Epidemiology of *Mycobacterium Bovis* in a Badger Population

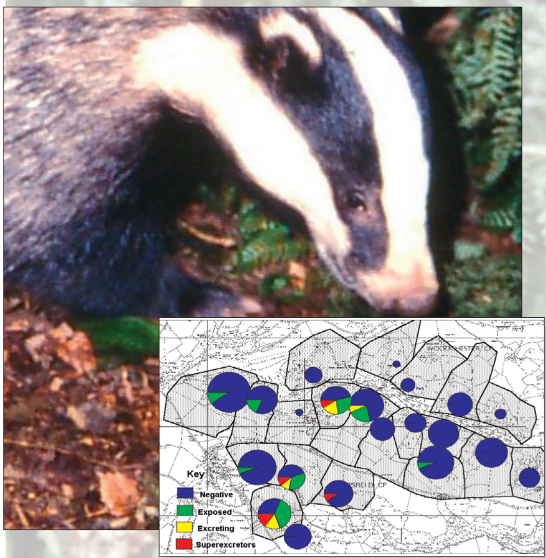

Figure 1. Woodchester Park social groups + infection status

Introduction

In this project we analyse data from a long-term mark-recapture study in order to identify demographic factors important in *M. Bovis* epidemiology in a high-density badger population. We also consider demographic differences in relation to pathology as indicated by culture sample results.

Data

We analyse data from the Woodchester Park badger population (see Figure 1) between the years 1982-2000 inclusive. The population density is high , (annual estimates ranging from 17 to 45 animals per square km). Social groups are identified through bait-marking. On the basis of trapping records we assign animals on the database to a particular social group within a given year. Various demographic data are recorded on trapping and a combination of culture and blood samples analysed for indication of infection with *M. Bovis*. Based on these clinical records we construct statistical models to identify factors associated with incidence (newly infected cases) and prevalence.

Disease Classification

We use the following definitions to represent progressive pathological states of *M. Bovis* infection; Negative - (0 +ve results), Exposed - (1 Elisa positive, 0 culture positive), Excretor (0+ Elisa positive, 1 culture positive) and Super-Excretor (0+ Elisa positive, 2+ culture positive).

With respect to the above definitions an animal is an incident case on the first occasion it is classified thus; and a prevalent case thereafter.

Statistical Analysis and Results

Incidence (Figure 2) and prevalence were first recorded on an annual basis. Smoothing splines were fitted to assess significance - for each measure $P < 0.05$. GLMMs were run to model the probability of incidence / prevalence on trapping. Explanatory variables included information at both individual and social group level, based on animal's social group at the time. Social Group and individual animal were fitted as random effects. Year was fitted as a 3rd order polynomial and time since last capture incorporated as an offset. Results for incidence are summarised in Table 1

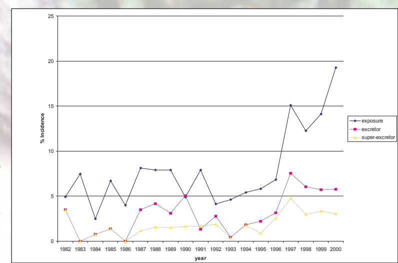

Figure 2. Percentage Incidence of the 3 Disease Classes in Core Study Groups

outcome	*significant predictors*
Exposed incidence	age (adult = -ve), season (spring = ++, summer = --), group condition (β =-ve)
Excretor incidence	condition, season (spring + ++, summer = --), group size (β =-ve),
Super-excretor incidence	age (adult = +ve), condition

Table 1. Significant predictors from GLMMs on incidence

Conclusions and Findings

- Temporal trend highly significant with recent increase in both *M.Bovis* incidence and prevalence
- Individual factors more important than group level in terms of susceptibility to infection
- Observed incidence significantly higher in spring - in practice may indicate onset of infection most intense during the winter
- Adults more susceptible to advanced stages of infection whereas cubs show higher incidence of Elisa +ve (maternal transmission of antibodies?)
- Excretor females have a higher annual probability of survival than Males (0.82 for females and 0.41 for males - from Conditional Arnason Schwarz model)
- Excretor/ super-excretor Females have a higher frequency of positive tracheal samples (males more likely to develop infection through bite wounds?)

Future Work

- Global model factoring in spatial parameterisation of infection pressure
- Account for uncertainty associated with current tests (Elisa test currently has specificity of approx. 41%)
- Model dynamics of inter and intra-group transmission

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