

Quantifying badger exposure and the risk of bovine tuberculosis for cattle herds in county Kilkenny, Ireland



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Objectives:

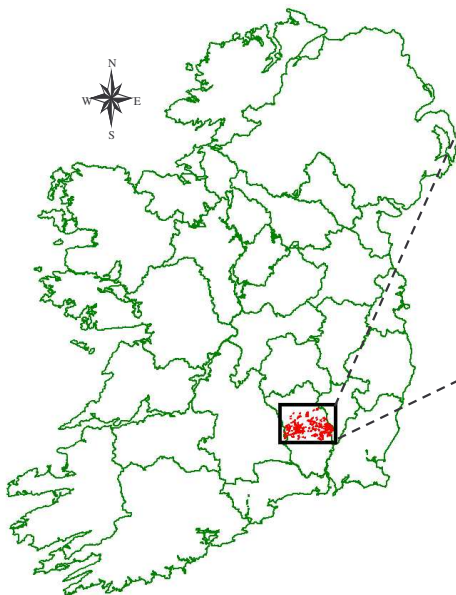
- 1.- To quantify the levels of badger exposure for cattle
- 2.- To test the hypothesis that increased badger exposure does not increase the risk of bovine tuberculosis (BTB) in a herd

Introduction:

Case herds developed BTB in the study period **January 1st 1996 until December 31st 1999**

The study design was a **matched case-control** study in which the control herds were selected using incidence density sampling.

Figure 1. Study area in County Kilkenny, Ireland



Badger data collection:

- **Before September 1st 1997**, badger data were available from “targeted” badger-removal operations that took place when a veterinary inspector, in the course of an epidemiological investigation of BTB breakdown in a herd, suspected badgers as the source of infection.

- **After September 1st 1997**,

data were obtained from the Kilkenny study area as part of the Four Area Badger Removal Project (FAP)

- The specific location of cattle within each farm, and the length of time that cattle spent in each farm field during the grazing season, was used to build an **exposure coefficient** to quantify the amount of badger exposure that cattle might have encountered on pasture.

Exposure coefficients for the entire area:

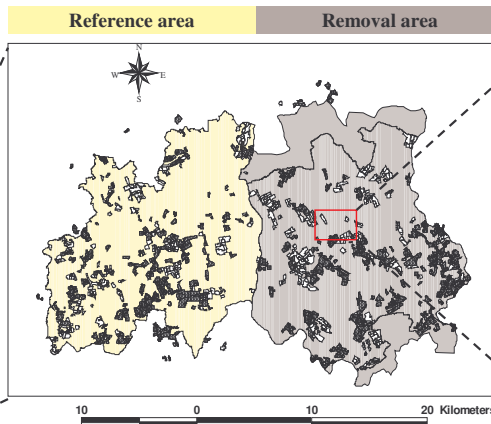
For Reference AND Removal area

-Active Settl Exposure Coefficient = $\sum_i [(AS)_i \times (CN)_i]$

-Inactive Settl Exposure Coefficient = $\sum_i [(IS)_i \times (CN)_i]$

where: i = number of fields in a farm, AS = number of active badger setts within 2 (or 5) km of field “i”, IS = number of inactive badger setts within 2 (or 5) km of field “i” and CN = cow-nights in field “i” (Figure 3).

Figure 2. Reference and Removal area in Co. Kilkenny and spatial distribution of case (black) and control (white) herds, 1996-1999



Exposure coefficients for the Removal area:

Only for the Removal area

- Annual 2 (or 5) km Badger Exposure Coefficient
- Annual 2 (or 5) km Tuberculous Badger Exposure Coefficient
- Annual Reciprocal Distance Badger Exposure Coefficient
- Annual Reciprocal Distance Tuberculous Badger Exposure Coefficient

Statistical analysis:

- A χ^2 test was used to compare the proportion of BTB-positive badgers in different periods of the study.
- The t-test was used to compare the mean number of badger setts (active or inactive) and badgers (or BTB-positive badgers) surrounding case and control herds.
 - When the data were not normally distributed the **Mann-Whitney-Wilcoxon test** was used.
- **Conditional logistic regression** was performed to assess the exposure coefficients.
 - The **Hosmer-Lemeshow test statistic** to check each model’s goodness of fit

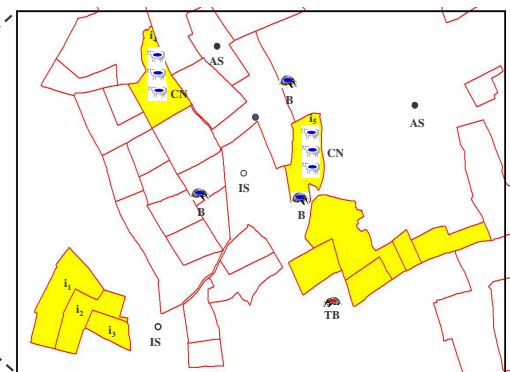
Results:

During the first 2 years of the FAP (Sept. 1, 1997- Aug. 1999), **354 badgers** were removed.

No significant difference was observed in the risk of badger tuberculosis between these 2 years ($\chi^2=1.372$, df=1, RR= 0.69, $p>0.10$).

Badgers caught before the FAP began were **twice as likely** to be classified “tuberculous” as badgers removed during the period Sept-1997 to the end of 1999 ($\chi^2=15.91$, df=1, RR=2.1 $p<0.001$)

Figure 3. Typical Irish Farm Representation



During 1996-1998 control herds had a significantly lower number of active ($p=0.047$) and inactive ($p=0.031$) badger setts within both 2 km and 5 km of their fields than case herds

We found a significant association (**OR=1.5, $p=0.048$**) between case herds and having a higher **active badger sett** exposure coefficient than their control herds at 2 km distance

None of the models based on the number of badgers (or tuberculous badgers) using either the fixed or reciprocal distance exposure coefficient for herd breakdowns from September 1997 until December 1999 showed a significant association between BTB herd status and the exposure coefficients.

Conclusion:

- We report an association between sett numbers and risk of a BTB breakdown, but this has not elaborated possible routes of transmission.
- Very detailed studies might add coherence to inferences about badgers as the source of most cattle BTB (e.g. the sighting of badgers within barns or interacting with cattle on pasture). However, given the apparent dynamic nature of badger movements, **quantitative measures of badger impact might require the use of units of concern beyond the individual herd.**
- Supplementing ecologic studies of “herd groups” with **molecular typing of badger and cattle BTB strains** might prove useful.