Agri-Food and Biosciences Institute ®

DARD E&I Project 12/3/S3

Field Survey for the Presence of Badger Setts in Co. Down, Northern Ireland

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FIELD SURVEY FOR THE PRESENCE OF BADGER SETTS IN CO. DOWN, NORTHERN IRELAND.

Bacteriology Branch

Veterinary Sciences Division

Agri-Food and Biosciences Institute

Citation:
Agri-Food and Biosciences Institute. (2014). Field Survey for the Presence of Badger Setts in Co. Down, Northern Ireland. Report to TB & Brucellosis Policy Branch, Department of Agriculture and Rural Development.

ISBN 978-1-84807-494-1

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Executive Summary

1. The economic costs of bovine tuberculosis to Government and the agricultural industry are significant, with the total cost of controlling the disease in Northern Ireland estimated at over £317 million in the last 15 years. The Eurasian badger has been recognised as an important wildlife reservoir of bovine TB and a potential source of infection for cattle. This report details the survey phase of a larger multi-phased research program on a "test and vaccinate or remove" (TVR) wildlife intervention strategy as a means of controlling bovine TB in Northern Ireland.

2. Findings from this survey will: allow detailed project planning for future TVR wildlife intervention research by providing an indication of badger social group density and facilitate the capture of badgers, by identifying the location of active setts, for any possible intervention phase.

3. Survey work was carried out in two *c.*100 km^2 zones in Co. Down, Northern Ireland. Permission to survey land was granted by 667 business units, accounting for 81.6 % of eligible land area in zone 1 and 83.7 % of eligible land area in zone 2. Surveying took place in two phases over a 16 week period in spring 2013 and a 9 week period in winter 2013/14.

4. A total of 10, 755 fields were surveyed of which 741 (6.9 %) contained at least one badger sett. Observed setts were given a classification of main, annex, subsidiary or outlier and whether they were active or inactive.

    a. A total of 788 setts were observed across the two zones (436 in zone 1 and 352 in zone 2) of which 78 % were classified as active.

    b. In zone 1 there were 68 active main setts and 67 active main setts in zone 2.

    c. This corresponds to an estimate of badger sett density of 0.91 and, 0.88 active main setts per km^2 and 4.39 and, 3.77 active setts per km^2 in zones 1 and 2, respectively.

Acknowledgements

The Department of Agriculture and Rural Development for providing the resources to carry out the survey and the guidance provided.

We would like to acknowledge all the business owners who provided permission to survey the land and their knowledge of the local area.

All field survey staff for their diligent efforts in carrying out the survey in some extreme weather conditions and rough terrain.

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Talmhaíochta agus
Forbartha Tuaithe

Fairms an
Kintra Fordèrin

Abbreviations

AFBI – Agri-Food and Bioscience Institute

DARD – Department of Agriculture and Rural Development

GPS – Global Positioning System

NWMC - National Wildlife Management Centre, AHVLA, formerly FERA – Food and Environment Research Agency

PPE – Personal Protective Equipment

QC – Quality Control

SOP – Standard Operating Procedure

TB - Tuberculosis

TVR – Test and Vaccinate or Remove

Background

Bovine tuberculosis (TB), caused by *Mycobacterium bovis*, is one of the most problematic endemic animal diseases to control that is currently facing Government, the veterinary profession and the farming industry in the United Kingdom and Ireland. Over the past 20 years, the Eurasian badger (*Meles meles*) has been increasingly recognised as an important wildlife reservoir of *M. bovis* and a potential source of bovine TB infection for cattle. The economic costs of the disease to both Government and the agricultural industry are significant, with the total cost to Government of compensation and controlling the disease in Northern Ireland currently estimated at *c.* £317 million over the past 15 years[1].

On 3 July 2012 the Minister for Agriculture and Rural Development announced the intention to undertake research on a "test and vaccinate or remove" (TVR) wildlife intervention strategy as a potential means of controlling bovine TB levels in the wildlife reservoir[2]. The proposed research on TVR intervention strategy is envisaged to be a phased approach, whereby the findings from each individual phase would support the scope and planning of subsequent phases.

A spatial stochastic model was developed by the National Wildlife Management Centre (NWMC), based on Northern Ireland specific data[3]. Based on the NWMC modelling, mid Co. Down was identified as an optimal area for TVR research. Two *c.*100 km^2 zones ('zone 1' and 'zone 2') were selected in for potential future TVR wildlife intervention research.The current phase of the project is the survey phase, where AFBI carried out field survey work during spring '13 and winter '13/14. This report provides outlines the findings from this survey.

Aims

The aim was to undertake a comprehensive sett survey of the two zones to determine the location and ecology of badger setts. This information will:

- Provide baseline data required for detailed project planning for the TVR wildlife intervention research.
- Facilitate the badger capture process by identifying the location of active setts at which to trap the badgers for the intervention phase.

[1] 'Agriculture and Rural Development Committee: Review of Bovine Tuberculosis' NIAO written submission 16 April 2012.
[2] http://www.northernireland.gov.uk/news-dard-030712-minister-oneill-points accessed on 28 March 2014.
[3] Smith, G.C., Budgey, R. And Delahay R.J. (2013) A simulation model to support a study of test and vaccinate or remove (TVR) in Northern Ireland.

Methodology

Permission

DARD TB Policy branch wrote out to all business units in both zones requesting permission for AFBI to access their land to carry out survey work. This information was transferred securely from DARD to AFBI using an encrypted Ironkey on a weekly basis where the relevant permission had been obtained by DARD. These data were uploaded to the secure database and work schedules for the field staff were produced.

Database

A secure multi-user level database was created that contained information on every business unit in the survey zones and had two main functions;

1. Map processing, whereby a cover sheet was produced containing the business owner's contact details and a list of each field associated with them within the survey zones.
2. Recording information obtained from the survey (see below).

Surveying

Surveying took place in two separate phases; phase 1 surveying took place in spring 2013 between 11 February 2013 – 31 May 2013 and phase 2 in winter 2013/14 between 13 November 2013 – 24 January 2014. Prior to surveying, contact was made with the designated person for each business unit, to affirm that consent had been given to access their land. It was also established if any large livestock were present or other issues that may affect the ability to survey and then an approximate date of survey was provided.

Image of badger run across an open field

Surveyors walked every linear field boundary assessing for the presence of badger activity. Woodland and other rough terrain was surveyed using transects of a width appropriate to the type of vegetation and terrain present. Each field that was surveyed was initialled and dated by the surveyor(s) and marked as a null return if no badger setts were observed. If a badger sett was observed, the 10 point Irish grid location was recorded on the Garmin 78S GPS units, the location marked on a paper map and a 'TVR survey sheet' filled in with a provisional assessment of sett classification). During phase 2, field signs (runs, latrines, paw prints and hairs) were also recorded on the survey maps and subsequently digitised using ESRI ArcMAP (v10.0) for future reference.

Each observed sett was assigned a unique number when entered into the database to allow for rapid and concise identification. The following information was obtained for each observed sett:

- Date surveyed
- Surveyor(s)
- Land type (Woodland, Open Farmland, Hedgerow, Scrubland)
- Sett type (Main, Annex, Subsidiary or Outlier)
- Activity (Active or Non-active)
- Evidence of badger runs
- Number of active entrances
- Number of partially active entrances
- Number of inactive entrances
- 10-figure Irish Grid reference

Image of active sett entrance displaying spoil heap with recent visible runs in/out of sett

If a field was unable to be surveyed this was also recorded with a short description of the reason. These issues only occurred in phase 1 of the survey and were resolved based on the recommendations from the interim report.

Bio-security

All field-based staff were trained in a bio-security protocol to minimise the potential to spread disease between land parcels. Prior to entering and after surveying a land parcel, each surveyor disinfected their PPE and the wheels of vehicles if they entered farmyards, using an approved disinfectant at a recommended dilution.

Quality Assurance

A number of quality assurance procedures were in place to ensure the accuracy and reliability of the survey findings. These were as follows;

On the TVR sett survey forma tick-box was placed to indicate whether the sett required further assessment. This allowed the surveyors to seek a second opinion on any sett findings, if required. All those setts marked for recheck were re-assessed by the most experienced member of the survey team and the database updated accordingly.

Due to farm fragmentation, there was the possibility of an individual sett being identified from more than one land parcel. At the end of each survey phase, all setts were plotted in ArcMap and a visual assessment identified those setts that were within ~25 m of each other. If necessary these setts were re-assessed by the most experienced surveyor to identify if they were an individual sett or multiple setts within close proximity and the database updated accordingly.

At the end of each phase, as a means of quality control a minimum of 5 % of all setts observed by each surveyor, within each zone, were randomly selected. Each of these setts was re-assessed by the most experienced member of the survey team and any differences recorded.

After both survey phases had been completed a quality assurance stage was implemented whereby setts that did not comply with the definition as outlined in the standard operating procedure were rechecked. Where possible this was achieved as a paper exercise, however in some instances required setts to be re-checked on the ground. These included setts where the number of entrances did not comply with the standard operating procedure (SOP). For example, the SOP classified an annex as a sett that was within 150 m of a main sett. At the time of survey, surveyors had to make a decision based on the information they had available to them at the time and this meant that they did not have information of

all setts within the immediate vicinity and a judgement call had to be made. For example, there were some incidences whereby a sett was classified as an annex sett but upon the completion of the survey there were no observed main setts in the immediate vicinity and this was subsequently classified as a main sett. Conversely, a number of main setts were independently observed within close proximity (< 200 m). These fitted the SOP definition for a main sett (i.e. ≥ 6 entrances), however as it was deemed likely that these were from the same social group the larger of the two setts was classified as the main sett and the smaller as the annex.

Results

Survey Areas

Zone 2 had a greater number of business units than zone 1, with these business units having, on average, almost two more fields than business units in zone 1 (Table 1). However the average area of land ownership was lower in zone 2 and this is reflective in the fact this zone had a greater number of small fields. However the mean field size masks the heterogeneous nature of the fields in zone 2, whereby in the mountainous regions there tended to be a smaller number of larger fields and the low-lying regions had a greater number of smaller fields. This is reflected with zone 2 having almost twice the number of fields larger than 25 acres and also less than 1 acre than in zone 1.

Table 1: Descriptive statistics of the business units and field attributes in zone 1 and zone 2.

Business units		
	Zone 1	**Zone 2**
Count	669	717
Mean Fields Possessed	11	13
Mean Land Attributed (acres)	44.78	41.89

Field Information		
	Zone 1	**Zone 2**
Number of fields	5986	7422
Mean field size (acres)	3.91	3.19
Maximum size (acres)	34.86	82.05
Minimum size (acres)	0.02	0.02
Fields >25acres	9	16
Fields <1 acre	675	1354

100 acres = 0.405 km^2

The total area of zone 1 and 2 was 100.14 km^2 and 99.67 km^2, respectively. However not all of this terrain was suitable to survey (e.g. roads, urban areas) and the total surveyable area was 90.75 km^2 and 90.82 km^2 based on single farm payment data. Permission was granted for 81.6 % for zone 1 and 83.7 % for zone 2 (Table 2).

Table 2: Summary statistics of the surveyed area in zone 1 and zone 2.

	Zone 1			**Zone 2**		
	Acres	**Km^2**	**%[1]**	**Acres**	**Km^2**	**%[1]**
Total Area	24744	100.14	-	24630	99.67	-
Surveyable area	22407	90.68	-	22419[2]	90.73	-
Permission	18293	74.03	81.6	18759	75.92	83.7
Surveyed	18293	74.03	81.6	18759	75.92	83.7

[1]Percentage of surveyable area for each zone
[2]424 acres in zone 2 were forest. [NB]100 acres = 0.405 km^2

Survey Findings

Table 3: Count of badger setts observed by sett classification in zone 1 and zone 2

	Zone 1			Zone 2		
Sett Type	**Active**	**Non Active**	**Total**	**Active**	**Non Active**	**Total**
Main	68	3	71	67	2	69
Annex	12	0	12	14	2	16
Subsidiary	58	16	74	39	9	48
Outlier	187	92	279	166	53	219

A total of 788 setts were observed across both survey zones of which 611 (77.5 %) were classified as being active. Overall, zone 1 had a higher total number of setts than zone 2 (436 vs. 352) and also of active setts (325 vs. 286). This resulted in zone 1 having a higher proportion of total active setts per km^2 than zone 2 (4.39 vs. 3.77, respectively). The higher proportion of total setts in zone 1 was not reflected in all sett classifications, whereby zone 1 had four less annex sett but two additional main setts, 26 additional subsidiary setts and 60 additional outlier setts.

In zone 1 there were a total of 68 active main setts that corresponds to an estimate of 0.91 active main setts per km^2 (Table 3). The corresponding figure for zone 2 is 0.88 active main setts per km^2, comprising 67 active main setts (Table 3).

The majority of entrances to setts were classified as being active (55.7 %), with 19.1 % being partially active and 25.2 % classified as inactive. This level of activity was almost identical in both zones. The largest main sett was observed in zone 2 with 27 entrances, with the largest sett in zone 1 having 23 entrances. In zone 1 main setts with 5 entrances were the most common, and in zone 2 main setts with 7 entrances were the most common. Annex setts ranged from having 3-8 entrances. Subsidiary setts had between 2- 6 entrances. Outlier setts with one entrance accounted for 40.8 % of all setts and 67.9 % of outlier setts.

Quality Control

As a means of quality control (QC) a minimum of 5 % of each surveyor's sett were randomly selected and re-assessed by the most experienced surveyor to ensure they fitted the description provided. There was a total of 44 rechecks in phase 1 and 16 in phase 2 (Table 4). In phase 1 QC, 36 (82 %) of QC setts were as observed in the initial survey, or with only a minor change in activity or number of entrances as is to be expected given the time difference between the initial survey with 14 (88 %) the corresponding figure for phase 2 QC. In total only 4 (6.8 %) setts were assessed as being from a different species (all rabbits) with 3 out of 4 of these assessments occurring in the early stages of the survey and in light sandy soil

Table 4: Summary statistics of quality assurance checks for Sett Survey

	Phase 1				Phase 2			
	Zone 1		Zone 2		Zone 1		Zone 2	
	Count	*%*	*Count*	*%*	*Count*	*%*	*Count*	*%*
Total	26	-	18	-	8		8	0
No-change	22	84.6	14	77.8	6	75	8	100
Classification change	1	3.8	3	16.7	1	12.5	0	0
Different species	3	11.5	0	0	1	12.5	0	0
Not accessible	0	0	1	5.6	0	0	0	0

whereby entrances were larger than usual for a rabbit warren. In these cases, 2 setts had been classed as outlier, one as a subsidiary sett and one as a main sett. A total of 5 (11 %) setts were reclassified from the original survey, 3 of which were due to the more experienced surveyor finding additional entrances in dense scrubland.

It should be noted that the classification of a badger sett is a subjective discipline and ultimately relies on the judgement of the surveyor, thus subject to surveyor bias. If the number of active main setts is to be used as a proxy for the number of social groups an acknowledgement of the limitations of such an approach should be expressed. Further ecological research including bait-marking, capture recapture techniques and attaching GPS collars to establish ranging behaviour and social group dynamics which would provide the basis for a more reliable estimate of the number of social groups.

Comparison to Previous Survey Work

The most recent population study of badgers in NI carried out in 2007-2008 estimated the mean social group density for Co. Down at 0.7 (0.39-1.02; 95 % CI) active main setts per km^2 (Table 5)[4]. A previous study[5] carried out in 1990-1993 had estimated the mean social group density for Co. Down at 0.90 (0.53-1.27; 95 % CI) active main setts per km^2. The current estimate for each zone (0.91 and 0.88, for zone 1 and 2, respectively) is above the mean estimate for Co. Down from both previous surveys but within the 95 % confidence intervals. However it should be noted that both the zones were selected on the basis of presumed high badger

[4]Reid, N., Etherington, T.R., Wilson, G.J., Montgomery, W.I. and McDonald, R.A. **(2012)** *Monitoring and population estimation of the European badger Meles meles in Northern Ireland*. Wildlife Biology: **18**(1) *pp46-57.*

[5]Feore, S.M. (1994) *The distribution and abundance of the badger Meles meles L.* Queen's University of Belfast.

density within Co. Down so it is expected that the badger density would be above the mean.

In relation to both Ireland and Great Britain the badger sett density is higher than publish densities in any region, with the south-west of England having the highest density at 0.70. However, intra-specific regional differences will exist whereby Woodchester Park, an area studied extensively over the past few decades, reported a badger social groups density of between 3.29 – 3.86 social groups per km^2 between 1990 – 2004[6].

[6]Vicente, J., Delahay, R.J., Walker, N.J. and Cheeseman, C.L. (2007) *Social organization and movement influence the incidence of bovine tuberculosis in an undisturbed high-density badger (Meles meles) population*. Journal of Animal Ecology: **76**(2) *pp*348-360

Table 5: Summary of Estimated Social Group Density in Previous Studies

	Area Surveyed (km^2)	Number of main setts observed	Mean Social Group Density	95 % Confidence Interval
Current Study				
Zone 1	**74**	**69**	**0.91**	-
Zone 2	**76**	**69**	**0.88**	-
Northern Ireland[4]				
County				
Antrim	30	-	0.49	0.39 - 0.59
Armagh	15	-	0.67	0.36 - 0.98
Londonderry	23	-	0.49	0.36 - 0.61
Down	24	-	0.70	0.39 - 1.02
Fermanagh	19	-	0.49	0.39 - 0.60
Tyrone	29	-	0.43	0.42 - 0.64
Landclass Group				
Drumlin farmland	25	-	0.84	0.46 - 1.22
Lakelands	7	-	0.33	0.00 - 0.73
Marginal lowlands	14	-	0.61	0.19 - 1.03
Central lowlands	21	-	0.49	0.19 - 0.80
Marginal uplands	33	-	0.71	0.41 - 1.01
Settled uplands	15	-	0.49	0.13 - 0.86
High uplands	13	-	0.43	0.05 - 0.80
Mountains	12	-	0.08	0.00 - 0.25
Ireland[7]				
Cork	188	127	0.68	-
Donegal	215	99	0.46	-
Kilkenny	252	129	0.51	-
Monaghan	305	120	0.39	-
England and Wales[8]				
England	1331	747	0.504	0.47 - 0.54
Wales	184	77	0.353	0.26 - 0.44
Region[9]				
North England	170	-	0.112	-
North- west England	72	-	0.167	-
North-east	121	-	0.174	-
West Midlands	177	-	0.463	-
East Midlands	153	-	0.190	-
England	91	-	0.286	-
East Anglia	161	-	0.087	-
South-west England	205	-	0.698	-
Southern England	131	-	0.374	-
South-east England	159	-	0.390	-
North Scotland	366	-	0.033	-
South Scotland	208	-	0.072	-
North and mid-Wales	143	-	0.322	-
South Wales	114	-	0.404	-

[4]Reid, N., Etherington, T.R., Wilson, G.J., Montgomery, W.I. and McDonald, R.A. **(2012)** *Monitoring and population estimation of the European badger Meles meles in Northern Ireland*. Wildlife Biology: **18**(1) *pp46-57*

[7]Sleeman, D.P., Davenport, J., More, S.J., Clegg, T.A., Collins, J.D., Martin, S.W., Williams, D.H., Griffin, M. And O'Boyle, I. (2009) *How many Eurasian badgers Meles meles L. are there in the Republic of Ireland*? European Journal of Wildlife Research: **55**(4) *pp333-344*

[8]Judge,J., Wilson, G.J., Macarthur, R., Delahay, R.J. and McDonald, R.A. **(2014)** *Density and abundance of badger social groups in England and Wales in 2011–2013* Nature Scientific Reports:4(3809) *pp*1-8

[9]Wilson, G, Harris, S and McLaren, G (**1997**). *Changes in the British badger population, 1988 to 1997.* Peoples Trust for Endangered Species, London

Conclusions

Approximately 5,238 km of field boundaries were surveyed from 667 business units and 10,755 fields. Each field that AFBI received permission to survey was surveyed and this amounted to 82 % of zone 1 and 84 % of zone 2. This was largely during a spring that saw some of the worst snowfall in memory in Northern Ireland.

In phase 1, permissions were received by AFBI as they became available over the course of 16 weeks, in tandem with the survey effort. This often limited survey efficiency and resulted in an average survey efficiency of 46 acres per surveyor per day. As a outcome of recommendations at the end of phase 1 surveying efficiency increased on-average by 15 % with a maximum survey efficiency of 67 acres per surveyor per day in phase 2.

In total 788 badger setts were observed across the two zones, ranging from one entrance to 27 entrances. As a measure of social group density, there were 68 active main setts in zone 1 and 67 active main setts in zone 2.This corresponds to an estimate of 0.91 and 0.88 active main setts per km^2 in zones 1 and 2 respectively.

In conclusion, the badger sett survey was carried out in two phases over 26 weeks the project successfully co-ordinated 15 staff surveying over 660 business units covering over 37, 000 acres of land, assessing more than 5200 km of field boundaries. From this almost 800 setts were observed across the two zones and a quality assurance scheme was in place to maximise the accuracy and reliability of survey findings. The results from this survey will contribute to the understanding of local badger ecology in Northern Ireland and provide the foundation for the co-ordination and assessment of any future proposed research.