Estimates of badger population sizes in the West Gloucestershire and West Somerset pilot areas

A report to Natural England

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Executive summary

1) Surveys for active badger setts were undertaken in two pilot areas (West Gloucestershire and West Somerset) in order to estimate the total number of active setts within each area.
2) These were supported by hair trapping surveys conducted to estimate the average number of badgers per active sett.
3) Corrections for sett mis-identification and sampling bias according to sett size were made to improve population estimates.
4) A number of other analyses were undertaken in attempts to further refine estimates, but the current estimates were concluded to be the most robust and biologically plausible.
5) Current, best-available estimates of populations, with 80% confidence in both limits, in the pilot areas during summer/autumn 2012 are 2657 to 4079 in West Gloucestershire and 1972 to 2973 in West Somerset.

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1. INTRODUCTION

The Government's policy is to allow controlled culling and vaccination of badgers in areas of high incidence of bovine TB in cattle in a carefully regulated way for the purpose of controlling the spread of the disease, in accordance with the requirements set out in Defra's Guidance to Natural England: "Licences to kill or take badgers for the purpose of preventing the spread of bovine TB under section 10(2)(a) of the Protection of Badgers Act 1992" (Defra publication PB13692).

In the first year of culling, a minimum number of badgers must be removed during an intensive cull which must be carried out throughout the land to which there is access, over a period of not more than six consecutive weeks. This minimum number should be set at a level that in Natural England's judgement should reduce the estimated badger population of the application area by at least 70% (para 10(c)(i) and (ii) of the Guidance).

Natural England should aim to ensure that culling will "not be detrimental to the survival of the population concerned" within the meaning of Article 9 of the Bern Convention on the Conservation of European Wildlife and Natural Habitats. For that purpose Natural England should determine appropriate area-specific licence conditions, and set a maximum number of badgers to be removed from the licence area (para 12 of the Guidance).

Hence, there is a requirement to gain an estimate of the population size that is sufficiently accurate for setting targets that meets these requirements. The estimate of population size must be based on information that is available to Natural England during the application process, and must relate to the whole culling area, whether culling will take place on a landholding or not. With the possible exception of a full census, any population estimate will have some degree of uncertainty; there will be an interval around the population estimate within which the true population is likely to lie: higher uncertainty leads to a wider interval around the estimated population.

Here we present estimates of population size and uncertainty about these estimates (as the relative standard error), using data gathered during surveys for active badger setts immediately prior to the anticipated start of badger culling operations.

2. METHODS

2.1 Selecting survey areas

GIS shapefiles of area outlines of each of the pilot areas and landholdings within them participating in the cull or vaccination programme were received from Natural England. Using Arc GIS 10 (ESRI, Redlands, California) a grid of 1km cells was superimposed over each area outline, which was aligned with the British National Grid. Cells that overlapped with the boundary of a pilot area were excluded from further work. From the remaining cells, 100 were selected at random from each area. Participating landowners were contacted by the badger control companies to inform them that they would be receiving a request to survey their land. Sufficient landowners were contacted to ensure access to approximately 80km^2 of land in the West Gloucestershire pilot area and 67km^2 in the West Somerset pilot area. We intended to survey only land falling within a randomly-selected cell, but time and access limitations forced us to survey land falling into immediately adjacent cells if it was a continuation of land falling within the selected cell.

2.2 Sett surveys

Surveyors worked in pairs, walking every linear feature and inspecting farmyards present within the survey area, noting the presence of badger setts, active latrines and badger runs on a 1:10,000 scale map and, on a data sheet, noting their location to the nearest 1m (i.e. with a 12-figure grid reference) using a hand-held GPS. Large woodlands were surveyed using multiple surveyors walking parallel transects within 20m of each other, until the entire woodland had been surveyed. Setts were classed as active if at least one entrance hole showed signs of recent badger activity, such as fresh spoil on the spoil heap, smooth, compacted earth in the entrance, or badger footprints in the entrance or on the spoil heap.

2.3 Hair trapping

Hair trapping was undertaken at active setts and other locations in order to collect genetic material from badgers. Material was collected every day for 10 days, and the hair traps were flamed with a cigarette lighter to denature any genetic material remaining on the trap after sample collection. This material was sequenced to derive profiles of individual badgers, and dates on which each individual was sampled, including multiple occasions.

2.4 Quality assurance

2.4.1 Staff training and auditing

All staff engaged in sett surveying activities were experienced badger sett-surveyors who received two days of training in the use of the relevant standard operating procedures. Adherence to the standard operating procedures was independently assessed and verified by an experienced badger sett surveyor during visits to the pilot areas. An independent assessment of data recording and manipulation was undertaken by an experienced external assessor. Errors identified by the assessor were corrected before final estimates were calculated.

2.4.2 Re-surveys

For each pilot area a total of 15 of the surveyed cells was repeatedly randomly drawn from the full database of cells surveyed until a set of 15 cells was drawn that contained at least 30 putative active setts. Land to which we had access within the 15 cells and contiguous land outside the cell that had been surveyed were re-surveyed by surveyors with no experience of those cells during the primary survey. Re-surveys were undertaken in the same way as during the primary surveys.

2.4.3 Photographic checks

During the primary surveys, surveyors took at least one photograph of at least one entrance hole of each putative active sett using a compact digital camera. A laminated sheet of white, A4 paper was placed next to the entrance hole, and on the paper was written the date, location (grid reference), unique cell identifier, unique sett identifier and unique surveyor identifier. This allowed identification of the location and sett as well as providing a means of assessing the scale of the entrance hole and accompanying signs of activity.

Photographs were downloaded and examined by an experienced sett surveyor. This observer looked for evidence within each photograph to refute the claim that the photograph was of an active badger sett entrance hole, therefore belonging to an active badger sett. Such evidence included debris blocking the entrance, vegetation covering the entrance, footprints other than those of badgers in the entrance, faeces from animals other than badgers in the entrance or on the spoil heap (especially rabbit droppings), size (holes appearing less than half the height of the A4 sheet were assessed as mis-classified).

The intention was to quantify overlap and mis-match rates between primary surveys and re-surveys in order to correct active sett counts upwards from the primary surveys, and to estimate the uncertainty component due to imperfect sett detection.

2.4.4 Peer review

Assumptions used to underpin analyses, calculations and interpretation were all externally peer-reviewed. Recommendations to improve estimates were followed. The peer-reviewers accepted the final outputs prior to production of this report.

2.5 Data analysis

To produce an estimate of the total number of active setts in each pilot area the average active sett density measured in the sample areas was multiplied by the total area of each pilot area, and uncertainty was included as the between-sample area relative standard error. Badger genetic profiles collected from hair traps within 40m of a sett were analysed using the CAPWIRE program (Miller et al. 2002. Molecular Ecology 14: 1991-2005) to estimate the number of badgers per active sett, averaged across active setts within 40m of a hair trap. However, in Somerset active setts with more than one active hole were over-sampled, and active setts with one active hole were under-sampled, potentially biasing the population estimate high. Therefore, we re-sampled the hair trapping data (without replacement) in both pilot areas to produce a balanced dataset with large and small active setts represented in proportion to their frequency observed in the field. The resultant estimates of the average number of badgers per active sett was multiplied by the total number of active setts within each area to derive a total population estimate for each area.

3. RESULTS

A total of 183 active setts were found in West Gloucestershire and 275 in West Somerset. Substantial variability in sett surveying ability meant that variation in sett counts between primary surveys and re-surveys was very high and biased. Consequently, sett counts could not be corrected for imperfect sett detection rates, so we assumed that all active setts were found.

Table 1. Measurements contributing to the population estimates.

Location	Somerset	Gloucestershire
Active setts surveyed	275	183
Number of 1 (km^2) squares surveyed	67	80
Area surveyed (km^2)	62.82	77.96
Total pilot area (km^2)	256.05	311.00
Photograph reliability	0.727	0.897
Estimated number of badgers per sett	3.061	5.193
RSE between location (%)	11.39	14.51
RSE mean badgers per sett (%)	21.69	21.31
RSE photograph reliability (%)	3.5	2.3
Average density (80% one-tailed interval) (number per km^2)	9.74 (7.7-11.61)	10.93 (8.54-13.12)

RSE = Relative Standard Error

In Gloucestershire 381 hair traps yielded 563 putative samples and in Somerset 331 hair traps yielded 526 putative samples. A total of 678 samples produced viable badger profiles.

Population estimates, with 80% confidence in both limits, for summer/autumn 2012 are as follows:

West Gloucestershire: 2657 to 4079

West Somerset: 1972 to 2973

4. DISCUSSION

These new estimates have arisen due to the availability of new data. The previous estimates of 15th October 2012 (which were 3145-4391 with a central figure of 3644 for West Gloucestershire and 3740-5085 with a central figure of 4289 for West Somerset, with 80% confidence in both limits) were calculated using an assumed average number of badgers per active sett of 5.4, which was calculated from two other studies conducted over several years in the Gloucester region. This was the best information available at the time, which has now been superseded by new information on the number of badgers per active sett collected in each of the pilot areas.

The new estimates equate to mean densities of 9.74 badgers per km^2 in the West Somerset area and 10.93 badgers per km^2 in the West Gloucestershire area. These are well within the limits of other populations in the west-country, which have included densities as low as $5.8km^{-2}$ and as high as $30.7km^{-2}$. (Cheeseman *et al*. 1981. J. Appl. Ecol. 18: 795-804).

The inability to correct for imperfect sett detection rates is unlikely to substantially affect estimates of sett abundance. We anticipated that sett detection would be imperfect in only one direction, *i.e*.

that setts that were present were not detected, because those incorrectly recorded as active setts were likely to have been filtered out during the analysis of photographs. However, rarely, some surveyors also reported multiple setts when only one was present *i.e*. they classified a single sett as multiple setts. This means that the error was more symmetrical than anticipated, limiting its impact on the central estimate or its uncertainty. Therefore, we are confident that the estimates presented here are as robust as they can be given the data available from which to calculate them.

The bias in sett sampling in Somerset was in large part due to collecting the data for a slightly different objective to the one addressed here. The main impact of sub-sampling the data to correct for this bias was a slight increase in uncertainty, and hence population estimate confidence limits. However, the alternative was a high-biased population estimate. Several attempts were made to re-analyse the data in order to refine estimates and decrease confidence intervals, but the current estimates were concluded to be the most robust and biologically plausible. The new estimates presented here are the best currently-available information on badger population size in the pilot areas, and these should be used in preference to the older estimates.