Mapping the presence of small mammalian predators on the river meadows of the Avon Valley

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Introduction

The egg and chick life-stages of waders attempting to breed in the Avon Valley are potentially vulnerable to a range of predator species, including fox, badger, otter, mink, polecat, stoat, weasel, hedgehog, brown rat, heron, little egret, carrion crow, rook, magpie, jackdaw, jay, buzzard, red kite, kestrel, sparrowhawk, tawny owl, barn owl and others. In the LIFE+ Waders for Real project we have focussed attention particularly on fox, because that allowed us to add value by transferring existing expertise, resources and ongoing research interests to the Avon Valley context; and because fox is implicated as a significant predator in virtually every study of predation on wading birds. The smaller mammalian predators listed above (mink to brown rat) are relatively un-researched and present a significant methodological challenge. This report describes an attempt to map the distribution of activity of these predators relative to nesting attempts by the wading birds.

Biologists frequently base their research methods on older hunting traditions. In the UK game-management tradition, small mammalian predators of ground-nesting birds have been caught using spring-traps (kill traps), either in natural burrows (e.g. rabbit burrows) or in artificial tunnels constructed for the purpose. The latter can be either 'blind' (one entrance) or 'run-through' (two entrances). They are generally made to appear like a natural burrow, and although some operators add bait, many do not.

The traditional method used by gamekeepers to catch stoats and weasels is to set a trap inside a tunnel. Biologists use the tunnel with an inked card in place of the trap, to record visits by the same species.

In New Zealand (NZ), polecat, stoat, weasel, hedgehog and brown rat were introduced by settling Europeans and because of their catastrophic impact on New Zealand's native avian fauna more research has been done on these predators in NZ than in the UK. Conservation workers in NZ initially adopted trapping practices from the UK but have gradually developed these to form their own tradition, which invariably uses bait and places little emphasis on 'landscaping' of the tunnel.

In both the UK and NZ, biologists have attempted to monitor these predator species using similar tunnels containing a footprint-recording medium rather than a trap. Early versions used a chemical reaction to produce a visible footprint on specially prepared paper, but later researchers have settled on non-drying ink as a more convenient technique. Pre-inked cards are available from commercial suppliers in both the UK and NZ. We followed earlier researchers in using 'ink tunnels' to attempt to map the activity of these small mammalian species in the Avon Valley river meadows.

Reliable presence/absence mapping depends on efficient detection of the species of interest. If there is an animal within reach of a tunnel, how likely is it to run through the tunnel and leave its footprints? We particularly wanted to estimate this 'detection probability' because then we can also state the probability that the species really is absent if no detections are made within a given period.

Of the small mammal species able to enter a tunnel of this size, the four mustelid species (weasel, stoat, mink, polecat) are the principle concern in this study because they are obligate predators of vertebrate prey.

Methods

The work was carried out in 2015 and 2016 on four of the sites designated as breeding wader 'hotspots'. The southern three sites were contiguous, the fourth was separated by about 7 km (see map, p.6).

Ink tunnels

187 tunnels were deployed in the late winter of each year, based on the intersections of a 150m grid. This gave a high tunnel density of 44/ha. Each tunnel consisted of a 50 cm length of plastic pipe with an 10cm square section and was incorporated into the landscape using local materials to give a natural appearance. Tunnels were generally placed in linear landscape features (hedges, ditch sides, etc) where these were available close to each grid intersection, because linear features are known to channel predator activity and because the tunnel was to some extent sheltered from livestock in such places.

As tunnels were set into position, pre-inked cards were inserted and fixed in place with double-sided tape. We used ink cards from two different manufacturers (Gotcha Traps Ltd, New Zealand and Perdix Wildlife Supplies, UK). Checking and maintenance fieldwork was carried out by two successive MSc students, Séonaid Barrett (University of York, 2015) and John Flothman (University of Reading, 2016). Every tunnel was checked once a week, and ink cards were replaced if they had tracks or were missing or spoiled. The fieldworkers were instructed to keep vegetation trimmed back from the tunnel entrances to create a clear and obvious approach.

Mink rafts

As a separate exercise, we also ran mink rafts on water courses in the same areas to determine the distribution of mink activity. Mink rafts are a form of tracking tunnel suited to wet animals in wet environments, using a moist clay-and-sand substrate to record tracks, rather than ink. Mink rafts have a lot of (GWCT) research behind them: they are known to be a sensitive mink detector, besides recording tracks of other mammals and birds using the same habitat and capable of passing through the 15x15cm square tunnel. 21 rafts were used in 2016. This was increased to 48 in 2017 to ensure that small ditches and drainage channels were adequately addressed.

Tunnels made from square-section plastic were set in suitable locations and fitted with an inked card to record small predator footprints.

Trail cameras

Trail cameras were also in use within the same hotspot areas. These were deployed with the aim of monitoring activity of larger mammalian predators (fox, badger, otter) and were not optimally positioned to detect small mustelid predators. Nevertheless, some images of smaller predator species were captured, and these helped to inform our analysis.

Attractants

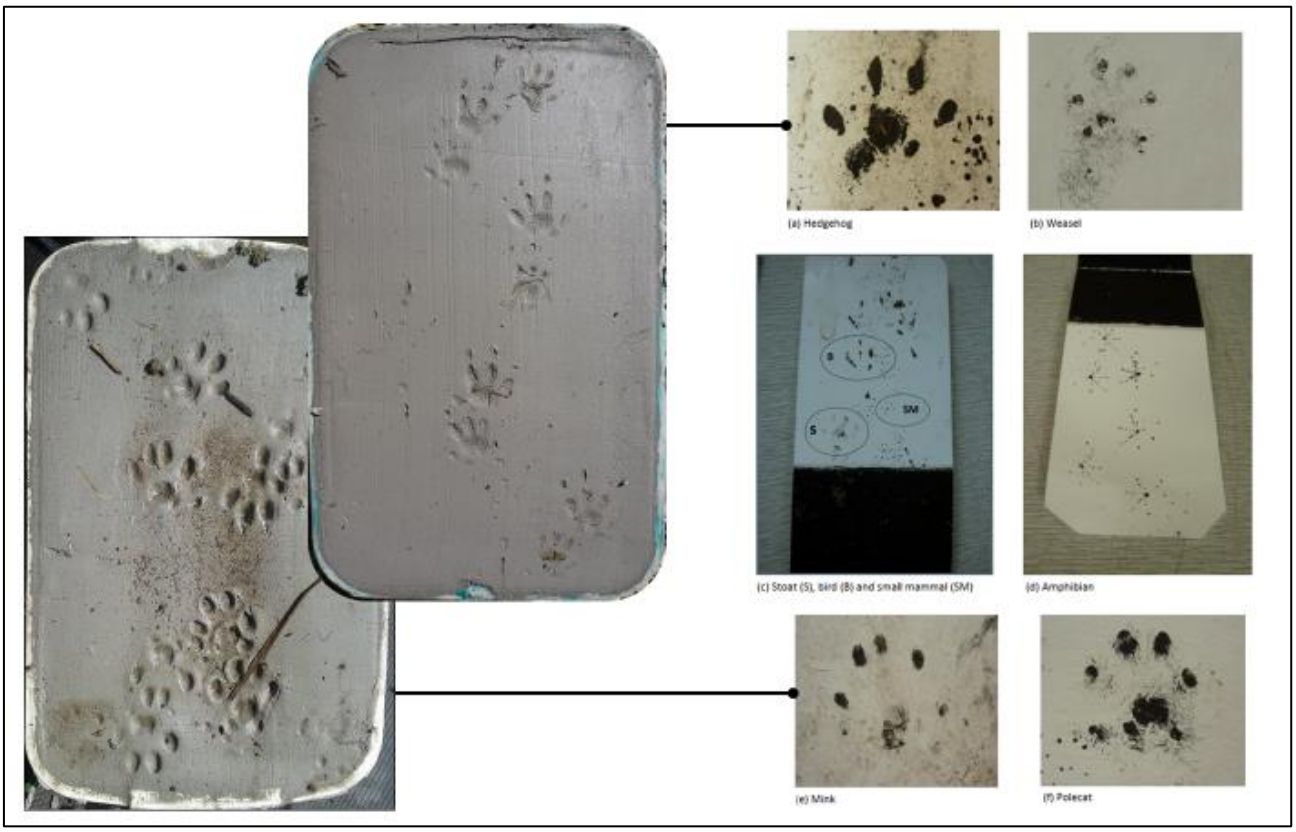
In 2016, we attempted to improve the efficiency of ink tunnels as mustelid detectors by adding bait (a whole fresh pheasant egg or dried rabbit meat) or a commercial scent attractant (Forsyth's Weasel Lure) used by fur trappers who target small mustelid species in North America. We used a randomised experimental design to formally test two comparisons: (a) no bait vs egg; (b) dried rabbit meat vs scent lure.

Results

Ink cards from both manufacturers proved very good at recording animals passing through the tunnels, with around 1,000 detections in each year. Most of these detections – 85% in 2015, 76% in 2016 - were of small rodents or shrews which collectively were found at 94% of the 187 tunnel sites. The next most frequently detected groups were small birds and amphibians (10% of all detections).

The quality of tracks recorded on ink cards was poor compared with a wet clay/sand medium as used on mink rafts, and for this reason reliable identification of tracks to species level was not possible. For example, brown rat (an opportunistic egg predator) could not be distinguished from water vole (a strict herbivore) with any confidence, unless droppings were also present. Hedgehog was clearly

recognisable, but very few detections were obtained (13 in total), and it's likely that the tunnel was on the small size for this species.



Footprints from ink tunnels (right) recorded a variety of species from amphibians, birds, shrews and voles to mink and polecats. However, footprints on ink cards are poor compared with those in a clay medium on mink rafts (left) and for mustelids cannot be reliably identified to species.

The four small mustelid species of particular interest (weasel, stoat, mink, polecat) have similar foot shape and considerable overlap in size. While small mustelid tracks could be confidently identified as such, we could not reliably distinguish the four species and a category of 'unidentified small mustelid' was unavoidable. For this reason, we combined all four species as one group. As a group, small mustelids were detected on 23 occasions, at 17 tunnel sites, in 2015.

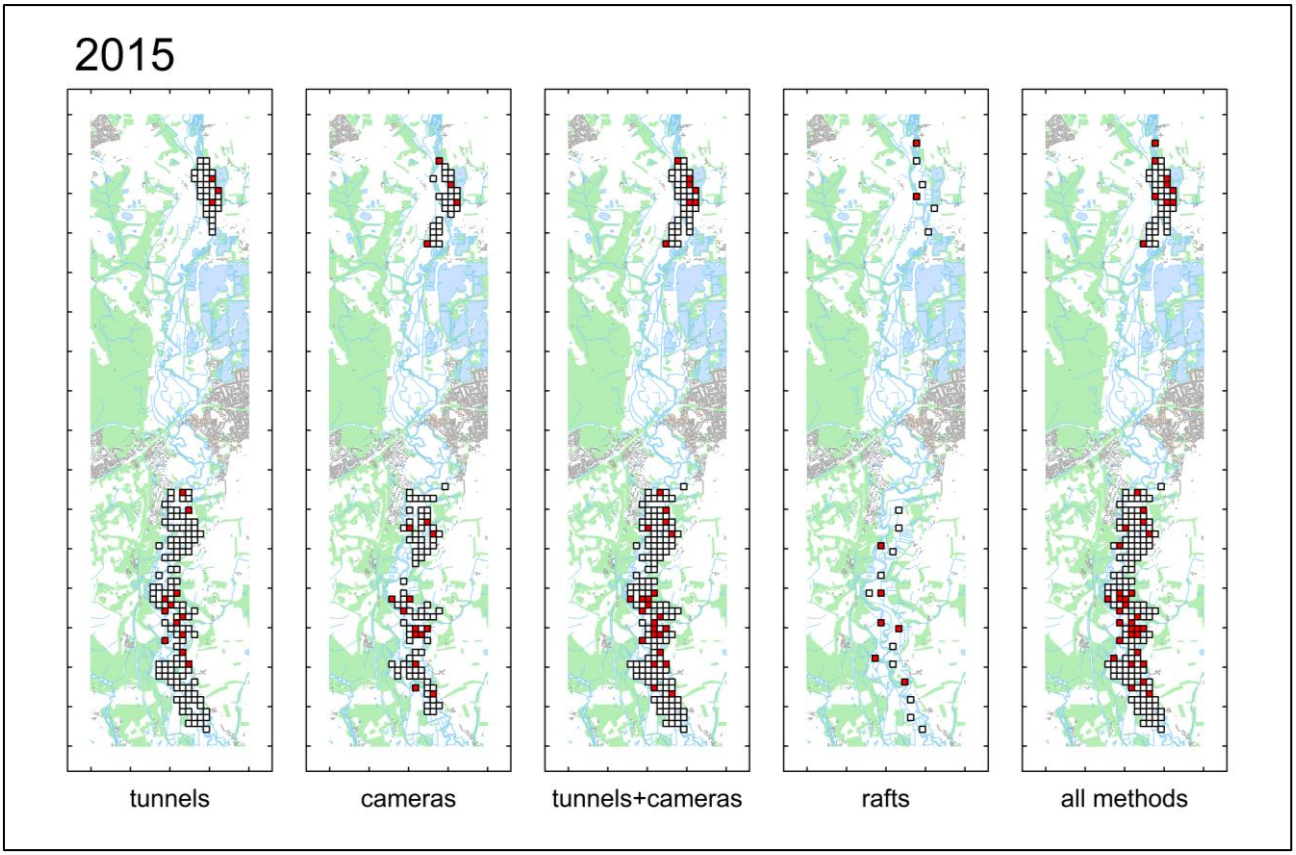
In comparison with ink-tunnel studies elsewhere, it seems likely that small mustelids were at very low density on these sites. However, at 11 tunnel locations small mustelids were detected on only one out of nine weekly checks, implying that even where one or more mustelid was present, the probability of failing to detect it in a given week was around 80%. This means a 17% (1 in 7) chance of failing to detect small mustelids through the entire season of 8 weekly checks.

Furthermore, trail cameras recorded stoat or mink on 34 occasions at 19 different sites in 2015. Mink rafts recorded mink on 26 occasions at 15 sites. These data were rendered onto the same 150m grid as the ink tunnels for comparison. It was clear that small mustelids had been present in at least one-fifth of the grid-squares, but that ink tunnels had failed to detect them in almost half of these. The implication is that the weekly detection probability in ink tunnels was actually <2%.

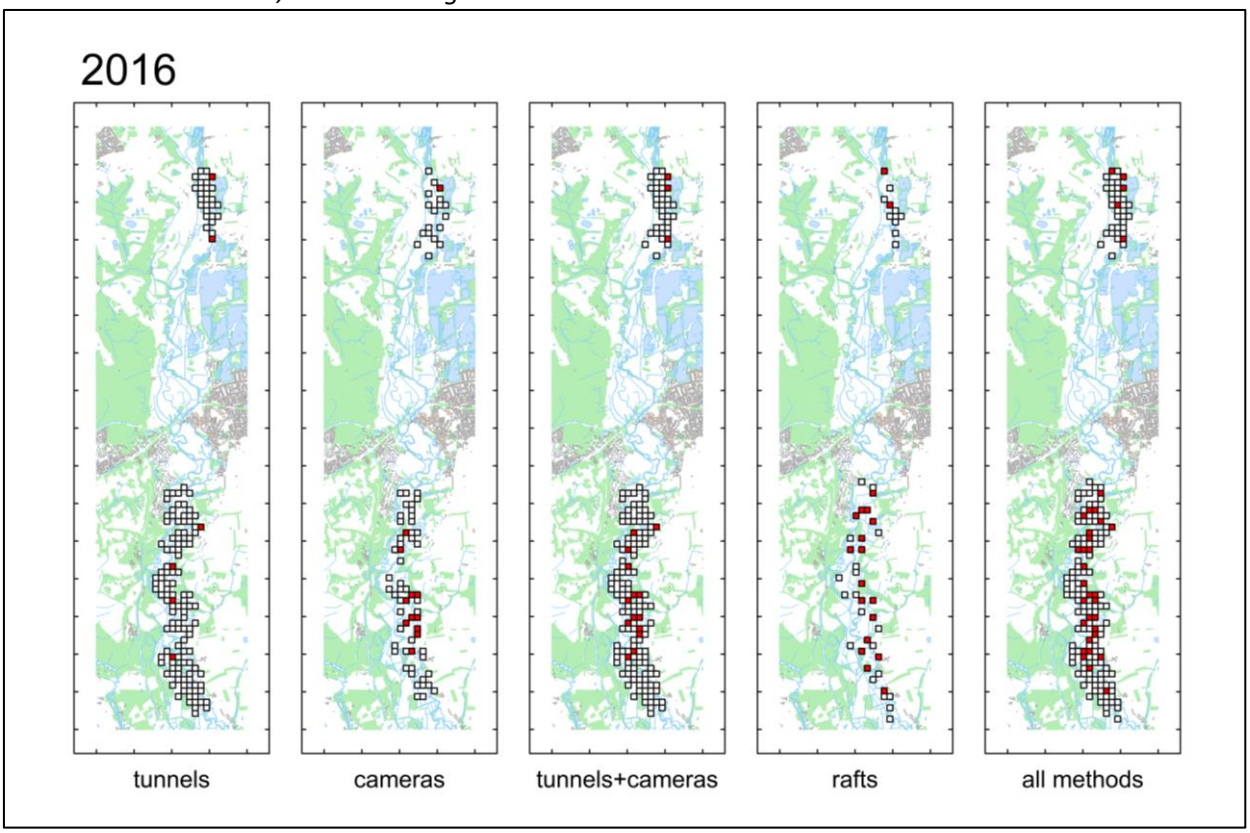
In 2016 the addition of an egg, dried rabbit meat or scent lure failed to increase the number of detections of small mustelids, in fact fewer detections were made than in 2015. Trail cameras and

mink rafts again showed that these species were present in the vicinity of tunnels that failed to record them.

Trail cameras (left) set to record large mammals like fox and badger also captured some images of stoat (two centre columns) and mink (right-hand column).



Distribution of detections of small mustelids by tunnels, cameras and mink rafts in 2015 (above) and 2016 (below). 150×150m grid squares indicate the coverage of each method. Red fill indicates small mustelid detections, white fill no detections. Axis tick marks are 1 km apart. Water courses and open lakes are shown in blue, woodland in green.



Conclusions

- Ink tunnels have been used by biologists in the UK and NZ to indicate population abundance of small mustelids by recording footprints. The concept of a tunnel as a landscape feature attractive to these species derives from kill-trapping practice in the UK. No other satisfactory methods have been developed to monitor small mustelids.
- We deployed ink tunnels systematically across 4 'hotspot' sites in the Avon Valley where wading birds attempted to breed with the aim of mapping occurrence of weasel, stoat, polecat and mink.
- Small mustelid predators were shown to be present on all four hotspot sites. Comparison of detection rates with other ink-tunnel studies suggests that their densities were relatively low.
- However, we found that ink tunnels had a low probability of detecting any of the 4 small mustelid species where these were shown to be present.
- Numerous records of voles and shrews at almost every tunnel location demonstrated that the ink card itself was fit for purpose. Tunnel density was also more than sufficient.
- Adding egg, meat or scent lure to ink tunnels failed to increase the probability of detecting small mustelids.
- Although we do not know the reason, we conclude that ink tunnels are an unsatisfactory tool for reliable mapping of small mammalian predator activity in this river meadow habitat. Trail cameras were unexpectedly better for stoats and mink (and presumably therefore polecats), but did not detect weasels, which are typically active out of sight in long grass or in vole tunnels.
- Approximately 1,000 person-hours of work were used in deploying and operating ink tunnels in 2015 and 2016. In view of the unsatisfactory results and the additional cost of supervising students, we abandoned this method for 2017-19. The use of cameras to record larger predators continued.
- While it is possible that trail cameras could be used for stoats (only) in a way that makes them more satisfactory than ink tunnels, the manpower cost of sorting stoat images from among all images captured makes this an inefficient and costly approach.
- At a more local scale (within hotspot sites), the lack of an effective research technique means that the distribution of small mammalian predator activity in relation to breeding waders is a significant knowledge gap. Nests (eggs) can potentially be monitored with nest cameras (with some risk of increasing predation) but we simply cannot say how likely these small predator species are to encounter wader chicks after they hatch and leave the nest.