



ELSEVIER

Contents lists available at ScienceDirect

## Journal of Environmental Management

journal homepage: [www.elsevier.com/locate/jenvman](http://www.elsevier.com/locate/jenvman)

## Research article

## Is vertebrate mortality correlated to potential permeability by underpasses along low-traffic roads?

Juan D. Delgado<sup>a,\*</sup>, Federico Morelli<sup>b</sup>, Natalia L. Arroyo<sup>c</sup>, Jorge Durán<sup>d</sup>, Alexandra Rodríguez<sup>e</sup>, Antonio Rosal<sup>f</sup>, María del Valle Palenzuela<sup>f</sup>, Jesús D.G.P. Rodríguez<sup>a</sup>

<sup>a</sup> Área de Ecología, Dept. Sistemas Físicos, Químicos y Naturales, Univ. Pablo de Olavide, E-41013, Ctra. de Utrera Km.1, Sevilla, Spain

<sup>b</sup> Department of Applied Geoinformatics and Spatial Planning, Czech University of Life Sciences Prague, Prague, Czech Republic

<sup>c</sup> Independent Researcher, Avda. Adolfo Suárez, Dos Hermanas, Seville, Spain

<sup>d</sup> Departamento de Ciências da Vida, Faculdade de Ciências e Tecnologia, Universidade de Coimbra, Calçada Martim de Freitas, 3000-456, Coimbra, Portugal

<sup>e</sup> Museo Nacional de Ciencias Naturales (MNCN)-Consejo Superior de Investigaciones Científicas (CSIC), C/ Serrano 115 dpdo, 28006, Madrid, Spain

<sup>f</sup> Dpto. Biología Molecular e Ingeniería Bioquímica, Área de Ingeniería Química, Univ. Pablo de Olavide, E-41013, Ctra. de Utrera Km.1, Sevilla, Spain

## ARTICLE INFO

## Keywords:

Road permeability  
Wildlife  
Underpass  
Rangeland  
Andalusia  
Road integration  
Road-kill

## ABSTRACT

Road permeability to animal movements depends among several factors on structures which, integrated in the road design, operate as safe conducts to mitigate vehicle collision and barrier effects. There is abundant evidence that wildlife makes use of such structures as safe passages to cross roads. We analyzed the spatial relationship between road drainage elements (N = 253; mostly culverts) as potential faunal underpasses, and mortality due to vehicle collisions in two seasons and on four relatively low-traffic roads (< 5000 cars/day) traversing oak rangelands of western Andalusia (S Spain). Focusing on amphibians, reptiles and mammals, we recorded and located casualties (N = 238 individuals, 35 species) along these roads, identifying and characterizing all potential underpasses. Overall frequencies of casualties and spatial distribution were highly variable both within and among these roads. We obtained an estimation of potential permeability for the different roads. We detected, located and described a wide supply and a very variable pattern of drainage culverts and other underpasses, with differences among roads in passage attributes potentially affecting permeability for wildlife, such as spatial arrangement, number, density (frequency or concentration of passages) and dimensions. We used Mantel tests to assess spatial congruence of passages and road-killed animals. We applied generalized linear mixed models fitted by maximum likelihood through Akaike Information Criterion to explain the variation in the distance of the 238 casualties to the nearest underpasses, with road transect and season as random factors, and traffic intensity, speed and vertebrate class as fixed effects. Both road-killed animals and underpass distribution followed aggregated patterns, and casualties were not significantly related to underpasses along any of the 4 roads. There were no differences in distance of casualties to the nearest underpass for the three vertebrate classes. Although existing underpasses were abundant, we could not correlate potential permeability with reduced mortality along these roads, and other factors potentially affecting roadkill aggregations should be evaluated along with permeability assessment. Mitigation of road-caused mortality can still be greatly improved for these roads, through measures of reconditioning and proper management of existing underpasses, aiming to maximize road permeability and reducing major impacts upon animal populations of Andalusian rangelands.

## 1. Introduction

The road network has been designed by humans to connect previously separated areas, increasing the ability of humans to reach formerly remote ecosystems and the capacity to transform the occupied environments. One of the most immediate effects of roads is ecosystem fragmentation, involving ecosystem area reduction, loss or alteration of key processes, and populations loss (and gains) of species leading to

altered composition and dynamics (Forman et al., 2002; Coffin, 2007). Amongst these issues, road permeability for wildlife is key in the management of road fragmentation (Bissonette and Adair, 2008; Loro et al., 2014, 2015; Rytwinski et al., 2015).

The Iberian Peninsula is one of the areas of Europe with greater biodiversity, being included in a global biodiversity hotspot. However, proliferation of transport structures and diffuse urban expansion favored by it are accelerating biodiversity loss at local and regional

\* Corresponding author.

E-mail address: [jddelgar@upo.es](mailto:jddelgar@upo.es) (J.D. Delgado).

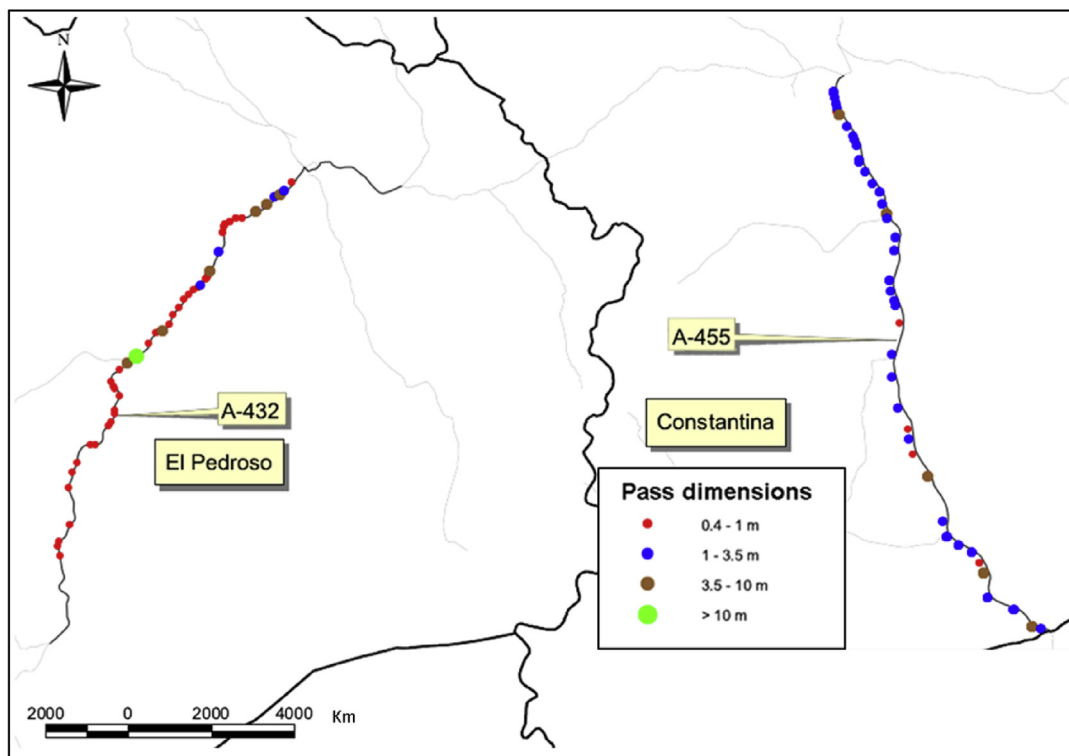
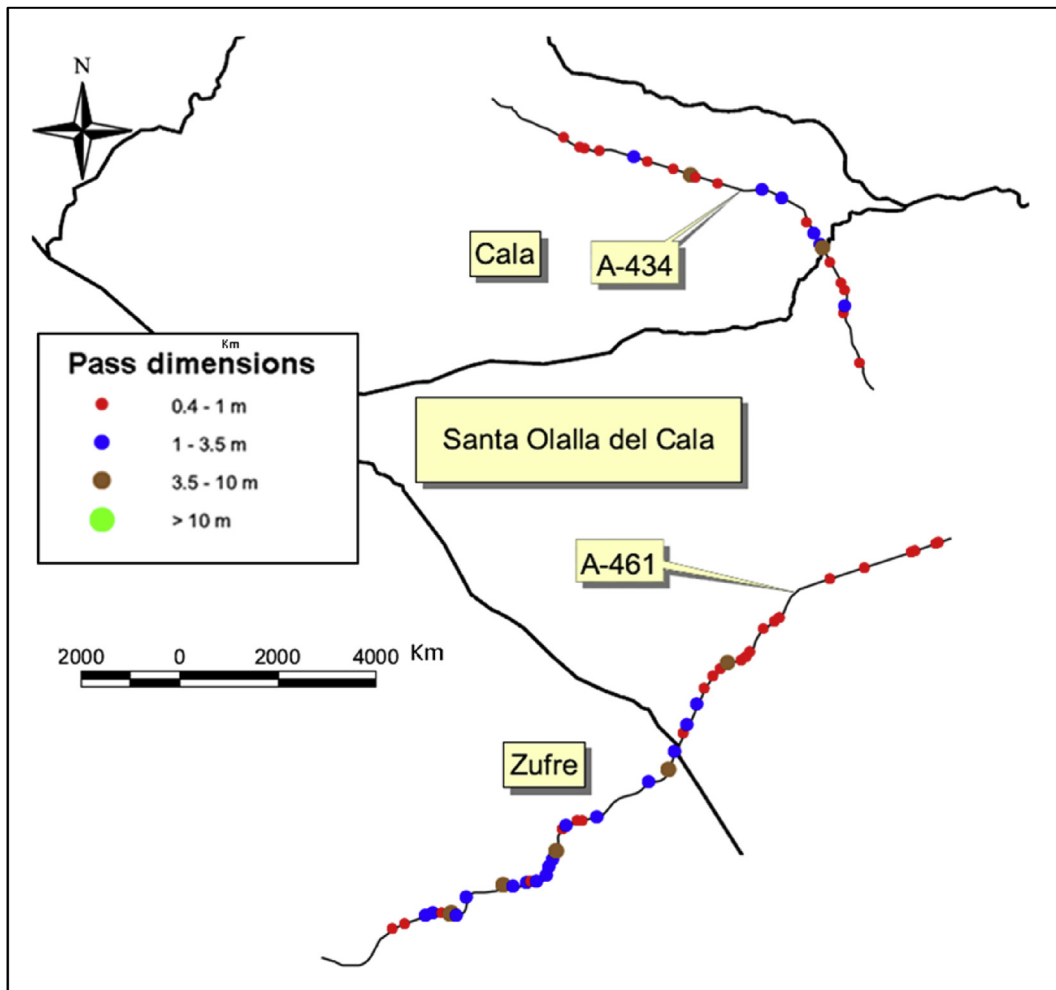


Fig. 1. Location, distribution and attributes of drainage structures (potentially used as faunal underpasses) in the four study roads.

Download English Version:

<https://daneshyari.com/en/article/7476372>

Download Persian Version:

<https://daneshyari.com/article/7476372>

[Daneshyari.com](https://daneshyari.com)