R E P O R T

HINDERING OTTER (*Lutra lutra*) ROAD KILLS PART 2

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ABSTRACT: This is the second part of a detailed enquiry into the relative effectiveness of different otter Road Traffic Accident prevention measures, with practical advice on construction.

EVALUATION OF THE RESULTS

The results in Part 1 (KÖRBEL, 1994) show, for the most part, the degree and distribution of the individual mapped factors for recorded accident sites only. Since it was possible to obtain comparable data on these factors for relatively few sites, the strength of these results is reduced. It is, therefore, not possible to extrapolate significant values for the individual mapped factors for the whole of the investigated region as calculations were made based on the sample only - determined by the recorded accident sites. This means that, for example, the result concluding that the majority of accidents sites coincide with the presence of rectangular or tunnel shaped ducts is correct. However, the question remains open just how representative these ducts are for the total region. Perhaps it is the case that roads intersecting a waterway signal, for the majority of cases, the presence of a duct.

The results did show, however, that potential accident sites cannot be predicted based on water way or biotope criterion as the available distribution of the accident sites on hand fell on all biotope and water types. Accident sites where a road did not intersect a water way were characteristically sites where several water bodies or water ways are in close vicinity of each other. However, in a few cases, sites were documented where an otter tried to cross a road at great distance from a water-way/road-way in close proximity. Preventive measures for the protection against otter road kills should, therefore, be undertaken at all sites where road way and water way are in close proximity of one another or an intersection exists.

The type of the road way is irrelevant as the risk of accident is dependent on the volume of traffic. For example, if "country roads" - which in their present poor condition and consequent lower traffic volume and speed have not been the sites of otter road kills - were to be improved, increased traffic volume and new accident sites are to be expected.

RECOMMENDATIONS FOR PREVENTIVE MEASURES TO AVOID OTTER ROAD KILLS

Just as the mapped results show, there are two basic distinctions among the types of accident sites: either a road and water intersect, or water exists on both sides between which otters cross and lies in close vicinity of a road. A procedure used to determine in which of the two cases mentioned above a road section falls and which measures can be taken is shown in Figure 1 ("revier" = habitat).

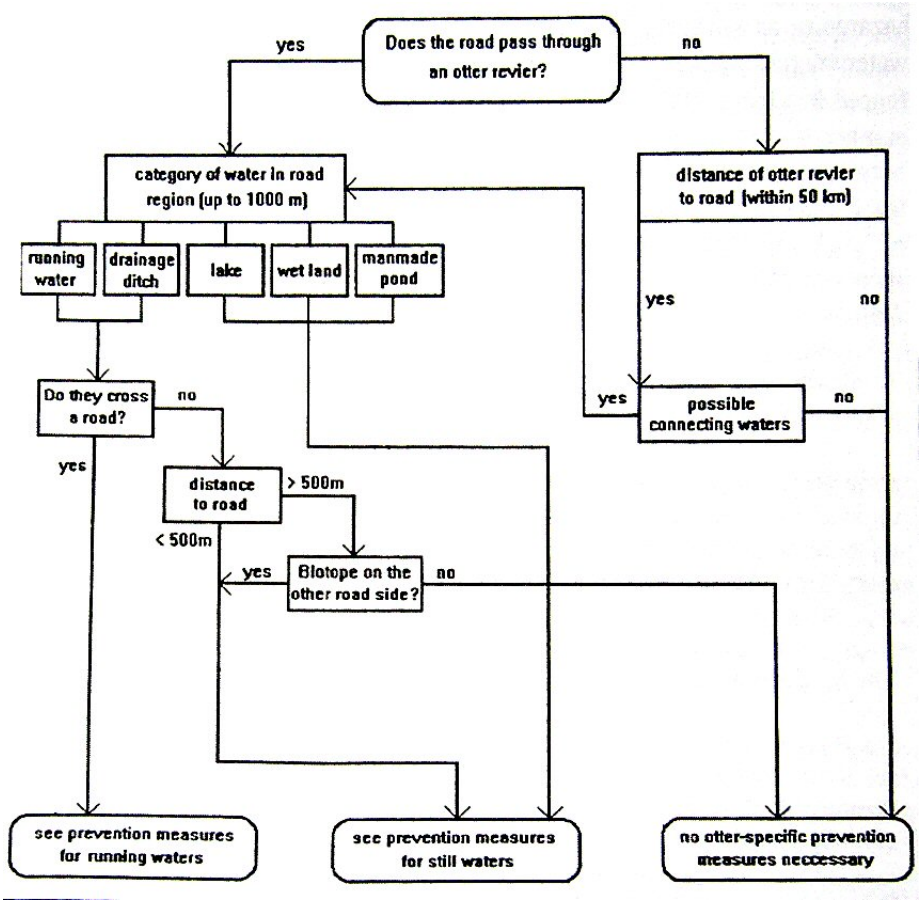

Figure 1: Determination of preventive measures

If the road bed does not actually run through an otter territory, it is still important to take measures within a 50 km range of the territory boundaries as otters are known to travel distances of 20 km during their active hours at night. In addition, it is important to take into consideration the possibility of migration as well a change in areas within a territorial range and that associated travel routes must be taken into account even at distances falling far outside the 50 km buffer. A restriction of preventive measures exclusively to existing otter territories would not allow the option of otters reestablishing populations in the gaps and, thus, recovery from its depleted number. For this reason, measures must be taken especially for those water ways where isolated otter populations exist so that connections among smaller populations can be reestablished and a chance for survival is given.

In most cases, the consideration of all waters lying within 1000 m of the road bed network seems to be adequate as approximately 95% of waters (not intersected by a

road) lie within 1 km from a road (see Part 1, Table 8). If it is, however, evident that otters are present in only portions of the considered area or that there is a network of frequented biotopes, then the range considered for preventive measures must extend well beyond 1000 m from the road.

CONSTRUCTION DESIGN OF BRIDGES AND DUCTS FOR NEW ROAD CONSTRUCTION SITES

Water and roads intersect at about 55% of the recorded accident sites, whereby this includes dried river beds and drainage ditches, as well as rivers (Part 1, Table 6). All water types show to be equally under risk. Even apparently unimportant and at times dried river beds can serve as passageways within otter territories or into areas outside of them. Preventive measures must, therefore, cover all water ways that intersect with a road.

Determining factors influencing whether an otter is forced to cross a road could lie on physical qualities of a bridge's or duct's construction, the presence of dams or similar obstacles or high water levels associated with the construction forms mentioned. The following preventive measures with respect to these factors are recommended:

Bridge and duct construction

Tunnels ought to be avoided in general as otters pass through tunnels of a certain minimum size and only when they are dry, not when water is diverted through them.

All waters which intersect a road within an existing or potential otter habitat ought to be crossed by bridge, for example, a rectangular shaped bridge. The bridge must span the water way leaving ample space on both sides for a natural river bank underneath the bridge. A width-height-length relationship acceptable to otters' needs to consider length of bridge span, bridge height above the bank, bank width and length underneath the bridge.

The following guidelines have been calculated for the measure of bridges:

Length up to 10 m: Height at least 100 cm above high water mark, 150 cm bank width on each side of which at least 100 cm lies above the high water mark.

Length up to 15 m: Height at least 150 cm above high water mark, 200 cm bank width on each side of which at least 150 cm lies above the high water mark.

Length over 15 m : per 100 cm additional length add 5 cm height above high water mark, 250 cm bank width on each side of which at least 200 cm lies above the high water mark.

Banks

The river banks underneath the bridge ought not to have an incline greater than 25%. The ground covering ought to reflect the natural surroundings and is not to be secured, cemented or the like. A few field stones would probably increase the attractiveness of the bank as marking area. The bank area adjacent to water also should not be secured. Possible wash out areas as well as new sediment deposits under the bridge are welcomed as they add added structure and, therefore, attractiveness for otters. Extra greening of the banks does not appear to be necessary.

Steering Measures

Latest telemetry results and observations via infrared cameras show that otters not only travel direct at the waters edge but also at some distance from it. To avoid these cases leading an otter to cross a road, a steering mechanism for each bridge is necessary. For this, fencing has been recommended. A six-sided, plastic coated mesh (mesh size: 4 cm, gauge: 3 mm) has worked well. The height of the fence should extend 150 - 160 cm above ground surface. To avoid the effects caused by erosion or digging, the fence should extend another 40 - 50 cm below ground surface. The fence should lie parallel to the road, not to the water way, to steer otters traveling at greater distance from the waters edge. About 100 m on each side of the bridge appears to be an adequate length.

Dams and other obstacles

The combination bridge/ dam is to be avoided in general. In addition, steps must be taken to ameliorate all sorts of measures having lead to an obstruction or restriction at the waters surface or on the river banks underneath or in close proximity to a bridge (within 100 m).

Lastly, it should be mentioned that the efforts to replace ducts with bridges not only benefits otters and other river bank dwelling mammals; it has a positive effect on the entire water ecology. A duct in a water way has the effect of a near to impassible ecological barrier. Because of the restriction of the water way, ducts, as a rule, prohibit the passing of otters, limits territorial and hunting flights of dragonflies and complicates the dispersion of many water insects. A conversion from duct to bridge compensates these negative effects. The new river bank has a positive influence on insects within the zone of the water's edge as well as for amphibians and spiders.

CONSTRUCTION DESIGN OF ROADS WITHIN REGIONS WITH OTTER OCCUPIED WATERS

Running waters did not intersect with roads at about 46% of the mapped accident sites (Part 1, Table 6). This means that about half of all otter victims occurred at sites where preventive measures concerning bridge construction would not have been useful, as no water existed at these sites.

The construction design of the preventive measure needs to accommodate the site and situation. Based on several experiences concerning the passage of otters and ducts, a model can be developed which would accommodate the local conditions. This models

holds a preference for a fencing in of the areas considered particularly hazardous and the use of tunnel passages.

The fencing should extend on each side 100 m beyond the zone considered as hazardous, as it cannot be assumed that otters will, when crossing between two water sources, choose the most direct path. The tunnel passages connecting the fenced in zones ought to lie at a distance of not more than 200 m apart from one another. A distance of about 200 m appears to be adequate, as a greater distance between passages leads to ”impatience” of the otter which then opts to climb over the fence - which it is physically capable of doing. In addition, the fencing needs to be placed such that the roaming otter is steered direct into the entrance of the tunnel passage (i.e. so that no possibility exits that the otter misses the passage entrance).

To obtain an adequate relationship between width and height (diameter) to length of the tunnel, the following proportions should be employed:

up to 10 m tunnel length:	100 cm tunnel diameter
up to 15 m tunnel length:	120 cm tunnel diameter
up to 25 m tunnel length:	150 cm tunnel diameter
more than 25 m tunnel length:	construction of a ”dry tunnel” according measures for road construction (see below)

The height and width of the ”dry tunnel” correlates to length as follows:

Height:by 25 m length, height at least 150 cm, per 100 cm more in length add 5 cm more in height.
Width: by 25 m length, width at least 300 cm, per 100 cm more in length add 10 cm more in width.

It is again important in such cases as these that the tunnel passages and ”dry tunnels” remain dry at all times of the year. This means that the entrances of either must either be even with ground level or slightly raised (up to 10 cm).

The tunnel passage or ”dry passage” should contain a 10 cm layer of sand or natural substrate found in the nearby surroundings.

In conclusion, it ought to be stressed that preventive measures of this sort are for the most part for the benefit of the otter, but have as a positive aspect benefits for other species. Similarly, the effect of isolating the road ways can, at least for parts, have similar effects for the little regarded animal groups, such as, ground dwelling insects and spiders.

There are also positive effects to be expected for small mammals, too. Representative of this group and thought to be endangered is the species water shrew (*Neomys fodiens*).

The following species ought also to be mentioned as they, too, will travel through the tunnel passages: muskrat (*Ondatra zibethica*), brown chested hedge hog (*Erinaceus europaeus*), badger (*Meles meles*), beaver (*Castor fiber*), fox (*Vulpes vulpes*), common house rat (*Rattus rattus*), ermine (*Mustela erminea*), common weasel

(*Mustela nivalis*), mink (*Mustela vison*), stone marten (*Martes foina*), polecat (*Mustela putorius*), common wild rat (*Rattus norwegicus*).

A positive effect for amphibians is not to be excluded; however, these sites and preventive measures have been chosen to protect the otter. It is clear that the recommended steering mechanisms and fencing is of a mesh size too large to steer the passing of amphibians into the tunnel passages. For the protection of amphibians, other preventive strategies would need to be employed.

RECOMMENDATIONS FOR THE REMEDIATION OF EXISTING ACCIDENT SITES

The loss of otters due to traffic related fatalities in the time since the reunification of Germany has increased by more than 500%. In addition to the implementation of preventive measures for traffic related deaths of otters in road construction matters, it is also necessary to remediate known existing sites of traffic death.

Based on the great variety in type of accident site, no general solution can be offered suiting all sites. An individualized action plan must be devised for each site based on the already named factors and in cooperation with the local nature conservation authorities, especially with the local otter protection group.

Based on the nature of the site, the following possibilities exist:

- Accident sites which do not intersect with a flowing water way
  For securing these sites, it is possible to implement the steering mechanisms and passage tunnels using the methods already described.
- Accident sites which intersect a flowing water way
  If the river or stream flows underneath a road and through a duct or rectangular duct and is very constricted at some point in its width, then the first goal would be to install a wide spanning bridge.

If this is not possible, then dry tunnels need to be constructed left and richt of the duct. Measurements for the dry tunnel passages and their corresponding steering mechanisms are to be used as described above for tunnel passages.

If the river or stream flows through a duct or rectangular duct, underneath a road and is not very constricted at some point in its width, then a berm can be built below the opening at the base of the bridge. A similar system has been recommended by STRIESE and SCHREYER (1993) for the improvement of bridges. These berm can only partially replace the non-existing river banks. Berms need to be at least 30 cm in width, and they should not lie higher than 20 cm above the water's surface. This solution is only applicable for locations with a constant water level, as berms should not be flooded at times of high water. Additional steering mechanisms are also in these cases absolutely necessary.

However, when the water way under consideration undergoes extreme water level fluctuation, which would at times overflow the berms, then tunnel passages left and right of the duct are necessary.

CONTROL FOR SUCCESS

After implementing the recommended measures for the various landscape, water, as well as, road types, a phase needs to be planned for in which the effectiveness is determined. In addition to direct observations, it is also possible to collect information via tracks left in the sand or via infra red film sequences. Without such a control, it is possible that errors in concept, design or planning inadvertently add to traffic deaths of otters at existing remediated sites or those planned for the future. Because of this possibility, it is essential that this control phase be completed, compared with the results from other projects and published promptly.

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