Using clay drain seals to assess the use of dry culverts installed to allow mammals to pass under the A1 trunk road, Northumberland, England

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SUMMARY

Monitoring the use of dry culverts installed as underpasses enables their effectiveness to be evaluated. We used clay-based drain seals to record mammal tracks in three different culverts under a section of a major road in Northumberland, UK. Prints including badger *Meles meles*, American mink *Mustela vison* and hedgehog *Erinaceus europaeus* were recorded on the clay drain seals demonstrating animal movement in both directions through the culverts. The prints were well preserved and easily recognisable.

BACKGROUND

In the UK and elsewhere, culverts under main roads and motorways have been installed in an attempt to provide safe passage for mammals, amphibians and other wildlife. Studies have shown that badgers *Meles meles* are fairly adaptable and will readily use man-made structures including culverts, to pass under roads. If correctly sited on or near to an existing badger path, such underpasses will maintain connectivity of home ranges (Highways Agency 2001). Designing suitable underpasses for other mammals may provide more of a challenge. Otters *Lutra lutra* may have problems with cylindrical culverts on smaller water courses as these can fill rapidly with water, reducing the air space available and making swimming more difficult. The effect of the increase in velocity as water is channelled through the pipe is intensified during high flows and animals swept into the structure can be drowned. If otters cannot pass through culverts due to high water levels and rapid flow, they may be forced onto roads and so risk being killed by traffic. One solution to this problem is the installation of a 'dry' culvert, constructed to compliment those culverts containing a watercourse in order to provide safe passage at periods of high flow.

The Highways Agency Biodiversity Action Plan (2001) states that at least 100 otters are killed on roads in England and Wales annually. Highway Agency data show 36 otter road kills were recorded on the A1 (a major road) between 2002 and 2006. The majority of road deaths occur between November to December and March to April. These correspond with periods of high rainfall when river water levels are high.

To alleviate the problem associated with flooded culverts, the Design Manual for Roads and Bridges (Highways Agency 2001) recommends that a culvert should be large enough to allow the incorporation of a dry passage that is accessible even during periods of high flow. If this is not possible, then an additional dry culvert should be installed above the predicted water level for the watercourse in question (Anderson 2003). These dry culverts are thus positioned so that they will not flood, therefore providing safe access up and downstream even during high water levels. Otters can be guided to the passage by means of a channel or fence running from the riverbank to the dry culvert entrance.

ACTION

Study sites: Seven purpose-built underpass structures (six dry culverts and one otter walkway) were constructed at locations along the A1 in Northumberland (northeast England) in an attempt to provide safe passage under this busy main road for otters during periods of high water flow. The structures were installed by the Highways Agency at specific locations where otter road kills had been recorded, thus contributing towards the Highways Agency Biodiversity Action Plan which attempts to limit accidental killing or injury by the provision of road underpasses. Otters were known to use the existing culverts on the nearby watercourses (anon 2005).

The principal aim of the current study was to monitor the use of three of the seven underpasses by otters and other mammals. These three sites were selected to provide coverage over a large section of the A1 in Northumberland, and based on knowledge that otters had been recently recorded using the watercourses (Anon. 2005). The three selected sites were located where three rivers (Back Burn, Belford Burn and Common Burn) were crossed by the A1. The dry culvert at Belford was installed in 2003, but not fenced until 2005. The underpasses at Felton on Back Burn and at Berwick on Common Burn were constructed in 2006; these culverts were fenced at the time of installation. The distance between the three sites (Felton in the south and Berwick-on-Tweed to the north) is approximately 46 km.

The Design Manual for Roads and Bridges states that a 600 mm diameter culvert is satisfactory to provide an underpass up to approximately 20 m in length. Back Burn and Belford Burn culverts are 600 mm in diameter, whilst that at Common Burn is 900 mm.

Monitoring: Sand pads have been used widely to indirectly monitor wildlife (anon 2001) and have been used to monitor culvert use (Clevenger, Chruszcz & Gunson 2001). However, this method was not considered suitable for the current study as it would have been difficult to construct the sand pads in the restricted area available and given the relatively difficult access of some of the locations, it would have made carrying the necessary materials arduous. It was also acknowledged that daily monitoring was not practical. Clay pads placed in rafts have been used as a non-invasive means to determine the presence of American mink *Mustela vison* on watercourses (Reynolds, Short & Leigh 2004). The raft uses a clay pad to record footprints. For the current study, it was decided to use clay-based drain seals (45 x 45 cm x 0.5 cm thick) placed at the entrances to three dry culverts (Fig. 1). Drain seals are used in pollution control to close drains in the event of a pollution incident. The seals are available from a number of suppliers (suppliers for this study were: Clean Innovations, Greenhill Mill, Colne, Lancashire, UK) and cost approximately £100 for a pack of four.

Figure 1. Installation of a clay drain seal at the entrance to a dry culvert (Photo: Dorian Latham)

The clay drain seals were checked at least weekly during the trial period, 28 August to 26 October 2007. As animals cross the clay pad an imprint of their tracks is left. At each visit any evidence of animal tracks was recorded, the pad was photographed, and then thoroughly wetted and smoothed to remove any tracks and leave a clean surface to record any subsequent tracks. Tracks left on the pad were identified using an animal track key (Bang & Dahlstrom 2006).

CONSEQUENCES

Mammal usage: Prints including badger, American mink and smaller mammals, e.g. hedgehog *Erinaceus europaeus* and brown rat *Rattus norvegicus* were recorded on the clay drain seals during the trial period. The tracks were well preserved and easily recognisable.

Badger prints (Fig. 2) were recorded frequently on the pads showing ‘upstream’ and ‘downstream’ movements, this concurring with the general conclusion of previous studies that badgers are reasonably acceptable of many underpass types (Anderson 2003). The dry culverts were also used by other mammals demonstrating that these structures provide an opportunity for passage by mammals that could otherwise be restricted by even low river flows.

The study has confirmed the presence of American mink (Fig. 3) on the Back Burn (a tributary of the River Coquet); this non-native species is known to be present throughout Northumberland.

Figure 2. Badger tracks recorded on a clay drain seal (Photo: Dorian Latham)

Figure 3. Mink (left) and badger tracks recorded on a clay drain seal (Photo: Dorian Latham)

Otters: Whilst it is disappointing that there was no positive identification of otters using the dry culverts this is not entirely surprising as there was no period of high water flow during the trial, therefore it is likely that otters would have continued to use the culverted water courses to pass under the road. No otters were recorded as road-kill during the study period at Back Burn, Belford Burn or Common Burn.

Effectiveness of drain seals: It was considered that the greatest advantage of this method is that the pads are easy to install, were easily cleaned and smoothed to provide a fresh surface allowing the direction and frequency of mammal passes to be recorded, and can be used in a number of different scenarios. There is no requirement to construct pits as would be required to house sand pads. In addition, the drain seals are perhaps more robust than the sand pads with tracks less liable to be lost through heavy mammal traffic or rainfall.

A disadvantage is that pads can desiccate, especially in dry weather, unless regularly re-wetted. They cannot be rehydrated once dry. The pad therefore has to be replaced if this occurs, which adds to the monitoring expense. In addition, if the drain seals are placed in too exposed a position, heavy rainfall can pit the clay making the smaller mammal tracks less visible and more difficult to identify.

If monitored and maintained correctly i.e. ensuring pads are kept sufficiently moist and smoothed after each visit, they can remain *in situ* and be effective for at least 2 months (three of four have proved still usable after 3 months).

Conclusions: Our aim was to provide a simple and cost effective means of monitoring the use of the dry culverts by mammals. This trial has shown that using clay-based drain seals is an effective method of recording mammal tracks, and, providing the drain seals are maintained, valuable information can be obtained that can help to inform future culvert design and mitigation schemes. The clay seals remain in place and it is hoped to extend the study over the winter to provide additional information of mammal movements, including during any periods of high water flow. It is hoped that otters may preferentially use the dry culverts in these conditions when the culverted watercourses are flooded.

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