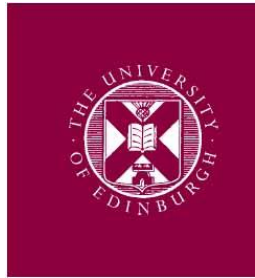




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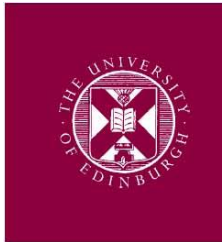
Leprosy in red squirrels: an emerging disease

Professor Anna Meredith MA VetMB CertLAS DZooMed DipECZM MRCVS

Jorge Del Pozo, Karen Stevenson*, Joyce McLuckie*, Sionagh Smith, Elspeth Milne

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Background

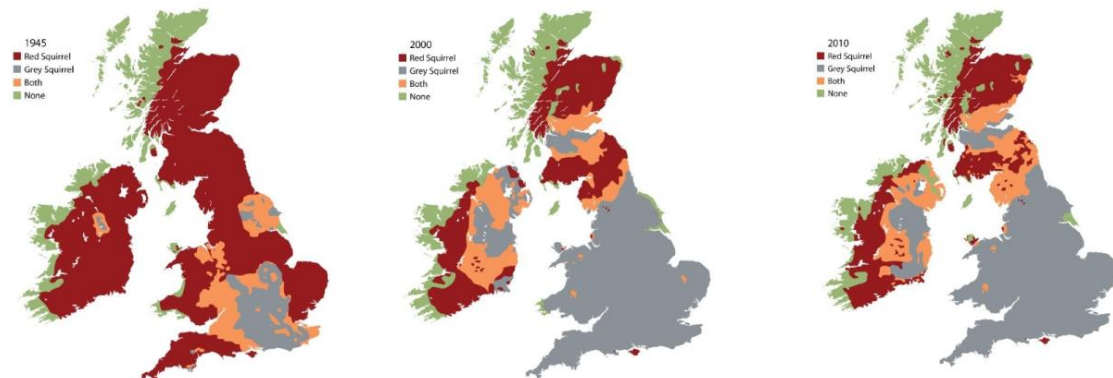


- Estimated 120,000 red squirrels (*Scuirus vulgaris*) in Scotland
- 75% of UK population
- 2005: squirrelpox virus (SQPV) first detected in Scotland in grey squirrels
- 2007: first cases of squirrelpox in red squirrels (McInnes et al 2009)
- R(D)SVS carries out scanning surveillance for red squirrels - carcasses submitted by wildlife rangers and public.

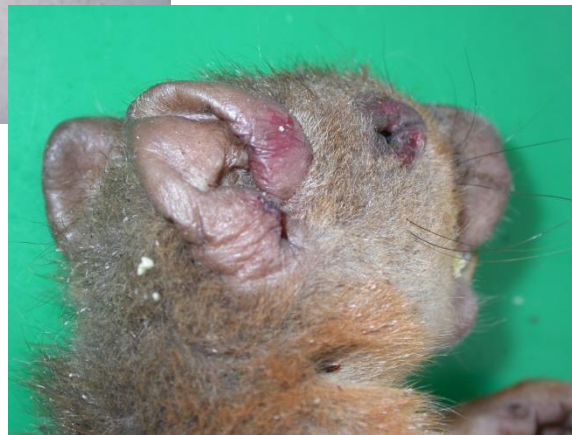
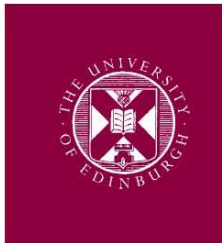
Squirrel Distribution Maps 1945-2010



Squirrelpox



Index case 2006



6 cases examined post mortem 2006-2013

Gross presentation all cases:

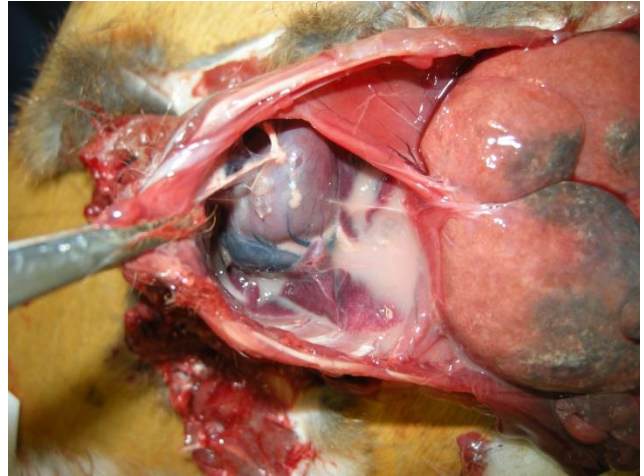
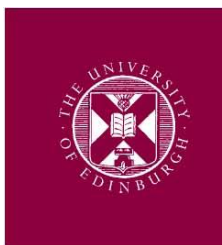
- Bilateral, well-defined variable alopecia and cutaneous swelling with 'shiny' appearance of :
 - snout
 - lips
 - eyelids
 - pinnae
 - vulva
 - distal extremities
- Mild ulceration and scabbing in some affected areas
- 5 adult males, 1 adult female
- All SQPV negative
- All in poor body condition, heavy ectoparasite burden
- 1 pneumonia, 1 chylothorax



Case 2:2010



Case 5: 2012



Chylothorax

Wild sightings 2012 onwards

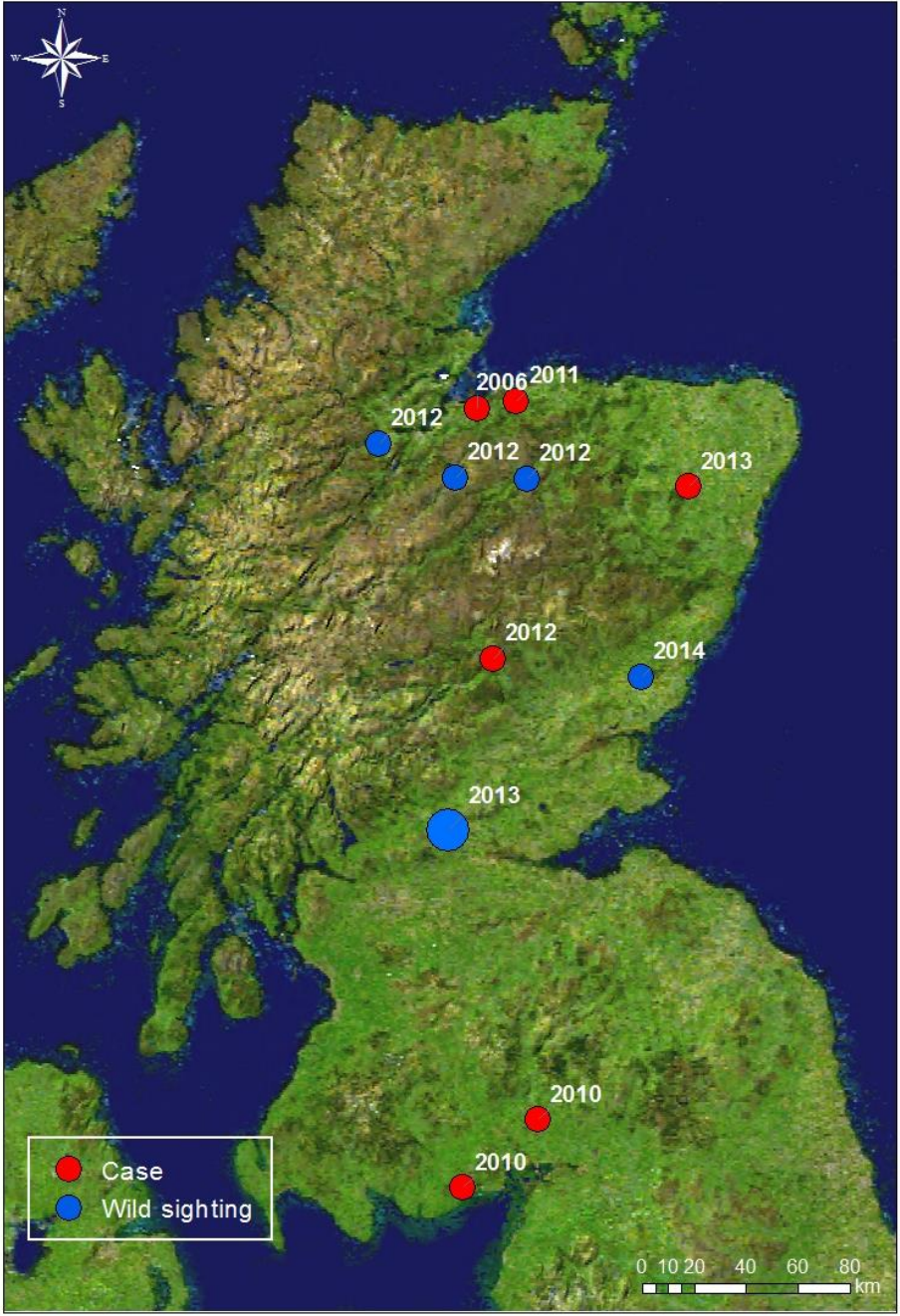




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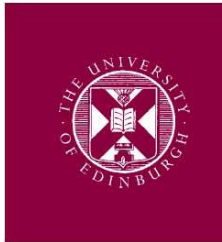


August 13th 2014



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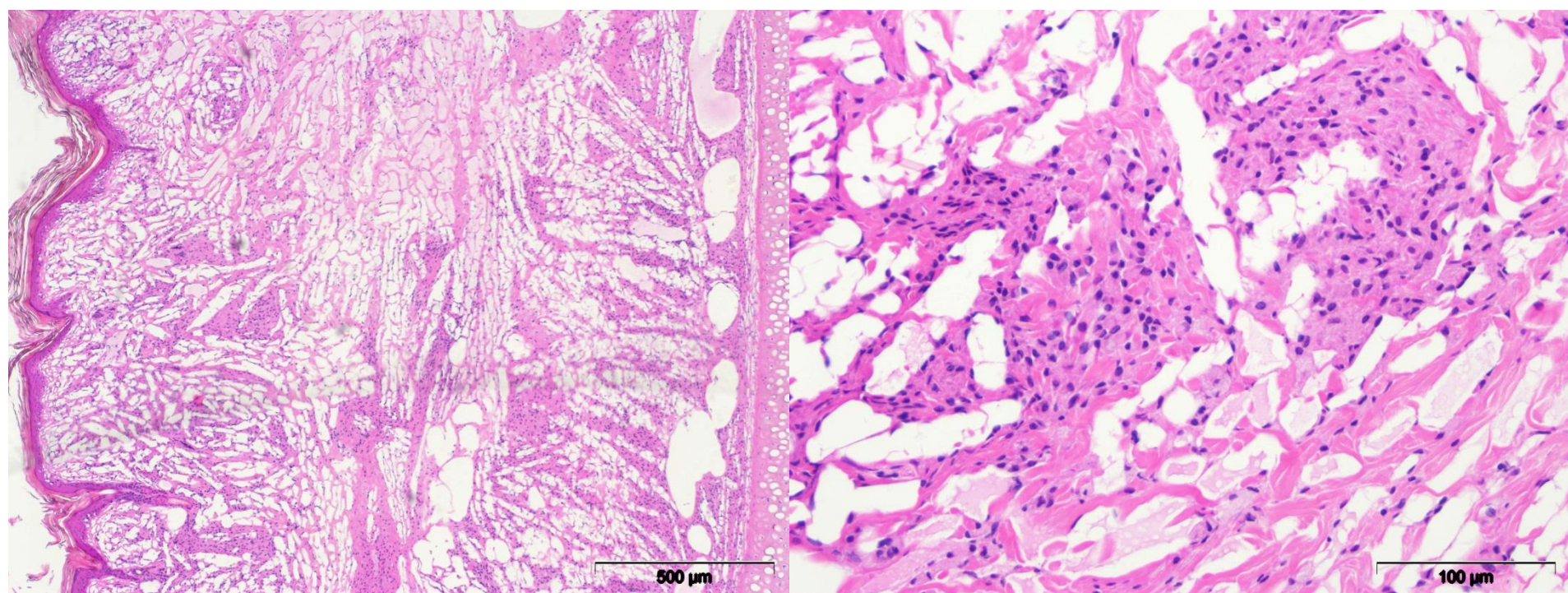




Histopathology - cases 4,5,6

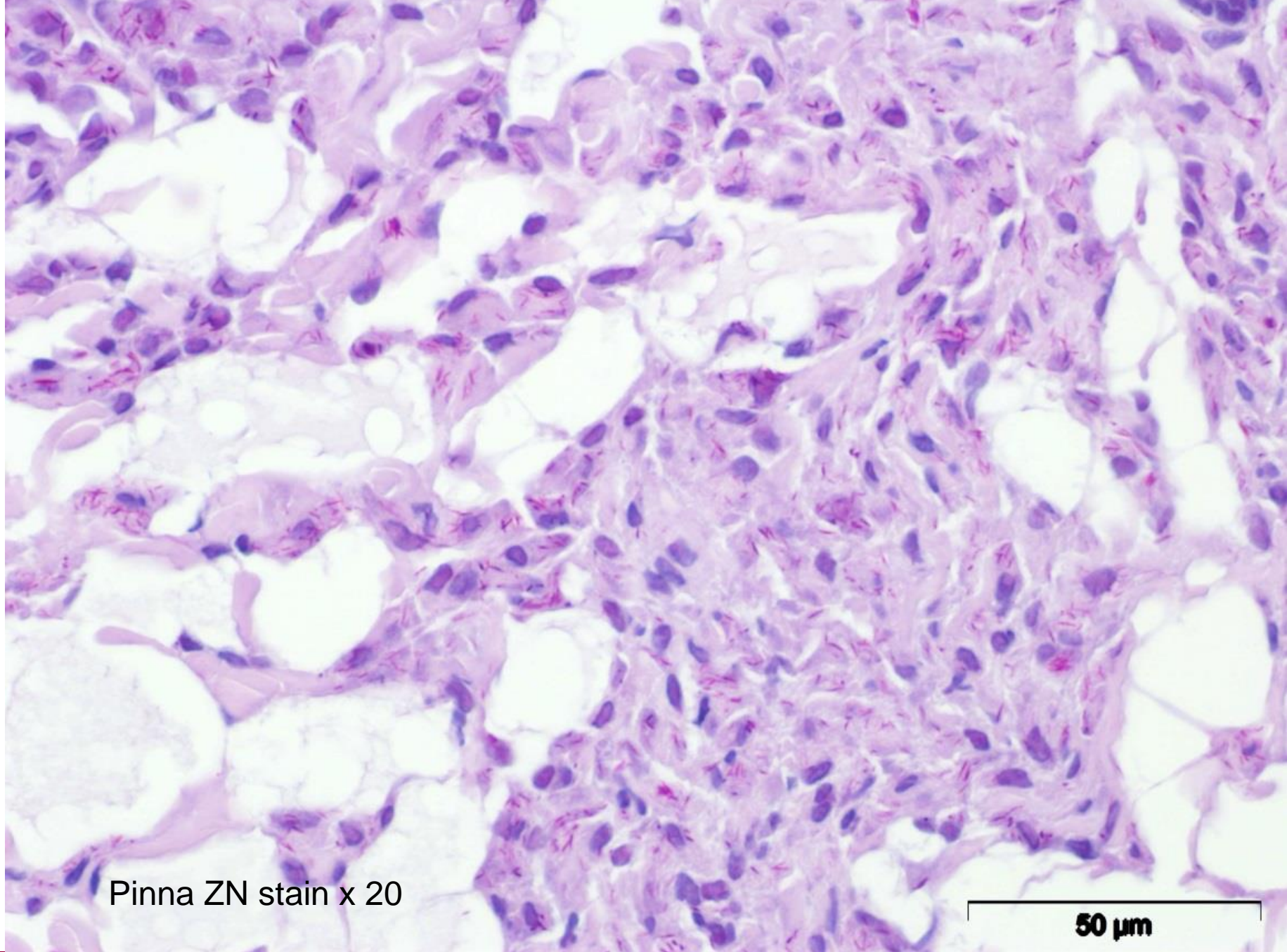
- Focally extensive granulomatous dermatitis
- Infiltration by epithelioid macrophages forming sheets (lepromatoid pattern); very rare formation of small clusters (granulomatous pattern)
- ZN staining: innumerable thin acid fast rods (AFB)
- In one case (5), also rare filamentous bacteria

Histopathology - Case 4



Pinna x 4 H&E

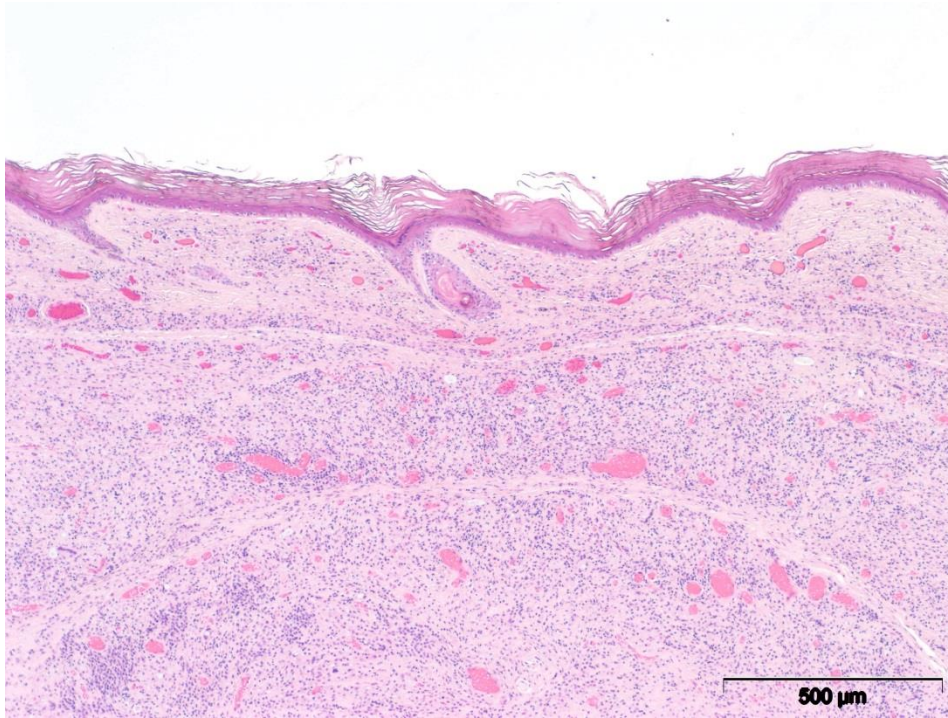
Pinna x 20 H&E



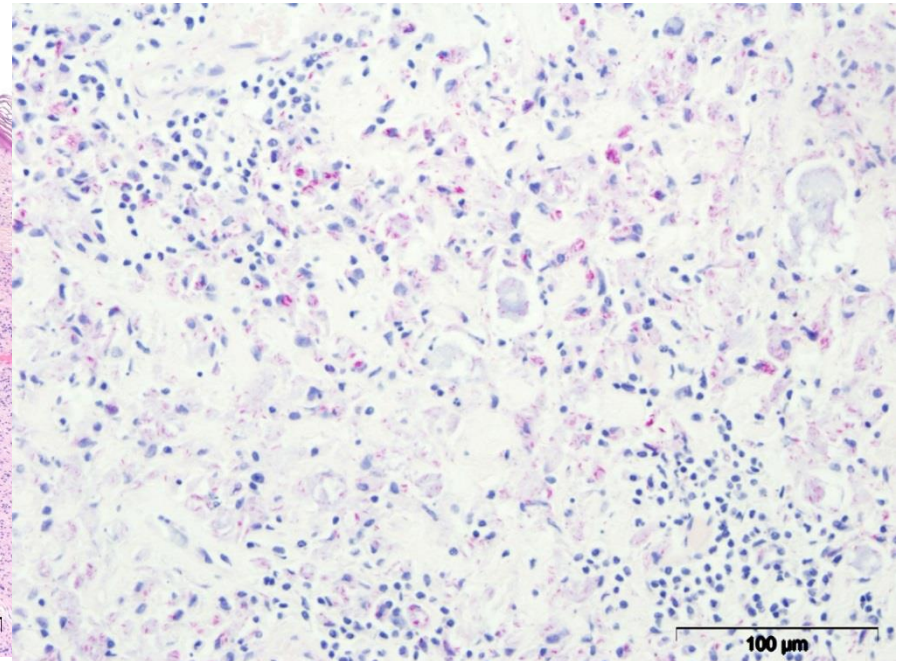
Pinna ZN stain x 20

50 μ m

Histopathology – Case 5

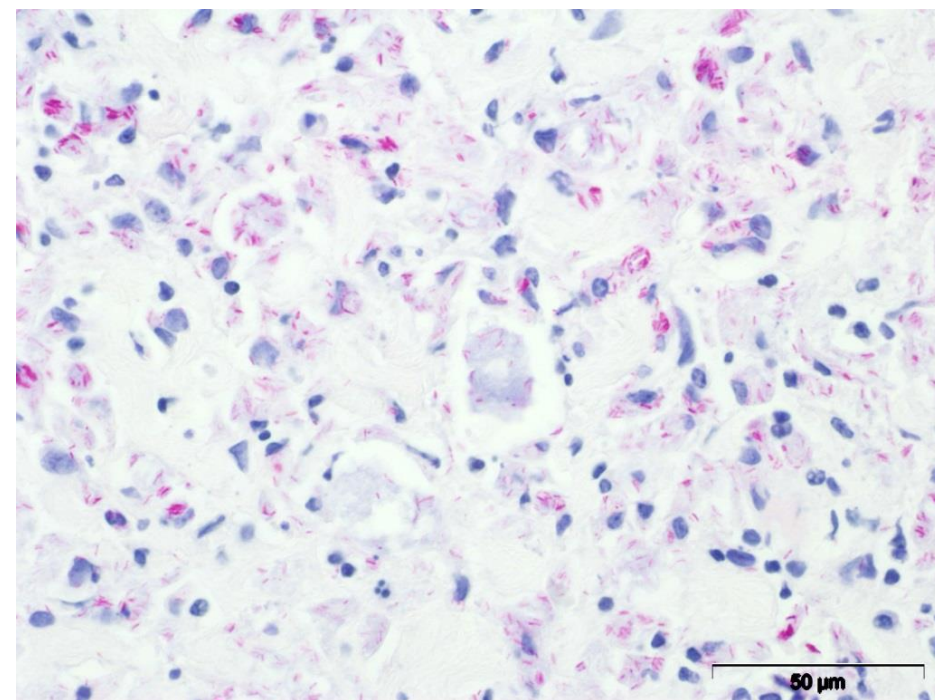


Leg x 4 H&E

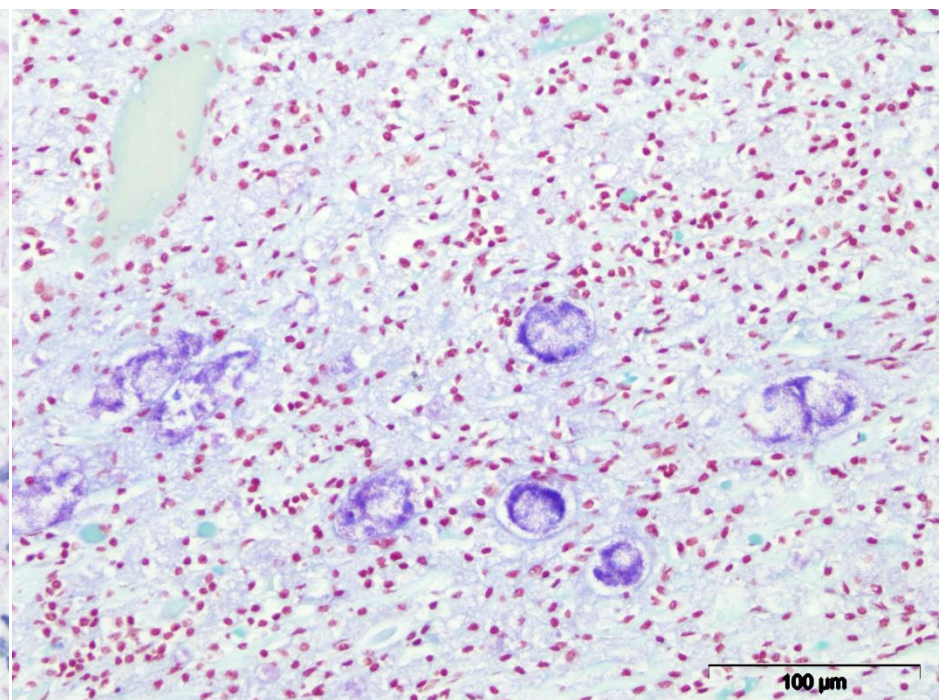


Leg x 20 ZN stain

Histopathology - Case 5



Pinna x 40 ZN



Pinna x 20. Gram

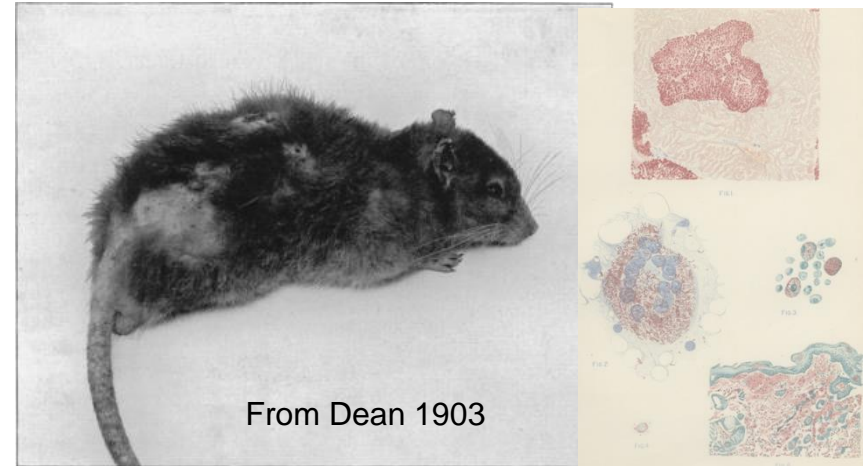
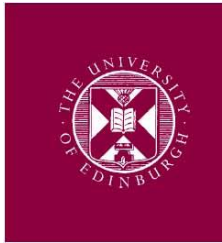


PCR analyses

- Fresh and fixed samples.
- All mycobacterial culture negative
- All IS901 negative (detects *M. avium avium*/*M. avium sylvaticum*)
- 2/3 IS900 negative (detects *M. avium paratuberculosis*)
- (Case 5 IS900 strong positive and F57 positive (MAP-specific), but culture negative)
- All heat shock protein 65 (Hsp65) positive
- Sequencing of Hsp65 PCR amplicons for cases 4 and 5 (BLAST®):
 - 99% sequence homology with *Mycobacterium lepromatosis* (FJ924)

Red Squirrel leprosy – a novel disease?

- *M. lepromatosis* described 2008 as another cause of human leprosy, in addition to *M. leprae*
- *M. lepraemurium* - 'murine/feline leprosy'
 - Murine leprosy first described 1902 in rats, Odessa, Ukraine; 1903 described in England
 - Use as model for human leprosy (*M. leprae*)
 - Non-zoonotic
- Benign (tuberculoid leprosy) or malignant disease (lepromatous leprosy), with a spectrum of intermediate stages
- Affects primarily skin and viscera, very rarely peripheral nerves.
- Do not grow on conventional mycobacterial media



From Dean 1903



Feline leprosy. Courtesy Natasha Mitchell

M.lepraemurium

- Natural mode of transmission in rodents not determined
- Lesions start in skin in areas most exposed to scratches and bites
- Possible respiratory transmission
- Experimental insect vector transmission not successful



M. lepromatosis

- US, Mexico, Caribbean, Singapore, Canada
- Diffuse lepromatous leprosy
- No reports in animals
- Not reported in UK

Patient with diffuse lepromatous leprosy, showing the characteristic madarosis and cutaneous lesions (left panel).

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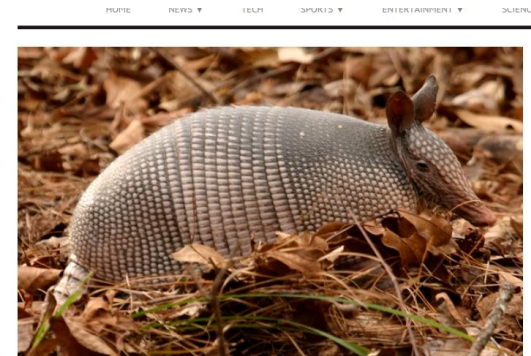


Vera-Cabrera L et al. J. Clin. Microbiol. 2011;49:4366-4368

Journal of Clinical Microbiology

Zoonotic implications?

- No cases confirmed of patients acquiring leprosy in England and Wales for 60 years.
- 167 cases "imported" from people who had lived in endemic countries, often in south Asia, reported between 2001 and 2013
Nearly 233,000 cases were reported globally in 2012
- *USA: M. leprae* from nine-banded armadillo



Florida Leprosy Outbreak Linked To Nine-Banded Armadillos

VICTOR JOHNSON on March 1, 2015 at 8:18 pm

Two of the three recently diagnosed with leprosy in Florida have been in contact with nine-banded armadillos, according to Volusia County health officials.

Armadillos, which are only found in the Western Hemisphere, are not naturally carriers of the disease, as they themselves were infected by European settlers who migrated to America.

The easily treatable disease can induce skin lesions and nerve damage if left untreated.

The *Daily Mail* reports roughly 95 percent of humans exhibit a natural immunity to the bacteria carried by the armadillos and that while there were roughly 250,000 cases worldwide in 2008, the



[Link to Publisher's site](#)

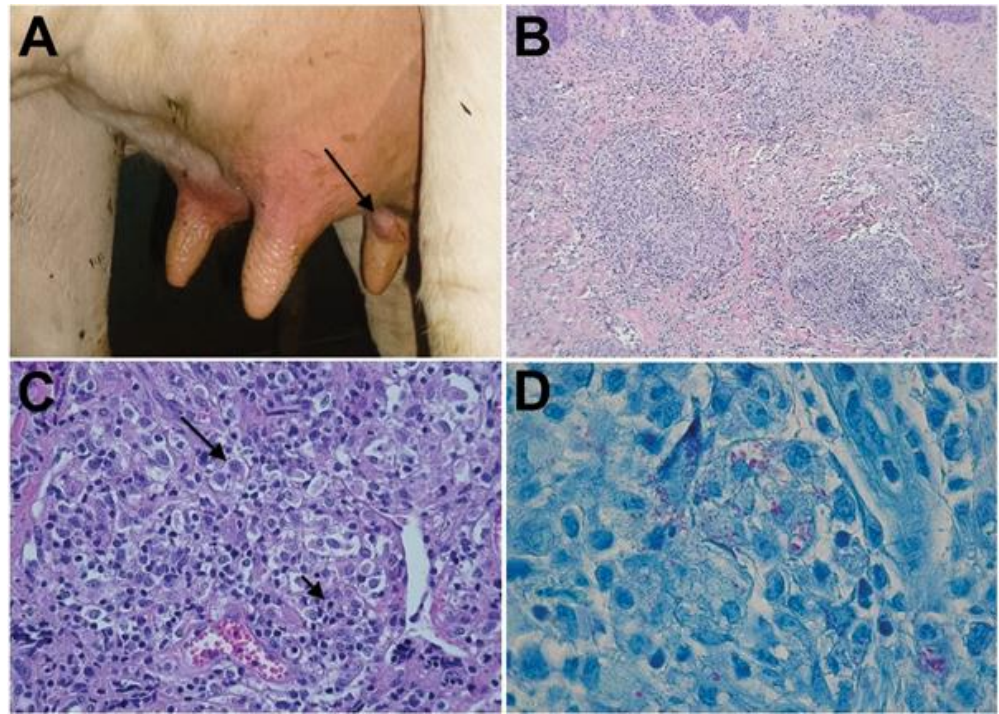
PMCID: PMC4257800

Emerg Infect Dis. 2014 Dec; 20(12): 2111–2114.

doi: [10.3201/eid2012.140184](https://doi.org/10.3201/eid2012.140184)

***Mycobacterium* Species Related to *M. leprae* and *M. lepromatosis* from Cows with Bovine Nodular Thelitis**

[Didier Pin](#), [Véronique Guérin-Faublée](#), [Virginie Garreau](#), [Franck Breyse](#), [Oana Dumitrescu](#), [Jean-Pierre Flandrois](#), and [Gerard Lina](#)





Early days - Next steps

- Working with WHO in Switzerland to characterise this apparently novel disease and confirm aetiological agent
- Sequencing of squirrel *M. lepromatosis* genome
- Numerous further sightings and photographic records
- Further case identified in Mersyside – *M. lepromatosis* and *M. avium* - skin and lung
- Rangers and NGOs aware and encouraged to send further cases
- Epidemiological studies

Acknowledgements

- Jorge Del Pozo, Elspeth Milne, Sionagh Smith
- Karen Stevenson and Joyce McLuckie, Moredun Research Institute



- Dr Darren Shaw - map
- Scottish Natural Heritage
- Saving Scotland's Red Squirrels project
- Members of the public



Courtesy Peter Lurz