Title

Environmental retrofit for highways: making wildlife a priority

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Bird-Protection Walls: An Innovative Way To Prevent Bird Strikes?

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Abstract: Bird strikes have been known for a long time as a severe negative effect of vehicular traffic. While the phenomenon has been studied for a couple of decades, the prevention of road kills has not been solved yet reassuringly. Of the several methods applied to reduce the collision risk, this study examined solid bird-protection walls that are pitched to raise the flight path of the small songbirds that cross the road.

Most specifically, the study examines the effects of applying bird-protection walls on the number of bird strikes and on the behavior of birds. The research area was situated along a four-lane motorway in Eastern Hungary, Central Europe. Extensive fieldwork was carried out in order to map the local breeding and migrant avifauna and to learn their substantial reactions to the barriers in their flying path. In parallel with observing live birds, road kills were also registered during the whole period of the study. The collected data were analyzed in function of the location of walls, of the relevant bird habitats, and of the technical parameters of the examined road section.

The results? Some issues related to road kills and identified the group of the most-threatened bird species. Several causes of the high risk of bird strikes could be determined and, surprisingly, none of them seemed to be handled efficiently by building these types of physical barriers.

The final results of the study are expected to become public at the end of the year.

Introduction

Several researchers have been discussing the patterns and ecological significance of road kills (Briggs et al. 1994, Primack and Standovar 2001, Hirvonen 2001, Erritzoe 2002), some have also studied those factors that seemed to give rise to the collisions (Erritzoe et al. 2003). Although it would have been a logical approach, crossed migration routes have not been mentioned in European studies so far among the main reasons of the high number of bird strikes. In Central and Eastern Europe, a significant number of passerine species migrate in large volume. They fly from tree to tree at a height of 5-10 meters from the ground surface. Their migration paths usually run along watercourses or long strips of forests and the birds flock together during their movement. Since (theoretically) a migration path crossed by a road can result in numerous road kills, the examined bird-protection instruments were designed at the intersections of the motorway and ecological corridors that were considered relevant in the migration of small songbirds. The walls are simply meant to raise the flight path of migrating birds that cross the roads at the height of the vehicles.

This study examines how effective these bird-protection walls are as regards to both the total number of bird strikes and the behavior of birds. In the paper we address several issues related to the ecological impacts of transportation on birds, especially those that are closely connected with road kills.

We report on: (1) what bird species are especially threatened by road hits, (2) which birds tend to avoid the motorway, (3) how birds react to the walls, (4) whether the number of bird strikes is lower behind the walls than anywhere else, (5) what species can really profit from this protection, and (6) whether the efficiency of the walls differs significantly in case of different types of habitats.

The study was funded by the Hungarian National Motorway Company (NA Rt.), who built the walls at the examined road sections. The project is divided into two phases; the first phase was the present research, while the second phase is expected to corroborate and refine the results of the first phase and it will aim at estimating the future risk level of bird strikes on the next, newly built road sections.

Study Area

We conducted this phase of the survey along a 7-km-long section of a four-lane East Hungarian motorway. This motorway is the only fast connection between the capital city and the Eastern part of the country, with an increasing traffic volume of around 5,000 to 11,000 vehicles per day.

The study area belongs to the ancient flood plain of River Tisza and it is occupied primarily by ploughlands, saline grasslands, and riparian vegetation. The first bird-protection walls in the country were built here, at four points of this road section, in December 2002.

Except for a short section of a few hundred meters length, the motorway was placed on an embankment here. It crosses the River Tisza that is belted by a riparian forest, a smaller watercourse in the midst of the study area, and a few pastures with a fishpond in the background.

Methods

In similar studies, the number of bird strikes are compared before and after the implementation of the examined measure. As the bird-protection walls and the motorway were constructed at the same time, another approach had to be chosen to evaluate the level of protection provided by the walls.

Our hypothesis, initiated from the planned function of the walls, was: if the transportation threatens the migrating birds and the walls were placed exactly at the migration routes, there must not be road-killed migrant birds anywhere along the whole road section. Naturally, non-migrant, e.g., feeding birds may still be hit behind the walls or at the unprotected sections.

If a significant number of migrating birds were killed at the unprotected sections and none of them were killed behind the walls, migrant birds would indeed be at a high risk of road kills, but the walls would not entirely secure their migration routes. In the third case, i. e., if there were a number of road-killed migrant birds behind the walls, that would indicate the incapability of the barriers, provided there were not other road kills along the unprotected sections.

Considering the potential discrepancy between numbers counted and numbers killed (Slater 2002), the initial hypothesis needed further indirect reinforcement based on other type of data than the sheer number and distribution of bird casualties. Primarily, a better understanding of the local migration paths and the migrant bird species, as well as their behavior, seemed to be essential. Similarly to the vagrant and migrant species outside the migration period, the role of the resident fauna could not been disregarded either. Also, several studies have demonstrated the vulnerability of breeding birds in the vicinity of roads (Reijnen and Foppen 1995, Reijnen et al. 1996).

To get an insight into all the above-mentioned issues, the study area was determined as a 400-400 m wide zone along each side of the road. Within this area, the bird habitats were classified and all the migrant, vagrant, and resident species were observed. The study area was divided into four easily recognizable zones (corresponding zones on both sides of the highway were combined): from the mid-line of the road up to the wildlife fence (on a par 10 m from the edge of the road), from 10 m to 50 m, from 50 m to 100 m, and from 100 to 400 m. We monitored and categorized the behavior of birds near the motorway in the zones within 100 m and tried to identify those human and non-human factors (e.g., traffic disturbance, habitat qualities) that significantly influenced their move. Behavior covered both birds' reaction to the traffic and characteristics of their move near the motorway. Their typically observed behavior was feeding, resting, breeding, crossing the road on their daily routes, and avoiding cars in motion.

From the point of view of the study, the most relevant factors were the typical approach distance and the typical height of the flight over the road.

The comparison of bird-counting data for sections farther than and within 100 m from the road helped us to select those species that are disturbed heavily by the traffic; these did not come closer to the motorway. According to our hypothesis, the crossing heights above the road surface were regarded as species-specific and a distinctive part of the behavior of birds. To select those species that tend to fly low over the road, we also recorded how many times and at what height (below 3 m, below 10 m, or higher) each perceived individual bird crossed the road above the walls and at the sections without walls.

The road-killed birds comprised the last source of data, which were registered in the function of the road sections. The data came from two sources. In the survey, we checked the roadside on foot one to three times every week during the whole study period. Technicians from the Hungarian National Motorway Management Companies also ran over the motorway by car at least twice a day, every day. They looked for animals bigger than a dove and only on the pavement. Thus, only a limited amount of valuable data was gathered during their work. Despite the different sampling method, their database helped us to obtain a quite-useful overview about road hits of larger birds like raptors and owls throughout the whole year.

Data Analysis

Since we managed to collect more than 5,000 occurences and behavior data altogether through the autumn and spring migration term, the database could be analyzed statistically. Both spatial and temporal distribution of the collected data was assumed to have great relevance, according to our examination approach.

The 3D spatial distribution of birds was drawn around the examined road section. As several authors (Briggs et al. 1994, Reijnen et al. 1997, Hirvonen 2001, Gutzwiller and Barrow 2003) have already pointed out, bird occurences perpendicular to the road are related to traffic disturbance. The second axis of spatial distribution (parallel with road) explains how the habitats of various quality influence the abundance of birds which are affected by the traffic. The typical flight height of the birds not only helps to estimate the theoretical risk of collisions, but we can obtain data on niche segregation among birds or on an aspect of species-specific behavior, i.e., how birds react to the traffic (they can be halted abruptly when they perceive the approaching cars and fly higher or can fly very high, excluding the possibility of any interference with ground transportation).

When more than 50 distinct occurrences data were available for a particular species, we set up three diagrams for the spatial distribution of the given birds around the road (as described above). The results were further refined by the perceived individual behaviors and the uncertainty in perception.

Despite the relatively large amount of data, the qualitative evaluation seemed to have a similar significance in those cases where we had little quantitative information on a given species or when a specific behavior form was experienced equivocally in the case of several species, but with no statistical significance. If these findings corresponded to our preliminary background knowledge of the given bird species, limited consequences could be drawn from the perceived individual, except for characteristic behavior.

The road kills were evaluated in function of the road length, of nearby habitats, and of the location of walls. The number of bird strikes was calculated for the protected and unprotected sections in the proportion of the total length of the examined motorway section.

Results

Altogether, the shorter or longer presence of 123 bird species could be demonstrated on this small area. Most of these species crossed the motorway at least once. The overwhelming majority of data was collected in spring, because of the favorable weather.

The spatial distribution of birds around the examined road section clearly indicated which birds approach the motorway and tend to cross at the height of the vehicles in motion and which birds avoid the busy traffic at a safe height.

From the three diagrams of spatial distribution, collision risk could be estimated for each species, as summarized briefly in the following. If the given bird approached the road frequently and if it mostly preferred crossing below 3 meters, it could be considered potentially threatened. The hot spots of high risk were selected on the basis of the distribution data along the road section.

The protection walls were considered efficient in the case if these potentially threatened birds all raised their flight path above 3 meters at the walls and if they did not dip down behind the walls onto the road. Also, in those road sections where there were not any walls, the threatened species could not usually fly over the road above 3 meters.

After the analysis, we found no proof that any of the four walls could prevent the striking of birds. On the contrary, the present structure of walls contributed to the slight increase of road kills. First of all, the solid walls formed windproof places for birds behind the walls at open grasslands (two documented hits). Secondly, raptors could sit on top of the walls and wait for the road-killed victims and small rodents that looked for dropped crop seeds on the road (two documented cases). Thirdly, birds could not see behind the walls, so flying over and dipping down abruptly behind the walls resulted in high-risk situations (one documented case of hits of 28 barn swallows in one group just before our study).

Road kills could be divided into three groups of birds: birds of prey, feeding passerines, and casual victims from other taxons. The birds most frequently hit in the survey period are listed below.

Table 1. List of most-frequently hit birds in the survey period

Tree Sparrow	**Bird species**	**Latin name**	**Number of road killed birds**
Barn Swallow	*Hirundo rustica*	20	
House Sparrow	*Passer domesticus*	12	
Long-eared Owl	*Asio otus*	4	
White Wagtail	*Motacilla alba*	4	
Corn Bunting	*Miliaria calandra*	4	
Buzzard	*Buteo buteo*	3	

As initially expected, the distribution of road kills showed no evenness. The highest number of victims, however, was found at the only resting place in the examined section. The number of road kills behind the walls was lower than anywhere else, but the difference cannot be regarded as significant. The migrant species accounted for half of the total number of road-killed birds, but the majority of these birds were killed before or after their migration.

Discussion

In conclusion, at this phase of the study, the following can be stated:

1. Unlike the initial assumption, migrant passerines are not threatened directly by the traffic. It is true that migrating birds were killed by cars at certain points of unprotected road sections, but they gave only less than 3% of total road kills. The majority of the species in migration were observed flying at a safe height over the motorway. Daily moves between breeding/resting and feeding place led to more victims from this group of birds before and after their migration.
2. The present structure of walls does not fulfil the original bird-protection goals. They are not efficient protection instruments at all for any bird species in an open landscape, but with a slight modification they can be useful in those sites where dense, tall vegetation (e.g., a forest) is located close to the road at both sides.
3. The number of road kills itself proved an insufficient source of information in the survey. The number of road kills varies year by year. The victims can be found and identified statistically only in an unreliable way. The reasons for bird strikes can be numerous, in addition to the crossed migration routes. The risk of road kills can be estimated more precisely from a combined analysis of the classified behavior of types of birds and a habitat survey.
4. In the measured range of traffic density (3,500-10,500 cars/ day) the available resources relevant for birds (e.g., food) have a more-significant role in the presence and abundance of birds than traffic. Several bird species prefer the embankment, road surface, and bridges to the surrounding habitats for feeding and breeding. These birds will be killed by the vehicles in higher number than those birds that cross the motorway by chance.

While several results of the study have been outlined, further in-depth analysis of the database is needed to conclude the research. It is expected at the end of the year, after the present and upcoming field-work phase.

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Biographical sketch: Csaba Varga is a conservation consultant and coordinator of projects, including ecological impacts of transportation, for BirdLife Hungary Land Stewarship Advisory Service. He obtained a M.Sc. in ecology in 1994 and he has been involved in environmental-impact studies ever since. Csaba's current research focus include niche segregation of birds on motorways and population biology of owls affected by the traffic. Akos Monoki is the leader of a biodiversity-saving target program for the Nimfea Environment and Nature Conservation Association. Bence Barsony is a dedicated voluntary conservationist and member of the Nimfea Environment and Nature Conservation Association.

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