



Public Health
England

Ticks, mammals and birds

- Ecology of ticks & *B. burgdorferi*

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Overview of presentation



Ticks

- Introduction to the British tick fauna
- Focus on *Ixodes ricinus* – the sheep/deer tick
- Tick surveillance at a **national** scale
- Tick mapping at a **landscape** scale – national parks/AONBs
- Tick mapping at a **habitat** scale – impact of woodland management
- Tick mapping in **urban** areas

Mammals & birds

- Understanding the **ecology of Lyme** borrelia in ticks and role of wildlife



The British tick fauna

22 species recorded

19 Hard ticks (Ixodid)

- 15 *Ixodes* species
- *Dermacentor reticulatus*
- *Haemaphysalis punctata*
- *Hyalomma marginatum* – (imported by migrant birds)
- *Rhipicephalus sanguineus* (imported by pets, not native)

3 Soft ticks (Argasid)

- 2 *Argas/Carios*
- 1 *Ornithodoros* – rarely imported on seabirds

Ixodes ricinus



Dermacentor reticulatus



Carios vespertilionis





Hard ticks (Ixodid ticks)

- Live **outdoors**, some are **nidicolous** (i.e. nest-dwelling); **arduous** lifestyle, require a **chance** meeting with animals.
- Once attached, they **engorge slowly**, **dispersed** by their hosts long distances on **migratory birds**
- Spend most of their time '**questing**' for blood hosts and **attached to their hosts** - high mortality rates due to host grooming, predation and environmental factors
- **Hard sclerotised plate** (scutum), forward-projecting **capitulum**.
- Except in male, all stages have a small scutum to allow them to **engorge**
- In the male the scutum completely covers its body. It does not engorge. It has **armoured plates**, to retain moisture levels.





Ixodes – specialist parasites of wildlife

7 species are principally bird ticks:

Ixodes arboricola

Tree-hole nesting birds



Ixodes caledonicus

Cliff nesting birds



Ixodes frontalis

Passerine birds



Ixodes lividus

Sand martins



Ixodes rothschildi

Burrow nesting birds



Ixodes unicavatus

Coastal birds



Ixodes uriae

Cliff colony birds





Ixodes – specialist parasites of wildlife

6 species are principally mammal ticks:

Ixodes acuminatus
Small mammals



Ixodes apronophorus
Wetland mammals



Ixodes canisuga
Fox tick



Ixodes ventraloi
Rabbit tick



Ixodes trianguliceps
Burrowing small mammals



Ixodes vespertilionis
Horseshoe bats





Ixodes – parasites of humans

2 species are mammal ticks but do bite humans:

Ixodes ricinus

Deer/Sheep/Pasture/Caster bean tick

Ixodes hexagonus
Hedgehog tick



Humans are occasional hosts



Humans are frequent hosts



Hedgehog tick, *Ixodes hexagonus*

Population shifts

Morfa Harlech

Dermacentor reticulatus

Unusual & Imported ticks

Importation of non-native ticks & EU policy

Rhipicephalus sanguineus



Hyalomma marginatum



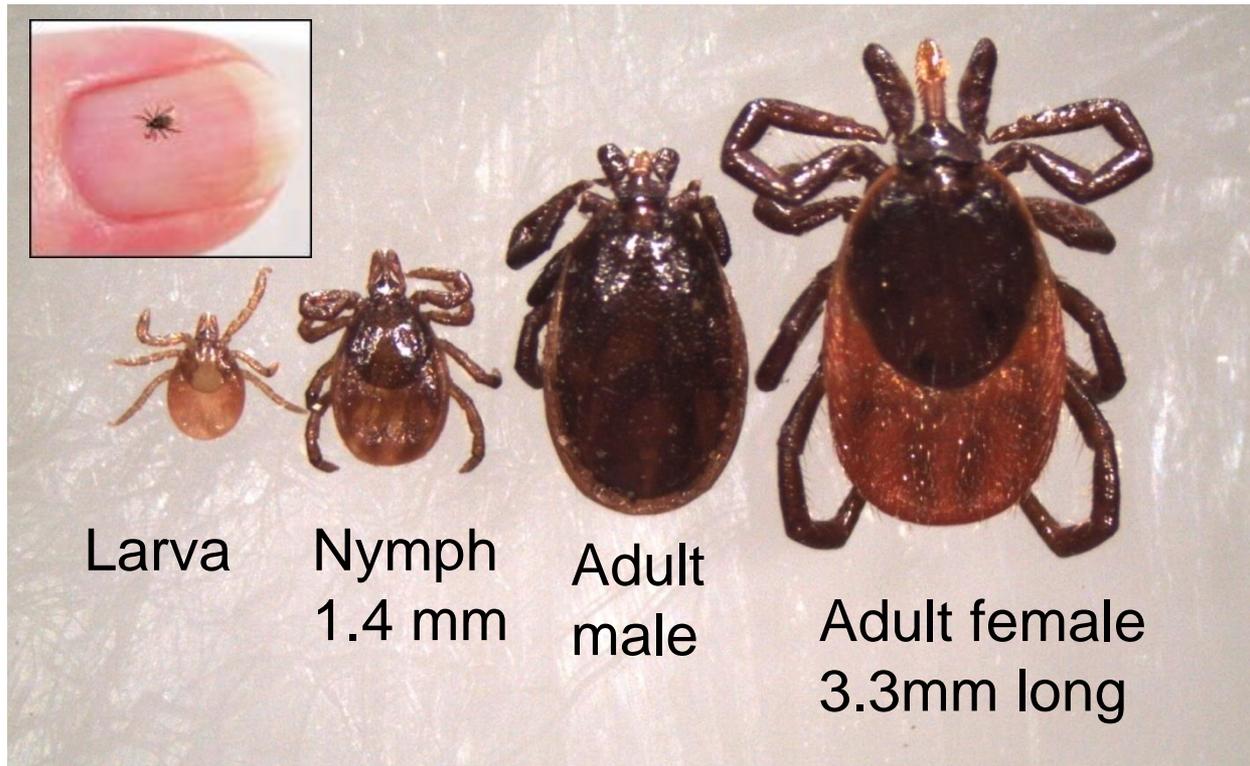
Monitoring for ticks on migratory birds

970 birds sampled, 7% infested, 21% *Hyalomma marginatum*

Wheatear, whitethroat, Sedge warbler, Redstart



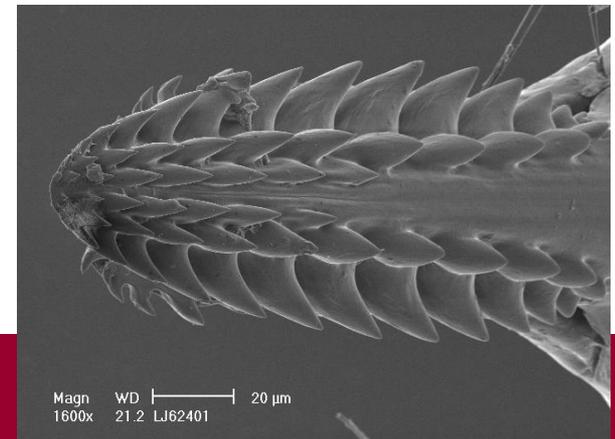
Ixodes ricinus (Deer/sheep tick)



Larva – 3 pairs of legs

Male – scutum covers entire body

Nymph and Female are similar – female much larger
with genital aperture and porose area





Nationwide tick surveillance



2013 data so far
(~640 submissions)

~8000 ticks since 2005 from TRS
Public, GPs, Vets, Wildlife charities
Further 10,000 ticks from field studies



Advice to public on tick bites
Advice on managing ticks in gardens
Tick awareness material
Tick identification to public, GPs and Vets



Raising public awareness of ticks



Ticks and your health | Information about tick bite risks and prevention

This factsheet provides important health advice and some basic precautions you can take to make sure you and your family avoid tick bites. Not all tick bites result in disease, but it is important you know how to effectively prevent tick bites and what to do if you do get bitten.

What are ticks and where can you find them?

Ticks are small, spider-like creatures that feed on the blood of animals, including people. Depending on its development stage, the size of a tick varies. Nymphs are about the size of a poppy seed, while adult ticks look more like tiny spiders.

Ticks can survive in many places, but prefer moist areas with dense vegetation or long grass. The species most commonly found on people is *Ixodes ricinus*, more commonly known as the sheep or deer tick. They are usually found in woodlands, grassland, moorland, heathland and some urban parks and gardens.

How do you come into contact with ticks?

Ticks don't jump or fly, but wait until an animal or person brushes past to climb on. They then bite to attach to the skin and start to feed on the blood. It may take several days to complete their blood meal, before they drop off. Ticks can be found throughout the year, but are most active between spring and autumn.

Main health risks

Ticks can transmit bacteria that cause diseases such as Lyme disease, which can lead to very serious conditions if left untreated. Symptoms of Lyme disease can include a circular rash, fatigue, and muscle and joint pain.

More serious conditions such as viral-like meningitis, facial palsy, nerve damage and arthritis can develop without treatment, so prevention and early detection are crucial. Lyme disease can be treated with a course of antibiotics.



A tick's size can vary, depending on its development stage, gender, species and whether it has fed recently.

Public Health England (PHE) is a new health organisation that includes the remit previously held by the Health Protection Agency. For more details, visit www.hpa.org.uk/Ticks

Ticks and your health | Information about tick bite risks and prevention

Perform a tick check

Make it a habit to check your clothes and your body regularly for ticks when you're outdoors, and again when you get home. Tick bites may not hurt and you don't always notice you've been bitten, so make sure you thoroughly check yourself, your children and your pets.

Ticks prefer warm, moist places on your body, especially the groin area, waist, arm pits, behind the knee and along hair lines, so look out for anything as tiny as a freckle or a speck of dirt. Take simple steps to avoid coming into contact with ticks, such as walking on clearly defined paths, avoiding dense vegetation and wearing light-coloured clothing so ticks are easier to spot and brush off. You can also use repellents such as DEET.

Help us record ticks

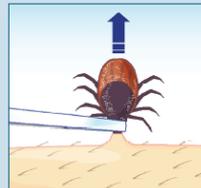
PHE monitors changes in tick distributions and investigates the drivers for change. Help us monitor ticks by participating in our nationwide surveillance via the Tick Recording Scheme (TRS). You can send in any ticks you come across, which helps us to update our knowledge of British tick species, their spread across the country and detect unusual species.

Visit our website for more information on how to take part and download a recording form to post with your specimens. For more information on British ticks or the TRS, please visit our website or email tick@phe.gov.uk

If you have been bitten

Being tick aware by knowing what ticks look like, where they can be found, and practicing prevention behaviours will help you to avoid tick bites. However, if you do get bitten, removing the tick quickly and correctly can help to reduce any potential risk.

- Remove the tick as soon as possible.
- The only safe way to remove a tick is to use a pair of fine-tipped tweezers, or a tick removal tool.
- Grasp the tick as close to the skin as possible. Pull upwards slowly and firmly, as mouthparts left in the skin can cause a local infection.
- Once removed, apply antiseptic to the bite area and keep an eye on it for several weeks for any changes.
- Contact your GP if you begin to feel unwell and remember to tell them you were bitten by a tick.



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Health Explained: What is Lyme disease?



24 May 2011 Last updated at 23:32

Lyme disease is a bacterial infection transmitted by tick bites. The ticks themselves have to be infected with the bacteria in order to pass it on, and most bites do not result in the condition, but the UK sees around 3,000 cases a year and the number is on the rise.

Jolyon Medlock runs the Health Protection Agency's tick surveillance and research project from the HPA's Porton Down laboratory. His unit has built up a collection of around 10,000 specimens collected from all over the UK.

They encourage members of the public to send in any ticks they find on themselves or pets after they have been out in the countryside. This information is helping to build up a better picture of the current distribution of ticks and where they may be expanding their range.

Jolyon Medlock explained to BBC News what Lyme disease is and what symptoms to look out for. He describes how people catch it from ticks, what can be done to prevent getting bitten and how to safely remove a tick.

Advanced search



015 A-Z > Ticks > General information > Film about tick awareness

Film about tick awareness

Find out more about what you can do to avoid getting bitten by ticks, and what to do when you have by watching this video. It gives a brief overview on how to spot ticks, how to remove them, and how to send in any ticks to the recording scheme.

Senior tick scientist at the Health Protection Agency, Maaike Pietzsch, explains how to avoid being bitten by ticks. Some ticks can pass on the bacteria that causes Lyme disease. This video shows what to do if you have been bitten by a tick and how to remove them.



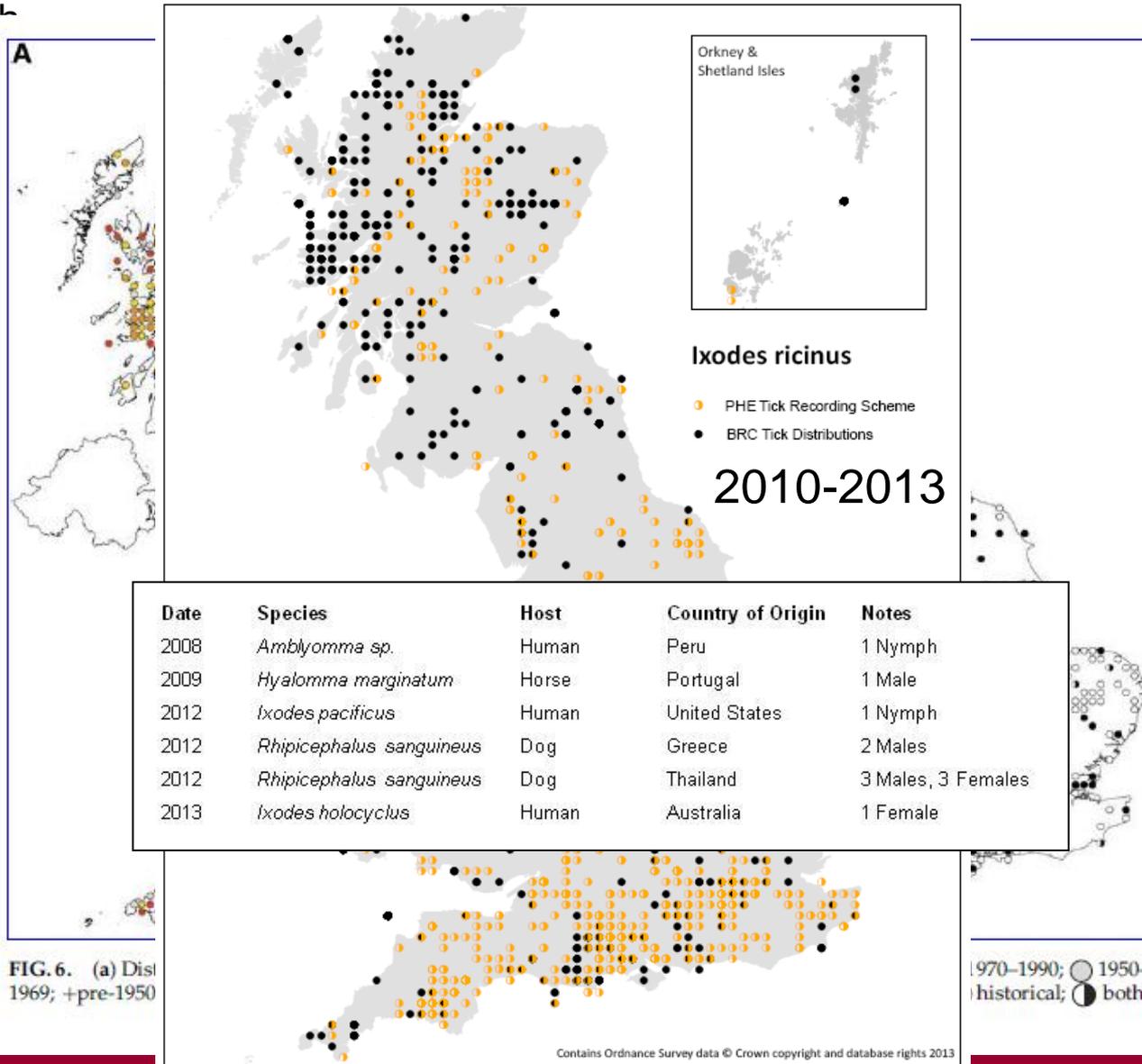
Ticks (Quicktime Movie, 48.6 MB) This format requires the Quicktime player. Download the Quicktime player.

Ticks (Windows Media Video, 48.4 MB)

Transcript

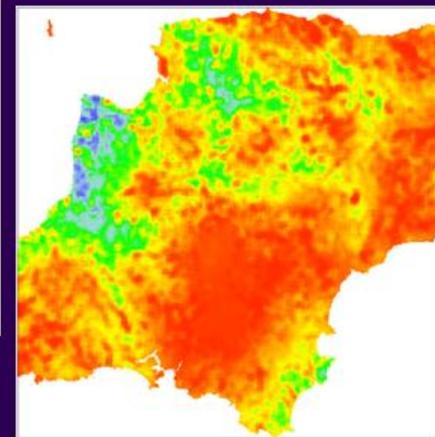
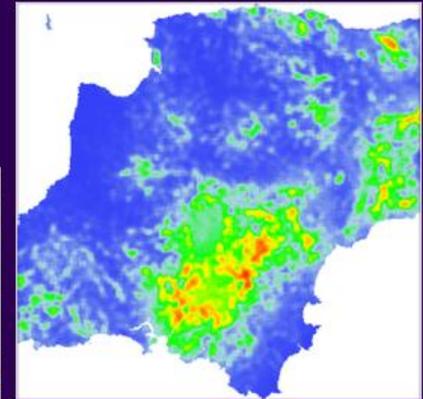
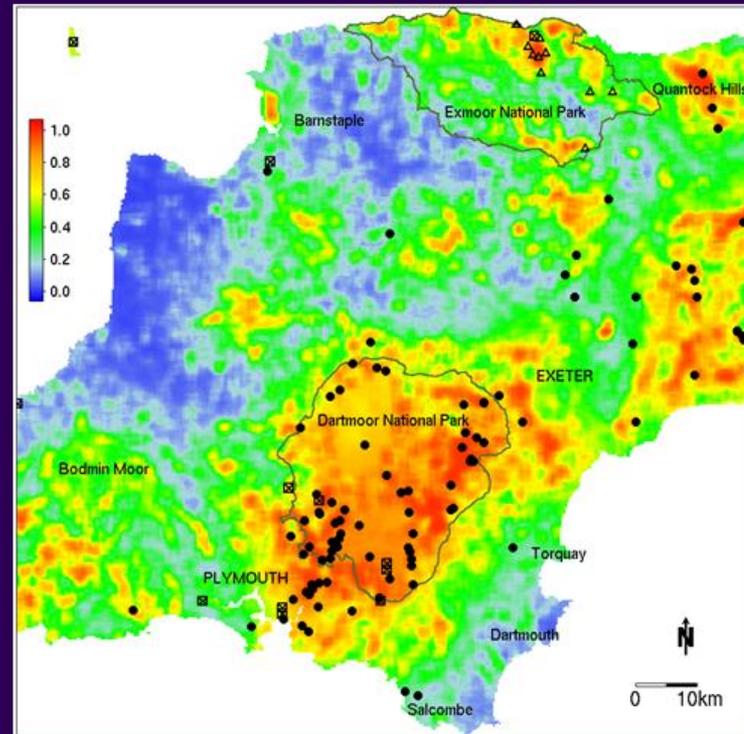
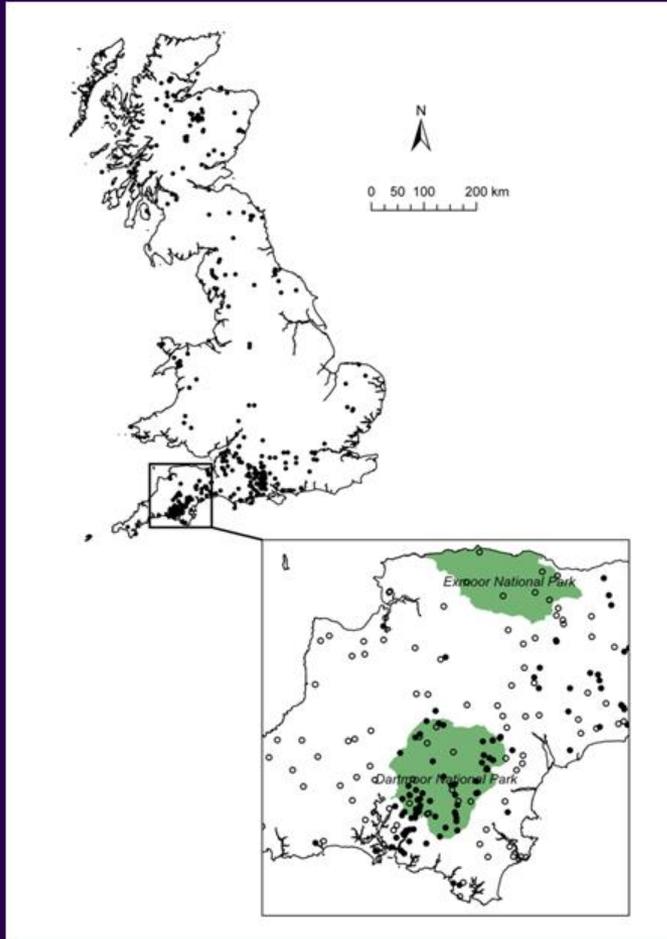


Ixodes ricinus distribution





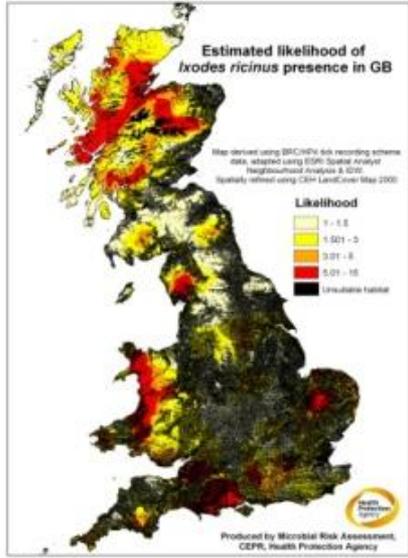
Nationwide geo-spatial mapping



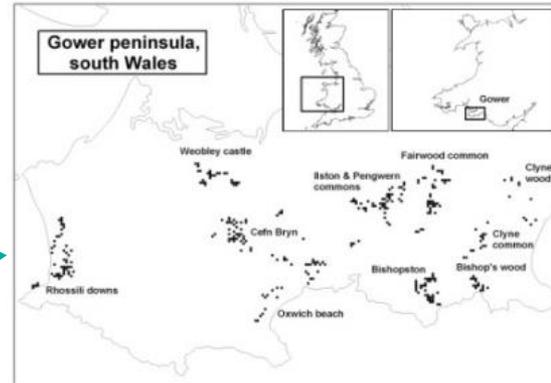


Public Health England

Mapping *Ixodes ricinus* at a landscape scale, e.g. national park / AONB



Mapping ticks in an AONB/National Park



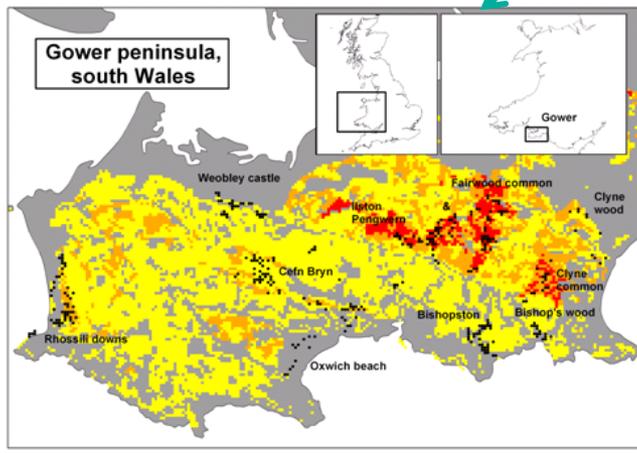
Eco/environ variables



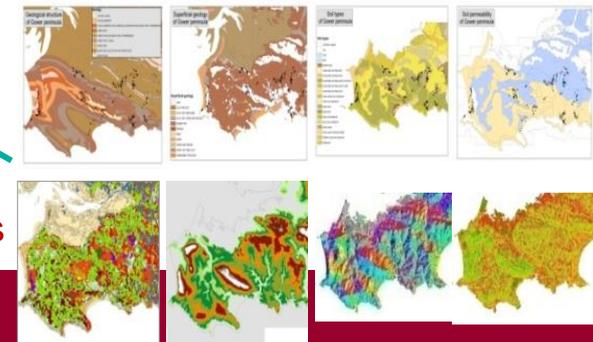
Predictor variables (landscape)

- W, SW, SE and E aspects
- Calcareous & neutral grassland; heathland
- Impermeable soils
- Impermeable bedrock & superficial geologies
- Presence of cattle & sheep grazing
- Reduced slope
- High soil moisture
- Lower midday temperatures

Refining risk



Identifying risk factors





Mapping *Ixodes ricinus* at a habitat scale - implications for woodland management

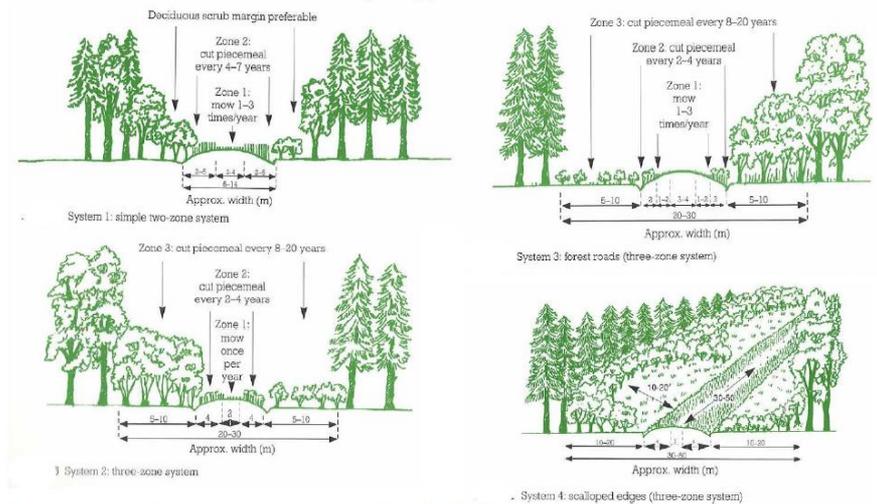
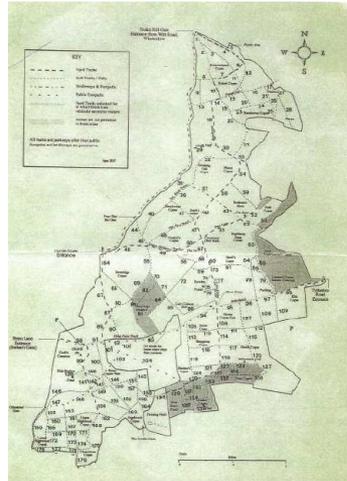


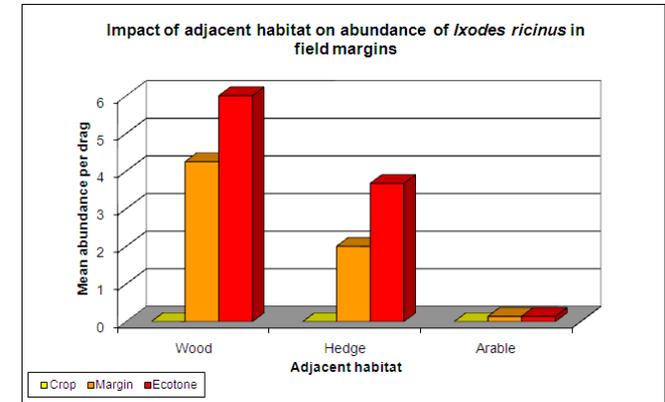
Figure 2: Schematic depiction of ride management strategies (after Warren & Fuller, 1993)

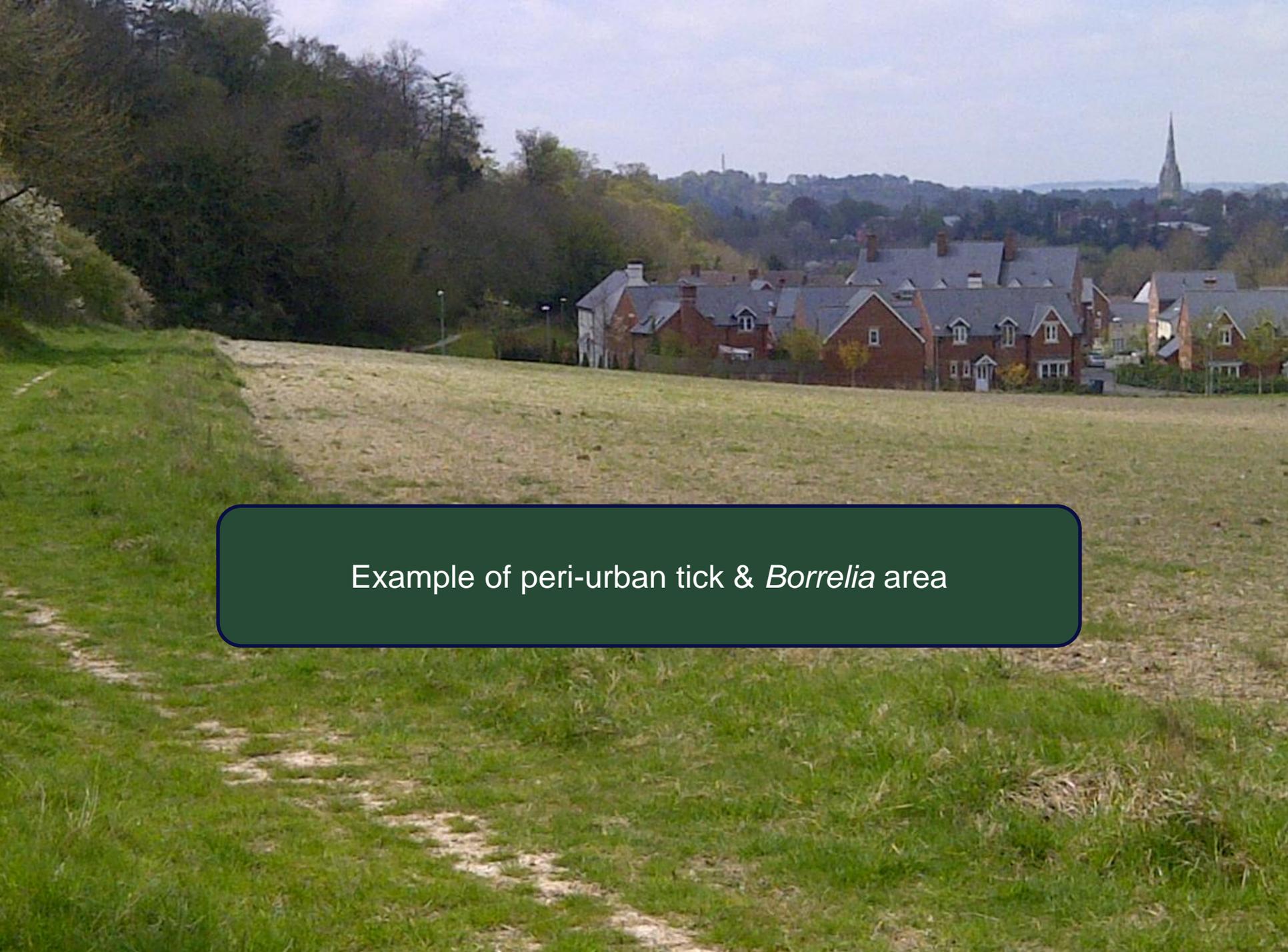


1. Management that promotes sunny south-facing rides promote nymph activity
2. Additional ride management is recommended in these locations
3. Regular mowing (and raking) of 1m path-side strip in spring should:
 - a. Keep nymph activity down
 - b. Reduce public exposure
 - c. Benefit rare herb growth and bare-soil invertebrates
4. Mat/mulch management – raking/stacking of leaf litter
 - a. Limits survival of ticks
 - b. Promotes biodiversity – reptiles, herbs, invertebrates
5. Scalloped edges in bramble areas
6. Spot treatment with bracken herbicide in hot-spots



Impact of habitat corridors on *Ixodes ricinus* - the role of field margins as habitats for ticks



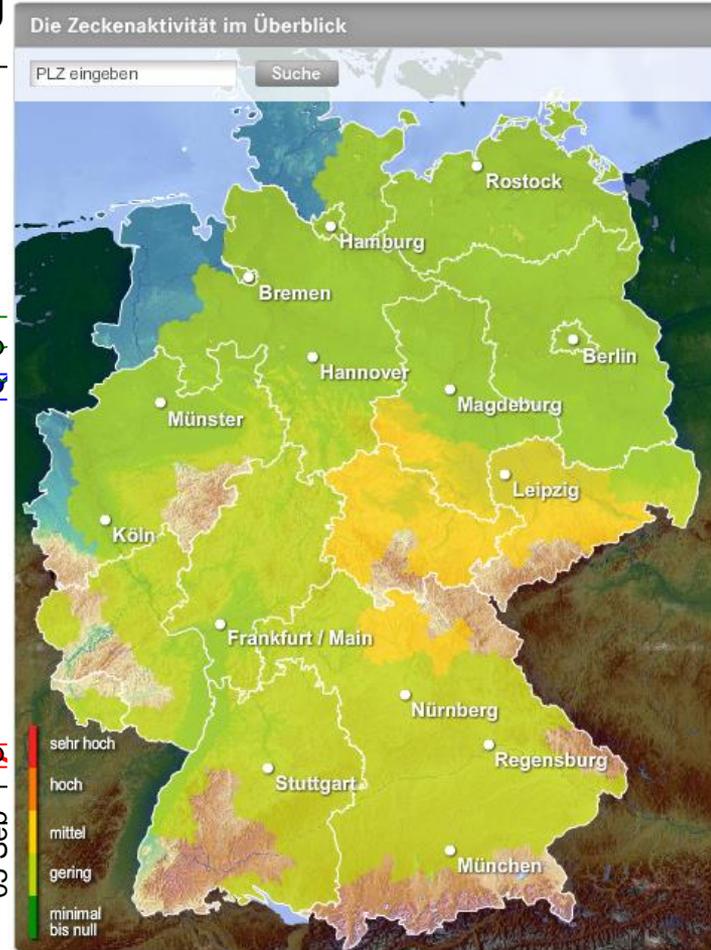
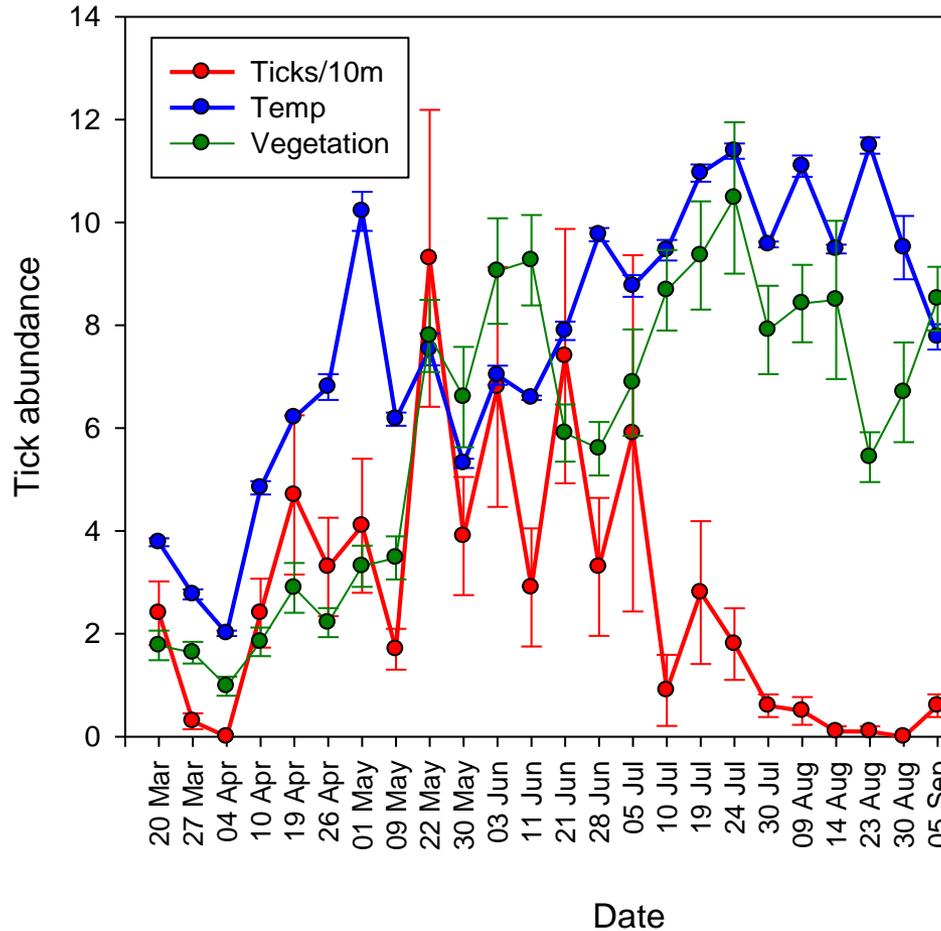


Example of peri-urban tick & *Borrelia* area



Early warning of increased tick activity

Tick activity for seasonal forecasting



Lyme borreliosis Transmission cycle

Large mammals:

- Deer species
- Sheep



Not generally involved in transmission cycles; localised transmission through co-feeding in sheep reported; both important tick hosts

Blood host

ADULT FEMALE

Feed



Trans-stadial

Source of infection,
More conspicuous
Low no. lower risk



Woodland

- *T. m.*
- *E. r.*
- *P. c.*



Medicinal

- *Sc. a.*
- *Le. e.*



S



- *S. arvensis*
- *M. agrestis*

What ecological factors are driving high *Borrelia* prevalence rates in ticks?

- Deer numbers
- Habitat
- Game bird releases
- Seasonality
- Urban v rural

HUMAN

probability
infection

diversity of
stages
non-prevalence rates
- Seasonal behaviour
of humans, hence exposure



- Host seasonal dynamics
- Seasonal changes in tick infestation rates
- Seasonal changes in tick infection rates
- Differences in *Borrelia* genospecies cycles

Trans-ovarial transmission very low: <2%



Role of small mammals at *I. ricinus* hosts

- Wood mouse (*Apodemus sylvaticus*) most important rodent host of larvae in UK (Dorset)
 - Peak infestation in August
 - Support 120/larvae/hectare/day
 - Higher than Bank vole (Dorset: 30/larvae/ha/day)
 - Similar reports across Europe
- Bank vole (*Myodes glareolus*) develops resistance to tick bites
 - Reduced rates of engorgement
 - Reduced moulting rates
 - Wood mice support higher tick fecundity
- Yellow-necked mouse (*Ap. flavicollis*) – No UK studies, but similar data in Europe to WM
- Black striped mouse (*Ap. agrarius*) most important rodent host in continental Europe: UK absent
 - Larval infestation rates 2-3 x other small mammals
 - Nymphal infestation rates 5x
 - Infection rates 58% higher
 - In Germany contributes 5 times more spirochetal infection
 - Absence in UK is therefore important





Small mammals and *Borrelia afzelii*

- Small mammals are important amplifying hosts of *B. burgdorferi*, particularly *B. afzelii*
- Infected by infective nymphs or transovarially infected larvae
- Life long infection (7-40 months)
- Bank voles develop lower immunity to spirochaetes -> develop higher infection rates: possibly more important in transmission cycles, however engorged ticks develop less well
- Strong association between small mammal rodents with *B. afzelii*
- Studies in Slovakia on infection rates
 - Engorged nymphs from small mammals: 47% infected
 - Questing nymphs: 7% infected



Role of other small/medium sized mammals

- Shrews (*Sorex araneus*, *S. minutus*)
 - Efficient tick predators
 - European studies: 80% infestation rates; mean 40-60 larvae/shrew; 18% infect
- Dormice
 - Hazel dormouse (*Muscardinus avellanarius*) – arboreal, winter hibernation
 - Fat dormouse (*Glis glis*) – Germany: L infest 2-3x, N infest 20x
 - 9 yrs, synanthropic, 70% infected, 95% derived N
- Grey squirrel (*Sciurus carolinensis*)
 - Norfolk studies: mean L 8-19 compared to mouse L 1-4: upto 100 larvae
 - More important in spring/early summer – more arboreal in autumn
- Red squirrel (*Sciurus vulgaris*)
 - Switzerland study: 370L (64%), 380N (69%), 1 F on 1 animal cf. QL 3%, Qn 34%
 - 70% infection rates (Bbss, Ba)
- Siberian chipmunk (in France)
 - potential new host and reservoir



Role of other animals



- Hedgehog (*Erinaceus europaeus*)

- Highly infested with ticks: Ireland study - >400L, 60N on 1 adult
- Also infested with *I. hexagonus*:
 - In Switzerland – means 50L, 11N, 2.5 F *I. ricinus*
 - Co-infested in woodlands, mono-infested (IH) in urban areas: IH 24%
 - Silent cycle of transmission

- Lizards

- Important dilution hosts in North America
- Intensity of LD transmission negatively associated with Sand lizard dist in Ger.

- Migratory birds (Swedish study)

- 23000 migrant birds surveyed, 2% infest, mean 2ticks/bird, 98% IR
- 30% of ticks in spring infected
- >6.8m ticks enter Sweden each spring, 4.7m leave in autumn; 1.3m infected
- Redwing – migratory restlessness reactivating latent infections



Role of woodland birds

- Ground feeding passerines are very important in Bb transmission
- Most important species (83% infested) are (Czech studies):
 - Robin (*Erithacus rubecula*)
 - Blackbird (*Turdus merula*)
 - Song thrush (*Turdus philomelos*)
- Robin fed 51% of all larvae feeding on birds
- Blackbird fed 54% of all nymphs (highest infestations 50 L and 20N/bird)
- Infection rates: 6-16% in larvae; 12-22% in nymphs
- *Turdus* sp. and *E. rubecula* very important amplifiers for *B. garinii* and *B. valaisiana*





Role of pheasant

- ~20 million pheasant (*Phasianus colchicus*) released in UK each year
- Densities in Dorset/Wiltshire studies: 500-1200 birds/km²
- Feed large numbers of nymphs:
 - 43n/bird in April; 23n/bird in June
 - Most important host nymphal host
- Male birds 4x infestation rates – testosterone and immunosuppression
- Infection rates in ticks from pheasant (Dorset):
 - 22% infected, cf. 0% questing population
 - Mostly *B. garinii* (neuroborreliosis) and *B. valaisiana* – important amplifiers – no evidence of *B. afzelii* : possibly eliminated
- Feed large numbers of questing nymphs -> exposure; infected adult ticks
- Reduction in *B. afzelii* – zooprophylactic role





Role of deer

- Very important host for all stages
- Irish studies on Fallow deer:

	L/50m	N/30s	A/30s	Inf qN	Inf qA
Deer	22-118	33-34	5-6.6	1.7%	3.1%
No deer	1.5-5.5	1.6-12.5	0.1-1.2	12.4%	17.9%

- Dilution hosts for *Bb*
 - Swedish studies
 - Compared moulted ticks from deer (0%) to questing N (7-11%)
 - 20% n infection rates: need 300,000 nymphs for infection
 - Typical infestation <100 nymphs
 - 100 ticks/kg vole v 3.7 ticks/kg deer -> immunity, low infection rates
- Role of deer: increase tick numbers; dilute infection rates -> sustain tick pop



Role of livestock



- Sheep

- Upland sheep – feed 80% of all larvae, >95% all N and A
- No systemic infection in sheep
- Studies in Scotland confirm co-feeding transmission
 - N:A 9cms; transmission during max. peaks of infestation

- Cattle

- Zooprophyllactic role on transmission
- French studies: infection rates in questing ticks inside/outside cattle enclosures
 - 4x lower infection rates in Nymphs inside enclosures
 - 6x lower in Adults
- Could we use cattle to dilute infection rates, and mop up ticks?

Lyme borreliosis Transmission cycle

Large mammals:

- Deer species
- Sheep



Not generally involved in transmission cycles; localised transmission through co-feeding in sheep reported; both important tick hosts

Blood host

ADULT FEMALE

Feed



Trans-stadial

Source of infection,
More conspicuous
Low no. lower risk



Could understanding the ecology of *Borrelia burgdorferi* be employed in understanding:

1. Rates of exposure
2. Determinants for high risk areas
3. Targeted management/grazing regimes to minimise ticks and *Borrelia*

HUMAN

probability
infection

- *M. agrestis*



diversity of
stages
non-prevalence rates
- Seasonal behaviour
of humans, hence exposure

- Host seasonal dynamics
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- Seasonal changes in tick infection rates
- Differences in *Borrelia* genospecies cycles

Trans-ovarial transmission very low: <2%



Mapping *Borrelia* infection rates in ticks across a landscape – South Wiltshire

- Heterogeneity of infection rates

- Imp

- D

Wiltshire tick abundance

80

Heterogeneity of *B. burgdorferi* prevalence in questing ticks – pilot study

- Seven regions of southern England compared (Exmoor, Dartmoor, New Forest, Surrey, Wiltshire, London, Salisbury)
- Prevalence ranged from 0-10%
- Urban fringe sites as high as 9%
- High biodiverse woodland sites had low prevalence
- 4 out of 5 of the sites showed dominance of one genospecies

Tick abundance per 5m²

0

Woodland High Woodland Low Woodland edge Chalk scrub Chalk grassland

Habitat type





Public Health
England



Jolyon Medlock



Kayleigh Hansford Maaike Pietzsch



Alex Vaux



Lisa Jameson



Association of
Port Health
Authorities



Chartered
Institute of
Environmental
Health





Public Health
England

Lyme disease conference

9 October 2013