

León 2012 Joint Meeting of

30th Meeting of the European Society of Veterinary Pathology
Annual Meeting of the European College of Veterinary Pathologists
24th Annual Meeting of the Spanish Society of Veterinary Pathology

León (Spain) September 5th to 8th of 2012



Wildlife Disease Control in the 21st Century



**Instituto de Investigación
en Recursos Cinegéticos**

CSIC - UCLM - JCCM

Christian Gortázar

Acknowledgements

RESEARCH FUNDING

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 - APHAEA
- Spain
 - Plan Nacional
 - INIA – Fau
 - CDTI
 - Ministerio de Agricultura
 - Castilla – La Mancha
- Past funding
 - Santander
 - TB-STEP (EU - FP7)

COLLABORATIONS

- VISAVET
- NEIKER
- Artemis
- E.B. DOÑANA
- INIA
- (...)

(CAUSING TROUBLE)



don't trust 'em

Presentation overview

- Infections shared with wildlife
- Wildlife monitoring
- Options for disease control
 - Intervention
 - Preventive actions
 - Population control
 - Vaccination & medication
 - No intervention
 - Zonification
 - Doing nothing
- Outlook: wildlife disease control in the 21st Century



Presentation overview

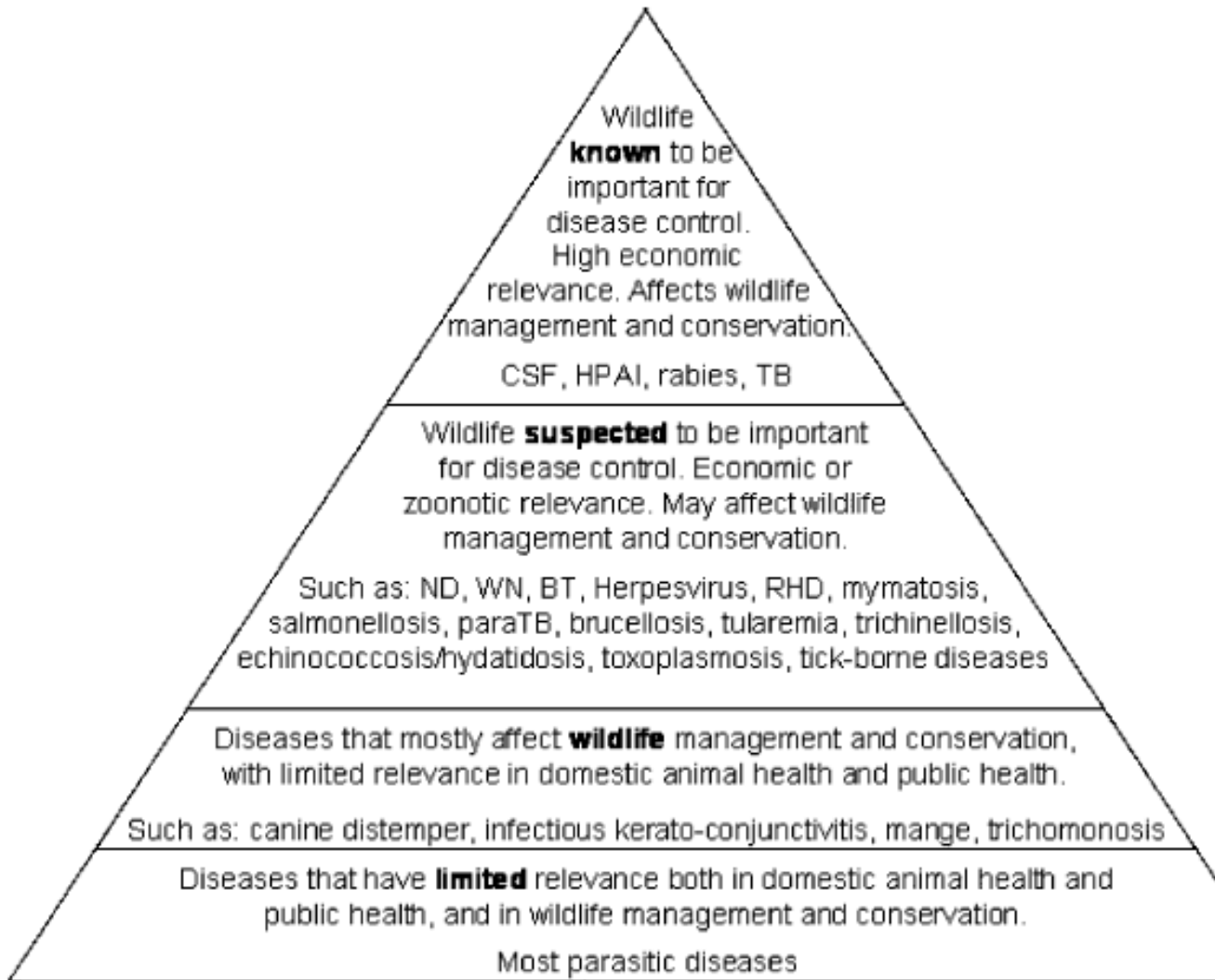
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Infections shared with wildlife

A huge list of shared diseases



CSF, wild boar



HPAI, waterfowl



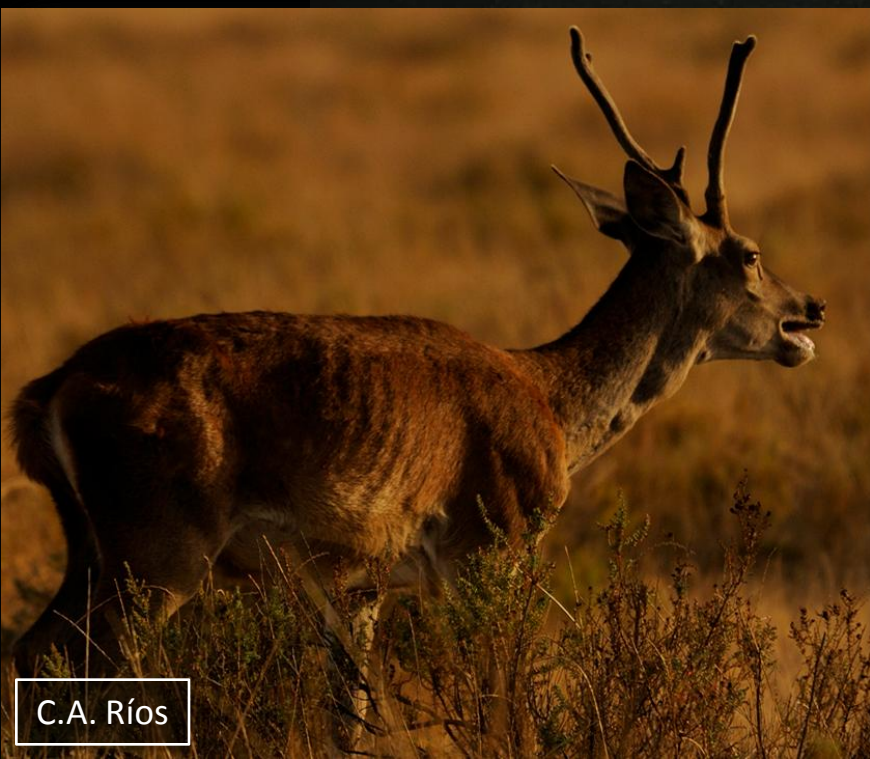
Rabies, fox. M. Artois

Example: TB (*M. tuberculosis* complex)

a)



b)



C.A. Ríos



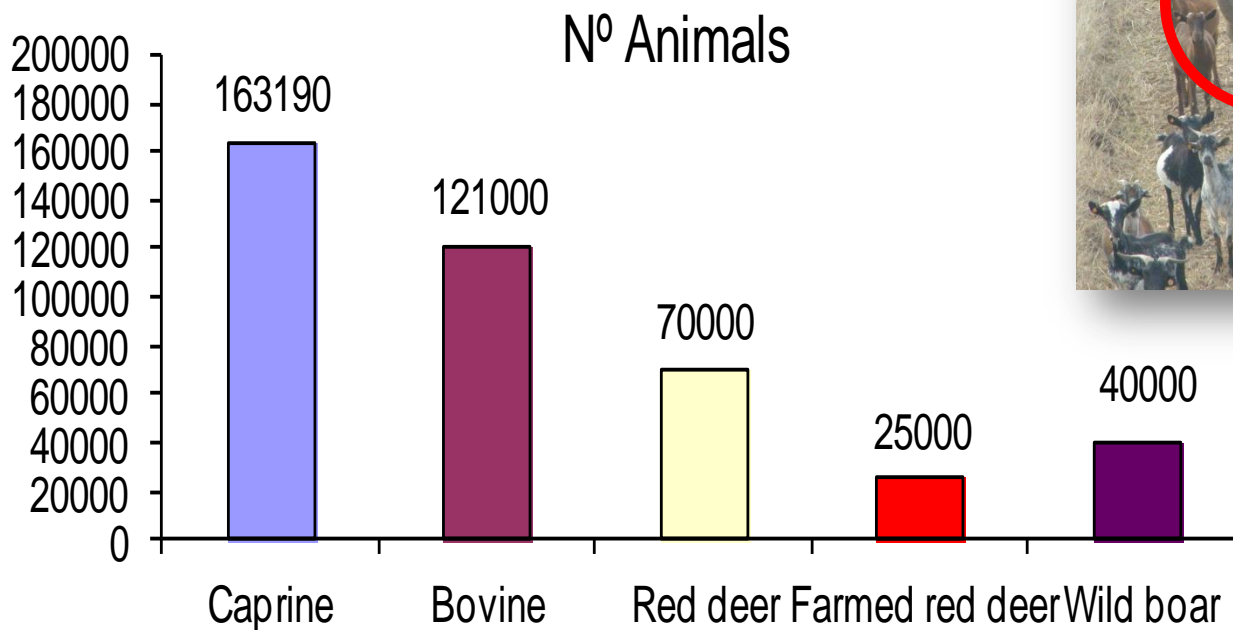
d)



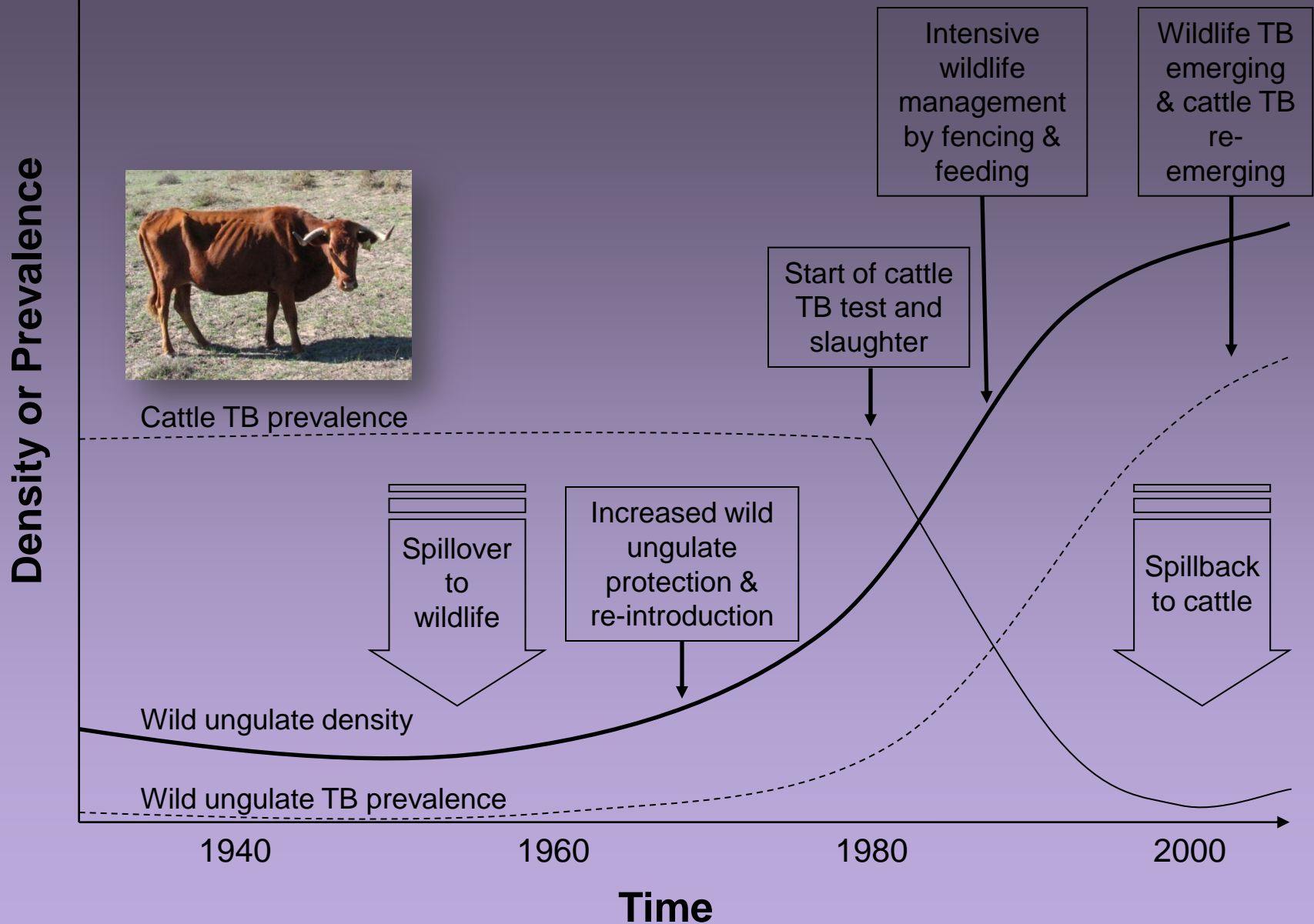
TB lesions in red deer, Spain. Source: IREC

Lots of wildlife!

- N^{er} heads in Ciudad Real province, Spain



Example: TB (*M. tuberculosis* complex)



Cattle TB prevalence

Wild ungulate density

Wild ungulate TB prevalence

1940

1960

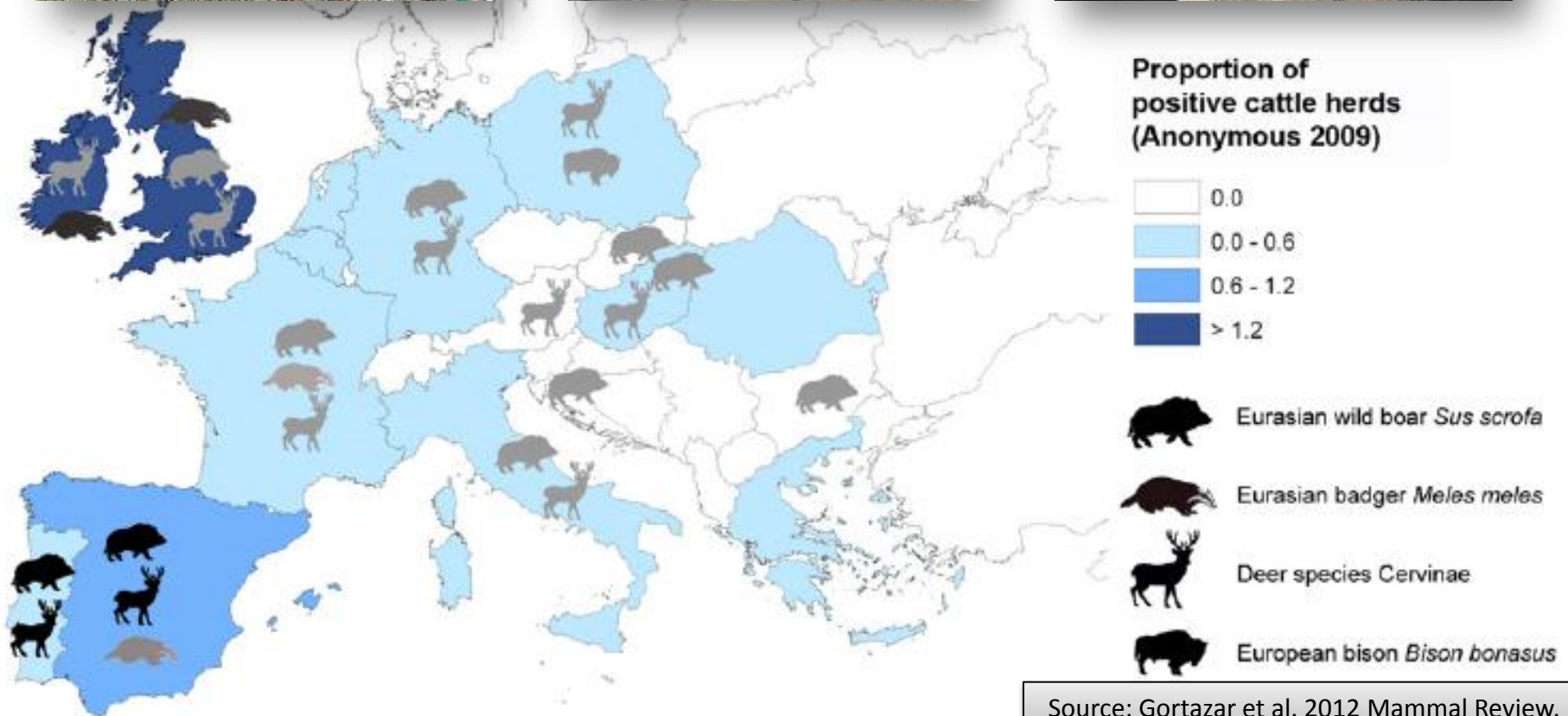
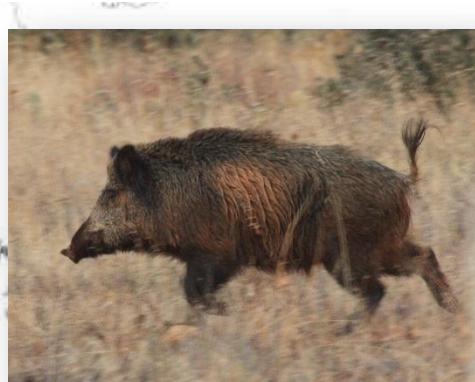
1980

2000

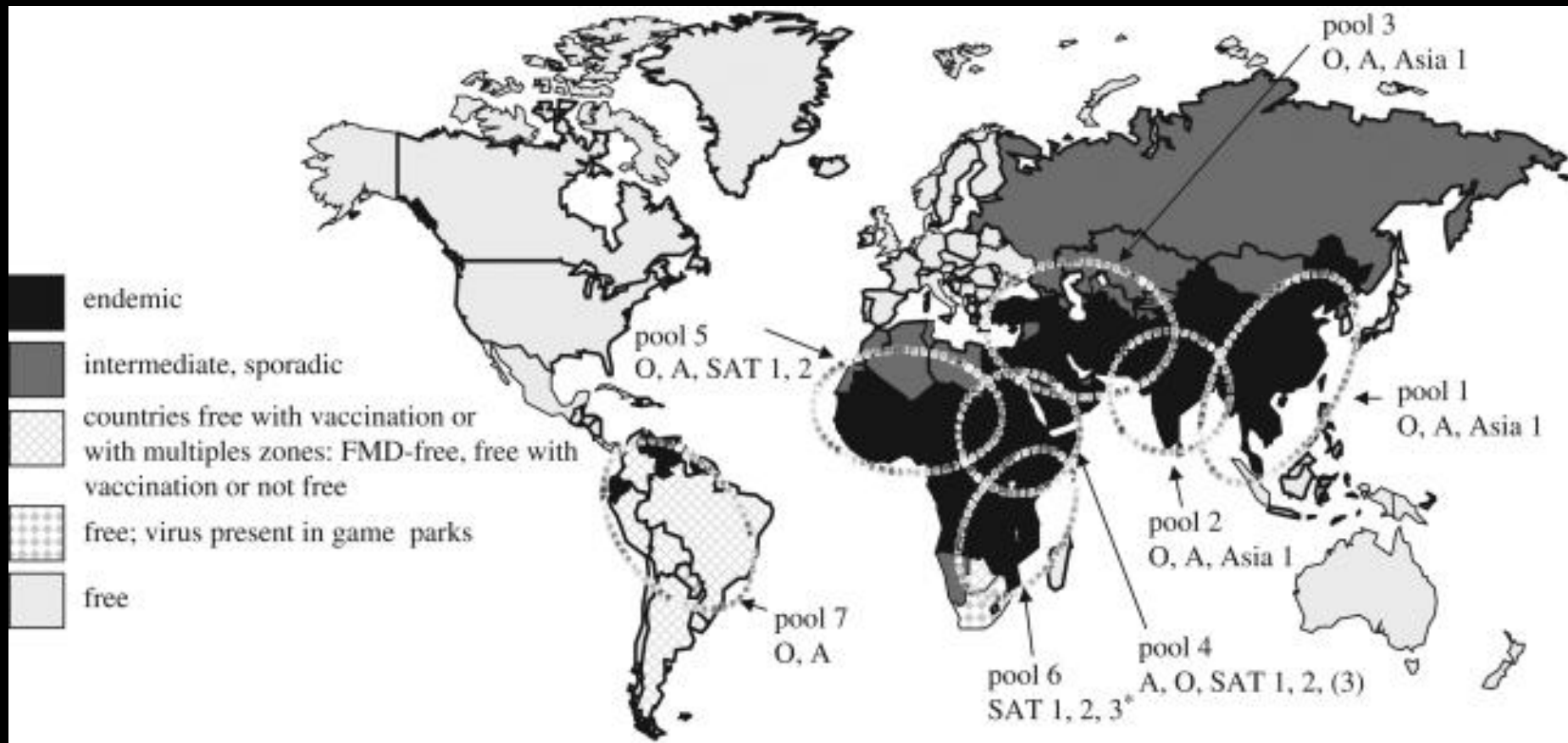
Time



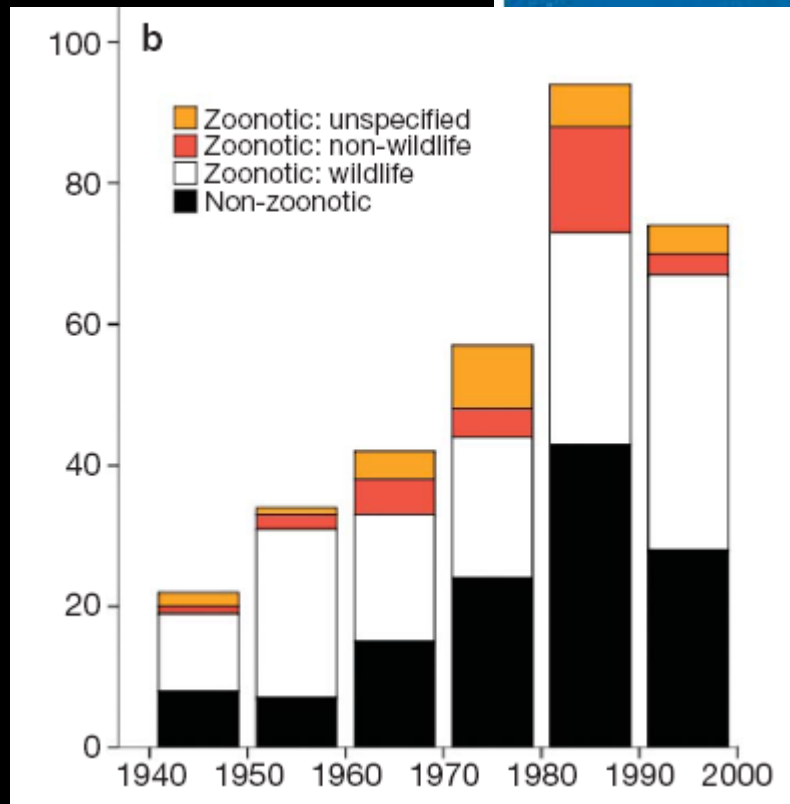
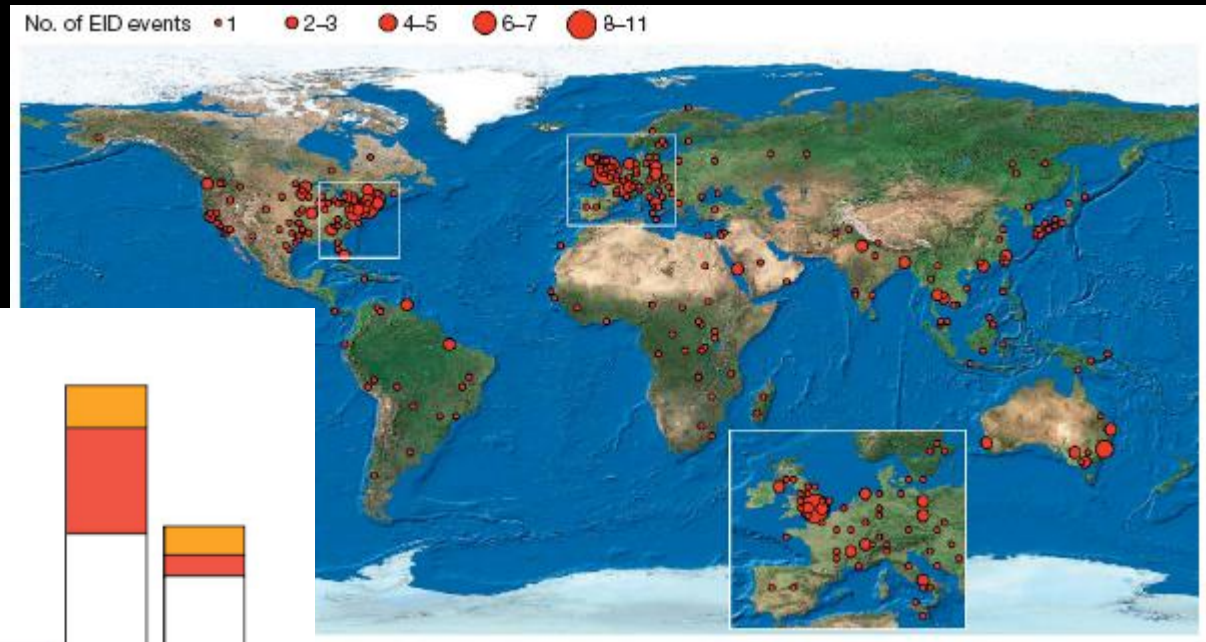
Example: TB (*M. tuberculosis* complex)



Example: Foot-and-mouth disease



Wildlife and emerging diseases



nature

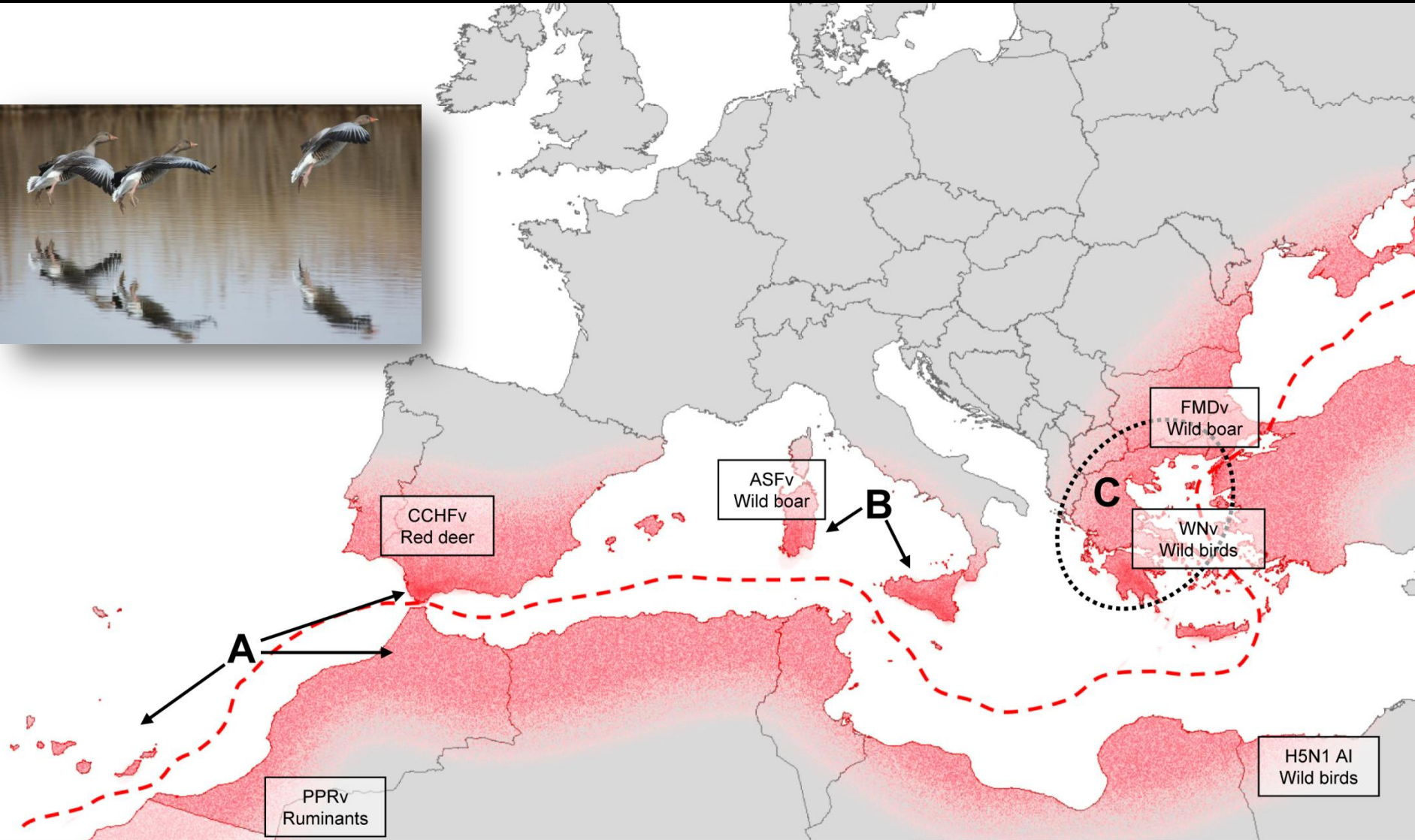
Vol 451 | 21 February 2008 | doi:10.1038/nature06536

LETTERS

Global trends in emerging infectious diseases

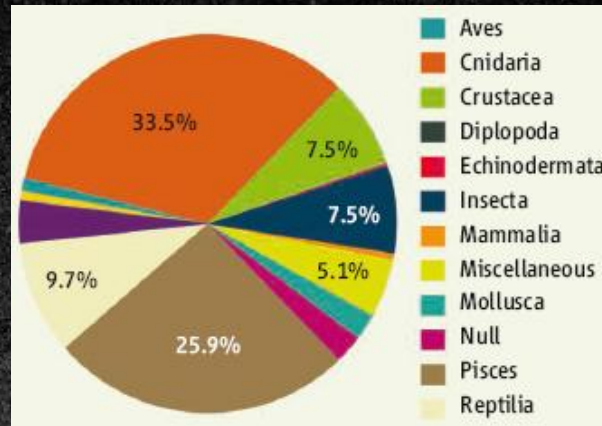
Kate E. Jones¹, Nikkita G. Patel², Marc A. Levy³, Adam Storeygard^{3†}, Deborah Balk^{3†}, John L. Gittleman⁴ & Peter Daszak²

Wildlife and emerging diseases



Wildlife movement and diseases

Wild animals & their pathogens move freely (wild boar undercrossing a farm perimeter fence)



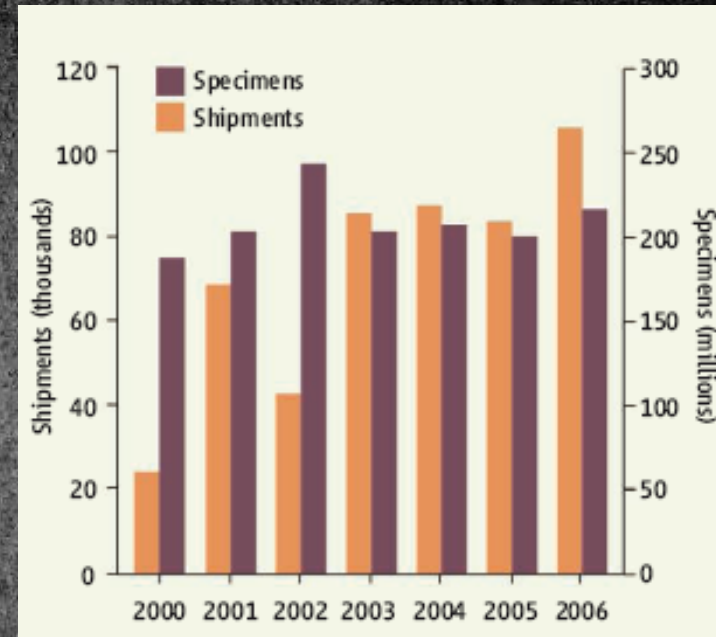
POLICYFORUM 1 MAY 2009 VOL 324 SCIENCE

ECOLOGY

Reducing the Risks of the Wildlife Trade

Katherine F. Smith,^{1,2*} Michael Behrens,³ Lisa M. Schloegel,^{2,4} Nina Marano,⁵ Stas Burgiel,⁶ Peter Daszak^{2*}

Wild animals or their remains are also massively translocated by humans, as pets, trophies, food...



Infections shared with wildlife



Total eradication of a shared infectious agent is almost impossible if wildlife hosts serving as natural reservoirs are ignored.

Presentation overview

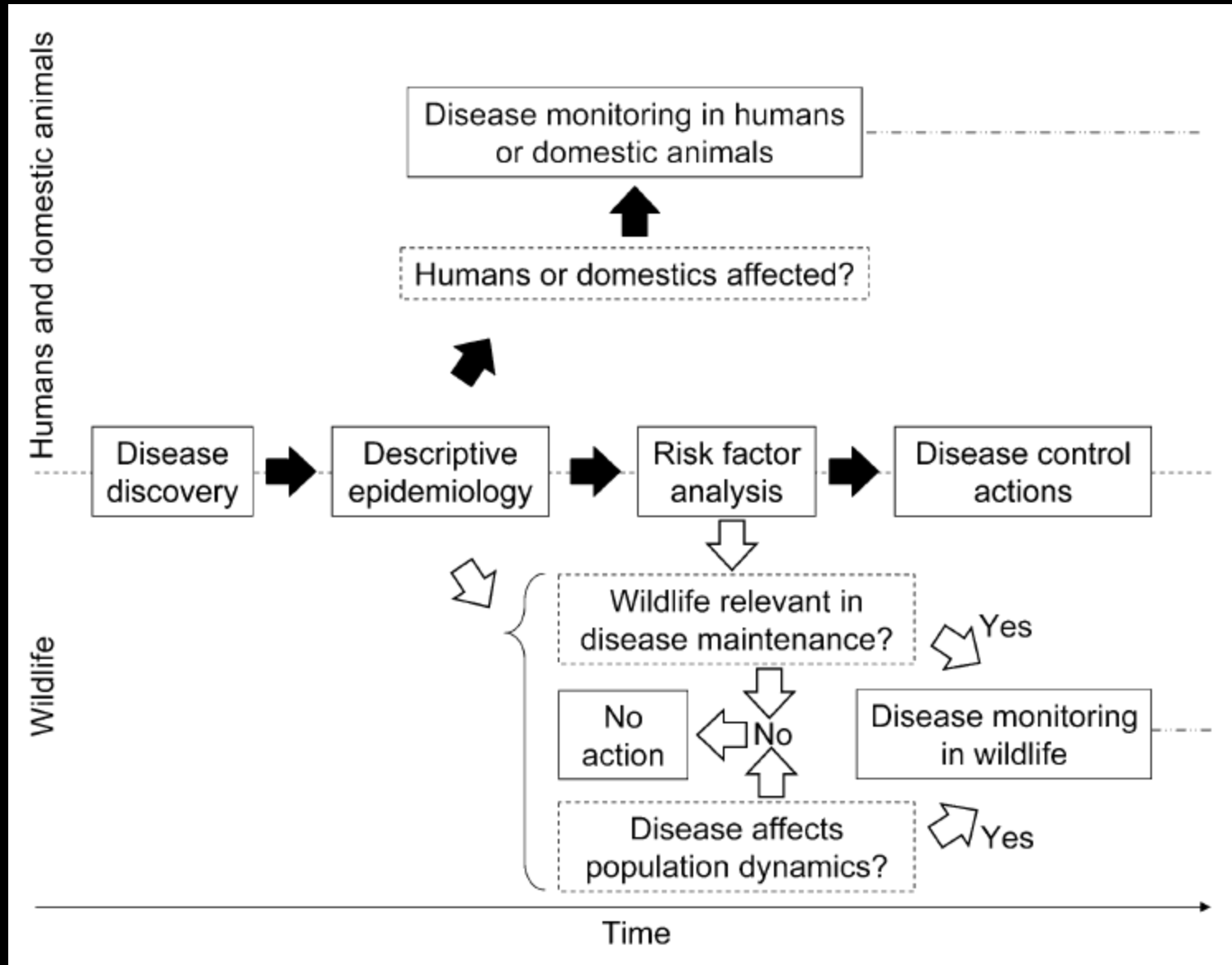
- Infections shared with wildlife
- **Wildlife monitoring**
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Wildlife monitoring: populations & diseases

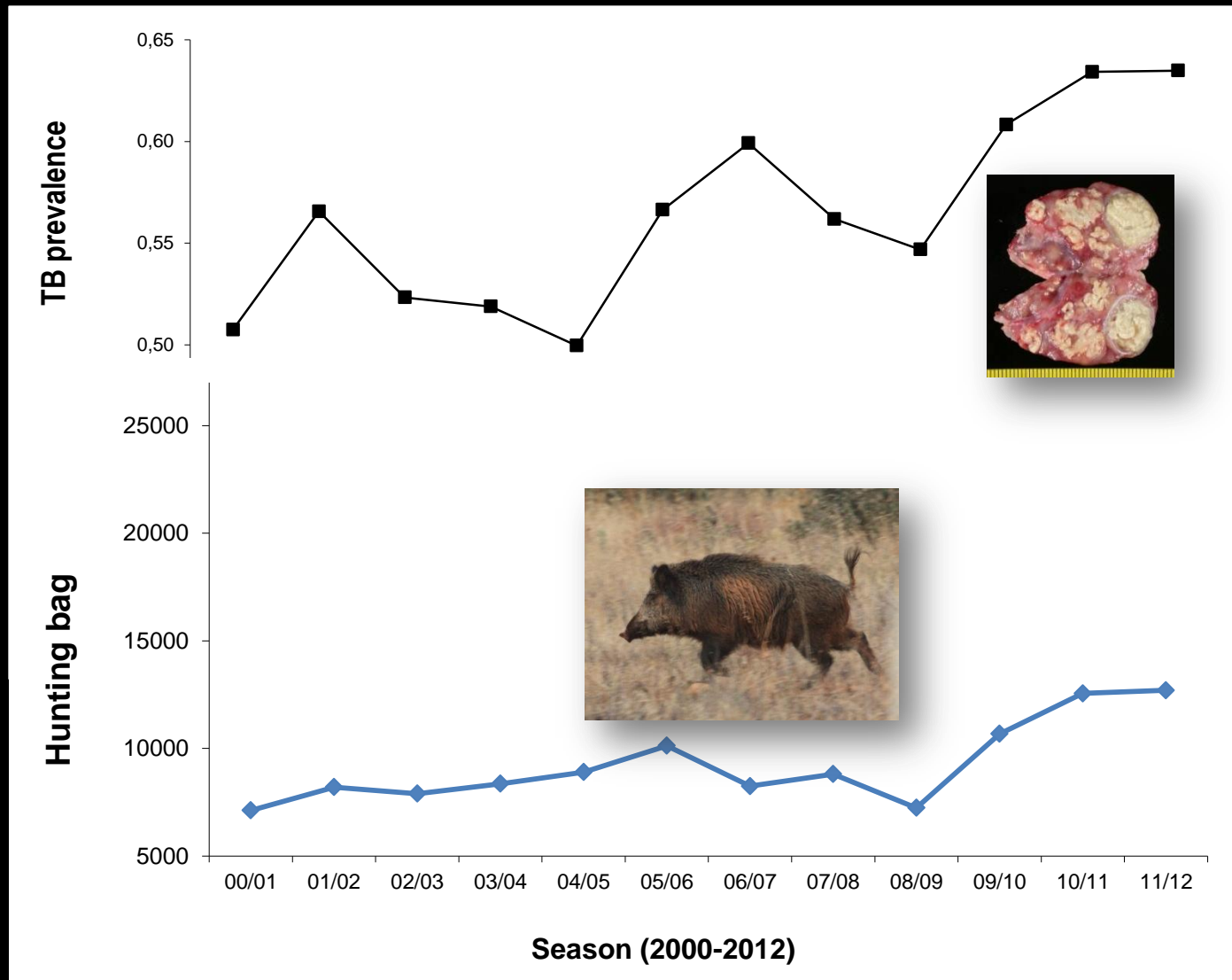
Disease monitoring



Disease monitoring in wildlife

- Key requisite for any disease control in wildlife - it will allow:
 - Identifying changes in disease occurrence
 - Critically assessing the impact of intervention
- Monitoring of wildlife diseases requires:
 - Defining the key wildlife hosts, data, samples
 - Monitor populations & diseases (not diseases or populations)
 - Methods for diagnosis and for time and space trend analysis
 - Reasonable sampling effort and stratification

Examples of wildlife disease monitoring



Wild boar TB prevalence and relative abundance in Ciudad Real, Spain. Source: J. Vicente, IREC. Unpublished.

Presentation overview

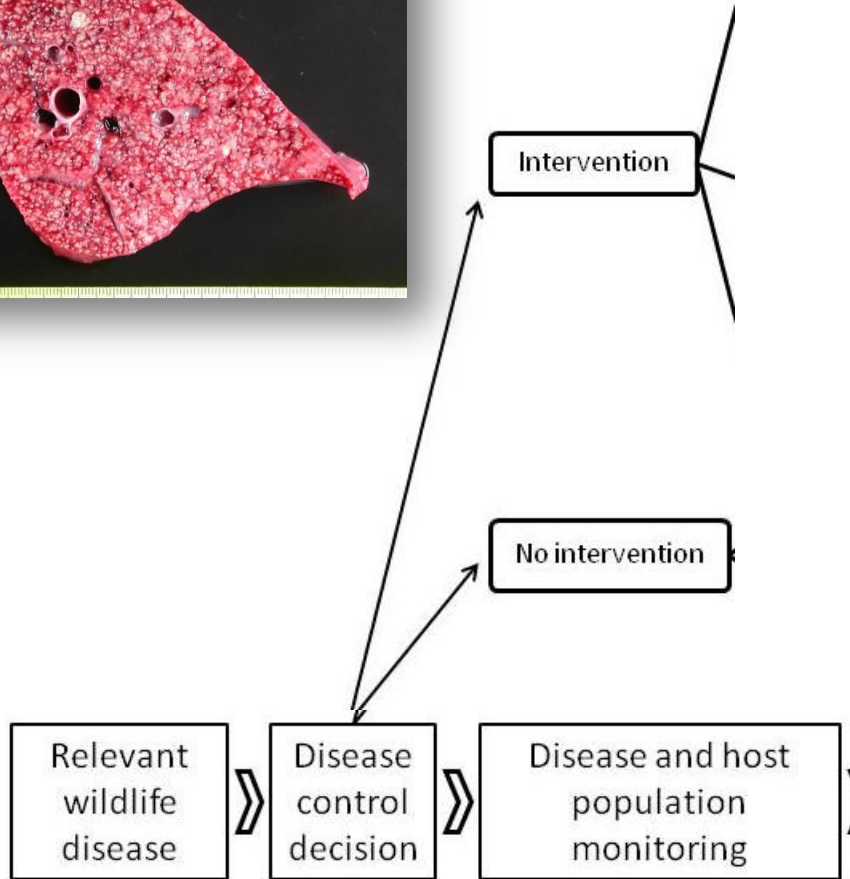
- Infections shared with wildlife
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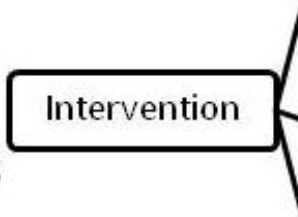
Wildlife disease control: options

Wildlife disease control



Wildlife disease control often consists in an intervention in more or less natural ecosystems and is, as such, often controversial¹

Wildlife disease control



Intervention

} 1st option: BIOSECURITY

- Translocation control
- Fencing and barriers
- Hunting offal disposal



Improving biosecurity at the interface

Biosecurity 1: Translocation control

Vol 435|26 May 2005|doi:10.1038/nature03548

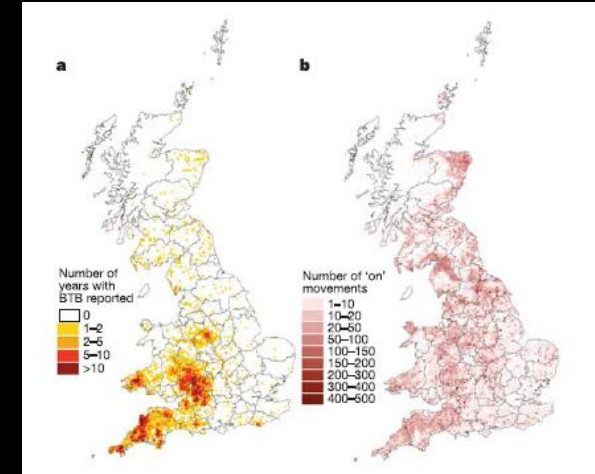
nature

LETTERS

Cattle movements and bovine tuberculosis in Great Britain

M. Gilbert¹, A. Mitchell², D. Bourn³, J. Mawdsley², R. Clifton-Hadley² & W. Wint³

Cattle translocations have been linked with cattle TB prevalence in the UK



Controlling health in wildlife translocations:

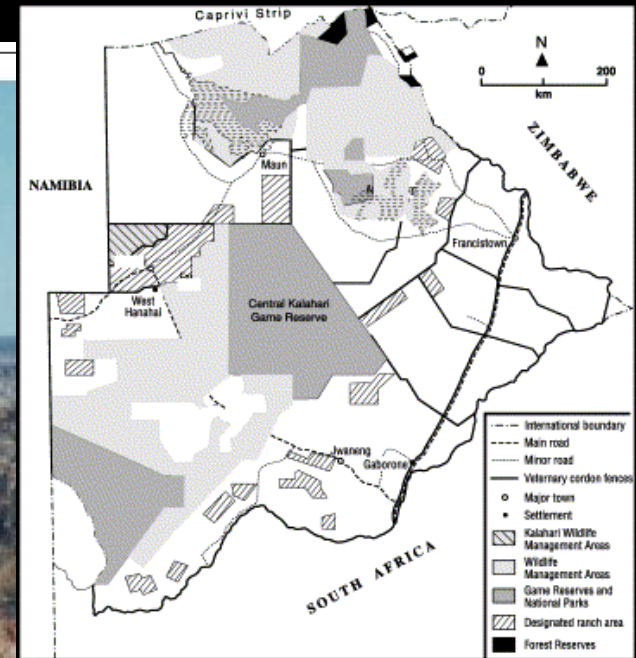
- Avoid unnecessary translocations
- Check disease status at source
- Check status at destination
- Include also other (sympatric) hosts
- Set up appropriate health protocols
- Use quarantines
- (...)

Biosecurity 2: Fences and barriers



Source: Schneider HP: Own photo 1985

FIGURE 4: Foot and mouth disease control fence on the border with Botswana.



→ Vulnerable to elephants, suids...

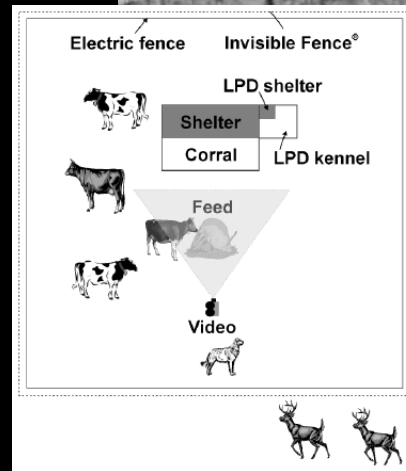
→ Interfere with natural movements and migration

Biosecurity 2: Fences and barriers



Figure 1. Examples of badger exclusion measures: solid aluminium sheeted gate (top left), aluminium sheeting installed on rail fence (bottom left), retractable electric fencing (middle), front and top opening aluminium feed bin (top right) and rail gate with adjustable galvanised aluminium panels (bottom right).

Biosecurity 2: Fences and barriers

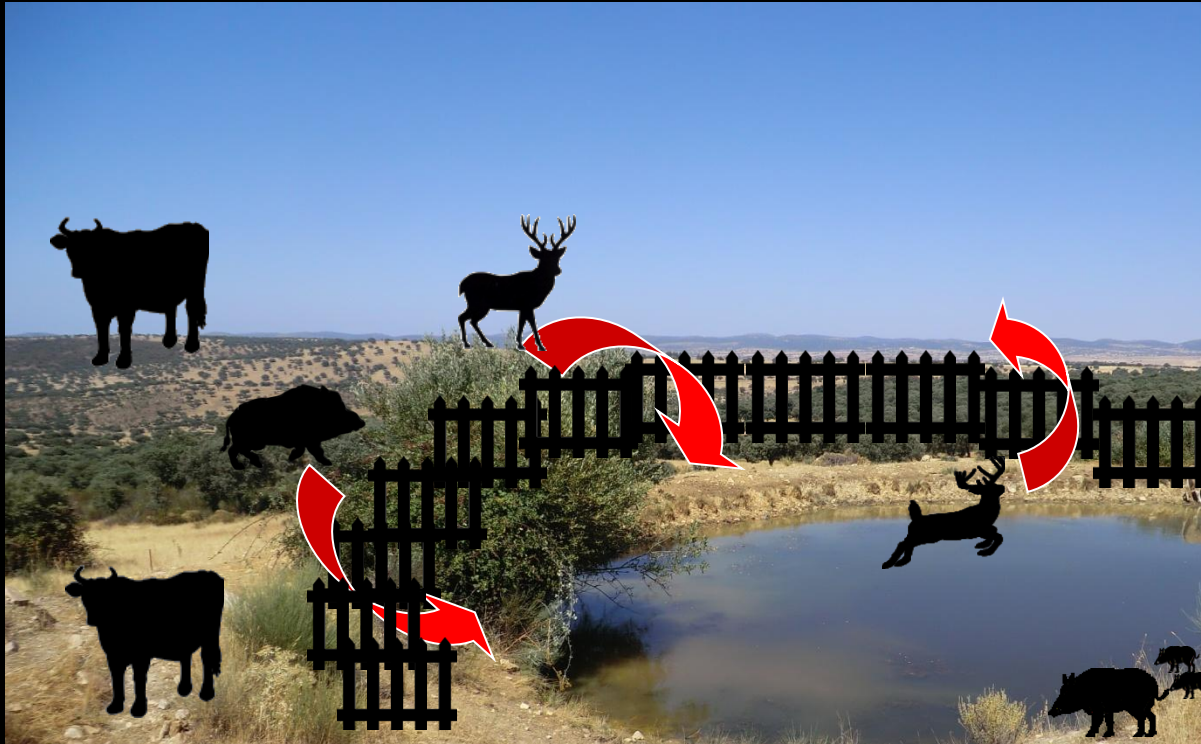


Biosecurity 2: Fences and barriers

J.A. Barasona (pictured) & colleagues detected MTBC in 10% waterholes, where indirect inter-species contact is frequent...



Biosecurity 2: Fences and barriers



“Wildlife only”
waterholes were
surrounded by a 1.2
m high fence that
wild ungulates but
not cattle can cross



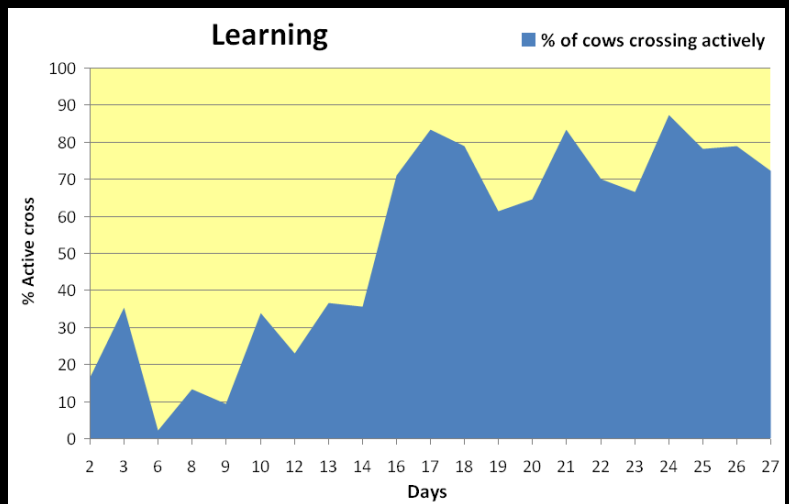
Biosecurity 2: Fences and barriers

Camera monitoring



Brush-activated door

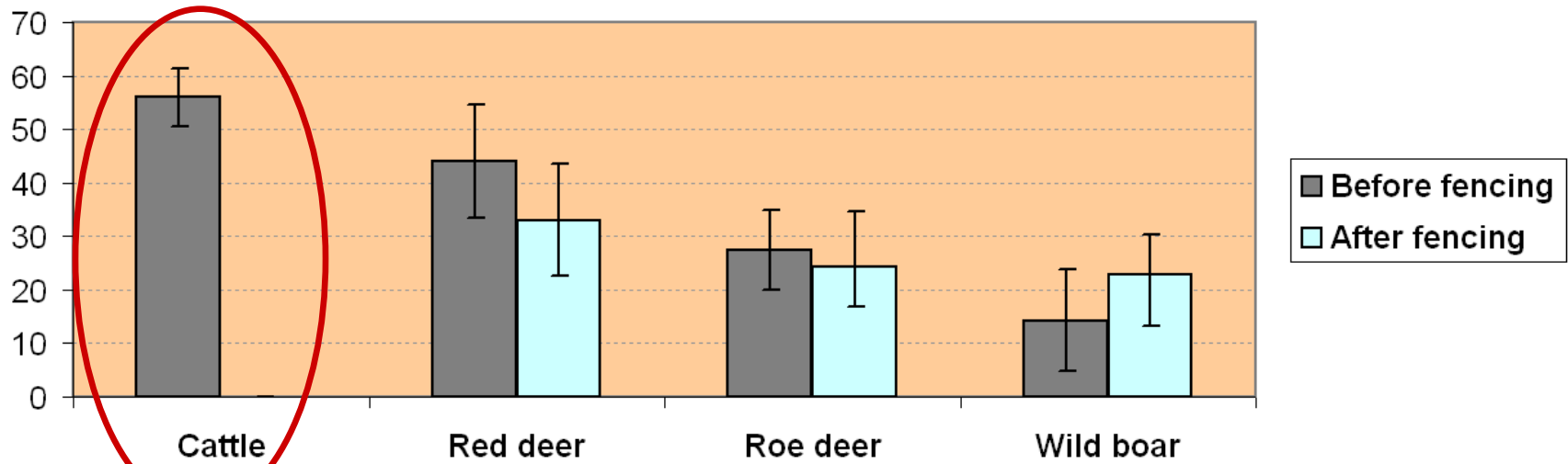




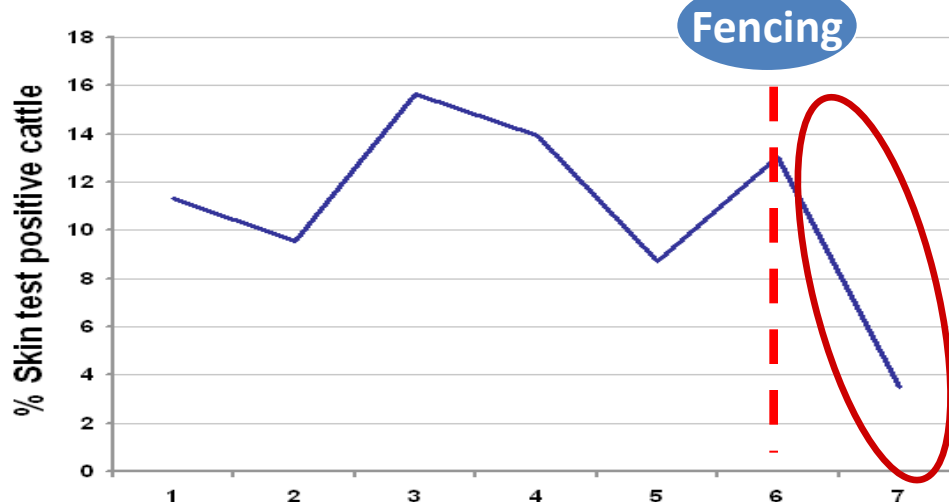
Many cows learned to operate the cattle-specific gate quickly and others followed and learned from them.

Biosecurity 2: Fences and barriers

Presence in "wildlife only" waterholes



Cattle TB incidence



Preliminary data shows a decreasing trend in cattle TB incidence, after separating cattle from wildlife at the waterholes

Biosecurity 3: Carcasses and hunting remains



Good!



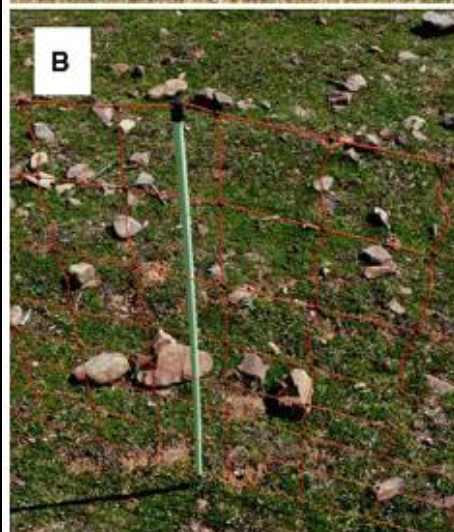
Wrong!

Biosecurity 3: Carcasses and hunting remains



...wild boar were only recorded at control sites...

(100% efficient)!



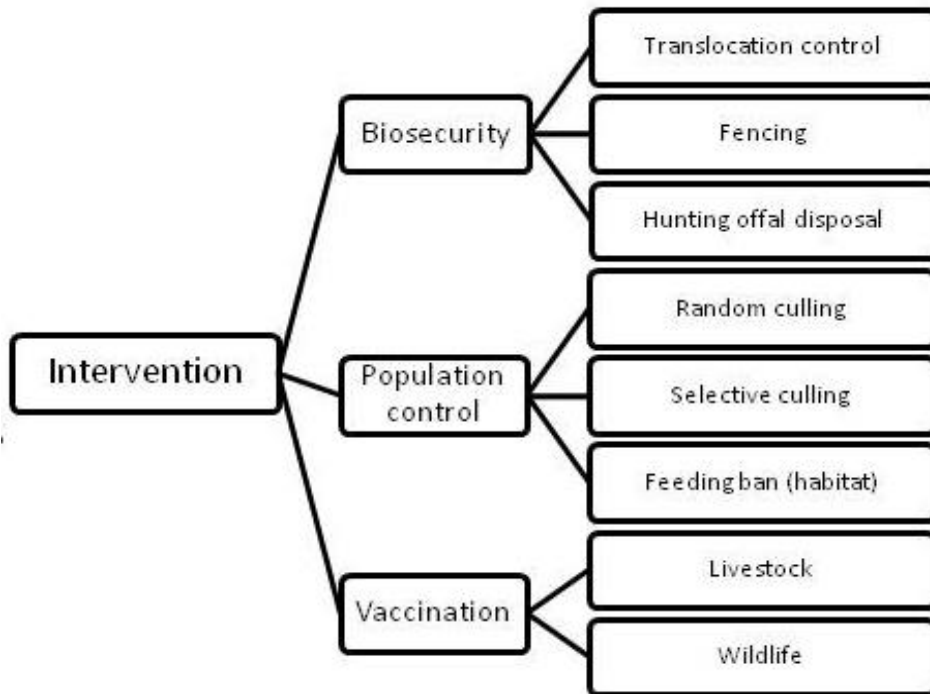
Biodivers Conserv
DOI 10.1007/s10531-012-0270-x

ORIGINAL PAPER

Linking sanitary and ecological requirements in the management of avian scavengers: effectiveness of fencing against mammals in supplementary feeding sites

Rubén Moreno-Opo • Antoni Margalida • Francisco García • Ángel Arredondo • Carlos Rodríguez • Luis Mariano González

Wildlife disease control



2nd option:
POPULATION CONTROL

- Random culling
- Selective culling
- Habitat management



Wildlife population control

Population control 1: Random culling

Carlson et al. *BMC Veterinary Research* 2011, 7:9
<http://www.biomedcentral.com/1746-6148/7/9>



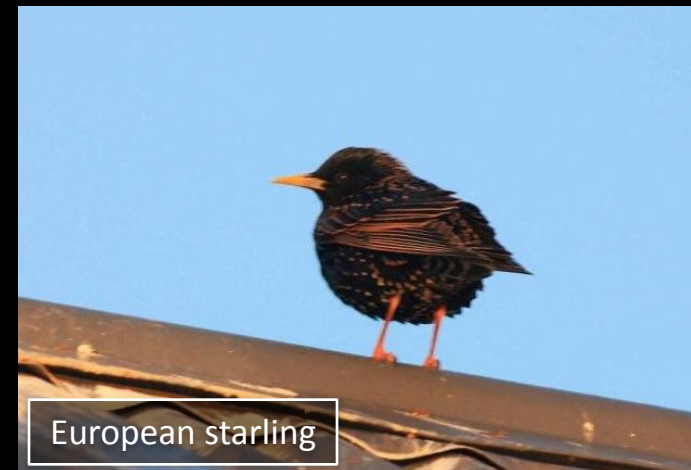
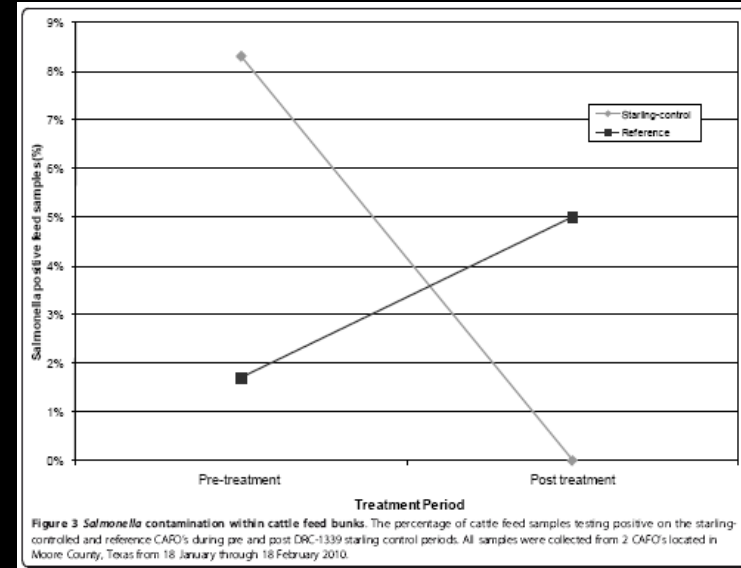
RESEARCH ARTICLE

Open Access

Efficacy of European starling control to reduce *Salmonella enterica* contamination in a concentrated animal feeding operation in the Texas panhandle

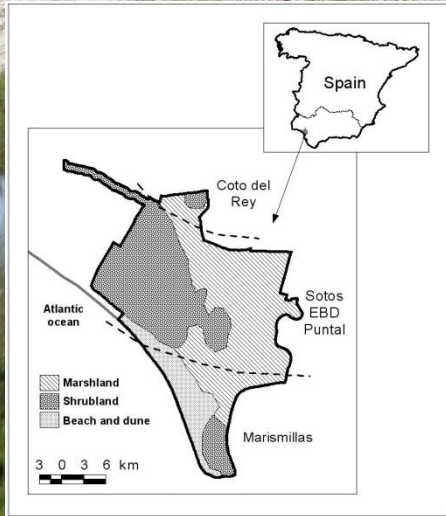
James C Carlson^{1*}, Richard M Engeman^{1†}, Doreene R Hyatt^{2†}, Rickey L Gilliland^{3†}, Thomas J DeLiberto^{4†}, Lary Clark^{1†}, Michael J Bodenchuk^{3†}, George M Linz^{5†}

- *S. enterica* disappeared from cattle feed bunks and substantially declined within water troughs following control operations
- Starling control should not be used as a stand alone tool to reduce *S. enterica*, → part of a comprehensive disease management plan



Population control 1: Random culling

Doñana National Park: a biodiversity hotspot



Population control 1: Random culling

Cattle share the park with wildlife



Wild boar (1700)



Cattle (1200)



Fallow deer (800)



Red deer (600)

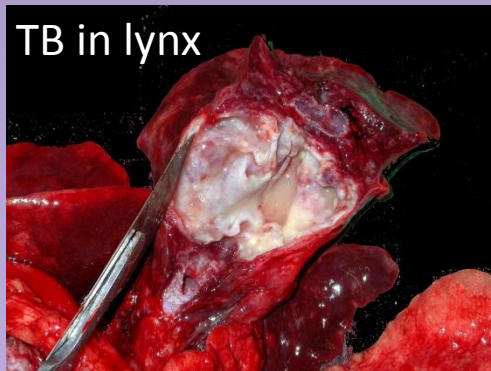


Iberian lynx (<50)



Population control 1: Random culling

TB is a conservation concern
for Iberian lynx

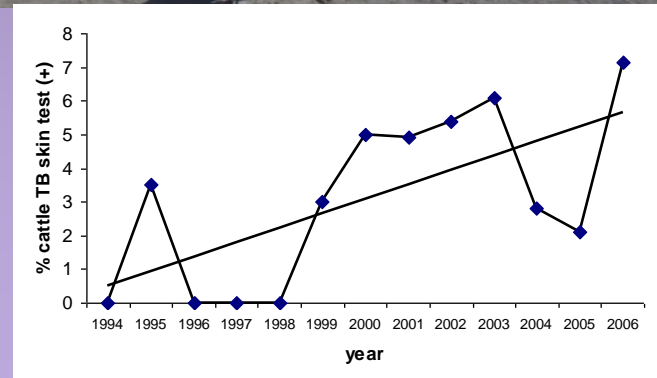


This adult lynx
"Pablo" (who
consumed deer)
died due to TB

Cattle skin test reactors
increased despite culling



Same MTBC strains as in wildlife



Population control 1: Random culling

- Wild boar culling...

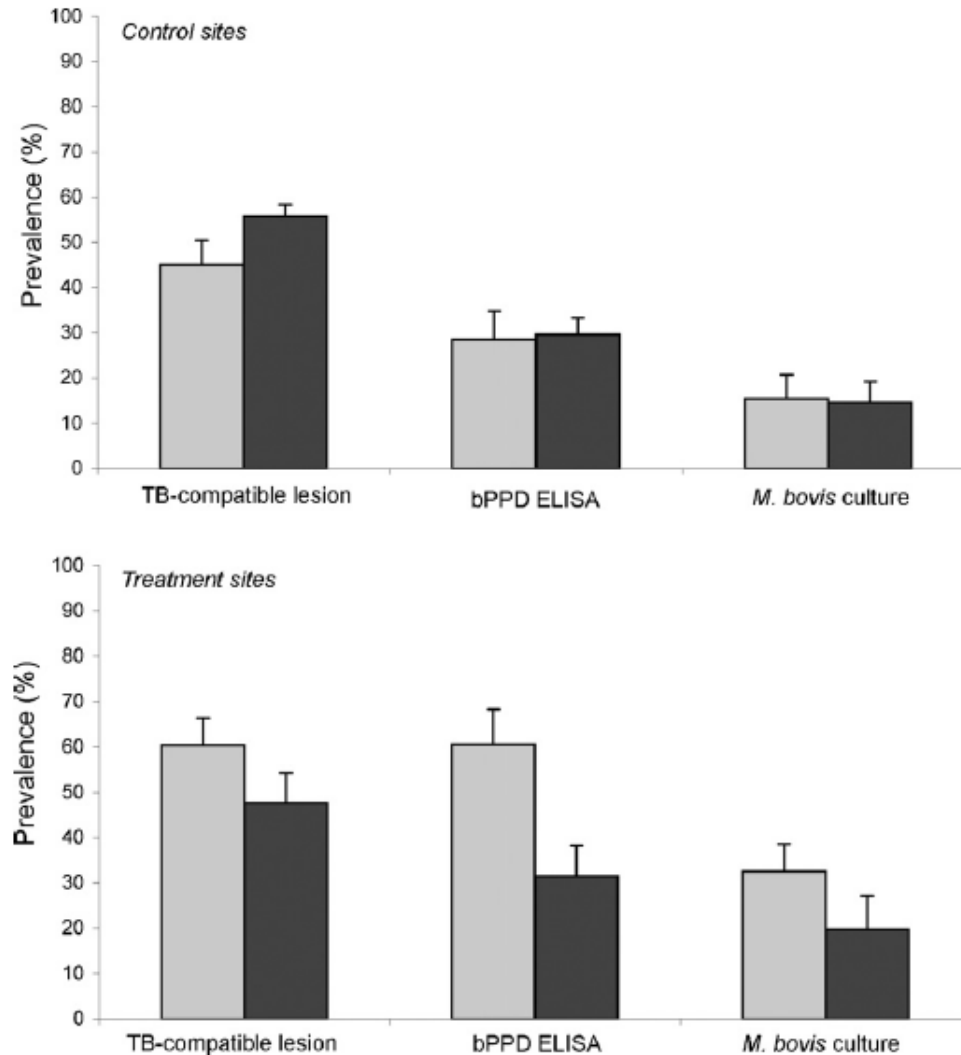


Fig. 1. Mean tuberculosis (TB) prevalences regarding TB-compatible lesions, bovine PPD ELISA and *M. bovis* culture, respectively, in wild boar sampled at Time 1 (T1, light grey) and Time 2 (T2, dark grey), in ten control sites (upper panel) and three treatment sites (lower panel) i

- Culled 50% of the park's wild boar
- Reduced wild boar TB prevalence (15-50%)
- Reduced cattle TB incidence

Population control 1: Random culling

bTB, conservation & invasive possums, New Zealand



P. Livingstone

Population control 1: Random culling

DANGER 1080 POISON
Possum control
SODIUM FLUOROACETATE
Green cereal pellet bait is laid on the ground in this area
Do not touch any baits or carcasses.
Strictly supervise all children.
Carcasses and baits are toxic to people and deadly to dogs.
If you suspect bait has been swallowed, seek medical or veterinary help immediately.
Unauthorized removal of signs or baits is an offence.
Lethal animals may contain toxic residues and should not be eaten.
Date: **7/08/2009**
GWRC Field Operator 04 526 5327 or 06 378 2484
pest_animals@gw.govt.nz
www.gw.govt.nz
greater WELLINGTON Biosecurity REGIONAL CENTRE



Possum culling is an industry in NZ

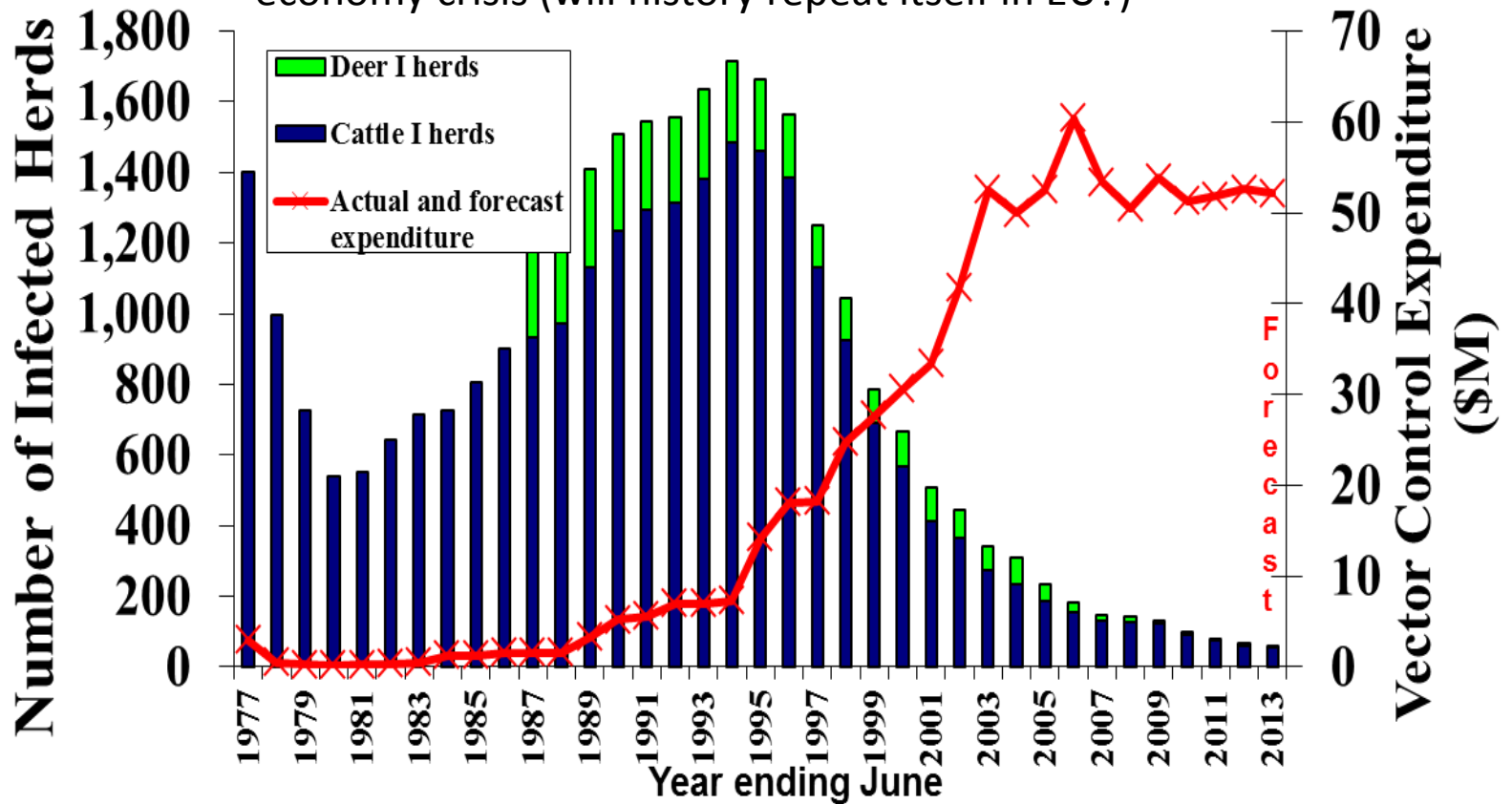
More funds are spent in possum culling than in cattle testing & compensations



Population control 1: Random culling



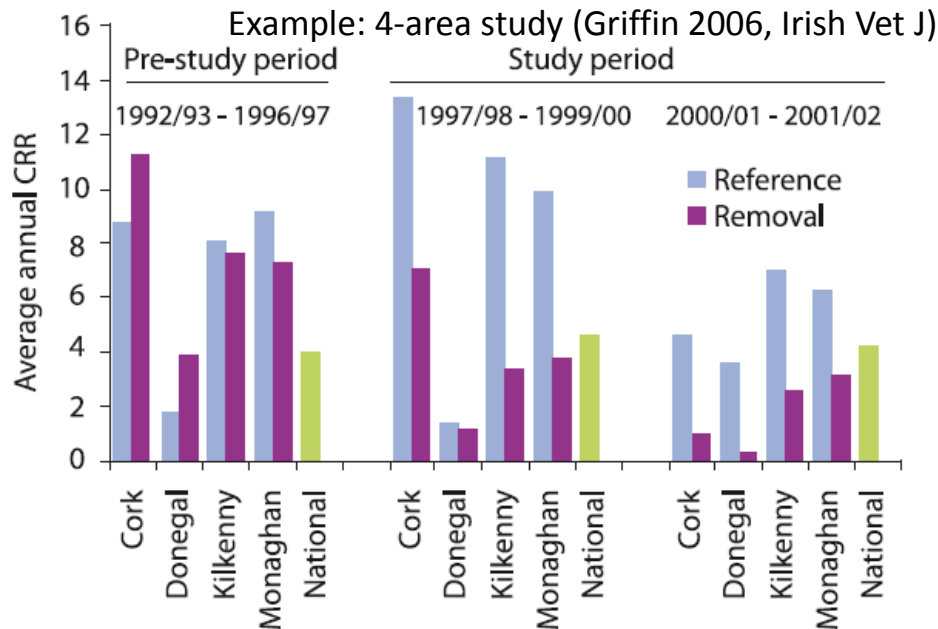
TB control in cattle through possum control. Possum control ceased in the early eighties because of funding due to an economy crisis (will history repeat itself in EU?)



Population control 1: Random culling



- “Nasty TB reservoir” vs. “beloved native wildlife”
- In Ireland and the UK, the ability to eradicate tuberculosis from cattle is severely constrained while infection continues to spread from badgers
- Culling experiments had variable effects on cattle TB
- Vaccination (possibly combined with culling) is seen as the best long-term strategy option



J. Comp. Path. 2011, Vol. 144, 1–24

Available online at www.sciencedirect.com

ScienceDirect



REVIEW

***Mycobacterium bovis* Infection in the Eurasian Badger (*Meles meles*): the Disease, Pathogenesis, Epidemiology and Control**

L. A. L. Corner*, D. Murphy† and E. Gormley*

Population control 1: Random culling

EXAMPLES WHERE RANDOM CULLING FAILED

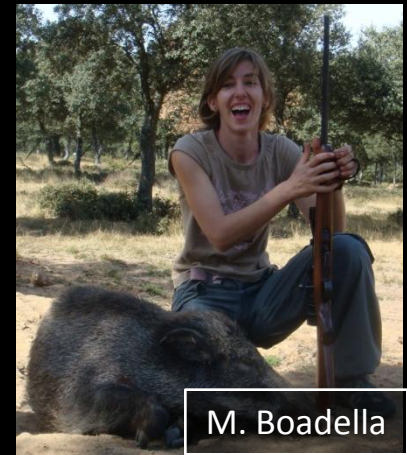
- Red fox culling – rabies
- Wild boar culling – Aujeszky's disease
- Wild boar culling – CSF



M. Artois

“Culling reservoir populations to control the transmission of pathogens has proven disappointingly inefficient”

“Culling could become a part of integrated control strategies (...) contributing to increase their success likelihood, or reducing the total expenses”



M. Boadella

Population control 2: Selective (targeted) culling

- A friendlier alternative to random culling: cull only infected individuals (= test & cull schemes in domestic animals)
- Can be very expensive
- Feasibility depends on:
 - Access to the animals
 - Convenient, sensitive and specific tests
 - Prevalence and spatial distribution



Population control 2: Selective (targeted) culling

500

MANAGING CHRONIC WASTING DISEASE

Feasibility of "test-and-cull" for managing chronic wasting disease in urban mule deer

Lisa L. Wolfe, Michael W. Miller, and Elizabeth S. Williams

- Tested >50% of estimated 350 mule deer wintering in Estes Park, Colorado, for CWD
- 9 (18%) males and 6 (5%) females test positive and removed from the population
- 41 field days: 5.2 person-hours/deer
- Drugs, telemetry, vehicles... 363 \$/deer
- → **Not viable at large scales**



Figure 2. Estes Park mule deer were habituated to people and were readily captured with a dart gun. Here, a yearling male mule deer is tonsil-biopsied by Lisa Wolfe (right) and Michael Sirochman (left) while other deer stand in the background. This photo was taken in October 2003; all 7 deer in the background were captured and tested during the 2002 field season. Photo by M. W. Miller.

Population control 2: Selective (targeted) culling

CSIRO PUBLISHING

Wildlife Research, 2012, 39, 104–111

<http://dx.doi.org/10.1071/WR11147>

Live-trapping and bovine tuberculosis testing of free-ranging white-tailed deer for targeted removal

Melinda K. Cosgrove^{A,E}, Henry Campa III^B, Stephen M. Schmitt^A, David R. Marks^C, Anthony S. Wilson^D and Daniel J. O'Brien^A



- 762 deer captured and tested for TB
- 8 (1.8%) adults positive on blood test
- Estimated TB prevalence was 2.5%
- Ability to trap and test a substantial number of deer given high deer densities (16–20 deer/km²), availability of traps and abundant workers
- Total cost of ~US\$228,000, or 38,000 per culture-positive animal
- **→ Not viable at large scales**



Animal side rapid tests, such as these lateral flow tests (Chembio, NY) are needed for test & cull strategies

Population control 2: Selective (targeted) culling



- Elk Island N.P. Alberta, Canada
- 100% effective in clearing bison and elk from *M. bovis* and *B. abortus*
- → **Worked in an isolated population**

Population control 2: Selective (targeted) culling



>300 wild boar tested
(Chembio lateral flow) and
segregated.
Positive wild boar will be
culled by hunting.

Population control 3: habitat management

- Supplementary feeding leads to population growth and spatial aggregation
- Feeding bans could contribute to a sustainable reduction of wildlife densities and spatial aggregation
- But: this creates **conflicts** with hunters and other stakeholders

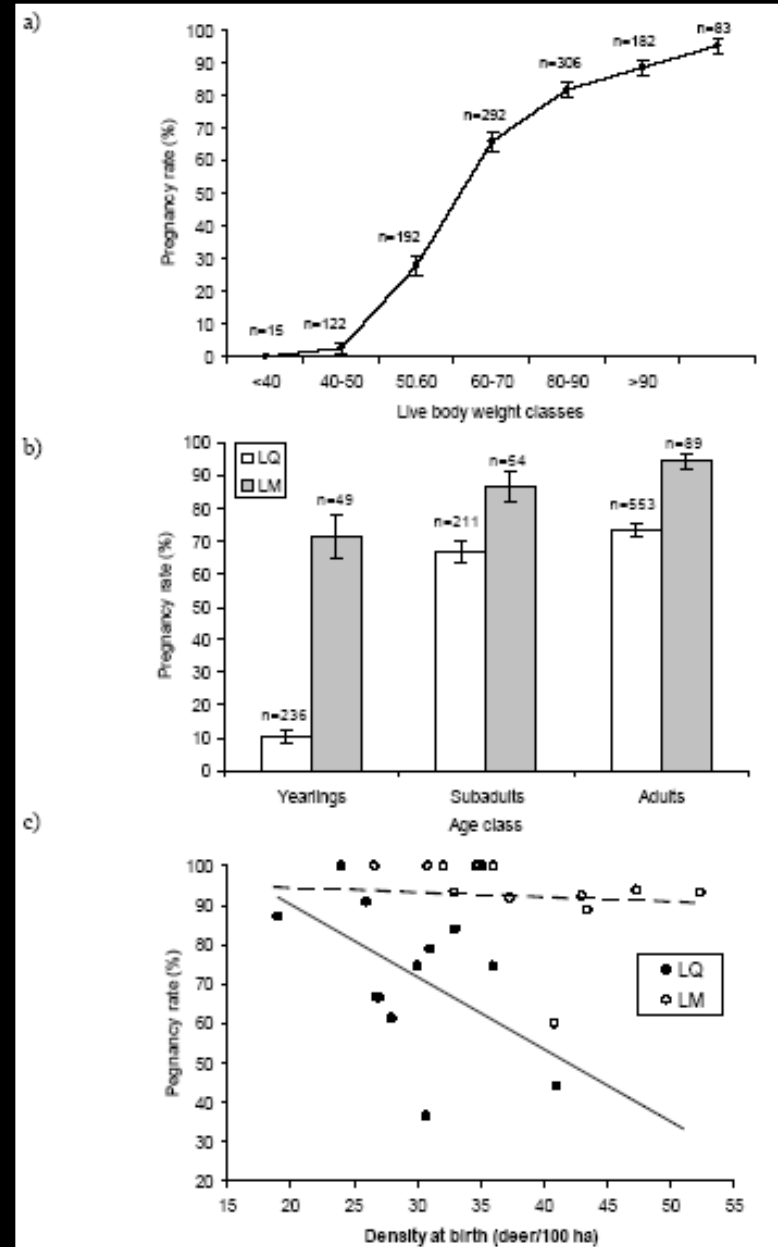


Oecologia
DOI 10.1007/s00442-010-1663-8

POPULATION ECOLOGY - ORIGINAL PAPER

Effects of density, climate, and supplementary forage on body mass and pregnancy rates of female red deer in Spain

P. Rodríguez-Hidalgo · C. Gortázar ·
F. S. Tortosa · C. Rodríguez-Vigal ·
Y. Fierro · J. Vicente

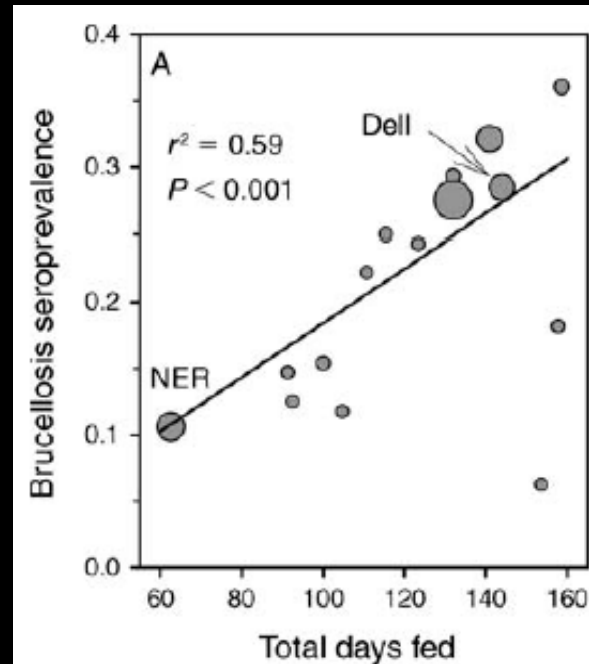


Population control 3: habitat management

Brucellosis in the GYE



Photos: NY Times

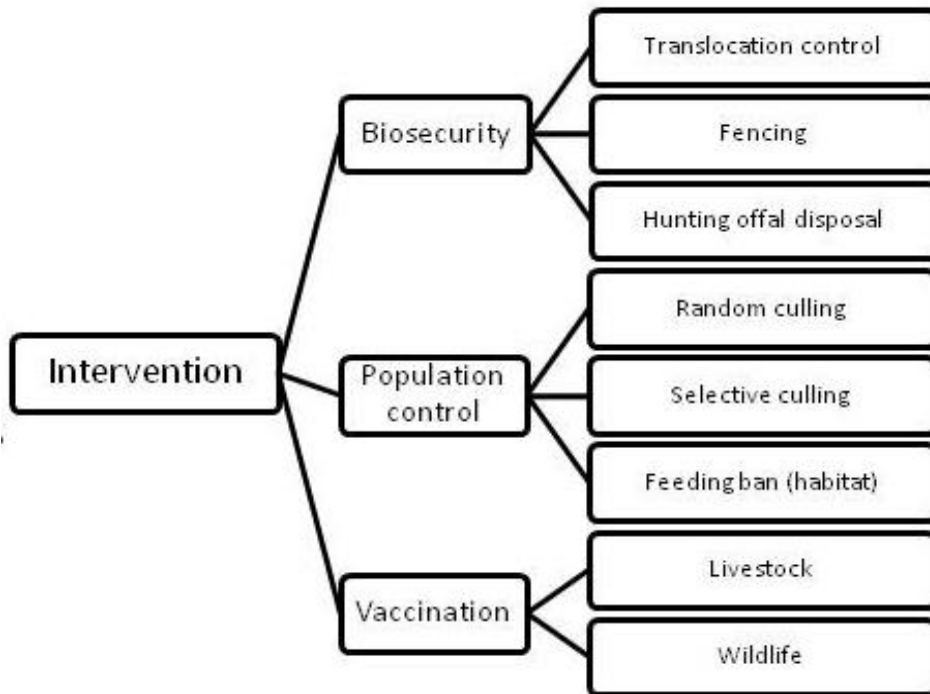


PAUL C. CROSS ET AL.

Ecological Applications
Vol. 17, No. 4

The longer the elk feeding period, the higher the *Brucella* antibody prevalence

Wildlife disease control



3rd option:
VACCINATION



Vaccination and medication

Vaccination and medication

- Examples of vaccination

- **Rabies** – fox and other carnivores – Europe, North America, ...
- **CSF** – wild boar – Europe
- **TB** – several hosts and sites
- **Foot-and-mouth** – livestock vaccination in endemic wildlife areas
- (...)

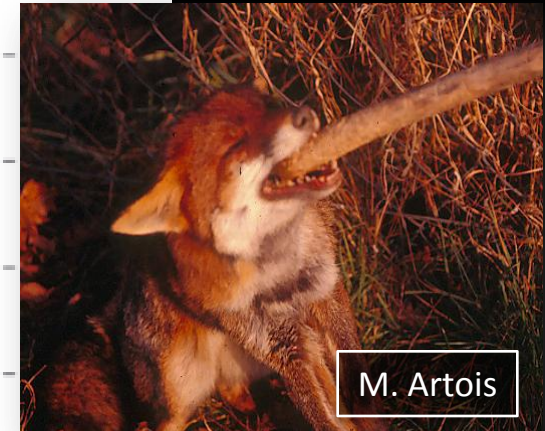
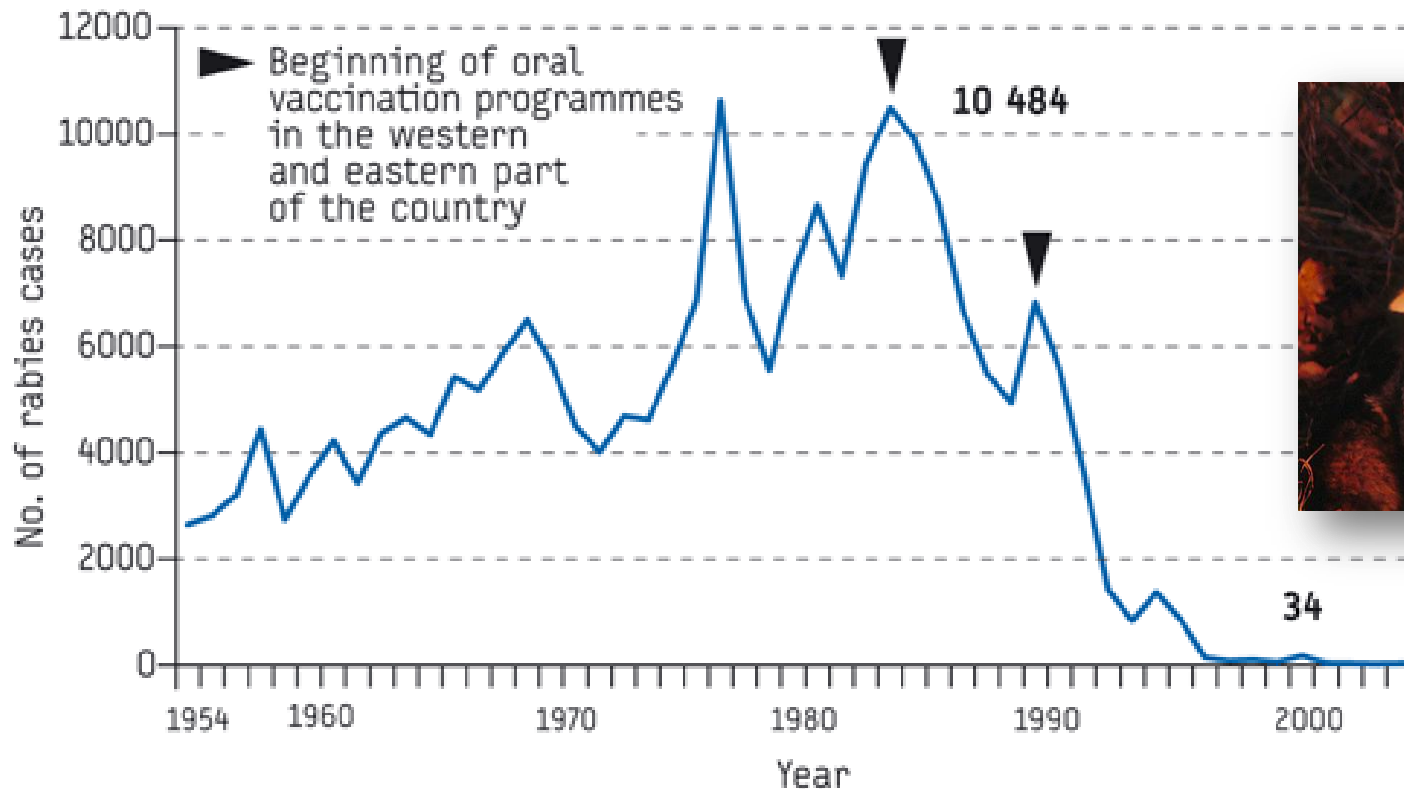
- Examples of medication

- ***Echinococcus multilocularis*** – red fox – Europe
- Acaricides to control **ticks & Lyme** – white-tailed deer – USA
- Pre-release or pre-**translocation** treatments
- Antiparasitics and antibiotics in **game** species
- (...)

Vaccination: rabies

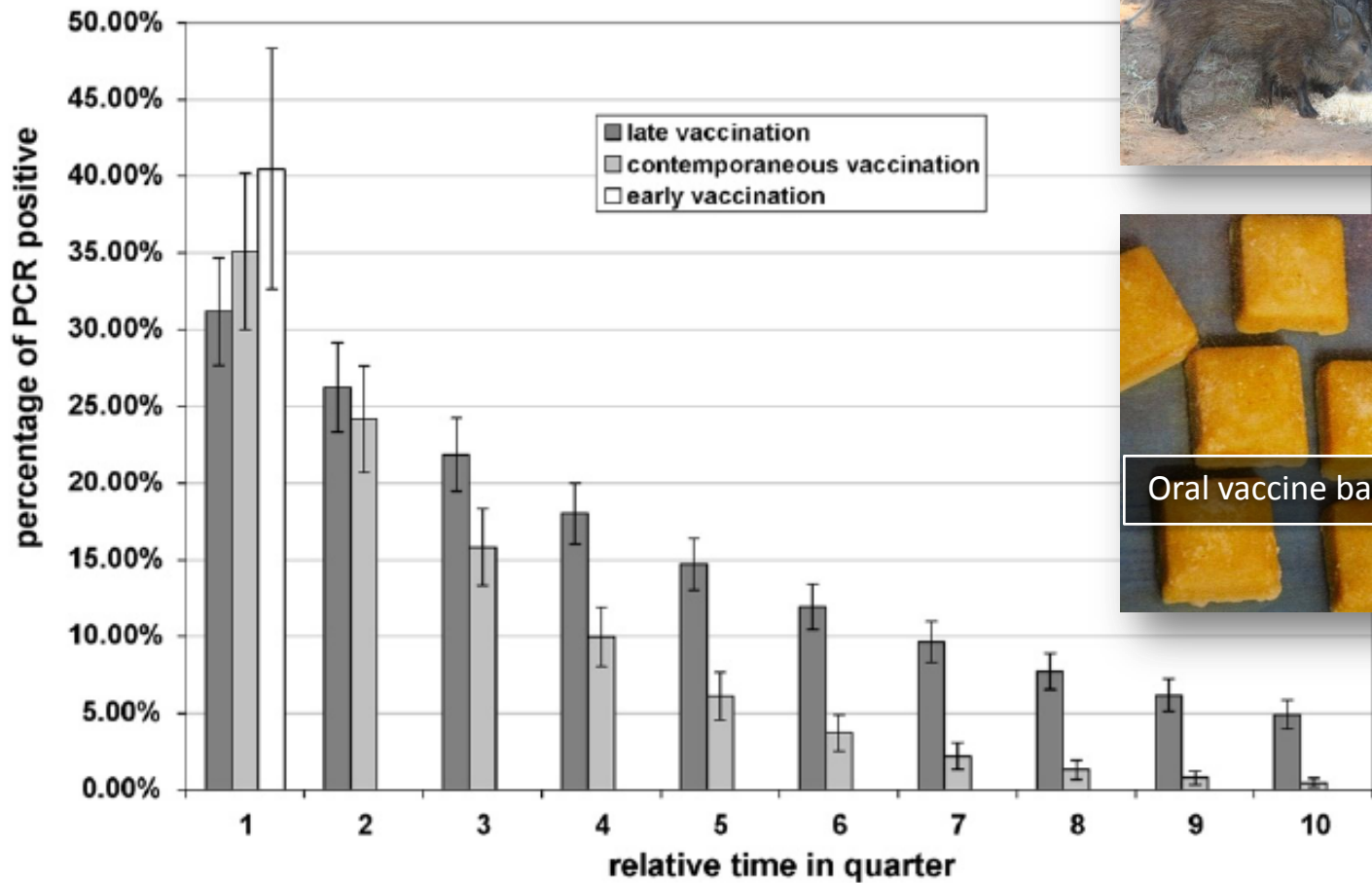
FIGURE 1

Development of sylvatic rabies (fox mediated rabies) in Germany, 1954-2005



Vaccination: CSF

S. Rossi et al. / Veterinary Microbiology 142 (2010) 99–107



Vaccination: TB

- Option 1: Vaccinate cattle
 - Research ongoing in UK & NZ
 - Main problem: interference of BCG vaccine with TB tests
- Option 2: Vaccinate wildlife
 - Field results available: Badger (UK), possum (NZ)
 - Ongoing field trials: Badger (Irl), wild boar (Spain)
 - Captivity trials: White-tailed deer (USA), red deer (NZ), African buffalo (SA), ...

PROCEEDINGS
OF
THE ROYAL
SOCIETY **B**

FirstCite®
e-publishing

Proc. R. Soc. B
doi:10.1098/rspb.2010.1953
Published online

Bacillus Calmette-Guérin vaccination reduces the severity and progression of tuberculosis in badgers

Mark A. Chambers^{1,*}, Fiona Rogers^{1,2}, Richard J. Delahay²,
Sandrine Lesellier¹, Ro



PROCEEDINGS
OF
THE ROYAL
SOCIETY **B**

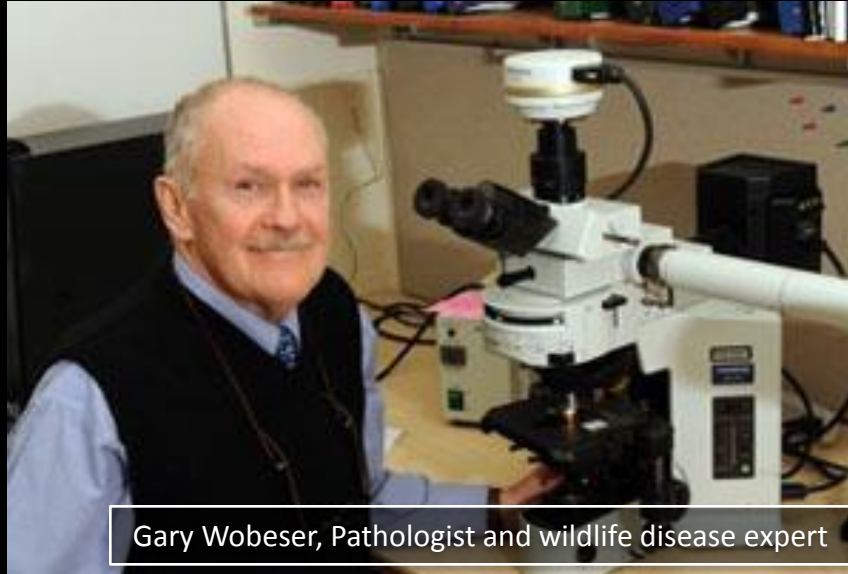
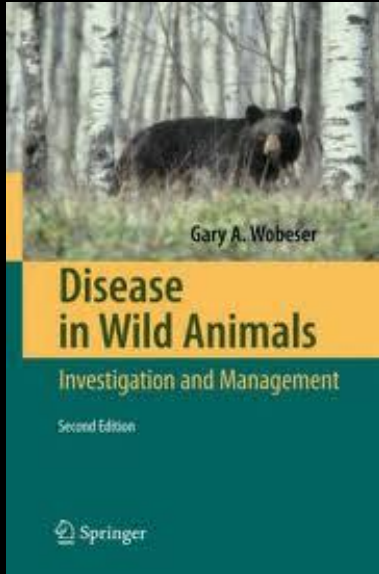
Proc. R. Soc. B (2009) 276, 2987–2995
doi:10.1098/rspb.2009.0414
Published online 3 June 2009

Oral vaccination reduces the incidence of tuberculosis in free-living brushtail possums

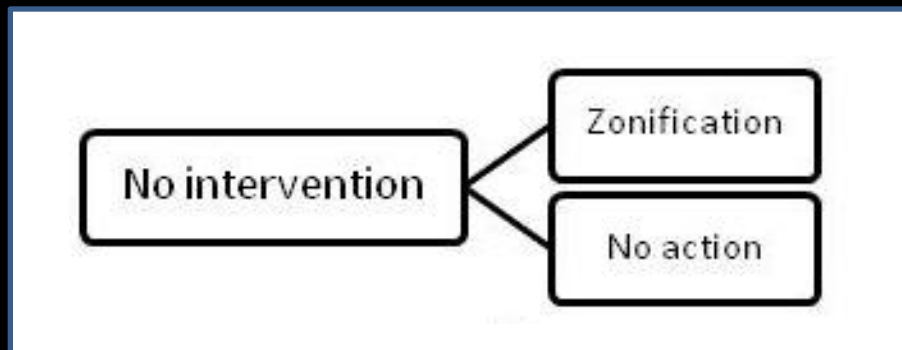
D. M. Tompkins^{1,*}, D. S. L. Ramsey^{2,†}, M. L. Cross³, F. E. Aldwell³,
G. W. de Lisle⁴ and B. M. Buddle⁵



Wildlife disease control



Gary Wobeser, Pathologist and wildlife disease expert

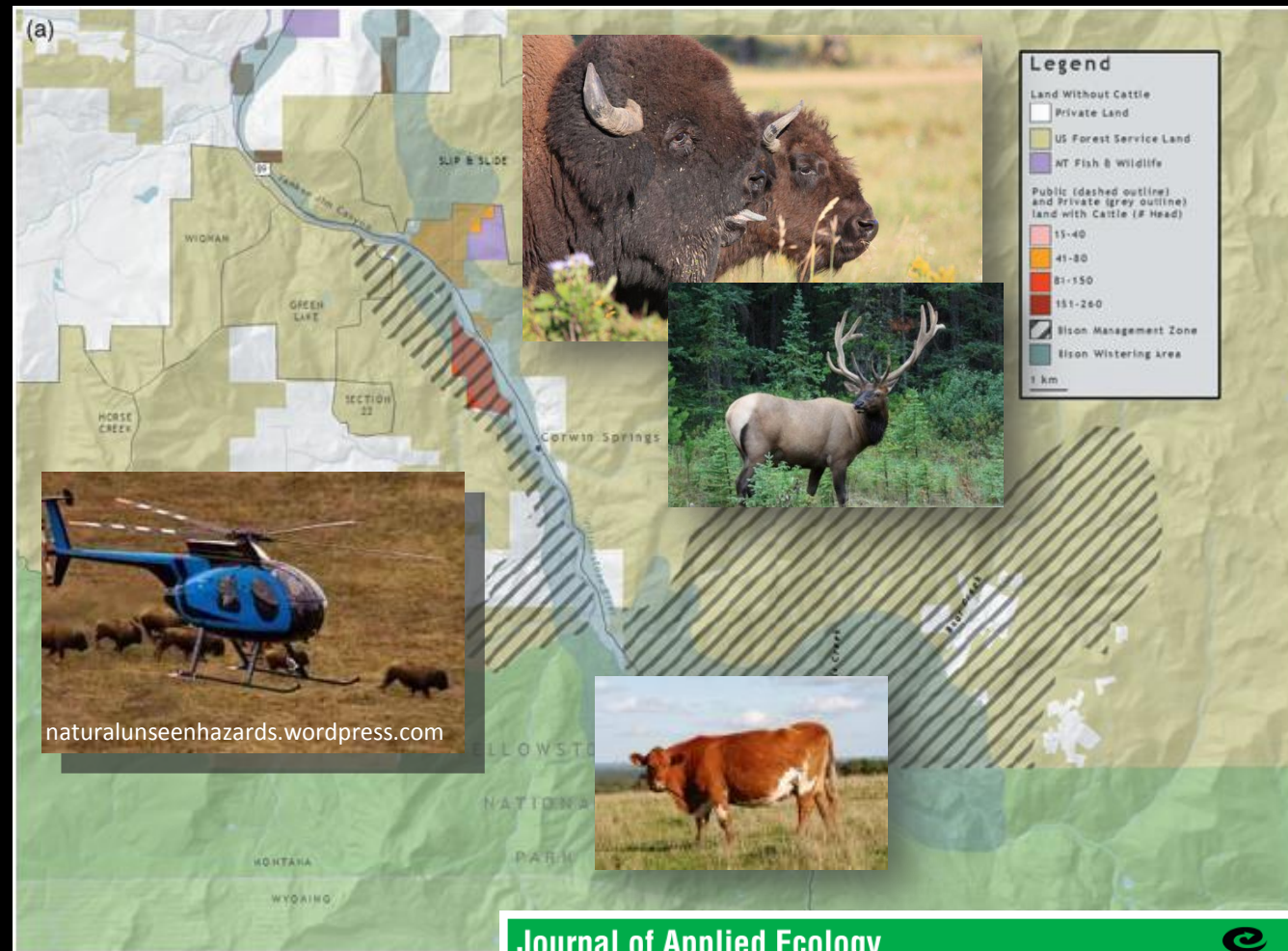




Compartmentalisation and zonification

Zonification: Brucellosis in the GYE

- Bison exiting the YNP are hazed back, or culled, at high expense
- Alternatives?
 - Cease grazing cattle (50% lower cost)
 - Zonification: brucellosis zone (1000x lower cost!)



Journal of Applied Ecology



Journal of Applied Ecology 2009, 46, 476–485

doi: 10.1111/j.1365-2664.2008.01602.x

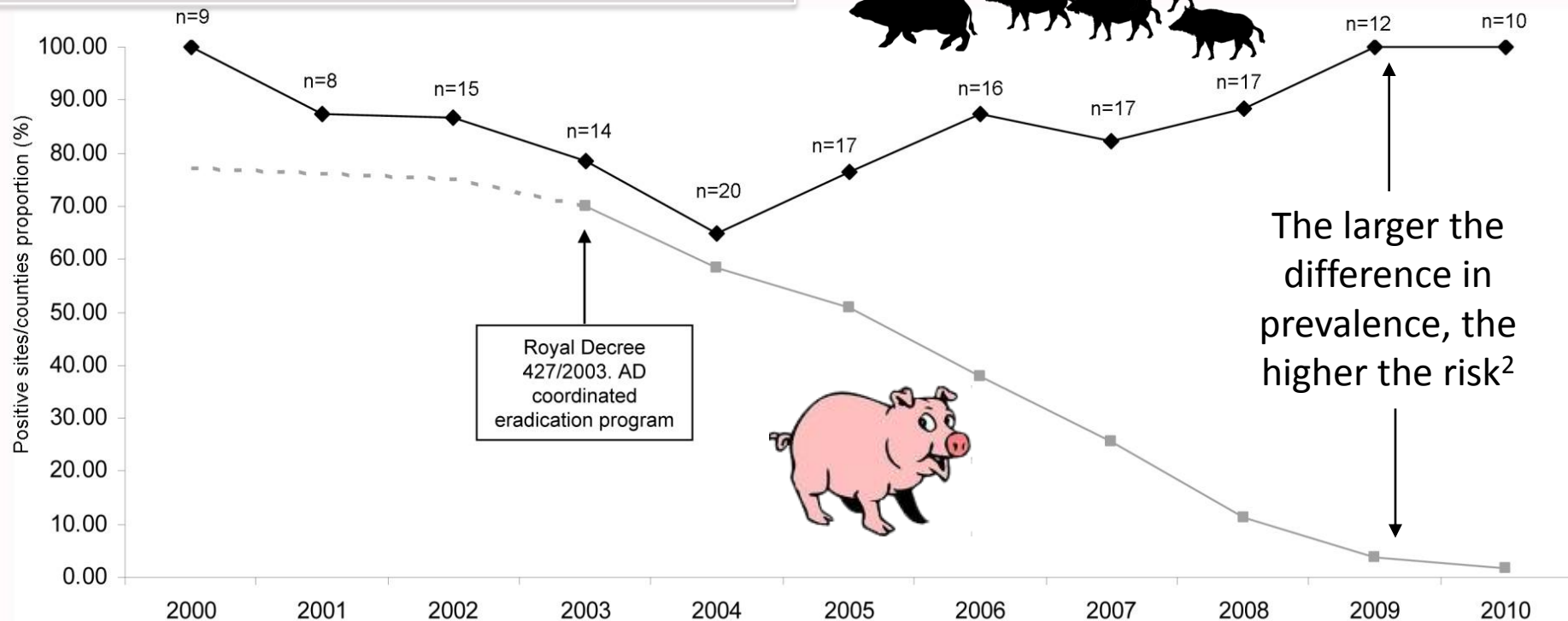
Wildlife–livestock conflict: the risk of pathogen transmission from bison to cattle outside Yellowstone National Park

A. Marm Kilpatrick^{1,2,*}, Colin M. Gillin³ and Peter Daszak¹

Compartmentalisation

- Establish health status by production system, not by geography¹
- Example: Country can be CSF-free in industrial pigs, but maybe not in wild boar, backyard pigs...

Prevalence of Aujeszky's disease in pig and wild boar populations, Spain



Presentation overview

- Infections shared with wildlife
- Wildlife monitoring
- Options for disease control
 - Intervention
 - Preventive actions
 - Population control
 - Vaccination & medication
 - No intervention
 - Zonification
 - Doing nothing



- **Outlook: wildlife disease control in the 21st Century**



Wildlife disease control in the 21st Century

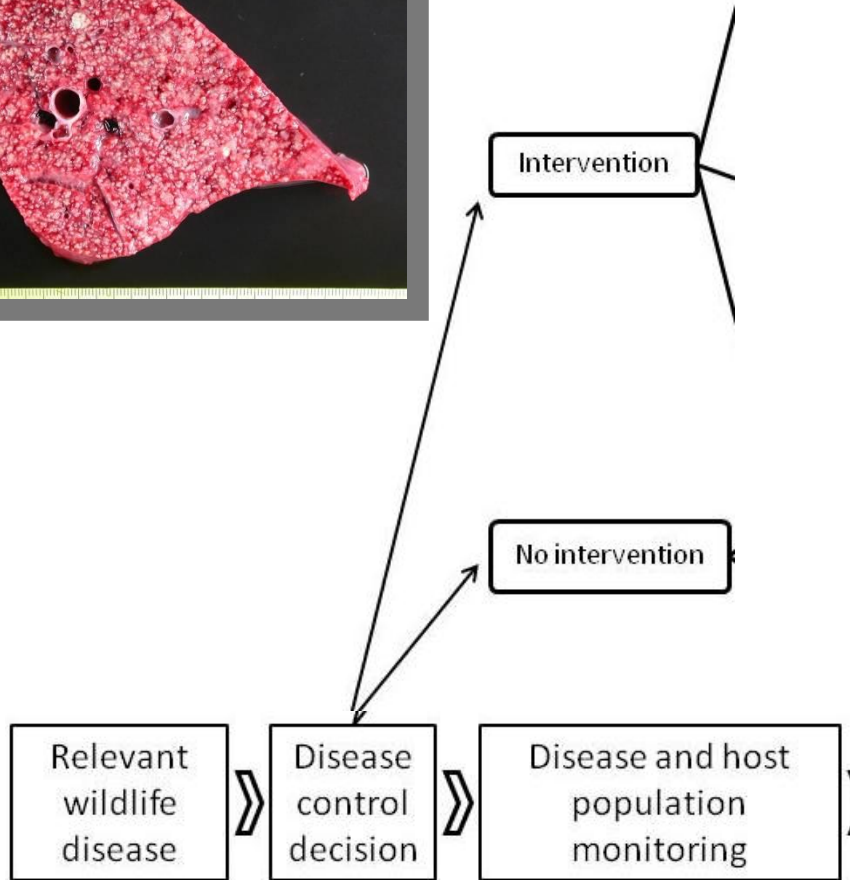
Wildlife disease control in the 21st Century

[Predicted changes]

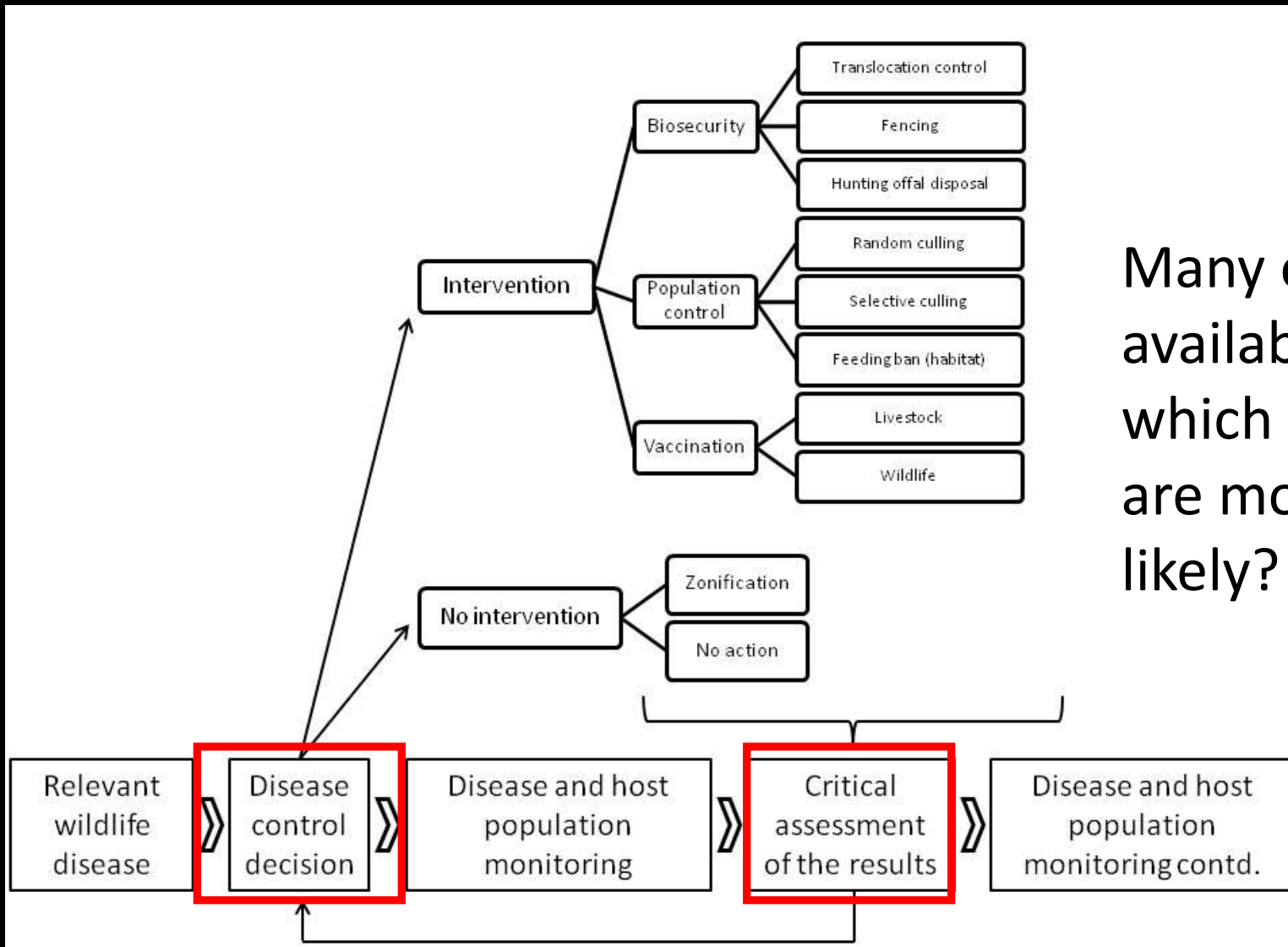
- WILDLIFE, LIVESTOCK & HUMANS
 - Habitat loss, extinctions, overabundance of a few successful species
 - Food & resource crisis, farming intensification, growing global trade
 - Overpopulation, poverty, climate change, migration...
- PATHOGENS & DISEASES
 - New disease control needs: more diseases, in more species
 - Larger gap between health status of livestock and wildlife
 - New emerging disease events
- DISEASE CONTROL
 - Increasing conflicts: opposition to population control, welfare concerns...
 - New research-derived knowledge: field tools software...
 - New biotech tools: diagnostics, vaccines, fertility control



Wildlife disease control



Wildlife disease control in the 21st Century



Many options available - which ones are more likely?

Wildlife disease control in the 21st Century

A: New vaccines, new delivery tools



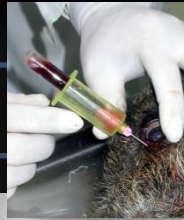
Piglets ingesting TB vaccine baits

Baiting a selective piglet feeder for TB vaccination. Spain 2012

Source: IREC/NEIKER/UCM.



4 years of BSL3 trials



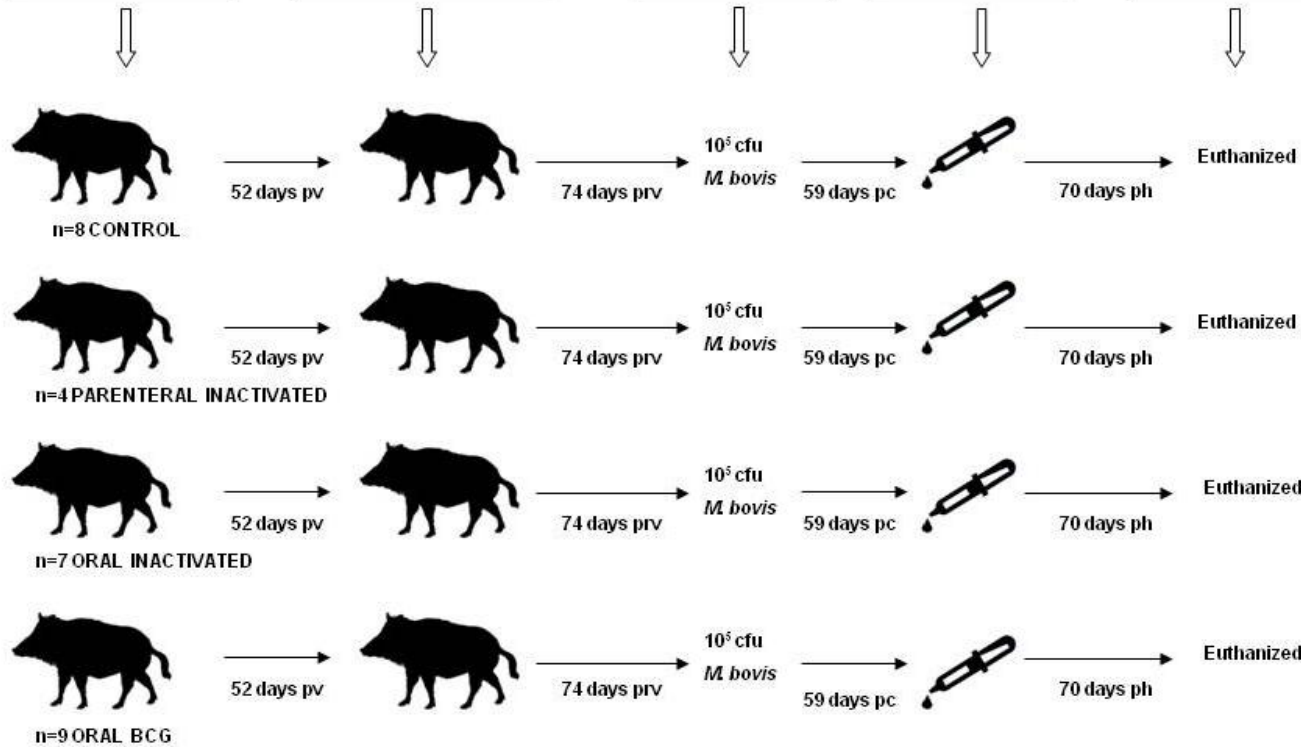
Vaccination
(T1)

Revaccination
(T2)

Challenge
(T3)

Handling
(T4)

Necropsy
(T5)



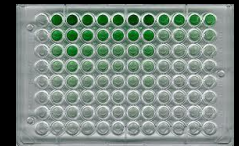
Total: n=28



Patología



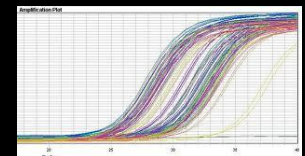
Cultivo



Serología



Gamma IFN



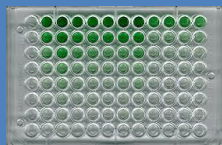
Expresión MUT



Pathology



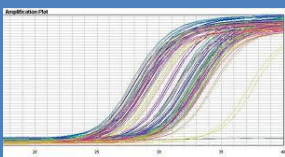
Culture



Serology



Gamma IFN

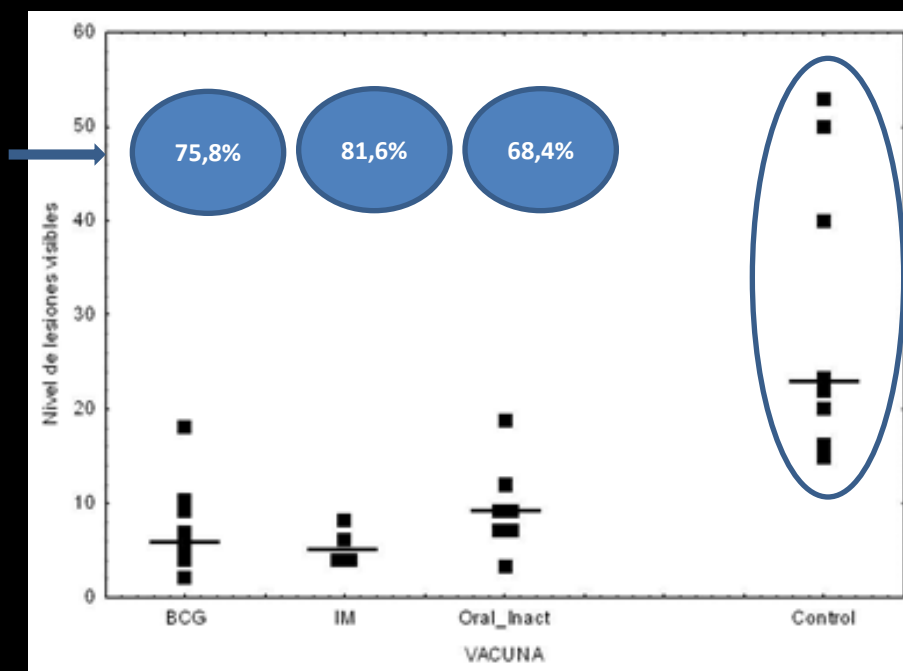


MUT expression

Pathology

❖ Levels of visible lesions at necropsy were significantly lower in vaccinated groups compared with the control group

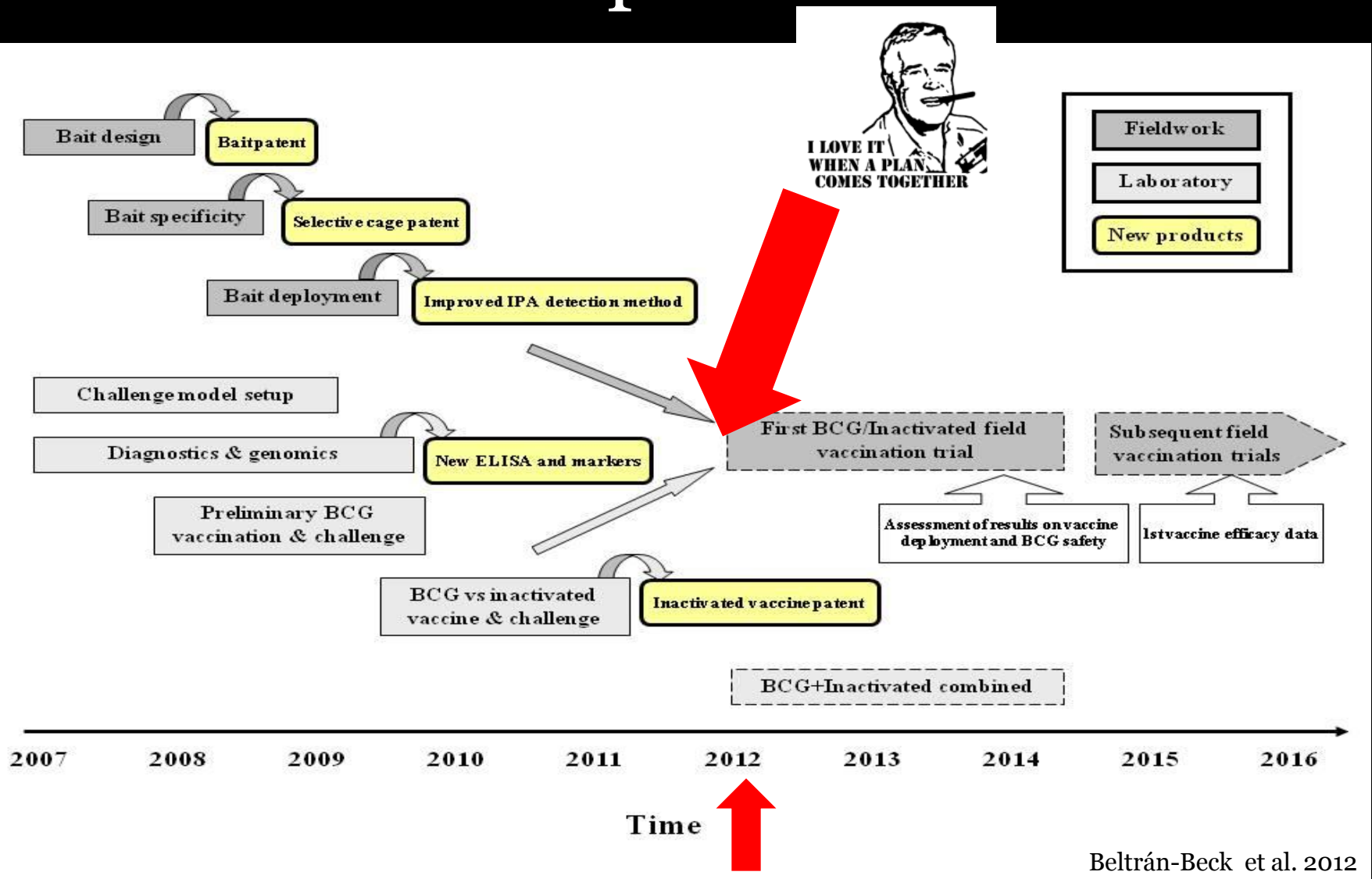
Levels of protection





Wild boar TB vaccine research

The plan



Wildlife disease control in the 21st Century

B: No action – crisis times

WORLD VIEW A personal take on events

Turn Spain's budget crisis into an opportunity

Strict funding cuts mean that the country's research focus on quality rather than quantity, says science



Spain's 2012 budget is the most austere in our democratic history. The government has been forced to optimize its limited resources in all areas — and science, technology and innovation cannot be exempted. That is why I have agreed to a significant, although not insurmountable, decrease in resources.

In the part of the budget allocated mainly to the grants and subsidies that are indispensable to research, there has been a €475-million (US\$591-million) reduction: a decrease of 22.5%. This comes on top of cuts in previous years, so it cannot be denied that we face a very challenging situation.

We know what needs to be done. My department must prioritize and strive for excellence. One-quarter of the Spanish labour force is unemployed, so although investment in science, technology and innovation is a priority, it must also be realistic. We must now stop talking about the importance of science, and instead commit ourselves to the need for excellence in science.

Research, development and innovation in Spain have unquestionably advanced over the past decade. But this accelerated growth can hamper the effective management of resources, and a number of overlapping institutions and functions have been created. Currently, there is a biotechnology research centre or a science park in almost every Spanish region.

To strengthen the research system in our country we must slim it down, but it is important to try we must slim it down, not quality. This process cut back on quantity, not quality. This process will be complex and unpopular: after all, nobody likes cuts or readjustments. Under the changes

WHEN IT COMES TO SCIENCE, OUR NUMBER-ONE PRIORITY REMAINS SUPPORT FOR SPAIN'S EXCELLENT RESEARCHERS.

CRISIS

NATURE NEWS BLOG

Scientists see funding slashed in Spanish budget


04 Apr 2012 | 15:55 BST | Posted by Brian Owens | Category: Policy, Uncategorized
Posted on behalf of Michele Catanzaro.

Research has been hit hard by Spain's austerity budget. The Spanish government has cut funding for research and development (R&D) by one-fourth in its [draft budget](#) for 2012, which was presented to Parliament yesterday. This cut "brings the funding back to 2005 levels, once inflation is taken into account", according to Carlos Andradas, president of the Confederation of Spanish Scientific Societies ([COSCE](#)).


According to COSCE's analysis, the overall funding for research will fall from €8.5 billion (US\$11.1 billion) last year to €6.4 billion in 2012 — a 25.5% reduction applied to both military and civil research.

Wildlife disease control in the 21st Century


- All options have **pros and cons**
- **Consider all options** for a given situation
- Promote **integrated control**, combining several tools




Improving biosecurity at the interface



Wildlife population control



Compartmentalisation and zonification



Vaccination and medication



Thank you!