



Department
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Food & Rural Affairs

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Setting the minimum and maximum numbers in West Gloucestershire and West Somerset for Year 3 of the badger cull

Advice to Natural England

August 2015



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Overview

1. Natural England is the licensing authority for the badger culls. It is a requirement of the Guidance and the licences to set a minimum number in advance of each year's cull in an authorisation letter that is issued to each cull company once the licensing authority is satisfied that the cull company's operations planning and funding are sufficient to deliver a successful cull. The purpose of setting a minimum number under the current licence is to ensure that the cull company delivers the required level of population reduction in order to achieve the expected benefits in controlling bovine TB.
2. This advice to Natural England sets out the approach for estimating the badger population in the West Gloucestershire and West Somerset cull areas in 2015 and the minimum number of badgers to be removed. The approach to setting the minimum and maximum numbers for each cull area in Year 2 of the badger culls was published by Defra in August 2014 in advice to Natural England¹.
3. The minimum number is intended to correspond to a 70% reduction of the population relative to the initial starting population before the culls started in 2013. The culling objective is for no more than 30% of the starting population to remain on conclusion of the cull. The 70% target is derived from the Randomised Badger Control Trial (RBCT) where it was estimated that the culls achieved a mean of 70% control of the starting populations across seven of the ten areas, which resulted in reductions of bovine TB in the cattle herds in those areas.
4. Culling also needs to "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 must set a maximum number of badgers to be removed from the licensed area.

¹ Setting the minimum and maximum numbers for Year 2 of the badger culls. Advice to Natural England. August 2014

<https://www.gov.uk/government/publications/advice-to-natural-england-on-setting-minimum-and-maximum-numbers-to-be-culled-in-year-2>

Estimating badger populations

5. In setting minimum and maximum numbers we need to be mindful of the uncertainty in estimating badger populations. If the numbers are set too low, there is a risk that disease control benefits are not realised. Conversely, setting the number too high may risk a scenario where too many badgers may be removed. In order to optimise delivery of bovine TB control benefits, we need to manage the uncertainty in estimating badger populations appropriately, using the best evidence available.
6. The estimate of population size must relate to the whole culling area, including any land within that area on which no culling is planned to take place. Any population estimate will have some degree of uncertainty which leads to an interval around the population estimate within which the true population is likely to lie.

Starting population in 2013

7. Before the culls started in 2013, the population was estimated in each area by carrying out sett surveys and “hair trapping”. The cull-sample matching (CSM) technique², which can only be carried out after the cull to make a retrospective estimate of the starting population, was considered by the Independent Expert Panel to be the most reliable method for estimating the starting population in 2013³. The range of population estimates (lower and upper 95% confidence intervals and the mid-point) derived from cull-sample matching were published in the AHVLA report on the entire period of the first year of the cull⁴ and are set out in Table 1 in Annex A.

² Appendix 1 - Monitoring the efficacy of badger population reduction by controlled shooting during the first six weeks of the pilots. Report to Defra. January 2014.

<https://www.gov.uk/government/publications/pilot-badger-culls-in-somerset-and-gloucestershire-report-by-the-independent-expert-panel>

³ Badger Culls in Somerset and Gloucestershire. Report by the Independent Expert Panel. March 2014

<https://www.gov.uk/government/publications/pilot-badger-culls-in-somerset-and-gloucestershire-report-by-the-independent-expert-panel>

⁴ The efficacy of badger population reduction by controlled shooting and cage trapping, and the change in badger activity following culling from 27/08/2013 to 28/11/2013. Report to Defra. February 2014.

<https://www.gov.uk/government/publications/pilot-badger-culls-in-somerset-and-gloucestershire-report-by-the-independent-expert-panel>

Methods used for estimating the population in 2015

8. In 2014, sett surveys were the preferred method (Method IV⁵) for the West Somerset area as this area had more comprehensive sett surveys than Gloucestershire.
9. In order to ensure that more accurate assessments of sett activity were available to provide more robust evidence to inform an estimate of the population and minimum number, both cull companies were instructed to carry out a thorough sett survey programme in 2015.
10. Sett surveyors were re-trained by APHA experts to ensure that a consistent approach was taken to assessment and reporting. The positions of all setts and their activity scores (in terms of numbers of active and inactive holes) were collated and plotted on maps. APHA surveyors then carried out a Quality Assurance check in sample parcels across the whole cull area, covering 10-20% of the re-surveyed area. APHA confirmed that the number of active setts recorded by the cull company surveyors in the participating area were broadly consistent with their findings.
11. However, APHA noted that there was a tendency by the cull company to over-estimate levels of activity, and estimated that about 50% of the active setts they checked during quality control assessments or training were less active than indicated in the surveys. No badgers were seen at setts that were assessed as partially active, indicating that these setts are less frequently visited by badgers from other main setts. A summary of the sett survey results is provided in Table 1 in Annex A.

Estimating the number of badgers per active sett

12. The population can be estimated by multiplying the number of active setts by the number of badgers per active sett.

$$P_n = S_n \cdot B_n$$

13. Where P_n is the population, S_n is the number of active setts and B_n is the average number of badgers per active sett after n years of culling.
14. While we have estimates of the average number of badgers per active sett using cull sample matching after the 2013 cull, this is actually a pre-cull estimate (B_0) but to account for any reduction in badgers per sett we need a

⁵ Setting the minimum and maximum numbers for Year 2 of the badger culls. Advice to Natural England. August 2014

<https://www.gov.uk/government/publications/advice-to-natural-england-on-setting-minimum-and-maximum-numbers-to-be-culled-in-year-2>

factor (termed α) to account for any changes the value of this will lie between 0 and 1.

$$P_n = S_n \cdot B_0 \cdot \alpha$$

15. Besides the logical assumption that the number of badgers per active sett will be reduced after culling, there is also empirical evidence and indications from other studies that this occurs. The number of active setts will also change as a result of culling.
- In a previous study of proactive culling, sett activity declined relatively steadily year on year, taking several years of culling to reduce active setts by 70% despite an apparent drop in the population of a similar proportion in the first year. Therefore it is likely that the number of badgers per sett will reduce after culling. Another study also found that, following culling, the remaining badgers use more setts.
 - While a proportion of setts remained active in both areas some had relatively little activity, indicating that there were fewer badgers per sett than usual (see Table 1 in Annex A).
 - Further night observations were carried out in Gloucestershire in 2015 with remote cameras and thermal imaging surveillance by experienced contractors on a sequence of nights. A number of sett locations were observed, including setts that had previously been assessed as active or partially active. Given the small sample size it is not possible to use these observations as definite indicators of numbers of badgers per sett, but, as observational snapshots, they have provided useful evidence to help refine our assumptions. On one large complex sett where low numbers of badgers have been removed, 5 cubs were observed. In all other observations, only 2 cubs were observed.
 - It is very likely that badgers from non-participating areas may roam longer distances into the participating areas to forage, and that a proportion of these were culled. This is supported by evidence from West Gloucestershire that in the first two years of the cull, badgers have been removed in 159 land-parcels with no setts. Thus, the average number of badgers per active sett in the non-participating area is likely to be reduced from the estimated starting average, although we do not know what that reduction might be.
 - Other evidence about levels of maize damage in autumn 2014 has also been considered. Farmers within the cull area have reported a significant reduction in the level of damage to maize crops normally associated with badgers. Farmers who grow maize outside the cull area continue to observe this damage. This evidence is circumstantial and we need to be careful how we use it, but each additional field observation adds some additional evidence and context to the overall understanding of the situation.
 - We also considered the observation by experienced APHA field researchers that there was a tendency by the cull company to over-estimate levels of sett

activity. About 50% of the active setts APHA checked during quality control assessments or training were less active than indicated in the surveys.

16. However putting a quantifiable value on this effect is difficult, as each active sett in the culling area will be affected to varying degrees, as will setts in the inaccessible area, Therefore we conservatively assume a value of α of 0.8 to approximate to the reduction seen in the levels of activity in active setts. This equates to a reduction of approximately one badger for every two active setts.

Non-participating areas

17. Not all land in each cull area is accessible for culling. Non-participating areas, where landowners have not signed up to participate in the cull is also not surveyed. The minimum number needs to take into account the badger population in the non-participating land within the cull area. Setts in the inaccessible area could not be directly targeted by contractors, and are therefore likely to all remain active. We have assumed that the number of active setts per square kilometre in the non-participating land is the same as the estimated number before the cull. This is a highly conservative assumption, but it is based on the original data used in estimating the starting population.
18. The population estimates based on the numbers of active setts for participating and non-participating areas are set out in Table 1 in Annex A. There has been a reduction in the number of active setts compared with the pre-cull surveys, and the reduction is greater in West Somerset than in West Gloucestershire.

Conclusions

19. The process of estimating wildlife populations in order to set targets is subject to uncertainty. This point was recognised by the Independent Expert Panel (IEP) in its report. Similarly, it is difficult to predict how a population may recover as a result of breeding and immigration from surrounding areas after a period of culling. However, operating with uncertainty does not prevent an effective cull from being carried out, as shown during the RBCT culls, where no minimum numbers or targets were set.
20. Taking into account the available evidence and following a similar rationale to 2014,

we use the sett survey method for estimating the population and define the population size at the lower end of the range. This is a precautionary approach and assumes that this method is the most reliable one available. This would set the minimum number of badgers

to be removed in West Gloucestershire at 265; and in West Somerset at 55.

21. The sett survey data for Gloucestershire is more comprehensive in 2015 than it was for 2014. Therefore a method based on data from the field is preferable to a method based on assumptions of population growth which were considered in 2014 for West Gloucestershire. The sett-based method was used in Somerset in 2014.
22. Given the overall uncertainty associated with the methods and the range (lower to upper limits), we consider that it is still more prudent to manage the uncertainty this year (as happened last year) by defining a realistic minimum number that can be revised in the light of new data, than to define it too high, with a risk of removing too many badgers. **Therefore, we conclude that the minimum number of badgers to be removed in West Gloucestershire in 2015 is 265. The minimum number of badgers to be removed in West Somerset is 55.**
23. While we have used the lower estimate, we have been unable to incorporate the variance in the estimates of the number of setts and the variation in the reduction in the average number of badgers per sett. The 95% confidence interval based on the 2013 CSM results therefore underestimates the variance, and so the lower end of the confidence interval used here is higher than the “true” lower 95% confidence interval.
24. The licence also requires Natural England to define a maximum number, for the purposes of avoiding the removal of too many badgers. In the first year of the cull, NE defined the maximum reduction level at 95% of the initial starting population (as opposed to the 70% minimum number) to avoid local extinction in the area. Therefore all of the calculations for the minimum can be repeated for this purpose, simply altering the goal to leave 5% of the initial population rather than 30%. The calculations are shown in Table 1 in Annex A. **Therefore, the maximum number of badgers to be removed in West Gloucestershire in 2015 is 679. The maximum number of badgers to be removed in West Somerset is 524.**
25. In the first year of the culls we learned that we were dealing with more uncertainty than we anticipated, and therefore in defining minimum numbers in subsequent years we needed to avoid false levels of confidence. As last year, we need to consider two realistic scenarios:
 - a) that during the cull, there is accumulating evidence that the number of badgers in the cull area is low, and that the number of badgers removed, against a high level of contractor effort sustained across the whole cull area, is towards the lower end of our estimates. In this scenario, if the minimum and maximum numbers were set too high, Natural England would need to consider adjusting the numbers down to bring them in line with the actual circumstances being observed in the cull to manage the risk of too many badgers being removed; OR

- b) that during the cull, there is accumulating evidence that the number of badgers is higher than the minimum and maximum numbers suggest, either because the cull company quickly exceeds the minimum number, or because feedback from observations suggests there is a higher level of activity observed than expected. In these circumstances, Natural England would need to consider the need to compel the cull company to continue the cull by revising the minimum and maximum numbers upwards to ensure that the optimum disease benefits can be secured.
26. Daily data collected through the course of the cull about the level of effort being applied across the cull area and locations of badgers removed, will enable Natural England to build an assessment of progress towards the cull total. This will allow Natural England to assess whether the estimated population was a reasonable reflection of the true population.
27. The Badger Control Deed of Agreement will allow Natural England to adjust the minimum number during the cull, if required. If the evidence suggests that there are more badgers than the estimates indicated (e.g. because the number of badgers killed per unit effort is relatively high), Natural England will have the ability to revise the number upwards to ensure that the cull company is required to carry on the cull in order to achieve effective disease control, within the 6-week period.
28. Conversely, if the estimates are too high there will be a risk of removing too many badgers. In these circumstances, Natural England could, on the basis of careful consideration of the evidence and provided that the level of effort applied by the cull company has been sufficient, adjust the maximum number downwards before 6 weeks have elapsed.

Annex A

Table 1 West Somerset and West Gloucestershire 2015 Sett survey results and calculations of minimum and maximum numbers

	West Somerset			West Gloucestershire		
	Inaccessible land	Accessible land	Total	Inaccessible land	Accessible land	Total
Cull Area size (km ²)	60	196	256	93.3	217.7	311
Area surveyed in 2015 (km ²)	N/A	177		N/A	217.7	
Active setts surveyed in 2015	<i>High level of activity</i>	78		N/A	132	
	<i>Low level of activity</i>	N/A	52	N/A	48	
	<i>Total</i>	N/A	130	N/A	180	
Estimated Total active Setts 2015	192.4	143.6	336.0	196.5	180	376.5
Estimated Active setts pre-cull 2012	192.4	622.4	814.7	196.5	458	654.8
Active setts in 2015 relative to 2012 pre-cull survey			41.2%			57.5%

	Lower level	Mid-point	Upper level	Lower level	Mid-point	Upper level
Population estimate from CSM 2013	1876	2225	2584	1658	1904	2151
Badgers per sett -pre cull (CSM 2013)	2.30	2.73	3.17	2.53	2.91	3.28
Badgers per sett -adjusted for two years of culling	1.84	2.18	2.54	2.02	2.33	2.62
Estimated Population 2015	618	734	852	762	876	988
30% population level	563	668	775	497	571	645
Minimum number	55	66	77	265	305	343
5% population level	94	111	129	83	95	108
Maximum number	524	623	723	679	781	880