

BACKGROUND

Lyme borreliosis is an enzootic infection caused by spirochaetes of the *Borrelia burgdorferi* sensu lato species complex. *B. burgdorferi* is carried and transmitted by Ixodes ticks and is the most prevalent arthropod-borne disease in the Europe and Northern America. To date, twelve members of the species complex have been isolated, and of these, three been shown to be pathogenic (*B. afzelii*, *B. garinii* and *B. burgdorferi* ss). It has been demonstrated that the genospecies differ phenotypically, not only in their pathogenicity, but also in their ecology. At present, the transmission cycle in Scotland is understudied, little is known about the genospecies, the hosts they use and the risk of disease to humans, wildlife and companion animals.

AIMS AND OBJECTIVES

To quantify the risk of acquiring Lyme borreliosis (LB) in Scotland by examining the transmission cycle of *Borrelia burgdorferi* sensu lato in *Ixodes ricinus* ticks and their hosts and relating this to human cases.

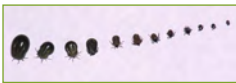


Fig 1. *Ixodes ricinus* ticks. Image courtesy of Alan Smith

This will be accomplished on two levels: **Countrywide:** examination of the distribution of LB cases and the clinical manifestations in these patients in an attempt to associate symptom complex distributions with *Borrelia* genospecies distributions.

Site specific: individual sites with high reported cases of LB will be investigated. The transmission cycle of *B. burgdorferi* in *Ixodes ricinus* ticks and their hosts will be examined.



Fig 2. Transmission cycle of *Ixodes ricinus* Image courtesy of EUCLAB

MATERIAL AND METHODS

Countrywide

Lyme borreliosis patients are questioned regarding where they received the infective tick bite and on the clinical manifestations of their disease in order to associate this with the genospecies of *Borrelia* (e.g. dermatological, rheumatological, neurological symptoms etc).

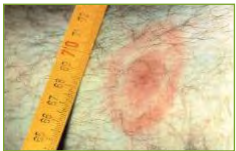


Fig 3. Erythema migrans rash (occurs in 85% of LB cases). Photo courtesy of EUCLAB

CONCLUSION

Although it appears it is possible to acquire Lyme borreliosis in many different areas of Scotland, the risk is not uniform. It is the aim of this study elucidate which factors increase the risk.

It is anticipated that the results of this work will provide a detailed understanding of the transmission cycle of *B. burgdorferi* in Scotland. It is possible that the information gathered can be used to implement prevention and protection measures.

SITE SPECIFIC

- Sites which have yielded infected tick bites were identified through patient questionnaires.
- 16 sites will be sampled (8 major and 8 minor) twice a year (once during spring and once in summer/autumn). Major and minor sites are paired and are close geographically, although may vary in habitat type, land management or environmental characteristics.
- Major sites will be blanket dragged to collect questing ticks and small mammals trapped to collect feeding ticks.
- Minor sites will be blanket dragged for questing ticks.
- All sites will have surveys of the vegetation, birds (point counts) and deer (dung counts).

OTHER HOST SPECIES

Additional ticks will be collected from deer (via gamekeepers and stalkers), birds (via the British Trust for Ornithology and the Scottish Agricultural College) and from squirrels (via the Institute of Zoology and the Scottish grey squirrel cull).

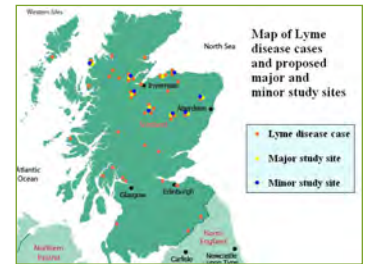


Fig 4. Map of Scotland showing Lyme Borreliosis Cases and Study Sites



Fig 5. Blanket dragging for ticks Image courtesy of Ellie Watts

ANALYSIS

Molecular

Ticks will be tested for *B. burgdorferi* s/l by PCR analysis of the histone binding gene. Real Time PCR will then be used on positive samples to determine the *Borrelia* genospecies through melting point analysis.

Modelling

Generalised linear models will be created in order to attempt to describe the relationships between the ecosystem variables that have been measured.

Geographical Information System

A predictive GIS will be created in association with TickMAP (developed by the Macaulay Institute) to create a risk map for Lyme borreliosis by elucidating the associations between ticks, their hosts, *B. burgdorferi* and human cases.

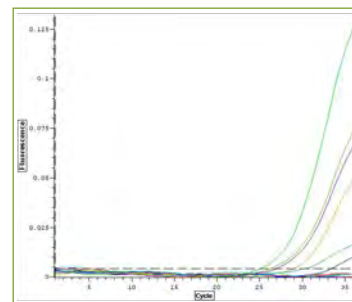


Fig 6. RT-PCR Dose-Response curve (Test of *Borrelia* primers)



Fig 7. TickMAP Habitat classes across Scotland Image courtesy of Jim McLeod

Acknowledgements: We would like to thank the numerous land owners who have gratefully given permission to use their land as study sites. We would also like to thank the clinicians at the microbiology unit of Aberdeen Royal Infirmary for their help and advice and the Lyme disease patients who have answered the questionnaires. MCJ is in receipt of a BBSRC-DTG studentship.

