



Department
for Environment
Food & Rural Affairs

Setting the minimum and maximum numbers in badger cull areas in 2022

Advice to Natural England

September 2022



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Overview

1. Natural England is the competent authority for badger control licensing for the purpose of preventing the spread of bovine TB. 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 preparations, 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 cull areas in 2022 and the minimum number of badgers to be removed and the minimum number of badgers that need to be vaccinated for a site in an Edge Area county to qualify for a no-cull zone.
3. The minimum number is intended to achieve a 70% reduction of the population relative to the initial starting population. 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 the 10 areas¹, which resulted in disease reduction benefits for 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 set a maximum number of badgers to be removed from the licensed area.

¹ Woodroffe, R., Gilks, P., Johnston, W. T., Le Fevre, A. M., Cox, D. R., Donnelly, C. A., Bourne, F. J., Cheeseman, C. L., Gettinby, G., McInerney, J. P. and Morrison, W. I. (2008), Effects of culling on badger abundance: implications for tuberculosis control. *Journal of Zoology*, 274: 28–37. doi:10.1111/j.1469-7998.2007.00353.x

5. The approach to setting the minimum and maximum numbers was published by Defra in 2014 to 2021, in advice to Natural England^{2 3 4 5 6 7 8 9 10}.
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. 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.

² Setting the minimum and maximum numbers for Year 2 of the badger culls. Advice to Natural England. August 2014
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/347536/badger-cull-setting-min-max-numbers-2014.pdf

³ Setting the minimum and maximum numbers for Year 3 of the badger culls. Advice to Natural England. August 2015.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/456777/bovinetb-min-max-advice-glos-somerset.pdf

⁴ Setting the minimum and maximum numbers in Dorset for Year 1 of the badger cull. Advice to Natural England. August 2015.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/456776/bovinetb-min-max-advice-dorset.pdf

⁵ Setting the minimum and maximum numbers in licensed badger control areas. Advice to Natural England. August 2016
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/548562/min-max-licensed-badger-control-areas-160824.pdf

⁶ Advice to Natural England on setting the minimum and maximum numbers in licensed badger control areas in 2017. <https://www.gov.uk/government/publications/advice-to-natural-england-on-setting-minimum-and-maximum-numbers-of-badgers-to-be-controlled-in-2017>

⁷ Setting minimum and maximum numbers of badgers to be controlled in 2018: Advice to Natural England. <https://www.gov.uk/government/publications/advice-to-natural-england-on-setting-minimum-and-maximum-numbers-of-badgers-to-be-controlled-in-2018>

⁸ Advice to Natural England on setting minimum and maximum numbers of badgers to be controlled in 2019 <https://www.gov.uk/government/publications/advice-to-natural-england-on-setting-minimum-and-maximum-numbers-of-badgers-to-be-controlled-in-2019>

⁹ Advice to Natural England on setting minimum and maximum numbers of badgers to be controlled in 2020 <https://www.gov.uk/government/publications/advice-to-natural-england-on-setting-minimum-and-maximum-numbers-of-badgers-to-be-controlled-in-2020>

¹⁰ Advice to Natural England on setting minimum and maximum numbers of badgers to be controlled in 2021 [Advice to Natural England on setting minimum and maximum numbers of badgers to be controlled in 2021 - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/publications/advice-to-natural-england-on-setting-minimum-and-maximum-numbers-of-badgers-to-be-controlled-in-2021)

7. This advice is divided into four sections.
 - Section A covers the areas where Supplementary Badger Culling is taking place in 2022.
 - Section B covers the areas where culling began in 2019 to 2021.
 - Section C covers the new areas that will begin culling in 2022.
 - Section D covers concluding remarks affecting all of the areas.
8. To ensure that the special status of the LRA remains, it is vital that we deal swiftly and decisively with any incursion of TB which involves both cattle and badgers. As such, adaptive management, where assessment of the evidence and consideration of a range of options takes place annually, is required. This is so that the most effective course of action is taken to enable eradication within the shortest timescale. The Chief Veterinary Officer (CVO) advises that eradication can only be achieved in an area if infection present in the badger population is addressed alongside that in the cattle population.
9. This year, culling will continue in Area 54-Lincolnshire. Although this area will not have minimum and maximum numbers issued as part of their licence due to the different objective of a cull in this area, they are included here for completeness. Area 32-Cumbria has now moved to vaccination across the whole area.

Section A: Areas 3 to 31

10. In 2022, Areas 3 to 21 will continue Supplementary Badger Control. Areas 22 to 31 will begin Supplementary Badger Control.
11. Both minimum and maximum numbers of badgers to be removed are required in order to sustain the benefits of licensed badger control while avoiding local extinction. As in previous years, for SBC areas 36% of the year one cull total is set as the baseline and the minimum and maximum numbers are set equidistant above and below the baseline so that the difference between them is equivalent to 25% of the pre-cull population. The minimum and maximum numbers are listed in Table 1 of Annex A.
12. This approach will be kept under review as culling in contiguous areas and the larger size of the cull areas could affect the relative levels of immigration and reduce the comparability of cull returns to those in the RBCT. Therefore, the amount of effort deployed by the cull companies and its spatial distribution will

continue to be monitored given the uncertainty in the size of the remaining badger population.

13. Areas 1 and 2 have now ceased culling operations after completing a fifth and final year of their SBC licence in 2021.

Section B: Areas 33 to 61

14. As several hundred badgers have been removed from these areas in previous culls, methods based solely on an un-culled population are no longer appropriate. Instead, as in previous years, surveys of the number of active setts were used to estimate the current population.

15. In order to ensure that accurate assessments of sett activity were available to provide robust evidence to inform an estimate of the population and minimum numbers, all cull companies were instructed to carry out a thorough sett survey programme. APHA surveyors carried out a Quality Assurance check in sample parcels across the whole of the cull areas in year two areas.

16. As described in detail in the 2015 advice to Natural England, the population can be estimated by multiplying the number of active setts by the number of badgers per active sett.

17. As described in 2018, the starting population is estimated by reducing the estimate of the population at the start of year two by one-sixth, to account for 20% population growth in the intervening period, and adding the number culled in year one. The minimum and maximum numbers are then calculated as in previous years, see Table 2 in Annex A. 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 by defining a realistic minimum number that aims to achieve the desired level of population reduction to secure the anticipated disease control benefits than to define it too high, with a risk of removing too many badgers.

18. Areas 37, 38, 40, 41, and 42 have no minimum number, this is because the population estimates indicate a population below 30% of the pre-cull population.

19. In 2022, culling will continue in Area 54 in the Low Risk Area. As explained in the December 2017 consultation document¹¹ and the Government's subsequent

¹¹ Bovine TB: consultation on proposals to introduce licensed badger control to prevent the spread of bovine tuberculosis in the Low Risk Area (England)

response¹², minimum and maximum numbers are of less utility in the Low Risk Area given the different aim of the cull. However, Area 54-Lincolnshire is included in this paper for completeness. Area 32 has now moved to vaccination across the whole area. Further details on the areas and the evidence supporting a cull there is set out in Annexes B and C.

Section C: New areas for 2022

20. Over the last six years, 57 successful first year culls have been carried out, these have taken place across the High Risk and the Edge Area, all taking place in the autumn and all using similarly trained contractors putting in similar levels of effort and using a mixture of controlled shooting and cage trapping. Therefore, we have a better picture of what success looks like and draw on the experience of previous culls and take the average number of badgers culled per km² in previous first year culls as the anticipated cull and set the minimum and maximum numbers equidistant around that value.
21. Using the same method as in 2021 the average number of badgers culled was taken as 3.18¹³ badgers per km². The minimum and maximum numbers are therefore set at 2.70 and 3.66 per km² which are equidistant about the average and maintains the 70%:95% ratio between the minimum and maximum number.
22. Given the overall uncertainty associated with all methods and the range (lower to upper limits), we consider that it is still more prudent to manage the uncertainty this 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.
23. The minimum and maximum numbers of badgers for the new areas in 2022 are shown in Table 3 of Annex A. This approach simplifies the process of setting the minimum and maximum numbers and allows companies to plan earlier without the need for complex calculations. As with previous years this range may prove

https://consult.defra.gov.uk/bovine-tb/badger-control-in-low-risk-area-england/supporting_documents/bovinetbconsultlicensecontrolraengland.pdf

¹² Summary of responses to the consultation on proposals to introduce licensed badger control to prevent the spread of bovine tuberculosis in the Low Risk Area (England)
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/736059/bovine-tb-lra-consult-sum-resp-updated.pdf

¹³ Standard deviation 1.18, range 1.81-7.21

too high for some areas and too low for others, but provided sufficient effort is expended the minimum and maximum numbers can be updated for a given area in the light of the experience in the field following the methodology used in previous years.

24. For the purposes of determining the amount of vaccination required in 2021 to make a vaccination site in an Edge Area county eligible for a no-cull zone in 2022, sites should meet the following criteria.
 - a. For sites with an area of 2.25km^2 or larger there should be at least 2.7 badgers vaccinated per km^2 . The 2.7 per km^2 minimum is based on the approach taken in paragraph 20 in setting the number of badgers that should be removed from a cull area in its first year. This is to ensure vaccination coverage is equivalent to the required cull level.
 - b. For sites smaller than 2.25km^2 the number should be at least 6 badgers which is equivalent to the number needed for a 2.25km^2 site to vaccinate 2.7 per km^2 . This is to ensure that small sites are awarded a no-cull zone only if they have vaccinated a sufficient number of badgers to warrant preventing a cull on adjacent land.

Section D: Conclusions

25. As badger culling continues, we have learnt that there is uncertainty in estimating badger populations, and therefore in defining minimum numbers in subsequent years we needed to avoid false levels of confidence. As with previous years, 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, despite 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, so as 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. 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 at an appropriate point, to ensure that the cull company is required to carry on the cull in order to achieve effective disease control.
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 at an appropriate point.

Annex A: Minimum and maximum numbers

Table 1 Minimum and maximum numbers for cull areas undergoing Supplementary Badger Culling.

Area	Minimum number	Maximum number
Area 3-Dorset	163	383
Area 4-Cornwall	131	380
Area 5-Cornwall	152	461
Area 6-Devon	294	1173
Area 7-Devon	145	455
Area 8-Dorset	475	1685
Area 9-Gloucestershire	219	1118
Area 10-Herefordshire	90	359
Area 11-Cheshire	122	408
Area 12-Devon	194	1155
Area 13-Devon	180	711
Area 14-Devon	85	425
Area 15-Devon	157	393
Area 16-Dorset	427	2057
Area 17-Somerset	86	723
Area 18-Somerset	50	302
Area 19-Wiltshire	284	1238
Area 20-Wiltshire	154	595
Area 21-Wiltshire	122	763
Area 22-Cornwall	448	1948
Area 23-Devon	146	1465
Area 24-Devon	114	421
Area 25-Devon	39	534
Area 26-Devon	55	569
Area 27-Devon	36	154
Area 28-Devon	36	302
Area 29-Gloucestershire	172	878
Area 30-Somerset	230	1795
Area 31-Staffordshire	373	2492

Table 2 Minimum and maximum numbers for cull areas in their second, third and fourth years of badger control.

Area	Minimum number	Maximum number
Area 33-Avon	360	993
Area 34-Cheshire	845	1685
Area 35-Cornwall	529	2163
Area 36-Staffordshire	47	594
Area 37-Devon	0	770
Area 38-Devon	0	963
Area 39-Dorset	40	473
Area 40-Herefordshire	0	691
Area 41-Staffordshire	0	144
Area 42-Wiltshire	0	2437
Area 43-Wiltshire	383	1324
Area 44-Avon	676	1700
Area 45-Derbyshire	171	1421
Area 46-Gloucestershire	201	427
Area 47-Herefordshire	349	1150
Area 48-Leicestershire	247	596
Area 49-Oxfordshire	242	735
Area 50-Shropshire	2675	4766
Area 51-Somerset	259	1887
Area 52-Warwickshire	644	1487
Area 53-Wiltshire	195	447
Area 54-Lincolnshire	N/A	N/A
Area 55-Shropshire	335	493
Area 56-Hampshire	651	1026
Area 57-Berkshire	312	457
Area 58-Staffordshire	464	861
Area 59-Worcestershire	142	362
Area 60-Shropshire	1137	1940
Area 61-Oxfordshire	497	882

Table 3 Size, and minimum and maximum numbers for new areas for 2022.

Area	Size (kmsq)	Minimum number	Maximum number
Area 62-Buckinghamshire	252	680	922
Area 63-Cornwall	103	278	377
Area 64-Cornwall	104	281	381
Area 65-Derbyshire	258	697	944
Area 66-Devon	151	408	553
Area 67-Hampshire	153	413	560
Area 68-Northamptonshire	501	1353	1834
Area 69-Oxfordshire	211	570	772
Area 70-Somerset	100	270	366
Area 71-Warwickshire	252	680	922

Area 72-Warwickshire	534	1442	1954
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Annex B: Summary of Area 32-Cumbria

Background

A potential 'hotspot' area (HS21) was declared in east Cumbria in the LRA of England during 2016. This was due to the emergence of a cluster of breakdowns associated with *Mycobacterium bovis* genotype 17:z. This genotype had not previously been identified in Great Britain, and investigations concluded that this was most likely introduced by cattle imported from Northern Ireland.

From identification of the index case in November 2014 to 15 August 2022 there have been a total of 48 breakdowns across 37 holdings. There are currently three open breakdowns. Collection of 'found dead' badgers and deer is ongoing in the area¹⁴. There have been three positive badgers, all of which were identified in 2017.

Assessing the options

In 2018, a simulation model was used to predict the potential epidemic length in badgers in HS21 as there was little information on the level of infection in badgers. Culling was found to be the intervention most likely to result in the removal of infection from the badger population within an acceptable timescale. In 2019, 2020 and 2021, the results from the surveillance carried out on culled badgers were considered by APHA epidemiologists and ecologists to make recommendations for intervention measures. This year, APHA experts have considered a further year of results from the post mortem examination (PME) of culled badgers alongside the location of cattle breakdowns.

There were no infected badgers identified in the area that continued culling operations in 2021¹⁵, increasing our confidence that infection has been eradicated from the badger population in the area (20.9% in 2018, 14.3% in 2019, 0% in 2020). The rest of the area (104km²) continued or began vaccination operations in 2021 as described previously¹⁰.

The CVO has considered the results and her advice is that badger control, whether culling or vaccination, still should remain in place for a fifth year as we are making tangible progress towards eradication. The aim of badger control within the LRA is disease eradication. The CVO has previously stated that two years of culling with no

¹⁴ NB: not all reported carcasses are collected and submitted for PME. More detail is provided at; https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/974351/tb-surveillance-in-wildlife-mar2021.pdf

¹⁵ The central minimum infected area (MIA; 74km²) where all infected badger carcasses had been located

disclosed infection in the badger population would have to be achieved before a move away from culling could be considered. We have now reached this point for the whole of Area 32.

As there has now been two years of culling with no infected badgers identified in the central minimum infected area, it is appropriate for the final part Area 32 to begin vaccination operations. Vaccination will now be carried out over the whole 214km² area. This year's vaccination operations were carried out between May and July of 2022 with 140 badgers vaccinated. The total number of vaccine doses delivered since 2020¹⁶ is 351.

Based on the evidence to date from cattle and wildlife surveillance showing an improving disease picture, APHA have continued to reduce the cattle testing frequency from six monthly to annual. Cattle keepers in the wider hotspot area (outside of Area 32) have been eligible for annual testing since 2020 and those that begin badger vaccination in 2020 have been eligible since Autumn 2021. Cattle keepers must meet various risk-based criteria and will be assessed on a case-by-case basis.

Stakeholders remain actively engaged with the eradication of disease in the area having delivered four years of effective badger control operations. In Autumn 2019, a steering group involving local stakeholders, with Defra funding, has implemented tools to further improve biosecurity such as free on-farm advice visits by private vets and issuing keepers with information packs. As such, an open farm event to discuss biosecurity was held early 2020 and 130 free advice visits were delivered in the area across 2020 and 2021.

'Found dead' badgers and deer will continue to be tested and the results of this, alongside the ongoing intensive surveillance of cattle, will inform future disease control measures in badgers and cattle in this area.

¹⁶ Vaccination was delivered over 103km² in 2020, 140km² in 2021 and the whole 214km² area in 2022.

Annex C: Summary of Area 54 – Lincolnshire

Background

A potential 'hotspot' area was established in June 2018 following the disclosure of *M. bovis* in a cattle herd in south west Lincolnshire in the LRA of England, near the border with north east Leicestershire in December 2017. Due to its proximity to, and shared genotype with, a cluster of Officially TB Free status Withdrawn (OTFW) breakdowns in north east Leicestershire, the hotspot is situated partially in the LRA and partially in the Edge Area.

From identification of the index case within December 2017 to 15 August 2021 there have been a total of 97 breakdowns across 95 holdings. Collection of 'found dead' badgers and deer is ongoing in the area. There have been three positive badgers, two in the LRA and one in the Edge Area portion of the hotspot, all identified in 2020.

Whole Genome Sequencing (WGS), carried out on all cattle and badger isolates, shows that they are part of clade B3-11 (encompassing the previous genotype 25:a and 25:b) and indicates that they are part of a distinct local cluster. Infection is thought to have originally been introduced to the Edge Area portion of the hotspot via cattle movements from the traditional homerange of this clade (Staffordshire, Shropshire, Cheshire or Derbyshire)

Assessing the options

As mentioned in Annex B, modelling was carried out for HS21 to predict the potential epidemic length in badgers as there was little information on the level of infection in badgers. Whole Genome Sequencing in HS23 suggested through greater variation within the sequences found, that the initial level of badger infection may be greater than observed in Cumbria¹⁷. PME results from the first year of operations confirmed the hypothesis that the level of infection in this area was higher than that in Area 32. This year, APHA experts have considered a further year of results from PME of culled badgers in the second year of operations (2021) alongside the location of cattle breakdowns.

A total of 156 carcasses from 2021 underwent PME, of which 16 were positive for *M. bovis* (10.3%). WGS was carried out and all isolates were clade B3-11. There has been an apparent prevalence reduction in the culled badgers across the two years of culling operations (24.5% in 2020, 10.3% in 2021). Infected badgers were not

¹⁷ There is more variation in sequences and less of a direct relationship to the local cattle cases, indicating that it may have been in the area for a longer period of time.

identified in the 20km² extension to the boundary which was added in 2020. As infected carcasses were mostly central and there is some degree of distinct clustering, it is likely that badgers were originally infected multiple times from cattle.

The CVO has considered the issue and her advice is that as infection remains spread across the area and there has not yet been two years without infection, it is most appropriate to continue with badger culling to reach the overall aim of eradication. As no infection was identified in the extension, APHA ecologists and epidemiologists have advised that the boundaries of the cull area should remain the same.

Culled badgers will continue to be tested and the results of this, alongside the ongoing intensive surveillance of cattle, will inform future disease control measures in badgers and cattle in this area.