Combining urban development and wildlife overpasses together in one multifunctional and multilevel building across highways. Innovative nature concepts in highly urbanised areas

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Abstract

The Netherlands is part of the Rhine, Meuse and Schelde Delta Metropolis stretching out over the Dutch Randstad (urban agglomeration of Western Holland), the German Ruhr district and Belgian Flanders. With the growing density of infrastructure and housing, nature areas and reserves are becoming increasingly more fragmented in this highly urbanised area. Linking nature areas and reserves over this infrastructure by means of wildlife overpasses is a costly business. Suggestions have been made for combining wildlife passages with other functions such as wayside restaurants or office buildings built over roads. It has been studied through desk research whether overpasses for fauna can realistically be developed as part of office buildings and this approach has been argued as to its ability to reduce the effect of fragmenting caused by the infrastructure of roads. It has been found essential in this respect to clearly define an ecological ambition level to which to gear the dimensions and the layout of the wildlife overpass. Furthermore, it is crucial to place the passage in a good position within the ecological network. A special point of interest applies as regards the exact location which is not primarily ecological but property-driven.
1 The Netherlands Delta Metropolis

With the exception of the three northern provinces, the Netherlands is situated in a new city, namely the Delta Metropolis. This metropolis is situated in the delta of the rivers Rhine, Meuse and Schelde and stretches out over the Dutch Randstad, the German Ruhr district and Belgian Flanders (figure 1). It is a spacious metropolis with villages, urban centres, suburbs, industrial estates, harbours, airports, forests, woods, lakes, beaches, reserves, pastureland, fields, roads, canals, railways and the monocultures of the high-tech areas of agricultural land (Geuze and Breugem [2]). Their spatial, economic, social and cultural interrelationship is strong. Practically all of the components that make up the spacious metropolis fulfil more than one function. The following are a few sketchy examples:

Figure 1: Northwest European Delta Metropolis (within circle) and its relations with other socio-economic centres (Space for Economic Dynamics, Ministry of Economic Affairs, 1997).

- People live, work, shop and go out in cities and nature develops there;
- People travel and shop at airports;
- People travel, telephone and – since the advent of mobility aesthetics – recreate on motorways;
- Food is grown on fields but these have a recreational function;
• Farms play a part in producing food but are more and more also a shop, restaurant, party room or care home.

2 Strong and weak functions

Some of the functions in the Delta Metropolis are weaker than others. Urban components in particular are driven by strong economic forces. They expand and the shadow of their planning often stretches far beyond the boundaries of time. Weaker green functions often suffer as a result. Around the urban centres green space gets in a state of disarray; noise pollution increases; former rural roads and paths become less suitable for slow traffic. With its Groen In en Om de Stad (Green In and Around the City) policy programme, the Ministry of Agriculture, Nature Management and Fisheries (LNV) is striving to preserve or develop enough green space of sufficient quality particularly around the urban components of the spacious metropolis (Ministry of LNV, 2001). Much attention was paid to quantitative objectives in the first phase of the programme. It has now been found that a purely quantitative goal does not suffice here. It does not provide adequate compensation for economical forces that use up green space. It is mainly the LNV that is interested in a goal aimed at a certain amount of green space.

3 Problem definition

Broader support for nature is required in the delta metropolis. Cities should have their green areas (Timmermans & Snep [7]). They must be of significance to the people in the city, like the Naardermeer (Naarder Lake) used to be for the upper middle class of Amsterdam and ‘to uplift the working class’. The Naardermeer was the first scenic area in the Netherlands to be acquired and safeguarded. Broadened support also means that there will be more parties to bear the cost of major investments in nature. More parties also means more wishes making it a greater challenge to realise all needs in one design. An example in this respect is the initiative to arrive at a multifunctional eco passage in Almere (Dura Vermeer, West8, Alterra, 2003). An office building is being built over the motorway that separates two green areas. An wildlife passage, referred to as a kantoroduct ('offic duct', Timmermans [6]), is being constructed on the roof of the building. The building is to become the 'Poort van Almere' (Gateway to Almere) and therefore much attention is being paid to its design. It is to be a prestigious building emanating a powerful green statement. It is therefore a model for the delta metropolis: nature, infrastructure and offices integrated in a very tight space.

The wildlife passage is currently being realised with a new investor as part of the project budget for the office block. This reduces the claim on available resources for nature development in the Netherlands; nature can be realised with funds not actually intended for nature but for creating working locations.

This idea raises an important question. Major investments are required whilst there hardly any experience is available in the field of the proposed combination
of functions. The question must first be answered as to whether such an investment is actually in the interest of nature objectives; additional investments can only be justified if a positive answer can be given. The key question is: is it too much to expect that a wildlife passage over a motorway can be successfully combined with offices in the form of an *officeduct*?

To answer this question, we charted the problems suffered by nature due to heavy road infrastructure by means of desk research. The ecological preconditions essential for drawing up a successful *officeduct* plan are derived from this research. The plan defines the expected ecological results on the basis of which preconditions can be included in the design and subsequent planning.

### 4 Officeduct

What is an *officeduct*? *Officeducts* are multifunctional structures (residential buildings, office buildings) that span a road.

Familiar examples of earlier *monofunctional* structures bridging a road are wayside service areas with a restaurant above the road. In the case of *officeducts* the bridge is designed not for one function only but for several functions based on multiple and intensive use of space. The bridge provides housing/office space and also functions as an overpass for fauna and/or a recreation corridor. The ultimate challenge for a construction such as this is to do full justice to all functions.

### 5 Fragmentation through heavy road infrastructure

Infrastructure usually has a fragmenting effect on nature. The figure below (figure 2) illustrates how infrastructure fragments animal populations: barrier effect, mortality, loss and disturbance of habitat. What are the consequences and how can an overpass for fauna help remedy them?

![Figure 2: Effects of fragmentation (right) on viable metapopulations (left).](image)

Roads form a barrier for many animal species or groups of species. To animals, a road is a wall they cannot break through. This has several
consequences. Animals become stressed and cease to move about; animals try to work their way 'around' the barrier; animals draw back. A traditional, monofunctional overpass for fauna is intended to remove the barrier effect of roads (Pfister et al. [3]). Different groups of species all have their own requirements as to the design of the overpass. Large mammals need trees and brushwood that act as a cover; preferably, their view of the road is obstructed as best as possible.

What is required for an wildlife passage for smaller mammals is dependent on their preferential biotope. This can be grassland and shrubs (e.g. for field mice), woods and brushwood (for common red-backed mice) or linear planting (for bats). Amphibians and reptiles are benefited mainly by small-scale highly varied vegetation such as shrubs, brushwood and boscage and occasionally water. The preferred habitat of birds is varied; it is important to gear the design to the less mobile bird species. Butterflies usually prefer a small-scale grassland or shrub structure, where they are sheltered from the wind and can find sufficient food; butterflies like the edge of a wood as a good corridor.

Every year, hundreds of thousands of animals are killed by road traffic. Many deaths are caused by daily movements of animals within their home range. Frequently, however, individual animals that move about (dispersion) are also killed as a result of road traffic, endangering the exchange of individuals between populations (Apeldoorn & Kalkhoven [1]). The purpose of wildlife overpasses is to solve this problem. Design, layout and management must also be aimed at this objective.

Mortality as a result of road traffic ensues from the animals' natural urge to move in a certain direction. Crossing the road can be a conscious act or otherwise. Many species of mammals realise the danger and make a deliberate decision selecting the most favourable moment to cross over. This is often at night. Their success depends on the individual's assessment of the danger and the extent to which the danger can be predicted (extent and regularity of frequency). Species like amphibians, reptiles and many invertebrates are not as adept at recognising danger and consider roads at best to be an open space providing little protection. This can make snakes, for instance, cross quickly, and toads, frogs and salamanders, for instance, to cross slowly. Furthermore, these animals often try to orientate themselves on a road to no avail. This being difficult, it takes them quite a while to cross the road and when a car approaches they are taken by surprise and run over. As a result, a small, quiet road can still cause hundreds of road victims. In the design and layout of the overpass for fauna it is important to ensure that animals do not decide to cross the road itself, but opt for the officeeduct as a sensible alternative. Species such as amphibians that make unconscious decisions must literally be lead over the road via the officeeduct. This can be done with fences and screens.

The habitats of all sorts of species are often destroyed when roads are constructed. Because for the time being the 'officeeduct' concept is intended for existing roads this negative effect does not apply. Conversely, the construction of officeducts can create habitats for certain species! This would mostly be for
smaller species. A good example are the populations of mice on the wildlife passages in the Veluwe (central Netherlands).

The term ‘disturbance’ is actually a collective term for all the consequences that directly or indirectly impact the chance of a certain animal species being present and that cannot be ranged under other effects. The main disturbances are caused by light, sound, movement and smell. The consequences are extremely diverse. Large mammals associate light with the presence of humans and is therefore disruptive; for amphibians it is disruptive due to its blinding effect but light is also appealing because many insects are attracted to it. Large mammals also associate sound with the presence of humans but it can lead to habituation; noise pollution makes it impossible for songbirds to demarcate their territory. It is not only the human scent that is disruptive; the scent of predators that use the same fauna passage is threatening to potential prey. Species like the hedgehog avoid tunnels, for instance, that are frequented by badgers. So if all species must use that same facility its measurements are important to prevent it being used by only a limited number of species.

The negative consequences of fragmentation can be mitigated by wildlife overpasses. Many measures are specific for certain animal species or groups of species. The question as to whether fragmentation can be mitigated for a species or group is therefore directly dependent on the design and layout of the passages. Furthermore, each species or group can, to a certain extent, get used to certain disruptive consequences.

6 Ecological preconditions for officeducts

Can a wildlife overpass be part of or be designed as an officeduct? In other words, can an officeduct be an ecological connection (see figure 3). For an officeduct to function successfully as an ecological connection it is essential that the fauna-related demands on these overpasses are taken into account. These requirements originate partially from the habitat requirements of the species concerned and the extent to which these species are sensitive to disturbance by humans. The ecological function of the officeduct is therefore highly dependent on what species are selected and the feasibility of the measures required. It is also important to decide in an early stage as to how much recreational use may be made of the passage alongside its eco use.

Furthermore, the relationship with the green space in the direct surroundings of the officeduct is important (Brinkhuizen & Van Mansfeld [5]). An officeduct is in practice not green-driven, but property-driven. For that reason, the choice of location will as yet not simply be prompted by its importance for nature, but also by urban development and architectural interests. Nevertheless, a good location in between green areas is essential. The use of the officeduct as an overpass for fauna and its chance of being a success greatly depend on the animals’ ability to reach the officeduct. Most animals will only reach it if the surrounding area is a suitable habitat and measures are taken to lead the species towards the officeduct. For an officeduct to function as a corridor it is essential that the existing biotopes
and landscape elements are present in a corridor-friendly configuration and that the habitats on both sides link up perfectly.

Figure 3: Artist's impression of an officeduct (Kees Scherpenzeel & Wim Timmermans).

Figure 4: Draft of a multilevel and multifunctional 'officeduct'. Urban development right above the highway (not further detailed), the wildlife overpass at the roof.
7 Conclusion

Roads have a fragmenting effect on nature. This impact comprises disturbance, habitat loss, barrier effect and mortality.

The purpose of overpasses for fauna is to mitigate some of these negative effects. An wildlife overpass and other functions in the shape of an officeduct can certainly be combined if sufficient attention is paid to the requirements of the various species in relation to the stated effects. A realistic ambition level will need to be defined based on ecology. The decision for certain species determines the ecological ambition level and is thus determinant for the dimensions, design, layout and management of the officeduct. The officeduct cannot be detached from its surroundings; the overpass for fauna must link up perfectly with the ecological structures in the immediate surroundings.

References


