



Animal &
Plant Health
Agency

Tick-borne diseases of extensive cattle and sheep

Paul Phipps

Wildlife Zoonoses and Vector
Borne Disease Research Group

APHA

Ticks as disease vectors



Phylum: Arthropoda, Class: Arachnida, Order: Parasitiformes

Three families: Argasidae (Soft ticks), **Ixodidae (Hard ticks)**, Nuttallidae (1 sp)

3 genera (*Ixodes*, *Haemaphysalis*, *Dermacentor*) described from UK

- Ticks may feed on multiple hosts during their life cycle
- Ticks secrete salivary fluid on attachment which is proteolytic, immunomodulatory.
- Tick borne pathogens transmitted in salivary fluid during feeding

Diseases transmitted to animals in UK

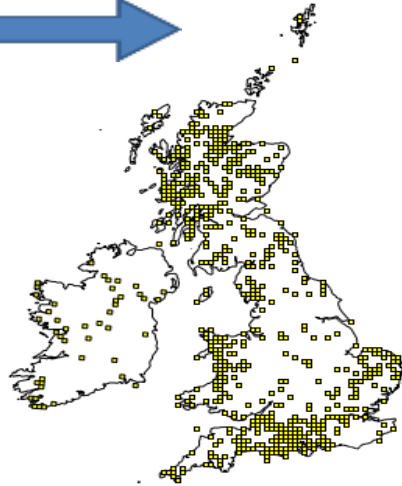
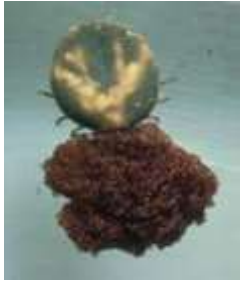
- Protozoa - babesiosis, theileriosis,
- Bacteria – Tick borne fever, Lyme borreliosis.
- Virus - Louping Ill



Ixodes ricinus (sheep, deer, castor bean tick)

Life cycle

Egg. (Ca 2000 per clutch)



Larva. Small and large mammals and birds



Nymph. Small, large mammals and birds



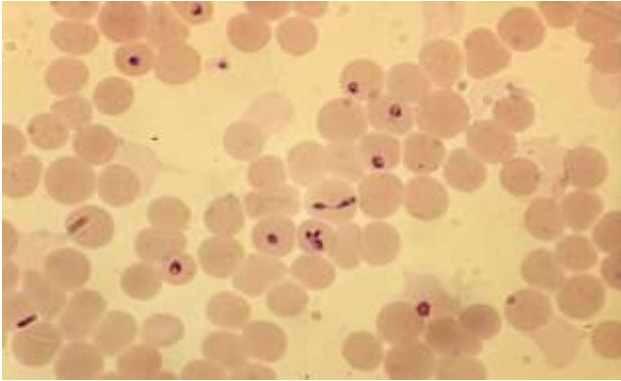
Adult. Large mammals

- All feeding stages hatch in late summer/autumn
- Host seeking peaks in spring and late summer/autumn
- Ticks unable to find host in Autumn seek host in following spring
- Ca 3 years to complete life cycle (only 20 days feeding on host)
- *I. ricinus* requires rH ca 90% to survive off host.

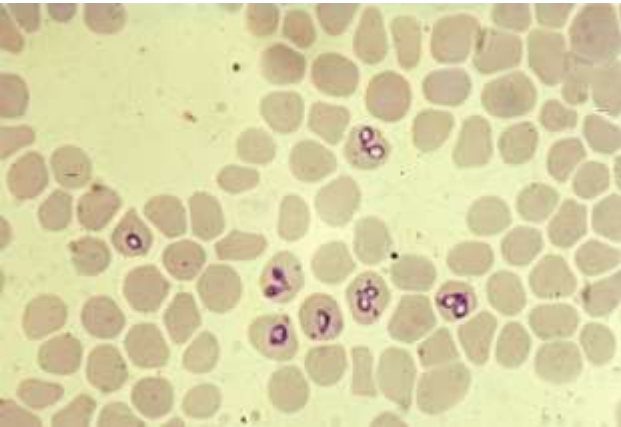


Babesia sp. infecting cattle in UK

B. divergens (Redwater Fever)



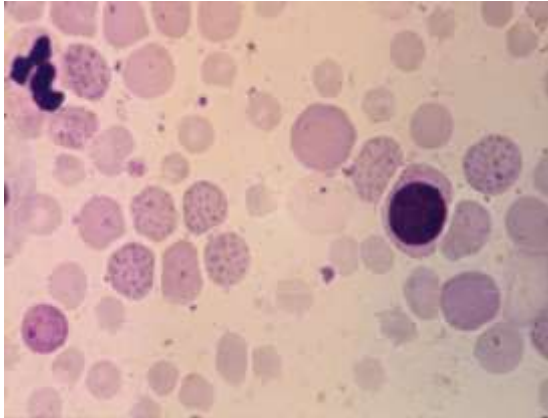
B. major (non pathogenic ??)



- Intra-erythrocytic protozoan parasite
 - *B. divergens* transmitted by *I. ricinus*
 - *B. major* transmitted by *Haemaphysalis punctata*.
 - Infection picked up by feeding female tick – transovarial transmission to larva via egg then transtadially to nymph and adult
 - Infection via sporozoites in the salivary fluid of feeding tick
-

Signs and symptoms of clinical babesiosis

Haemolytic anaemia following *B. divergens* infection



- Increased temperature (>40C)
- Pipe stem diarrhoea may be followed by constipation
- Hammer pulse (visually evident)
- Respiratory distress
- Haemoglobinuria (port wine red urine due rupture of the rbc's)
- Anaemia
- Abortion in pregnant cows
- Death (although rare in UK cattle)
- Premunity following recovery (carrier state)

Endemic Stability = Low level of disease

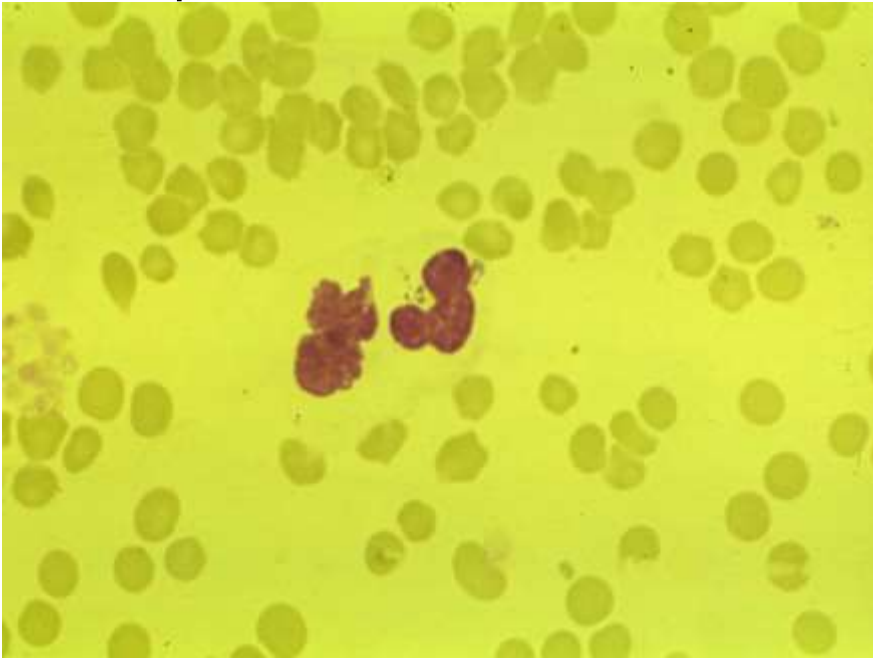
Calves below 6months resistant to disease

Colostrum Ab from carrier dams

Continued tick challenge

Tick borne fever: *Anaplasma phagocytophilum*

A. phagocytophilum in bovine neutrophil



- Transmitted by *I. ricinus*, in UK.
 - Symptoms include high fever >40C, severe loss in milk production
 - Infects neutrophils, eosinophils and later monocytes.
 - Immunosuppressive - may lead to Tick pyaemia, pasteurellosis, septicaemic listeriosis, louping ill.
 - Abortion storms in naive animals.
-

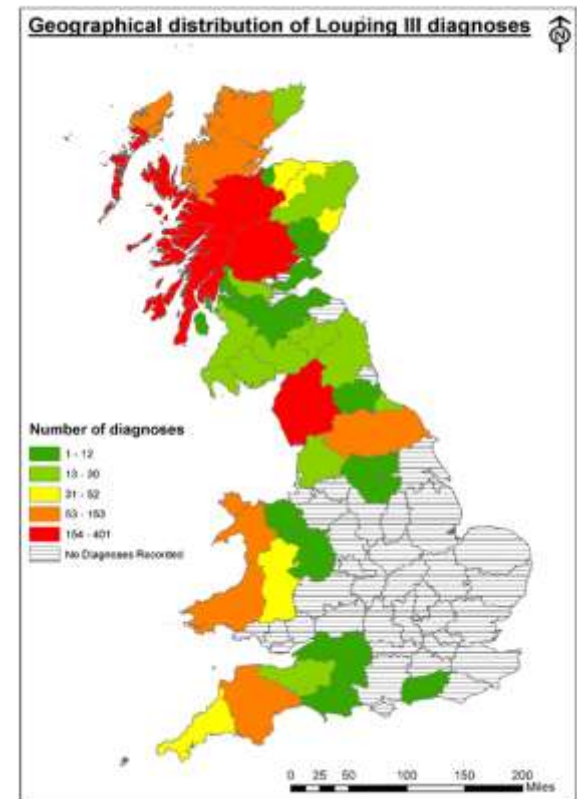
Louping Ill

A Flavivirus,
Limited geographical distribution
Causes acute encephalomyelitis in sheep
Vaccine available for veterinary use
Other domestic animals and wildlife affected
Transmitted by *Ixodes ricinus* ticks



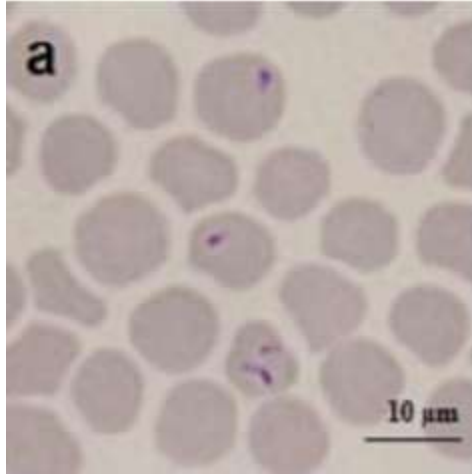
Louping ill in the UK (2007)

Species	Number of cases
Sheep (<i>Ovis aries</i>)	31
Cattle (<i>Bos taurus</i>)	12
Red grouse (<i>Lagopus lagopus scoticus</i>)	67
Hare (<i>Lepus timidus</i>)	17



Theileriosis of cattle and sheep

Ovine *Theileria* sp in sheep rbc



- Transmitted by *Haemaphysalis punctata* ticks (Coastal habitats in South East and West Wales)

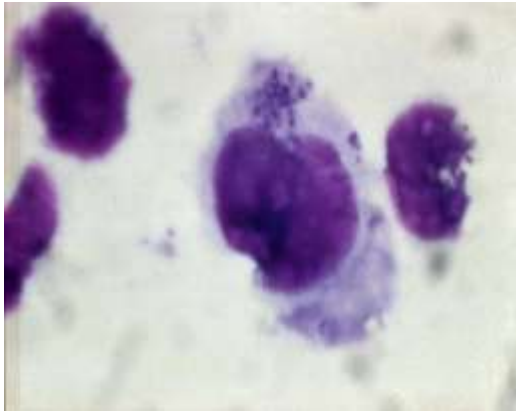
Cattle

- *T. mutans* described by Brocklesby et al 1972 . Low pathogenicity.

Sheep

- *T. ovis* – Lewis & Purnell 1981 (Ogmore, South Wales)
- *T. recondita* – Alani and Herbert 1988 (Lleyn peninsular, North wales)
- Low pathogenicity

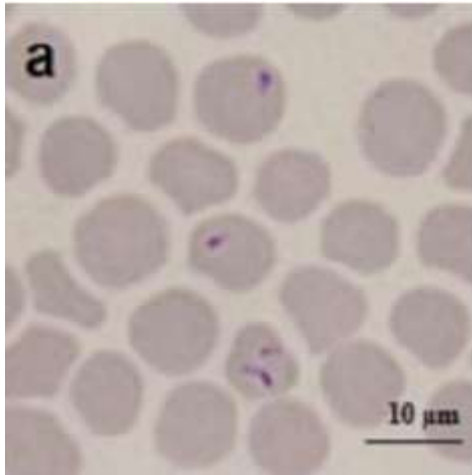
Theileria sp schizont in lymphocyte



However.....

Ovine theileriosis UK

Phipps et al. (2016) **Detection of *Theileria luwenshuni* in sheep from Great Britain. Parasites & Vectors 9:203**



- April **2005** mortality associated with heavy infestations of *H. punctata*.
- 60 ewes and their lambs grazing north Kent marshland **25 deaths**.
- PM revealed: Oedema of lips, tongue, lungs, froth in trachea. Spleen enlarged, kidneys pale, anaemia.
- Anaplasmodin inclusions in Giemsa stained blood smears
- **No disease reported since**

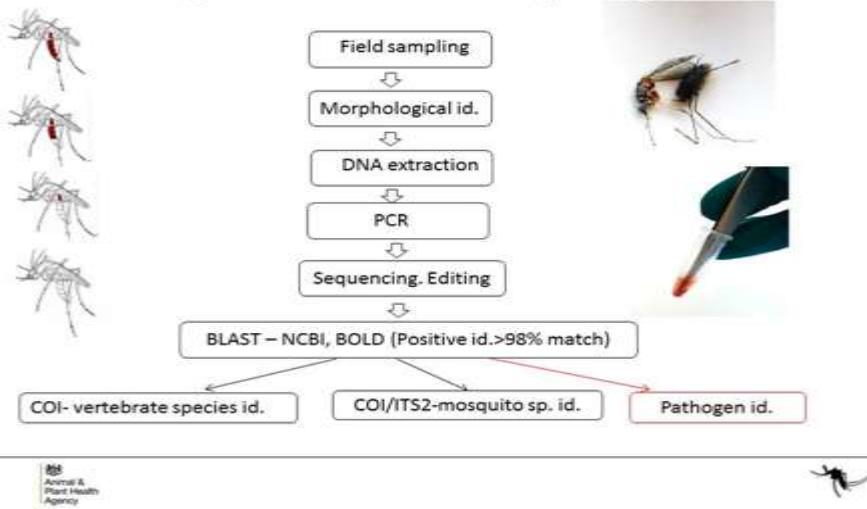


2012

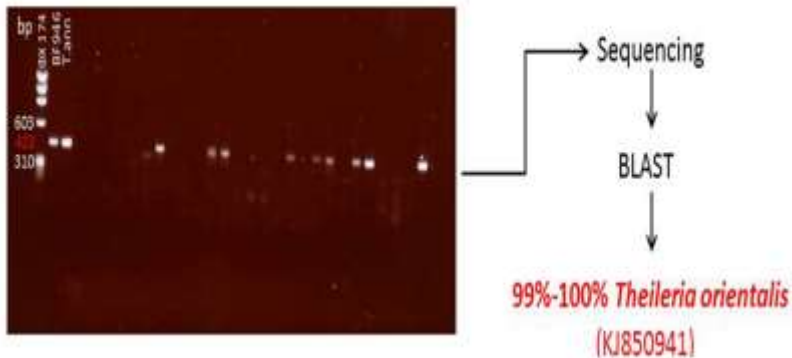
- 21 blood samples collected from sheep grazing same pastures
 - 16/21 positive by pan-piroplasm PCR, sequencing revealed *T. luwenshuni*.
 - Same parasite reported as pathogenic in China and transmitted by *Haemaphysalis* sp. (Yin et al 2007)
 - Is this *T. ovis/T recondita* previously reported in the 1980s ?
-

Bovine theileriosis UK

Mosquito blood meal analysis - protocol



Pan-Piroplasm Real-Time PCR



- Brugman et al (2015) Parasites and Vectors, 8(421), 1-8
Molecular species detection, host preferences and detection of Myxoma virus in the *Anopheles maculopennis* complex in Southern England.
- Xenodiagnosis of viral disease in mosquitoes collected from Elmleigh Marshes, Isle of Sheppey.
- Blood meal analysis showed that *A. atroparvus* and *C. annulata* (mosquitoes) both fed on cattle
- *Theileria orientalis* detected by pan-iroplasm PCR and sequencing – a strain of the organism currently causing well publicised disease outbreaks in NZ and Australia
- Is this the *T. mutans* described by Brockelsby et al in 1972?

Thank you for your attention!

Paul Phipps,
Wildlife Zoonoses and
Vector Borne Disease
Research Group,
Virology Dept
APHA.
