Provision of artificial badger setts and use of remote camera monitoring to determine Eurasian badger *Meles meles* sett occupancy, Suffolk, England

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SUMMARY

During electricity substation upgrading works at a site in Suffolk (England), five Eurasian badger *Meles meles* setts were closed (under licence) in 2009 as they were directly under the footprint of the works. As part of the licence agreement, mitigation included provision of three artificial setts. After completion of construction, monitoring indicated that all three setts displayed signs of occupancy and increased badger commuting and foraging evidence around their vicinity. In 2011, a remote motion-activated infra-red camera was used to determine badger occupancy at a three-entrance outlier sett that also required closure during the badger breeding season. Previous extensive monitoring showed that badgers were unlikely to be present. However, a monitoring program using the remote camera was implemented to ensure that this was the case. When evident that badgers were not using the sett, it was destroyed under supervision of an ecologist. Being a novel, non-invasive monitoring technique this was done in liaison with the governmental statutory body, Natural England, but without the need for a licence. Remote monitoring techniques like this could be applied in similar situations where work is required during the badger breeding season (December to June) when licences are not normally issued.

BACKGROUND

The electricity substation in Suffolk (south-east England) where the Eurasian badger *Meles meles* mitigation works were undertaken is of national importance, distributing 15% of the country's supply. Since 2009, the South East Electricity Substation Alliance (SEESA) has been undertaking works to extend the substation. Works are being implemented in two stages, with Stage 1 (to increase substation capacity for the London 2012 Olympics) recently completed, and Stage 2 (to extend the substation to accept electricity feeds from renewable energy projects) is ongoing.

In England badgers are protected under the Protection of Badgers Act 1992, and Natural England (the governmental licensing authority) can issue licences to disturb or interfere with badger setts, where this is unavoidable, in order to permit an action which would otherwise be unlawful. Where 'a structure or place which displays signs indicating current use by a badger' (The Protection of Badgers Act 1992) or there are signs of recent occupancy or use (Natural England guidance note on "current use" of a badger sett) a licence must be obtained to interfere with any badger sett. Whilst a precautionary approach should be taken in all matters with animal welfare considerations, unnecessary licence applications increase the burden of time and costs to all parties - a well considered and documented approach (as undertaken in this present study) can be used to alleviate this where and when appropriate. As with all surveying, familiarity of the subject and accurate assessment of the evidence is paramount, as well as a thorough understanding of the current legislation and guidance.

An initial survey was undertaken to identify and classify (based on Neal & Cheeseman 1996) the setts across the site and surrounding area, and the importance of the setts was assessed based on their seasonal use. In total 16 badger setts have been recorded around the site (since the original survey in 2009) with varying levels of activity throughout the year. The study presented here summarises the

badger mitigation measures undertaken during the electricity substation upgrade works, including provision of artificial badger setts and use of remote camera monitoring to determine badger sett occupancy.

ACTION

Study site: The substation site is located in a rural area surrounded by arable fields with a nearby small relic ancient broadleaf woodland. The landscaping includes many vegetated banks (created to screen the site from the surrounding areas) and high levels of badger activity in the area.

Stage 1 sett closure: Five badger setts were closed under licence in November 2009 as they were directly under the footprint of the Stage 1 works. A standard system of one-way gates and reinforced banks were installed and monitored for badger activity over three weeks (2-23 November 2009) to ensure no badger had re-entered. Following this the sett structures were destroyed and the tunnels excavated and backfilled as detailed in the agreed licence application to reduce the opportunity for re-occupancy.

Artificial setts: As part of the licence agreement, mitigation included provision of three artificial setts. These were constructed in September 2009 (prior to closure of the existing setts) and located in areas that would both maintain movement of badgers around the current site and that would have minimal future disturbance due to ongoing works. Two artificial setts were located within 100 m of the original setts in an area of grassland, and the third approximately 400 m away along a woodland edge. Each artificial sett has three entrances and was constructed by creating tunnels and chambers using a mechanical excavator, with waterproof plywood and wooden batons to reinforce the sides (Fig. 1). The tunnels were topped with plywood and the spoil piled on top creating a mound approx 1.5 m high by 10 m long and 3-4 m wide. Whips (saplings) of native shrubs (including hawthorn *Crataegus monogyna* and blackthorn *Prunus spinosa*) were planted to provide cover and foraging opportunities for badgers, once established. In addition, several earth piles (approximately 1.5 m high, 10 m long and 3 m wide) were constructed adjacent to the artificial setts to encourage the excavation of new ones by the badgers themselves.

Post construction monitoring on a monthly basis was undertaken around to review levels of activity at each sett and across the wider landscape to identify any new activity.

Stage 2 sett closure and remote camera monitoring: The scope of the works for Stage 2 included an outlier sett located under the proposed footprint for a new structure where the substation was to be extended. Closure was unavoidable as even if the structure were able to be relocated the sett would still remain within the live Stage 2 substations electrified fencing, which would pose a risk both to badgers and site operations. The closure needed to be completed by March 2011.

Earlier monitoring indicated that the sett was primarily occupied by European rabbits *Oryctolagus cuniculus*, with the last evidence of badger activity in November 2010. However, it should be noted that badger activity in the UK markedly decreases over winter. While badgers do not truly hibernate they typically spend the majority of their time in larger setts closer to the centre of their range, foraging and roaming less. They typically breed in the larger well-used setts but non-dominant breeding females may occupy less popular locations.

Figure 1. One of the artificial setts under construction (left) and completed (right). (Photos: Tim Allen)

As such, while for significant parts of the year this sett had low occupancy, the lack of positive evidence since November was insufficient to be certain that badgers were not present. As February lies within the badger breeding season (typically from December to June) Natural England are minded to refuse licence applications to close setts due to the welfare considerations of any young which may be present. It was therefore proposed upon agreement with Natural England, that intensive monitoring over a 2-week period would be sufficient to assess if badgers were using the sett. If absence was proven beyond reasonable doubt, then this would enable the sett to be destroyed without the need for a licence. Likely occupancy must be determined by a suitably qualified ecologist with thorough knowledge of badger ecology.

Two monitoring methods were proposed, one being frequent visual checks (once every 2-3 days) and the second the use of a motion-activated remote infra-red camera. Advantages and disadvantages of each were considered (Table 1). On consideration of the advantages and disadvantages of both methods the remote camera option was selected. A remote 'trail' camera (Hawke ProStalk PC3000) with an infra-red flash was set up on a plastic orange traffic cone (approximately 50 cm in height and 5 m from the sett entrances) concealed with cut vegetation (as the area is occasionally accessed by the public) on 21 February and left for two weeks. The camera was set to take bursts of three photographs each time it was triggered, set at 'medium sensitivity', with a delay time between photographs of 30 seconds. The camera was programmed to take photographs between 18:00 to 06.00 h to minimise pictures taken during daylight hours whilst incorporating usual peak badger activity times above ground.

CONSEQUENCES

Artificial sett use: The three artificial setts all displayed signs of badger occupancy, plus increased badger activity around their vicinity (mainly in the form of footprints) in comparison to the initial survey data. The first signs of activity were recorded within one week after completion of sett construction. Activity peaked within the first two months and it seems likely badgers were investigating the new setts and the disturbed ground around them. Activity around the setts became more consistent over time and there are now several well worn 'badger paths' to and around each of the setts. A single entrance on one of the setts collapsed in December 2010 but was re-opened by badgers in June 2011.

Table 1. Advantages and disadvantages of proposed monitoring methods to determine badger sett occupancy.

Manual checks by an ecologist every 2-3 days		**Deploy infra-red remote camera**	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
Direct observation of field signs.	Requires at least five site visits (i.e. higher transport and labour costs).	Requires only two site visits (one to deploy and one to collect the camera).	A narrow field of view meaning activity in the wider area around sett entrances are not be captured (although use of multiple cameras would overcome this).
Able to react to evidence immediately and relate field signs to activity in the wider area.	Wet weather (heavy rainfall) can obscure field signs.	Able to gather direct evidence of presence via photographs even if field signs absent.	In an area with public access a camera could be vandalised or stolen.
	Field signs may be present without actual occupancy occurring, i.e. badgers investigating sett entrance but not using it.	Potential to give further information on badger movements.	Tests and calibration may be required to prove suitably sensitive to be triggered by badgers.
		May indicate number of individuals using a sett.	Time required to process photographs.

Remote camera monitoring results and sett closure: The camera was triggered six times, taking a total of 18 photographs. One image of a badger was taken on 22 February at 01.30 h. It was not recorded again and most likely it was passing by whilst foraging; it did not emerge from the sett nor return to it. The other images did not show any mammal evidence and it is suspected that the camera may have been triggered by a piece of vegetation in front of the camera moving in the wind, or a fast-moving animal not captured due to the slight delay (approximately 1 second) between the motion being captured and the camera triggering.

Once it was established that there was no badger activity in the sett, it was destroyed by digging the three tunnels back using a mechanical excavator with an ecologist present to observe any signs of badgers (or other mammals); none were present. The excavated spoil was then replaced and compacted to discourage any new digging.

Discussion and conclusions: The three artificial setts all displayed signs of badger occupancy soon after sett construction. The remote camera proved a cost effective method for monitoring badger activity around the sett entrance and could be applied to other similar situations. It is likely this technique would be most appropriate for small setts which can be covered by the field of view of a single camera. Multiple cameras could be deployed to monitor larger areas but this would naturally incur higher costs. It is well suited to secure sites (i.e. no public access), or those in which frequent access may be difficult.

The sensitivity of the camera seemed sufficient to pick up badgers and this technique has been successfully used in monitoring animals of similar size, for example European otter *Lutra lutra* (Garcia De Leaniz *et al.* 2006). However, when returning to collect the camera, fresh rabbit droppings were found around the sett entrances. This suggests that the camera was either not sensitive enough to be triggered by the movements of these smaller animals, or more likely, they visited the vicinity during periods when the camera was inactive. It proved useful to have a setting to enable a burst of photographs to be taken each time the camera was triggered to capture animals moving across the field of view. The single photograph of the badger was the third in the sequence of the three photograph burst, which suggests there was a short delay in triggering this particular camera subsequent to capturing movement. Had the camera only been set to take one photograph each time the badger may not have been captured passing through the frame. Given this, it is suggested that practitioners undertake an appropriate camera calibration exercise before commencing monitoring to ensure the equipment is suitable to capture the evidence needed.

If using a remote camera monitoring system it is also important to recognise that installation (e.g. presence of a novel object and/or an unfamiliar scent) could potentially affect mammal activity for several days, especially where the site is not normally subject to human disturbance, or if targeting species particularly sensitive to infra-red light such as the otter (Garcia De Leaniz *et al.* 2006).

We suggest that this remote camera monitoring technique can be a useful addition to the more traditionally employed field survey methods, but it is unlikely that it would replace traditional surveying for any sites.

ACKNOWLEDGEMENTS

The work was undertaken by Mott MacDonald as part of the South East Electricity Substation Alliance. We thank the site staff at the substation, and the SEESA environmental coordinators Andy Younge and Nicola Catt.

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