MULTIUSE OVERPASSES: DOES HUMAN USE IMPACT THE USE BY WILDLIFE?

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ABSTRACT

In the highly fragmented landscapes of the Netherlands, currently the pressure of both the public and recreational interest groups intensifies to open up wildlife passages for recreational co-use. The most frequently expressed request is to allow hikers, bikers and horseback riders to pass across wildlife overpasses. The objective of our study was to assess whether the use of wildlife overpasses by medium-sized and large mammals is affected by such human co-use. We chose two wildlife overpasses where human co-use is currently allowed – overpass Zanderij Crailoo and overpass Slabroek - and monitored the use by both mammals and humans for over one year. The monitoring aimed primarily to assess which species use the crossing structures, to assess the frequency of crossings, and to assess the behavior of the animals while crossing. The results were compared with data on the use of wildlife overpasses without human co-use elsewhere in the country. Furthermore, we studied whether there is a correlation between the crossing frequency of humans and the crossing frequency of the animals as well as the time of the day that the animals use the overpass. Crossings were detected of almost all medium-sized to large mammal species that were present in the areas around the studied wildlife overpasses. Crossing rates were not necessarily lower compared to wildlife overpasses without human co-use. For example, Roe deer passes overpass Zanderij Crailoo more often than any other studied overpass in the country. At overpass Slabroek, however, a higher number of species crossed less frequently than expected. Human co-use potentially affects the speed in which the animals pass; Roe deer crossed more frequently in a trot or gallop at the overpasses with human use compared to an overpass closed to humans. The effect was larger at the smaller overpass Slabroek. No strong correlations, positive or negative, were found between the crossing frequency of humans and the crossing frequency of wildlife. However, some of the species do tend to use the overpass later in the day on days with high recreational use. These results help to improve decision-making on opening wildlife overpasses for human use and provide guidelines for the design of such crossing structures. Recommendations for further research are: (1) to carry out an experimental study in which human co-use is manipulated, (2) to replicate the study at other sites, (3) to extend the study to other animal groups, (4) to repeat the study on overpass Zanderij Crailoo and Slabroek after five years, (5) to conduct comparative studies on overpasses without human use to increase base-line information, and (6) to carry out similar studies at wildlife underpasses with human co-use.

INTRODUCTION

Wildlife overpasses have been proven effective means to mitigate habitat fragmentation due to transport corridors. They allow animals to cross roads safely and hence avoid populations from becoming isolated. Busy roads can also be barriers to hikers, cyclists or horseback riders. Therefore, in the Netherlands currently questions are raised whether also people could be allowed to make use of wildlife overpasses. The national and provincial government is often reluctant to approve such requests as yet it is not clear what the impact of recreational co-use will be on the use of these crossing structures by wildlife. The objective of our study was to assess whether the use of wildlife overpasses by medium-sized and large mammals is affected by human co-use (Van der Grift et al. 2010).

We chose two wildlife overpasses where human co-use is currently allowed – overpass Zanderij Crailoo and overpass Slabroek (see box *Study Sites*) - and monitored the use by both mammals and humans for over one year (2007-2008). The monitoring aimed primarily to assess the impacts of human co-use on (1) animal crossing rates, (2) the time at which the animals pass, and (3) the behavior of the animals while crossing. Use of the overpasses by mammals was monitored with track beds. The time on which the animals passed was registered by active infrared trail monitors (Trailmaster TM1550). The same device was used to count passing humans as well as the time of their passage.

Study Sites

The studied wildlife overpasses differ considerably in design and landscaping. Overpass Zanderij Crailoo is, excluding its ramps, about 300 m (984 ft) long and exists of two bridges, placed at a short distance from each other, crossing a provincial road and railroad respectively (Fig. 1). The overpass is 50 m (164 ft) wide and landscaped with a mosaic of shrubs, heath, grassland, open sand, tree stumps and a loamy ditch in which rain water stagnates. Overpass Slabroek is, excluding its ramps, about 100 m (328 ft) long and exists of one bridge that crosses a highway, provincial road and unpaved forest road (Fig. 2). The overpass is 15 m (49 ft) wide and landscaped with a mosaic of grassland, ruderal vegetations and a loamy ditch in which rain water stagnates. Both overpasses are open for hikers, cyclists and horseback riders between sun rise and sun set. At overpass Zanderij Crailoo one semi-paved trail has been constructed for hikers and cyclists, with immediately adjacent a narrow horse trail. Between these trails and the rest of the overpass are a zone with shrubs and a 1 m high fence. At overpass Slabroek one paved trail has been constructed for hikers, cyclists as well as horseback riders. Between this trail and the rest of the overpass there are no screening measures. Overpass Zanderij Crailoo was opened in 2006, overpass Slabroek in 2003.

HUMAN CO-USE

At overpass Zanderij Crailoo about 180,000 hikers/cyclists and about 1,700 horseback riders pass in a year (Fig. 3). At overpass Slabroek about 60,000 hikers/cyclists/horseback riders pass in a year (Fig. 4). Most human crossings take place in the months April - July (Fig. 5). Per day on average about 500 people pass overpass Zanderij Crailoo and about 165 people pass overpass Slabroek. There are, however, differences in use between the days of the week. At both overpasses most crossings of humans were registered on Sundays (Fig. 6), with an obvious peak between 14:00 and 16:00 hour. The high number of human crossings in the weekend and the peak in use in the early afternoon suggest that both overpasses are primarily used for recreational purposes. After all, if the overpasses were primarily used by commuters, higher numbers on weekdays and a peak in the early morning and late afternoon would be expected.

Figure 1. Wildlife overpass Zanderij Crailoo. Photo courtesy of Goois Natuurreservaat / W. Metz.

Figure 2. Wildlife overpass Slabroek.

**Figure 3. Cyclists and hikers use wildlife overpass Zanderij Crailoo.
Photo courtesy of Goois Natuurreservaat.**

Figure 4. Recreational use of wildlife overpass Slabroek.

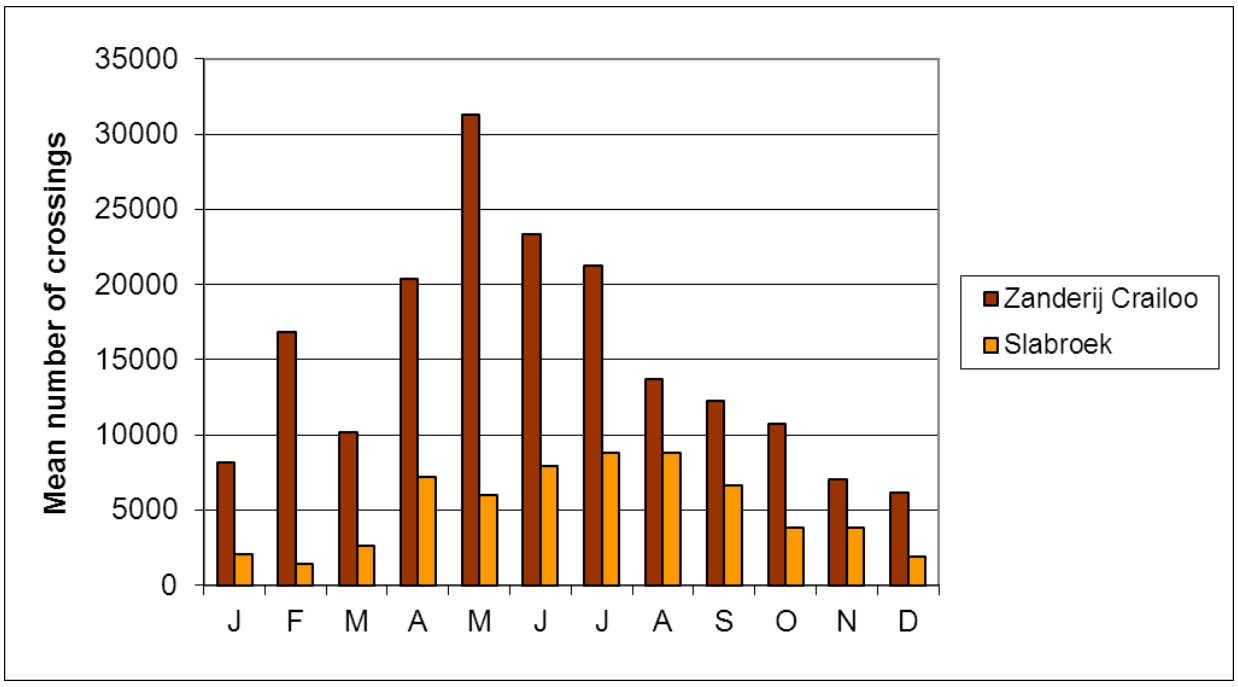

Figure 5. Mean number of crossings of people – hikers, cyclists and horseback riders – per month at wildlife overpass Zanderij Crailoo and Slabroek.

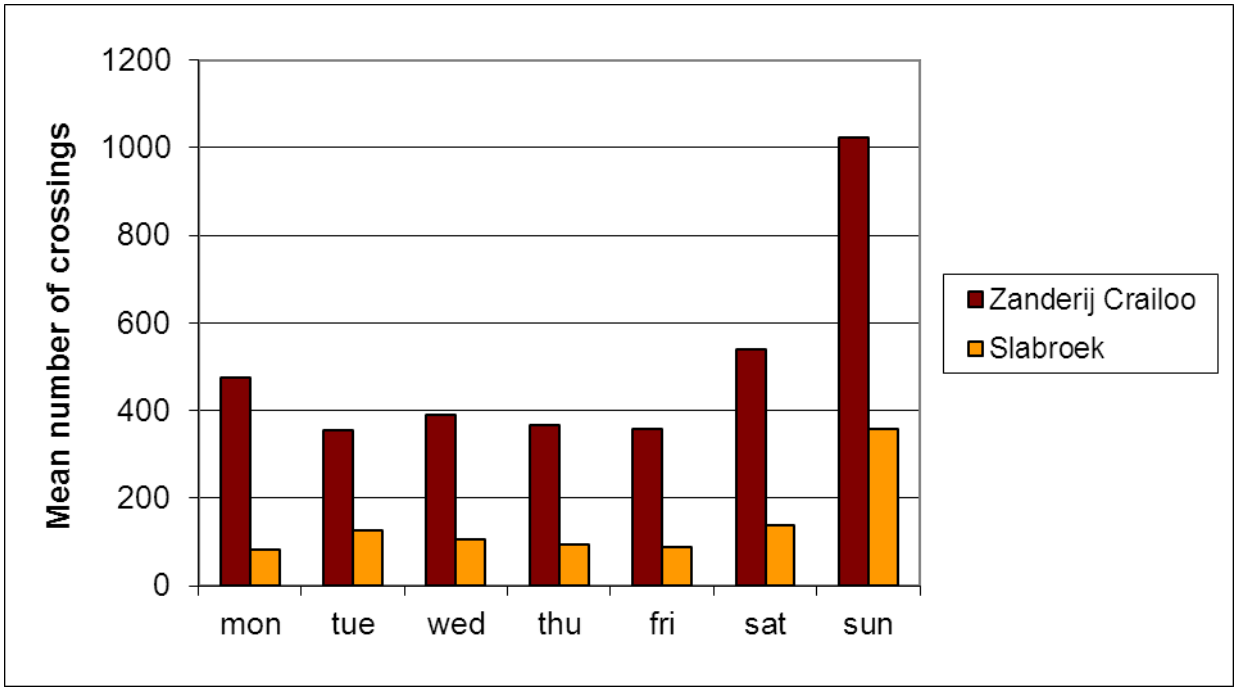

Figure 6. Mean number of crossings of people per day at wildlife overpass Zanderij Crailoo and Slabroek.

WILDLIFE CROSSING FREQUENCIES

At overpass Zanderij Crailoo and overpass Slabroek crossings of respectively 10 and 8 mammal species have been registered. Crossing frequencies differ considerably over the species. Some species pass daily while others pass only ones or twice per year (Fig. 7). To assess possible effects of human co-use on wildlife use we compared animal crossing frequencies on days with many people with animal crossing frequencies on days with little or no people. We found no strong correlations, either positive or negative, between the crossing frequencies of Roe deer (*Capreolus capreolus*), Red fox (*Vulpes vulpes*), Rabbit (*Oryctolagus cuniculus*) and European hare (*Lepus europaeus*) and the number of humans that used the overpasses. Hence, on busy days more or less similar numbers of animals pass as on quiet days. The same applies for the other species that used the overpasses, but statistical inference is low as for these species the overall number of crossings was limited.

If compared with wildlife overpasses without human co-use elsewhere in the Netherlands, the crossing frequencies at overpass Zanderij Crailoo and overpass Slabroek appear to be not necessarily lower. At Zanderij Crailoo the mean number of crossings per year of Roe deer, Red fox, Pine marten (*Martes martes*), Stoat (*Mustela erminea*) and Red squirrel (*Sciurus vulgaris*) exceed the national mean. Roe deer passes here even more often than on any other studied overpass in the country. At overpass Slabroek the mean number of crossings per year of Badger (*Meles meles*) and Polecat (*Mustela putorius*) exceed the national mean. At this overpass, however, also species can be pointed out with considerably lower crossing frequencies than the national mean, despite their occurrence in relatively high densities in the area. This applies for Roe deer, Red fox, European hare, Rabbit and Red squirrel. All these species seem to avoid the overpass, indicating that the crossing structure does not function properly for these species.

TIME OF CROSSING

Animals appear a few hours later on the overpass on days with many people passing as compared to days with little or no people. On busy days the animals cross from about 19:00 hour onwards. On quiet days many animals already enter the overpass from about 16:00 hour. After midnight the crossing patterns of busy and quiet days show hardly any difference. Hence, the animals seem to postpone the moment at which they use the overpass as a consequence of human co-use. This adds to the fact that the animals appear already several hours later at the overpass – no matter the extent of human co-use – as compared to their activity at a random spot in the surrounding area.

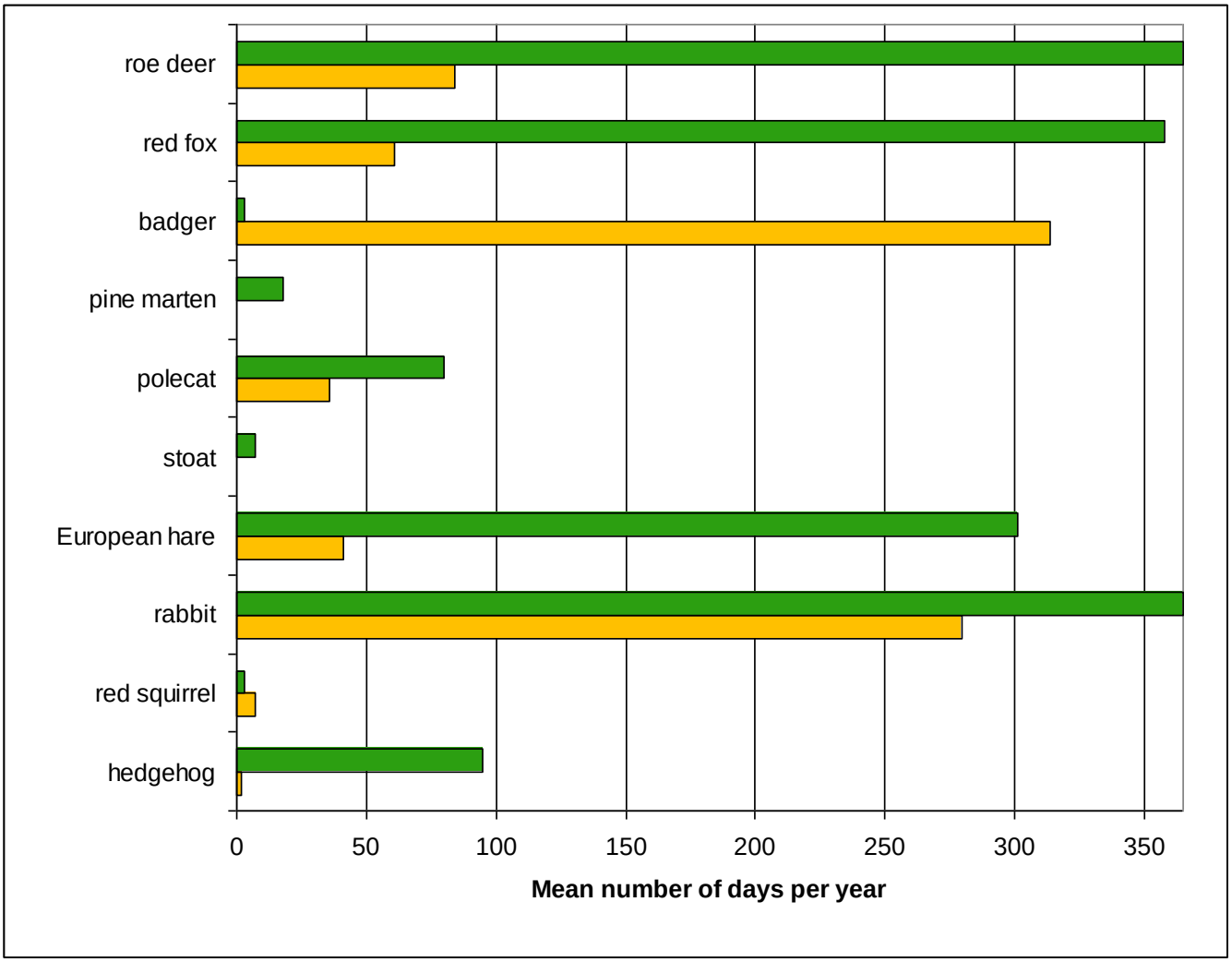

Figure 7. Mean number of days per year that a species can be expected at wildlife overpass Zanderij Crailoo (green) and Slabroek (yellow).

ANIMAL BEHAVIOR DURING CROSSING

Human co-use of an overpass may have an effect on the speed in which the animals pass. Roe deer pass more often in trod or gallop at overpasses with human co-use than at an overpass where humans are not allowed (Fig. 8). The extent in which a higher speed of crossing is chosen seems to be dependent on the width and landscaping of the overpass: the smaller an overpass and the less screening between human trail(s) and the rest of the overpass, the higher the numbers of animals that pass in trod or gallop. The polecat seems to adopt an overpass more readily as hunting area – indicated by print patterns that resemble stalking gaits - if human co-use is absent. None of the registered species at overpass Zanderij Crailoo and overpass Slabroek seem to change the location at which they cross an overpass as a result of human co-use. No indications were found that animals avoid zones adjacent to the trails for humans or prefer zones that are situated furthest away from those trails.

Figure 8. Roe deer cross wildlife overpasses mainly walking (left). At a wildlife overpass without human use, used in our study as a reference, roe deer cross in only 3% of all crossings in a trot (center) or gallop (right). At the study sites here addressed this percentage is higher: 7% at overpass Zanderij Crailoo and 21% at overpass Slabroek. The higher percentages suggest that the animals experience more stress while crossing and hence chose for a higher speed or that passing animals are more often disturbed and show a flight response.

ALLOWING HUMAN USE OF OVERPASSES OR NOT?

Our research shows that human use of wildlife overpasses does not result in low crossing rates for most of the studied mammal species, under the condition that the overpass is of sufficient width and carefully landscaped. It also shows that human use has no effect on the location where animals pass, but does have an effect on the speed with which the animals pass and the time of crossing. Overpass Slabroek – narrow and without any screening between the recreational trail and the natural parts of the overpass – functions obviously less for most of the studied species, if compared with overpass Zanderij Crailoo. Use of the overpass is for some of the studied species even so low that these species seem to avoid the overpass. Hence, in decisions on allowing humans to use wildlife overpasses or not, overpass width and landscaping should be taken into account. If these meet with certain guidelines (see box *Guidelines for the Design of Overpasses with Human Co-Use*) co-use by humans is expected not to be a problem for Badger, Roe deer, Red fox, Polecat, Hedgehog (*Erinaceus europaeus*), European hare and Rabbit. The same possibly applies for Pine marten, Red squirrel and Stoat, but for these species the research is inconclusive as the overall registered number of crossings were low. For these species – and mammal species that do not occur at the two study sites, such as Red deer (*Cervus elaphus*) and Fallow deer (*Dama dama*) – additional research is needed, preferably with an experimental design in which the ecological functioning of each overpass is tested during a time period with and without human co-use. Furthermore, we recommend (1) to carry out an experimental study in which the frequency of human co-use is manipulated, (2) to replicate the study at other sites, (3) to extend the study to other animal groups, (4) to repeat the study on overpass Zanderij Crailoo and Slabroek after five years, (5) to conduct comparative studies on overpasses without human use to increase base-line information, and (6) to carry out similar studies at wildlife underpasses with human co-use. This will allow for validation of our findings and result in an ongoing increase of our knowledge about the effects of human use on the functioning of wildlife crossing structures.

Guidelines for the Design of Overpasses with Human Co-Use

Recommendations to avoid or mitigate impacts of human use of wildlife overpasses are: (1) Place the recreational zone, in which all trails and accompanying screening measures should be placed, on one side of the overpass. (2) Construct a trail for the recreational use of the overpass. If more than one trail is needed, situate them immediately next to each other. (3) Place a fence - minimum height: 1 m (3.3 ft) - between the recreational zone and nature zone of the overpass that stops people from passing but is permeable for wildlife. (4) Develop (shrubs) or construct (earthen wall, screen) a visual barrier between trail(s) and the rest of the overpass. (5) Develop enough cover (e.g. vegetation, dead wood, boulders) on the overpass to provide hiding possibilities for passing animals. (6) Base the width of the natural zone on the overpass on the in literature and handbooks recommended width, i.e. 40-60 m (131-197 ft), instead of the minimum width. (7) Widen the overpass with the width needed for the recreational zone. It is recommended to reserve at least 10 m (33 ft) for this zone if located immediately adjacent and on the inside of the screening measure at the edge of the overpass, meant for mitigating disturbance (light, noise) from the road underneath. If located on the outside of this screening measure, less space – approximately 5 m (16.5 ft) – is needed for the recreational zone (Fig. 9).

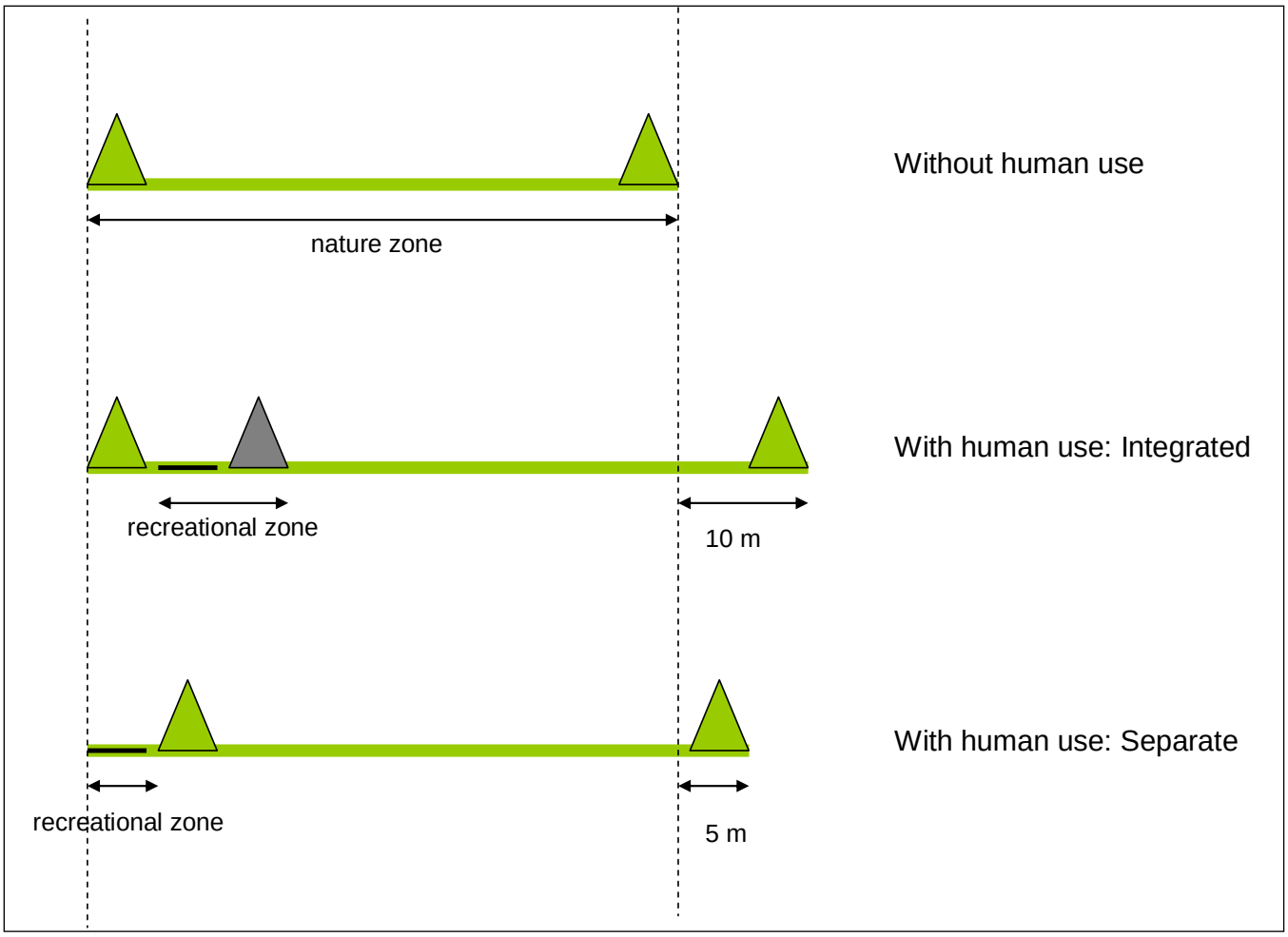

Figure 9. Schematic view that illustrates how the width of the recreational zone relates to its location on the overpass. If the recreational zone is embedded in the nature zone (situation 'Integrated'), additional space is needed to provide screening between the recreational trail(s) and the rest of the overpass. If the recreational zone is situated on the far edge of the overpass (situation 'Separate'), no additional space is needed as the screening measure that is meant for mitigating disturbance from the road underneath will provide the necessary screening between recreational trail(s) and the rest of the overpass.

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BIOGRAPHICAL SKETCHES

Edgar van der Grift works as a senior research scientist at Alterra, part of Wageningen University and Research Center, 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, part of Wageningen University and Research Center, 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.

Rogier Pouwels is a research scientist at Alterra, part of Wageningen University and Research Center, The Netherlands. He focuses on spatial modelling, population viability analyses, and studies that address impacts of recreational use of natural areas on wildlife. He has been one of the leading scientists in designing, planning and evaluating the Dutch National Ecological Network.

Jolanda Dirksen is a research assistant at Alterra, part of Wageningen University and Research Center, The Netherlands. Her main field of interest is planning and designing ecological networks. She focuses on questions that relate to spatial conditions of effective ecological networks as well as field studies in which wildlife crossing structures are monitored.

REFERENCE

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