Effectiveness of fauna passageways at main roads in The Netherlands

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Keywords: fauna passageways, monitoring, mammals, amphibians, population viability, roads, red deer, badger, crested newt

Conference topic: monitoring/research methods

Abstract

Many different types of fauna passageways have been constructed in The Netherlands, and many more will be constructed within the next twenty years. In the past decade the Road and Hydraulic Engineering Institute of the Dutch Ministry of Transport, Public Works and Water Management commissioned several investigations to assess the use and effectiveness of these fauna passageways. The results of these investigations are used to improve layout, design and maintenance of both existing and planned passageways. Furthermore, the aim is to answer the question whether these passageways are effective to guarantee population viability in the long term. This study focusses on three species: red deer (*Cervus elaphus*), badger (*Meles meles*) and the great crested newt (*Triturus cristatus*).

Monitoring the use of fauna pipes

Introduction

Recent studies have given a fairly good picture of the use of badger tunnels (fauna pipes) by badgers (Das en Boom, 2001; Both, 1989; Derckx, 1986; Dinther, 1994; Maaskamp, 1983; de Groene Ruimte, 1998). The general conclusion is that badger tunnels meet their aim very well when they are situated on the right location and when they stay dry.

However, a question that remained was which other animal species use these passageways and especially what factors affect this use. Of about 50 fauna pipes the use was investigated to answer the following questions:

- What species use the passages?
- With what frequency are the passages used, and how does the established frequency relate to the activity in the immediate vicinity?
- What species are expected to make use of the passages considering their occurrence in the proximity and information about the use of other facilities but are not detected?

This study also had to give insight into the effect of the design of the fauna pipe (dimensions) on the use of the passage:

- Are shorter fauna pipes and/or fauna pipes with a larger diameter used by more species and/or are they used more frequently by animals than longer fauna pipes and/or fauna pipes with a smaller diameter?
- Do amphibians and smaller mammals have a preference for relatively short fauna pipes and/or fauna pipes with a relatively large diameter?

In addition the effect of landscape characteristics and guiding to the fauna pipe on the use by species (groups) and the effect of the use by predators on the use by prey was analysed.

The answers to these questions will give Rijkswaterstaat more insight into the requirements for optimising the use by species (groups).

Method
First a selection of fauna pipes was made using the following criteria:

- the fauna pipes are located in areas with a comparable species composition and density (regions where (almost) all target species occur) so as to limit the number of zero-values;
- the fauna pipes do have a diameter of at least 30 cm and at the most 100 cm, so that a comparable range of species can use the fauna pipes (all pipes were large enough to accommodate the badger and the fox, but too small for the roe deer). The fauna pipes were more or less on the same route in order to have an efficient relation between the number of fauna pipes to be visited and the necessary travelling time and fieldwork hours. Moreover this will restrict the influence of regional differences in the present species.

The final selection of pipes focused on a proportional spreading of the variables that were to be investigated over the number of fauna pipes. Summarised, the finally selected fauna pipes met the following requirements:

- the fauna pipes differed in dimensions and in blending into the immediate vicinity. However, fauna pipes with distinguishing features (variables) that were equal to other pipes, were amply represented in the study.
- the fauna pipes were not permanently flooded and were not otherwise less accessible to animals.
- the fauna pipes - to the best of our knowledge - were not or were only incidentally used by badgers.
- the fauna pipes were installed at least one year before the beginning of the fieldwork, so that the factor of 'habituation' was not expected to play an important role.

During two periods: 8 weeks in the autumn of 2001, and 8 weeks in the spring of 2002 track boards (2 m long) with inking pad and paper sheets, specially developed for this study (see figure 1), were inserted as far as possible (ca. 1.5 m) into the fauna pipes at one side. In addition as a control a track board was placed in the proximity of each fauna pipe. Track board papers were checked and (if necessary) replaced each week.

Figure 1. Track board with inking pad and paper sheets at the entrance of a fauna pipe.

Results
All 50 fauna pipes were used by animals during the research period. The pipes were used by a total of 14 target species: hedgehog, red fox, badger, beech marten, polecat, stoat, weasel (figure 2), brown rat, wood mouse, red squirrel (figure 2), hare, rabbit, toad (species unknown) and frog (species unknown). On average tracks of 3.8 species per fauna pipe were found and in one pipe tracks of the largest number of target species were found: nine species.
In addition to badger hedgehog, red fox, beech marten, stoat and brown rat are rather frequent users (tracks in 14 to 21 pipes), while tracks of polecat and weasel were less often found (tracks in 10 and 8 pipes respectively).
Non-target species that used the pipes were cat and raccoon.
Tracks of amphibians were recorded in 12 fauna pipes and on 21 references. It is noticeable that tracks of newts were only recorded on the references, and not in the fauna pipes. Possibly, the newt avoided the fauna pipes selectively compared with the rest of the habitat. The use by toads and frogs varied from incidental to frequent (maximum 1.9 and 2.0 tracks a week respectively).
Most species, with the exception of mice and amphibians, seem to use the fauna pipes deliberately. Most species use the pipes to the same degree in spring and autumn. However, only badgers used the pipes significantly more often in spring, whereas brown rats used the pipes significantly more often in autumn. Use by badgers did not have a significant negative effect on the use of the same pipe by other animal species. This suggests that some use by badgers does not exclude the use by other species. However it must be taken into account that the investigation did not include pipes, regularly used by badgers.
A frequent use by cats turned out to have a significant negative effect on the use by other mammals (e.g. mice). The use of fauna pipes by red squirrels and hares was only found for one pipe each species; squirrel tracks were even rather numerous.

Figure 2. Examples of footprints obtained with the ink method; red squirrel (l), weasel (r).

Guiding to the entrance turned out to be only significantly important for the red fox. However, the correlation was the opposite of what was expected: more foxes passed through tunnels with a poor guidance (linear landscape elements with poor cover at a distance of over 10 metres from the pipe opening).
Mustelids and amphibians used pipes with a length of 40 metres or less more frequently than longer pipes.

Effectiveness of fauna passageways at population level

Introduction
Although the use of fauna passageways is determined for a variety of species, the question remains unanswered about the effectiveness of the passageways to guarantee population viability. In order to find an answer to this question, a project was started to monitor population development of three indicator species over a long period.

Selection of species to monitor effectiveness of fauna passages
Potential species suitable to include in a monitoring programme had to meet most of the following criteria:

- sensitive to fragmentation effects of roads;
- a core population of the species needs a large area;
- dispersion capacity is low;
- life span is not too long;
- the species is not very rare;
- knowledge of ecology of the species is sufficient;
- monitoring population developments is not too difficult;
- political interest for the species;
- it is not an exotic species.

The selection resulted in a list of 17 species, belonging to the group of mammals, amphibians, reptiles and butterflies.

In the next phase from this list three species were selected, each representing a species group with specific requirements for a fauna passageway. These species had to satisfy the following criteria:

- the species are known to use at least one specified type of fauna passageway;
- the type of fauna passageway that is used by the species must have been constructed in substantial numbers;
- the three species must belong to different animal groups to gain the greatest possible insight into the effectiveness of fauna passageways;
- if possible, the species must be indicative for the behaviour of several species;
- the range of distribution of the species must not be too small;
- if possible, the species must represent a number of habitat types, which was 'translated' into: two species of dry areas, and one species of humid/wet areas;
- the species must have a support base (such as target species of nature policies, and species mentioned in the Habitat Directive);
- if possible, the species must represent various scale levels;
- if possible, the species must be 'caressable', which means that the species must appeal to a broad public.

Based on these criteria we selected the following species: red deer, badger, and the great crested newt. For red deer ecoducts are supposed to facilitate genetic exchange between populations intersected by roads. Badger pipes and walking strips in culverts or beneath bridges are supposed to increase population viability of badgers and great crested newts respectively.

Suitable research locations
In the following stage of the project potential study areas were determined where the effectiveness of fauna passageways at the level of populations can be assessed.

The method for finding these suitable research locations differed for each selected species. In order to find potential research locations for the great crested newt it had to be analysed where traffic roads have a major effect on the sustainability of habitat networks of the great crested newt, and where mitigating measures are expected to be effective for enhancing network sustainability. These analyses were carried out with the LARCH expert system developed by Alterra [LARCH: Landscape Analysis and Rules for the Configuration of Habitats].
On the basis of these analyses two trunk road sections were indicated as most promising research sites for the great crested newt, and 9 other sections were labeled as promising locations. The latter means that further investigation into the exact distribution of the great crested newt and its habitat is needed before it can be decided whether these sections will also qualify.

LARCH was not used to assess possible research locations for the badger because this species cannot easily be modelled with the LARCH system. Therefore we used a number of criteria to assess suitable research locations. These analyses resulted in seven road sections indicated as *most promising* research locations. Another eleven sections were labeled *promising* research sites. A final decision about the use of these locations as research site can only be made after further detailed investigations of the distribution of badgers within each identified location.

Potential research locations for the red deer had to meet the following requirements:

- two (local) populations of red deer are separated from each other by an existing or future trunk road;
- the populations on both sides of the trunk road have been isolated for the longest possible time;
- the populations are large enough to take a sample of about 50 animals from each population;
- fauna passageways are not yet constructed, or have only recently been constructed.

The analysis of the red deer populations in The Netherlands resulted in 5 potential research locations. Genetic research may show whether the genetic variation between these populations is large enough to measure possible changes in the genetic variation as a result of defragmentation measures.

Next phase of the project

The next step will be to analyse in detail which of the potential research locations are best suitable for the evaluation of effectiveness of fauna passageways. If this results in enough research locations, a monitoring programme has to be designed and conducted for some years (depending among others on the species) to answer the question whether defragmentation efforts are sufficient to ensure population viability of the wildlife species addressed.

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