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Short communications - **Brevi note**

Impact of noise barriers on birds. A case study along a Tuscany highway

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Abstract – One of the most harmful impact that the presence of an infrastructure can cause on birds is the death by direct collisions, both against the vehicles passing and the related structures, like noise barriers. Despite the great concern raised in the last years about the entity of this issue, little has been made to avoid or mitigate this problem. In this short-note we report a case study on the impact of these structures on birds along a highway in Tuscany. Our findings seem to stress the presence of a significance effect in terms of numbers of both collisions and of species involved.

Among the many detrimental impacts that an infrastructure may have on birds, one of the most important is, without doubts, the deaths caused by collisions with transparent soundproof panels (Coffin 2007). These are structures that aim to limit noise pollution in urban sections or in the vicinity of residential areas, consisting, in many cases, of transparent panels. At an international level the extent of the problem is widely recognized (Klem 2006, 2009, Seewagen 2008) and the numerous studies carried out show that direct collisions against transparent manmade structures, including building windows, is by far the leading cause of direct mortality in birds, with a far greater impact than that of many other phenomena often perceived (and not only by the general public) as much more serious (Sibley 2003). In Italy, however, few studies have been carried out (Dinetti *et al*. 2008) and even fewer interventions to mitigate such effects, despite the fact that in recent years new types of dissuaders have been successfully tested, which are much more efficient - and aesthetically acceptable - than the often used decals or stickers depicting birds of prey or other birds (Rössler *et al*. 2009, Schmid *et al*. 2013).

In this short paper we present the results of one study, carried out on behalf of SPEA Ingegneria Europea, the engineering division of Autostrade per l'Italia, aimed at assessing the impact of noise reduction barriers on the stretch of the A1 highway between the Firenze Scandicci and Firenze Nord exits. The study examined only some of the barriers present in this section of highway: four on the southbound carriageway (B1, B2, B3 and B4), with lengths of 86, 88, 154 and 704 m respectively, and two on the northbound carriageway (B5 and B6), both of 76 m; the barrier B4 was monitored only partially, over a length of 330 m, due to the presence of an active worksite. Impact was assessed by identifying, on both sides of the barriers, the carcasses of birds who died as a result of collision. The barriers were all made of plexiglass, a completely transparent material.

The surveys were carried out by a single researcher, on a weekly basis, over the period between June 18 and September 13, 2010, during the off-peak morning hours, when traffic is less intense. For each carcass found, the following data were recorded: the barrier, the side of the barrier where the carcass was discovered (i.e. external or internal), and the species of bird.

Similar research experiences involving identification of carcasses, conducted mainly in the field of wind farm impact, have shown that simply considering the numbers obtained in the field, i.e. the number of carcasses actually retrieved, results in an underestimate, sometimes important, of the real impact of an infrastructure (Morrison 2002, Duffy & Steward 2008). Several factors can considerably reduce the effectiveness of the surveys; the most important one is probably the structure and the height of the vegetation in the area, which can significantly limit the ability to identify and retrieve the carcasses. Another source of bias might be the removal of carcasses by predators (scavengers). To evaluate the effect of these factors, on four separate occasions, a fellow researcher placed a variable number of carcasses (from here called controls) in

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the area of the barriers. These controls were recognizable by the colour-marking of some parts (claws and/or beak); the researcher assigned to the task of searching carcasses was informed of the control presence, but was unaware of their number and, above all, of the dates and places of deployment. In such a way it was possible to evaluate, for each barrier, the efficiency of the research methodology (the percentage of tests retrieved against the total placed) and then define a corrective measure that when applied to the number of birds found really died as a result of collision made it possible to calculate a more reliable estimate of the impact. The corrective measure was simply a proportion, the percentage of efficiency equal to the number of carcasses recovered. The trial was carried out for all the barriers, excluding B3, in which case the correction applied was the average of those calculated for the other five barriers.

Finally, to assess the possible effect of structures other than the barriers on mortality, we examined any significant relationships between the rate of collision and the different types of land use. For a 300-m radius area around each barrier, we drew up a map of the land use, considering the main eco-system types in the area: open water, fallow land, cultivated land, residential areas, industrial areas and roads. To assess the possible effect of land use on the rate of mortality we first carried out a preliminary investigation, using Spearman's rank correlation (Siegel & Castellan 1992) and then tested possible effects using Generalized Linear Models (GLM; Rushton *et al*. 2004).

We carried a total of 14 surveys, during which 50 carcasses belonging to 19 species were found (Table 1). In five cases it was not possible to identify the species. The species found included a red-backed shrike and four kingfishers, both considered species of conservation importance, both under the 79/409/EEC Birds Directive, and subsequent updates, and the Tuscan Regional Authority law 56/2000. Table 2 shows the data for individual barriers: the number of carcasses found, the efficiency of the research and the estimate of impact.

Using the estimate of the research efficiency as a corrective measure to apply to the number of carcasses actually recovered, a total of 0.23 collisions per day was found for every 100 m of barrier, i.e. it is estimated that every day, along the 1184 m of barriers examined, 2.7 birds died. These data were consistent, although slightly higher, with the results of the only two other cases of similar studies published in Italy (Capitani *et al*. 2007, Cairo 2008). In particular, along a stretch of the Bergamo ring road, Cairo (2008) estimated a mortality of 0.95 individuals per day for 700 metres of barrier, i.e. 0.14 individuals per day per 100 m. Regarding the effect of the different types of land use in the area of each barrier, none of the analyses carried

Table 1. Number of carcasses per species found during the study surveys.

Common name	Scientific name	Nummber of carcasses
Feral pigeon	*Columba livia* forma domestica *domestica*	9
Wood pigeon	*Columba palumbus*	5
Blackbird	*Turdus merula*	5
Kingfisher	*Alcedo atthis*	4
Serin	*Serinus serinus*	3
Greenfinch	*Carduelis chloris*	3
Moorhen	*Gallinula chloropus*	2
Swift	*Apus apus*	2
Barn swallow	*Hirundo rustica*	2
Pheasant	*Phasianus colchicus*	1
Collared dove	*Streptopelia decaocto*	1
House martin	*Delichon urbicum*	1
White wagtail	*Motacilla alba*	1
Blackcap	*Sylvia atricapilla*	1
Red-backed shrike	*Lanius collurio*	1
Magpie	*Pica pica*	1
Starling	*Sturnus vulgaris*	1
Italian sparrow	*Passer italiae*	1
Goldfinch	*Carduelis carduelis*	1
undetermined		5

Table 2. Number of surveys carried out, carcasses and controls found at the sites of the different sections of barriers; it is reported also the efficiency of the search, expressed as a percentage of controls recovered, and the estimate of impact, overall and for each barrier, with a confidence interval of 5%. Efficiency tests were not made at barrier n. 3 (B3).

Barrier	**Survey**	**Carcasses**	**Controls**			**Mortality rate** (collisions/day/100 meters)	
			Positioned	Recovered	Efficiency	Observed	Estimated
B1 (86 m)	11	7	11	5	44.4%	0.106	0.238
B2 (88 m)	13	8	20	9	44.5%	0.100	0.225
B3 (154 m)	14	9	no test	40.6%**	0.060	0.147	0.147
B4 (303 m)	13	14	25	6	24.6%	0.099	0.404
B5 (76 m)	14	10	18	9	54.2%	0.134	0.248
B6 (76 m)	11	2	17	6	35.4%	0.034	0.096
Total		**50**	**91**	**35**	**40.6%**	**0.089 ± 0.029**	**0.226 ± 0.096**

out revealed any significant effect due to the nature of the surrounding environment. It is possible that the number of carcasses recovered is too small to reveal significant differences, although it may also be the case that there is no significant effect of land use typologies because of the period in which the surveys were carried out. The research period in fact fell, for most species, in the post-breeding phase, when adults were no longer confined to the nesting territory and fledglings had already dispersed. The results showed a significant impact on birds, especially if considered in the light of the widespread use of transparent noise reduction structures. Our findings, even though related to a limited area and timeframe, nevertheless confirmed these structures as a factor significantly affecting bird mortality (Klem 2009). This study also confirmed how this impact can also relate to species of conservation importance (Zbyryt *et al*. 2012), in the particular cases of the red-backed shrike and kingfisher. These findings emphasize the need, and the urgency, to undertake large-scale mitigation and prevention interventions, considering the methods and techniques that are now available, interventions that should be required directly in the designs of projects for the construction of any structures involving the use of transparent panels.

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