Evaluation of the Potential Consequences for Wildlife of a Badger Control Policy in England

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Executive Summary

1. Policy proposals for controlling TB in cattle include a range of options for badger management by culling and/or vaccination. We have conducted an outline assessment of the ecological considerations that would be required for the competent authority, which in this case is Natural England (NE) who will be responsible for issuing licences, to evaluate potential licence applications under this policy. These are in addition to the various considerations pertaining to the culling and/or vaccination of badgers themselves.

2. A number of legislative requirements may apply to the implementation of a badger control policy. Principal among these are the Habitats and Birds Directives, for which the UK has designated Natura 2000 sites which receive a high level of protection in domestic and European law. The Wildlife and Countryside Act and subsequent legislation impose a series of requirements on the protection of sites and species in domestic law.

3. The Area of Interest for this potential policy includes parishes on 12-month cattle testing intervals. This Area extends across 10 whole counties in which there is a large number of protected sites (83 SACs, 18 SPAs and 1370 SSSIs), totalling approximately 2600 km^2. Further protected sites are located in other counties that are not wholly subject to annual TB testing.

4. The Area also contains a number of nationally and internationally significant populations of protected species, including Annex 1 Birds Directive species and Annex 2 Habitats Directive species, and habitats, principally Annex 1 Habitats Directive habitats, for which Natura 2000 sites within the Area of Interest have been designated. Thus applications for management of badgers that might impact directly or indirectly upon these habitats or species areas require consideration. This document provides some of the relevant background information to allow NE to assess whether such activities may require Ecological Impact Assessments.

5. Natural England as the licensing authority will issue licences subject to strict criteria and conditions. As part of the licensing process NE will undertake a screening exercise to determine whether the application may have a significant effect on a protected European site. Unless such an effect can be ruled out on the basis of clear evidence, they will carry out an appropriate assessment of each application.

6. It is not desirable or possible at this stage to conduct a formal Ecological Impact Assessment (EcIA) given that no licence applications have yet been made. However it may be appropriate for potential applicants and NE to conduct such an EcIA before the determination of an individual licensing decision. It will be incumbent upon applicants and the relevant authorities to evaluate the appropriate course of avoidance or mitigation of impacts of the actions, and ensure the obligations arising from the various legislative provisions are addressed.

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Introduction

The Government is considering two intervention methods for the management of bovine Tuberculosis (TB) in badgers: culling and vaccination. The two proposed methods for culling badgers are cage trapping, with despatch of animals by shooting, and shooting of free-ranging badgers. Vaccination would be deployed via cage trapping with intra-muscular injection of BadgerBCG. In the preferred option, farmers and landowners will apply for licences to tackle TB in badgers through culling, vaccination, or a combined strategy of culling and vaccination. Licences will be issued under the Protection of Badgers Act 1992 to cull badgers, subject to a specific set of criteria, while licences to trap and vaccinate badgers will be issued under arrangements already in place. The criteria for granting licences include: culling to be carried out in areas of high and persistent levels of TB i.e. applications being composed predominately of 12-month interval testing areas; culling areas to be a minimum area of 150 km^2; land access available for culling for over 70% of the area; culling to be carried out annually for at least 4 years.

Our remit was to provide a document that details the potential ecological impacts that might result from culling badgers and/or vaccinating badgers in combination with culling. We have considered the area covered by 12-month parish testing intervals, as advised by Defra, and have termed this the 'Area of Interest'.

This area covers much of south west England and the West Midlands. On account of the large size of the Area of Interest, and lack of information on the location, number and size of any potential culling areas, it is clearly not possible to follow a conventional Ecological Impact Assessment (EcIA) process as detailed by the Institute of Ecology and Environmental Management at this stage. Indeed the decision whether to carry out an EcIA rests with the relevant competent authority, which in this case is Natural England (NE). Without specific details of proposals in hand, it is not possible to assess explicitly the likelihood or significance of impacts on protected species or habitats at European, UK, national or regional levels.

Therefore this document seeks to characterise the possible impacts for the consideration of Defra and NE. At this stage, all potential impacts that can be anticipated have been included, with no attempt made to screen out any impacts that may be considered of low significance. It is intended that, on the basis of the information provided within this document, NE will be able to determine whether further steps are necessary, which potential effects may need to considered and under what circumstances an EcIA or similar assessment may be requested.

The document summarises the various pieces of legislation in England that are relevant with respect to the proposed control methods. Locations of sites protected as a result of their European importance (Special Areas of Conservation (SACs) and Special Protection Areas (SPAs)) and national importance (Sites of Special Scientific Interest (SSSIs)) are mapped for the Area of Interest, and the extent of land area covered by such sites is presented by county. Protected species and habitats are tabulated and their likely relevance to the proposed activities described. A general review is presented of the potential impacts that the proposed activities could have, both direct (physical impacts of vehicles, fire-arms usage etc.) and indirect ecological effects (resulting from reducing badger population densities).

Legislation and relevant policy

The following section lists the relevant legislation in the context of the current badger control proposal. It is intended to summarise the legislation, but not to be considered as legal interpretation.

Habitats and Birds Directives

The Habitats Directive (92/43/EEC, adopted in 1992) requires EU Member States to protect species and habitats of European importance. The aim of this Directive is to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements. Listed in the Directive are protected habitats (Annex 1) and species (principally Annex 2). In domestic legislation the directive is primarily transposed in England by the Conservation of Habitats and Species Regulations 2010, producing a network of Special Areas of Conservation (SAC).

The Birds Directive (2009/147/EC, adopted in 1979) provides a framework for the conservation and management of wild birds in Europe. It sets broad objectives for a wide range of activities at the discretion of each Member State, including the protection and maintenance of the populations and assemblages of wild bird species across their natural range, and the identification and classification of Special Protection Areas (SPAs) for populations and assemblages of rare or vulnerable species, regularly occurring migratory species and wetlands of international importance.

SACs and SPAs form a network of Natura 2000 sites (European protected sites). An 'appropriate assessment' (AA) is required to be carried out if "*any plan or project not directly connected with or necessary to the management of the site but likely to have significant effects thereon, either individually or in combination with other plans or projects.*" Hence Appropriate Assessments are required where plans or projects that are not directly linked to the management of that site may have a significant effect on the conservation objectives, and would ultimately affect the integrity of the site. Integrity can be defined as the ability of the site to fulfil its function to continue to support protected habitats or species. Any planning should identify all potential negative impacts, and either amend the plans to avoid any significant impacts, or introduce a mitigation plan that removes any negative impacts. The 'competent national authorities' e.g. a government department or public body, shall agree to a plan or project only after ascertaining that it will not adversely affect the integrity of the site. Projects can still be permitted if there are no alternatives, and there are imperative reasons of overriding public interest (IROPI). This process is known as Habitat Regulations Assessment (HRA) of which an AA is a part. The process works on the precautionary principle which means the onus is on the proponent to prove that no adverse impact will occur. If any doubt remains then it is assumed that a negative impact will occur.

It should be noted that Planning Policy Statement 9 (PPS9) states that Ramsar sites (important wetland sites) should receive the same level of protection as SPA and SAC. They should therefore also be considered in the HRA process.

The Conservation of Habitats and Species Regulations 2010

In England and Wales, the Regulations place a duty on the UK Secretary of State to implement the EU Habitats Directive and Birds Directive through the designation and protection of important

European sites and species. Under the Regulations, competent authorities have a general duty, in the exercise of any of their functions, to have regard to the Directives. The designations in the UK of Special Areas of Conservation (SACs), for habitats and species, and Special Protection Areas (SPAs), for birds are part of the European Natura 2000 network.

Potential relevance to current proposal: A licence application for badger control could be received for an area that includes a European site, or is close enough to a site such that impacts on its functions are possible. In such a scenario there may be a requirement for the proponent and the competent authority to decide whether an HRA is needed. For example, if badger control was proposed to take place in or close to a European site designated for its ground nesting bird assemblage, the potential negative effects of increased fox numbers and associated nest predation, might lead to the requirement of an HRA.

The Wildlife and Countryside Act

The 17 Schedules of the Wildlife and Countryside Act 1981 (WCA) provide for the protection of wildlife (including birds, animals and some plants) the countryside, and the designation of protected areas in Britain. The Act enables the notification of Sites of Special Scientific Interest (SSSIs), selected as the best national examples of habitat type, or sites with notable species or geological features, and contains measures for their protection and management.

Potential relevance to current proposal: There are a range of possible implications for the proposed policy that result from this legislation. For example, throughout a license application area there may be a risk to Schedule 1 bird species protected under the Act, through for example, disturbance caused by shooting or the process of digging-in badger traps. Furthermore applications to cull badgers in an area that includes or borders SSSIs could potentially have legislative implications (especially under the CRoW Act, see below) including possible damage to protected habitats through trapping activities. It is assumed that under the current legislation any entity applying for a culling/vaccination licence would have to prove that no planned actions would contravene current legislation.

Countryside and Rights of Way (CRoW) Act 2000

The CRoW Act places a duty on Government Departments to consider the conservation of biodiversity and maintain lists of species and habitats for which conservation steps should be prioritised or promoted. The CRoW Act imparts powers of the Wildlife and Countryside Act 1981 to further the conservation and enhancement of SSSIs, and to introduce offences whereby third parties can be convicted for 'reckless disturbance' or damaging SSSIs.

Natural Environment and Rural Communities (NERC) Act 2006

The NERC Act places a duty on public bodies and statutory undertakers to ensure due regard to the conservation of biodiversity and the landscape whilst performing its functions. The Act requires the Secretary of State to publish a list of habitats and species which are of principal importance for the conservation of biodiversity in England. These species and habitats, listed under Section 41 of the NERC Act, have been identified as requiring action under the UK Biodiversity Action Plan (UKBAP).

Under the proposed policy NE may require the submission of a form of evidence from the applicant which demonstrates that no significant impacts from a culling operation will take place or have been suitably mitigated against, reducing the impacts to a negligible level. This can be, but does not need to be an EcIA, and may be required in order for NE to discharge its duties under the NERC Act.

Biodiversity Action Plans (BAP)

Based on the Rio Convention on Biological Diversity (1992) which provides the legal framework, the UKBAP is the national strategy with associated action plans to identify, conserve and protect existing biological diversity, and to enhance it wherever possible. The UKBAP, consisting of 1150 species and 65 habitats, describes the biological resources of the UK and provides detailed plans for conservation of these resources. Action plans for the most threatened species and habitats have been set out to aid recovery with Local Biodiversity Action Plans (LBAPs) established to address biodiversity priorities within regions or at specific sites (e.g. *Biodiversity South West* is an example of a regional BAP, which involves local authorities and private organisations working in partnership to deliver 24 LBAPs)

The significance of the UK BAP on the issues considered here, is that the features listed in the UKBAP are equivalent to those identified for protection under the NERC Act as described above.

Characterisation of potential impacts of badger control on the ecosystem

The potential impacts of the current proposals appear to fall into two broad categories: direct physical impacts on habitats or species, caused by activities such as driving vehicles, digging traps into position to catch badgers for culling or vaccinating and indirect ecological impacts, caused by the reduction in badger density and the changes in biological processes such as predation and competition.

Direct impacts

A number of direct effects of a badger control policy are possible. These may occur in certain circumstances and at certain times of year, have significant negative impacts on either individual species, assemblages of species and/or designated sites. In the absence of specific method statements for planned operations it is only possible here to review those actions we think are likely to occur should a licence be granted.

Direct impacts considered here are those that would result from the physical actions of shooting and/or trapping. There are three main areas considered; disturbance, direct damage or harm to protected species and habitats, and the accidental capture of non-target species. Each activity likely to be associated with badger control operations is listed and the potential direct impacts for each listed.

Shooting of free-ranging animals

It is envisaged that shooting of free-ranging animals will be carried out at night either on foot or from vehicles or high seats, using lamps. At this stage the number of shooting hours is not known so quantitative assessment of impacts is not possible. It is possible that there will be a significant increase in the amount of shooting in licenced areas, over and above that currently carried out for vermin control. This has the potential to cause disturbance and/or direct damage to protected species. Disturbance and/or direct damage from shooting has the potential to occur in a number of forms, with varying effects and significance depending on geographic locations and ecological conditions.

Disturbance

Shooting: The most obvious form of disturbance would derive from the use of firearms itself. This could have a negative effect on protected species through displacement away from roosting/resting areas, feeding areas or from dependent young, e.g. nests. This could have a significant negative effect on the local status of the affected species. In the case of shooting from a high seat, the focussed nature of the shooting effort may mean that this practice should be evaluated differently from a more diffuse approach to shooting.

Lamping: There may be a significant level of disturbance from the use of high powered lamps over and above that normally experienced. For example, high and intermittent levels of illumination have been shown to affect the behaviour of bats. In addition, high levels of illumination in an area may cause behaviour similar to that outlined for disturbance from firearm use, i.e. displacement away from roosting/resting areas, feeding areas or from dependent young, e.g. nests. This has the potential to have a significant negative effect on the local status of the affected species.

Driving: It is assumed that in order to carry out badger control using shooting as outlined in Defra's consultation document some proportion of the activity would necessitate vehicles to be driven off-road. There is therefore a risk of elevated levels of disturbance from vehicles away from the normal areas (i.e. roads). This again has the potential to cause the displacement of protected species away from roosting/resting areas, feeding areas or from dependent young, e.g. nests. This has the potential to have a significant negative effect on the local status of the affected species.

Increased footfall: The increase in the number of man hours spent by people in close proximity to protected species, whether using firearms or not, could potentially increase the levels of disturbance. The sight, sound and scent of humans could potentially have a disturbing effect in certain situations, which at a sufficiently high level could have a negative effect on protected species by causing the displacement of protected species away from roosting/resting areas, feeding areas or from dependent young, e.g. nests. This has the potential to have a significant negative effect on the local status of the affected species.

Direct damage or harm

Injury or death to protected species: When using rifles and spotlights at night there exists the risk of accidentally shooting a non-target species. The legal implications of this will depend on the species in question. However, use of sufficiently trained operatives should reduce this risk to a negligible level.

Damage to protected habitats or species through increased vehicle use and/or footfall: There is a risk of damage to protected habitats and/or species from vehicles and people operating in these areas. In areas where protected species of ground nesting birds are breeding there would be an increased risk of nest destruction or death of chicks. In addition a significant increase in the amount of footfall on certain protected habitats could potentially cause elevated levels of erosion and hence a significant reduction in the quality of the habitat.

Trapping

Disturbance

Vehicles: It is assumed that traps will be transported by vehicle to a point as close as possible to a target badger sett. This is likely to be a large vehicle, and could be accompanied by a trailer or a smaller off-road vehicle such as a quad bike. The risks of impacts of disturbance on protected species

would have to be considered relative to the existing levels of disturbance. Trapping operations will require access to the sett on a daily basis for several days, and the cumulative impacts of disturbance from vehicles may potentially become significant. Disturbance from trapping operations may cause the displacement of protected species away from roosting/resting areas, feeding areas or from dependent young, e.g. nests. This could have a significant negative effect on the local status of the affected species. The effects of the trapping process *per se* whether for the purposes of shooting or vaccinating, are considered to be the same, except in situations where the length of operations (the number of repeated visits to the trapping location) is different.

Shooting: Depending on the background level of exposure to shooting activities, the use of shooting to despatch badgers in traps may cause a significant level of disturbance to protected species in the locality of the trapping operation. Again this may well cause the displacement away from roosting/resting areas, feeding areas or from dependent young e.g. nests. This could potentially have a significant negative effect on the local status of the affected species.

Human: A typical badger trapping operation involves several visits to the sett on consecutive days. An initial visit is required to deploy the traps. The traps are locked open and pre-baited for a number of days. Pre-baiting involves putting bait into the traps to encourage badgers to enter the traps for a food reward. This may have to be done on up to 10 days, although can be significantly fewer, depending on how quickly badgers start habitually taking the bait. If vaccinating, the pre-baiting would be followed by two consecutive days of trapping. If culling, then this could be considerably longer. The necessity of re-visiting a site multiple times whilst carrying out a vaccinating or trapping operation will often mean a significant increase in the levels of human disturbance in and around a sett as well as the route of access to the sett. Disturbance from humans has been shown to cause abandonment of nests and/or the prevention of breeding attempts by some birds. If the access route or the sett were close to the breeding site of protected species this may have a significant localised effect.

Direct damage or harm

Vehicles and walking: The likely impacts from both vehicles and walking are considered to be of a similar nature to those outlined above. Owing to the repetitive nature of a trapping operation it is expected to carry a higher risk of causing significant damage or harm both to protected habitats and species. A trapping operation typically involves 8 – 10 repeat visits to dig traps into position, pre-bait, and then trap badgers. For example the probability of a nest being destroyed will be proportional to the time spent either on foot or in a vehicle whilst in close proximity to the nest. This is likely to be significantly greater during trapping operations than shooting of free-ranging animals.

Digging in of traps: When badger traps are deployed it is necessary to 'dig them in.' This involves the shallow excavation of top soil, placing the trap on the bare soil, and covering the base of the trap with soil. This is carried out to prevent the easy displacement of the trap by badgers or other wildlife, and minimise the deterrent effect for badgers that walking on bare mesh may have. There is therefore a risk of damage to protected habitats and or harm to protected species. Hedges and hedge banks where badger setts are often located, are used by a range of species, such as nesting

birds or hibernating animals such as great crested newts or dormice. Digging-in of traps in and around hedge banks has the potential to cause the harm to these protected species.

***Capture of non-targets*:** Capture of non-target animals in badger traps is a well known occurrence, and presents two issues with legal implications. These are the capture of animals that under normal circumstances it is illegal to trap without a licence (Schedules 1 and 5 of the WCA), and the capture of animals where it is illegal to release them into the wild (Schedule 9 of the WCA). The methods for dealing with such occurrences need to be addressed and planned for. Furthermore the capture of a European protected species such as an otter, could have legal ramifications, especially if the capture had a significant effect on the local status of that species. For example trapping of a female with dependent young which led to the death of the young, or the abandonment of a breeding holt. However, in practice otter captures in badger traps are thought to occur rarely, if ever.

Indirect impacts

Manipulating carnivore populations can have significant effects on the structure of ecological communities (Schmitz *et al.* 2004) and removing or reducing the abundance of carnivores may have wider knock-on consequences for the ecology of other species and communities (Henke and Bryant 1999; Berger *et al.* 2001; Johnson *et al.* 2007). This section reviews the existing ecological evidence regarding the known effects of badger removal on the abundance of other species. Much of the evidence comes from research carried out during and alongside the Randomised Badger Culling Trial (RBCT) (Bourne et al. 2007). The RBCT provided a rare opportunity to study the effects of removing a top predator on the remainder of the ecosystem under experimental conditions. The aim of the RBCT was to compare the incidence of cattle infections in a series of 100km^2 study areas, each with one of three experimental 'treatments': no badger culling; reactive badger culling around infected properties; proactive removal of a substantial proportion of resident badgers. Monitoring of the abundance of several species was carried out in a sample of the RBCT study areas to detect changes in population size that occurred in response to badger removal (Defra 2007).

General

The badger is primarily an opportunistic forager (Neal and Cheeseman 1996). In the south of the UK, earthworms appear to be generally the most important food item in terms of frequency of occurrence and biomass (Neal and Cheeseman 1996). A range of mammal species have been seen to occur regularly in badger diet, including rodents (voles, mice and rats), insectivores (moles, shrews) and lagomorphs (rabbits and hares). Birds also appear in the diet of badgers (Neal and Cheeseman 1996; Hounsome and Delahay 2005). Badgers are also important predators of hedgehogs (Doncaster 1992). However, badgers also compete for resources with other species, e.g. foxes, and therefore badger removal may have knock-on effects beyond reductions in direct predation, through changes in abundance of competitor species, and consequently on their prey (Trewby et al 2008).

Ground nesting birds

A number of possible ecosystem responses to badger removal have the potential to have an impact on bird populations. Given that badgers directly eat the eggs and chicks of ground nesting birds, then their removal could result in increasing bird populations. Alternatively, if reduced badger numbers were to lead to an increase in bird predators such as foxes or hedgehogs, this could increased predation pressure and have a negative impact on populations.

Although badgers are known to eat birds and their eggs (Neal & Cheeseman 1996), their potential impact on bird populations is not clear. Taking of avian prey is thought to be largely opportunistic, and the indeed the majority of bird remains found in badger diet analyses are thought to be from carrion (Neal and Cheeseman, 1996). There has been some speculation in the past that predation by badgers may have contributed to the continuing decline observed in many ground nesting bird populations although without supporting scientific evidence. A meta-analysis of studies regarding the occurrence of birds in the diet of UK badgers showed that bird remains were found in 8% of badger faecal / stomach samples (Hounsome and Delahay 2005). Research carried out within the RBCT (Defra 2007) showed that meadow pipit and skylark populations remained constant in culled areas but declined in non-cull experimental control areas. Also, artificial nests deployed to

investigate rates of badger predation tended to have higher survival rates in areas where badgers were culled compared to no-cull control areas. These results should be treated with caution (Hounsome 2005) as there is more than one potential explanation for these results. For example, removal of badgers, and hence a degree of predation may have enabled populations of skylarks and meadow pipits to remain constant while other factors served to suppress populations in non-removal areas. However, by chance the proactive cull sites had larger areas of prime habitat for these species. Hence, an equally valid interpretation is that regional reduction in meadow pipit and skylark abundance due to unmeasured environmental factors and (with no contribution from badger removal), could potentially have caused a contraction in range towards these core areas, resulting in the observed patterns.

If badger removal were to result in an increase in the abundance of other predators of ground nesting birds, such as foxes, hedgehogs, stoats or weasels, then ground nesting birds might experience higher levels of predation. Some authors have suggested that predation by mammals can have significant impacts on ground nesting birds. For example, one recent review suggested that nocturnal mammalian predators were the largest contributors to overall predation of wader nests (Macdonald and Bolton 2008). However, evidence for this being associated with declining populations is equivocal, and difficult to separate from the effects of changes in farming practices. An RSPB study into curlew breeding success in Northern Ireland found that 90% of nest failures were due to predation, with foxes identified as the main species involved (Grant *et al.,* 1999). In a study conducted on the South Downs, grey partridge populations were found to be 2.6 times higher after three consecutive years of predator control when compared to sites where no control activities had occurred (Tapper *et al.,* 1996). Little empirical data exists on the impacts of hedgehogs on ground nesting birds in the UK, although they are thought to be primarily responsible for significant population declines of waders in the Western Isles of Scotland, where they are an introduced species (Jackson 2001).

Removal of badgers during the RBCT precipitated change in the abundance of species that may have a greater and more direct role in the predation of ground nesting birds than badgers. Hedgehog and fox abundance increased significantly in certain areas in response to badger culling. Such effects and the corresponding increased predation pressure could potentially have a significant adverse impact on the survival and nests of ground nesting birds.

Lagomorphs

There are records from the UK of badgers eating rabbits and hares (Kruuk and Parish 1981; Neal and Cheeseman 1996; Trewby 2008), however there is no evidence that badger predation limits or regulates lagomorph populations, and this seems unlikely given badger feeding habits in the UK (Roper 1994). Foxes, by contrast are thought to be important predators of rabbits and hares, and given the potential for fox populations to increase in response to badger culling (Trewby et al 2008), then the predator-prey relationships between foxes and lagomorphs are the primary interest in this current context. The role of foxes in limiting or even regulating rabbit populations has been studied with different outcomes, with some concluding that fox predation could potentially regulate rabbit populations (Trout 2000) while others concluded that although important, fox predation may not be sufficient to regulate rabbit populations (Baker *et al.* 2006). Given that rabbits are an important prey

species for other native carnivores such as stoats, weasels and polecats, any change in rabbit density brought about by the effects of badger removal, has the potential to adversely affect populations of these species. These different study outcomes may reflect the changing ecological and environmental conditions at different locations. Modelling studies have suggested that foxes may play a major role in limiting brown hare populations (Reynolds and Tapper, 1995). In empirical studies, foxes have been shown to be negatively associated with the distribution of hares (Vaughan *et al.* 2003) and Lindström *et al.* (1994) found fox predation to be a crucial factor in limiting the numbers of hares. During the RBCT, in the areas where fox density increased in response to badger culling, no statistically significant changes in lagomorph density were detected (Trewby 2008). However, this should not exclude the possibility of there being negative impacts on lagomorph densities in different locations and ecological conditions. Therefore, given the potential importance of fox predation on rabbits and hare populations combined with the increase in fox density seen in response to badger culling in the RBCT (Trewby et al 2008), then badger removal could potentially have an impact on lagomorph populations.

Foxes

The badger and red fox are sympatric throughout most of England. They feed on similar food types and have similar activity patterns (Lloyd 1980; Neal and Cheeseman 1996; Baker and Harris 2008; Delahay *et al.* 2008). Anecdotal evidence also suggests that foxes use active badger setts as breeding dens and that badgers may predate fox cubs (Neal and Cheeseman 1996; Baker and Harris 2008). Thus, foxes and badgers may compete for resources such as food and suitable breeding sites. The badger is the larger of the two species and apparently dominant in aggressive encounters (Neal and Cheeseman 1996; Macdonald *et al.* 2004) and so may be hypothesised to be the superior competitor. Hence, a reduction in badger density might be predicted to result in an increase in the availability of food resources or breeding sites, allowing the fox population to increase. In the only experimental investigation of the competitive relationship between badgers and foxes, fox abundance did indeed increase in response to badger culling (Trewby et al 2008). Following the initiation of badger culling, mean fox density increased by 57% in culled areas within 24 months, but decreased concurrently by 27% in control areas. In three of the four experimental pairings, there were substantial reductions in the badger population after the initial cull (>60%) and here, where badgers were culled, mean fox densities 1.6–2.3 foxes per km^2 higher than where no culling took place. In contrast in the one area where badger culling was thought to have been less effective (39.3%), fox densities were unchanged (Trewby et al 2008). The reasons for this impact are not known. One hypothesis is that following badger removal, foxes are able to exploit food resource that had previously been monopolised by badgers, although no such shift in fox diet was observed in during this research. Another explanation is that the removal of the badgers would leave an abundance of readily accessible, disused setts which foxes could then exploit as breeding dens, rapidly increasing fox productivity and hence density.

Given the importance of the fox as a predator in the areas likely to be subject to badger culling, any such population response could have significant knock-on consequences.

Hedgehogs

Badgers are important predators of hedgehogs, and both species eat similar invertebrates, such as earthworms and beetles (Neal and Cheeseman 1996; Reeve 1994). Hedgehogs will avoid areas where badgers are active, and therefore be excluded from the most productive habitats, with potential consequences for reproductive performance and survival. In such a relationship (called intra-guild predation (IGP); see Polis *et al.*, 1989) the predator, in this case the badger, may exert a particularly strong influence over the prey population through the combined effects of predation and competition.

Research has shown that hedgehogs can accurately detect badger odour and avoid sites tainted with it, as well as exhibiting a stress response when breathing air that has been impregnated with badger odour (Ward *et al.,* 1997). Translocation experiments have demonstrated hedgehog dispersal away from centres of badger activity and towards residential buildings and urban areas (Micol, 1994). There is also evidence to suggest that hedgehog populations may be regulated by badgers (Doncaster, 1992; Doncaster 1994). During the RBCT, hedgehog population density increased by more than 100% in the proactive cull areas, in comparison to the no-cull control areas where they experienced a slight decline (Defra 2007). This effect was limited to amenity grassland areas in and near villages. Hedgehog numbers found in pastoral areas were extremely low, and no such effect was observed. Based on the previous work described above, it can be concluded that the removal of badgers from an ecosystem, could result in a significant increase in hedgehog abundance. The absence of badgers could lead to hedgehogs moving into suitable areas which they have previously been excluded, with potential impacts on other species groups such as ground nesting birds.

Protected sites, habitats and species within Area of Interest

In order to illustrate the extent of protected attributes in each county within the Area of Interest, data was collated, mapped and tabulated from a range of sources. GIS boundary data for European and UK designated sites were downloaded from the Natural England website. These data were used to map the protected sites, and calculate their size. For areas where only parts of a county were under 12 monthly TB testing, boundaries of the parishes were digitised using data obtained from Defra. Information on distribution, conservation status, ecology and legal designation for birds, mammals, plants and invertebrates was compiled for the Area of Interest, and assessed for inclusion in this review. Similarly, information on protected sites, and the habitats and/or species for which they are designated was compiled. The relevant EU guidance documents for the management of specific habitat types were reviewed in order to determine habitat types on which badger control operations might have an impact.

Information was compiled from the following sources:

1. Habitats Directive (Annex 2), JNCC: (http://www.jncc.gov.uk/ProtectedSites/SACselection/SAC_species.asp)
2. Birds Directive (Annex 1, 2.1 & 2.2). Joint Nature Conservation Committee (JNCC) 'Conservation Designations' list: http://www.jncc.gov.uk/page-3408.
3. SPA species list, JNCC: http://www.jncc.gov.uk/page-1419.
4. Wildlife and Countryside Act (Schedule 1): http://www.legislation.gov.uk/ukpga/1981/
5. NERC Act (Section 41). Natural England 'Habitats and Species' list: (http://www.naturalengland.org.uk/ourwork/conservation/biodiversity/protectandmanage/habsandspeciesimportance.aspx).
6. The UK Biodiversity Action Plan website: http://www.ukbap.org.uk/.
7. The National Biodiversity Network Gateway (http://www.searchnbn.net/index_homepage/index.jsp).
8. Royal Society for the Protection of Birds: http://www.rspb.org.uk/
9. British Trust for Ornithology: http://www.bto.org/

The following figures and tables indicate the distribution of protected sites within the Area of Interest and detail the number and extent of protected sites in each county. The list is not exhaustive, and is intended to give a guide to the relative prevalence of statutory protection across the Area. Figure 1 shows the Area of Interest, within which a licence application for badger control could be considered, and the distribution Natura 2000 sites within the area. The Area of Interest is defined by the location of 12 monthly testing parishes. The distribution of SACs and SPAs is presented separately in Figure 3 and Figure 4 respectively (Appendix). All SACs and SPAs are also designated as SSSIs, although parts of these are managed as National Nature Reserves (NNRs). A map of SSSIs is given in Figure 2, but it should be noted that many SSSIs are too small to be visible at this map scale. The number and area of protected sites in each county wholly under 12 monthly TB testing is shown in Table 1. The number and area of protected sites in counties that fall partially in the areas of interest are shown in Table 2. Table 3 presents the distribution of SSSIs only, of different sizes in counties wholly under 12 monthly testing (Appendix).

Protected species occurring in the Area of Interest considered to be at potential risk from badger control operations, are listed in Table 4 (Appendix). Protected habitats under the Habitats Directive known to occur in the Area of Interest, and the potential impacts on them arising from badger control operations are given in Table 5 (Appendix).

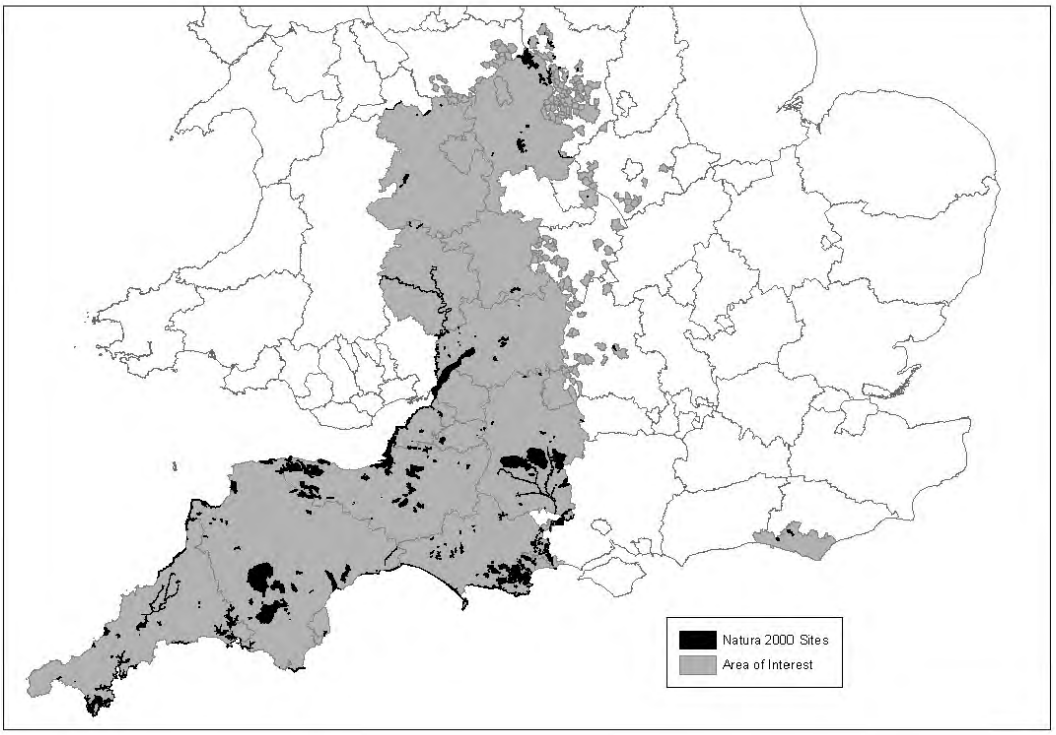

Figure 1. All Natura 2000 sites (Special Areas of Conservation and Special Protection Areas) in Area of Interest.

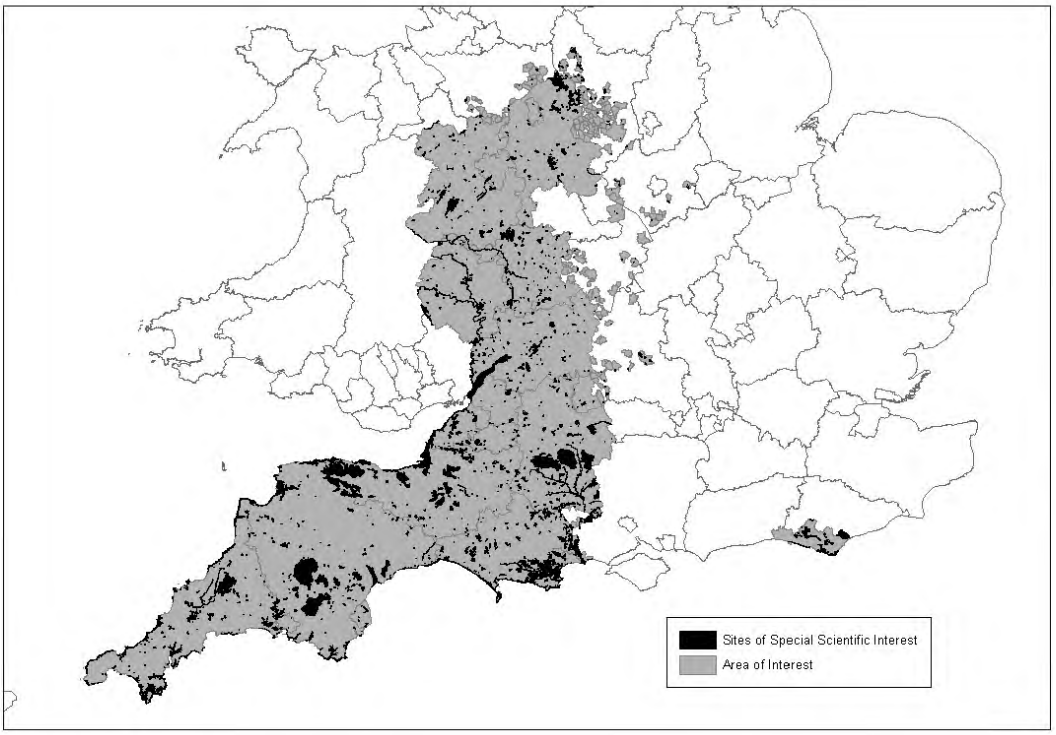

Figure 2. Distribution of Sites of Special Scientific Interest (SSSIs) in Area of Interest.

Table 1. The number and total area of European and UK protected sites in each county, wholly under 12 monthly TB testing.

County	Number of SPAs	Total area of SPAs (ha)	Number of SACs	Total area of SACs (ha)	Number of SSSIs	Total area of SSSIs (ha)	Proportion of county that is protected (%)
Wiltshire	3	29,678	10	51,364	141	58,987	17
Gloucestershire (including South Gloucestershire)	2	8,854	8	49,214	147	17,997	15
Somerset (including N. Somerset, Bristol & Bath & N.E Somerset)	3	24,572	12	59,160	193	51,677	13
Devon	3	4,629	19	46,743	215	62,940	9
Dorset	4	12,430	15	13,582	144	22,580	8
Cornwall	2	2,000	16	20,667	171	22,095	6
Staffordshire	1	3,420	8	4,918	68	10,905	4
Herefordshire	0	-	4	1,049	77	5,585	3
Worcestershire	0	-	2	362	117	5,457	3
Shropshire (Including Telford & Wrekin)	0	-	7	1,696	113	8,965	0.5
Total	18	85,583	101	248,755	1,386	267,188	

Table 2. Number and extent of protected areas in counties that are not wholly within the Area of Interest.

County	% of county under 12 month testing	Total SPAs and SACs in affected parishes	Total area of SPAs and SACs in affected parishes (ha)	Total SSSIs in affected parishes	Total area of SSSIs in affected parishes (ha)
Derbyshire	27	4	16,273	39	36,476
East Sussex	23	2	261	21	6,542
Warwickshire	20	1	4	13	202
Cheshire	12	0	-	11	328
Oxfordshire	9	1	177	21	754
Leicestershire	8	0	-	10	374

Discussion

The Institute of Ecology and Environmental Management provides detailed guidance on the mitigation of ecological impacts of projects. In what is an iterative process, proponents are encouraged to:

1. Avoid negative ecological impacts - especially those that could be significant.

2. Reduce or mitigate negative impacts that cannot be avoided.

3. Compensate for any remaining significant negative ecological impacts.

Furthermore, simply avoiding carrying out operations in or adjacent to protected areas (including European sites) may not necessarily remove the need for any potential negative effects to be investigated, as impacts from culling operations may extend beyond culling areas into protected sites.

In order to meaningfully assess impacts of proposed badger control operations, scheme details are obviously required. Given the above framework, the most obvious step that applicants could take to avoid much of any potential regulatory burden would be to not work on any protected sites. Hence the boundaries of any badger control area could be drawn with this in mind, although given that impacts from culling operations may extend beyond culling area boundary, consideration would have to be given to what the zone of influence would be. This is particularly relevant in the case for Natura 2000 sites due to the level of legal protection. An example of this could be avoiding carrying out trapping for culling or vaccinating in sensitive areas such as SACs designated for rare plant assemblages that could be damaged by vehicular use or trap deployment. Sites of Special Scientific Interest are often small, and their protected status may be as a result of geological rather than ecological features. Hence badger control operations in certain circumstances may have little or no negative impacts, illustrating why applications may require to be assessed on a case by case basis. There are likely also to be impacts that could potentially be reduced through careful planning. For example disturbance of protected bird species through the use of firearms could potentially be reduced by only permitting firearm use outside of the breeding season at that location.

This document aims to provide the necessary background information required for NE to be allowed to make a 'screening opinion', or decide on the need or otherwise for an EcIA and/or HRA in respect of specific licence applications. The report aims to highlight the possible mechanisms whereby an ecological impact may occur as a result of the proposed badger control work. This report makes little attempt to 'screen out' those potential impacts that are unlikely to occur, as this is an iterative process and according to the IEEM guidelines should involve consultation with competent authorities (NE) and other relevant bodies. The information within the report should provide the basic foundation for such consultation between potential applicants and the relevant authorities.

It is likely that such a consultation would result in the screening out of many of the potential impacts discussed here, for the whole of the Area of Interest, with only site-specific issues to

be considered over and above those already considered of no significance. One possible approach could be to produce a Generic Screening Report applicable to the whole Area of Interest. Therefore if NE deemed that EcIAs were necessary in order to issue a license, then this could, in a high proportion of cases, be a rapid and inexpensive process compared to the usual EcIA process, involving significantly less consultation with the competent authority or statutory consultees.

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Appendix .

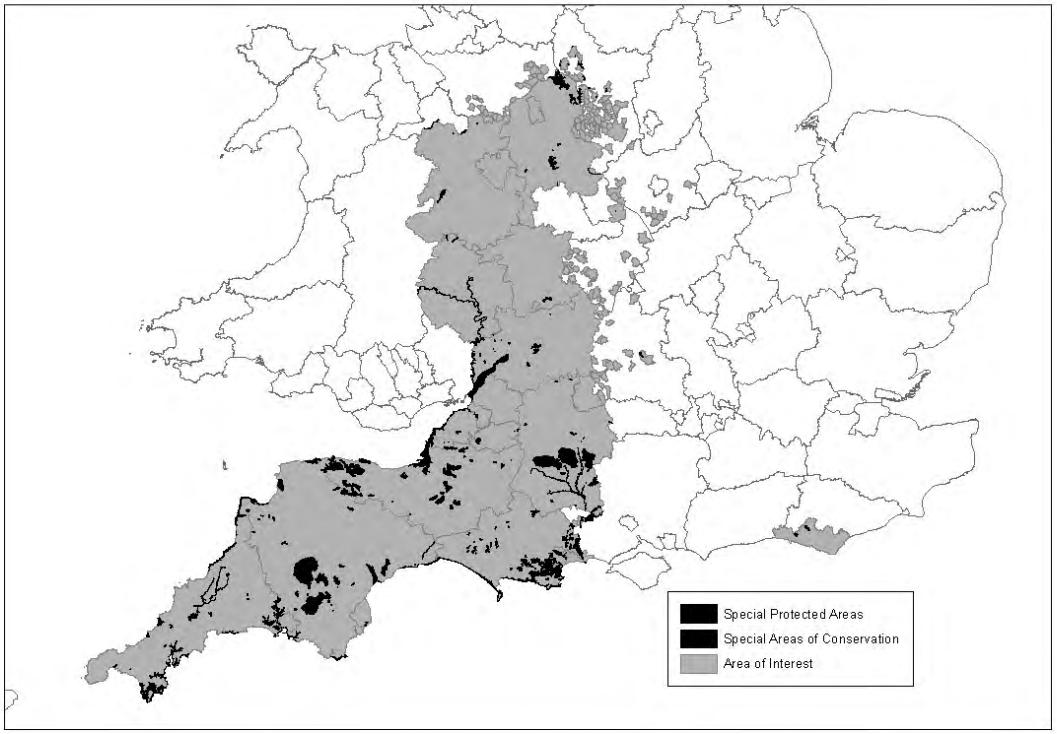

Figure 3. Distribution of Special Areas of Conservation (SACs) in the Area of Interest

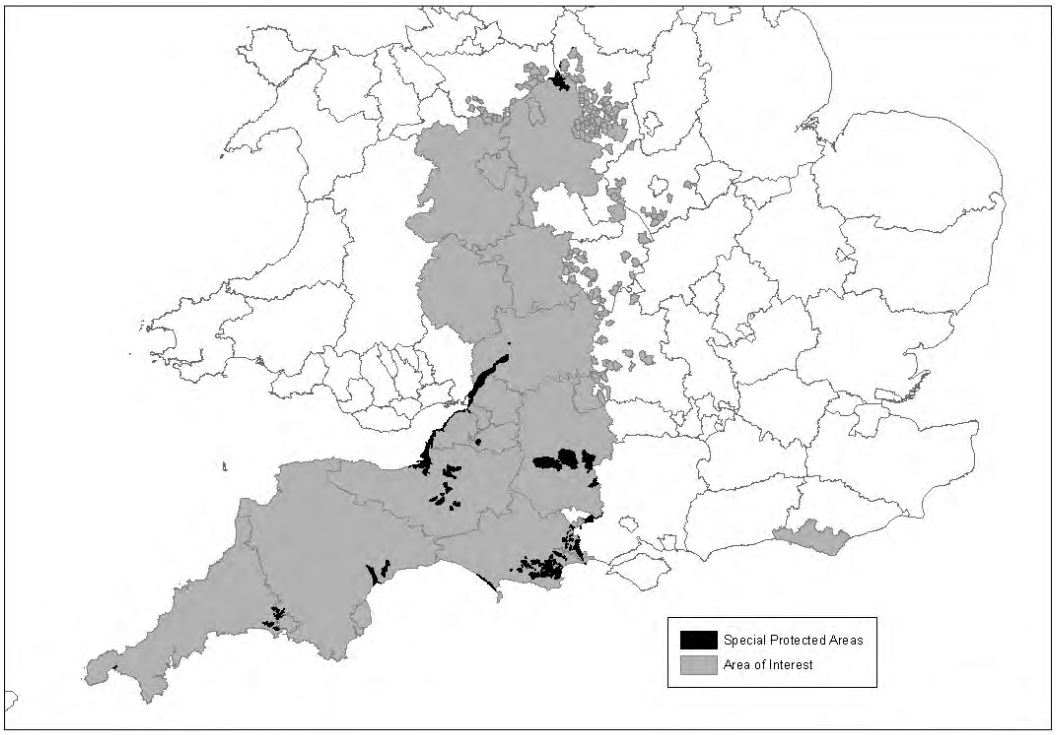

Figure 4. Distribution of Special Protection Areas (SPAs) in Area of Interest

Table 3. Numbers of Sites of Special Scientific Interest of various sizes in each county, wholly in the Area of Interest.

	Number of SSSIs				
County	**<10 ha**	**10-100 ha**	**100-1000ha**	**> 1000ha**	**Total**
Wiltshire	40	76	22	3	141
Gloucestershire (including South Gloucestershire)	77	54	14	2	147
Somerset (including N. Somerset, Bristol & Bath & N.E Somerset)	78	79	34	8	193
Devon	84	84	34	13	215
Dorset	63	33	44	4	144
Cornwall	59	68	41	3	171
Staffordshire	22	32	11	3	68
Worcestershire	73	36	7	1	117
Herefordshire	41	24	11	1	77
Shropshire	66	32	13	2	113

Table 4. Protected species present within the Area of Interest. (SPA/SAC Grade A: Outstanding example in a European context. Grade B: Excellent example of the feature but of somewhat lower value than grade A sites).

SPECIES	Protection Status	Possible negative impacts from badger control activities	Feature of Natura 2000 site in Area of Interest?	Potential Cumulative Impacts
Invertebrates (Under European Legal Protection):				
Marsh fritillary ***Euphydryas aurinia***	Habitats Directive Annex 2 (Arthropods)	Disturbance & Displacement: Digging, Driving.	7 Grade A/B SACs in Area of Interest	Repeated disturbance may affect population status
Notes: Possible negative or positive impact from localised fluctuations in rabbit numbers grazing of larval food plant (Devil's-bit Scabious).				
Vertebrates (Under European Legal Protection):				
Great crested newt ***Triturus cristatus***	Habitats Directive Annex 2 (Amphibians)	Disturbance & Displacement: Digging, Driving.	5 Grade A/B SACs in Area of Interest	Repeated disturbance may affect population status
Notes: Infrequent predation from badgers resulting in a positive impact from reduction in badger numbers (possible negative off-set by predation increase from hedgehogs). Possible disruption of winter hibernation sites or summer foraging areas.				
Lesser horseshoe bat ***Rhinolophus hipposideros***	Habitats Directive Annex 2 (Terrestrial Mammals)	Disturbance & Displacement: Digging, Driving, Shooting.	3 Grade A/B SACs in Area of Interest	Repeated disturbance may affect population status
Notes: Possible negative impact as vulnerable to disturbance at linear habitat corridors (hedgerows) where badger trapping likely to occur. Shooting at night may require the use of artificial light, the use of which, if sustained and repeated, might influence bat behaviour.				
Greater horseshoe bat ***Rhinolophus ferrumequinum***	Habitats Directive Annex 2 (Terrestrial Mammals)	Disturbance & Displacement: Driving, Shooting.	6 Grade A/B SACs in Area of Interest	Repeated disturbance may affect population status
Notes: Possible negative impact as vulnerable to disturbance at both summer and winter roost sites (underground crevices). Shooting at night may require the use of artificial light, the use of which, if sustained and repeated, might influence bat behaviour.				
Barbastelle bat ***Barbastella barbastellus***	Habitats Directive Annex 2 (Terrestrial Mammals)	Disturbance & Displacement: Driving, Shooting.	3 Grade A/B SACs in Area of Interest	Repeated disturbance may affect population status
Notes: Possible negative impact as very vulnerable to disturbance at both summer and winter roost sites (crevices in old trees). Shooting at night may require the use of artificial light, the use of which, if sustained and repeated, might influence bat behaviour.				
Bechstein's bat ***Myotis bechsteinii***	Habitats Directive Annex 2 (Terrestrial Mammals)	Disturbance & Displacement: Driving, Shooting.	4 Grade A/B SACs in Area of Interest	Repeated disturbance may affect population status
Notes: Possible negative impact as vulnerable to disturbance at both summer and winter roost sites (crevices underground and in old trees). Shooting at night may require the use of artificial light, the use of which, if sustained and repeated, might influence bat behaviour.				
Otter ***Lutra lutra***	Habitats Directive Annex 2 (Terrestrial Mammals)	Disturbance & Displacement: Digging, Driving, Shooting.	1 Grade A/B SAC in Area of Interest	None expected
Possible negative impact from disturbance of holts in breeding season. Accidental capture of otters in traps possible but unlikely based on previous studies				

SPECIES	Protection Status	Possible negative impacts from badger control activities	Feature of Natura 2000 site in Area of Interest?	Potential Cumulative Impacts
Dormouse ***Muscardinus avellanarius***	Habitats Directive Annex 4; Conservation of Habitats and Species Regulations 2010 Schedule 2; England NERC S.41; UKBAP Priority Sp.	Disturbance & Displacement: Digging.	-	Uncertain
Notes: Possible negative impact of displacement from disturbance to hedgerows and nest sites from culling activities. Possible increase in predation pressure due to elevated fox population.				
Birds (Under European Legal Protection):				
Chough ***Pyrrhocorax pyrrhocorax***, Corncrake ***Crex crex***, European Nightjar ***Caprimulgus europaeus***, Hen Harrier ***Circus cyaneus***, Merlin ***Falco columbarius***, Roseate Tern ***Sterna dougallii***, Stone-curlew ***Burhinus oedicnemus***, Woodlark ***Lullula arborea*** Dartford warbler ***Sylvia undata***	Birds Directive Annex 1	Disturbance & Displacement: Digging, Driving, Shooting.	Number of SPAs in Area of Interest for: European Nightjar (2), Hen Harrier (3), Merlin (1), Stone-curlew (2), Woodlark (2).	Unknown, depends in part on the effect of increased fox numbers, relative to the impact of reduced badger population.
Notes: Possible negative impact on ground nests from driving across sites and digging in traps. Possible negative impact from an increase in fox predation of eggs and chicks in nests on ground. However, reduction in predation pressure from badgers. Possible negative impact on breeding sites from shooting activities.				
Grey Partridge ***Perdix perdix***	Birds Directive Annex 2.1	Disturbance & Displacement: Digging, Driving, Shooting.	-	Unknown, depends in part on the effect of increased fox numbers, relative to the impact of reduced badger population.
Notes: Possible negative impact from an increase in fox predation of eggs in nests on ground. However, reduction in predation pressure from badgers. Possible negative impact on ground nests from driving across sites and digging in traps. Possible negative impact on breeding sites from shooting activities.				
Eurasian Curlew ***Numenius arquata***, Northern Lapwing ***Vanellus vanellus***, Skylark ***Alauda arvensis*** **subsp.** ***arvensis/scotica***, Song Thrush ***Turdus philomelos*** **subsp.** ***Clarkei***	Birds Directive Annex 2.2	Disturbance & Displacement: Digging, Driving, Shooting.	Number of SPAs in Area of Interest for: Eurasian Curlew (3), Northern Lapwing (4).	Unknown, depends in part on the effect of increased fox numbers, relative to the impact of reduced badger population.

SPECIES	Protection Status	Possible negative impacts from badger control activities	Feature of Natura 2000 site in Area of Interest?	Potential Cumulative Impacts
Notes: Possible negative impact from an increase in fox predation of eggs in nests on ground. However, reduction in predation pressure from badgers. Possible negative impact on ground nests from driving across sites and digging in traps. Possible negative impact on breeding sites from shooting activities.				
Plants (Under European Legal Protection):				
Early gentian ***Gentianella anglica***	Habitats Directive Annex 2 (Flowering Plants)	Disturbance: Digging, Driving.	7 Grade A/B SACs in Area of Interest	None expected
Notes: Possible negative or positive impact from localised fluctuations in rabbit numbers, where plant benefits from rabbits grazing competing species.				
Birds (Under UK Legal Protection):				
Common Cuckoo ***Cuculus canorus,*** Corn Bunting ***Emberiza calandra* subsp. *calandra/clanceyi,*** Grasshopper Warbler ***Locustella naevia,*** Marsh Warbler ***Acrocephalus palustris,*** Red Grouse ***Lagopus lagopus* subsp. *Scotica,*** Reed Bunting ***Emberiza schoeniclus,*** Ring Ouzel ***Turdus torquatus,*** Tree Pipit ***Anthus trivialis,*** Wood Warbler ***Phylloscopus sibilatrix,*** Yellowhammer ***Emberiza citronella,*** Yellow Wagtail ***Motacilla flava* subsp. *flavissima***	England NERC S.41; UKBAP Priority Sp.	Disturbance & Displacement: Digging, Driving, Shooting.	-	Increasing negative impact on breeding populations
Notes: Possible negative impact from an increase in fox predation of eggs in nests on ground. However, reduction in predation pressure from badgers. Possible negative impact on ground nests from driving across sites and digging in traps. Possible negative impact on breeding sites from shooting activities.				

SPECIES	Protection Status	Possible negative impacts from badger control activities	Feature of Natura 2000 site in Area of Interest?	Potential Cumulative Impacts
Cirl Bunting ***Emberiza cirlus*** Firecrest ***Regulus ignicapillus*** Hobby ***Falco subbuteo*** Kingfisher ***Alcedo atthis*** Red Kite ***Milvus milvus*** Barn Owl ***Tyto alba*** Peregrine ***Falco peregrines*** Common Quail ***Coturnix coturnix*** Little Tern ***Sterna albifrons***	Wildlife & Countryside Act, S. 1	Disturbance & Displacement: Driving, Shooting.		Increasing negative impact on breeding populations
Notes: Possible negative impact on breeding sites from activities associated with trapping and shooting, or shooting alone.				
Mammals (Under UK Legal Protection):				
Water Vole ***Arvicola amphibius***	England NERC S.41; UKBAP Priority Sp.	Disturbance & Displacement: Digging.	-	Uncertain
Notes: Possible negative impact as vulnerable to predation by foxes. Possible disturbance from digging of winter burrows on dry ditches.				
Hedgehog ***Erinaceus europaeus***	England NERC S.41; UKBAP Priority Sp.	None	-	Increasing positive impact on population
Notes: Possible positive impact from reduction in badger numbers.				
Brown Hare ***Lepus europaeus***	England NERC S.41; UKBAP Priority Sp.	Disturbance & Displacement: Driving.	-	Uncertain
Notes: Possible negative impact of displacement and disturbance from culling activities. Likely increase in predation pressure due to elevated fox population.				
Harvest Mouse ***Micromys minutus***	England NERC S.41; UKBAP Priority Sp.	Disturbance & Displacement: Digging.	-	Uncertain
Notes: Possible negative impact of displacement from disturbance to nest sites from culling activities. Predation increase from foxes.				
Polecat ***Mustela putorius***	England NERC S.41; UKBAP Priority Sp.	Disturbance & Displacement: Digging/shooting.	-	Uncertain
Notes: Possible negative impact from competition from foxes. Possible negative impact of displacement from disturbance from culling activities.				
Other Ecological Receptors:				
Fox ***Vulpes vulpes***	Wild Mammals (Protection) Act 1996	Disturbance & Displacement: Digging.	-	Uncertain
Notes: Possible positive impact from reduction in badger numbers; increased availability of breeding sites and reduced dietary competition.				
Rabbit ***Oryctolagus cuniculus***	Wild Mammals (Protection) Act 1996	Disturbance & Displacement: Digging.	-	Uncertain
Notes: Possible positive or negative impact from reduction in badger numbers, increased breeding sites,				

SPECIES	Protection Status	Possible negative impacts from badger control activities	Feature of Natura 2000 site in Area of Interest?	Potential Cumulative Impacts
increased fox predation.				

Table 5. Annex 1 protected habitats under the Habitats Directive within the Area of Interest.

HABITAT TYPE	Significance / Value of Habitat	Counties within Area of Interest containing this habitat	Potential Threats from Badger Control Operations	Cumulative Impacts
Northern Atlantic wet heaths with *Erica tetralix*	Wet heath is an important habitat for a range of vascular plant and bryophyte species of an oceanic or Atlantic distribution in Europe, several of which have an important part of their EU and world distribution in the UK.	Cornwall Devon Dorset Somerset Wiltshire Staffordshire	a) Habitat damage / Disturbance to ground nesting birds. b) Loss or damage to dwarf shrubs can lead to expansion of grassland habitats and loss of wet heathland. c) Trampling by human activity and soil compaction by vehicles can lead to erosion and habitat loss. d) Habitat likely to be under specific management regime that includes burning and grazing, would need to be taken into consideration when planning work. e) Ground disturbance due to digging in traps; one of the key indicators of restoration success in this habitat is few areas of disturbed bare ground (*EU Management Plan for Wet Heath)*	Likely, repeated access to same areas by fieldworkers and vehicles may lead to erosion. Placement of traps in the same sites over consecutive years could lead to intense, localised damage to the ground. Repeated disturbances to ground nesting birds could impact the population or lead to site abandonment
Temperate Atlantic wet heaths with *Erica ciliaris* and *Erica tetralix*	This form of heathland is confined to warm, oceanic locations in the UK. It is a rare habitat, occurring naturally only in Dorset and Cornwall. This is an EU priority Habitat.	Cornwall Dorset	See above	See above

HABITAT TYPE	Significance / Value of Habitat	Counties within Area of Interest containing this habitat	Potential Threats from Badger Control Operations	Cumulative Impacts
European Dry Heaths	Dry heaths in the UK exhibit exceptional diversity in comparison with examples found elsewhere in the EU.	Cornwall Staffordshire Devon Dorset Somerset	Habitat contains many rare species of butterflies, beetles, ground nesting birds and reptiles. These could be affected through disturbance or habitat degradation as a result of badger removal / vaccination operations. In addition, sites may support plant and mosses etc. of international importance.	Likely to be cumulative effects of repeated access to the same areas of an SAC.
Dry Atlantic coastal heaths with *Erica vagans*	In the UK, this habitat occurs at a single site, the Lizard, in the extreme south-west of England, where its total extent is less than 1,000 ha. This is an EU Priority Habitat.	Cornwall	Potential impacts on rare plant communities through vehicular access. Potential impacts on ground nesting birds e.g. nightjars, curlews and lapwings, through increased site access. Risks of nest desertion as a result of increased use of firearms.	Repeated visits by vehicles could lead to long term damage to rare plants. Repeated disturbances to ground nesting birds could impact the local population or lead to site abandonment
Juniperus communis formations on heaths or calcareous grasslands	Salisbury Plain represents *Juniperus communis* formations near the southern edge of the habitat's range on chalk in southern England, where it is particularly rare. This site is the best remaining example in the UK of lowland juniper scrub on chalk.	Wiltshire	Unlikely that Juniper trees will be detrimentally affected by badger control operation. Damage very unlikely except in the case of very young plants.	Unlikely
Calaminarian grasslands of the Violetalia calaminariae	Calaminarian grasslands and associated rock outcrops provide a habitat for several scarce plants. Some sites hold important populations of rare bryophytes and lichens.	Cornwall Staffordshire	Home to many rare species of metallophytic bryophytes; these could potentially be damaged through trampling and substrate disturbance whilst digging in traps	Repeated trap deployment at the same sites over a number of consecutive years likely to cause intense, localised damage to bryophyte communities.

HABITAT TYPE	Significance / Value of Habitat	Counties within Area of Interest containing this habitat	Potential Threats from Badger Control Operations	Cumulative Impacts
Semi-natural dry grasslands and scrubland facies: on calcareous substrates (Festuco-Brometalia)	Semi-natural dry grasslands, which were once widespread in Europe, are now a scarce and threatened habitat. There are no overall estimates available for the extent of this habitat type in Europe as a whole. Holds important populations of the UK endemic Annex II plant Early gentian *(Gentianella anglica)*	Dorset Bristol Somerset Staffordshire Gloucestershire Wiltshire	a) Species of international importance e.g Marsh Fritillary Butterfly are found in this habitat, disturbance or habitat destruction could affect local populations. b) Disturbance to ground nesting birds; unintentional human disturbance during the breeding season has already been held responsible for breeding failures in this habitat. c) Trampling due to human activity and soil compaction by vehicles can lead to erosion and changes in species composition *(EU Management Plan)* d) Bare patches of earth created where traps are sited provide favourable areas for invasion by undesired species.	Repeated disturbances to ground nesting birds could impact the population or lead to site abandonment. Likely, repeated access to same areas by fieldworkers and vehicles may lead to localised erosion. The creation of permanent bare patches of earth through consecutive years of disturbance may increase the chance of invasive species establishing in the community.
Semi-natural dry grasslands and scrubland facies: on calcareous substrates (Festuco-Brometalia) (important orchid sites)	This priority habitat type comprises Festuco-Brometalia calcareous grasslands containing important orchid assemblages and/or rare orchids.	Wiltshire Dorset	As above, but with additional consideration given regarding potential damage to rare orchid species held within the habitat.	As above Repeated access to the same areas on a site may cause long term damage to populations of rare plants, including orchids.

HABITAT TYPE	Significance / Value of Habitat	Counties within Area of Interest containing this habitat	Potential Threats from Badger Control Operations	Cumulative Impacts
Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae)	Many sites show transitions between *Molinia* meadows and other Annex I habitats, and several sites also support the Annex II species marsh fritillary *Euphydryas aurinia*.	Devon Wiltshire Dorset Somerset	a) Species of international importance e.g Marsh Fritillary Butterfly are found in this habitat, disturbance or habitat destruction could affect local populations. b)Potential for damage to rare plant populations, including orchids, through trampling and soil compaction	Consecutive years of damage to plants depended on by Marsh Fritillary e.g Devils-bit Scabious could impact on local population status. Repeated access to the same areas on a site may cause long term damage to populations of rare plants including orchids.
Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*)	This Annex I type comprises species-rich hay meadows on moderately fertile soils of river and tributary floodplains. This grassland type is rare in the UK and occurs almost entirely in central and southern England, with a few outlying fragments along the Welsh borders.	Staffordshire	a) Potential for damage to rare plant populations, including orchids; trampling due to public access already known to be problematic on single UK site. Badger removal / vaccination operations would increase this impact, particularly if vehicles were used. b) Disturbance to ground nesting birds, particularly during the breeding season; conflict already exists between managing the habitat and reducing disturbance to birds.	Repeated access to the same areas on a site may cause long term damage to populations of rare plants including orchids. Repeated disturbances to ground nesting birds could impact breeding success or potentially lead to site abandonment.
Atlantic acidophilous beech forests with *Ilex* and sometimes also *Taxus* in the shrublayer (Quercion robori-petraeae or	In the UK the native range of this Annex I type is restricted, and extensive stands on acid sites are rare outside south-east England.	Wiltshire	a) Unlikely that tree community would be physically damaged by activities relating to badger removal / vaccination operations. b) Disturbance to ground nesting birds possible c) Habitat known to contain rare mosses and lichens but these are epiphytic and are therefore unlikely to be impacted. Similarly,	Cumulative physical impacts on habitat itself unlikely. Repeated disturbances to ground nesting birds could impact breeding success or potentially lead to site abandonment.

HABITAT TYPE	Significance / Value of Habitat	Counties within Area of Interest containing this habitat	Potential Threats from Badger Control Operations	Cumulative Impacts
Ilici-Fagenion)			a rich diversity of invertebrates exists, however these are also associated with trees, which are unlikely to be affected by operation.	
Asperulo-Fagetum beech forests	UK stands of this habitat are richer in Atlantic plant species than those of continental Europe. Several rare plant species are associated with this habitat type.	Wiltshire	a) Unlikely that this habitat would be physically damaged by activities relating to badger removal / vaccination operations. b) Disturbance to ground nesting birds possible c) Damage to rare plants possible from trampling, soil compaction from vehicles, digging in traps etc	Cumulative physical impacts on habitat itself unlikely. Repeated disturbances to ground nesting birds could impact the population or lead to site abandonment.
Tilio-Acerion forests of slopes, screes and ravines	*Tilio-Acerion* forests provide a habitat for a number of uncommon vascular plants. Some localities have important assemblages of epiphytic lichens.	Bristol Herefordshire Somerset Staffordshire Devon Dorset Gloucestershire	a) Habitat supports rich plant communities which could potentially by damaged through access on foot / vehicles and through digging in traps. b)Common dormouse populations known to occur in this habitat, disturbance could lead to reduced breeding success c) Habitat known to contain rare lichens but these are epiphytic and are therefore unlikely to be impacted.	Repeated use of same sites could lead to site degradation as plant communities are disturbed.

HABITAT TYPE	Significance / Value of Habitat	Counties within Area of Interest containing this habitat	Potential Threats from Badger Control Operations	Cumulative Impacts
Old acidophilous oak woods with *Quercus robur* on sandy plains	Veteran trees are relatively abundant in UK stands compared to examples in continental Europe, and are often associated with assemblages of notable lichens, fungi and invertebrates.	Wiltshire Dorset	a) Ground flora of this habitat is generally species poor, therefore less need to consider damage due to trampling, digging in traps etc. b) Habitat known to contain rare lichen and fungi species, as well important invertebrate species, however these are associated with veteran trees which are unlikely to be adversely impacted.	Cumulative impacts not anticipated.
Old sessile oak woods with *Ilex* and Blechnum in the British Isles	A key feature of European importance is the rich Atlantic bryophyte communities that are often well-developed within this Annex I type. Some woodlands hold rich lichen floras, especially epiphytic assemblages.	Devon Somerset Staffordshire Cornwall	a) Habitat known to contain rare lichens but these are epiphytic and are therefore unlikely to be impacted. b) Large variation in richness of ground flora; site specific approach would be required to determine potential damage c) Rich bryophyte communities, including several rare species, found on the ground; potential for damage due to trampling, substrate disturbance for digging in traps.	Cumulative impacts possible; repeated disturbance of substrate to dig in traps may damage bryophyte communities at a local level.
Alluvial forests with *Alnus glutinosa* and *Fraxinus* excelsior (Alno-Padion, Alnion incanae, Salicion albae)	Clearance has eliminated most true alluvial forests in the UK. Many surviving fragments, as elsewhere in Europe, are fragmentary.	Wiltshire Dorset Devon Somerset Cornwall	This habitat is unlikely to be populated by badgers, given the high probability of flooding due to its low lying location adjacent to water sources.	Unlikely that this habitat would be included in badger removal / vaccination operations.
Taxus baccata woods	Pure yew woods are relatively rare in Europe. The selected sites include	Wiltshire	The single SAC designated for this SAC, within the area in question, is the smallest	Cumulative impacts possible; repeated disturbance of

HABITAT TYPE	Significance / Value of Habitat	Counties within Area of Interest containing this habitat	Potential Threats from Badger Control Operations	Cumulative Impacts
of the British Isles	extensive pure yew *Taxus baccata* stands and also yew groves occurring as distinct communities within larger woodland blocks, so that the range of structural and functional relationships between yew and other woodland types is represented.		example within its series. a) Unlikely that ancient yew tree community (for which the SAC is designated) would be physically damaged by activities relating to badger removal / vaccination operations. b) Possible effects on regeneration if damage is caused to young, developing yew trees which are establishing themselves from the scrub. c) Few plants exist under the yew trees; however there are important plant communities under the broadleaved trees, including orchids, which could be damaged through trampling, soil compaction and digging in traps.	substrate to dig in traps may damage plant communities at a local level.