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15 years of wolf monitoring plans at wind farm areas in Portugal. What do we know? Where should we go?

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15 years of wolf monitoring plans at wind farm areas in Portugal

what do we know, where should we go?

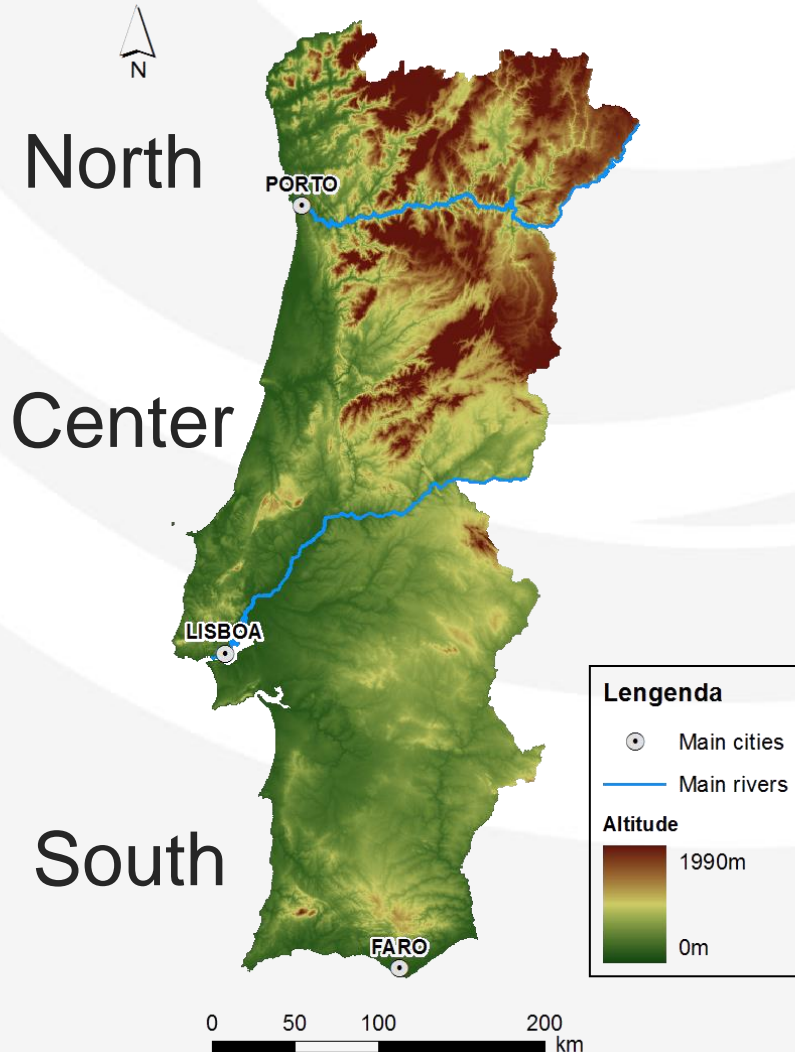
Gonçalo Ferrão da Costa,  Francisco Petrucci-Fonseca  & Francisco Álvares 



6 - 8 SEPTEMBER
ESTORIL, PORTUGAL



Setting the context



Portuguese landscape specificities

Area: 92 212 km²

Human population: 10 320 000 inhabitants

Human density: 114 inhab/km²

14 310 km of road network (0.15km/km²)

Max altitude: 1990m

North and Center more mountainous

Costal areas more populated

Mountainous areas with low forest cover (<20%)

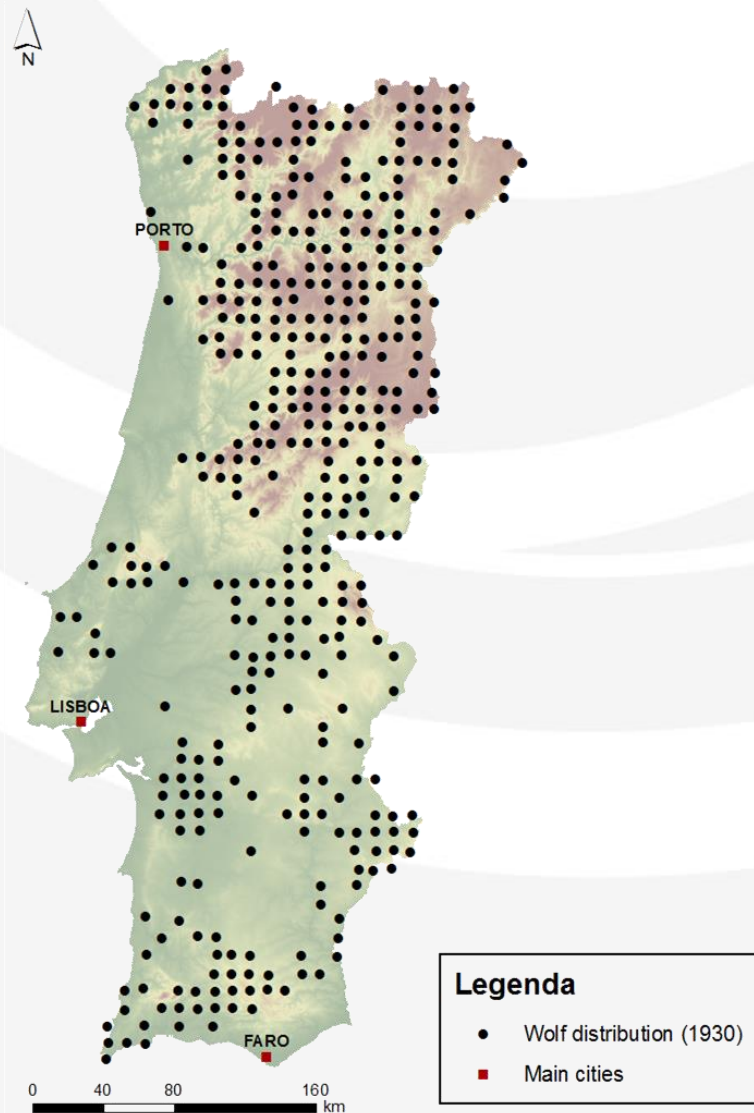


Setting the context



Wolf status in Portugal

1930

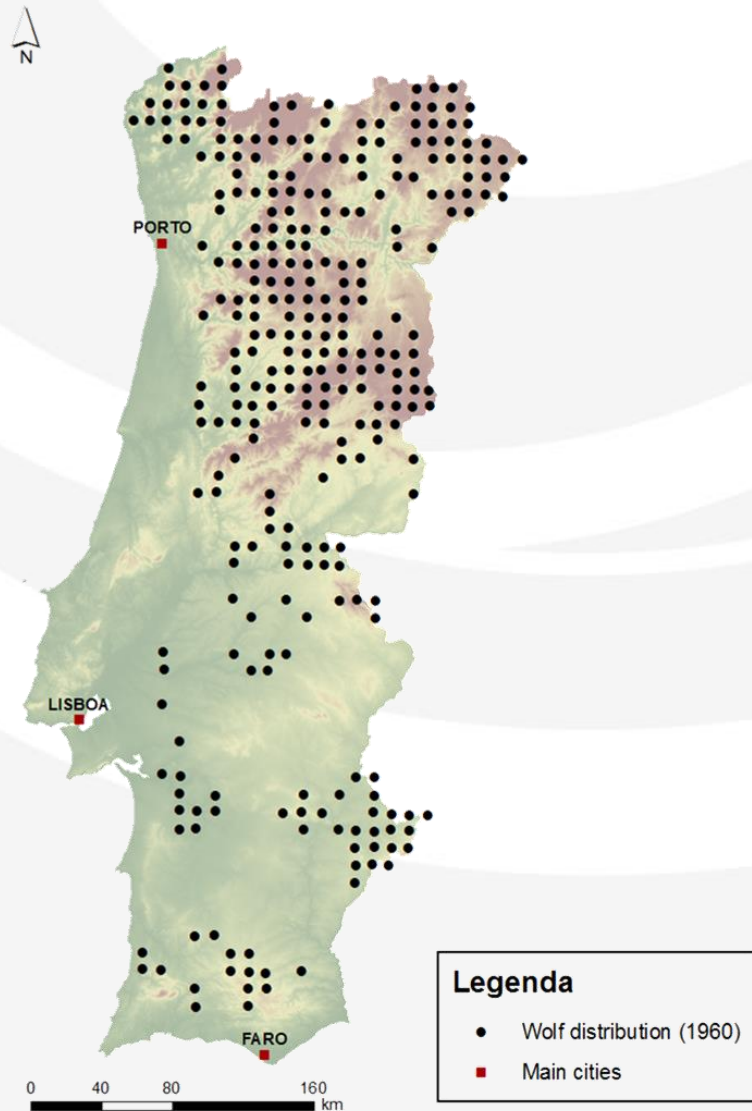


Setting the context



Wolf status in Portugal

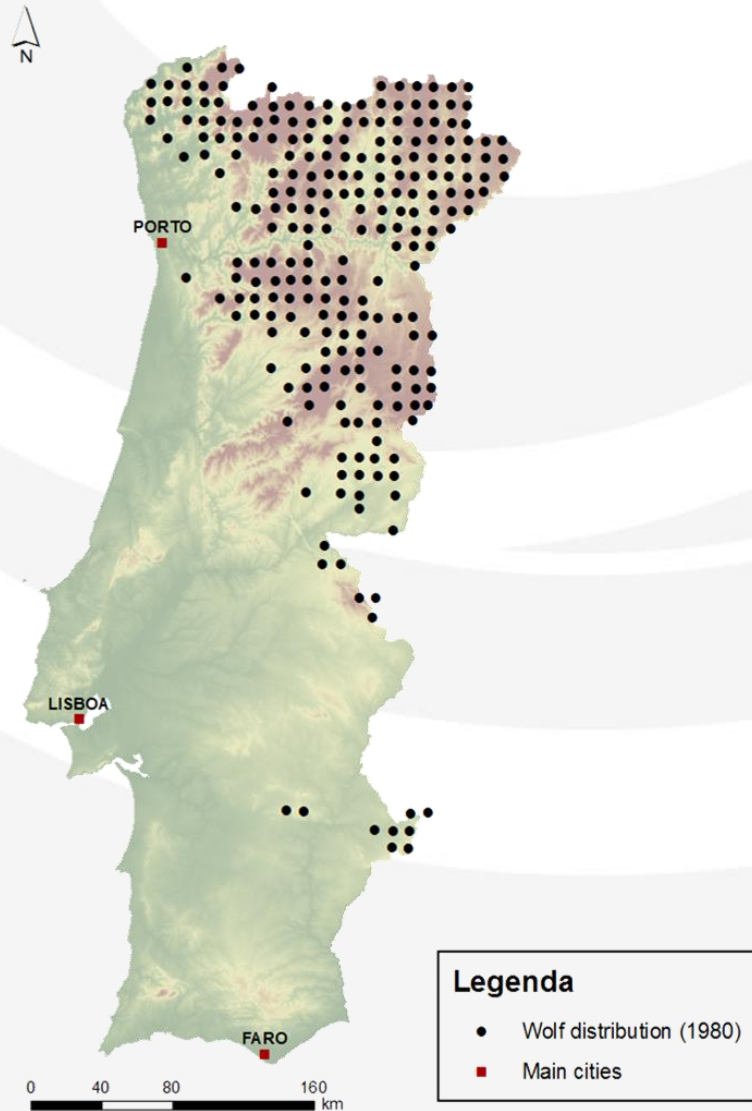
1960



Setting the context



Wolf status in Portugal



1980



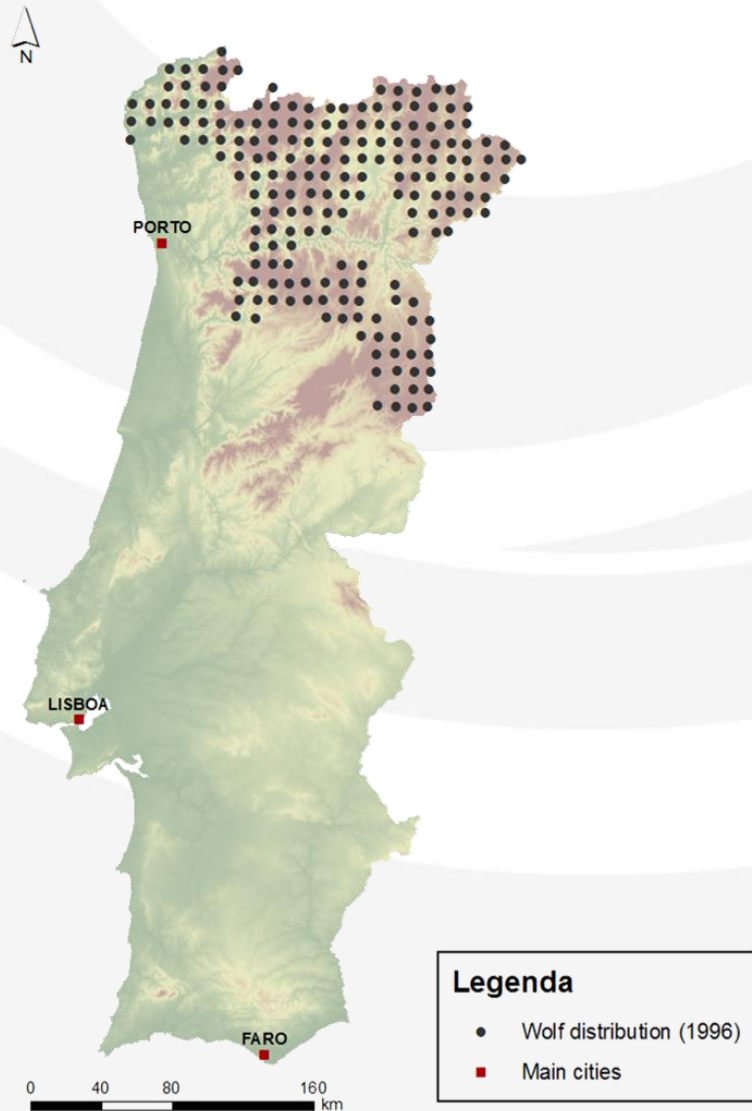
looking deep into nature

Setting the context



Wolf status in Portugal

1996

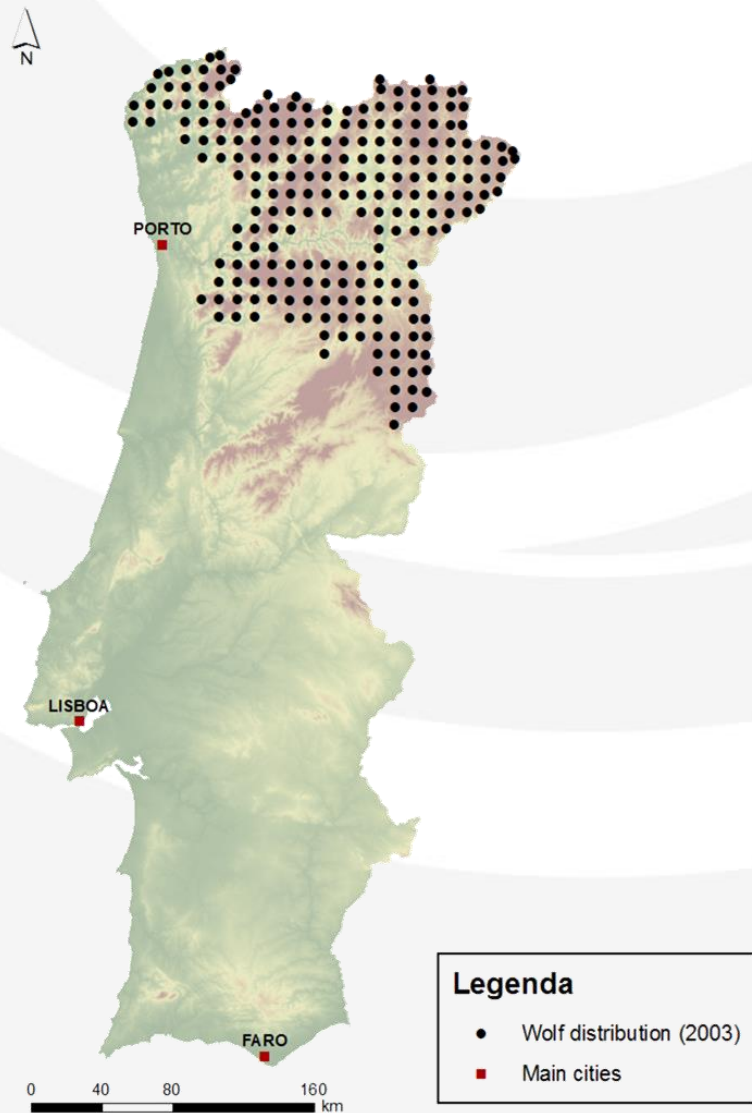


Setting the context



Wolf status in Portugal

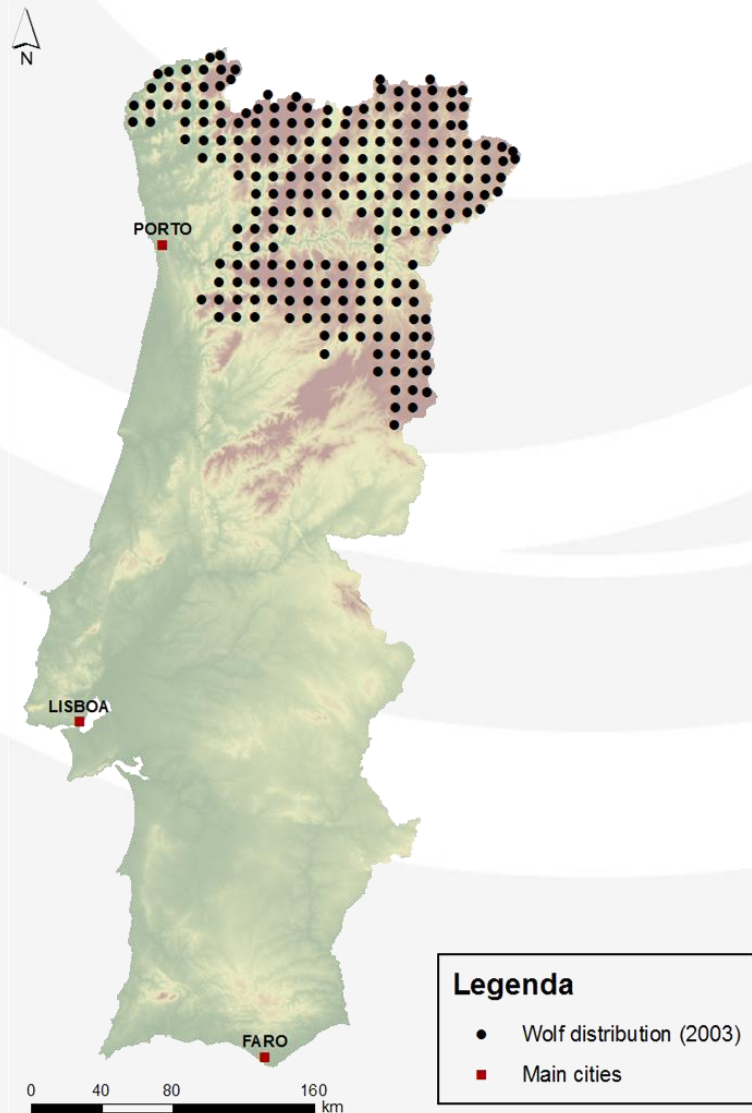
2003



Setting the context



Wolf status in Portugal



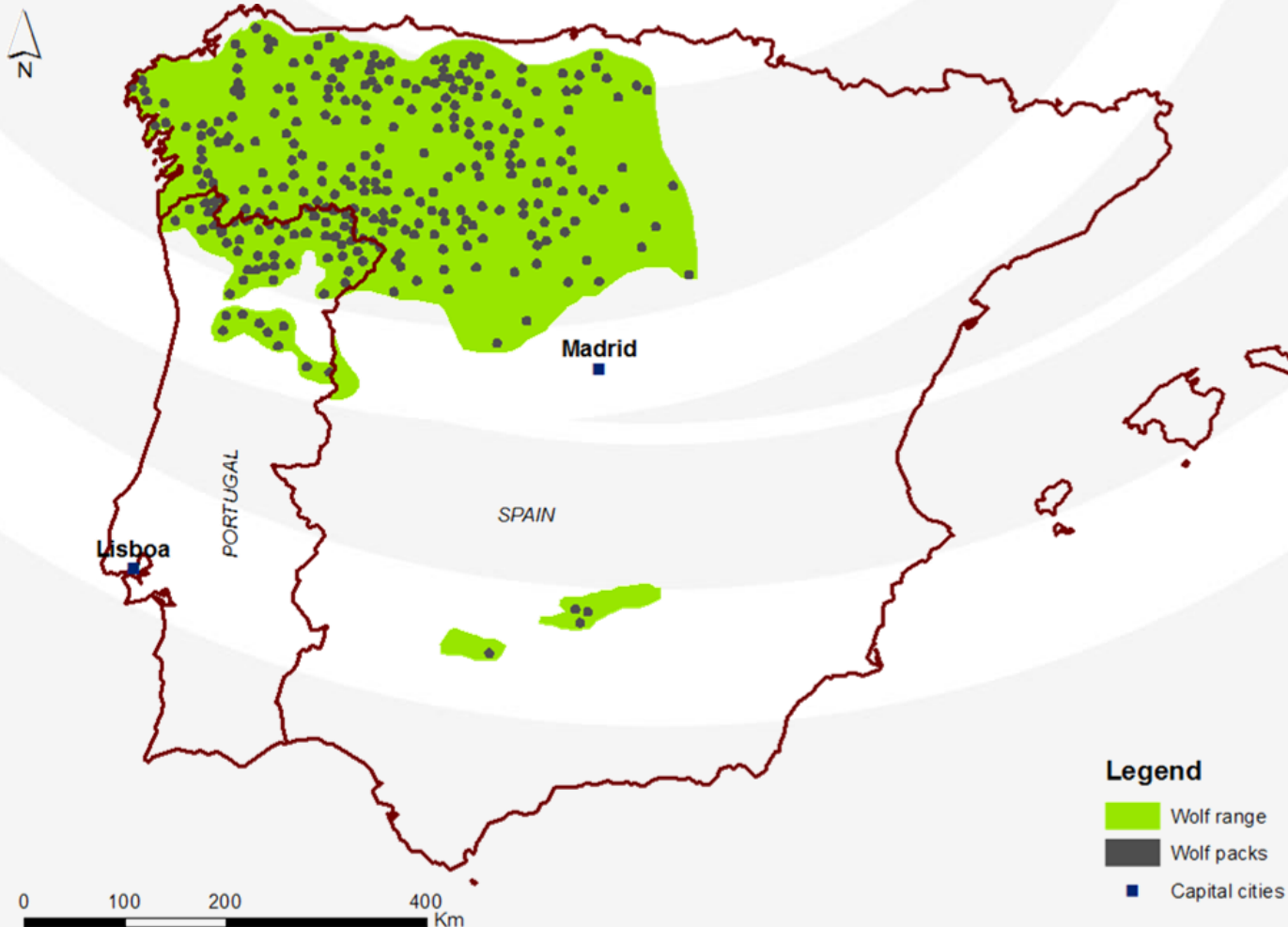
- Endangered species (EN)
- Fully protected
- 200-400 individuals
- ± 60 packs
- Range: 20 000 km²
- Mean Altitude: 670m (max 1520m)
- Human/dens: 40 inhab/km²
- Road/dens: 0.47km/km²



Setting the context



Wolf status in the Iberian Peninsula



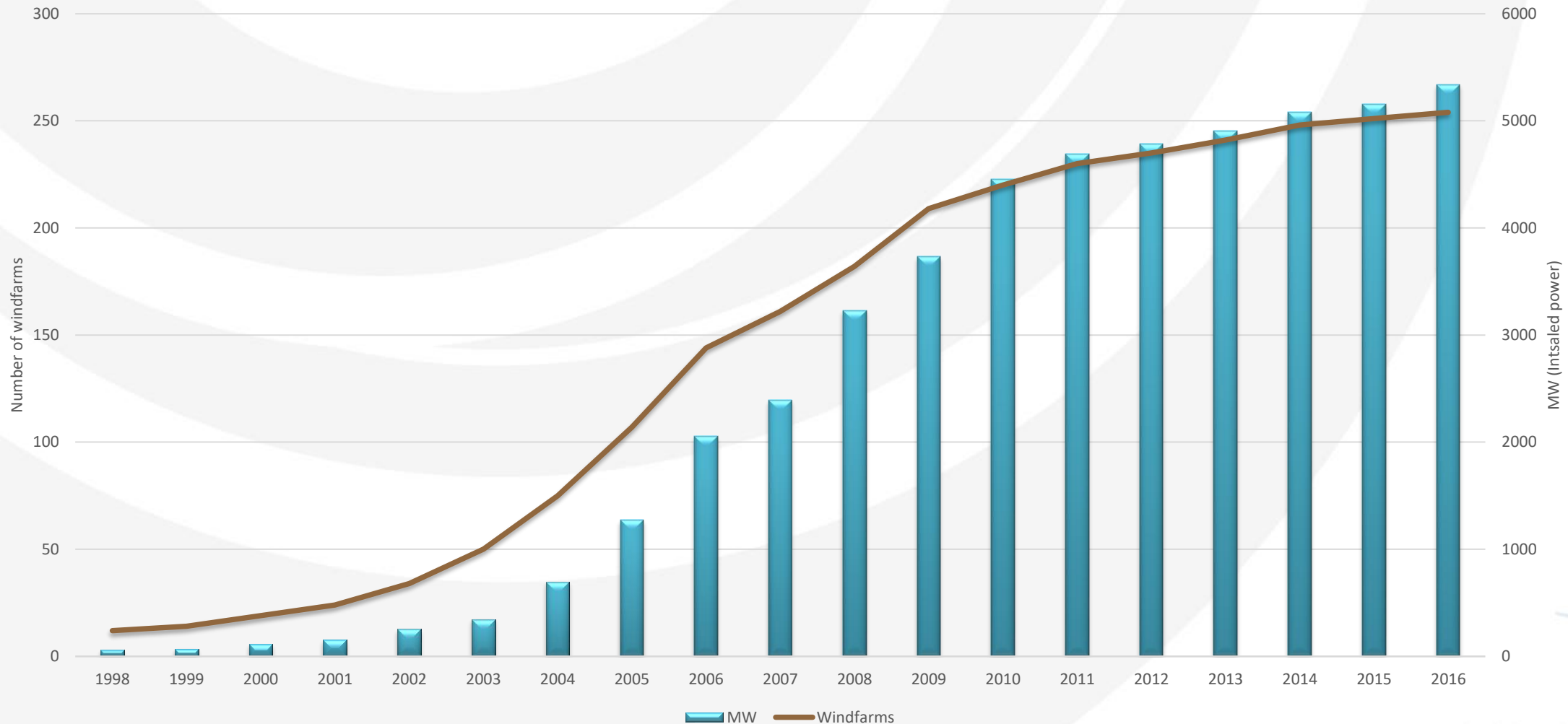
- 2000-2500 wolves
- 8% - 20% of Iberian Wolf Population
- N Douro connected to Spanish population
- S Douro isolated & more threatened



Setting the context



Windfarm development

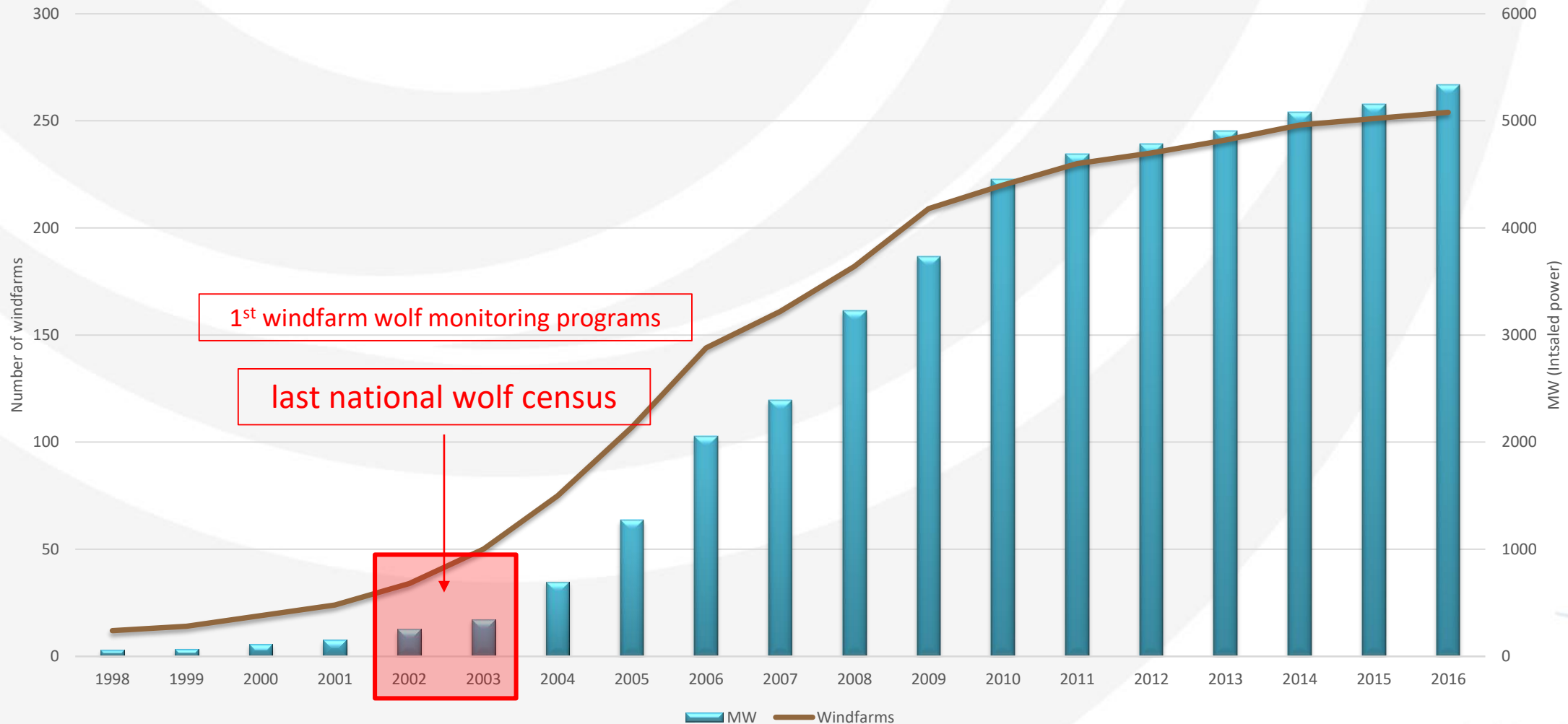


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Setting the context



Windfarm development

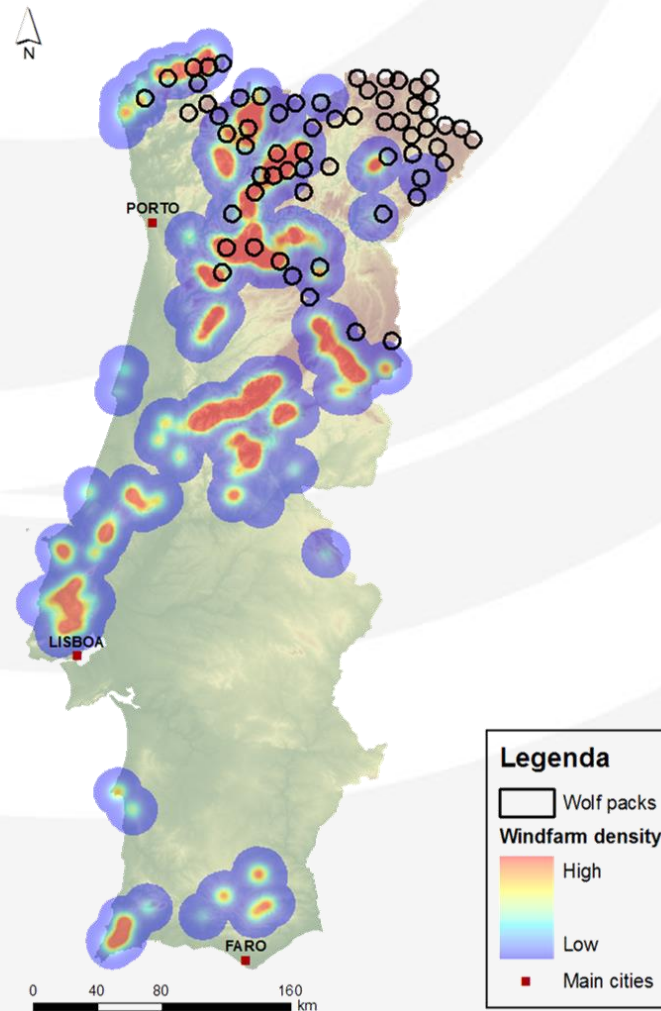
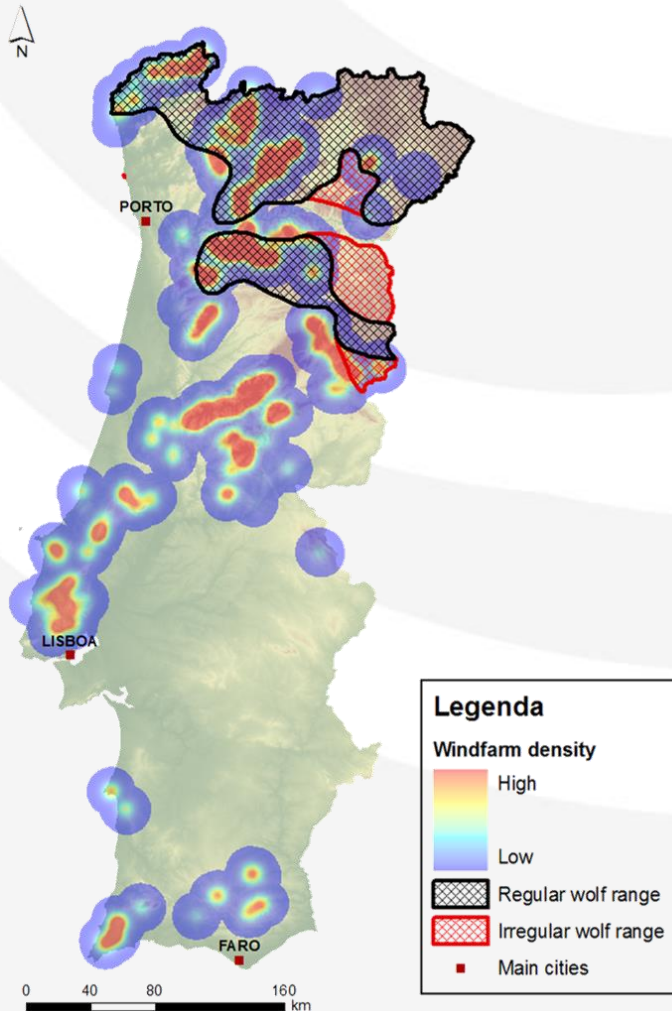


Setting the context



Windfarms and wolves

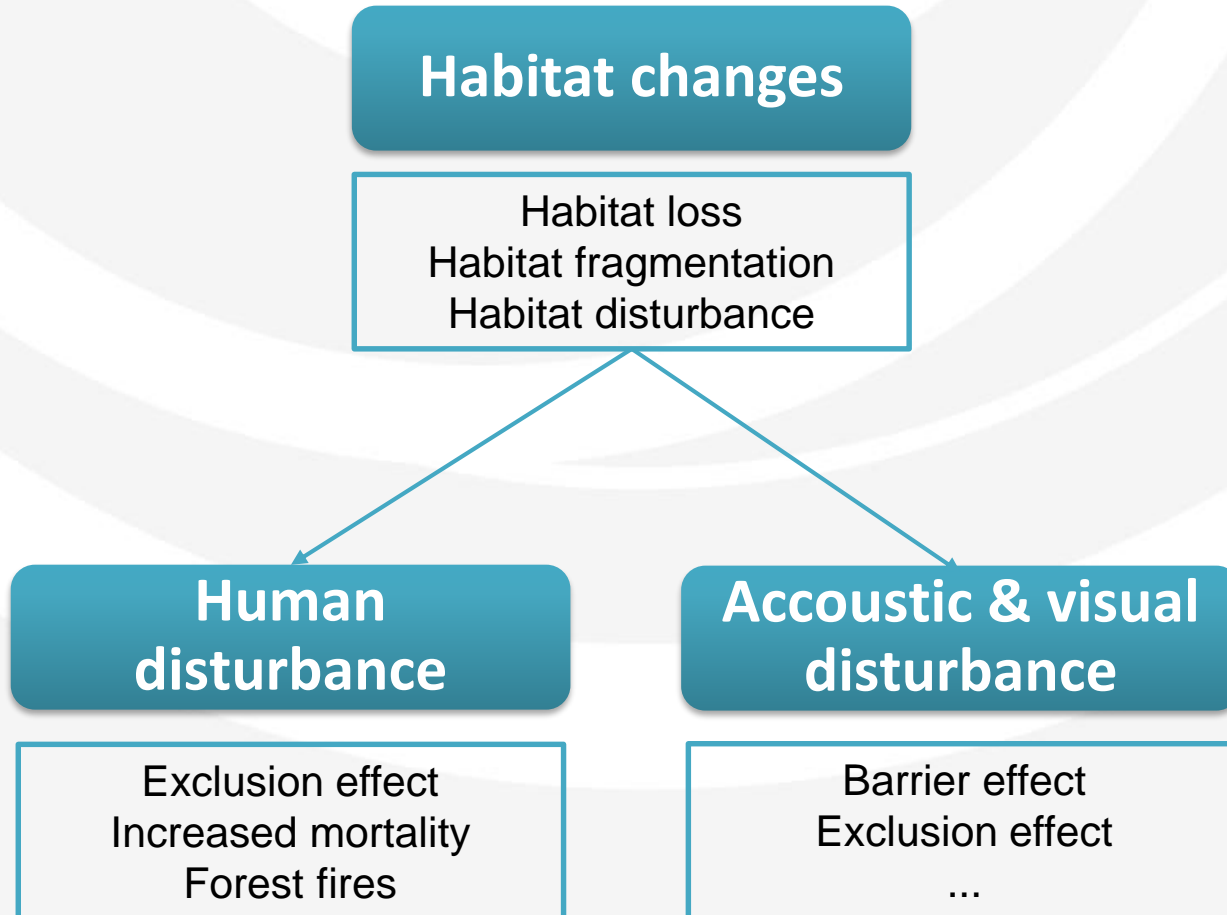
- ± 1000 wind turbines inside wolf range
- 4.8 wind turbines/100km²
- 25 wolf packs affected (>1/3 total packs)
- Packs with more than 120 wind turbines inside their territory (S Douro)



Setting the context



Potential impacts on wolves

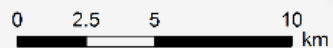
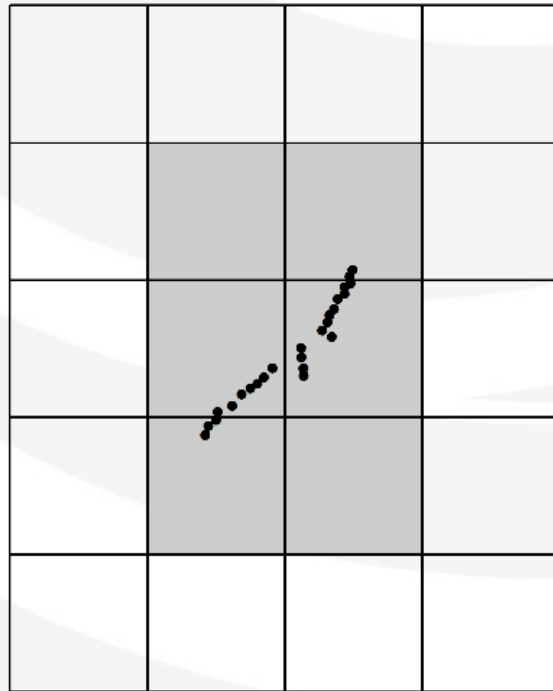


Due to the **endangered status** of this large carnivore in Portugal, wolf is a focal species in EIA procedures.

Several monitoring plans were conducted in the last years, resulting in a reasonable amount of information on the effects of wind farms on wolves.

Wolf survey designs

Before-After-Control-Impact (BACI)



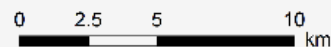
• Wind turbines

5km x 5km cell

■ Impact area

□ Control area

Impact-gradient



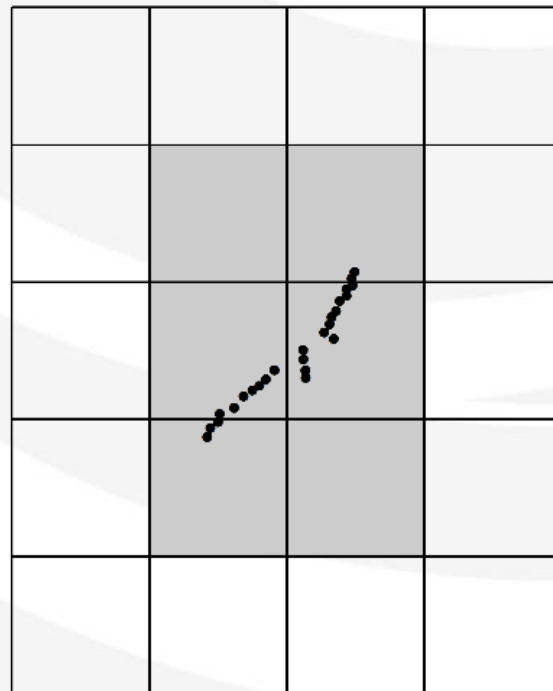
• Wind turbines

□ 1000m buffer



Wolf biological parameters

Before-After-Control-Impact (BACI)



0 2.5 5 10 km

• Wind turbines

5km x 5km cell

■ Impact area

□ Control area

Biological parameters

- presence/absence
- use of space (relative abundance index – IKA)
- breeding location & success rate
- traffic at windfarm areas



Wolf sampling techniques

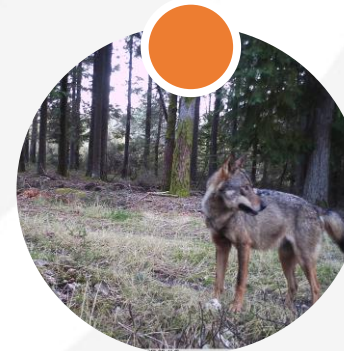
SCATS SURVEYS

linear transects on each grid cell, repeated every month, season, year. Collected scats validated by genetic analysis.



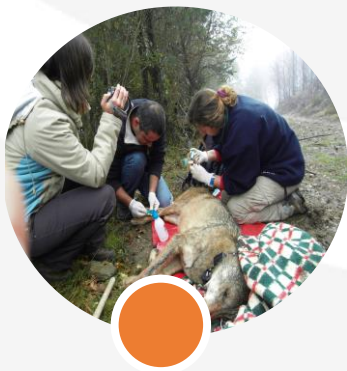
CAMERA TRAPPING

1 or 2 cameras per grid cell, active 30-45 consecutive days per season. Only in ideal habitat conditions. Great outreach potential.



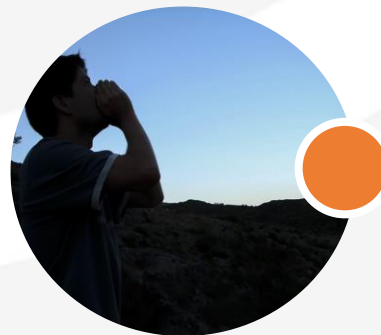
TELEMETRY

Fine-scale movement and behavioral data. Only used in few long-term monitoring/conservation programs



HOWLING STATIONS

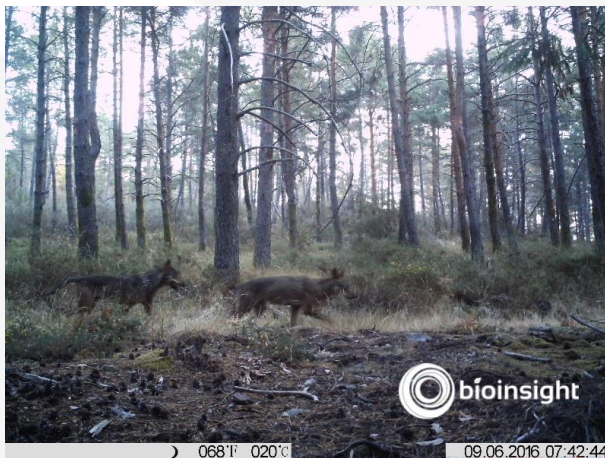
Conducted ideally in August-September. To confirm denning area and pups presence. Only with good weather conditions.



Methodologies



Camera trapping



Great public outreach



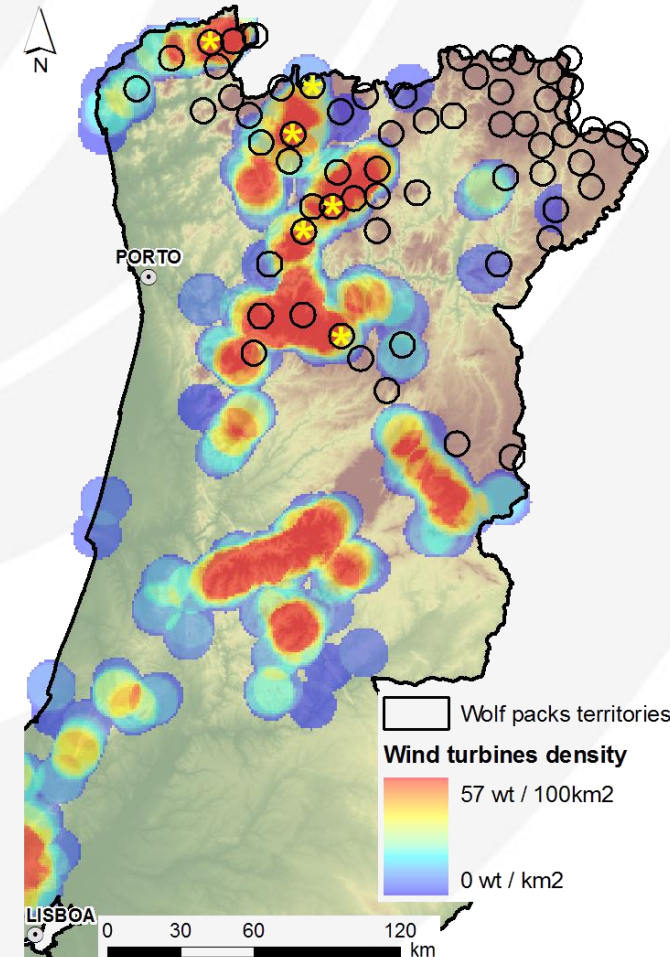
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Results



Wind farm	Wind turbines	Wolf pack affected	Monitoring years
Alto do Marco	5	Sombra	5
Alto Minho I	49	Vez	10
Cabeço Alto	9	Larouco	5
Falperra	20	Falperra/Sombra	6
Meroicinha II	6	Sombra	5
Negrelo-Guilhado	11	Falperra/Sombra	6
Outeiro	13	Vaqueiro	6
Serra da Nave	19	Leomil	10
Serra do Alvão	21	Sombra	6
Serra do Barroso III	11	Barroso	8
Vila Cova	17	Vaqueiro	6

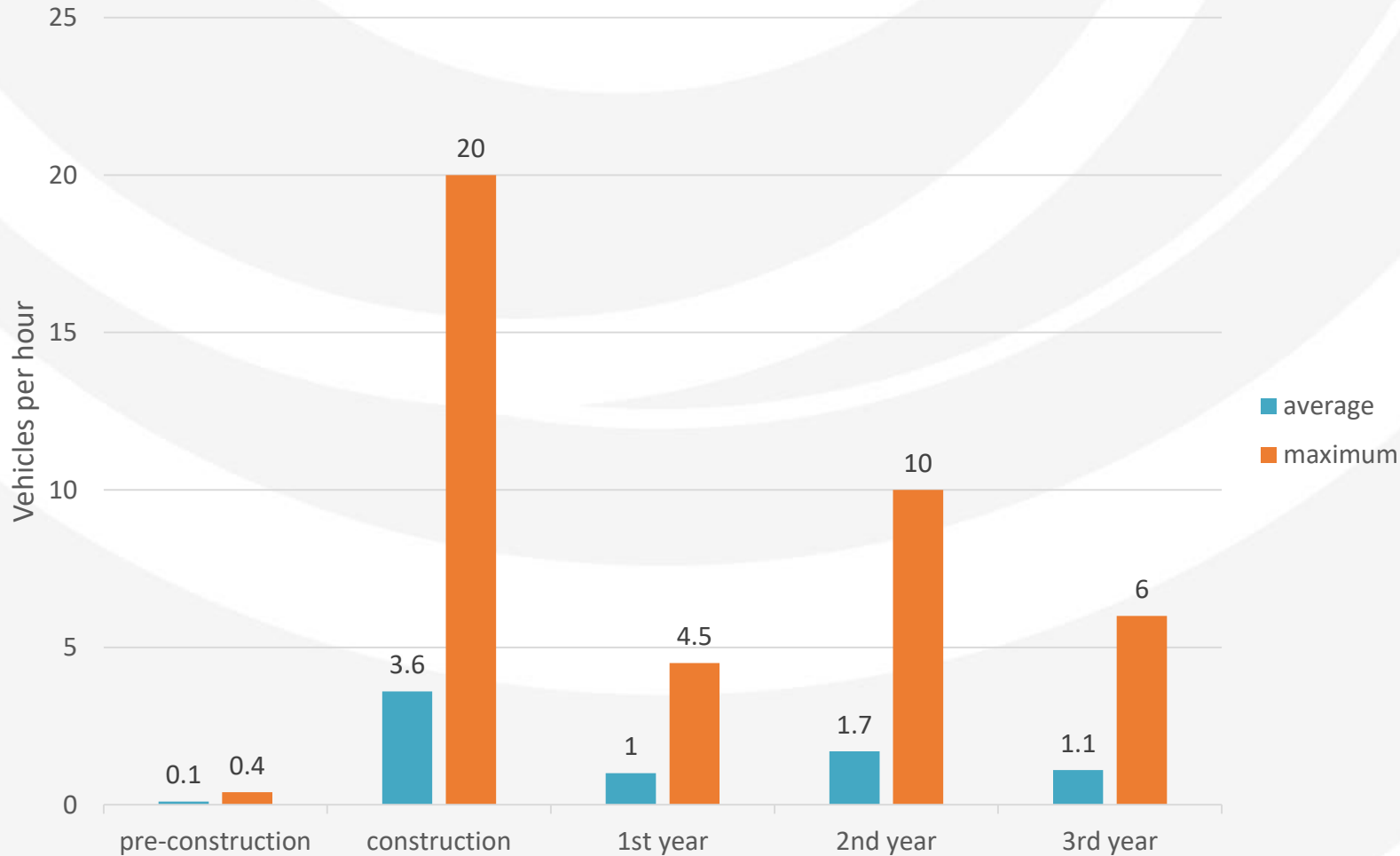
Data sources



Results



Recorded traffic on windfarms



Traffic disturbance

Windfarms are related to a significant increase in road traffic.

The recorded traffic was, in average, **36x higher** during construction period than in pre-construction, reducing to **11x higher** in the 3rd year of operation.

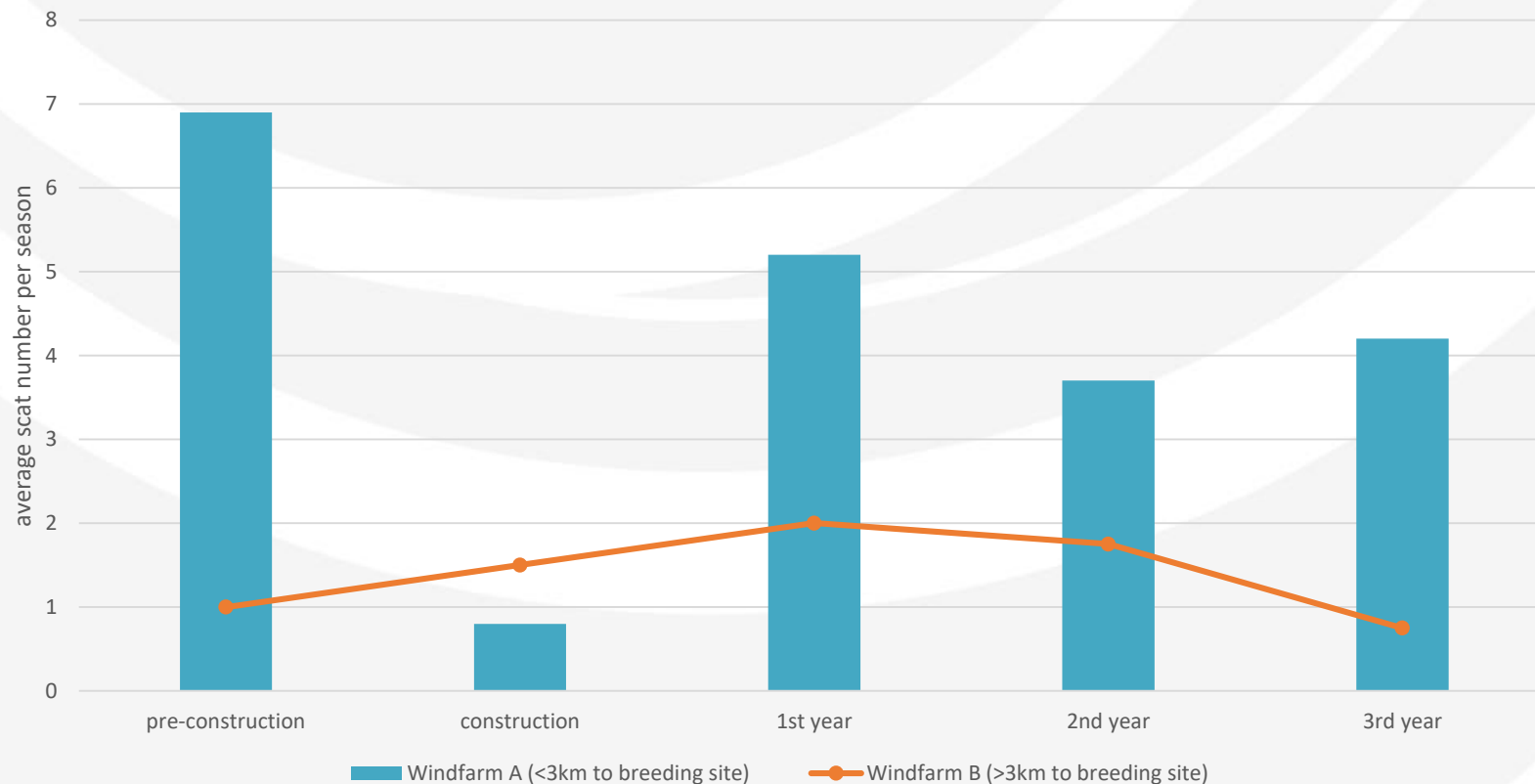
Nocturnal traffic

Traffic associated with hunting



Space use by wolves

Wolf relative abundance in windfarm areas (<2000m)



Wolves showed some avoidance to windfarm areas particularly during construction phase but with a limited effect in time.

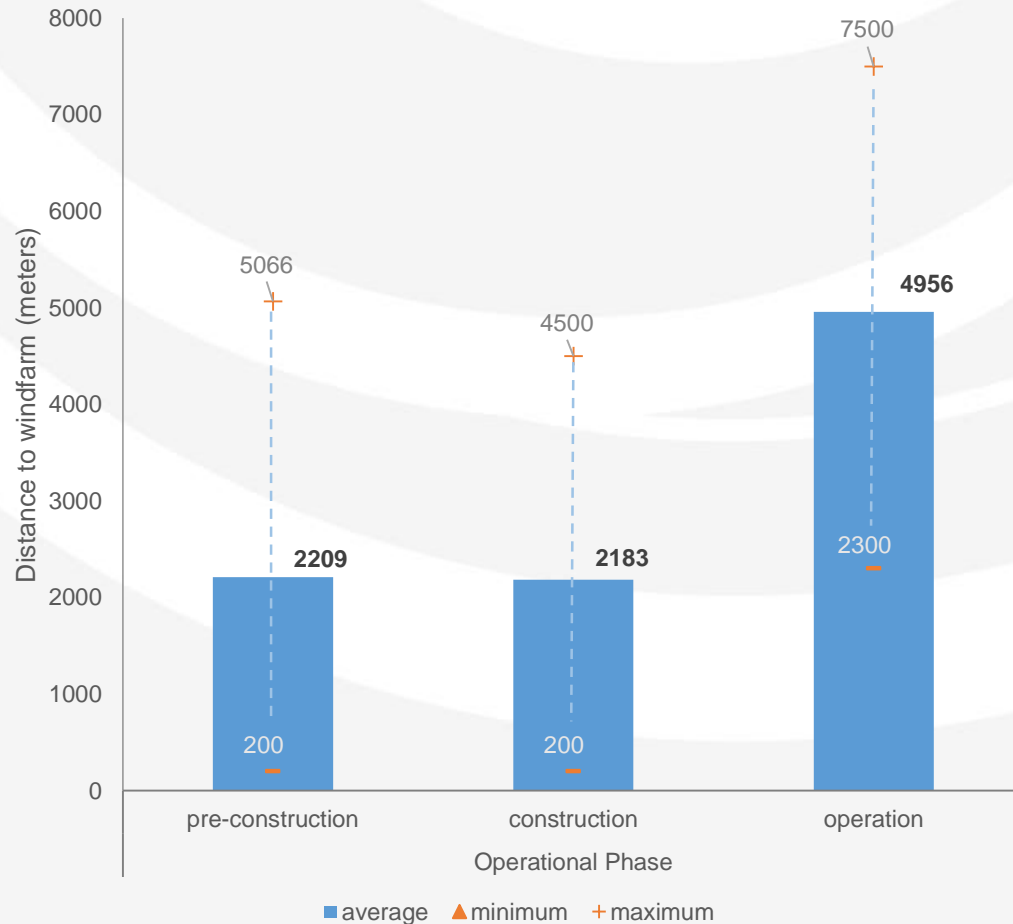
This effect is not so evident when windfarms are located far away from pack denning sites.



Results



Wolves breeding site location

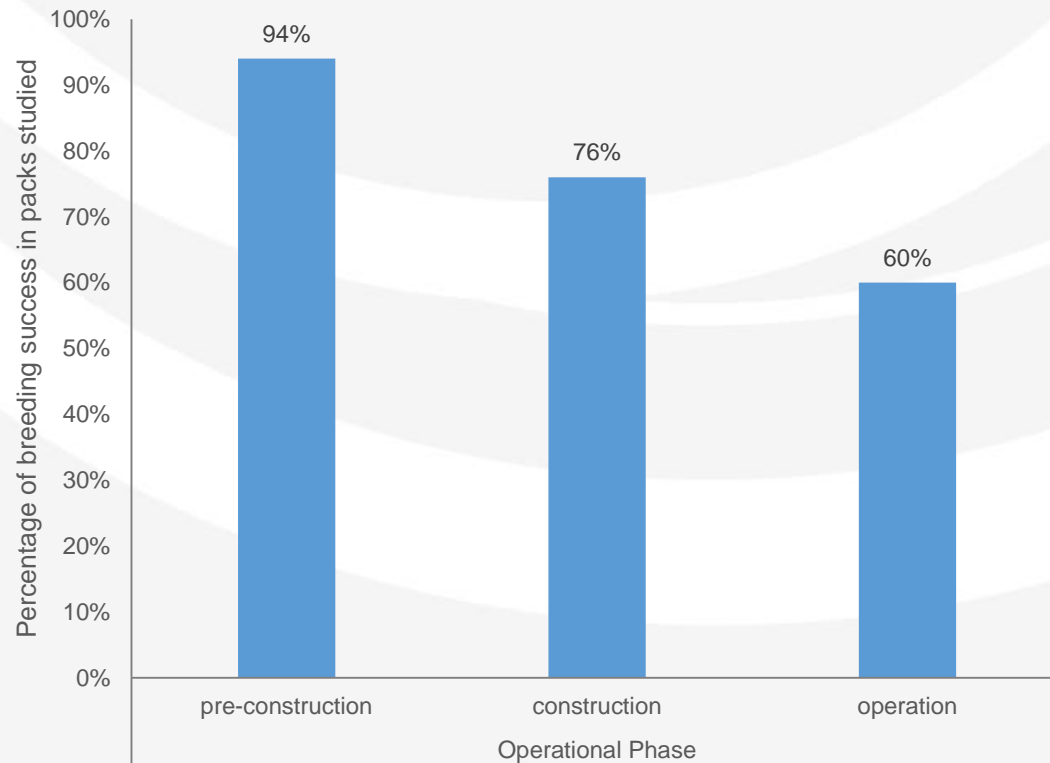


Windfarms **induce shifts** on wolf breeding site locations.

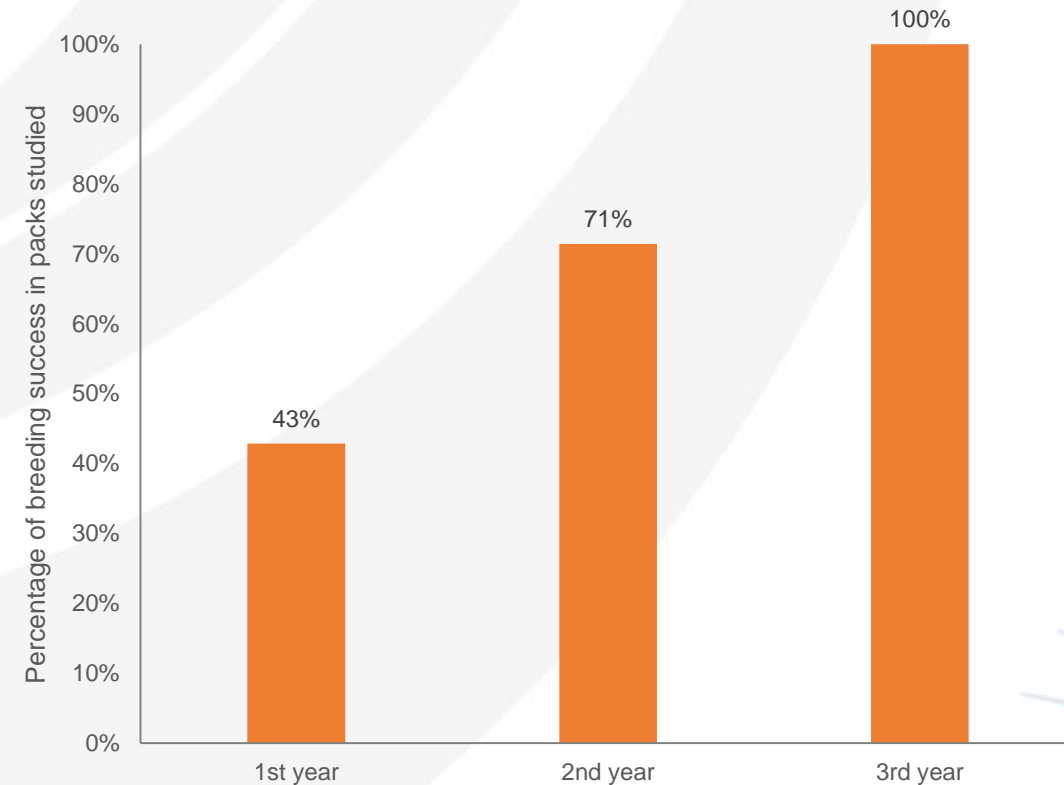
In **humanized** and **heterogeneous** landscapes such as Portugal, this ecological response may expose wolves to new or more intense level of threats.

Wolves breeding success

Breeding success



Breeding success at operation phase



Mitigation & Compensation



Mitigation

- **Protection** of known wolf breeding sites: at least a **2km buffer** considered as non-construction area for all windfarms elements (wind turbines, cables, road network and powerlines)
- **Condition (closing)** windfarms road network in order to reduce traffic disturbance.
However, in Portugal, the use of gates in the main accesses to wind farms has been difficult to implement due to public use of those areas and the claim for free access to mountain ridges by local populations.

Compensation

- **Habitat management:** Improve habitat suitability for wolf breeding; Increase wild prey populations
- **Damage prevention measures:** Use of livestock guardian dogs and electric fences



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Data collection

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Helena Rio-Maior
Monia Nakamura
Pablo Sierra
Sara Roque



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Chapter 5

The Indirect Impacts of Wind Farms on Terrestrial Mammals: Insights from the Disturbance and Exclusion Effects on Wolves (*Canis lupus*)

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Biodiversity and Wind Farms in Portugal

Current knowledge and insights for an integrated impact assessment process

Editors: **Mascarenhas, M., Marques, A.T., Ramalho, R., Santos, D., Bernardino, J., Fonseca, C.** (Eds.)

Provides an insight into the main impacts of Portuguese wind energy facilities on wildlife, in particular birds, bats and wolf

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