# Are road verges corridors, biodiversity refuges or ecological traps?

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LIFE LINES
Linear Infrastructure Networks with Ecological Solutions

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UNIVERSITY OF ÉVORA

# Presentation outline

1. Introduction
2. Case study 1 - Verges as corridors
3. Case study 2 - Verges as refuges
4. Case study 3 - Verges as feeding areas
5. Case study 4 - Verges as ecological traps
6. Take home messages


National Capital 675,000 in 2003)
over 300,000
over 200,000
over 100,000
over 50,000
other main city
other city
Chief town of district
Portuguese districts have the name of their chiefs towns.
Madeira and Azores are Autonomous regions.
PORTUGAL
Porto
Vila Nova de Gaia
Coimbra
Leiria
Santarém
Armadora
LISBOA (Lisbon)
Setúbal
Évora
Castelo Branco
Viseu
Vila Real
Braga
Viana do Castelo
Faro
SPAIN
ATLANTIC OCEAN
AZORES
MADEIRA
ezilon.com
PORTUGAL
0 km 20 40 60 km
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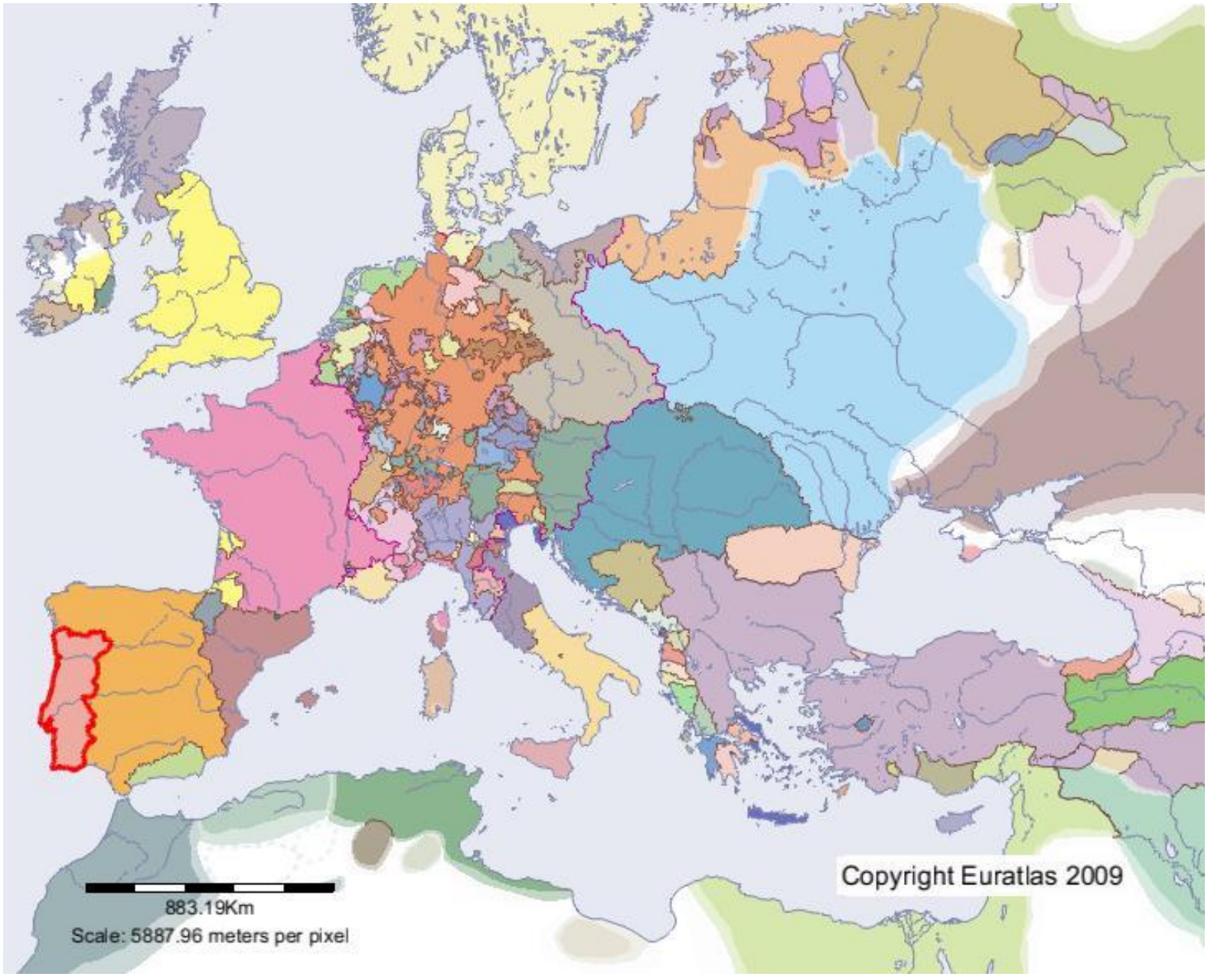
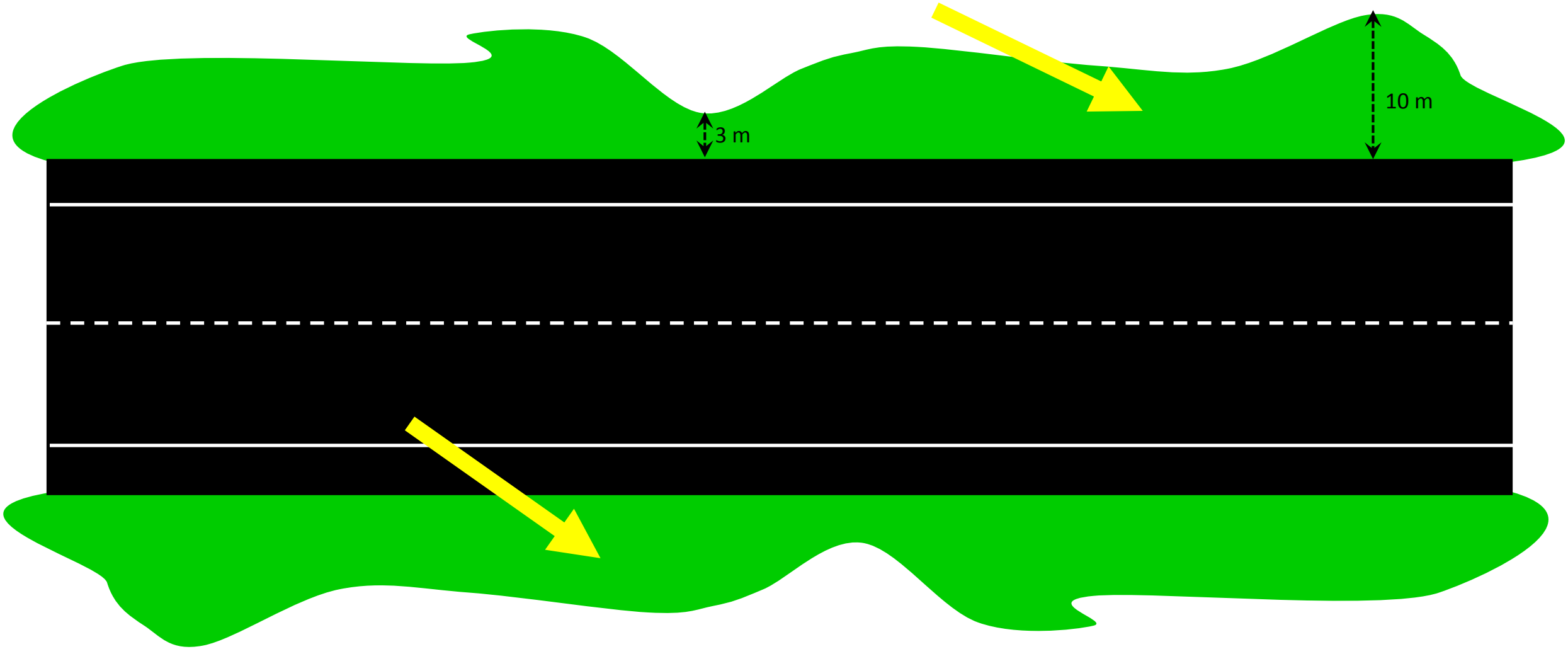

883.19Km
Scale: 5887.96 meters per pixel
Copyright Euratlas 2009

# The Portuguese “Montado” (a highly biodiveristy rich agroforestry system)

# ROAD VERGES

The thin strips of vegetation surrounding road carriageway



# ROAD VERGES (Alentejo– Portugal)

# Road Verges in Portugal

- 277 000 km of extension
- 250 000 ha of surface area (the double of the larger protected area in Portugal)

**The idea of using them for biodiversity conservation purposes offsetting road negative impacts is appealing but…**

# Case study 1:
# Road verges as corridors

Galantinho *et al* (submitted). Road verges provide connectivity for small mammals: a case study with wood mice (*Apodemus sylvaticus*) in an agro-silvo pastoral system *Journal Environmental Management*.

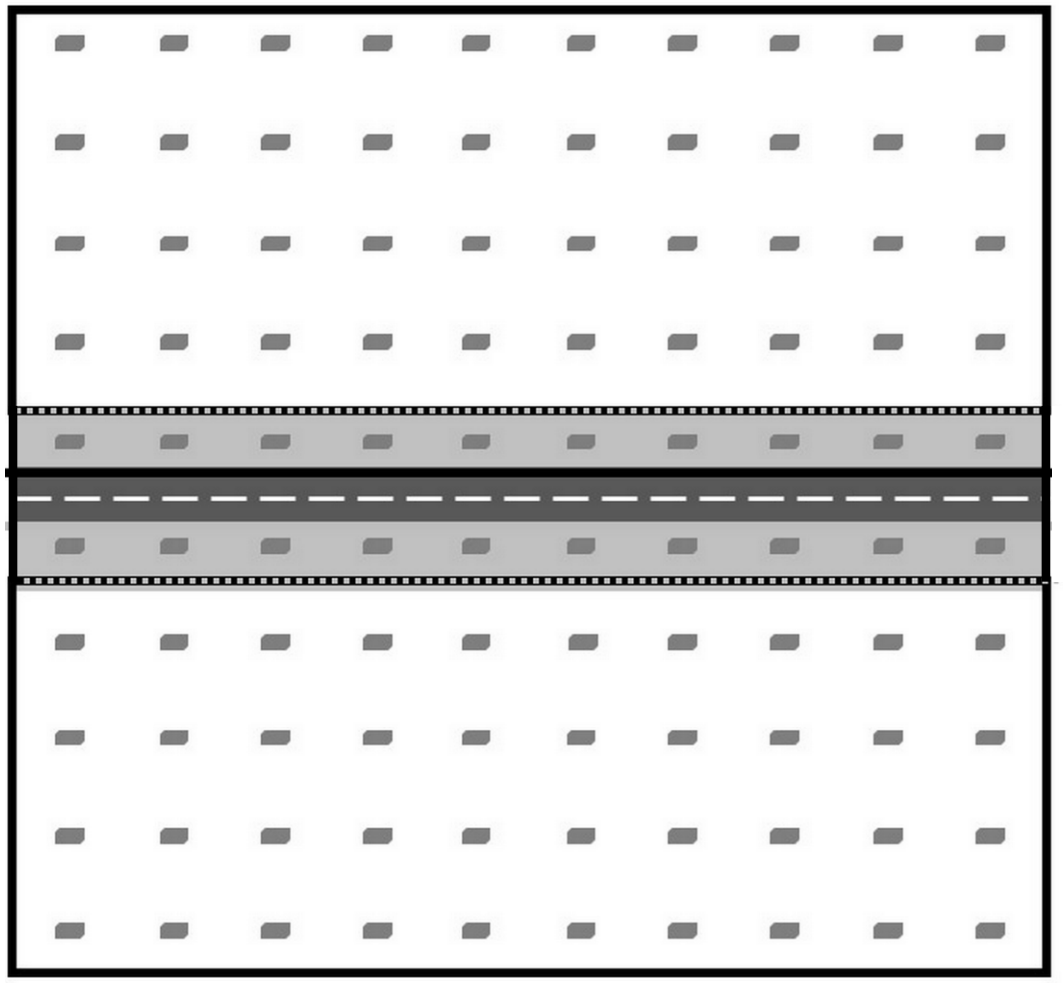
# Two year capture-recapture study of Wood Mouse (*Apodemus sylvaticus*) on road dominated environment

**MAIN GOAL**

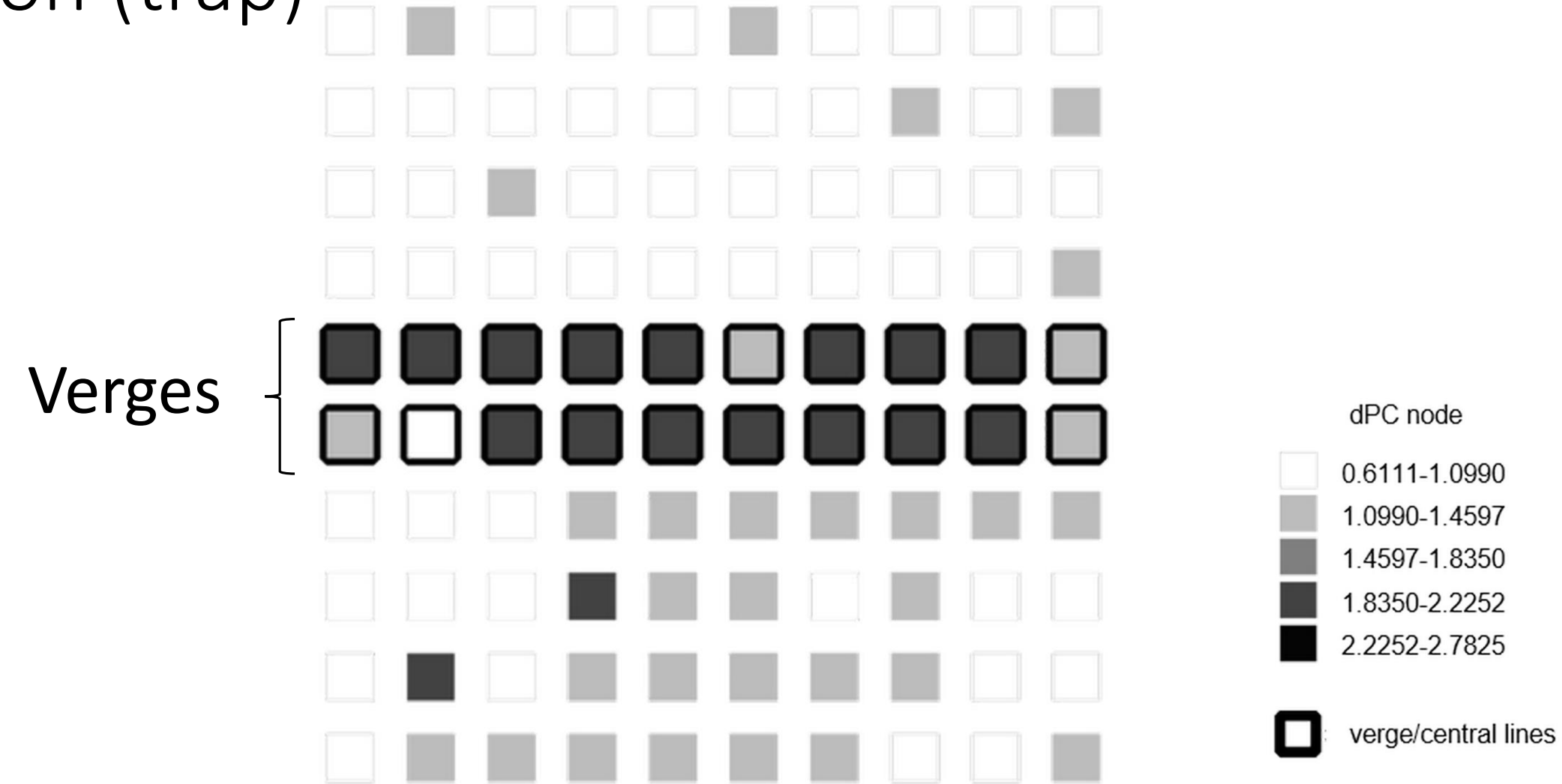
Quantify and compare with surrounding areas (Mediterranean forest), the importance of verges for wood mouse movement (connectivity)

# Study design and methods

- 100 traps displaced on a 10x10 grid
- Two central lines are the road verges
- Traps equally spaced (12 m)
- Every for week sampling sessions during 4 consecutive nights each
- Each trap contribution for Wood Mouse movement was evaluated with the probability of connectivity index (Saura and Pascual-Hortal, 2007)



# Probability of movement (connectivity) at each location (trap)



# Main conclusion

Overall probability of movement on road verges is about twice than the one observed on surrounding areas. This suggests that verges are important connectivity providers for small mammals and may play a major role as ecological corridors.

# Case Study 2
# Road verges as refuges

Ecol Res (2011) 26: 277–287
DOI 10.1007/s11284-010-0781-4

ORIGINAL ARTICLE

Helena Sabino-Marques · António Mira

**Living on the verge: are roads a more suitable refuge for small mammals than streams in Mediterranean pastureland?**

# MAIN GOAL

Quantity the importance of road verges for small mammals comparing with importance of riparian areas, the latter being one of the best habitats for this group in Mediterranean regions.

# METHODS

- Study conducted on a heavily grazed landscape
- Four study sites: two road segments and two riparian vegetation areas
- Capture-recapture with Sherman medium size traps with 90 traps per site.

# Study design

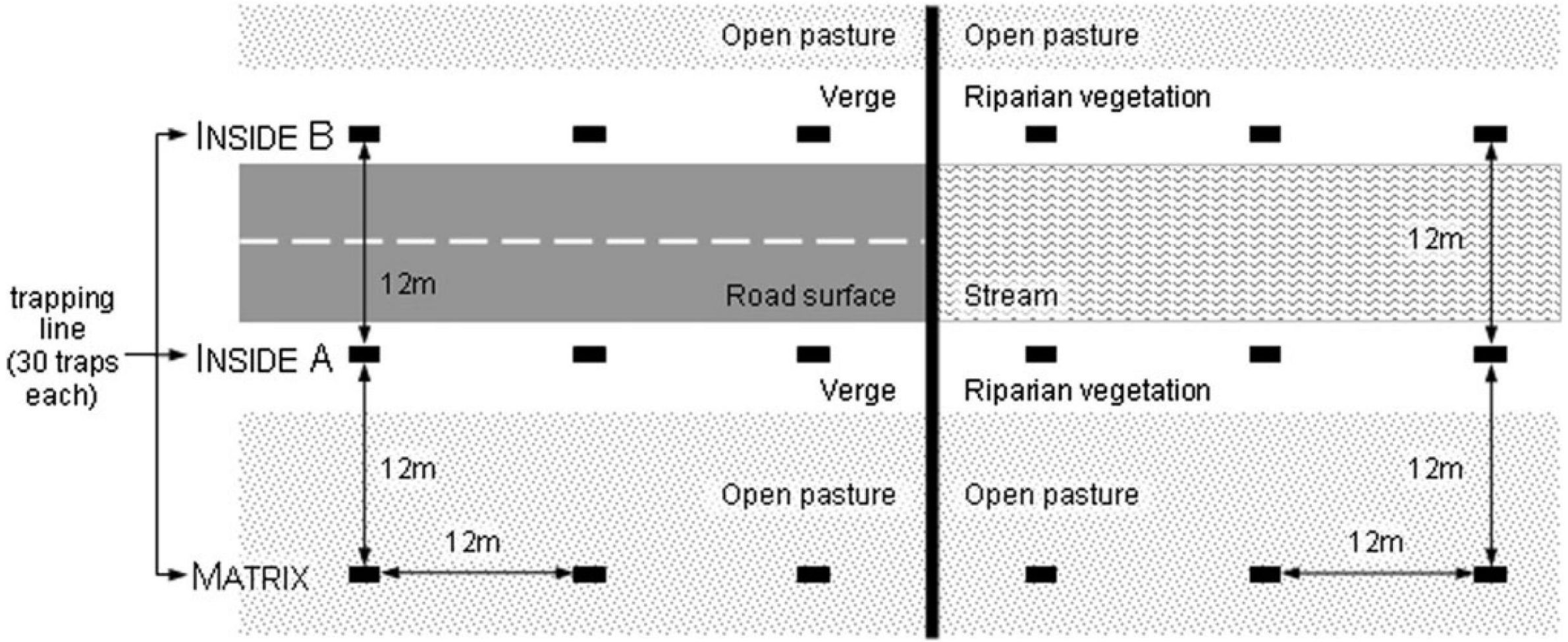
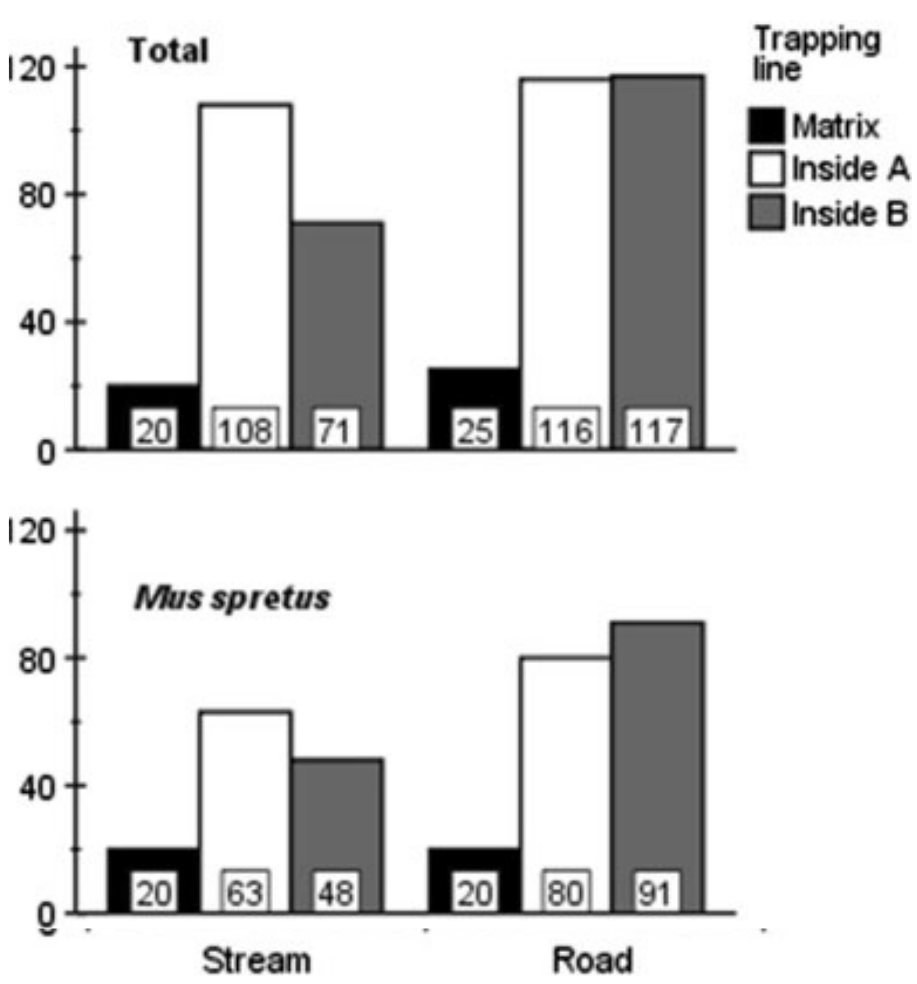
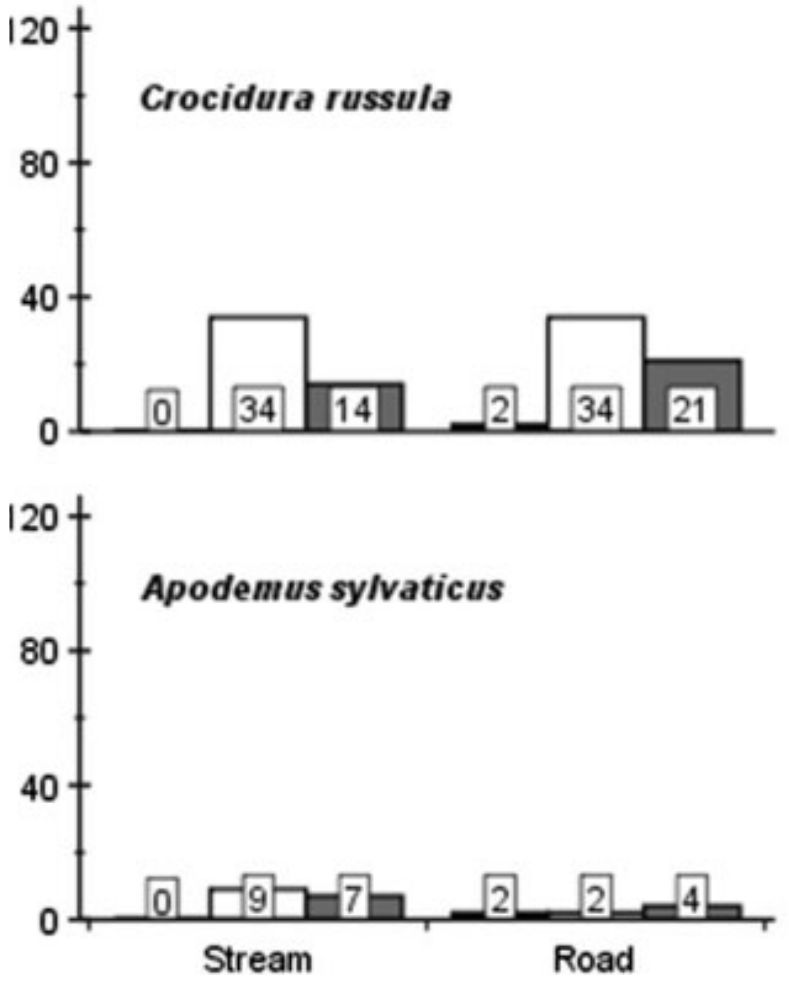



**Fig. 1** Schematic of Sherman live-trap positions along linear habitats at the road and stream sites

# Number of small mammal captures per system type



# Main conclusion

1. On roads crossing highly unhostile habitats verges can be an important refuge for small mammals
2. In highly grazed Mediterranean areas, the role of verges is comparable with the role of riparian galleries, one of the most important habitats for these group of mammals

# Case Study 3
# Road verges as (presumably) feeding areas

Science of the Total Environment 660 (2019) 340–347

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv


## Road effects on bat activity depend on surrounding habitat type

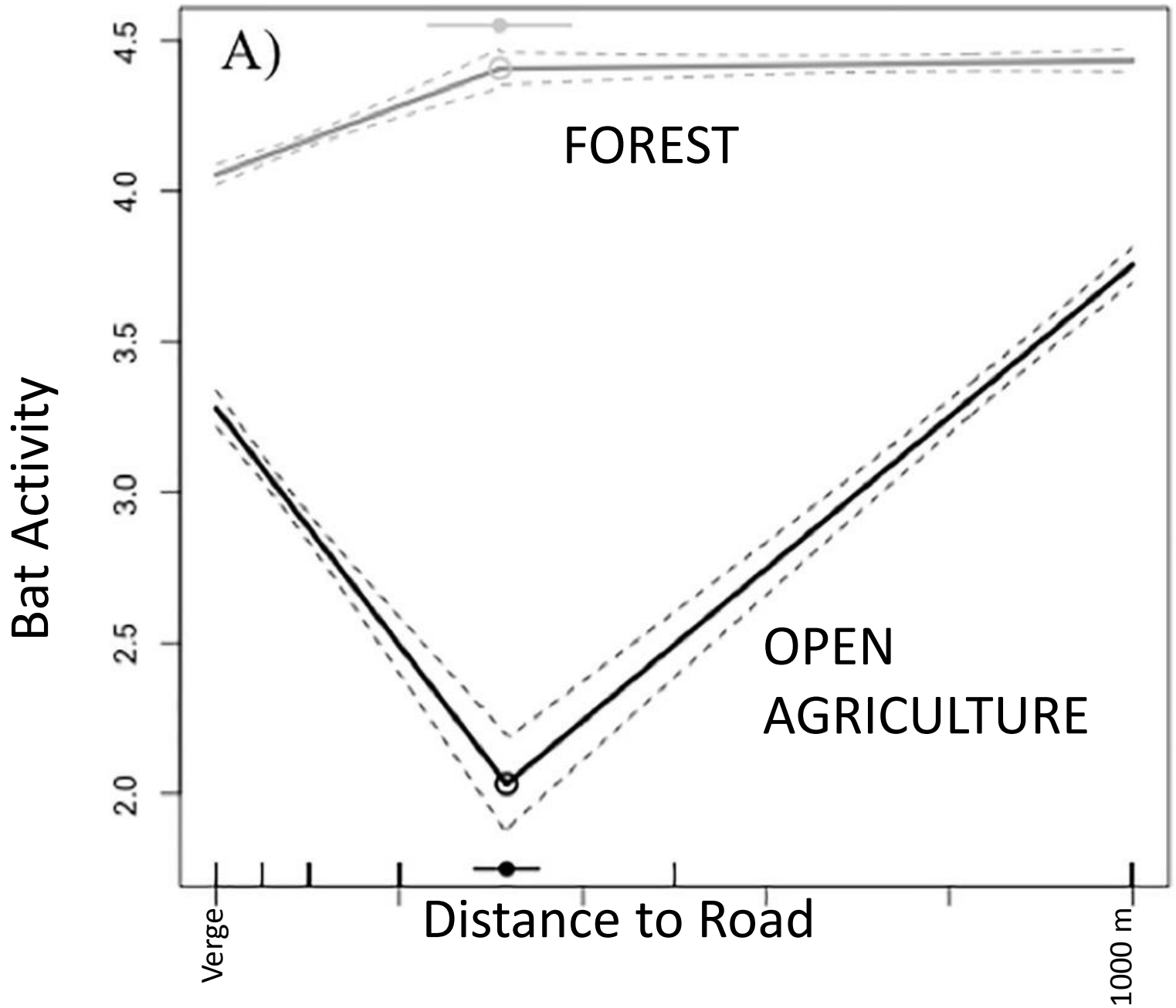
Denis Medinas [a,b,*], Vera Ribeiro [a,b], João Tiago Marques [a,b], Bruno Silva [b], Ana Márcia Barbosa [b], Hugo Rebelo [c,d,e], António Mira [a,b]

# MAIN GOALS

- Evaluate the effects of distance do road on bat activity, comparing two landscape types: Mediterranean forest (Montado) and open agricultural areas.

# METHODS

- Bats sampled with ultrasound acoustic surveys on sampling points from the verge until 1000m away from road.
- Relationship between bat activity and distance to road on each landscape type was evaluated using general linear mixed models (GLMM).
- In this talk only results for all bat species considered together are presented.


A)
FOREST
OPEN
AGRICULTURE
Bat Activity
4.5
4.0
3.5
3.0
2.5
2.0
Distance to Road
Verge
1000 m

# Main conclusions

1. On well preserved forest areas, bat actvity (presumably for feeding) on verges is reduced when comparing with areas away from the roads, probably due to road disturbance
2. However, verges can be a valuable habitat for bats when roads cross simplified agricultural landscapes

# Case Study 4
# Road verges as traps

Journal of Environmental Management 247 (2019) 644–650

Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman


Research article

## Factors influencing predator roadkills: The availability of prey in road verges

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[b] Unidade de Biologia da Conservação, Departamento de Biologia, Universidade de Évora, Pólo da Mitra, 7002-554, Évora, Portugal

# MAIN GOALS

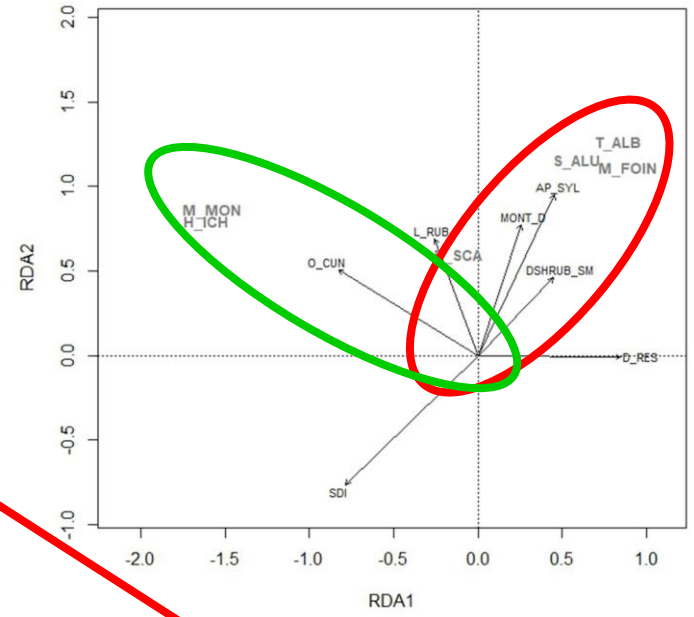
- Quantify the influence of prey (small mammals) availability on road verges on predator (snakes, owls and mammal carnivores) roadkills.
- Compare the relative importance of prey on verges with other important variable sets known to influence roadkills (landscape features and verge characteristics)

# METHODS

- Along one year predator roadkills were monitored daily by an experienced observer
- Aboveground small mammals abundance was evaluated with live-trapping
- Abundance of burrowing small mammals and rabbits were based on presence signs (mole hills and droppings).
- Association between predator roadkills on 500 m road segments and small mammal abundance, landscape features and verge characteristics was evaluated with multivariate Redundancy Analysis.

# Predator roadkills – prey species relationships










# Relative importance of prey abundance in explaining predator roadkills

| Species | PREY | LAND | VERG | Total |
|---|---|---|---|---|
| Egyptian mongoose | 27.8 | 23.2 | 26.7 | 65.2 |
| Stone marten | 8.2 | 37.6 | 16.3 | 44.0 |
| Tawny owl | 12.3 | 27.5 | 14.0 | 31.1 |
| Barn owl | 33.1 | 24.1 | 2.4 | 49.3 |
| Montpellier snake | 19.7 | 49.8 | 2.9 | 63.9 |
| Ladder snake | 11.0 | 0.5 | 0.4 | 11.7 |

Proportion of variation of each predator kills explained by each main variable set. PREY – Prey abundance; LAND – Landscape features; VERG – Verge characteristics.

# Main conclusion

Abundance of prey (small mammals) on verges is an important driver of predator roadkills, including snakes, owls and mammal carnivores.

# TAKE HOME MESSAGES

- Verges provide connectivity for small fauna and thus may act as ecological corridors promoting the movement of some species.
- Road verges can be an important refuge for small fauna, providing shelter and feeding areas.
- However, the importance the role of verges as refuge or corridors is dependent on the surrounding landscape.
- These roles are particularly valuable when roads cross simplified agricultural areas, but seem to be minor on forest areas.
- Abundance of prey on road verges may attract predators to road surroundings increasing their roadkill risk. In this case they act as an ecological trap.

# SHOULD WE BET ON ROAD VERGES FOR BIODIVERSITY CONSERVATION?

They have the potential but…

- No concrete answer yet
- Depends on the species/groups and the landscape context.
- Further studies are needed in order to decide properly about this important question.
- For now, a specific analysis for each concrete case is needed before a decision is taken.

Registration and abstract submission are now open!!!

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