

PAPER

Exploration of the power of routine surveillance data to assess the impacts of industry-led badger culling on bovine tuberculosis incidence in cattle herds



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C. A. Donnelly, A. I. Bento, A. V. Goodchild, S. H. Downs

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C. A. Donnelly,
A. I. Bento,
Imperial College
London,
London, UK
A. V. Goodchild,
S. H. Downs,
Animal and Plant Health
Agency,
Surrey, UK

E-mail for
correspondence:
c.donnelly@imperial.ac.uk

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Context

In the UK, badgers (*Meles meles*) are well known sources of infection and there have been lively debates as to whether badger culling should play a role within the Government's cattle tuberculosis (TB) control strategy. The key source of information regarding whether badger culling reduces cattle TB in high cattle TB incidence areas is the randomised badger culling trial (RBCT). In late 2013, two pilot areas were subjected to industry-led badger culls which differed importantly from the RBCT culling in that free-ranging as well as cage-trapped badgers were shot and culling took place over a longer time period. Although the pilot culls were undertaken 'in order to confirm the effectiveness and humaneness of controlled shooting', a government commitment was promised to compare cattle TB incidence in culled areas to that in 'similar uncultured areas to identify any changes in trends that might be attributable to badger control'. However, the impacts will be harder to evaluate since culling was not randomised between comparable areas for subsequent comparisons of culling versus no culling. Also, additional biosecurity advice was given to farmers within culling areas but not in the comparison areas.

Main conclusion

If, for example, five culling areas began culling in 2015 with five more in 2016 and the culling had a similar effect to that of RBCT proactive culling, then it is likely that significant differences in the herd incidence rates of the official TB-free status of the herd withdrawn (OTFW) (confirmed) between culling and the comparison areas could be observed in 2020 (when 12 areas had been observed for four or more years). It is therefore possible that significant differences could be observed in 2019 (when seven areas had been observed for four or more years and five had been observed for only three years).

Approach

To explore the power of routine surveillance data to assess the impacts of industry-led badger culling on cattle TB incidences, the expected numbers of OTFW herd TB incidents were calculated, for areas with and without culling assuming that each area contained 200 (or 100) annually tested herds and a baseline incidence of confirmed herd incidents of 0.15 (or 0.10) per herd per annum, based on the estimated time-dependent impact of RBCT proactive culling within culled areas.

The null hypothesis was that industry-led culling would have no impact on the incidence of OTFW herd incidents. A two-sided test was performed so that the alternative hypothesis would include both a decrease and an increase in cattle TB incidence. Power is the probability of rejecting the null hypothesis when the null hypothesis is false. Illustrative power estimates were obtained from 10,000 Poisson simulations per scenario with up to four years' follow up and up to four comparison areas per culling area.

Results

Calculations indicated that unless very large numbers of culling and comparison areas were studied, one-to-one-matched culling and comparison areas will likely need to be observed for at least three years after culling begins before any significant differences in the incidence of OTFW herd incidents are observed.

Interpretation

Extra Poisson variation (that is, variance beyond that expected by chance) in the counts of OTFW herd incidents, as was observed within the RBCT, will increase the required sample sizes with n being proportional to the variance of the square roots of the observed counts. Therefore, the results presented here should be viewed as maximum estimates for power of comparisons between culling and comparison areas for a given sample size.

Although the selection of multiple comparison areas is important because it will increase precision and guard against comparison areas being lost completely due to subsequent conversion into culling areas, their inclusion is unlikely to substantially shorten the duration of the follow up. This loss of comparison areas may be particularly challenging for the analysis if the probability of a comparison area subsequently being culled increases with the incidence of OTFW herd incidents in the area.

Significance of findings

The licence criteria set out by Natural England relating to the proportion of badgers to be removed by culling were based on RBCT results. If the industry-led culling removes a substantially smaller or substantially greater proportion of the badger population than RBCT proactive culling did, the present estimates of sample sizes and years of follow up required will not be appropriate. The introduction of new control policies in the culling areas that are not introduced in comparison areas means that it will not be possible to distinguish the independent effects of culling, although the effect of culling combined with other policies can still be evaluated.

Significant decreases in confirmed cattle TB incidence within proactively culled areas and significant increases in confirmed cattle TB incidences up to 2 km outside the proactively culled areas were both observed effects of proactive culling within the RBCT. Thus, cattle TB incidence will be monitored up to 2 km outside of industry-led culling areas and compared to cattle herds on land up to 2 km outside of comparison areas. The approach presented here could be used similarly for the detection of any increased risks on land outside of those areas subjected to industry-led culling.

The rollout of industry-led culling within a national cattle TB control policy would be controversial. It is crucial that the best possible estimates of the effects of such culling on cattle TB incidence are obtained to inform all stakeholders and policymakers.