Indirect estimation of regional roadkill risk when there is no roadkill data

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INTRODUCTION

Roadkills are one of the most obvious impacts of roads and traffic. The usual way to estimate the risk is by spatial modelling using predictive variables associated with road kill sites. This methodology is not applicable before roads are built or in roads with a low probability to find victims (those with low traffic intensity, e.g. unpaved roads, or where there is a high removal rate by scavengers). We developed an indirect method to estimate a spatially explicit index of the risk of collisions *R* for different species on a regional scale $R = f(P_{crossing} \cdot D_{crossing} \cdot AADT)$; where *R* (0,1) and

$P_{crossing}$ = Expected crossing probability or number of crossing events (depending on spp abundance) defined by the abundance and phenology of the species and the characteristics of the local environment (site specific)

AADT = Annual average daily traffic: traffic intensity estimated with direct counts or with a site specific model of traffic intensity

$D_{crossing}$ = Exposure to vehicles during crossing, estimated as the distance traveled within the risk zone (wheel width or vehicle running width, depending on species body size)

APPROACH

Characterization of the area:

- Mapping the road network in Doñana Park (SW Spain, except in the marshland, Fig. 1, Table 1).
- Cartography of environmental and road variables in all 200 m road sections.

Table 1: Roads within Doñana

	km	Km/km2
All	2190	4,02
Dirt roads	1263	2,32
Firebreaks	777,2	1,43
Improved	105,4	0,19
Paved	44,3	0,08

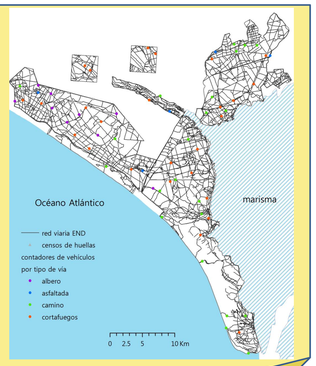

Fig.1: study area

Traffic intensity: *AADT*

- Roads with low traffic: stratified seasonal sampling with magnetometers in 62 sites (figs. 1&2)
- Main roads: official daily measures

Fig.2: Magnetometers

Track censuses:

- In cleaned sandy roads we counted the number of crossing events in 24h (fig. 3) and the crossing distance (fig. 4) in 183 200m transects every season (Table 2)

Fig.3: cleaning tracks

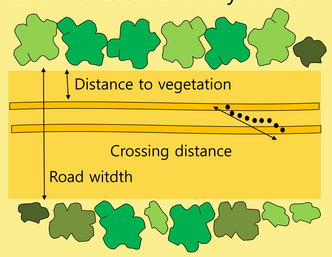

Fig.4: Track census scheme

Sp/group	Total no tracks	No tracks/km	Cross. distance in m (x̄ ±SD)
Europan rabbit	5925	82,29	2,98±3,46
Red deer	1143	15,87	3,84±7,18
Red fox	999	1,.87	9,31±14,72
Wildboar	874	12,14	3,71±6,57
Rodents	526	7,30	2,23±1,10
Horses	221	3,07	30,53±22,84
Dogs	153	2,12	23,50±22,52
European badger	132	1,83	17,03±19,13
Egypt. mongoose	64	0,89	3,69±5,75
Cows	59	0,82	10,25±16,01
Iberian Lynx	23	0,32	8,22±12,13
Common genet	14	0,19	2,71±1,64
Cats	9	0,12	8,56±7,04
Eurasian otter	2	0,28	3,00±1,41
Anurans	1028	14.28	9,02±9,80
Lacertids	1126	15,68	5,83±6,25
Snakes	69	0,96	8,67±7,33

Table 2: Data obtained during the track censuses

Example: ROAD KILL RISK FOR EUROPEAN RABBIT AND IBERIAN LYNX

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1. Modeling $P_{crossing}$ in 200m sections

Extrapolated to the road network

European rabbit

no. crossings = month + vegetation type + distance to water + %pasture | %scrubland

Iberian lynx

$P_{crossing}$ = no rabbit cross. + distance to water

2. *AADT* estimates for 200m sections

Main roads: actual data

Improved dirt roads: seasonal counts

Other roads and firebreaks modeled as

AADT = distance to house + weekend + protection level x season

3. Estimates of roadkill risk *R*

R = *f* ($P_{crossing}$ x *AADT* x species crossing distance)

Values standardized between 0 and 1

4. Identification of risk areas

The application of the estimates to the road network on a regional scale permits the identification of high-risk areas even before a road is built. Results can be validated with road-kill data (in both examples there is a high coincidence, Figs. 5-7)

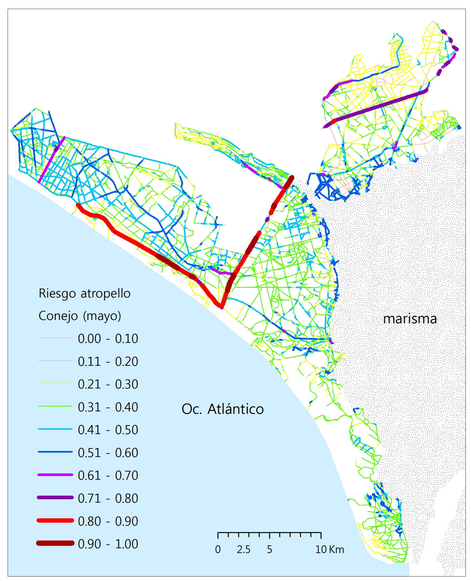

Fig.5: Roadkill risk map for European rabbits during the annual maximum abundance

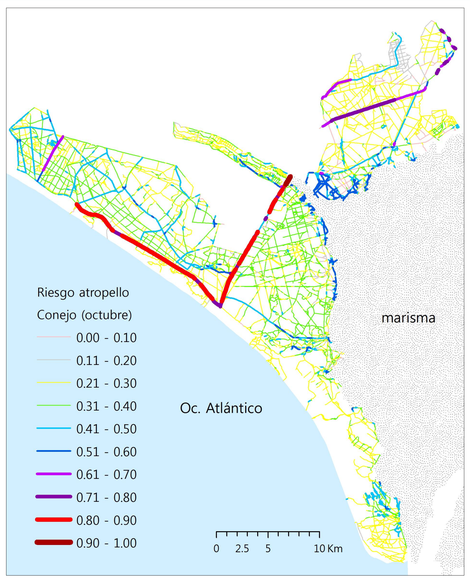

Fig.6: Roadkill risk map for European rabbits during the annual minimum abundance

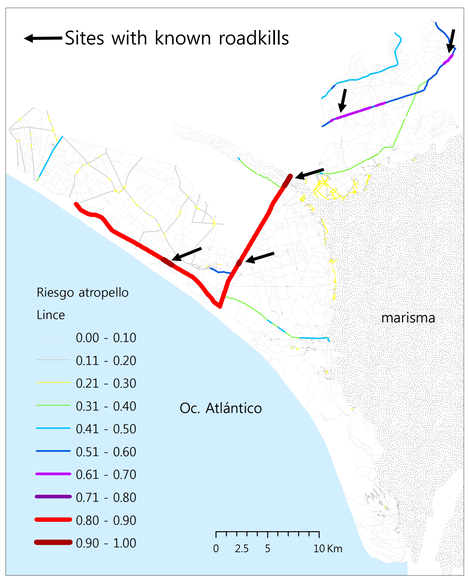

Fig.7: Roadkill risk map for the Iberian lynx

CONCLUSION

The proposed method can be very useful in the identification of areas at high risk of collision when no roadkill data is available, as occur in already developed road networks with low risk to identify roads to be eliminated or where to locate crossing structures and before road construction to decide where to locate mitigation measures. Radiotracking of the focal species can be used instead of track censuses.

Acknowledgements
This work is the result of a collaboration agreement between EBD-CSIC and the Ministry of the Environment of the Regional Government of Andalusia. We are especially grateful for the support of the staff of Doñana National Park (Lalo Cobo and Curro Quirós) and Land Rover Spain.