

# Road killing of lizards and traffic density in central Italy

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**Abstract.** The use of roads and the mortality by traffic collision were assessed for three lizard species (*Lacerta bilineata*, *Podarcis sicula*, *Podarcis muralis*) in a hilly area of central Italy. Roads were chosen to include two different habitats and two different traffic levels, resulting in four categories. For both habitats, the density of lizards using roads was significantly higher at lower traffic levels; the density of road killing was significantly higher on roads at low traffic too. Among the three species, the mortality of *Lacerta bilineata* was higher on low traffic roads crossing pasture with shrubs.

## Introduction

Road traffic affects wildlife in several ways, among which direct killing of animals as a result of collision with cars is one of the main causes of mortality for many species of vertebrates in the European countries. The intensity of this impact on wildlife populations depends on many factors, concerning both ecological traits of different taxa and road features. For birds, it seems that the density of traffic strongly affects collisions with vehicles, but detailed studies are scanty (Erritzoe *et al.*, 2003). The occurrence of reptiles is generally documented in lists of road-killed species, but specific studies are scanty too. Concerning snakes, Bonnet *et al.* (1999) showed a risk of road-killing for adult males during the mating season and for juveniles during dispersion. Lizards use open habitats created by management of road sides: moreover, asphalt used as a substrate can result in increasing the basking performance. In this work we investigate the influence of traffic density on (1) the use of roads by lizards and (2) the intensity of road-killing for lizards.

## Materials and methods

The field work was carried out in a hilly area of central Italy (Marche) bordering the Apennines. The landscape was dominated by corn fields interspersed with hedges and woods in lowland (habitat 1), while at higher altitudes pastures with moderate shrubbery were common (habitat 2). Roads were chosen among asphalt ones to include two different traffic densities for these two main habitat types, resulting in four road categories: (1a) field-hedges mosaic with high traffic (2a) crop-hedges mosaic with low traffic (2b) pastures-shrubbery with high traffic (2c) pastures-shrubbery with low traffic. Roads were considered at high traffic (> 30 cars/hour) or at low traffic (< 5 cars/hour) according to a preliminary count of cars in the central hours of the day. A total length

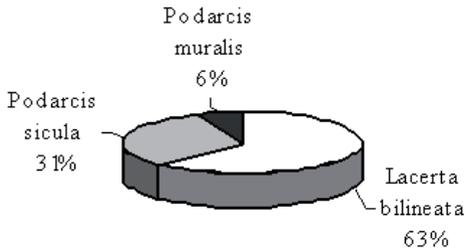
of 30 km was surveyed by car at slow speed during late morning (about 10.00 – 12.00 a.m.) in August 2004, repeating the counts three times a week. For each survey we report on maps both lizards observed using the road, and – once stopping to allow identification – lizards found dead on the same route. Count of lizards was standardized to number / km: statistical analysis was based on a non-parametric comparison between pair of roads (Mann-Whitney test).

## Results

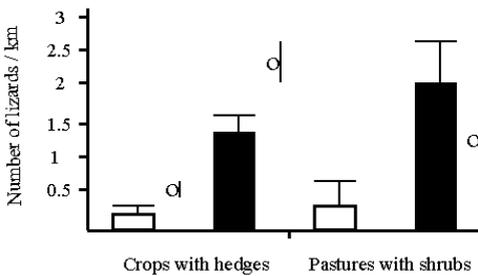
We observed three species of lizards along roads (*Lacerta bilineata*, *Podarcis sicula* and *Podarcis muralis*) ( $n = 36$ ). Almost all the observations (95 %) resulted in lizards basking at short distance from the road sides, with a few individuals observed crossing the road. All the three species occurred among those lizards found dead ( $n = 16$ ), with the highest relative frequency for *Lacerta bilineata* (Fig. 1). Density of observed versus killed lizards along each road was not directly compared for the different detectability of the two samples.

First, we analyse differences between values of lizard counts at high and low traffic level. The mean number / km of lizards observed was significantly higher along roads with low traffic, both in habitat 1 ( $z = 2.94$ ,  $df = 1$ ,  $P < 0.005$ ) and in habitat 2 ( $z = 3.05$ ,  $df = 1$ ,  $P < 0.005$ , no lizards observed in pastures-shrubbery with high traffic).

In the same way, the mean number / km of lizards found dead was significantly higher along roads with low traffic in habitat 1 ( $z = 2.68$ ,  $df = 1$ ,  $P < 0.01$ ) and in habitat 2 ( $z = 2.58$ ,  $df = 1$ ,  $P < 0.01$ ) (Fig. 2). Among the three species, the mortality of *Lacerta bilineata* was higher on low traffic roads crossing pastures with shrubbery. On these roads, in a few cases this species was also observed catching grasshoppers (Acrididae), that were found dead by road-killing in a great number. When basking on the road, *Lacerta bilineata* stays restless for long periods, although escaping if approached by walking. On maps the distribution of the collisions showed that most of



**Figure 1.** Relative frequencies of lizard species found dead by road-killing.



**Figure 2.** Comparison of lizards' abundance in the four road types. Bars (white: high traffic; black: low): mean values of number of road-killed lizards / km (with SD). Circles: mean values of number of observed lizards / km (with SD). No lizards were observed on high traffic roads in habitat 2.

the road-killings were located on the side immediately after a bend, when cars arrive suddenly at fast speed, probably not allowing the lizards to be avoided.

## Discussion

Roads with lower traffic volumes were more used by lizards for basking and feeding than roads with higher car densities. Although our data refer to a short part of the annual activity period and the sample could be too small, the concordance shown by our results for the two different habitats seems to reinforce our findings, and not to be related to a general higher density of lizards in a particular habitat. The occurrence at higher densities

in low traffic roads could be explained because lizards were not immediately disturbed when entering the road, or by being not familiar with the cars' passage. Roads with higher traffic can make lizards avoiding them totally, or produce a learning effect. However, density of lizards could be already lower in the surroundings of these roads because of indirect disturbance such as noise, pollution or resources availability.

Road-killing affecting lizards has been poorly investigated, and comparisons are possible only with studies concerning vertebrates as a whole. In a study carried out in Tuscany, values of 0.35 lizards dead / km / year were found (Scoccianti *et al.*, 2001); these data are similar to ours for high traffic roads but are lower if considering the different duration of the study. For lizards, the frequency of road-killing on roads at low passage of cars could be a consistent risk for the population viability if considering the large development of roads in the Apennine countryside of central Italy. *Lacerta bilineata* in particular seems to be the most sensitive species to collision (although it is easily detectable, because of larger size, when compared to *Podarcis* sp.). *Lacerta bilineata* is reported as a species of interest in many regional Red Lists: moreover, it has been also suggested as an ecological indicator for the agri-environments in Tuscany (Corti and Lebboroni, 2004). A little more attention provided by everyone driving should be sufficient to avoid further decline of this species.

## References

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