MONITORING WILDLIFE OVERPASS USE BY AMPHIBIANS: DO ARTIFICIALLY MAINTAINED HUMID CONDITIONS ENHANCE CROSSING RATES?

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Abstract

In the Netherlands wildlife overpass “Groene Woud” is one of the first that aims to provide habitat connectivity for amphibians. In both the design and management of the overpass much attention has been given to create optimal humid conditions for amphibians, including a chain of small pools across the overpass and its access ramps. The question we addressed is if the measures significantly improve the use of the overpass by amphibians. We monitored amphibians 1-2 times a week at the overpass and in the direct surroundings for three years (2006-2008). We analyzed the impact of the overpass adaptations on amphibian use by comparing amphibian numbers in the wetland zone on the overpass with amphibian numbers in the dry zone on the overpass. We found that, depending on general weather conditions, the adaptations to maintain a humid environment on the overpass and its ramps significantly improve overpass use by amphibians. As a result wildlife overpasses with special adaptations as implemented at the Groene Woud overpass may become an alternative, and less costly, measure than elevating roads to restore habitat connectivity for semi-aquatic species in wetland areas.

Introduction

In the Netherlands wildlife overpass “Groene Woud” is one of the first that aims to provide habitat connectivity for amphibians. The overpass, opened in 2005, is situated in the heart of National Landscape Groene Woud and connects wetland areas that are bisected by motorway A2. The wildlife overpass is 50m wide and about 65m long (Figure 1). It crosses the motorway 7m above ground level. The access ramps are 110m (west) and 85m (east) long and have a gradient ratio of 1:14 and 1:10 respectively. The overpass is covered by a layer of 0.5m topsoil. On the access ramps the topsoil depth is 1m. The topsoil layer on overpass and access ramps consists of soil that originates from the immediate vicinity of the overpass. The topsoil is put in place in such a way that the original sequence of soil layers is maintained. Along the edges of the overpass 2.5m high embankments have been constructed to reduce disturbance from light and noise emitted by passing traffic. The overpass is closed for public.

In both the design and management of the overpass much attention has been given to create optimal conditions for amphibians. Besides a controllable groundwater level on top of the overpass, across the whole length of the overpass and its access ramps a wetland zone has been constructed existing of a chain of small pools (Figure 2). Water is pumped up to the top of the overpass and slowly released through the cascade of small pools towards bigger pools at the feet of the access ramps (Schellekens et al. 2005). The philosophy of these special adaptations is to maintain sufficient humid conditions to improve amphibian use throughout the dry season. The question we addressed is if those expectations are correct, i.e. whether the use of the overpass by amphibians is significantly improved in contrast with the situation that the humid conditions on the overpass are not artificially maintained.

Figure 1. Wildlife overpass Groene Woud across motorway A2 in The Netherlands (Photo courtesy of Rijkswaterstaat).

Figure 2. Wetland zone on wildlife overpass Groene Woud immediately after construction, consisting of a series of small ponds on loamy soils supplied by water that is pumped up to the top of the overpass (Photo courtesy of Rijkswaterstaat).

Methods

We monitored amphibians 1-2 times a week at the overpass and in the direct surroundings for three years (2006-2008). The surveys on the overpass took place along four about 180m long transects across overpass and access ramps (Figure 3). The ponds at the feet of the access ramps were start- and endpoint of the four transects. Transect 1 and 2 were located in the wetland zone of the overpass with the series of small ponds in between the two transects. Transect 3 and 4 were located in the dry zone of the overpass, bordering a wall of tree stumps. Along each transect 20 wooden plates (60x60x2 cm) were spread out (Figure 4). During surveys all transects - up to 3m on both sides of each transect - have been actively searched for amphibians. Furthermore, all amphibians that were found underneath the wooden plates were counted. We analysed the impact of the overpass adaptations on amphibian use by comparing amphibian numbers in the wetland zone on the overpass with amphibian numbers in the dry zone on the overpass.

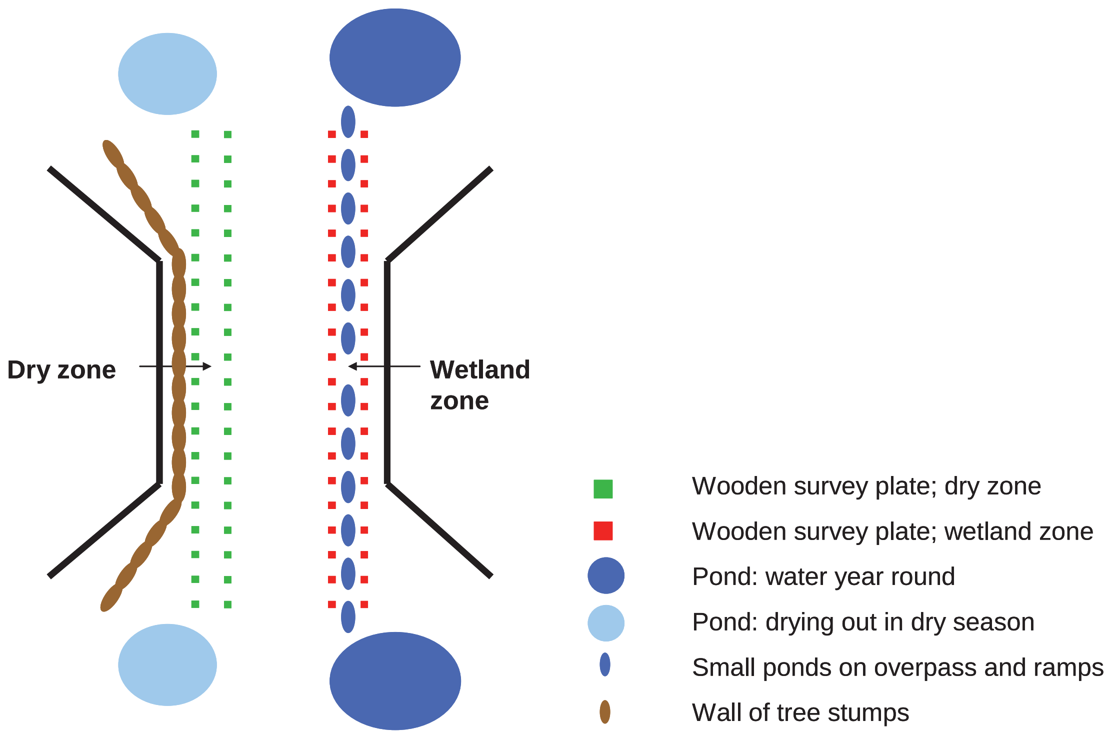

Figure 3. Study design with two transects in the wetland zone and two in the dry zone.

Figure 4. Wooden plates that were systematically spread out along the four transects functioned as artificial shelters which eased and standardised the counting of amphibians on the overpass. In the front the wetland zone with one transect on each side. In the back the dry zone with two transects as well, bordering the wall of tree stumps (Photo courtesy of E. van der Grift).

Results

On the overpass six amphibian species have been found: common toad (*Bufo bufo*), common frog (*Rana temporaria*), marsh frog (*Rana ridibunda*), edible frog (*Rana klepton esculenta*), smooth newt (*Triturus vulgaris*) and great crested newt (*Triturus cristatus*) (Figure 5). In total 2706 observations of amphibians have been recorded on the wildlife overpass (Table 1). Most observations concerned the common frog (78%), followed by common toad (15%), species that belong to the green frog complex (*Rana esculenta synklepton*; 5%), great crested newt (1.5%) and smooth newt (<1%). Based on these numbers about 5000 observations of amphibians can be expected yearly if the overpass was surveyed daily (Table 1).

Species	2006		2007		2008		2006-2008	
	n	N	n	N	n	N	N	G_w
Common toad	31	263	177	818	193	992	2073	691
Common frog	455	3862	1003	4634	642	3300	11797	3932
Green frog-complex								
- species not determined	5	42	98	453	36	185	680	227
- Marsh frog	0	0	0	0	1	5	5	2
- Edible frog	1	8	1	5	1	5	18	6
Great crested newt	17	144	5	23	22	113	281	94
Smooth newt	6	51	7	32	5	26	109	36
Total	515	4372	1291	5965	900	4500	14963	4988

Table 1. The number of observations of amphibians for each species during the field surveys (n), the expected number of observations if the overpass is surveyed daily (N), and the average number of observations in one year calculated over all research years (G_w).

Figure 5. The counting of amphibians underneath one of the wooden plates. Over the whole research period 15,440 plate checks have been carried out. During 1,190 (~8%) of these checks amphibians were found. In about 80% of the cases that amphibians were present underneath a wooden plate it concerned one individual. In the remaining 20% more than one animal was found underneath the plates with a maximum of seven animals underneath one plate (Photo courtesy of B. Vervoort).

The first amphibians were observed on the overpass in February and March, although still in low numbers (Figure 6). In April and May the number of observed adults and subadults increased considerably. In summer (July-August) and early fall (September-October) the highest numbers of amphibians were found on the overpass. In these periods most observations concern juveniles. In November the number of observations of amphibians on the overpass drops quickly. The animals retreat to their wintering habitat in this period, which resulted in only a few observations of amphibians on top of the overpass, especially underneath the wooden plates where some animals seem to intend to winter. Larvae – of common frog and common toad – were only incidentally found in the small ponds on the overpass. Eggs have not been recorded on the overpass.

We found that, depending on general weather conditions, the adaptations to maintain a humid environment on the overpass and its ramps significantly improve overpass use by amphibians. The number of observations of amphibians in the wetland zone on the overpass is at least 1.5 times higher than the number of observations in the dry zone. On average 12.5 amphibians were observed within the wetland zone each survey versus 6.5 amphibians in the dry zone. Due to technical problems the water pump was not operational year round, which caused the wetland zone to dry out temporarily at several occasions. In these periods on average 5.6 amphibians were observed within the wetland zone each survey versus 6.8 amphibians in the dry zone.

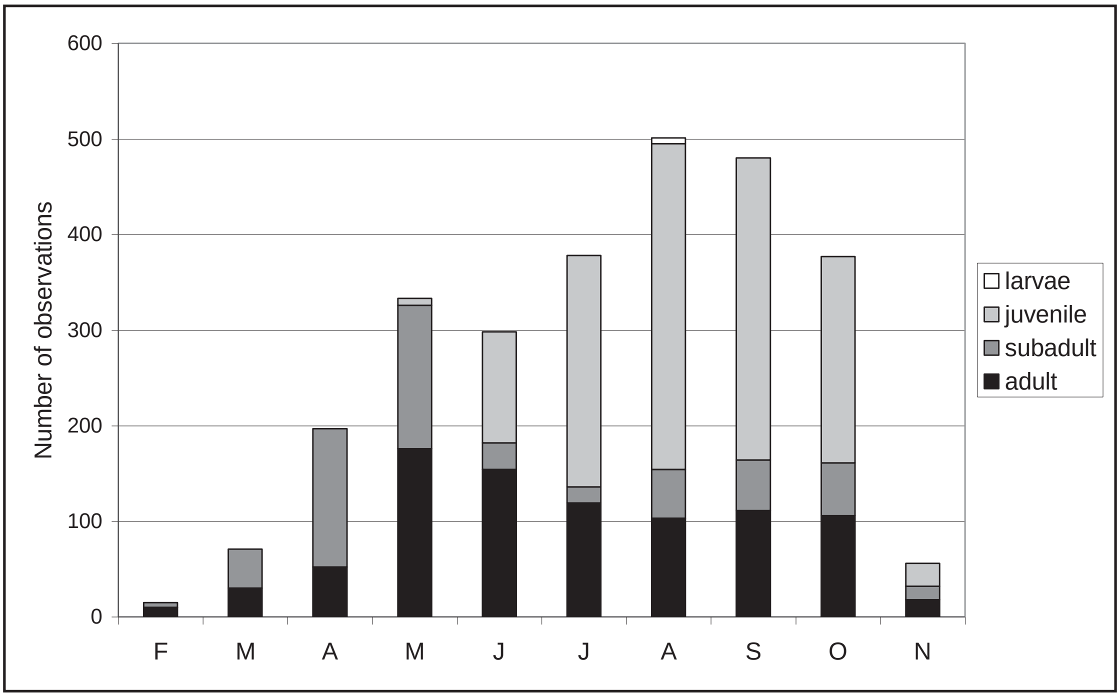

Figure 6. The number of observations of amphibians per month and per age group on wildlife overpass Groene Woud over 2006-2008. In the months January and December no surveys have been carried out.

Conclusions

Although the special measures to create humid conditions on top of the overpass did not work properly year round due to technical problems it can be concluded that de creation of a wetland zone improves use of the overpass by amphibians. This conclusion can be seen as an argument to consider special measures to maintain humid conditions on wildlife overpasses more often, especially when amphibians are seen as target species for the defragmentation measure. As a result wildlife overpasses with special adaptations as implemented at wildlife overpass Groene Woud may become an alternative, and less costly, measure than elevating roads to restore habitat connectivity for semi-aquatic species in wetland areas. A second conclusion is that at moments the wetland zone had dried out due to failure of the water pump, the dry zone hosts significantly more amphibians. This seems to be caused by the more humid conditions and better shelter possibilities for amphibians in the high vegetation in the dry zone at those moments compared to the relative less vegetated wetland zone. The presence of the wall of tree stumps in the dry zone, providing amphibians with shelter, may have further contributed to the difference in number of amphibians between wetland and dry zone in periods that the water pump did not work, as the higher number of amphibians in the dry zone also occurred in periods when the vegetation in this zone had hardly been developed yet. The creation of sufficient cover, such as a wall of tree stumps, low embankment of boulders or a row of branches, and the development of sufficient vegetation cover, can therefore be recommended to improve the use of wildlife overpasses by amphibians. Further research should focus in more detail on individual movements of animals to better quantify overpass use and qualify the role of the linkage in maintaining amphibian life cycles and population persistence.

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Biographical Sketches

Edgar van der Grift works as a senior research scientist at Alterra, Wageningen University and Research Center, Wageningen, The Netherlands. His work focuses on the assessment of the impacts of habitat fragmentation on wildlife populations and the effectiveness of measures that aim to reduce such fragmentation and increase habitat connectivity, e.g. the establishment of landscape linkages, ecological corridors and wildlife crossing structures at roads and railroads. Besides his scientific research he acts as a consultant for policy makers, road planners and conservation groups during the preparation and implementation phase of projects that aim for the establishment of effective ecological networks and road mitigation measures.

Fabrice Ottburg is a research scientist at Alterra, Wageningen University and Research Center, Wageningen, The Netherlands. He is involved in applied and multi-disciplinary ecological research and consultancy in the field of animal ecology. He focuses on ecological impact assessments and studies that concern habitat fragmentation, mitigation/compensation, nature restoration and nature management.

Robbert Snep is a research scientist at Alterra, Wageningen University and Research Center, Wageningen, The Netherlands. His main field of interest is urban and landscape ecology. His research focuses on the question how citizens experience urban biodiversity and what spatial and/or management measures are needed to optimize the potential of cities and business sites in preserving natural values.

References

Schellekens, E., W. Arts & H. van Beusekom 2005. Een creatief en uniek concept voor waterhuishouding, bodemprofiel en breedte: natuurbrug Het Groene Woud. Groen 61 (11): 12-17.