3rd International Jackal Symposium

02-04 November 2022, Gödöllő, Hungary

STAY HOME, STAY SAFE? HIGH HABITAT SUITABILITY AND ENVIRONMENTAL CONNECTIVITY INCREASES ROAD MORTALITY IN A COLONIZING MESOCARNIVORE

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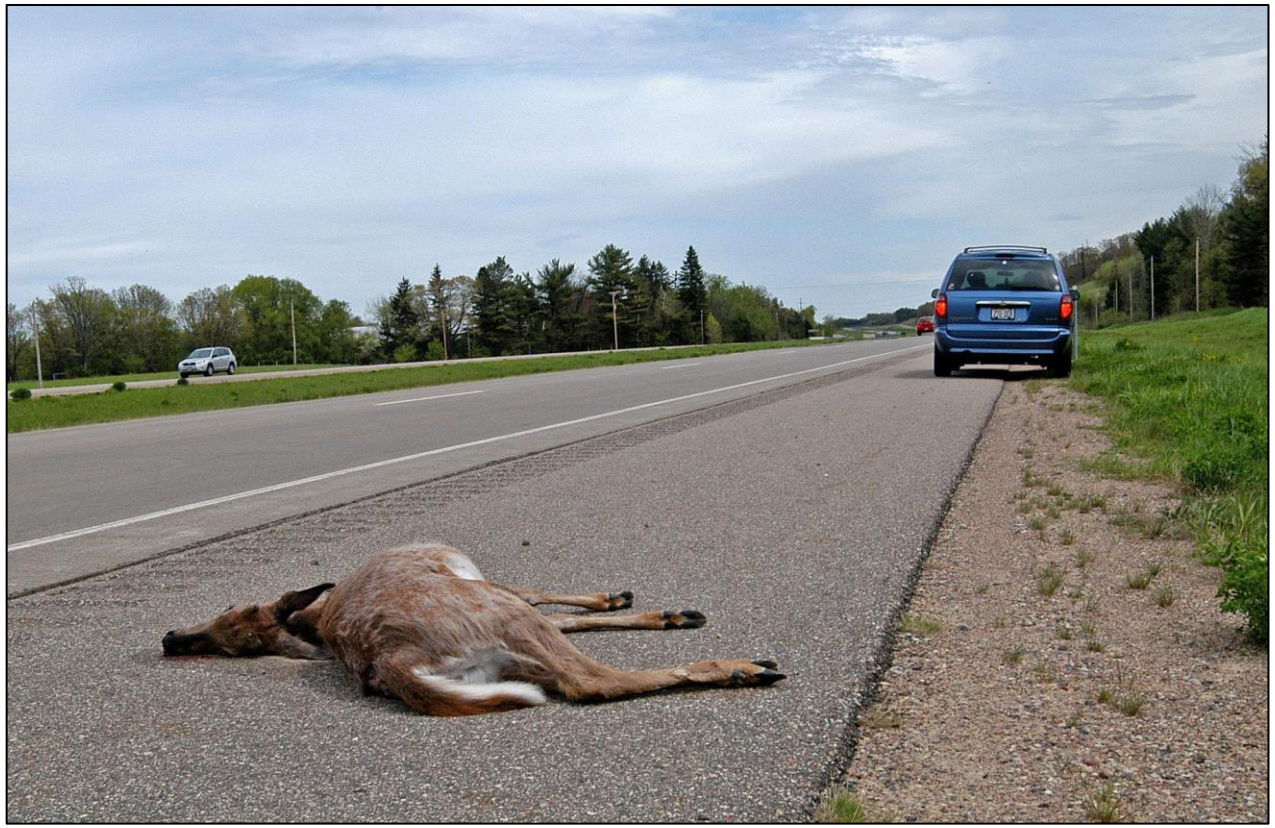
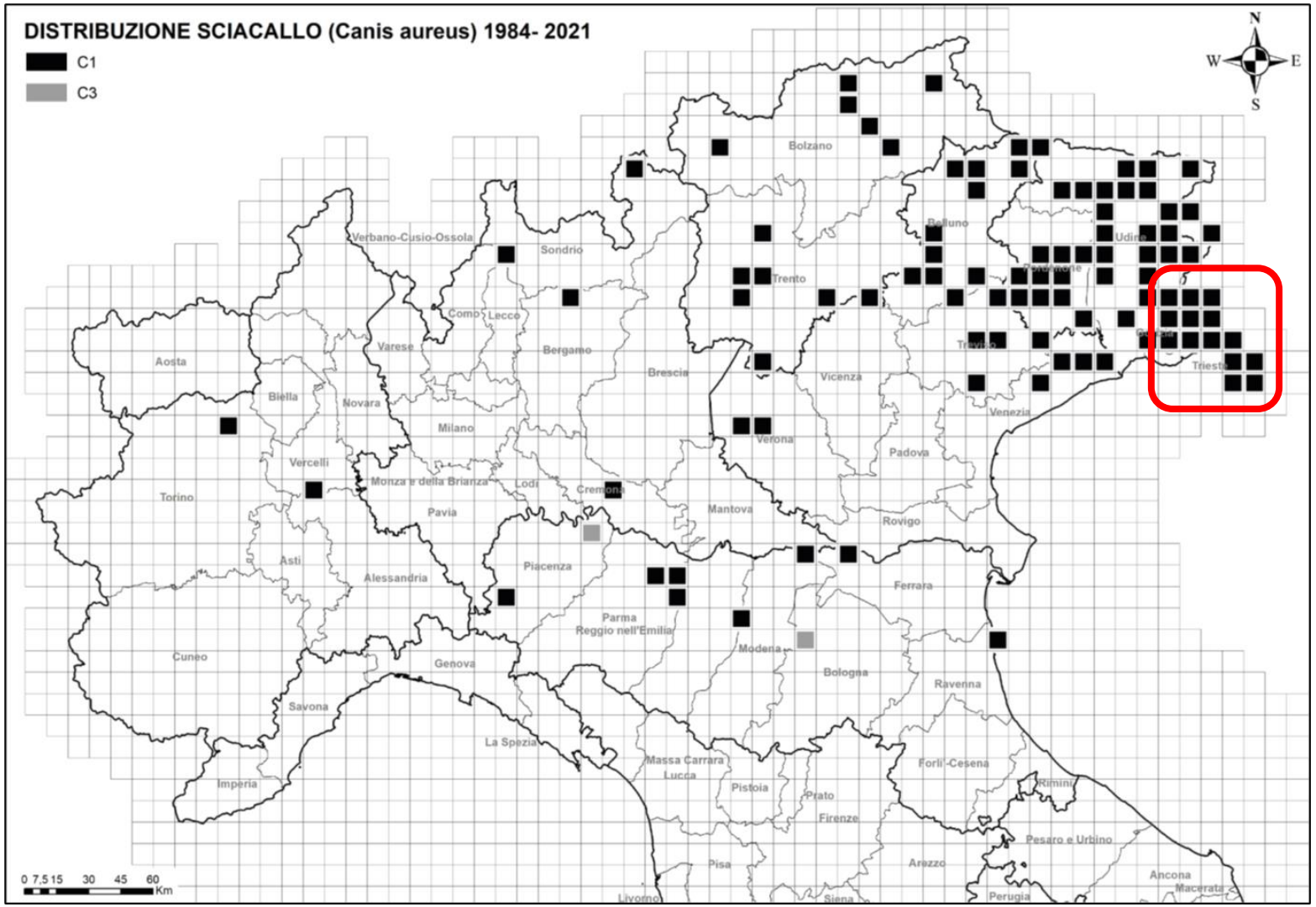
Habitat fragmentation as a consequence of the realization of anthropogenic structures (e.g., roads) may alter the species' behaviour (e.g., activity patterns and/or dispersal capacity) and represents a serious risk in terms of vehicle collisions.



Road-killing is one of the major threats affecting the long-term survival of some vertebrate species. Furthermore, it represents a serious risk to human safety potentially causing substantial economic damages.

Carnivores are especially vulnerable to road-killing risks due to their large home-ranges, low population densities, low reproductive rates and dispersal capacity.



Highest densities reached in the Karstland (Gorizia and Trieste).

Lapini *et al.* (2021)

Purpose of the research: assessing the factors affecting the road mortality risk for golden jackal, both through the analysis of habitat suitability and connectivity and by exploring the landscape metrics at sites of road-kill incidents.

(***i***) Habitat suitability and connectivity (i.e., higher mortality risk near less favourable areas and higher landscape connectivity).

(***ii***) Human-modified landscapes (i.e., higher risk closer to human infrastructures and in highly fragmented habitats).

(***iii***) Biological and/or seasonal factors (i.e., higher risk biased toward males and sub-adults, and during the breeding season).

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Study area: Friuli Venezia Giulia region (north-eastern Italy).

Data collection: golden jackal presence assessed through acoustic stimulations (i.e., jackal-howling) carried out from 2010 to 2020.

These data were used to calibrate the habitat suitability model using MAXENT.

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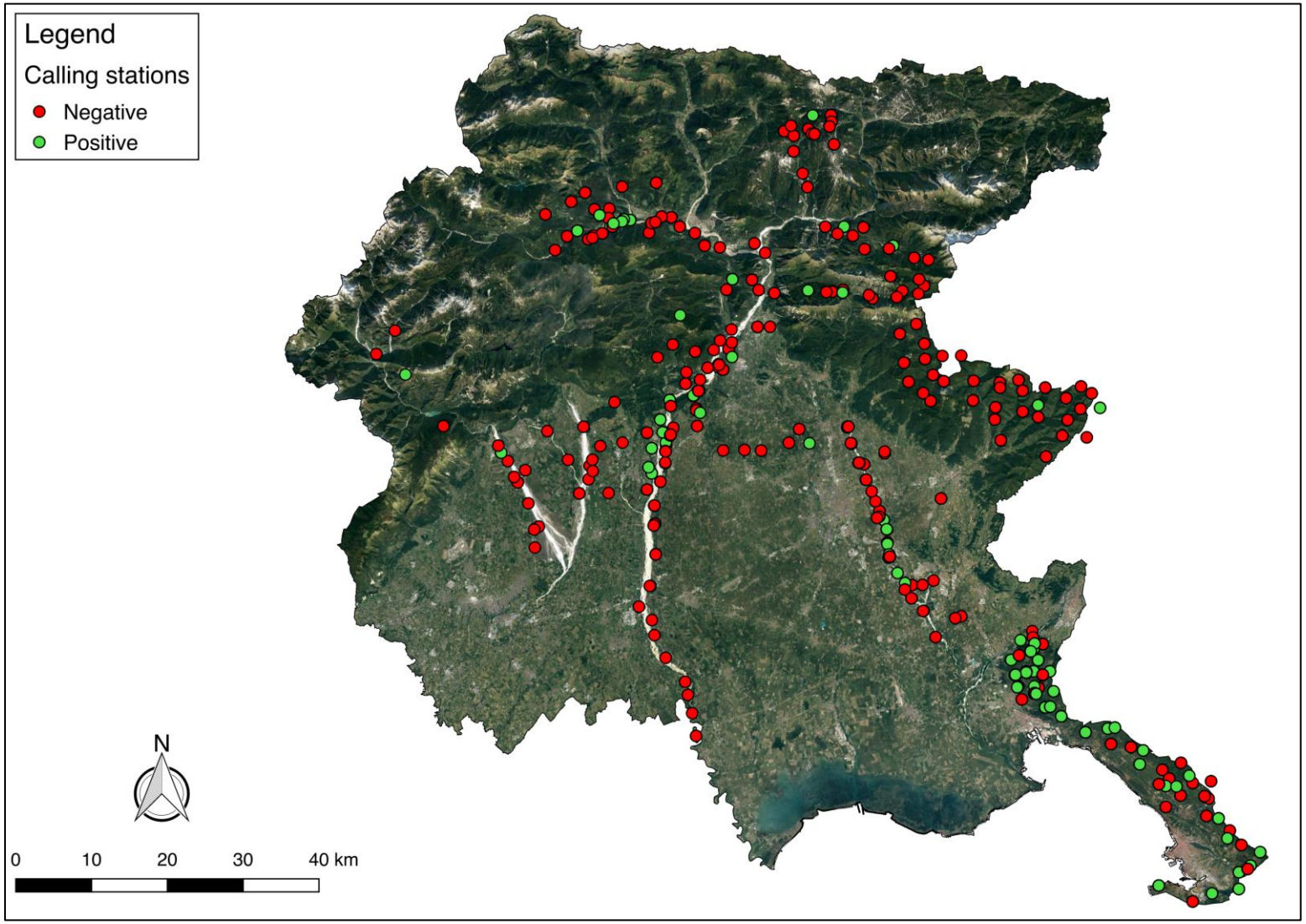
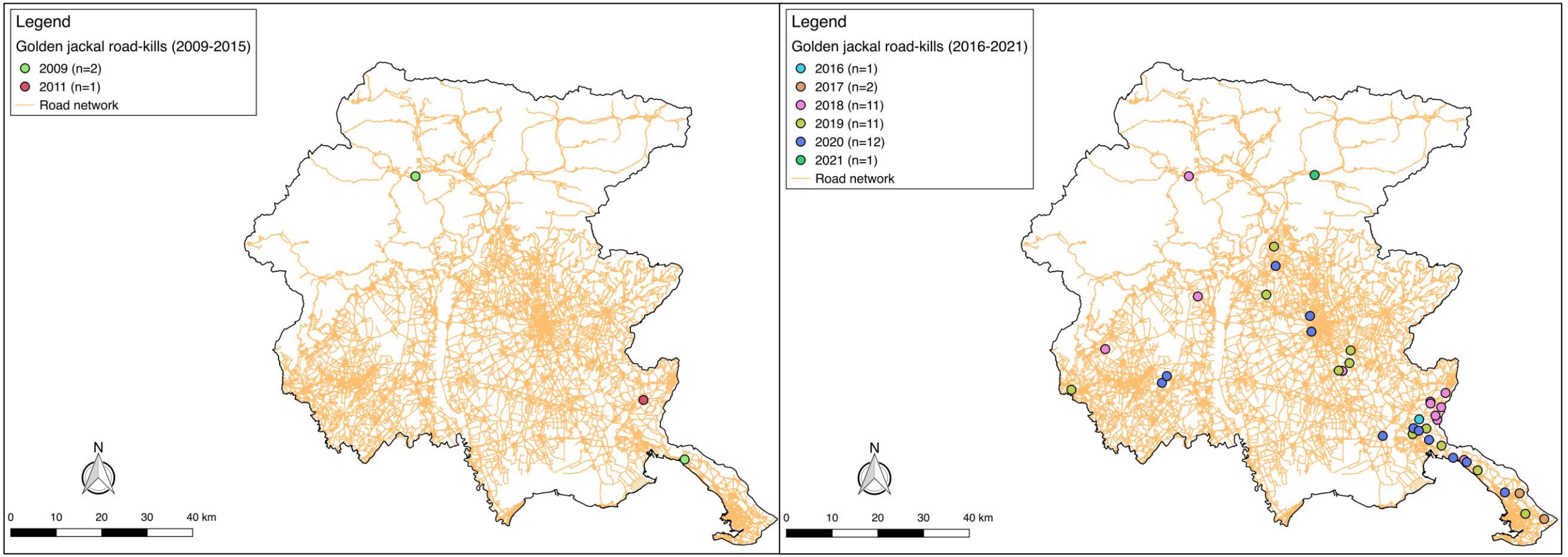


Locations of 41 road-killed golden jackals were collected from 2009 to 2021.



Frangini *et al*. (2022)

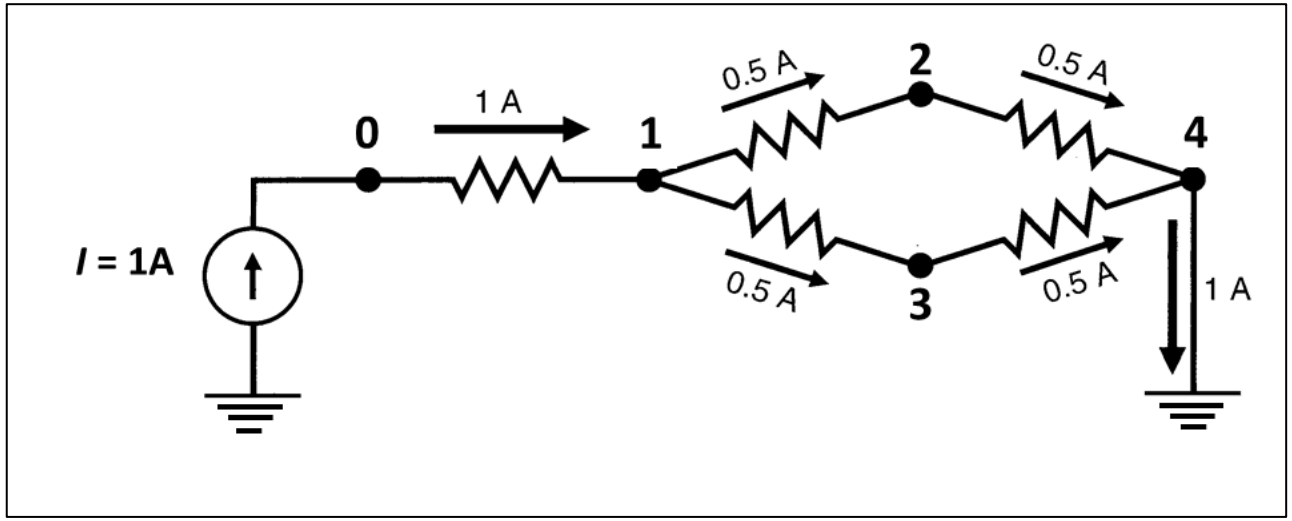
Table 1 Predictors used to calibrate the habitat suitability model (HSM)

Predictor	Category	Description
Land cover	Categorical	11 land cover categories derived from Corine Land Cover 2018
Tree cover density	Continuous	Percentage of tree cover in each cell
Elevation	Categorical	14 altitudinal categories (e.g. 0-200 m asl, 200-400 m asl, 400-600 m asl, etc.) derived from DEM
Slope	Continuous	Slope derived from DEM
Imperviousness	Continuous	Percentage of the soil sealing in each cell

Frangini *et al*. (2022)

We selected five meaningful environmental variables according to the golden jackal habitat requirements.

CIRCUITSCAPE



Habitat connectivity was assessed using the circuit theory, implemented in the Circuitscape Software.

The choice to use the circuit theory relies on the assumption that the golden jackal has been expanding across the Alpine areas.

Table 2 Predictors tested in the Bayesian generalized linear model (BGLM) and generalized linear model (GLM)

Variable	Description	Scale
Topography	Presence of road embankments and/or steep slopes along road edge	Microscale
Vegetation	Presence of vegetation on the road verge	Microscale
Guardrail	Presence of guardrails and/or lateral fences	Microscale
Culvert	Presence of culverts within the proximity of the roadkill site	Microscale
Dist_slo	Euclidean distance from the nearest Slovenian source population	Microscale
Dist_cross	Euclidean distance from road intersections	Microscale
Dist_settl	Euclidean distance from human settlements	Microscale
Road_type	Road category (highway, state road, regional road, local road)	Microscale
HS3_perc	Percentage of the most suitable habitat category within the buffer	Macroscale
Road_dens	Road density (km/km^2) within the buffer	Macroscale
Cur_mean	Mean current value within the buffer	Macroscale
Number of patches	Number of patches of the most suitable habitat category	Macroscale
Mean patch area	Mean value of the area (km^2) of the most suitable habitat category	Macroscale
Euclidean Nearest-Neighbour Distance	Euclidean distance (km) among the most suitable habitat patches	Macroscale
Landscape division index	1—(the sum of the most suitable habitat area/buffer area)	Macroscale

Frangini *et al*. (2022)

To assess the influence of landscape features on golden jackal road-kill sites, we investigated a set of 15 landscape metrics comparing the 41 road-kill locations to 80 randomly generated points along the road network.

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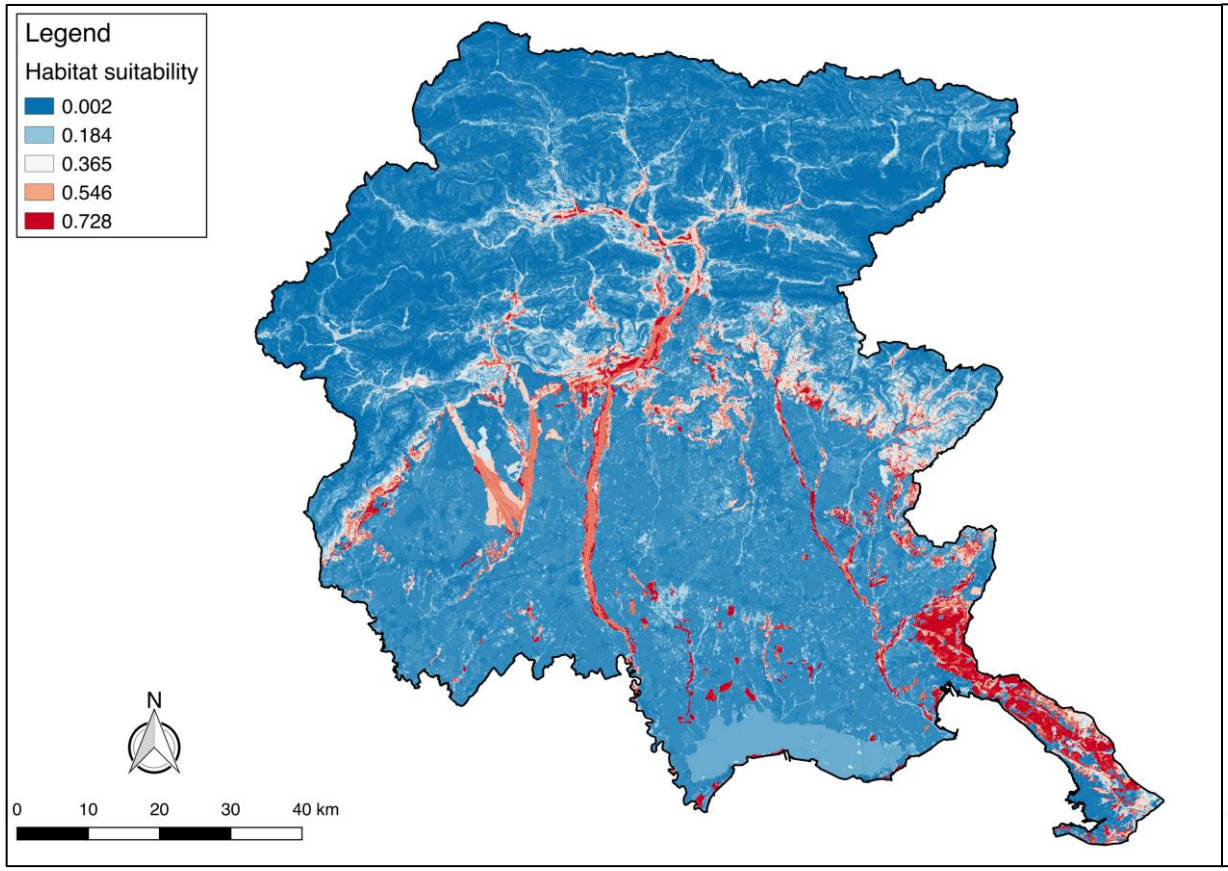
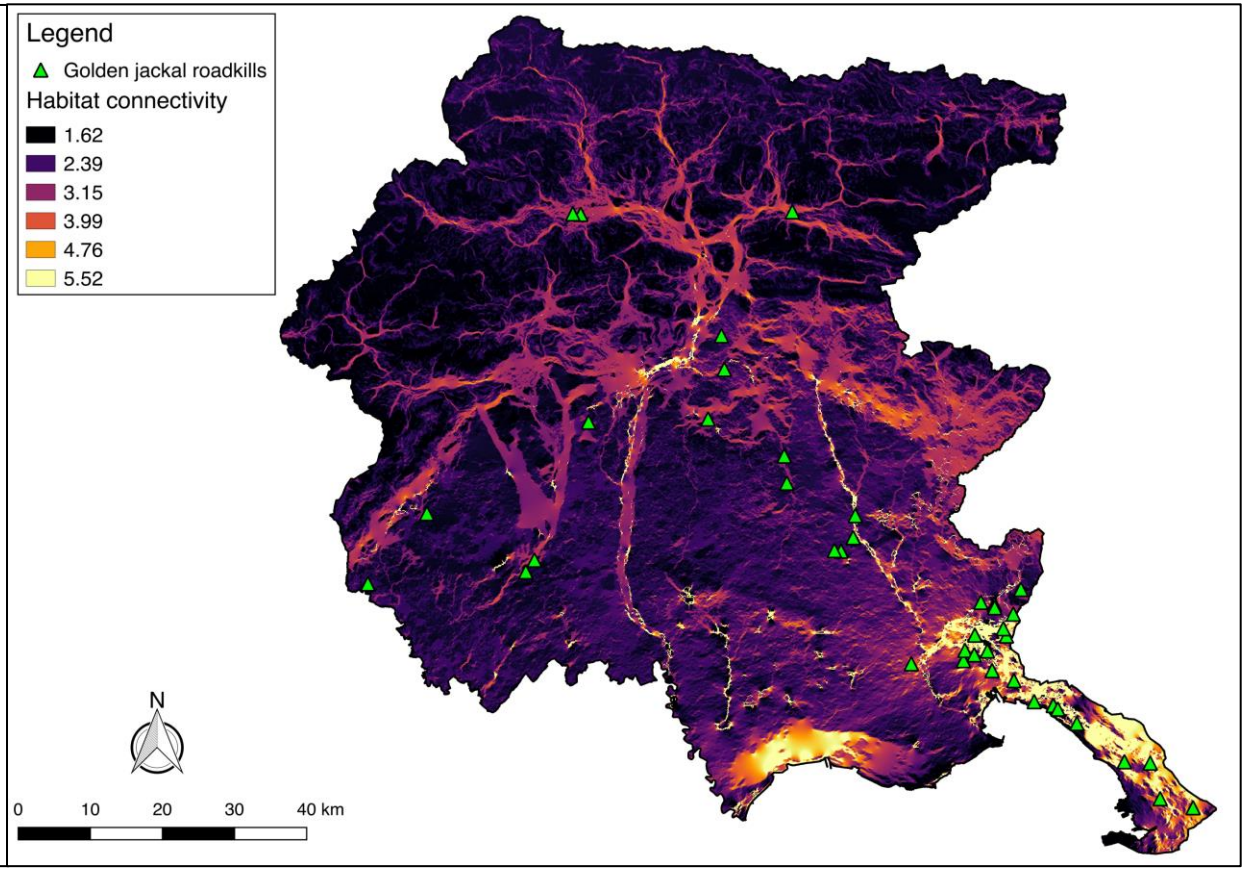
Data were analysed in R using both Bayesian generalized linear models (BGLMs) and generalized linear models (GLMs) with residual's showing a binomial distribution.

Topography	Vegetation	Guardrail	Culvert	Dist_cross	Dist_settl	Distance	Road_type	Origin
0	1	1	0	101.05	63.93	3132.21	1	1
0	0	0	1	32.94	1526.41	80013.03	4	0
0	0	1	1	580.77	106.17	5057.96	1	0
0	1	0	0	154.37	1713.01	4801.54	4	1
1	1	1	1	167.92	715.44	2088.51	1	1
0	1	0	0	144.04	1241.42	1494.77	2	0
0	1	0	0	289.67	923.10	703.69	2	0
0	1	1	1	101.02	63.93	3132.21	1	0
1	1	1	1	155.54	2336.05	80868.27	2	1

To compare the difference in terms of number of road-killed individuals between sexes, age classes and seasonal periods (autumn–winter vs. spring–summer) the Two-Tailed One-Proportion Z-Test was applied.

Overall, we obtained 479 golden jackal responses and after applying spatial filtering, we kept a final dataset of 159 golden jackal locations.





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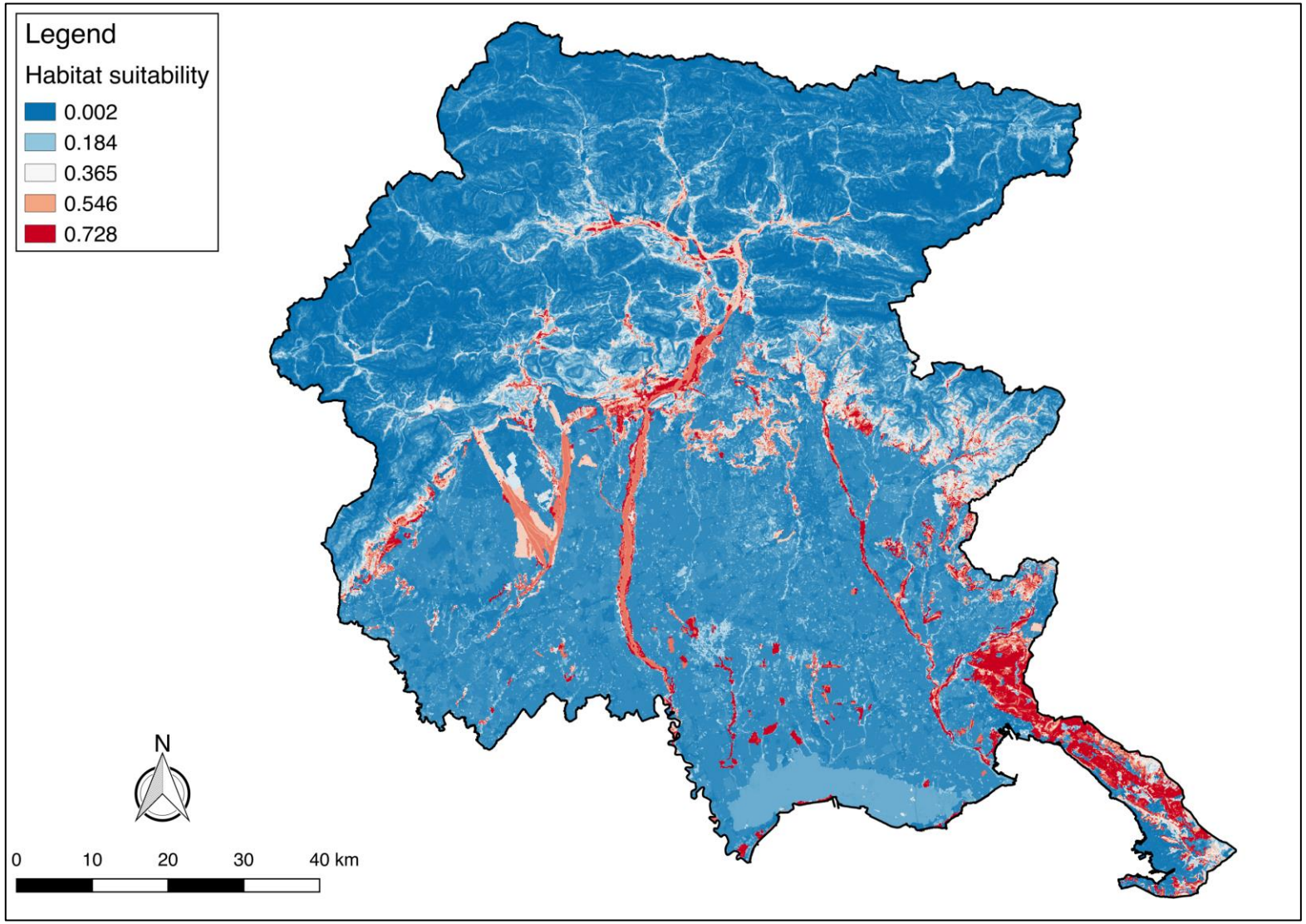
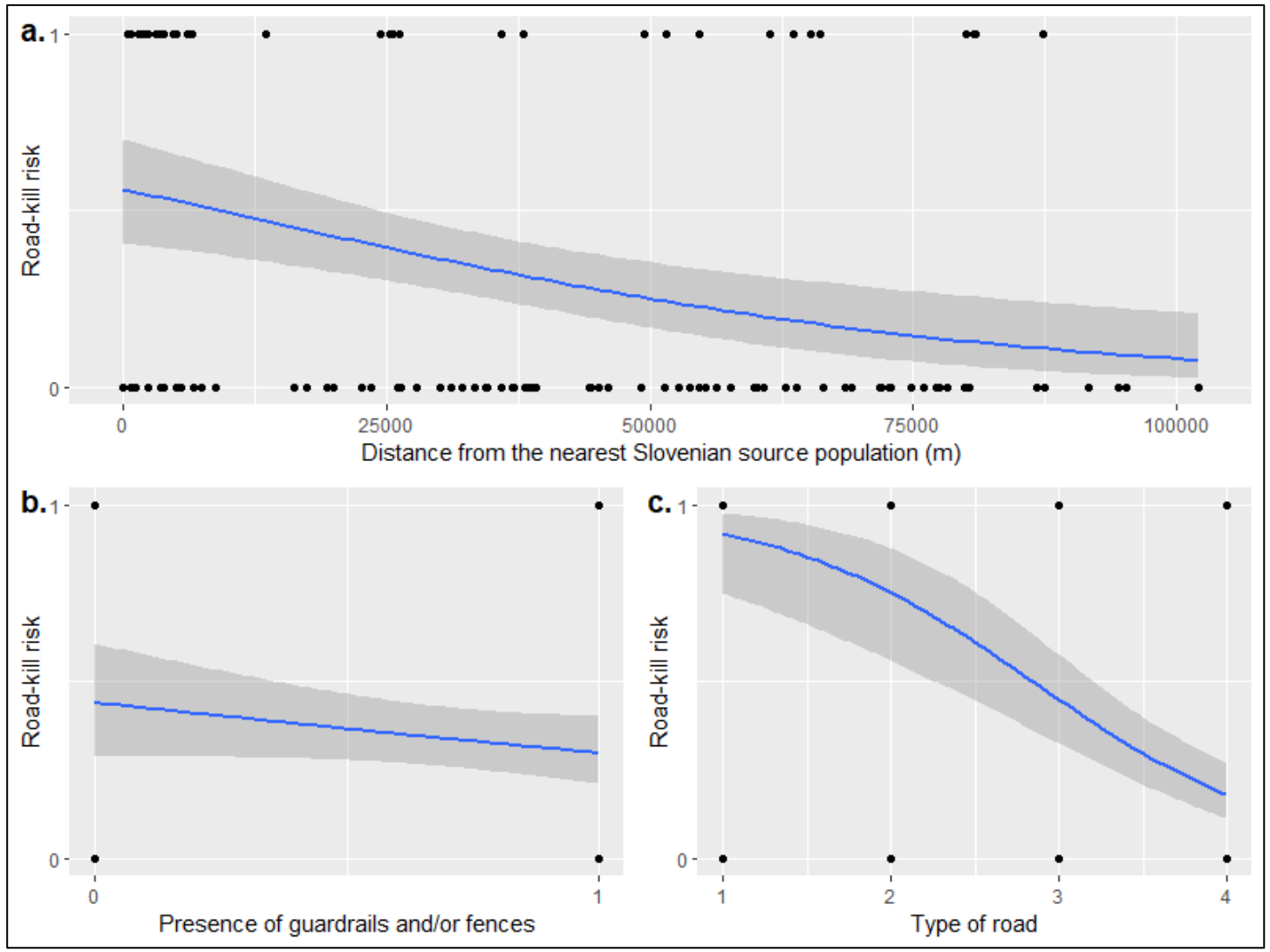


Land use/cover, elevation and slope were the environmental variables mostly affecting the habitat suitability model.

The quality of the habitat increased in response to increasing forested and open areas. Conversely, pastures and cultivation intermixed with natural habitats played a secondary role.

Suitability decreased in response to increasing slope and elevation.

Frangini *et al*. (2022)



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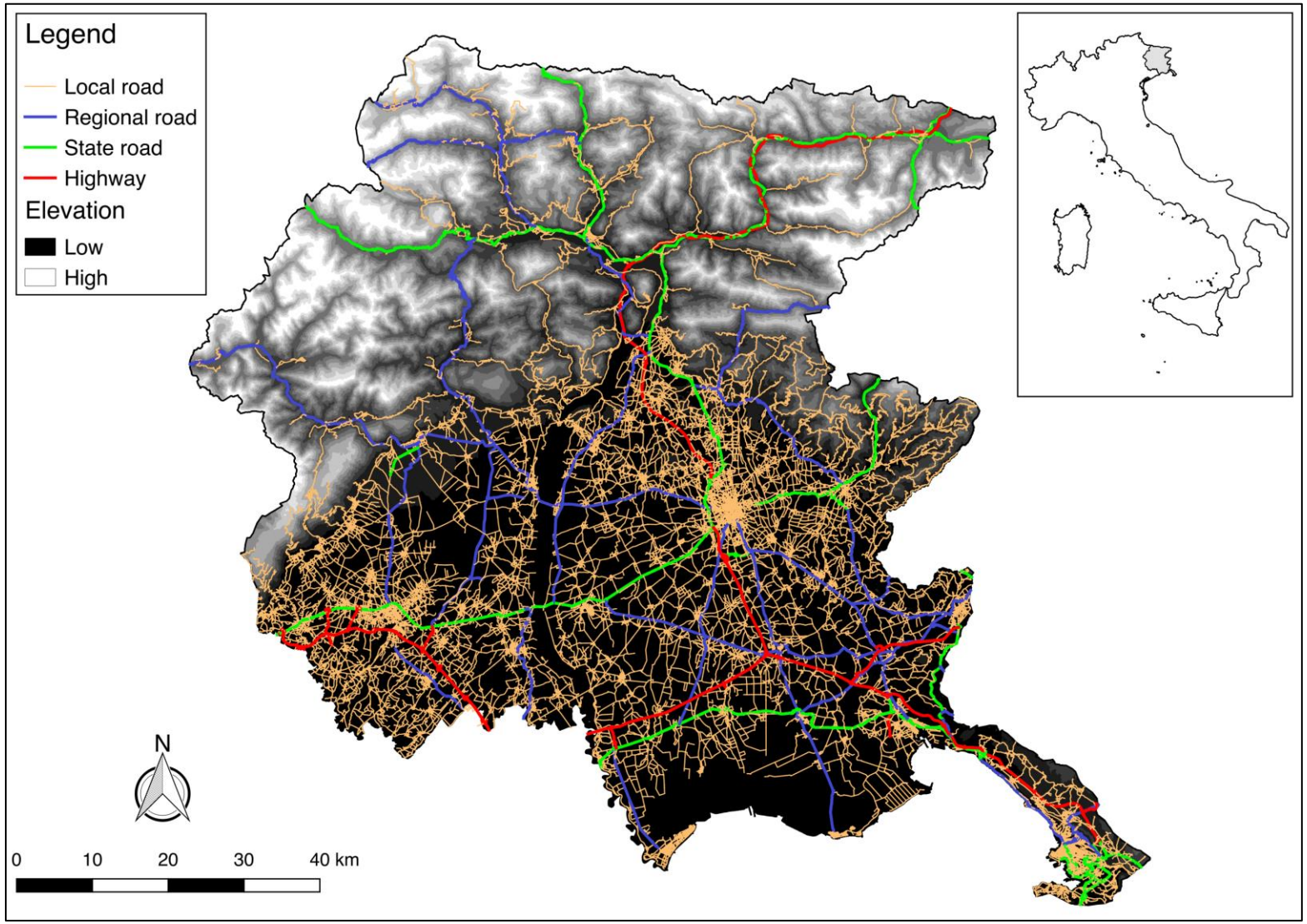
As for the micro-scale variables, the results obtained revealed that the risk for jackals of being road-killed significantly decreases in response to the distance from the nearest Slovenian source population (BGLM, $p = 0.04$), presence of guardrails and/or fences (BGLM, $p = 0.01$), and the type of road (BGLM, $p < 0.001$).

Type of roads:

(1) Highways; (2) State road; (3) Regional road; (4) Local road



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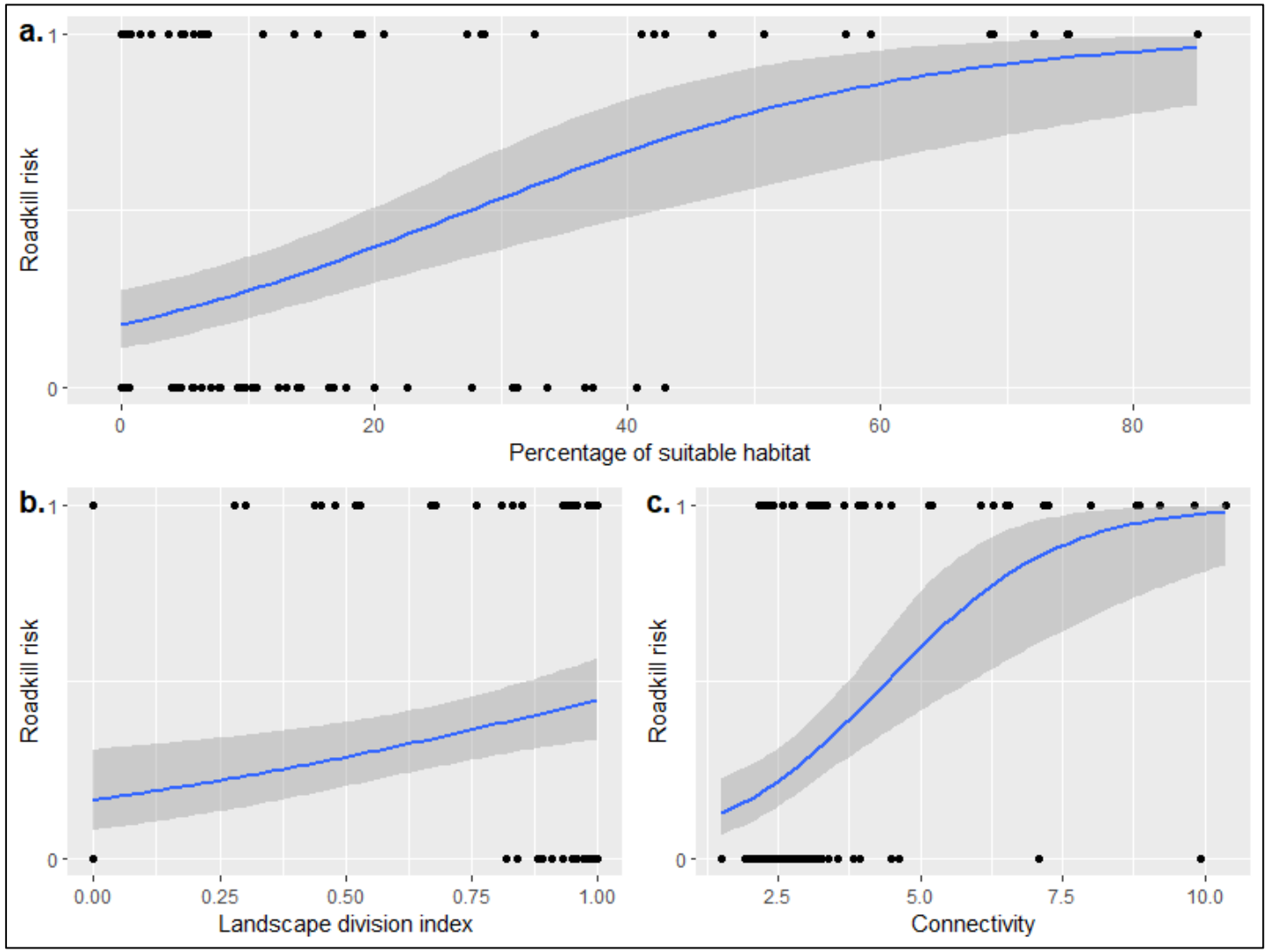

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As for the macro-scale variables, the results obtained revealed that the risk for jackals of being road-killed significantly increases in response to the percentage of suitable habitats (GLM, $p = 0.02$), habitat fragmentation (GLM, $p = 0.006$), and the habitat connectivity (GLM, $p = 0.03$).

No significant difference in terms of road-killing risk was instead found comparing sexes ($\chi^2 = 0.28$, $p = 0.59$), age classes ($\chi^2 = 1.09$, $p = 0.30$) and seasonal periods ($\chi^2 = 2.56$, $p = 0.10$).

(*i*) Habitat suitability and connectivity (i.e., higher mortality risk near less favourable areas and higher landscape connectivity).

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We do believe that, where possible, the realization of wildlife underpass or overpass, as well as the proper maintenance of road fences, may sensibly reduce the risk of vehicle collisions.

Since these actions are not always economically feasible, acoustic warnings and/or light deterrents may represent additional mitigation strategies.

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