# Badger (*Meles meles*) road mortality in the Netherlands: the characteristics of victims and the effects of mitigation measures

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**Abstract:** Of the badger (*Meles meles*) population in the Netherlands of the 1980s, a high percentage (locally up to 25%) of the population was killed yearly by road traffic. This led the Dutch authorities to instigate mitigation measures such as fauna tunnels and fences. Between 1990 and 2006 data has been gathered on badger victims in the Netherlands which can be used to test if these mitigation measures have been effective. We present here data on the total number, age and sex of the victims, their distribution over the Netherlands, and over national, provincial and municipal roads and test whether mitigating measures results in a decrease in traffic victims. The badger victim dataset shows a clear peak in victims in March, and relatively low numbers in December, January and February. Most fatalities occurred within the distribution range of the badger. Nationally, the sex-ratio of victims did not differ from 1:1, but in 1990, more of the fatalities outside the badger's distribution range were female. In absolute terms, most victims were reported from municipal roads. However, relative to the total length of roads within the range of the badger, most victims occurred on provincial roads. The number of traffic victims is significantly lower when mitigation measures have been in place for a while. The challenge for conservation lies in minimising victim numbers at provincial and municipal roads. As badger victims occur over a huge length of municipal roads mitigation along these routes will be difficult. Still, a number of measures are recommended, including for example placing fauna passages at well-known badger tracks, decreasing speed limits, relocating badger setts or closing roads for through traffic.

*Keywords*: traffic victims, fauna tunnels, road fences, eco-ducts, wildlife passages, road ecology, *Meles meles*, badger.

## Introduction

In the 1900s, the badger (*Meles meles*) population in the Netherlands was estimated to number between 2500 and 3000 setts, containing over 4000 individuals (van Moll 2005). By the 1960s this number had declined drastically (van Wijngaarden & van de Peppel 1964) and it stayed low until the mid 1980s (van Wijngaarden et al. 1971, Wiertz & Vink 1986), with about 400 setts in the whole of the Netherlands.

A number of causes for this decline have been suggested (van Wijngaarden & van de Peppel 1964, Wiertz & Vink 1986, van Apeldoorn et al. 1995). These included hunting and poaching, the disturbance and destruction of setts, habitat loss, pollution, isolation of metapopulations, hampered migration and road traffic. By the 1980s, it was clear that the number of badger traffic victims was continuing to rise (Wiertz & Vink 1986; figure 1) and that a high percentage of the population, in some areas up to 25%, was being killed by road traffic: (Broekhuizen et al. 1994, van Apeldoorn et al. 1995, Bekker & Canters 1997). In 1984 the Dutch Ministry of Agriculture, Nature and Fisheries launched a badger protection policy to address the decline in badger numbers (Beheersoverleg Dassen 1983, Sneep 1986).

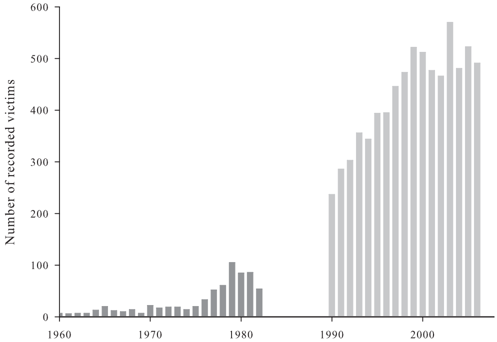


Figure 1. The number of recorded badger traffic victims in the period 1960-1982 (Wiertz & Vink 1986) and 1990-2006 (this study); in the period in between there was no registration.

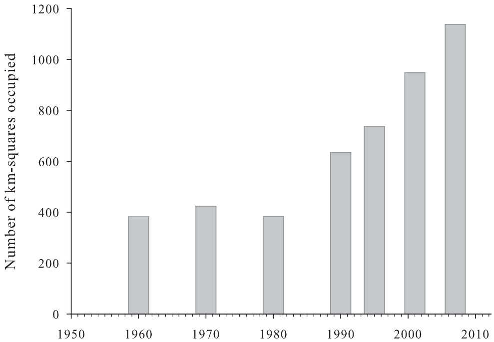


Figure 2. Number of 1x1 km squares in the Netherlands, occupied by the badger. Sources: van Wijngaarden & van de Peppel (1964), van Wijngaarden et al. (1971), Wiertz & Vink (1986), Wiertz (1991), van Moll (2005), Witte et al. (2008).

The proposed measures included habitat improvement and de-fragmentation, reintroductions, refunding farmers for crop damage and educating hunters and landowners (Sneep 1986). In 1990 national policies for nature and transport (the Nature Policy Plan and the Second Transport Structure Plan (Ministerie van Landbouw, Natuurbeheer en Visserij 1990, Ministerie van Verkeer en Waterstaat 1990 respectively) underlined the necessity of halting further habitat and population fragmentation by roads and to counter the existing level of fragmentation. These policies paved the way for de-fragmentation programmes (Bekker & Canters 1997). The Nature Policy Plan introduced the National Ecological Network (NEN) and the Second Transport Structure Plan stated that no further fragmentation of nature and landscape by motorways would be allowed and that the existing level of fragmentation must be decreased. These policies, updated in 2000 (Ministerie van Landbouw, Natuur en Voedselkwaliteit 2000) and in 2005 (Ministerie van Verkeer en Waterstaat 2005) are the basis of current policy, described in the Long Term De-fragmentation Programme (Ministerie van Verkeer en Waterstaat et al. 2004). This programme has identified 208 bottlenecks between national infrastructure (roads, rail roads and canals) and the National Ecological Network (NEN) and has set a target of eliminating these bottlenecks by 2018.

In the 1990s and 2000s, the distribution and population size of the badger increased strongly (Wiertz 1992, van Moll 2005, Witte et al. 2008) (figure 2). This increase may be attributed to addressing most of the assumed causes of decline, such as compensation for damage to crops (Faunafonds 2006), establishing management scheme agreements with farmers that have setts on their land (Faunafonds 2006), a decrease in PCBs and heavy metals (except in floodplains, van den Brink & Ma 1998), the raising and translocation of orphaned or threatened badgers (van Moll 2005), the countering of habitat loss and implementing mitigation measures at problem sites on the national road network. Here we focus on the efficacy of the latter.

The most frequently implemented mitigation measures to help badgers safely across roads are small round tunnels (with a diameter of 40-50 cm), constructed from concrete or steel, combined with fencing (Kruidering et al. 2004). These tunnels are known to be used by badgers (Maaskamp 1983, Derckx 1986, van Dinther 1994, Bekker & Canters 1997, Brandjes et al. 2002). Apart from tunnels there have also been adaptations to existing infrastructures, such as bridges and viaducts, to make them suitable for co-use by badgers (Kruidering et al. 2004).

There is no current data on the proportion of the national badger population (also in terms of age and sex) that is killed by traffic, whether there is any difference between road types, and whether establishing tunnels contributes to a decrease mortality. This knowledge can help to optimise conservation and mitigation measures, by aiming them at certain road types or certain parts of the badger range and can also be used as a model for other terrestrial mammals.

In this paper, we present and analyse data on badger traffic victims gathered by the Das & Boom Society and Rijkswaterstaat between 1990 and 2006. As a first step we present the age and sex of the victims and the temporal and spatial patterns in victim numbers. In an expanding population, females are the agents of population spread. For this reason, we pay extra attention to the sex-ratio of victims found outside the known distribution range of badgers, and compare these results with an earlier study. As a second step, we determine the distribution of victims along national, provincial and municipal roads. Finally, as a third step, we test whether taking mitigating measures results in a decrease in traffic victims.

## Methods

### Collecting badger traffic victim data

The datasets of badger traffic victims and of mitigation measures were not specifically gathered for this study. Traffic victim data were gathered by the Das & Boom Society and Rijkswaterstaat. Badger victims were generally found by the public, by inspectors of Rijkswaterstaat and a network of volunteers. Until 2000, volunteers of the Das & Boom Society went to the majority of reported sites to determine the age (sub-adult, adult) and sex of traffic victims. After 2000, the age and sex were no longer determined in the field by these volunteers, but were sometimes given by the person reporting the badger victim. The location of accidents is available, with in coordinates precise to within ten metres, as well as the road name, type and responsible authority and date. The dataset covers the period from 1 January 1990 to 31 December 2006.

### Estimating badger range and population size

The changes in badger range and population size in the last 40 years have been well documented through national badger censuses: systematic surveys in which all suitable badger habitats were checked for inhabited setts. Badger censuses were carried out in 1960 (van Wijngaarden & van de Peppel 1964), 1970 (van Wijngaarden et al. 1971), 1980 (Wiertz & Vink 1986), 1990 (Wiertz 1992), 1995 (van Moll 2005), 2001 (van Moll 2005) and 2007 (Witte et al. 2008) (figure 2). A badger census involves conducting a survey of the potential habitats of badgers, with each square km of potential habitat being checked for badger presence, setts or tracks. The exact methodology is described in the reports of each census. We assume that the 2007 census is a good representation of the range and population in 2006 and use this data to compare the traffic victims of 2006 with the badger range.

### Roads and road mitigation

Rijkswaterstaat provided us with spatial data about the Dutch national road network. Data on fauna tunnels and eco-ducts at motorways came from the WEGENSNIP database (Rijkswaterstaat 2007). Additional data about fauna tunnels along provincial and municipal roads were provided by the Das & Boom Society. These datasets detailed the type of wildlife crossing, structure, location, road type and year of construction. Our analysis only looked at wildlife crossing structures that were accompanied with wildlife fences to guide the animals to the structure and keep them off the road. Roads with wildlife fences but without wildlife crossing structures were not considered as sites with mitigation measures for the purpose of this analyses.

### Demographic analyses and distribution of victims

First, we report the descriptive statistics from the traffic victim database: the number of victims each year and the total number of victims each month, with an age and sex class breakdown. We separately analyse victims were reported outside the known range, for the years when a badger census was carried out. Badgers are considered to be outside their known range when they are reported from a location more than two kilometres from the known distribution range of badgers in that year (two kilometres is the maximum distance that resident badgers move away from their setts in the Netherlands ( van Wijngaarden & van de Peppel 1964, Wansink 1995) and elsewhere in western Europe (Neal & Cheeseman 1996, Palphramand et al. 2007). We use a Chi-square test to test for the sex-ratios within the total victim population over the whole year, in the mating period only, and among fatalities outside of the known badger range. We compare these data with data reported by Müskens & Broekhuizen (1993) whose study of badger victims in the 1980s, found that badgers killed by traffic further than three kilometres from known setts were more often females.

Next, to correct for the effects of population growth and wider distribution on victim numbers, we express the number of recorded victims as a percentage of the population for the years in which a census was done (dividing the number of victims by population size in the census years). Following Wiertz & Vink (1986) we assume that there is usually one sett per $km^2$, and that setts are inhabited by 3.2 badgers. We divide the number of badger victims by the number of populated $km^2$ x 3.2 badgers $km^{-2}$ x 100% in order to calculate the percentage of the population that were recorded as traffic victims.

### Badger victims by road type

In the analysis we distinguish three road types: national roads, provincial roads and municipal roads. These road types have different speed limits (respectively 120 or 100 km $hour^{-1}$, 100 or 80 km $hour^{-1}$ and 50 to 30 km $hour^{-1}$), and different traffic densities.

We then enter traffic victims and road maps into a GIS, with the location of each fatality also being coded in terms of road type. Next, we calculate the absolute number of traffic victims by road type. As there are far more municipal roads than provincial or national roads, it is likely these roads will claim more victims. To take this into account we also calculated the number of victims per kilometre of each type of road within the known range of badgers, for each of the census years.

### The effect of mitigation measures

We tested the effect of mitigation measures on badger mortality by comparing the number of victims around each road mitigation site, before and after the construction of the wildlife crossing structure. We used two kilometres of road length on each side of the mitigation site, as this is the maximum range a non-dispersing badger will move from its sett in the Netherlands (van Wijngaarden & van de Peppel 1964). We assumed that the number of badger fatalities more than two km from the mitigation measure would be unaffected by the measure.

An increase in numbers and/or the expansion of the range of badgers over the study period are potentially confounding factors when testing the effect of mitigation measures: a road may show more victims after the implementation of a mitigation measure if badgers were absent in the area in the years preceding the implementation and moved into the area afterwards. To avoid such problems, we only selected mitigation sites (*n*=126) situated within the 1990 badger range, locations which could potentially have had badger victims over the whole period. To further correct for population change, we weighted the number of victims at each location in a given year by dividing this figure by the number of victims that occurred nationally in that year.

We tested the effect of mitigation measures on the number of victims using a Generalised Linear Model approach, modelling the number of victims in each year at these locations, divided by the number occurring nationally in this year as a function of the number of years that each mitigation measure has existed. So, for a location with a measure implemented in 1998, this number would be -8 in 1990 and +2 in the year 2000. Location is included in the model as a factor. Because the pattern of victims follows a Poisson-distribution, with many zero counts, we used a quasi-Poisson error term, with a log link function. We evaluated the model by using Nagelkerke's $R^2$ (McCullagh & Nelder 1983). All statistical analyses were done in statistical package R (R Development Core Team 2008).

## Results

### Demography, phenology and distribution of victims

There was a steady rise in the number of badgers recorded as victims of traffic between 1990 and 2000, which then seemed to stabilise at around 500 victims per year between 2000 and 2006 (figure 1). Of course, these numbers may underestimate the true figure: not all animals that are found are reported, and not all animals hit by cars are found.

Of the 7,279 badger victims reported between

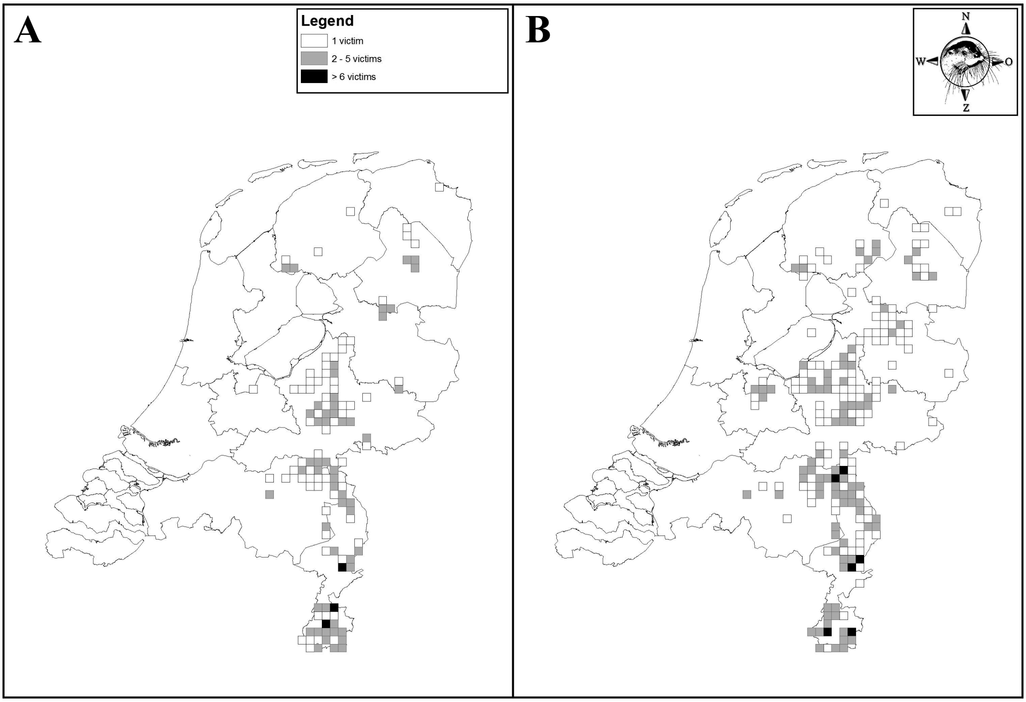


Figure 3. Distribution of victims in 1990 (A) and 2006 (B).

Table 1. Number of badger traffic victims (with sex and sex ratio) for the period 1990-2006; for the mating period (March) in the period 1990-2006, and found outside known badger range in the 1980s and badger census years (1990, 1995, 2001 and 2006). * *P*<0.05 ** *P*<0.01.

[1] Data from Müskens & Broekhuizen (1993).

| | | Male victims | Female victims | Sex ratio | $\chi^2$ |
|---|---|---|---|---|---|
| 1990-2006 | all victims | 2539 | 2447 | 1.04 | 1.700 |
| 1990-2006 | victims in March | 325 | 296 | 1.10 | 1.354 |
| 1980s[1] | all victims | 277 | 249 | 1.1 | 1.491 |
| | outside range | 5 | 20 | 0.3 | 9.000** |
| 1990 | all victims | 78 | 89 | 0.9 | 0.725 |
| | outside range | 3 | 16 | 0.2 | 8.895** |
| 1995 | all victims | 171 | 156 | 1.1 | 0.688 |
| | outside range | 27 | 15 | 1.8 | 3.429 |
| 2001 | all victims | 122 | 100 | 1.2 | 2.180 |
| | outside range | 5 | 7 | 0.7 | 0.333 |
| 2006 | all victims | 105 | 135 | 0.8 | 3.750* |
| | outside range | 10 | 9 | 1.1 | 0.053 |

1990 and 2006, 142 animals were killed by trains. Another 140 victims in the dataset were badgers that had drowned in canals. The distribution of victims generally follows the range of badgers, although some victims do occur far outside the known range (figure 3).

There is no difference in the number of male and female badgers that were killed by traffic in the whole set (table 1) or in the mating season, March ($\chi^2_{1,621}$=1.35, $P$=0.24). In 1990 there was a difference in the number of males and females killed outside the badger distribution range, but not in 1995, 2001 and 2006 (table 1). The number of victims is lower in the winter months (November to January) than in other months (figure 4), whilst in March there is a peak in numbers of victims. Sub-adult victims are seen first in April, but are only numerous in June, July and August. They constitute more than 10% of the victims in those months.

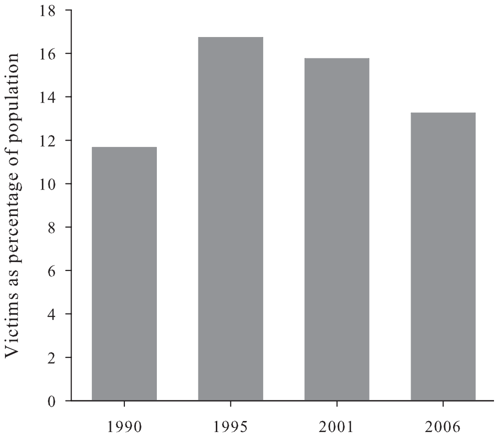


Figure 4. Number of traffic victims per month per age class in the period 1990-2006.

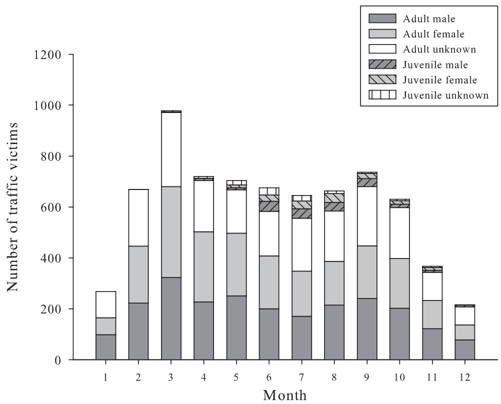


Figure 5. Estimate of the percentage of the Dutch badger population that is killed by traffic for census years.

On the basis of these calculations we estimate that in 1990, recorded badger traffic victims accounted for 12% of the (estimated) Dutch badger population. In 1995, this percentage rose to 18%. In the 2000s, it declined again: an estimated 17% of the population was killed by traffic in 2001, and 13% in 2006 (figure 5).

### Road types

In absolute terms, most badgers are killed on municipal roads and the fewest on national roads (figure 6A). When corrected for the length of each road type within the range of badgers, a different pattern emerges: the lowest number of victims per kilometre of road occurs on municipal roads, and the most on provincial roads (figure 6B).

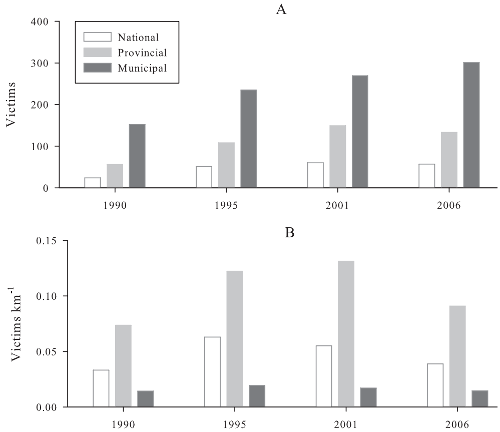


Figure 6. Absolute (A) and mean (B) numbers of victims on national roads, provincial roads and municipal roads.

### The effect of mitigation measures

There is no clear pattern in the relative number of victims before, during and after a mitigation measure is taken (figure 7), and there are large standard deviations within the data. However the generalised linear mixed model shows that the number of traffic victims is significantly lower the longer mitigation measures have been in place ($P<0.04$, Nagelkerke's $R^2=0.41$).

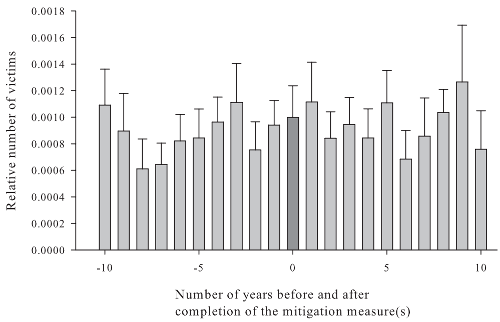


Figure 7. Average (+ s.d.) number of victims relative to the national number of victims and the number of years a mitigation measure is in place. Year '0' is the year the mitigation measure was implemented, 'year -8' is eight years before construction, year 8 is eight years after construction.

## Discussion

### The demography and distribution of victims

In line with earlier studies (Berendsen 1986, Davies et al. 1987) the majority of the animals killed were adults. The figures suggest that between 12% and 18% of the Dutch badger population was killed by traffic each year. However these percentages are almost certainly an underestimate, because not all victims that are found are reported and animals that are hit by cars but not killed immediately will move themselves away from the roadside and will not be found. Our estimates also do not include the number litters or juveniles that became orphans and subsequently died, Broekhuizen et al. (1994) estimated that at least 10% of all litters were lost because lactating females were killed at roads.

Overall, between 1990 and 2006, similar numbers of male and female badgers were killed by traffic, corroborating earlier studies (Davies et al. 1987, Müskens & Broekhuizen 1993, Broekhuizen et al. 1994). This is in contrast to other mustelids such as pine marten (*Martes martes*) (Müskens & Broekhuizen 2000), where more males than females die in traffic. We attribute this to the difference in the social structure of badger families. Badgers live and mate within social groups, which occupy a fixed home range, whilst other mustelid species live solitarily and mate promiscuously. For this reason, other male mustelids have larger home ranges than females (Johnson et al. 2000), resulting in higher mobility, increasing the frequency of road crossing, and thus increasing the chance of becoming a traffic victim.

There were relatively few victims in the period between November and January. Badger activities are lower in winter (Neal & Cheeseman 1996) and home ranges are smaller than in other seasons (Palphramand et al. 2007). Less mobility means there will be a smaller chance of being killed by traffic. Our results are supported by several other studies: road fatalities are lower in the winter months for badgers in the UK (Davies et al. 1987), in the Netherlands (Müskens & Broekhuizen 1993) and for other mustelid species (Müskens & Broekhuizen 2000).

There is a peak in victim numbers in March, with no difference in the number of male and female victims. As dispersal of badgers is not an event, but a slow and gradual process (Roper et al. 2003), we rule out the dispersal of young adult males and females as the main cause of the peak in victims in our dataset in March. Badgers show a peak in mating activity in early spring, which coincides with increased mobility due to marking of territory boundaries and looking for mates (Woodroffe et al. 1993). This increased mobility will increase the chance of getting killed by traffic. An earlier study found a bimodal pattern in victim numbers, with a peak in March, similar to our findings, and a second, smaller peak in August-September, which was attributed to a second peak in sexual activity (Davies et al. 1987). Such a late summer peak is not present in our data. However, Davies et al. (1987) analysed data from one year only, and report this year to be a particularly dry one. Drought can increase traffic mortality because of difficulties in finding food (Neal 1977), so the second peak reported by Davies et al. 1987 may well be an anomaly. We found no significant differences in the sex-ratio of traffic victims found outside known badger range in 1995, 2001 and 2006, although more females were killed in 1990. Müskens & Broekhuizen (1993), in their study of badger victims in the 1980s, found that badgers killed by traffic further than three kilometres from known setts were more often female. Possibly, the expanding population during our study period increased the number and proportion of dispersing males, resulting in increased mortality among them.

## Road type

Most victims occurred on municipal roads (figure 6A). This is hardly surprising: this type of road makes up for the majority of the road network of the Netherlands. Yet these are also the hardest type of road on which to decrease traffic victims as the fatalities are widely dispersed. The number of victims per km of road is highest on provincial roads (figure 6b) and this number increased over the study period. We hypothesise that the difference in mortality between road types is caused by the greater ease of access for wildlife on provincial roads, as opposed to national roads. In the Netherlands, national roads must have a ten metre obstacle free zone on either side (Dienst Verkeerskunde 1992, Adviesdienst Verkeer en Vervoer 2006), which makes traffic more visible to wildlife and vice versa. Higher traffic speeds on provincial roads may also increase the risk of wildlife being hit. Badgers may also avoid wider, noisier and busier national roads more than the quieter provincial and municipal roads. In the south of the UK, most victims also occur on smaller roads and far fewer on motorways (Clarke et al. 1998). And, during the study period (and especially in the first half) many more mitigation measures were implemented on national roads than on provincial and municipal roads.

Policy-wise, measures to lower the number of badger traffic victims should be primarily be taken along municipal and especially on provincial roads, as the relative number of victims per km on these roads is higher. The number of victims on the provincial roads and municipal roads could be lowered with management measures such as implementation and maintenance of fauna tunnels (Kruidering et al. 2005), fauna passages at well-known badger tracks, lowering of speed limits, or by closing off certain stretches of road (Jaarsma et al. 2007) during the night and/or in periods when collision probabilities are high. To be most effective, measures should be planned along sections with many recorded mortalities, making use of relevant landscape elements (ditches, tree lines, etc) and following a landscape-oriented approach (Kruidering et al. 2005).

### The effect of mitigation measures

At many locations mitigation measures show an effect in reducing victim numbers and our analyses show fewer victims in the years following mitigation measures being taken. In these analyses there were confounding factors. The effects of implementing mitigation measures may have been obscured by the growth and expansion of the badger population in the Netherlands during the study period, despite our efforts to correct for this. An analysis of well studied local situations, as performed by van Apeldoorn et al. (2006) and Vink et al. (2008), or a measure-by-measure analysis, taking also into account factors such as roadside habitat and municipal population size, give additional insights in the effects of these measures on badger mortality.

## Conclusion

We calculate that around 10-20% of the total badger population in the Netherlands is killed by road traffic annually, although this is probably an underestimate. March is the most common month for badger road mortalities, with figures being much lower in the winter months. In absolute terms, most badger mortalities are on municipal roads, but when expressed per kilometre of road, most mortalities occur on provincial roads. Mitigation measures reduce the number of victims. As there are several factors that could have affected the Dutch badger population it is hard to establish the extent to which road management has contributed to the recent increase of badgers in the Netherlands. However it is clear that mitigation measures have decreased mortality among Dutch badgers. For this reason it is important that these mitigation measures remain operational (Janssen et al. 1997, Vereniging Das & Boom 2002, Ouden & Piepers 2006).

In absolute terms most traffic victims are reported from municipal roads, but in relative terms most occur on provincial roads. In the case of municipal roads, the mortalities occur over a huge length of roads, making it difficult to take appropriate mitigation measures that will reduce these numbers. Still, some measures are feasible. These include fauna passages along well known badger routes or at locations where fatalities occur, decreasing speed limits or closing roads for through traffic (Jaarsma et al. 2007), closing them at night, or closing them during the peak fatality season.

Victim numbers are highest in March and lowest in the winter months, implying that major maintenance of tunnels and other mitigating measures is best undertaken between November and January. This way badgers, and other mustelids, will find the measures functioning and ready to use when they become more active in spring. However, frequent inspections and maintenance remain important throughout the year. Specific mitigation measures, such as fences or tunnels, are more effective when backed up by knowledge of the local badger population and its spatial behaviour.

Mathematical models indicate that an increase of life expectancy of badgers will result in more females in the age of highest reproductive success, and therefore in a relatively big increase in the population (Seiler et al. 2003). However, this proposed mechanism has not been tested in the field. The challenge now lies in testing the extent to which the decrease in mortality brought about by mitigation measures, together with the decrease in habitat fragmentation, will translate into a growth in the badger population as a whole.

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## Samenvatting

**Verkeersmortaliteit onder dassen (*Meles meles*): eigenschappen van slachtoffers en effectiviteit van mitigerende maatregelen**

In de jaren ’80 werd jaarlijks een groot deel (op sommige locaties 25%) van de in Nederland aanwezige dassenpopulatie (*Meles meles*) door het verkeer gedood. Dit gegeven was de aanleiding voor de Nederlandse overheden om een groot aantal uiteenlopende mitigerende maatregelen te realiseren, zoals de aanleg van faunatunnels en de plaatsing van rasters. Om de effectiviteit van deze maatregelen te kunnen nagaan werden vervolgens in de periode 1990-2006 gegevens over het voorkomen van dassenslachtoffers verzameld. We presenteren hier de verkregen dataset, tonen de verdeling van slachtoffers over wegtypen en toetsen of mitigerende maatregelen een afname van slachtoffers tot gevolg had. Het verloop op jaarbasis van de gevonden aantallen dode dassen vertoont een duidelijke piek in april. Er vallen daarentegen relatief weinig slachtoffers in de maanden december, januari en februari. De meeste slachtoffers vallen binnen het verspreidingsgebied van de das, maar ook daarbuiten werden slachtoffers gevonden. De sex-ratio onder de slachtoffers was 1:1, met uitzondering van 1990 toen er buiten het verspreidingsgebied van de das meer vrouwelijke dan mannelijke slachtoffers werden gevonden. In absolute aantallen vielen de meeste slachtoffers op gemeentewegen; gewogen naar lengte van elk wegtype vielen de meeste slachtoffers op provinciale wegen. Het aantal verkeerslachtoffers onder dassen was significant lager nadat er mitigerende maatregelen waren gerealiseerd. De uitdaging voor wegbeheerders ligt nu vooral in het minimaliseren van slachtoffers op gemeentewegen. Aangezien het aantal kilometers van dit wegtype in het verspreidingsgebied van das enorm groot is, is dit geen geringe opgave. Er zijn echter goed implementeerbare methoden zoals aanleg van tunnels en rasters bij bekende dassenwissels, het verlagen van de maximumsnelheid of het verkeersluw maken van bepaalde wegen in kerngebieden van de das.

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