Prioritizing road sections for wildlife fencing based on road mortality hotspots and coldspots

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INTRODUCTION

Roads have many negative effects on wildlife:
- habitat loss
- reduced habitat connectivity and animal movement
- increased air and water pollution and noise
- **increased wildlife mortality by vehicle collisions (roadkill)**

In order to reduce roadkill, mitigation should include wildlife fencing (Rytwinski et al. 2016).

We used roadkill data from 3 roads:
1 from Quebec (HWY175) and
2 from Brazil (BR-101 and ERS-386)
to answer the following research questions:

Research Questions:

1. Are there thresholds in the effect of fence length on the expected reduction in road mortality?
2. How can sections of roads be effectively prioritized for wildlife fencing?
3. How should different scales be considered?

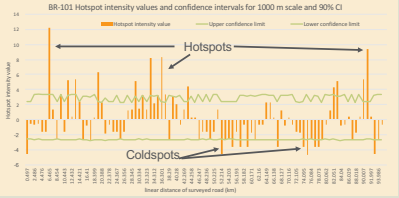
METHODS

Road BR-101 is a major road connecting Rio Grande do Sul state to other states in Brazil:
- 2 lanes (at the time, now 4)
- 100 km survey length
- January 2003 - January 2004
- medium-sized mammals (from guinea pig to neotropical otter)

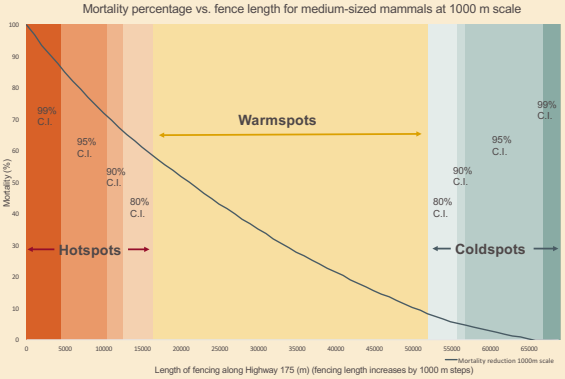
RSC-453/ERS- 486 (Rota do Sol) is located in Rio Grande do Sul State, Southern Brazil:
- 2 lanes
- 66 km survey length
- July 2009 – June 2010
- medium-sized mammals and reptiles

Highway 175 is in Quebec:
- 4 lanes
- 68 km survey length
- 4 summers: June - September 2012-2015
- medium-sized mammals (from weasel and mink species to Canadian lynx)

- Analysis was done using *Siriema V2.0*
- Scales of analysis used were: 100 m, 200 m, 400 m, 1000 m (diameter)
- Confidence intervals (C.I.) used were: 80%, 90%, 95%, 99%
- Hotspots (above the upper confidence limit), warmspots, and coldspots (below the lower confidence limit) were identified



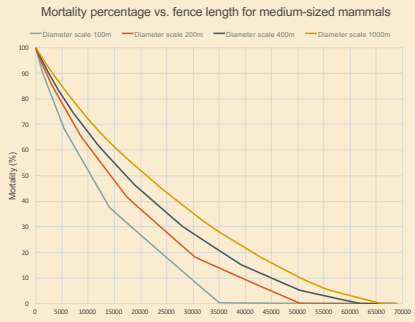
RESULTS



Prioritize sections of road

This graph shows how road mortality can be reduced with a given fence length (at the 1000 m scale). Changing the confidence interval (C.I.) affects the amount of hotspots/coldspots detected:
- Fewer hotspots and coldspots at 99% C.I. compared to 80% C.I.
- Using different C.I.s allows for prioritization of road sections for fencing

The graphs for the other two roads provide similar results.



Consider the scale - FLOMS

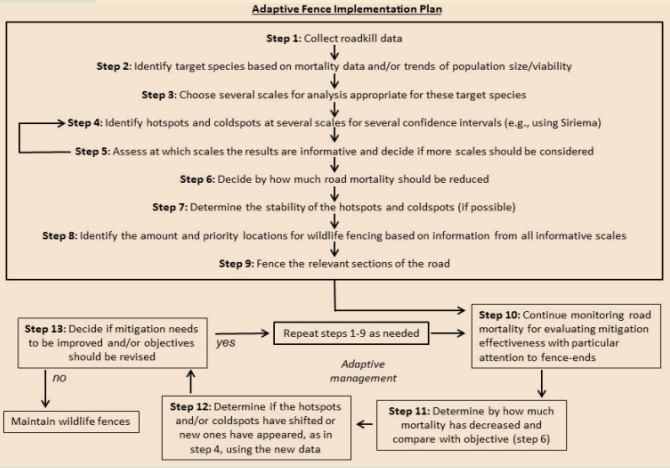
- FLOMS = **F**ew-**L**ong-**O**r-**M**any-**S**hort (fences)
- The FLOMS trade-off: Is it better to have a few long fences or many short ones?

- Analysing hotspots at smaller scales (100 m) compared to larger scales (1000 m) can change results
- At smaller scales, a shorter amount of fencing appears to reduce the same amount of mortality than at a larger scale.

DISCUSSION

- The spatial pattern of hot-, warm-, and coldspots of roadkill allows for prioritizing road sections for mitigation:
  - e.g. hotspots should be fenced and, ideally, adjacent warmspots as well.
- Fencing certain sections will be more effective than fencing others:
  - Fencing hotspots will be most effective, while fencing coldspots will be least effective.
- In some cases, however, coldspots may need to be fenced as well
  - e.g. if they are between two hotspots, because animals may move along the fence and cross the road at the end of the fence ("fence-end effect"), and a coldspot can then become a hotspot.
- Fences are barriers to animal movement, therefore wildlife passages should also be installed (Jaeger and Fahrig 2004), possibly at hotspots occurring at the 99% C.I.

Our **Adaptive Fence Implementation Plan** consists of 13 steps to follow in order to prioritize road sections for wildlife fencing.



CONCLUSION

- There are no thresholds in the effect of fence length on reduction in road mortality:
  - There are no abrupt changes between hot-, warm-, and coldspots: the transition is gradual.
    - This is shown by using different scales of analysis and different C.I.s.
- Hotspots have high priority for fencing and coldspots have low priority :
  - Hotspots occurring at 99% C.I. have the highest priority.
  - Coldspots occurring at 99% C.I. have the lowest priority.
- Larger scales of analysis should generally be used for animals with larger home ranges and smaller scales for animals with smaller home ranges (e.g., deer vs. porcupines).
- Hotspots might change over time, especially if a new hotspot emerges at the end of a fence ("fence-end effect").
- The FLOMS trade-off and the fence-end effect should be considered: Longer fences are recommended where feasible.
  - Therefore, the Adaptive Fence Implementation Plan requires adaptive management (steps 10 - 13).

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Sources :
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