The use of the 'Woeste Hoeve' wildlife overpass by mammals

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Abstract: The Woeste Hoeve is a wildlife overpass in the Netherlands, built in 1988, to reconnect parts of the Veluwe nature reserve, which were separated by the A50 motorway. Wildlife overpasses cost a substantial amount of money, but apart from an evaluation one year after its construction, the use of the Woeste Hoeve has not been investigated. This study was performed to quantify the use of the Woeste Hoeve by large mammals. The fieldwork used track counts to record the number of passages across the Woeste Hoeve and compare these to passage rates on pathways in the adjacent nature area. To quantify the movement of animals across the wildlife overpass, the direction of the tracks and the distance to the edge of the overpass were recorded. In addition to these observations, pathway densities on the Woeste Hoeve and in the neighbouring nature area were recorded and compared. The Woeste Hoeve wildlife overpass is frequently used by wild boar (*Sus scrofa*), red deer (*Cervus elaphus*) and red fox (*Vulpes vulpes*), and to a lesser extent by roe deer (*Capreolus capreolus*), badger (*Meles meles*) and domestic cat (*Felis catus*). The overpass is used by species to the same degree as found in the first survey by Litjens (1991) in 1989, with the exception of fallow deer (*Dama dama*), which were not recorded in the present study. No preference for the middle section of the wildlife passage was detected. Red deer and wild boar have a significant preference for using pathways to cross the wildlife overpass. The density of pathways is higher on the Woeste Hoeve compared to the surrounding areas. This research confirms that a width of 50 m seems adequate for a wildlife overpass to be used by large herbivores on a regular basis.

Keywords: wildlife overpass, track counts, passages, pathways, badger, red fox, red deer, roe deer, wild boar, Veluwe.

Introduction

Many wildlife overpasses have been built in order to mitigate the consequences that wildlife suffers from manmade structures, particularly road networks (van Wieren & Worm 2001, Bissonette 2002, Woess et al. 2002). Apart from the direct effect of road kills, there are indirect effects of habitat loss, fragmentation and the reduced quality and connectivity of habitats. These latter effects have been significantly underestimated (Bekker 1989, Bissonette 2002). As large wildlife overpasses are expensive to construct, their effectiveness is a point of debate. Although many studies have been conducted on the use of wildlife overpasses, only a few studies address the effectiveness of these measures in reducing the barrier effect of motorways (Forman 2003).

According to Pfister et al. (1997) there are several advantages of wildlife overpasses. First, they reduce animal mortality from traffic. Second, the opportunity for individuals to migrate from one area to another facilitates genetic exchange between populations, increasing their viability. Third, wildlife overpasses enlarge habitats by linking fragmented areas. The linkage of these fragments facilitates (seasonal) migratory movements and enhances the (re)colonisation of areas by animals.

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The use of a wildlife overpass is determined by several factors including its location, dimensions and nearby alternatives for crossing the highway (Pfister et al. 1997, Forman 2003). Pfister et al. (1997) conducted a study on the effectiveness of green bridges in Europe. Sixteen wildlife overpasses with different dimensions, located in France, Germany, Switzerland and the Netherlands, were investigated by means of track counts and video monitoring. The narrow overpasses of less than 20 m in width were used significantly less than the wider structures. Moreover, animals cross these narrow structures at a higher speed (Pfister et al. 1997). However a standard required width can not be given, since this depends on the function and the target species of the wildlife overpass. It is important that the wildlife overpass meets the species-specific habitat requirements of large mammals. Pfister et al. (1997) suggested that at a minimum width of 50 m these requirements are fulfilled for all mammal species covered in his surveys.

During the study conducted by Pfister et al. (1997) it was observed that animals avoid using the outer sections of the wildlife overpass. Red fox (*Vulpes vulpes*), badger (*Meles meles*), and hare (*Lepus europeus*) all mainly made use of the middle section. Roe deer (*Capreolus capreolus*) also preferred the middle sections, although to a lesser extent than other species (Pfister et al. 1997). This behaviour was also observed in a study carried out by Mathiasen & Madsen (2000) at a fauna underpass located in Denmark. During this research, involving infrared video-monitoring of mammals crossing a 13 m wide underpass, it was observed that roe deer always kept a distance of 3.5 m from the wall. No explanation for this behaviour was given in either of the two studies.

In the Netherlands the Woeste Hoeve and Terlet wildlife overpasses, both 50 m wide, have been built across the A50 motorway. This motorway intersects the Veluwe, a large forested area in the eastern parts of the Netherlands. Since the end of 1988 these two overpasses have been the only possibilities for mammals to cross the A50 motorway (Litjens 1991). They were mainly built to serve as a corridor for red deer (*Cervus elaphus*) and were constructed on traditional migration paths, and therefore referred to as 'Cerviducts'.

The use of the Woeste Hoeve and Terlet overpasses by larger mammals was studied by Litjens (1991) in 1989, shortly after the completion of their construction. The study involved counting tracks on a track plot, a strip of bare soil that was raked after each count. Litjens found that both wildlife overpasses were used by roe deer, red deer, wild boar (*Sus scrofa*) and red fox. In addition the Woeste Hoeve was used by fallow deer (*Dama dama*) and badgers, and rabbits (*Oryctolagus cuniculus*) were observed on Terlet (Litjens 1991). Litjens observed roe deer and fallow deer residing on the Woeste Hoeve. Animals residing on an overpass might block it for other animals. In view of this, Litjens recommended considering changing the management of the area surrounding the Woeste Hoeve to make the wildlife overpass less attractive as a foraging area, thereby enhancing the crossing of animals. Litjens also observed that more animals passed from west to east than in the opposite direction. No explanation was given for this finding.

This study focuses on the use of the Woeste Hoeve by wildlife, using techniques similar to those of Litjens (1991). The study was designed to quantify the use of the overpass by different medium-sized to large mammal species, to compare the pathway (the number of pathways crossing a line of a fixed length) and track densities (the number of tracks per unit area on a track plot) on the overpass and in the surrounding area and to test whether animals crossing the overpass had a preference for the middle section while crossing. Use of the areas surrounding the Woeste Hoeve was taken as a baseline reference, enabling a comparison to be made between frequency of use of the overpass and the nearby habitats of these species.

Study area

The study was performed in the southern part of the Veluwe in the Netherlands, which covers an area of 23,500 ha, and where forest and

heath lands are the main vegetation types. Larger mammals within the reserve include badger, fallow deer, muntjac (*Muntiacus reevesi*), rabbit, raccoon dog (*Nyctereutes procyonoides*), red deer, red fox, roe deer, Scottish highland cattle, and wild boar. Not all these species are present in the direct vicinity of Woeste Hoeve. At the time of our study (winter 2004/2005) the estimated densities of red deer, roe deer and wild boar were 2.4, 4.6 and 6.9 animals/100 ha respectively (figures estimated from spring counts of red and roe deer and a total autumn count of wild boar - G.J. Spek, unpublished data).

The Woeste Hoeve wildlife overpass (52.07 º N, 5.57 º E) has a minimum width of 50 m and a length of 140 m. The wildlife overpass is level with the surrounding nature area and slightly concave in shape. The vegetation on the wildlife overpass mainly consists of grasses, common rush (*Juncus effusus*), dwarfed pedunculate oak (*Quercus robur*) as a result of browsing, and Scotch pine (*Pinus sylvestris*). The visual disturbance of the traffic is reduced by 1.5 m high earth walls along both sides of the overpass. The overpass and the surrounding area are not accessible to the public. Some people do visit the area, but this does not seem to influence the use of the wildlife overpass by mammals (Litjens 1991). Two small ponds that function as watering places for animals were constructed in the surrounding area. One is located 500 m northwest of the wildlife overpass, the other 500 m northeast. The forest surrounding the Woeste Hoeve has patches of pine forest, areas with deciduous trees and some mixed forest. In addition to the closed forest there are patches of open forest and heather.

Materials and methods

Track observations on Woeste Hoeve wildlife overpass

From November 2004 to January 2005 tracks were measured, photographed, and the species identified using Diepenbeek (2003). A 3 m wide strip of sand was created in the middle section of the wildlife overpass, covering the whole width of the overpass (figure 1 and photo 1). The small, relatively steep earth walls (width ~0.7 m) on both sides of the overpass, without any visible sign of tracks or pathways, were excluded from the track plot. The sand strip was raked every day before crossings were recorded. From Tuesday till Friday, when weather conditions allowed, the tracks of animals that had crossed the sand strip were measured. The direction of each group of tracks belonging to a single animal was noted, the distance from the northern side of the wildlife overpass and the distance from the nearest wildlife pathway crossing the overpass were measured. It was assumed that if an animal uses a pathway to cross the wildlife overpass, its tracks will continue on the sand strip. Passages were assigned to the nearest pathway (<1 m distance) to obtain data on the number of passages per pathway. After the measurements, the strip was raked to erase old tracks.

Track observations on track plots in the surroundings of the overpass

The wildlife overpass is covered by numerous wildlife pathways. To check if there was a difference between the number of tracks per pathway on the wildlife overpass and in the adjacent nature area, track plots were also made in the adjacent nature areas on both sides of the wildlife overpass (figure 1). At each side 25 randomly placed plots were made on existing pathways, by removing the vegetation and the upper soil layer, and loosening the soil along a 1 m length of the pathway. The width of the plots varied, ranging from 40 cm on very narrow pathways to up to 1 m on broader pathways. The distance between these track plots and the wildlife overpass ranged from 123 to 726 m (median: 296 m). The number and direction of crossing animals were noted on the same days as on the Woeste Hoeve.

Density of pathways

In addition to differences in the number of tracks recorded on each pathway, there could also be

Photo 1. Woeste Hoeve with track plot, seen from the southern side. *Photograph: M. Renard.*

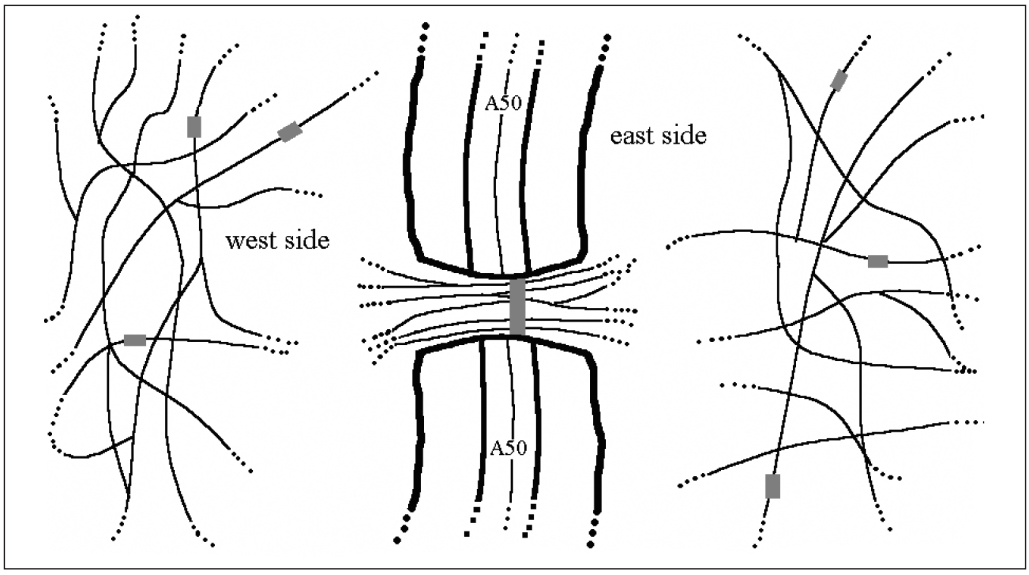

Figure 1. Schematic drawing of the positions of the track plots on the pathways on the west and east side of the wildlife overpass together with the track plot on the Woeste Hoeve wildlife overpass. Track plots are shown as grey fields. Dots indicate that only a part of the pathway and road structure is shown.

a possible difference in the density of the pathways over the wildlife overpass and in the surrounding area. To compare pathway densities, transects were made on the Woeste Hoeve and in the adjacent nature areas. Ten parallel transects crossing the entire width of the wildlife overpass were walked to record the location of the pathways. Similarly ten randomly placed transects of 50 m were walked on both the east and west sides of the wildlife overpass. The pathway density was determined by the ratio between number of recorded pathways crossing the transects and the transect length. The pathway density and the number of passages per pathway were combined to calculate the number of passages per metre, on the assumption that all the passages were recorded in the track plots.

Statistical analysis

Statistical tests were performed in SPSS 12.0 for Windows. The track data did not follow a normal distribution, and we therefore report on the 5th and 95th percentiles to illustrate the range of data distribution. Non-parametric tests were used to test for differences between the three areas (the overpass and the areas west and east of the overpass). A Mann Whitney-U and a Kruskal Wallis test were applied to test for differences in the number of passages per pathway. In case of a significant difference between groups a non-parametric multiple comparison test for unequal sample sizes was performed (Zar 1984). The density of the tracks per metre followed a normal distribution and could be analysed with an ANOVA, followed by a Tukey multiple comparison test.

To test if the animals had a preference for the middle section of the wildlife overpass, the observed distances of their tracks from the northern side of the overpass were compared with computer-generated random distances from the northern side. These distances ranged between 0 and 48.5 m, the length of the sand strip. To test if animals follow pathways while passing the wildlife overpass, the observed distances from the nearest pathway were compared with distances from the pathway derived from computer generated random passages.

Results

Recording of tracks occurred on 33 days. In total 547 passages were registered. A large variation in number of passages per day was observed, but there were no days without passages (figure 2). The number of passages of red deer and wild boar were tested for changes over time; and no significant trends over time were detected (Kruskal Wallis test; figure 3).

The use of the Woeste Hoeve in 1989 and in the present study is given in table 1 which shows the mean number of passages per species per day. The total number of passages per day appeared to be larger in 2004-2005, but this could not be confirmed statistically. The larger number of passages in 2004-2005 was mainly caused by more passages per day by wild boar and red fox. Fallow deer were not observed during the present study.

There was a significant difference between the number of passages per pathway in the three test areas (Mann Whitney U test, P=0.002, n=335, 411 and 672 respectively). The number of passages per pathway was significantly higher (P<0.05) on the east side (5^{th} and 95^{th} percentiles: 0-1.4 passages per pathway), compared to both the west side (0-0.9) and the wildlife overpass (0-0.9). There was no significant difference between the number of passages per pathway on the west side and on the wildlife overpass. These data are highly skewed, due to the large number of zero counts.

However, the relatively low number of tracks per pathway on the wildlife overpass compared to the east side could, in theory, be compensated by the higher pathway density on the overpass. The pathway density averaged 0.67 pathways/m on the Woeste Hoeve (95% confidence intervals: 0.63-0.70), but only 0.30 (0.24-0.33) and 0.34 (0.25-0.39) pathways/m in the nature areas on the west and east sides respectively. This gives a significant higher number of passages per metre on the Woeste Hoeve (ANOVA $F_{2,31}$=75.607,

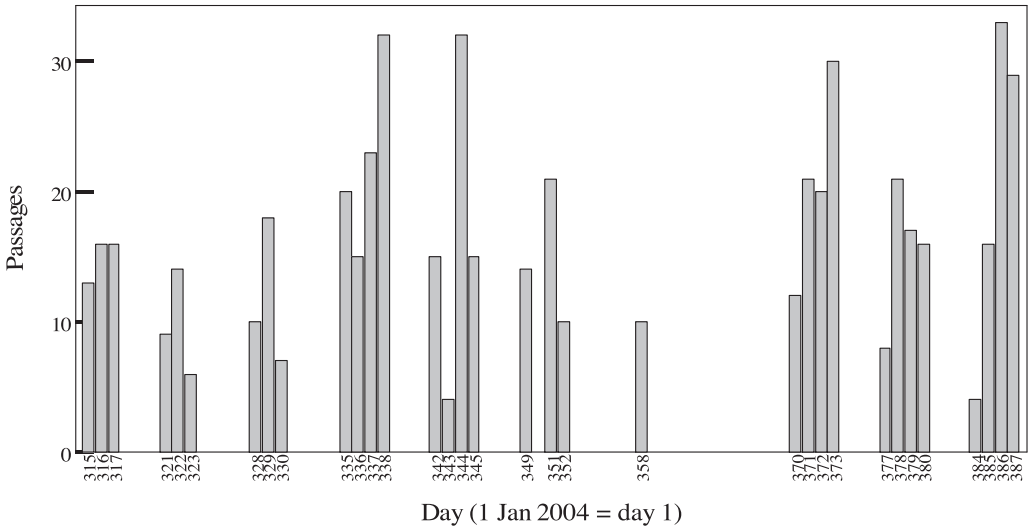

Figure 2. Overview of the use of the Woeste Hoeve wildlife overpass. Bars represent the total number of passages per observation day. Day numbers start at 1 January 2004 and continue to 2005; 1 January 2005 = day 367.

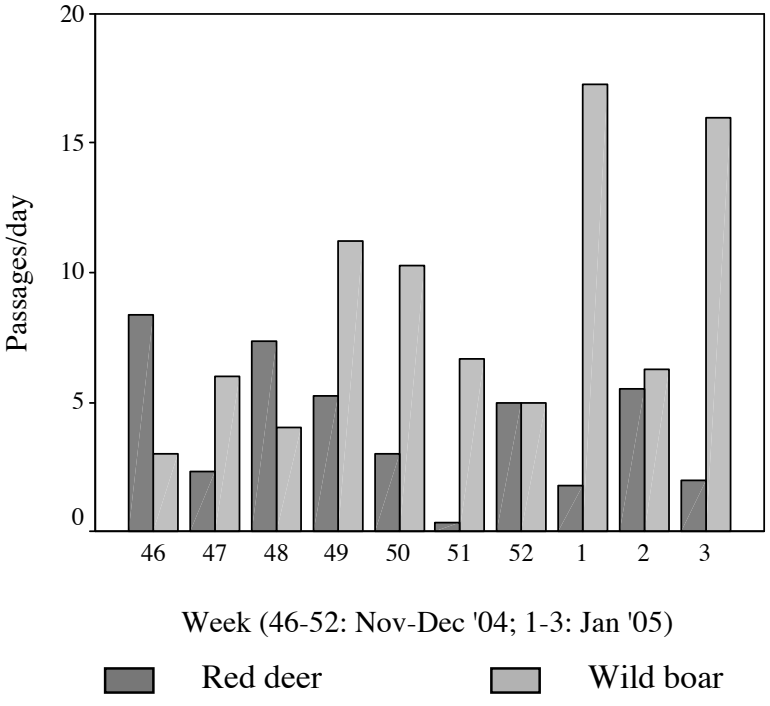

Figure 3. Mean daily passages of red deer and wild boar over the Woeste Hoeve wildlife overpass. Observations were performed in the period between November 2004 (weeks 46-52) and January 2005 (weeks 1-3).

Table 1. Mean number of passages per day in 1989 (Litjens 1991) and 2004-2005 and total number of observed passages in 2004-2005 on the Woeste Hoeve wildlife overpass. Observations in January, November and December 1989 and the period November 2004 - January 2005.

Woeste Hoeve	Total	Red deer	Wild boar	Roe deer	Fallow deer	Red fox	Badger
Passages/day 1989	12.6	4.1	6.0	0.7	1.7	0.1	0
Passages/day 2004/2005	16.6	3.9	9.3	0.5	0	1.91	0.5
Total 2004-2005	547	130	308	15	0	63	15

$P<0.001$) compared to the west and east sides (Tukey multiple comparison test $P<0.05$). No significant differences were found between the east side of the nature area and the Woeste Hoeve in terms of the number of passages per metre. Furthermore, there was no significant difference between the number of passages per pathway on the Woeste Hoeve and those in the combined nature areas.

Observed passages were divided into three groups, according to their distance from the north side of the overpass (north, middle and south; figure 4). For all species, the observed distances between the passages and the north side of the overpass were compared with randomly generated distances from the north side (Kruskal Wallis test). No significant difference was found for the track locations of red deer, with the observed distance being similar to the randomly generated distances. For wild boar however, there was a difference between the observed data and the randomised track locations ($P<0.001$, $n=303$); wild boar used the north side of the wildlife overpass significantly less than they used the middle and the south sides. No significant differences between the groups were demonstrated for roe deer, red fox, badger, or domestic cat.

Of the total number of 547 tracks observed on the Woeste Hoeve, 254 tracks were of animals passing the wildlife overpass in a west to east direction, and 290 were passages in the opposite direction.

On the overpass the distances of observed passages from the nearest pathway were more clustered around zero (the midpoint of the nearest pathway) than the random distances ($P<0.001$, $n=534$). The observed distances from the nearest pathway were significantly lower than the random distances for both wild boar and red deer ($P<0.001$, $n=303$ and $P=0.033$, $n=122$ respectively), indicating that these two species preferred walking on pathways while crossing the overpass, in stead of using the areas next to pathways. The low number of roe deer, red fox and badger tracks meant that this test could not be performed for these species.

Discussion

Use of the Woeste Hoeve

During this survey the Woeste Hoeve wildlife overpass was frequently used by wild boar, red deer and red fox, and to a lesser extend by roe deer, badger and domestic cat. Litjens (1991) found that fallow deer used the Woeste Hoeve in 1989. However, during this study, no tracks of fallow deer were recorded, presumably because fallow deer have disappeared from this part of the Veluwe (J. Heikens, personal communication).

No tracks of smaller mammal species were found on the Woeste Hoeve track plot, nor on the plots in the adjacent nature area. This could imply that the sand that was used for the track plots was not suitable for detecting smaller tracks. It may also be the result of a low density of small

mammals in the area, or because they cross the overpass using the fence or along the relatively steep earth walls on either sides of the overpass (Litjens 1991), which were not included in our track plot. The species composition in this survey was identical to that found by Litjens in 1989, with the exception of fallow deer and domestic cat.

Quantitative use of the Woeste Hoeve

The results show that the Woeste Hoeve was used at least as much as the surrounding areas. The number of crossings per pathway was slightly lower on the wildlife overpass, but the pathway density per metre was higher. The number of crossings per metre was higher on the overpass than on the west side and similar to that on the east side. However, this calculation is based on the multiplication of the mean number of passages per pathway and the density of the pathways per metre. The passages per pathway did not follow a normal distribution, and had a skewed distribution with many zero counts, so the error margins of these estimates are large. However use of the Woeste Hoeve seems at least comparable with that of nearby habitats. We did not measure the density of wildlife passages outside pathways in the two nature areas. We therefore recommend also carrying out track counts away from pathways in nature areas in future studies.

Another issue to consider is that we do not know how far the disturbance effect of the road extends, and whether this affects the density of wildlife, even at distances greater than those between the overpass and our track plots in the two nature areas. For instance Ward et al. (2004) showed that roe deer densities are lower near roads, although the ranges at which roads influence deer densities are still unknown. It would

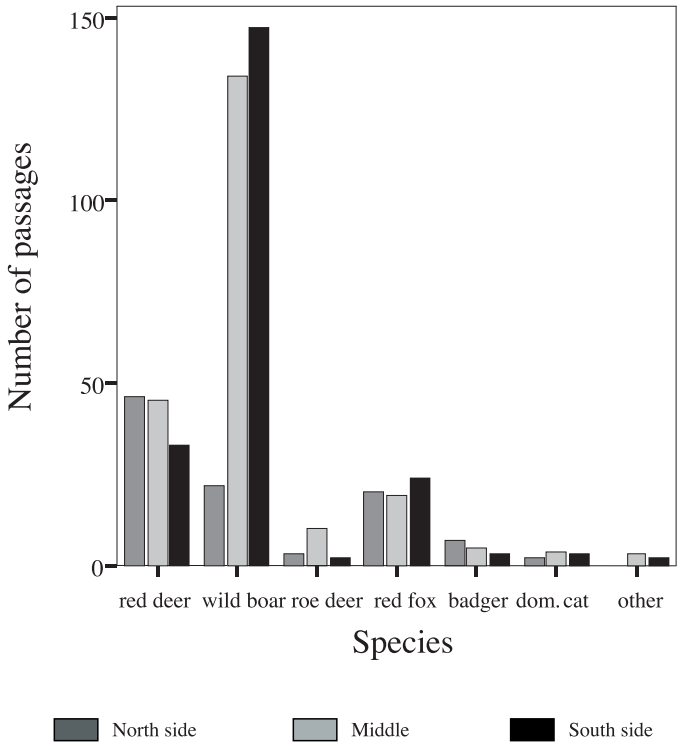

Figure 4. The total number of passages per species observed in the period November 2004 - January 2005 on the north (0-16 m), middle (16-32 m) and south sides (32-48 m) of the Woeste Hoeve wildlife overpass.

therefore be useful to include track plots at varying distances from the road to detect whether it causes a gradient in wildlife density.

Animals residing on the Woeste Hoeve

With the exception of a domestic cat, the researchers saw no animals on the Woeste Hoeve. This strongly indicates that no animals currently reside on the wildlife overpass. Furthermore, roe deer, one of the species that Litjens observed residing on the overpass in 1989, only passed over the sand strip on the overpass 15 times during the present study. This indicates that roe deer do not permanently inhabit the overpass. However, the browsed vegetation on the Woeste Hoeve clearly shows that some animals do forage on the Woeste Hoeve. Video monitoring of the behaviour of the animals using the overpass could provide information on the behaviour of the animals while crossing the overpass.

Direction of passages

There was no significant difference between the number of passages from west to east and the number of passages in the opposite direction. While seasonal variations in the direction of passages could occur, this could not be demonstrated within a period of 3 months. A year-round study should be performed in order to evaluate the difference in direction of animal passages between different seasons. The factors that influence the direction of the movements of animals should also be studied and should include a study of the difference in forage availability between the west and east sides.

Spatial preference for crossing the wildlife overpass

Pathways were evenly distributed across the wildlife overpass. This indicates that the whole width of the wildlife overpass is being used. The measurements of the distance of pathways from the northern side show that species differed in their preference for the sides of the area while crossing the wildlife overpass. For red deer no difference was found between the observed distance of pathways from the north side and the randomised distances from the north side. For wild boar though, a significant difference was found, as it mainly used the south and middle section of the overpass and avoided the north side. No explanation can be given for this although it could be speculated that this is influenced by the patterns of vegetation growth on the wildlife overpass. This is supported by a study carried out by Clevenger & Waltho (2005) on attributes of highway crossing structures that facilitate movement of large mammals. They found that distance from cover was the most important landscape attribute determining the passage of several large mammal species, with increased cover providing greater protection and security for animals approaching the overpass (Clevenger & Waltho 2005). The south side of the Woeste Hoeve has more shrubby vegetation, which could explain the preference of wild boar for this side.

Preference for pathways

The distances from the observed passages on the track plots to the nearest pathway were less than the distance from randomly generated pathways. These differences were significant for observed and random distances from the pathways of wild boar and red deer and imply that these species prefer following pathways while crossing. This supports the observation by Litjens (1991) that large mammals mainly used fixed pathways while crossing the wildlife overpass.

Differences between species

Red deer and wild boar frequently used the wildlife overpass. Roe deer only sporadically passed over the Woeste Hoeve. This can not be explained by differences in population numbers, since the population density of roe deer is higher than that of red deer. It may be due to a smaller home range or lower dispersal distances of roe deer, compared to those of red deer and wild boar, or the time of year the survey was carried out. Roe deer have a more solitary lifestyle compared to red deer and show territorial behav-

iour throughout some parts of the year (S.E. van Wieren, personal observation). In a forest environment Roe deer have home ranges varying from 60-200 ha (Raesfeld et al. 1986), while the home ranges of red deer range from less than 40 ha up to 500 ha (Bützler 1986).

The difference between red deer and wild boar, although less striking, can partly be explained by differences in the population densities of these species. As mentioned before, species-related seasonal differences may influence the number of passages. The rutting season for red deer occurs in September and October, and in November and December for wild boar, so the current study does not demonstrate the effects of rutting behaviour.

In order to determine the factors that affect the inter-species differences in the use of wildlife overpass, behavioural observations are recommended, preferably through video monitoring.

The width of the wildlife overpass

None of the wildlife species studied here avoided the margins of the passage and showed a preference for the middle section. The number of pathways can have an important influence on the total number of animals crossing the wildlife overpass, as most animals used pathways while crossing. Since more pathways can be accommodated on a wider overpass, the width of an overpass could influence its use. However, this also depends on the intensity of use of these pathways, and more importantly, whether the total number of crossings would increase, and whether animals from a larger source area would cross a wider overpass. This can only be solved through an experimental approach, or a good meta-analysis, that includes passages of different widths.

The width of the Woeste Hoeve overpass appears to be adequate, given that all the large mammal species that reside in the area around it make use of it. In addition the track density and pathway density estimates indicate that use of the overpass is similar to use of the nearby nature area, although wildlife densities might be higher further away from the road. The density of the tracks on the overpass showed a funnelling effect, with a far higher pathway density than on the areas west or east of the overpass. While the track density per passage was no higher on the overpass than in the surrounding areas, the number of passages per metre was higher on the overpass than in the surrounding area due to the higher pathway density. Pfister et al. (1997) recommend a width that is sufficient for larger mammals to pass the overpass in a stress-free manner, so that they will use it not solely for emergencies, but on a regular basis. They also recommend that overpasses contain an environment that is comparable with the natural habitat of the mammals that will use it (Pfister et al. 1997). Our results show a substantial use of the Woeste Hoeve, and this indicates that, according to Pfister's conclusions, it meets the requirements of large mammals.

Conclusions

The Woeste Hoeve wildlife overpass is well-used. All large mammal species that occur in the area around the Woeste Hoeve use the overpass to a certain extent. The number of passages recorded on the Woeste Hoeve was in the same order of magnitude as in the adjacent habitat. There was not a significant difference in the direction of recorded passages.

In contrast to the observations made by Pfister et al. (1997), there was no preference for the middle section of the wildlife overpass. Only wild boar showed a preference for some sections, preferring the south and middle sections to the northern section.

Red deer and wild boar preferred to follow pathways while crossing the overpass, as calculated from a comparison of observed and random passages.

Although it is difficult to make a solid statement about the quantitative use of wildlife overpasses they increase the possibility for genetic exchange between populations and connect different habitats, thereby enhancing the foraging and migratory movements.

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Samenvatting

Gebruik van wildviaduct 'Woeste Hoeve' door zoogdieren

Hoewel de kosten voor de constructie van een wildviaduct hoog zijn, is er tot op heden betrekkelijk weinig onderzoek gedaan naar de effectiviteit van wildviaducten. Dit onderzoek concentreerde zich op het gebruik van wildviaduct Woeste Hoeve door middelgrote tot grote zoogdieren op de Veluwe. Er is gekeken of er een toename in gebruik was te zien in vergelijking met de laatste evaluatie in 1989. Daarnaast is er onderzocht of dieren op het wildviaduct gebruik maken van de totale beschikbare breedte. Voor het kwantificeren van het gebruik van het wildviaduct is het gebruik van wissels in het omringende natuurgebied vergeleken met het gebruik van de wissels op Woeste Hoeve. Het veldwerk vond plaats tussen november 2004 en februari 2005. Met behulp van een zandbed zijn de dagelijkse passages van dieren op de Woeste Hoeve geteld. De positie van de sporen op het wildviaduct is ingemeten om het bewegingspatroon van dieren op Woeste Hoeve te analyseren. In het omringende natuurgebied zijn 50 plots aangelegd op bestaande wissels om daar het aantal passages per dag te kunnen tellen. De Woeste Hoeve wordt frequent gebruikt door wild zwijn (*Sus scrofa*), edelhert (*Cervus elaphus*) en vos (*Vulpes vulpes*), en in mindere mate door ree (*Capreolus capreolus*), das (*Meles meles*) en (verwilderde) huiskat (*Felis catus*). In tegenstelling tot het onderzoek van 1989 zijn er geen sporen van damherten (*Dama dama*) gevonden. Edelhert en wild zwijn maken gebruik van wissels als ze het wildviaduct passeren. Er is geen voorkeur gevonden voor het passeren van het wildviaduct over het middelste gedeelte dus de dieren vermijden de zijkanten van het wildviaduct niet. De wissels op de Woeste Hoeve worden in dezelfde mate gebruikt als de wissels in het natuurgebied aan de westkant en minder dan de wissels aan de oostkant. Doordat

de wisseldichtheid op de Woeste Hoeve hoger is, is het aantal passages per meter op de Woeste Hoeve gelijk aan het aantal passages per meter in het omringende natuurgebied. De Woeste Hoeve wordt op een regelmatige basis gebruikt door grote zoogdieren. De mate van gebruik is gelijk aan die van het omringende natuurgebied. Hieruit kan geconcludeerd worden dat de Woeste Hoeve met een breedte van 50 meter voldoet voor een regelmatig gebruik door middelgrote tot grote zoogdieren en hiermee succesvol twee gebieden van de Veluwe met elkaar verbindt.

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