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OTTER ROAD CASUALTIES

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ABSTRACT - Many otters (*Lutra lutra*) are killed on roads each year. At present, it is not possible to determine whether or not this has an impact on otter populations, whether they are declining, recovering or stable. New roads should be designed with the needs of otters in mind in areas which otters are likely to recolonise as well as those where they are already present. It is possible to reduce the number of otters being killed on existing roads by appropriate mitigation but this may be expensive and it is important to consider the costs as well as the benefits. Dead otters are a valuable resource for population studies and there is great value in collecting carcases for post mortem studies. It is also important to record the sites of all road deaths to inform priorities for mitigation.

Key words: *Lutra lutra*, casualties, conservation, mitigation, road

RIASSUNTO - ***Incidenza del traffico veicolare sulla mortalità della Lontra***. Molte lontre (*Lutra lutra*) sono uccise sulle strade ogni anno. Attualmente, è impossibile valutare se tale fattore ha un impatto sulle popolazioni di Lontra e se tali popolazioni sono in declino, in recupero o stabili. Le nuove strade dovrebbero essere tracciate tenendo conto delle necessità della Lontra sia in aree probabilmente soggette alla ricolonizzazione sia in aree dove la specie è già presente. E' possibile ridurre la mortalità della Lontra sulla rete viaria esistente mediante appropriati interventi di mitigazione, per i quali è importante valutarne i costi e i benefici. Le carcasse delle lontre morte sono particolarmente utili per studi di popolazione e i loro siti di rinvenimento consentono di definire le aree prioritarie in cui adottare misure di mitigazione.

Parole chiave: *Lutra lutra*, mortalità sulle strade, conservazione, mitigazione

INTRODUCTION

During the twentieth century, otter *Lutra lutra* populations declined over much of western Europe at the same time as the number of cars in use and the distances travelled by individuals increased dramatically. Inevitably, as otter populations have begun to recover, increasing numbers of animals have been killed on roads (Simpson, 1998; Bradshaw and Slater, 2002). Otters are reasonably conspicuous animals and where there has been an effort to keep records of road traffic casualties (RTCs) it has proved possible to collect significant numbers.

What these numbers mean, in terms of the population dynamics of otters, is difficult to discern. It is clear that there are measures which can be taken to reduce the risks to otters however, and the question arises as to how much effort should be invested in this, as op-

posed to other forms of conservation. The aim of this paper is to review experiences of otter RTCs in the UK with a view to informing debate on such questions as: a) Are RTCs a threat to otter populations or their recovery? b) What measures are available to prevent, or reduce the risks of RTCs? c) How should resources be allocated?

HISTORICAL BACKGROUND

The first indication that there had been a decline in the otter population of Britain came from otter hunters in the early 1960s, when they realised that they were finding far fewer animals than previously (Ivester-Lloyd, 1962). An analysis of a subset of their records (Anon, 1969) showed that there had been a significant decline in hunting success between 1957 and 1967 and the authors suggested a number of factors which might have caused it, but these did not include road casualties.

Chanin and Jefferies (1978) using a full set of otter hunting records from 1950 to 1971 demonstrated that the otter's decline in Britain started in the mid 1950s and was contemporary with the first use of dieldrin and related pesticides, which they considered to be a likely cause. This paper also reported that in some places otters had repeatedly been found dead on roads at the same place with one instance of five otters killed over a six year period.

In monographs on otters published in the 1980s, Chanin (1985) and Mason and MacDonald (1986) noted that considerable numbers of otters were killed on the road but did not suggest that this was likely to have a significant effect on the population. Mason and MacDonald (1986) pointed out that: "*It is impossible to predict the effects of these mortalities on the status of local populations unless perhaps the populations are so low that any accidental death could be critical*". This is more likely to be the case for declining populations than recovering ones.

Despite this, by 1996, when the Framework for Otter Conservation was published (Joint Nature Conservation Committee, 1996) it concluded that anthropogenic mortality was one of six threats to otters including "… *accidental killing on roads and incidental killing in traps* …" and that this had "… *implications for the viability of populations especially where otters are recolonising new areas and population size is small*".

Thus, when the UK Biodiversity Action Plan for otters was written, "*Incidental mortality, primarily by road deaths…*" was considered to be one of the "*Current factors causing loss or decline*", although, by that time, the otter population in Britain was recovering , rather that declining.

ASSESSING THE EVIDENCE

Although some information on otter road casualties was collected in the 1970s and 1980s, it was not until the 1990s that systematic attempts were made to record these and, where possible, to retrieve carcases for post mortem examination. One consequence of this was that increasing numbers of dead otters were reported and the number known to have been killed increase dramatically. This is clearly illustrated

in Figure 1, which also shows that over the same period, systematic otter surveys returned increasing numbers of positive sites.

This marked increase in recorded casualties, which might also be attributed in part to better reporting, may have been one of the reasons why the apparent whether or not the number of otter casualties has had an impact on otter populations. Although 500 otter road casualties were recorded in southwest England between 1984 and 2004, National Surveys showed that the proportion of sites with signs of otters increased from 43% in 1984-06 to 83%

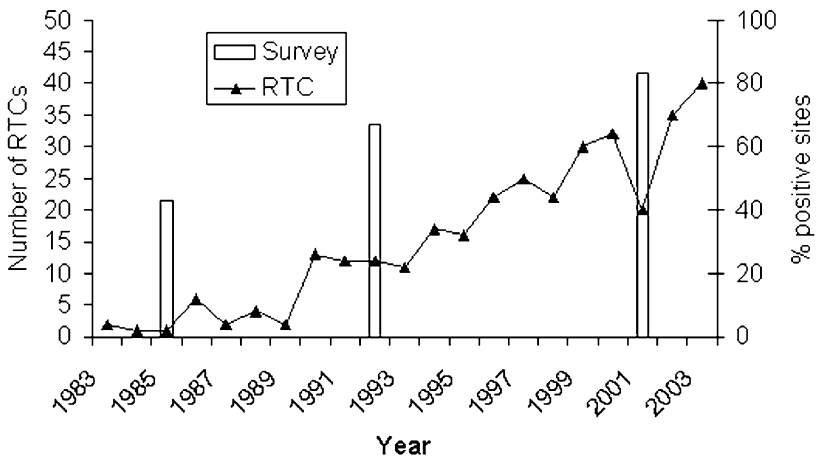

Figure 1 - Annual number of RTCs in Southwest England from 1983 to 2004 and percentage of sites found positive for otters during three national surveys in the same area.

significance of road casualties increased in people's minds.

Figure 1 shows a temporal relationship between road kills and the results of otter surveys, but it is also possible to examine the data in a spatial context. Figure 2 illustrates this, comparing the density of otter road kills in seven 100km squares in southwest England with the survey results for the same area. The correlation between these is high ($r^2 = 0.86$) and one might interpret this as evidence that the 'standard otter survey' (Reuther *et al*., 2000) does provide some measure of otter numbers (Laura Bonesi, pers. comm.).

At present, neither spatial nor temporal correlations allow us to determine in 2000-02. This demonstrates that otter populations can recover, despite a considerable cull on the roads but does not indicate whether or not the rate of recovery is affected. It should be noted that, to date, the otter's recovery has mainly been taking place in areas where the density of major roads is lower than in the areas they will colonise over the next few decades.

Another approach to this is to compare the number of RTCs recorded in an area with annual culls by otter hunters. Otter hunting in the UK was a traditional country pursuit in which otters were hunted by specially trained, and in some areas specially bred, hounds to provide sport for the participants.

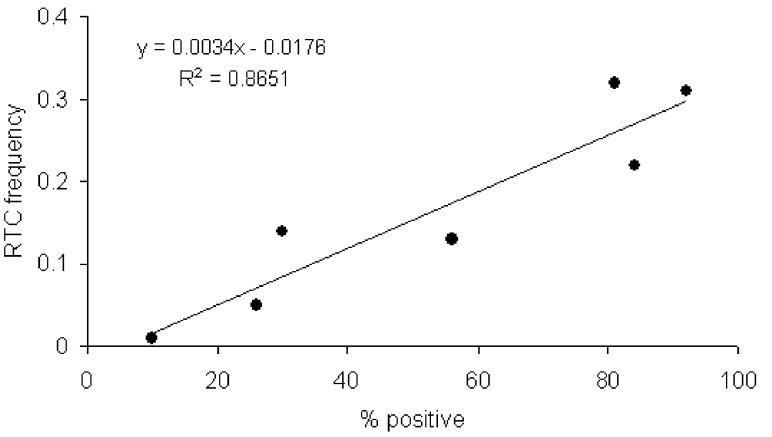

Figure 2 - Comparison of RTC frequency (otters grid-square-1 year-1) with the percentage of sites found positive for otters during the national survey of 2000-02 in seven 100km x 100km national grid squares.

Although 'control' of otters was a recognised aim of hunting, the need to provide an exciting chase was important. Individual Otter Hunts had traditional areas in which they were active and they kept records of their success, including the number of days spent hunting each year, the number of otters seen and the number killed (Chanin and Jefferies, 1978). Otter hunting ceased after otters were protected in England and Wales in 1978.

Two hunts were traditionally active in southwest England and although the areas they hunted did not coincide exactly with current boundaries they were equivalent to the area used in Figure 1. Otter hunting flourished during the 1920s and 1930s and data are available for both hunts from 1925-1939 (Chanin and Jefferies, 1978; Chanin, unpublished data). Over that 15 year period the annual cull averaged 36.47 (SE = 1.62). By comparison the mean number of RTCs for the five years from 2000 to 2004 was 31.4 ranging from 20 to 40. It should be noted that neither dataset includes all anthropogenic mortality during those periods. The hunt records include all otter which they killed but not those killed by others such as river-keepers while the RTC data includes only those carcases that were reported. Nevertheless, the numbers are reasonably similar.

Conclusion

While there is no question that roads are a significant threat to individual otters which might be killed or seriously injured on them, there is no evidence as yet that the number of otters killed on roads in Southwest England is sufficiently high to have an adverse effect on the recovery of the otter population.

COLLECTING AND RECORDING ROAD CASUALTIES

The value of road kills for post mortem studies of animals has long been recog-

nised and in the UK, otters have been collected for these purposes since the 1970s, initially on an *ad hoc* basis. In the 1990s, systematic collections of otter corpses began under the auspices of the Environment Agency who set up a collection and delivery system to ensure that bodies were rapidly sent to centres in south Wales or southwest England. A similar scheme has operated in Scotland.

In addition to providing reports on post mortems, the pathologists archived tissues, some of which were later used in DNA studies (e.g. Dallas *et al*., 2002 and 2003) and others for chemical analysis. A substantial proportion of the carcases, particularly from south and southwest England were studied by a veterinary pathologist with considerable experience. This has led to a substantial body of literature based on his studies and a number of significant findings, including the following:

a) Many otters suffer from bite wounds inflicted by other otters, some leading to fatal infections (Simpson, 2006);
b) Probable infanticide and cannibalism (Simpson and Coxon, 2000);
c) A relationship between PCB levels and vitamin A in a wild population (Simpson *et al*., 2000);
d) Retinal dysplasia in otters, correlated with lower levels of vitamin A and higher concentrations of dieldrin (Williams *et al*., 2004);
e) A species of fluke, new to Britain, probably imported with exotic fish (Simpson *et al*., 2005).

More recently, the Environment Agency has incorporated these projects into its national surveillance scheme for toxic chemicals.

Concurrently with this, the Environment Agency has maintained a database which records the location of otter casualties which has made it possible to identify places where otters are repeatedly killed (sometimes described as 'hot spots' or 'black spots') which has helped to focus efforts to provide mitigation. For example there are two sites in southwest England where five otters have been killed, over a six year period in one case and over eight years at the other (but with three of these within 15 months). In each case the rivers were blocked by weirs which are impassable to otters, forcing them to cross the road if they wished to travel upstream. Ramps which allow otters to bypass the weirs have now been installed at both of these sites and otters are known to use them.

STUDIES OF ROAD CASUALTY SITES

The fact that road casualties, perhaps mistakenly, have been considered to be a significant threat to the recovery of otters in Britain has led to the Highways Agency commissioning a series of studies with a view to providing advice on mitigating the impact.

A study of otter casualties throughout the UK led Philcox *et al*. (1999) to conclude that a disproportionate number of otters were killed on trunk roads and A roads, which carry more, faster, traffic, and that more otters were killed in months when rainfall and river flows were higher.

In a subsequent study Grogan *et al*. (2001) matched known casualty sites

with similar sites where none had occurred. A wide range of parameters were recorded (shape, size, water flow) in an effort to determine whether it would be possible to predict sites were otters were most likely to be killed. When undertaking a survey of trunk roads in southwest England I adopted a different approach (Chanin, 2000). All places where the roads crossed a watercourse which was shown on 1:50,000 scale maps were surveyed, together with any where otters casualties had occurred. I recorded a range of parameters similar to those collected by Grogan *et al*. (2001) In neither study was it found possible to make predictions, except at sites where otter passage beneath a road was permanently blocked by a weir or sluice so that the animals were always forced to cross the road, rather than travel under it.

One other feature of the study in southwest England was that a disproportionate number of otters were killed on sections of road running along watersheds. Any otter trying to travel from one catchment to another in such areas had no option but to cross the carriageway where there were no drainage channels passing under it. There was no evidence for regularly used crossing places (although these might exist) but there were stretches of where significant numbers of otters were killed along a length of a few kilometres. For example, five otters were killed in 3 years along a 4km stretch of road bordering the River Camel Special Area for Conservation.

One may conclude from these studies that otters might be killed at any point where a road crosses a waterway and in some areas, even where it does not. Heavy rain and high water flows will increase the probability that otters are forced to cross roads but the probability of an otter crossing the road at a particular point will also be influenced by the frequency with which otters use that stretch of waterway and variations in flow rate. The probability of an otter being killed as it crosses the road is itself influenced by, for example, time of day, traffic volume and speed.

It is also clear that otters will, on occasion, cross roads when they do not need to and there is no easy way to prevent this.

PREVENTING CASUALTIES

While it may seem self-evident that it is desirable to reduce the number of otters killed on the roads it is important to recognise that this might be done for various reasons. For example:

Humanitarian: to reduce the suffering of individuals which are not killed outright or to prevent the death of dependant cubs if their mother is killed.

Conservation: because RTCs are a threat to the viability of the population or might slow down or prevent its recovery.

Public safety: to reduce the risk of accidents to road users who might endanger themselves while trying to avoid killing an otter crossing the carriageway.

While all of these reasons may be valid and of equal concern, to road management authorities for example, it is important to consider them carefully when allocating resources. Thus, advocating expensive mitigation to marginally reduce road deaths may not be the

best use of funds designated for conservation.

There are several methods available to prevent, or at least reduce the probability of, RTCs occurring and the costs and benefits of these need to be considered on a site by site basis.

Construction of new bridges and culverts

One output from the work undertaken by Grogan *et al*. (2001) was a revision of the UK Highways Agency's Design Manual for Roads and Bridges (Highways Agency, 1999), known as the DMRB. This provides guidance on suitable designs for crossings of waterways which is intended to inform planning on major road schemes. While pointing out that it would be desirable to build all bridges and culverts large enough for otters to pass through them whatever the water flow, the authors acknowledge that in some places it may be necessary to incorporate ledges or tunnels for otters, and specification for these are provided.

Given the expansion in otter range in the UK over the past thirty years, it should be considered a matter of principle that all crossings of watercourses by new roads should be designed to minimise risks to otters, since it must be assumed that otters will colonise catchments from which they are currently absent during the next few years or decades. In particular, permanent barriers to otter movement should not be installed under any roads.

The DMRB guidelines were designed to be used on motorways and the largest of non-motorway roads, where structures may be very large and underpasses, therefore, very long. For smaller roads the specifications may be reduced proportionately, while bearing in mind the size of the animal. For example the DMRB recommends tunnel diameters of 600-900mm, while otters will readily enter tunnels as small as 300mm in diameter.

Mitigating the effects of existing structures

There are two main approaches to providing mitigation at sites which have lead to otter casualties although, in some sites, it may be advisable to use both:

a) Creating alternative passages under the road by constructing ledges, ramps or additional tunnels which are above (most) flood water levels.
b) Installing fencing to prevent otters gaining access to the road.

Which of these is appropriate depends both on the nature of the structure involved as well as the timing of installation.

Ramps and ledges - Where passage by otters is permanently blocked by a weir a simple ramp constructed of steel plate can be an effective remedy. However it should be very firmly attached in spate rivers and installed in such a way as to minimise the risk that it will snag floating debris and thereby impede flow (Fig. 3).

In the UK, 300mm wide mild steel plate 4.5mm thick bolted to steel brackets at 2m intervals has proved satisfactory (Fig. 4). Evidence of use by otters has sometimes been found within a few

days of installation.
An otter's passage under a road may be temporarily blocked either by high rates of water flow or because the culvert fills to the top leaving no air space.

Figure 3 - Otter ramp over a weir where five casualties had occurred prior to its installation

In the first case it may be practical to bolt a steel ledge above maximum water levels along the whole length of the bridge or the culvert, so that otters can walk along it when swimming is impossible. A similar design to the ramps (above) may be used although it is important to ensure that the otter can reach these when water levels are high. In most cases it is likely that a ramp leading up to the ledge will need to extend outside the structure itself to a point which otters can reach by swimming or walking under flood conditions.
It is important to bear in mind the fact that it may still be beneficial to reduce the risks to otters by installing a ramp which is covered by extremely high spates but available at more normal ones, where a permanently usable ramp cannot be fitted.

Tunnels - Where a culvert fills to the roof or is the wrong shape for attaching a ledge (arched or cylindrical) a secondary, alternative tunnel may be sometimes be practical (sometimes called an 'underpasses' or 'dry cul-

Figure 4 - Close-up of ramp and support.

vert'). These can be extremely expensive and disruptive to install after the initial construction of a road but they should not have any impact on the structure itself, do not run the risk of creating an obstruction and are much less likely to suffer damage during severe flood events. Generally, for post-construction mitigation, it is most cost-effective to install these when other road works are undertaken at the same time.

As with ledges, an underpass which itself occasionally floods may provide benefits by reducing the frequency that otters are forced to cross the roads and thereby reduce the probability of casualties.

Fencing - This is often recommended as a simple approach to reducing the risk of road casualties and is recommended by the DMRB as an essential part of any mitigation process. However its use should be considered with care at any site since it can create problems as well as solve them.

Although otters can climb over and dig under fences when confined in captivity it is more likely in the wild that they will try to walk round a fence than do either of these. Thus the specifications for fencing probably do not need to be as rigorous as for badgers. The DMRB recommends that fences should extend for at least 100m on either side of the water crossing concerned although otters have been killed crossing roads at greater distances from water than these. It should also be noted that fencing is

susceptible to damage during roadside maintenance and it is necessary to check its integrity at regular intervals.
The following points should be considered before installing fencing:

a) It may be more beneficial to use fences to guide otters from the water's edge to a safe crossing such as an underpass or ledge, than to simply prevent access to the road *per se*.
b) Is fencing needed on both sides of the road? Otters are more likely to be prevented from travelling upstream than down by floods, except where culverts are filled to the top. Fencing on both sides may lead to otters being trapped on the carriageway if they follow a fence to its end, go around it and then try travel back towards the water course.
c) Preventing otters from crossing watersheds by fencing known crossing points may be more detrimental to the population than accepting some losses as the price for allowing animals (of various species) to disperse freely.

PRIORITIES FOR ACTION

In the UK, approaches to reducing the risk of otter road casualties have evolved over a period of time. Initially they took the form of local action inspired by individuals with a particular concern for otters but more recently the problem has been taken up by government bodies such as the Environment Agency and the Highways Agency who have adopted a systematic approach to it.

Based on these experiences, the following should be considered in areas where the problem is only just beginning to be recognised.

COLLECT INFORMATION

Monitoring RTCs - Ensure that the locations of all casualties are centrally recorded and that the information is reviewed at intervals as a means of identifying sites where otters are being killed regularly so that mitigation can be considered.
Post mortems - Arrange for corpses to be collected and delivered to a veterinary pathologist for examination. Ideally corpses should be examined fresh (not frozen) by one or a very small number of experienced pathologists working to agreed procedures, including for the recording and archiving of information and histological material.

AGREE AND ENFORCE APPROPRIATE DESIGNS FOR NEW ROADS

Agree guidelines for bridge and culvert design which is compatible with otter use. This needs to be accepted by national and local bodies involved in road construction. Guidelines must be followed in areas which otters are likely to recolonise as well as those where they are already present.

CARRY OUT MITIGATION ON EXISTING ROADS

Use information from RTC monitoring, possibly combined with pro-active sur-

veys on major routes to identify structures such as weirs under bridges, which create high risks for otters by them forcing onto the road surface. Implement a programme of mitigation focussing first on areas where otters are already present and then moving on to areas which they will recolonise in due course.

CONCLUSIONS

It is obvious that as the numbers of otters increase in an area the number that are killed on the road will increase too. What is not so obvious is the extent to which losses through road kills will have an impact on the viability of a declining population, the maintenance of a stable population or the rate of increase of a recovering otter population. In the UK, otter populations continue to recover despite increasing casualties and there is no evidence as yet to indicate that they have a detrimental effect.

Although it will never be possible to prevent all road kills it is possible to reduce the risk in some areas and also to use road casualties as a valuable resource for understanding population processes, monitoring diseases and the burdens and effects of toxic chemicals in wild populations.

Consideration of road kills should be regarded as an important component of otter conservation but careful thought should be given to the merits of recording and using RTCs as well as the costs and benefits of preventing them.

It is important to recognise that increasing otter road casualties is a consequence of successful conservation rather than, necessarily, an indicator of failure.

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