New Zealand	BCG Danish 1331	Subcutaneous	3 × 10^5 CFU	297	520	85%
	Batissa et al. (2021)	Ethiopia	BCG RussiaSubcutaneous		1x10^6	18	22	28%
	Retamal et al. (2021)	Chile	BCG RussiaSubcutaneous		2-8x10^5	60	62	66%

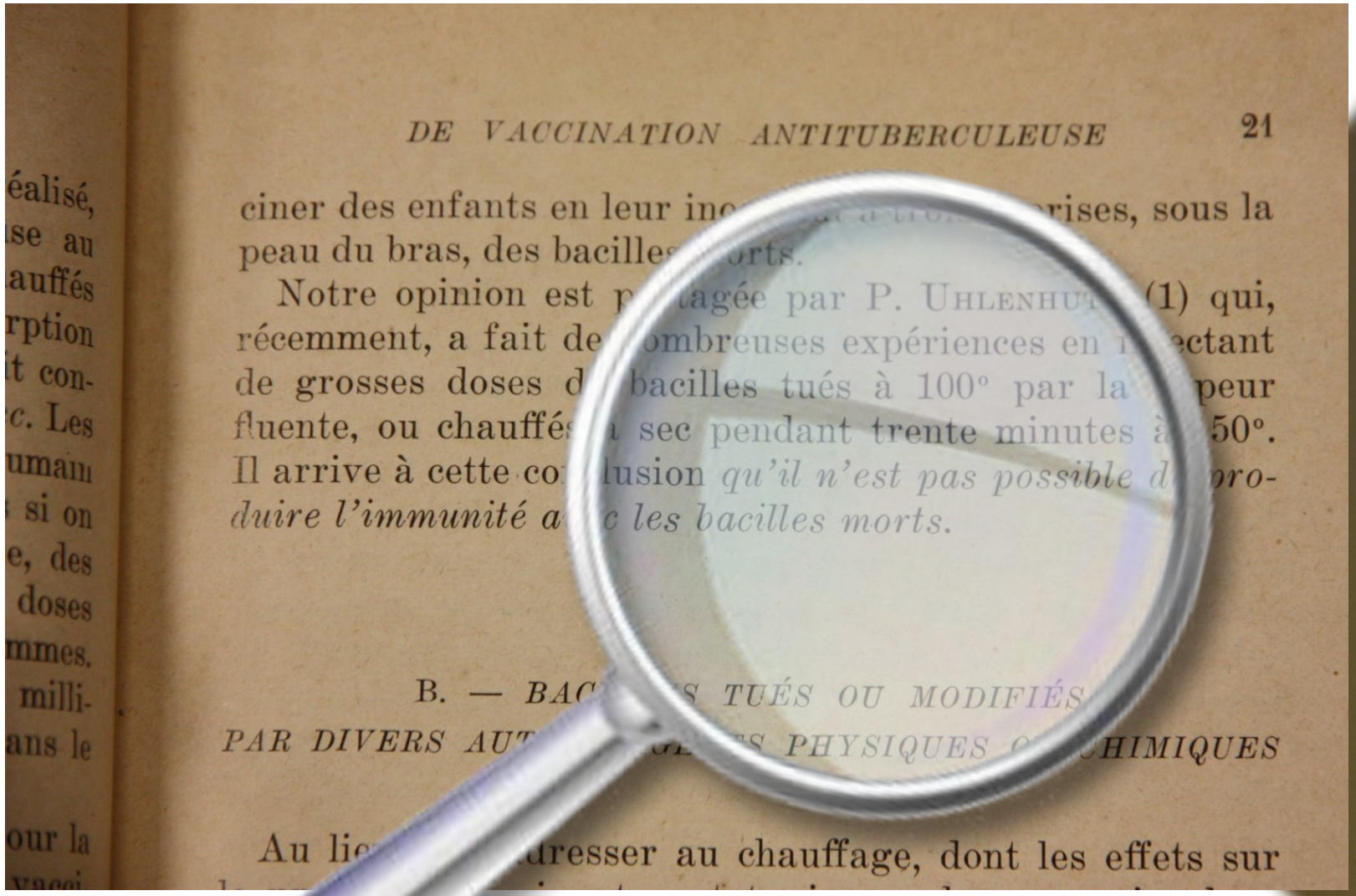
673 34

Development of a deployable tuberculosis vaccine for cattle

Field Trial update – March 2024

The on-farm aspect of the latest phase (Phase 2) of the TB vaccine field trials has been completed. This phase of the trial enabled government to collect safety data for inclusion in upcoming marketing authorisation applications. All GB administrations have taken the decision to move to a further phase (Phase 3) to gather additional data on the DIVA test specificity and explore options to optimise the performance of the new test. Phase 3 will assess BCG vaccination and the companion DIVA skin test on a broader cohort of herds to further inform our collective planning for delivery. We are continuing to work at pace but will only deploy the vaccine and companion DIVA skin test when we have all the right steps in place. Our aim is to deliver an effective cattle TB vaccination strategy within the next few years to accelerate our continued progress towards achieving OTF status for England and Wales.

Heat-inactivated mycobacteria



DE VACCINATION ANTITUBERCULEUSE 21

ciner des enfants en leur ino rises, sous la peau du bras, des bacilles orts.

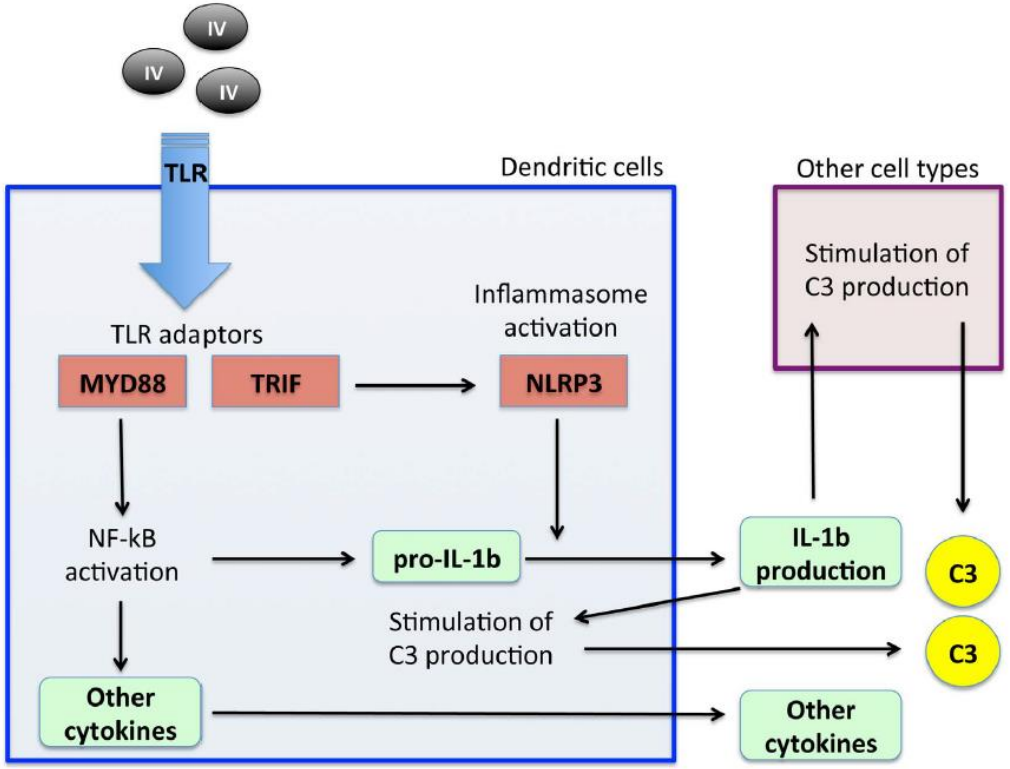
Notre opinion est p tagée par P. UHLENHUT (1) qui, récemment, a fait de ombreuses expériences en i ectant de grosses doses d bacilles tués à 100° par la peur fluente, ou chauffés sec pendant trente minutes à 50°. Il arrive à cette co lusion *qu'il n'est pas possible d pro-duire l'immunité a c les bacilles morts.*

B. — *BAC S TUÉS OU MODIFIÉS*

PAR DIVERS AUT S PHYSIQUES C HIMIQUES

Au lie dresser au chauffage, dont les effets sur

Heat-killed *M. bovis* vaccine HIMB



Heat inactivated vaccine (HIMB)
"Machuquillo de Ramón"

Dr. Ramón Juste, NEIKER

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Protection against Tuberculosis in Eurasian Wild Boar Vaccinated with Heat-Inactivated *Mycobacterium bovis*

Joseba M. Garrido[1], Iker A. Sevilla[1], Beatriz Beltrán-Beck[2], Esmeralda Minguijón[1], Cristina Ballesteros[2], Ruth C. Galindo[2], Mariana Boadella[2], Konstantin P. Lyashchenko[3], Beatriz Romero[4], Maria Victoria Geijo[1], Francisco Ruiz-Fons[2], Alicia Aranaz[4], Ramón A. Juste[1], Joaquín Vicente[2], José de la Fuente[2,5], Christian Gortázar[2]*

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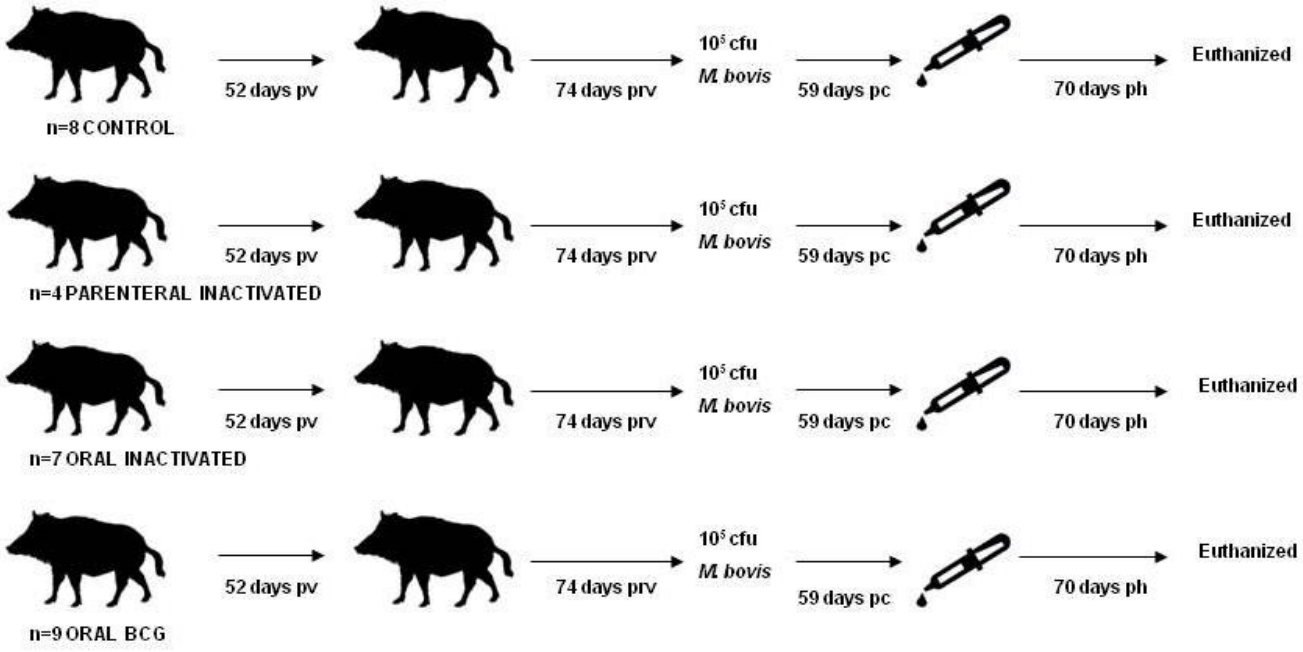
Oral Vaccination with Heat Inactivated *Mycobacterium bovis* Activates the Complement System to Protect against Tuberculosis

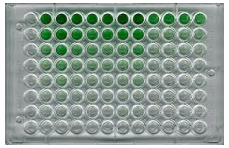
Beatriz Beltrán-Beck[1,9], José de la Fuente[1,2,9], Joseba M. Garrido[3], Alicia Aranaz[4], Iker Sevilla[3], Margarita Villar[1], Mariana Boadella[1], Ruth C. Galindo[1,2], José M. Pérez de la Lastra[1], Juan A. Moreno-Cid[1], Isabel G. Fernández de Mera[1], Pilar Alberdi[1], Gracia Santos[1], Cristina Ballesteros[1], Konstantin P. Lyashchenko[5], Esmeralda Minguijón[3], Beatriz Romero[6], Lucía de Juan[6], Lucas Domínguez[6], Ramón Juste[3], Christian Gortazar[1]*



Total: n=28

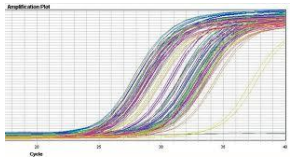
Pathology

Culture



Serology

Gamma IFN



Gene expression

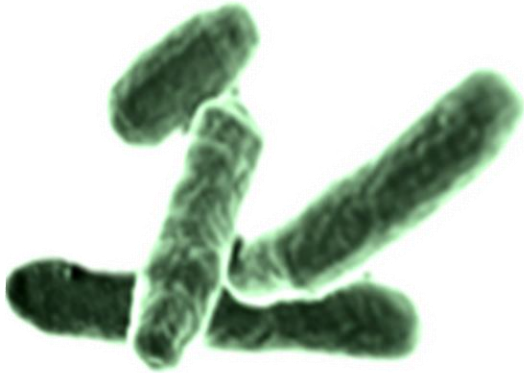
- Pig and wild boar
- Red deer
- Goat
- African buffalo
- Cattle
- European badger
- Zebrafish (*M. marinum*)

Resultados de 15 años de investigación

- Niveles de protección son equivalentes en BCG y HIMB
- Al igual que BCG, HIMB confiere una protección incompleta, reduciendo las lesiones y la excreción
- Al igual que BCG, HIMB funciona por vía parenteral y por vía oral
- A diferencia de BCG oral, HIMB oral no causa interferencia diagnóstica
- A diferencia de BCG, HIMB no necesita frío
- A diferencia de BCG, HIMB no conlleva riesgos por supervivencia o excreción

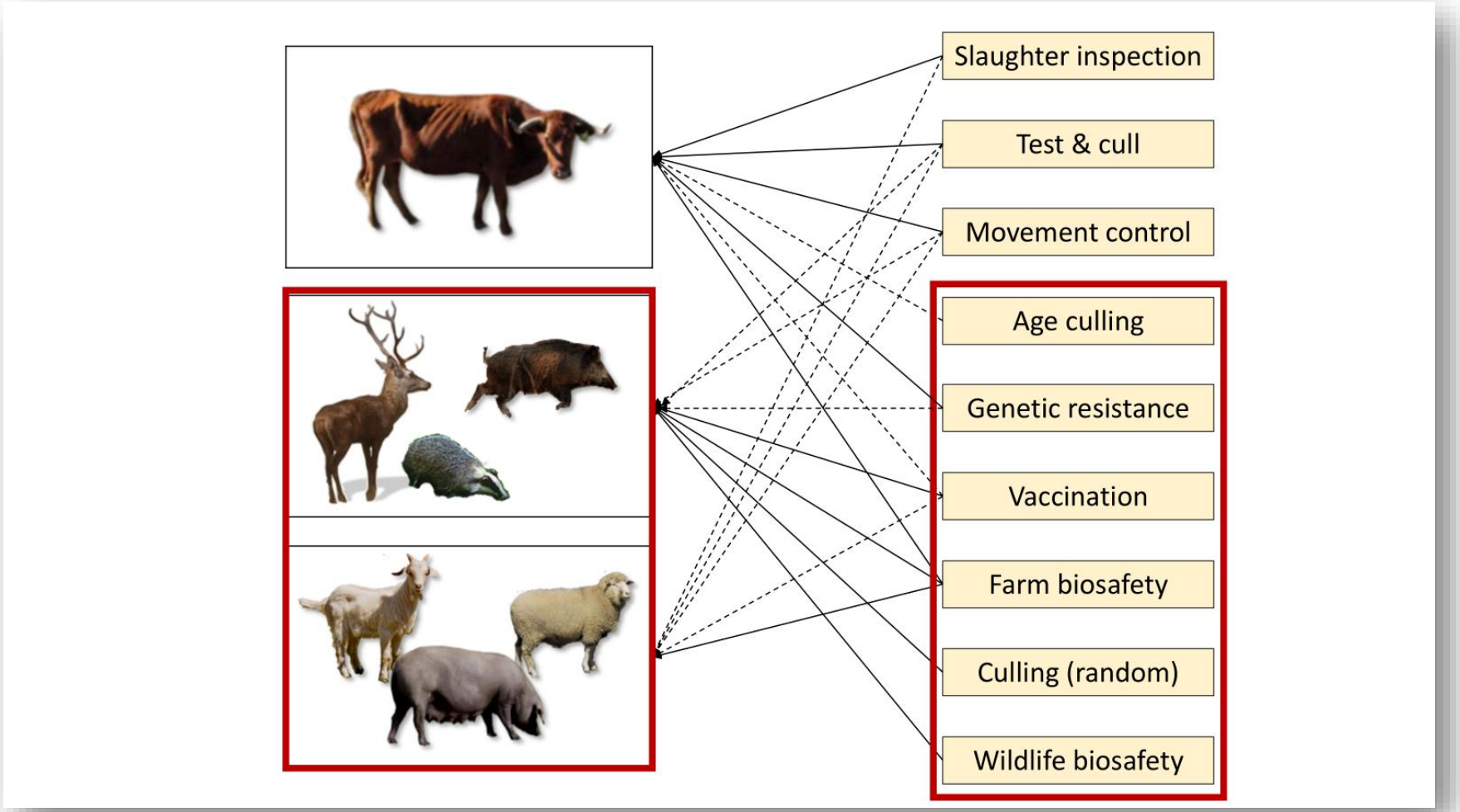
Estructura de la presentación

- Situación actual de la TB animal
- Epidemiología: hospedadores y transmisión
- Análisis de riesgos y diagnóstico epidemiológico
- Herramientas de control
  - Pruebas y matadero en bovinos
  - Control de hospedadores no bovinos
  - Bioseguridad
  - Vacunación
- **Cuatro mensajes clave**



New Zealand's farmers are actively involved in the TB control scheme

1: Ganaderos



2: Comunidades

Ejemplo en ganaderías de carne: Navarra, España


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]


Jordi Martínez Guijosa

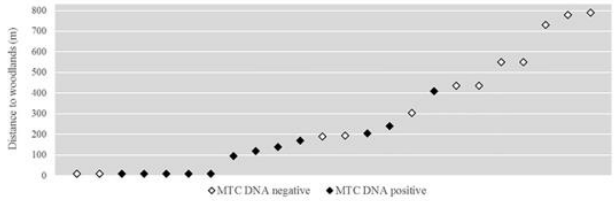
24 predios
20 variables

Se analiza la comunidad de hospedadores y se identifican como relevantes:
- Bovinos
- Jabalí
- Tejón
- Ovinos

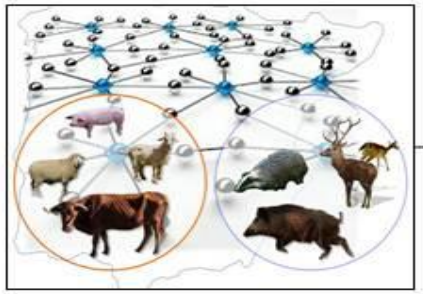
Los predios se clasifican en (+) o (-) según se detecte ADN ambiental de CMT en esponjas.

Factores de riesgo principales:
- "uso de **pastos regionales**" (**ovino, jabalí**)
- "proximidad a bosques" (**jabalí, tejón**)

El muestreo de ADN ambiental mediante esponjas ayuda en análisis de riesgo



3: Diagnóstico epidemiológico



A.- No actuar ni desarrollar vigilancia sanitaria (desaconsejado)

B.- No actuar (coste>beneficio), pero realizar vigilancia sanitaria

C.- Actuar (coste<beneficio), siempre realizando vigilancia sanitaria

Vigilancia poblacional y sanitaria

Prevención y bioseguridad

Control de poblaciones

Vacunación

1. Diagnóstico epidemiológico

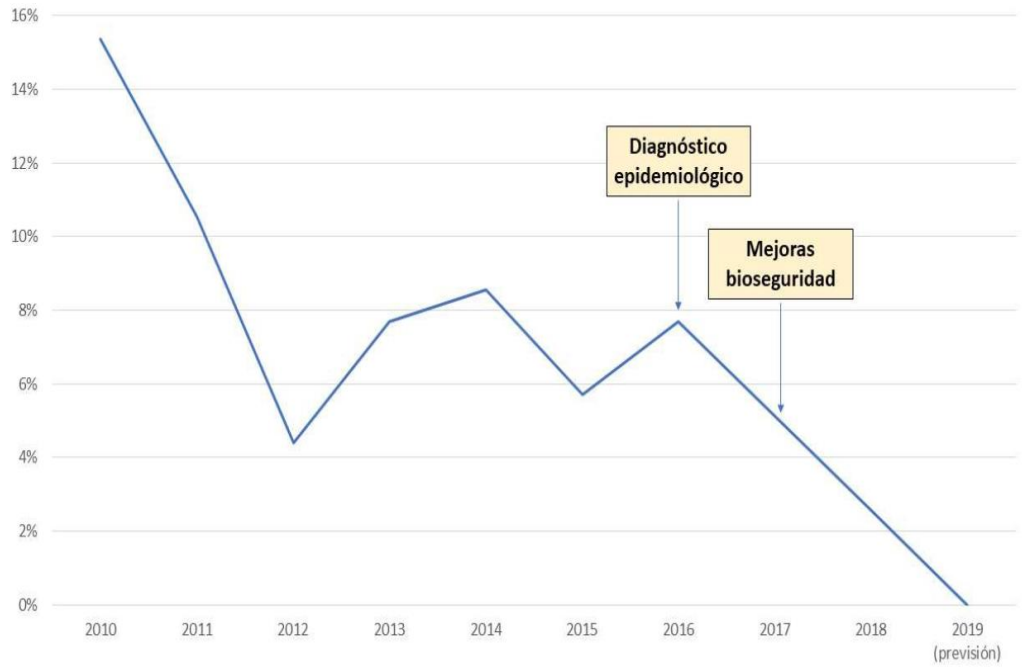
2. Decisión entre tres opciones

3. Intervención (control integrado)

4. Valorar el efecto de la intervención y nueva decisión

4: Control integrado

De la TB animal se puede salir



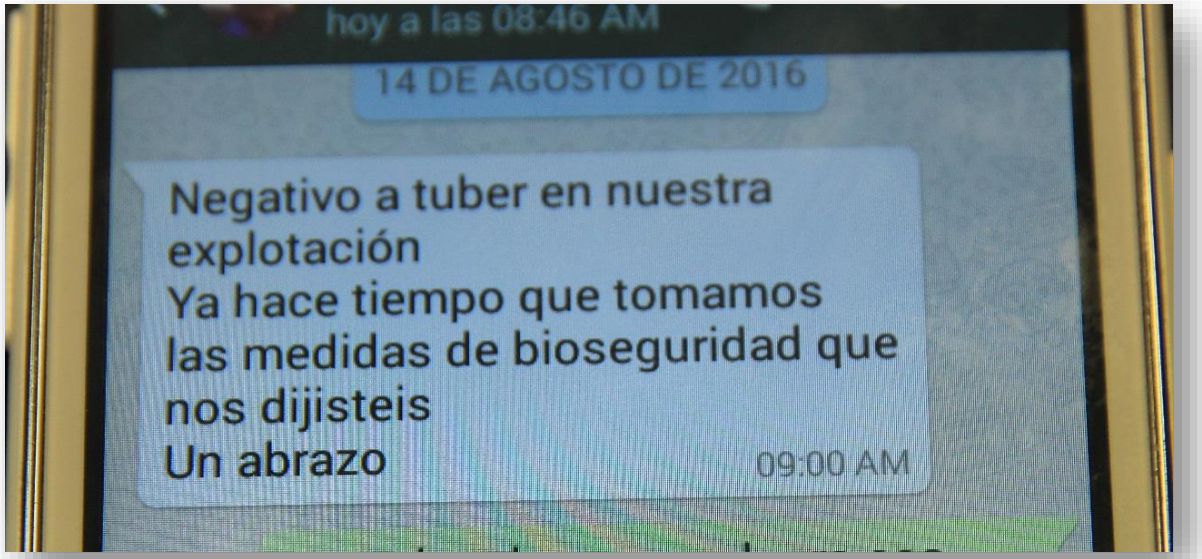


Figura 18.- Mejora de la prevalencia de TB en ganado tras la aplicación de medidas de bioseguridad en charcas y abrevaderos (fuente: Gobierno de Navarra).

Futuro

Campaña de saneamiento

Campaña de saneamiento

Vacunación

Bioseguridad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