Conference "Nature inclusive windfarm development ", November 5 2021, Zagreb, Croatia

Large carnivores and windfarms:
mitigation measures and monitoring in Portugal

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Large Carnivore Initiative for Europe
IUCN/SSC WORKING GROUP

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Associação de Conservação do Habitat do Lobo Ibérico

Disturbance effects of windfarms on terrestrial mammals

- Few available knowledge

- Small-sized mammals:

Small mammal catches show no measurable effect due to windfarm construction and operation (Spain; De Lucas et al. 2005);

Red fox or European hare droppings show no measurable effect due to wind farm construction (Germany; Menzel & Pohlmeyer 1999);

Ground squirrels show evidences of increased vigilance due to rotor noise (USA, California; Rabin et al. 2006).

Source: Hellddin et al. (2017). Wildlife and Wind farms. Pelagic Publishing.

Disturbance effects of windfarms on terrestrial mammals

- Few available knowledge

- Ungulates:

Reindeer appear not to be disturbed by noise from wind turbines but wind turbines and roads lead to some direct habitat loss and roads and power lines may act as barriers to movements (Norway; Flydal et al. 2002, 2004; Vistnes et al. 2004; Colman et al. 2008);

Elk, deer and pronghorn are temporarily displaced during construction but with no direct habitat loss (USA, Arnett et al. 2007);

Elk with some direct habitat loss and disturbance during construction, but no population level effects (USA, Oklahoma; Walter et al. 2006).

Source: Hellddin et al. (2017). Wildlife and Wind farms. Pelagic Publishing.

Disturbance effects of windfarms on terrestrial mammals

- Few available knowledge

- Large carnivores:

Black bear show some indication of avoidance during wind farm construction (USA, Vermont; Wallin 1998);

Black bear may be disturbed by human activity such as roads and industrial development up to a distance of 1 km (Linnell et al. 2000);

Bears and wolves avoid and experience increased mortality in areas with high forest road density (Mace et al. 1996);

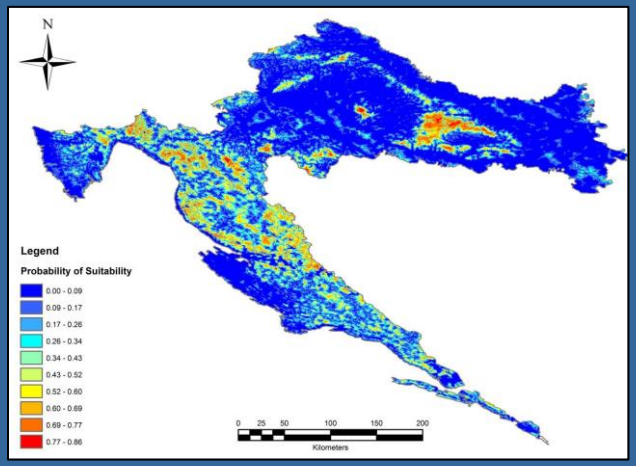
Wolves show some effects on breeding patterns due to wind farm construction (Portugal; Álvares et al., 2017; Ferrão da Costa et al. 2018).

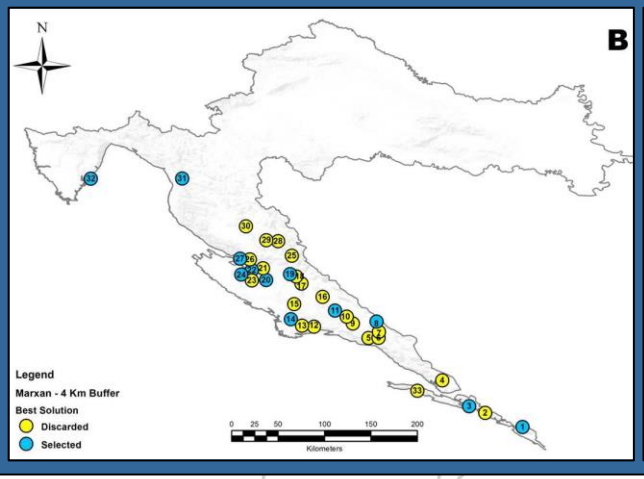
Source: Hellddin et al. (2017). Wildlife and Wind farms. Pelagic Publishing.

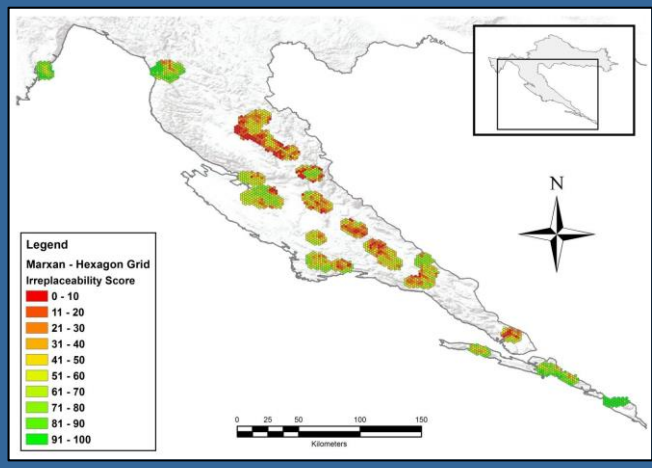
Disturbance effects of windfarms on large mammals

- Increasing concern at European level, particularly for large carnivores (wolf, brown bear and lynx)

- Preventive planning in Croatia:
  Wind farm site prioritisation based on wolf breeding habitat







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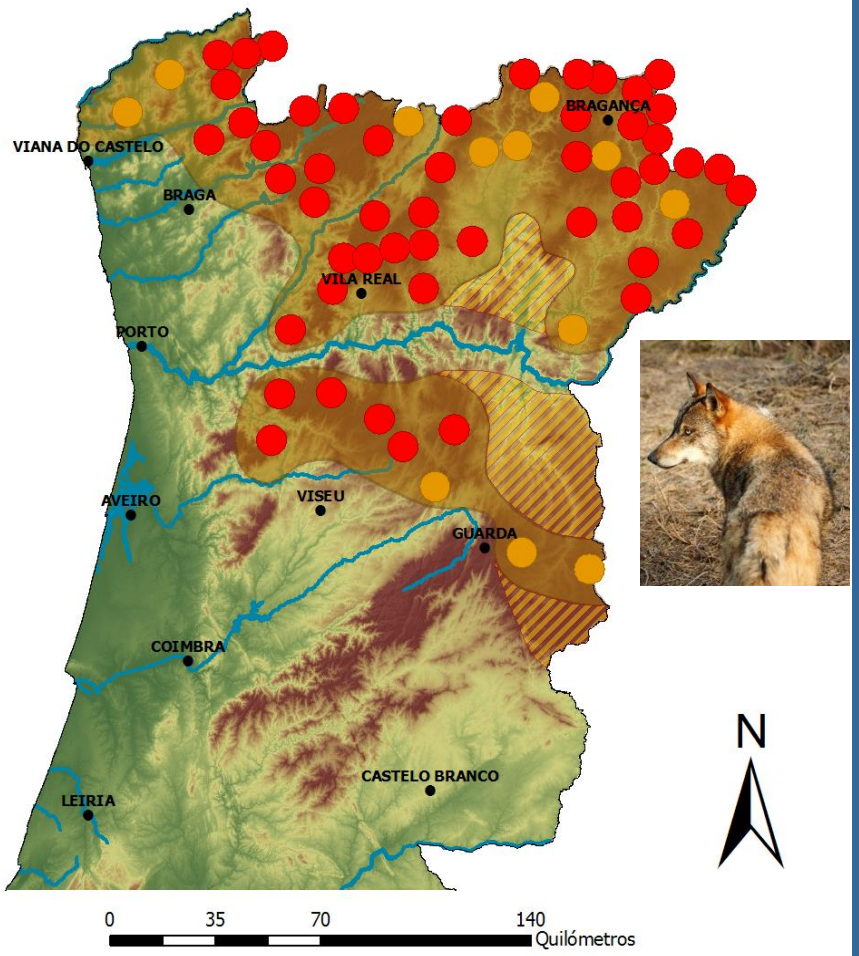
ORIGINAL ARTICLE

Framework for strategic wind farm site prioritisation based on modelled wolf reproduction habitat in Croatia

Gioele Passoni[1] · J. Marcus Rowcliffe[2] · Ari Whiteman[1] · Djuro Huber[3] · Josip Kusak[3]

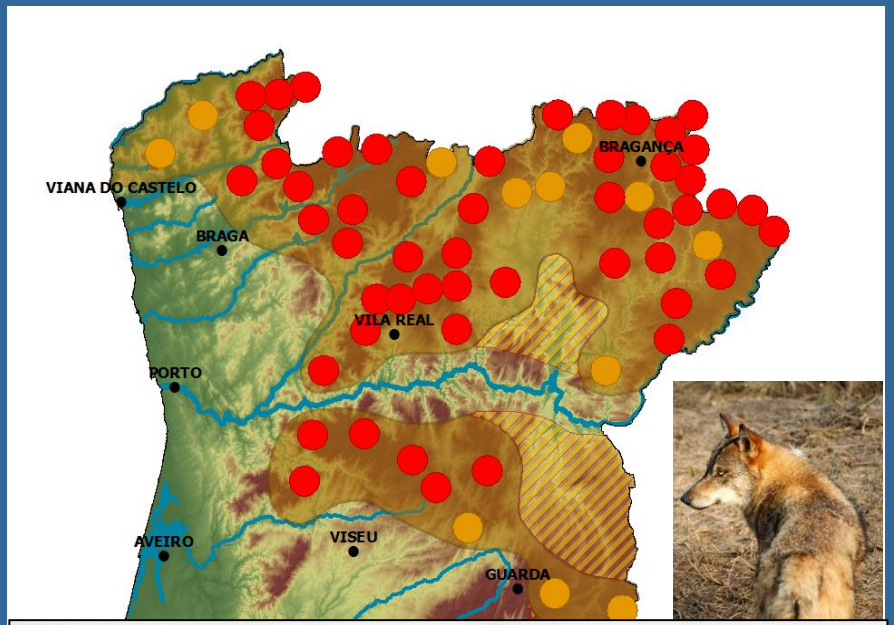
Wolves and wind farms: the Portuguese setting



- Protected at a national level
- Endangered status (EN)
- 63 packs; ± 300 individuals

Source: Pimenta *et al*. (2005). Wolf National Census 2002/2003

Wolves and wind farms: the Portuguese setting



- Protected at a national level
- Endangered status (EN)

- 63 packs; ± 300 individuals

- Ecological features:

Livestock comprises >80% diet
High human-caused mortality

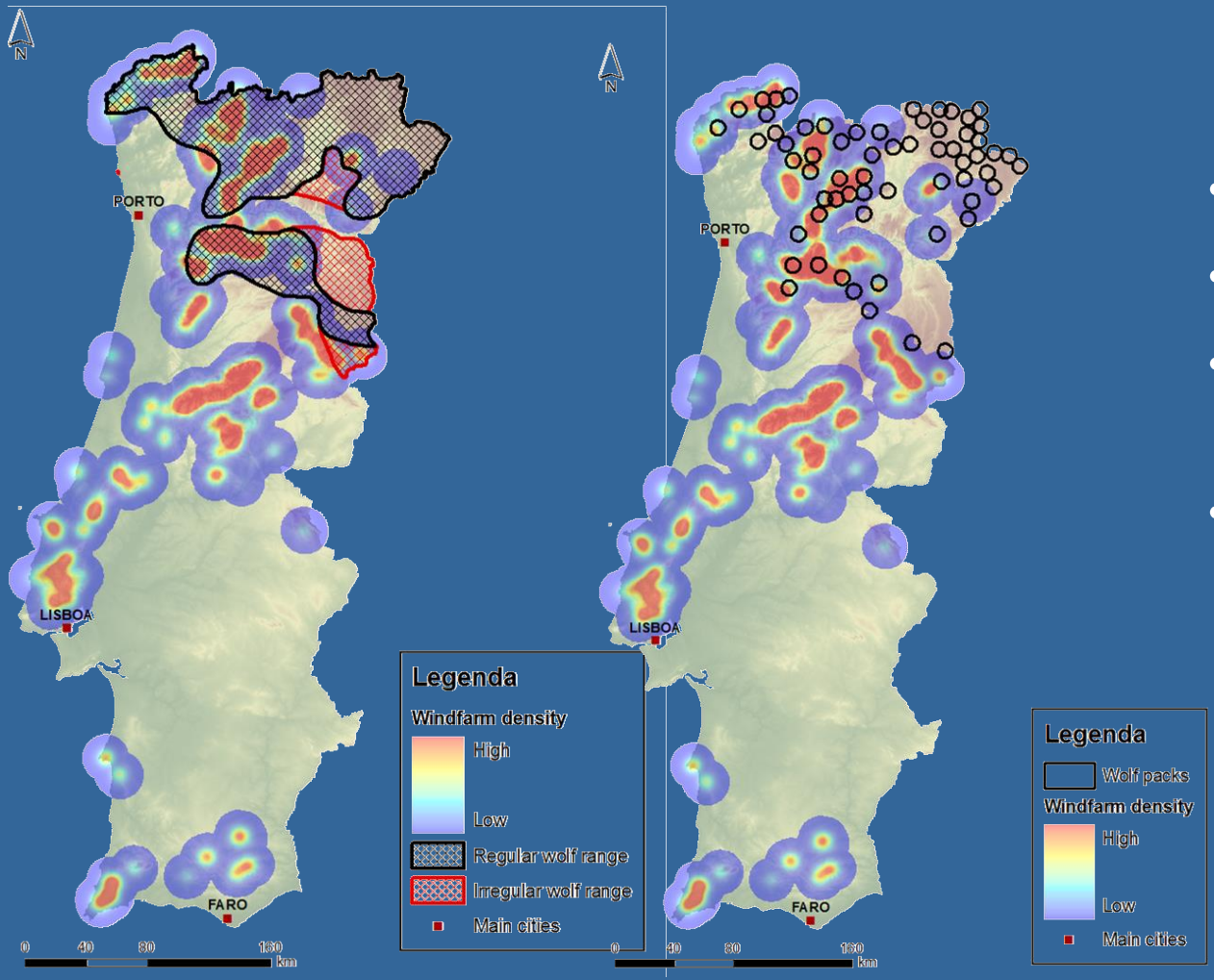
- Habitat features:

Mountainous areas with intensive human use
High human density (~ 40 inhab./km2)
High road density (~ 0.7 km/ km2)
Low forest cover (~ 20 %)
Mostly shrub land (> 60%)

- Focal species in Environmental Impact Assessments

Wolves and wind farms: the Portuguese setting

Windfarm development within wolf range

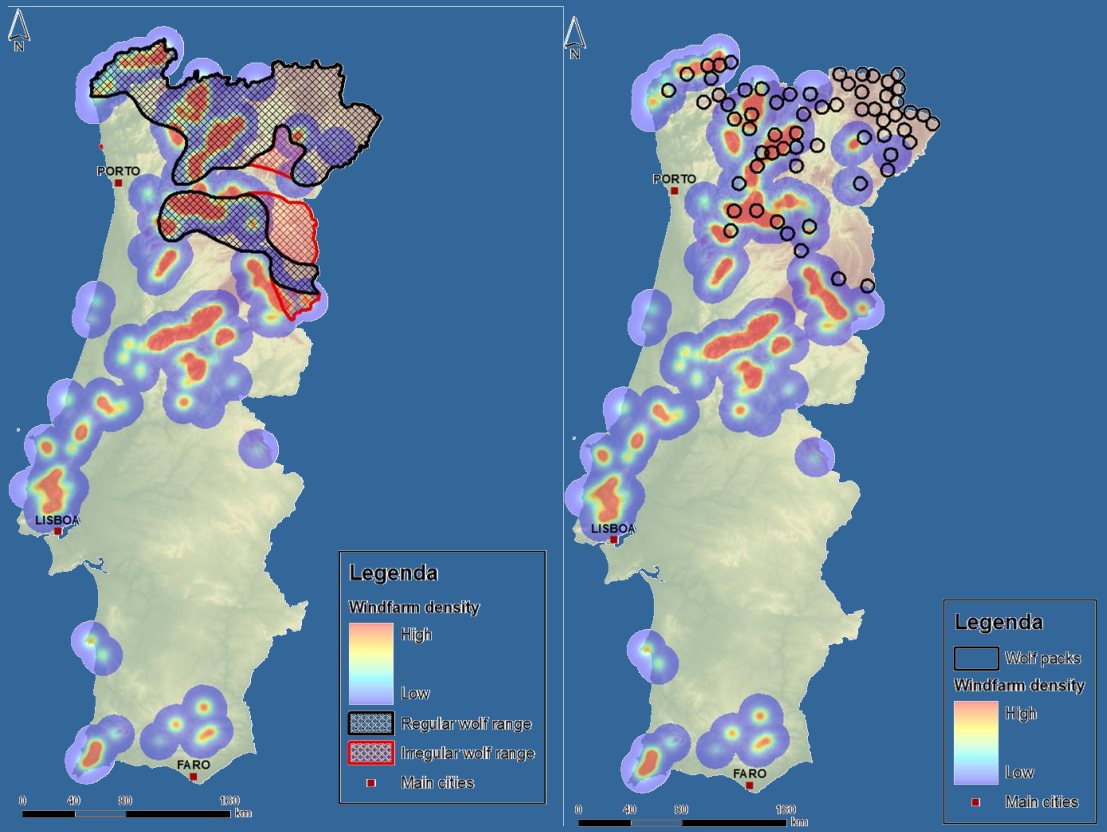


- ± 1000 wind turbines
- 5 wind turbines/100km^2
- 28 wolf packs affected (>45% total packs in PT)
- Packs with more than 120 wind turbines inside their territory

Source: Ferrão da Costa et al. (2018). Biodiversity and Wind Farms in Portugal. Springer Publishing.

Wolves and wind farms: the Portuguese setting

Windfarm development within wolf range



Potential impacts on wolves:

- Human disturbance (↑ mortality risk)
- Acoustic/visual disturbance
- Habitat changes

Acoustic and visual disturbance from wind turbines

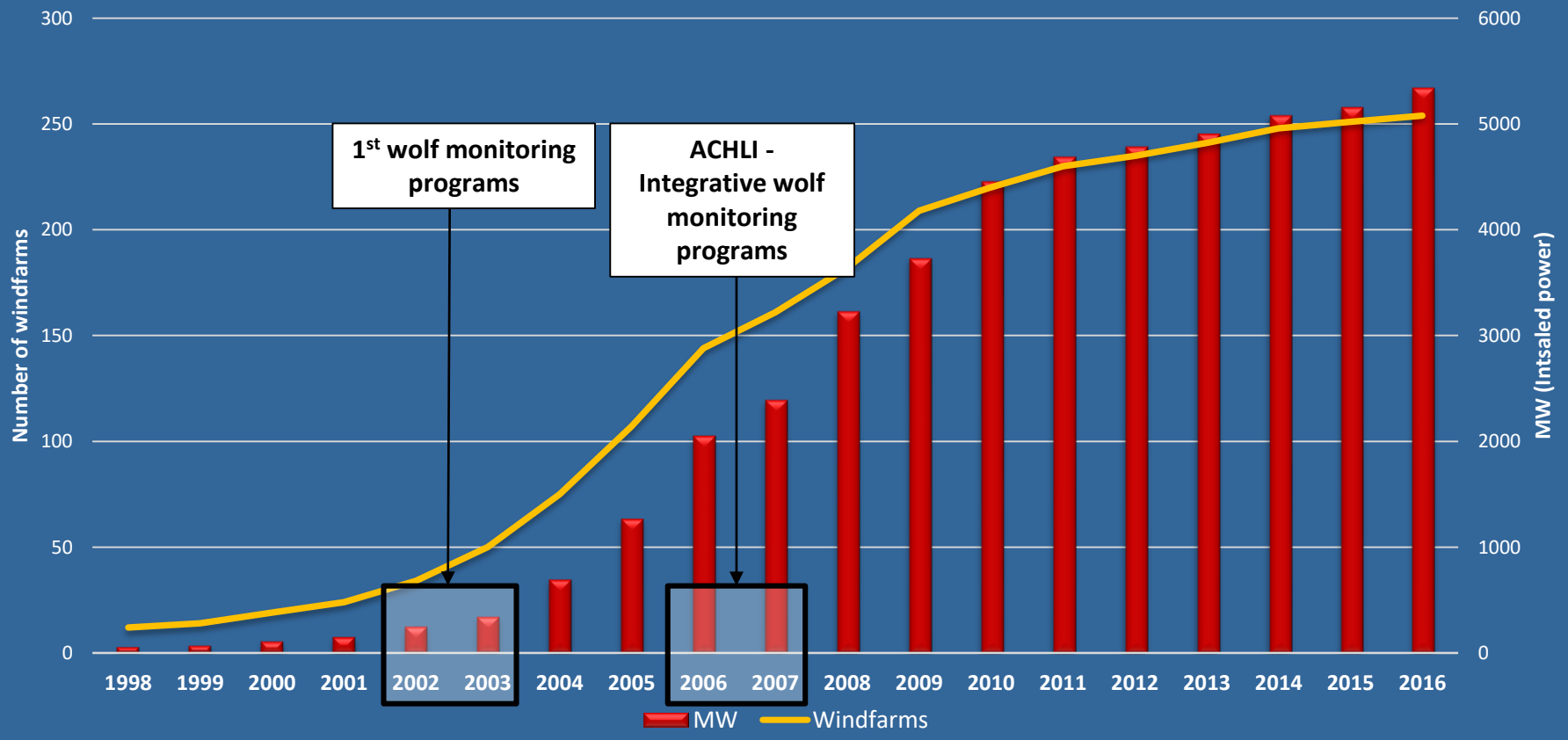
Increase of traffic in road network built for wind-power development

Habitat disturbance during power line construction

Source: Ferrão da Costa et al. (2018). Biodiversity and Wind Farms in Portugal. Springer Publishing.

Wolves and wind farms: the Portuguese setting

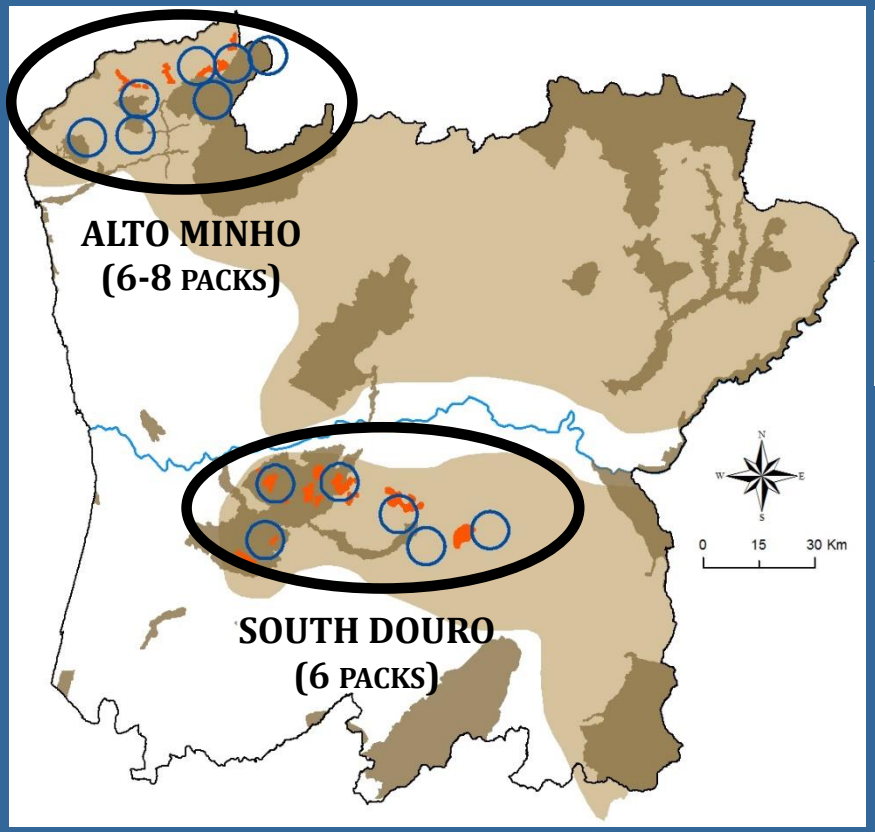
Windfarm development in Portugal



Source: Ferrão da Costa et al. (2018). Biodiversity and Wind Farms in Portugal. Springer Publishing.

Wolves and wind farms: the Portuguese setting

Long-term monitoring of two wolf populations occurring in different ecological settings



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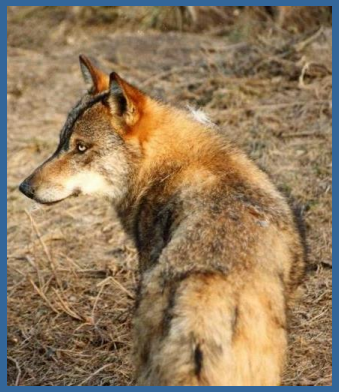

ACHLI – NGO (non-profit organization) created in 2006

17 members – all renewable energy developers

Responsible for managing regional monitoring plans (wolf monitoring) and the “Wolf Fund” (habitat compensation)

Wolves and wind farms: the Portuguese setting

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Associação de Conservação do Habitat do Lobo Ibérico

"WOLF FUND"

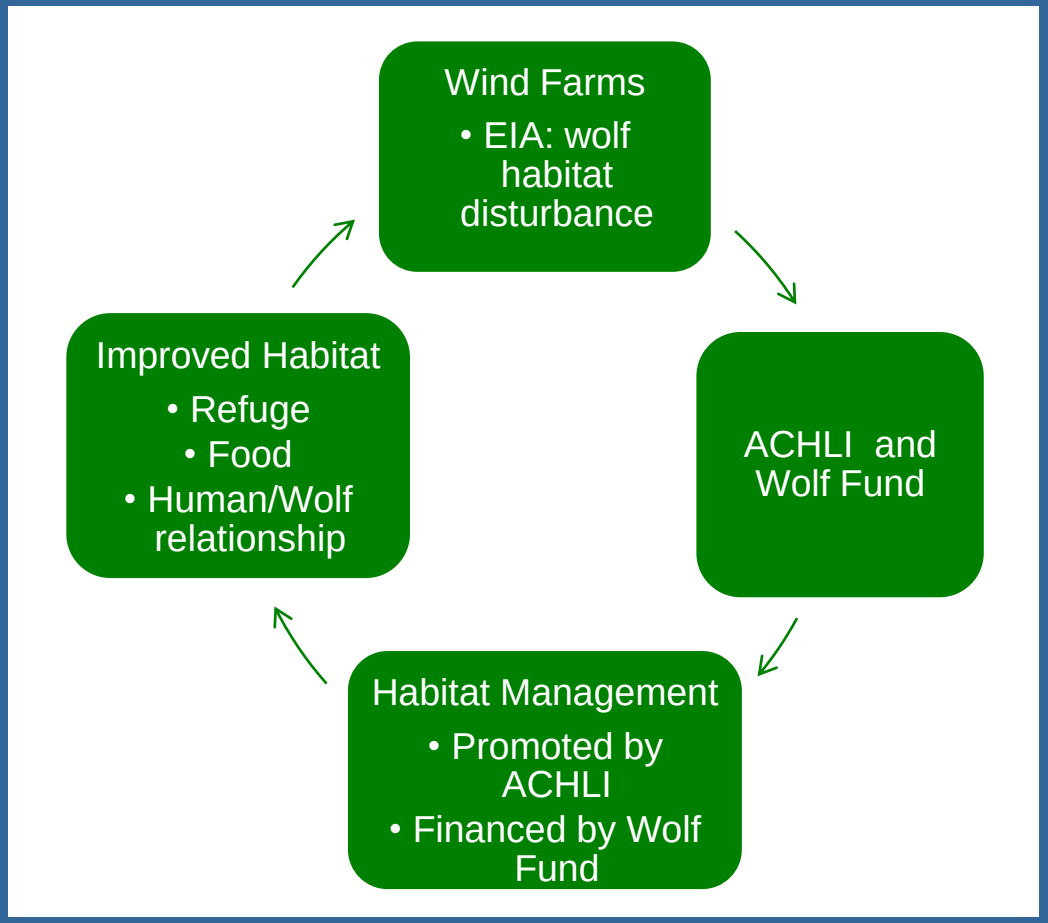
Annual contributions based on installed capacity

Allows joint efforts of different EIA compensation measures

Compensation scheme directed to habitat management projects

Supervised by National Authorities

Engagement of local populations



Wolves and wind farms: the Portuguese setting

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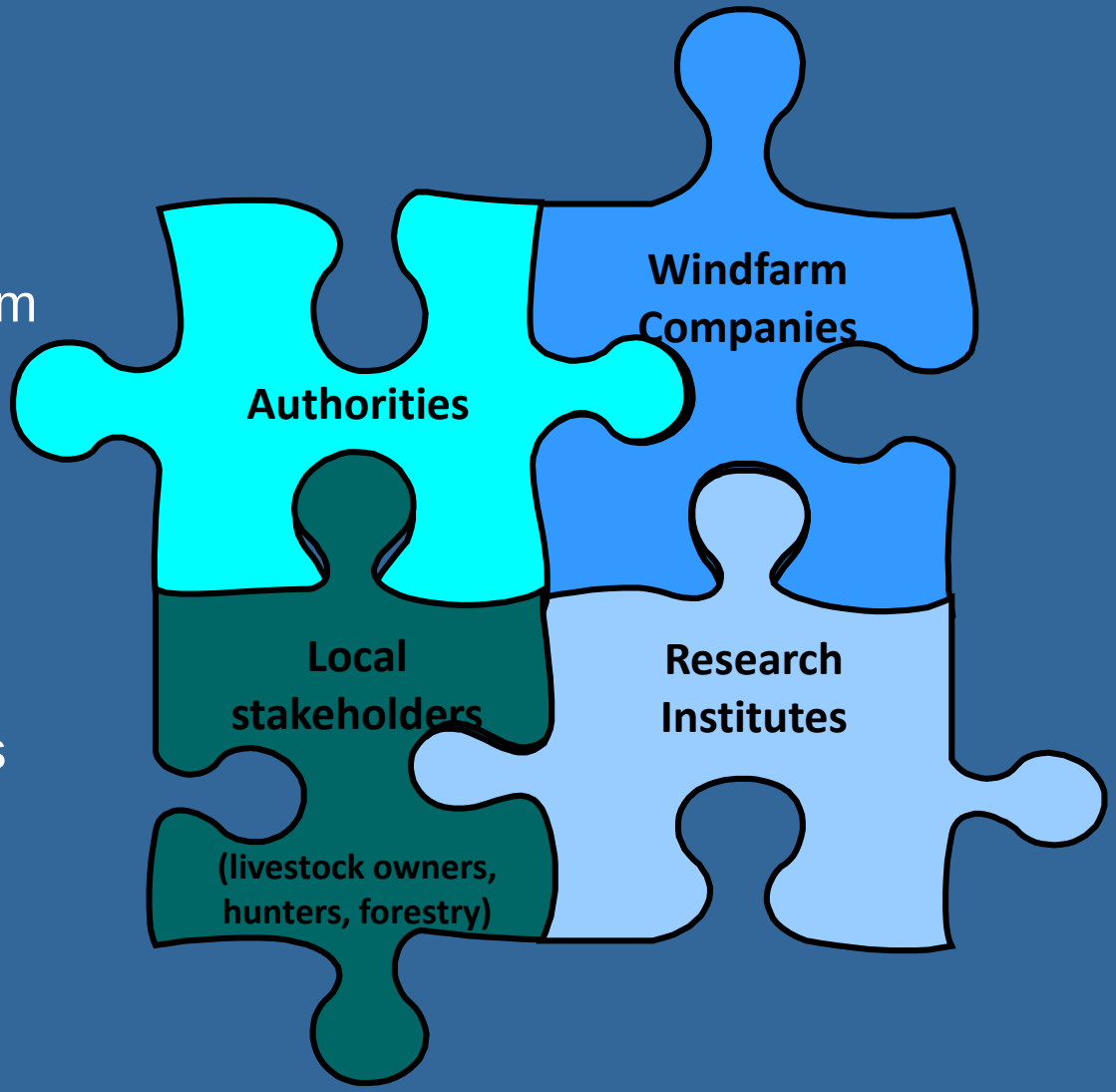
Innovative approach for windfarm monitoring, mitigation and compensation related to disturbance effects on wolves

Networking with several stakeholders

Feasibility in applying measures and procedures

Need for replicability in other areas within wolf range or for other endangered species (e.g. birds of prey, bats)



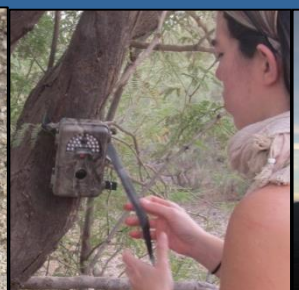
Methodological approaches for monitoring potential effects

- Assessment of road traffic (nº vehicles/hour)

- Evaluation of wolf space use and breeding patterns
  (Multi methodological approach based in non-invasive genetic monitoring, detection of breeding packs and GPS telemetry)

Field Methods:

- Scat surveys and quantification through abundance indexes (confirmation of wolf scats by genetic analysis)
- Howling surveys, camera-trapping and direct observations
- GPS telemetry of resident wolves

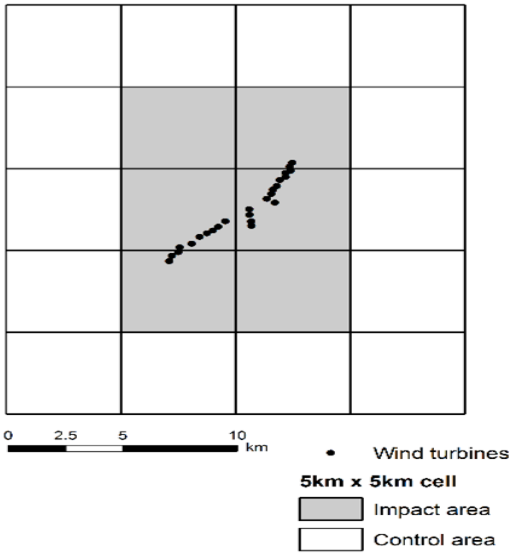


Methodological approaches for monitoring potential effects

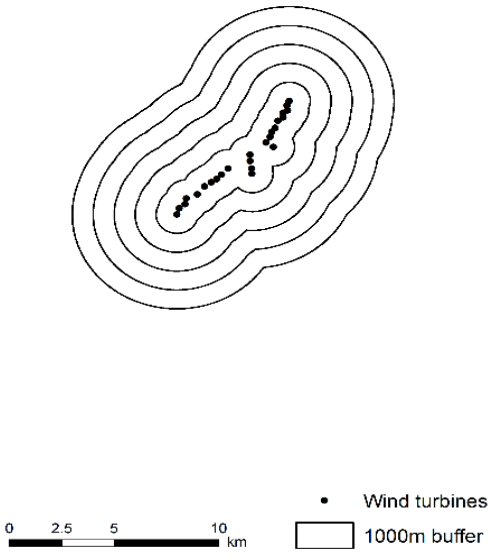
Impact assessment based on:

- **Temporal evolution of wolf presence indicators inside "Impact area" (proximity to wind turbines)**
- **Differential use between "Impact area" (e.g. with wind turbines) and "Control area" (e.g. remaining pack territory without wind turbines)**

Before-After-Control-Impact (BACI)



Impact-gradient



Wolf biological parameters

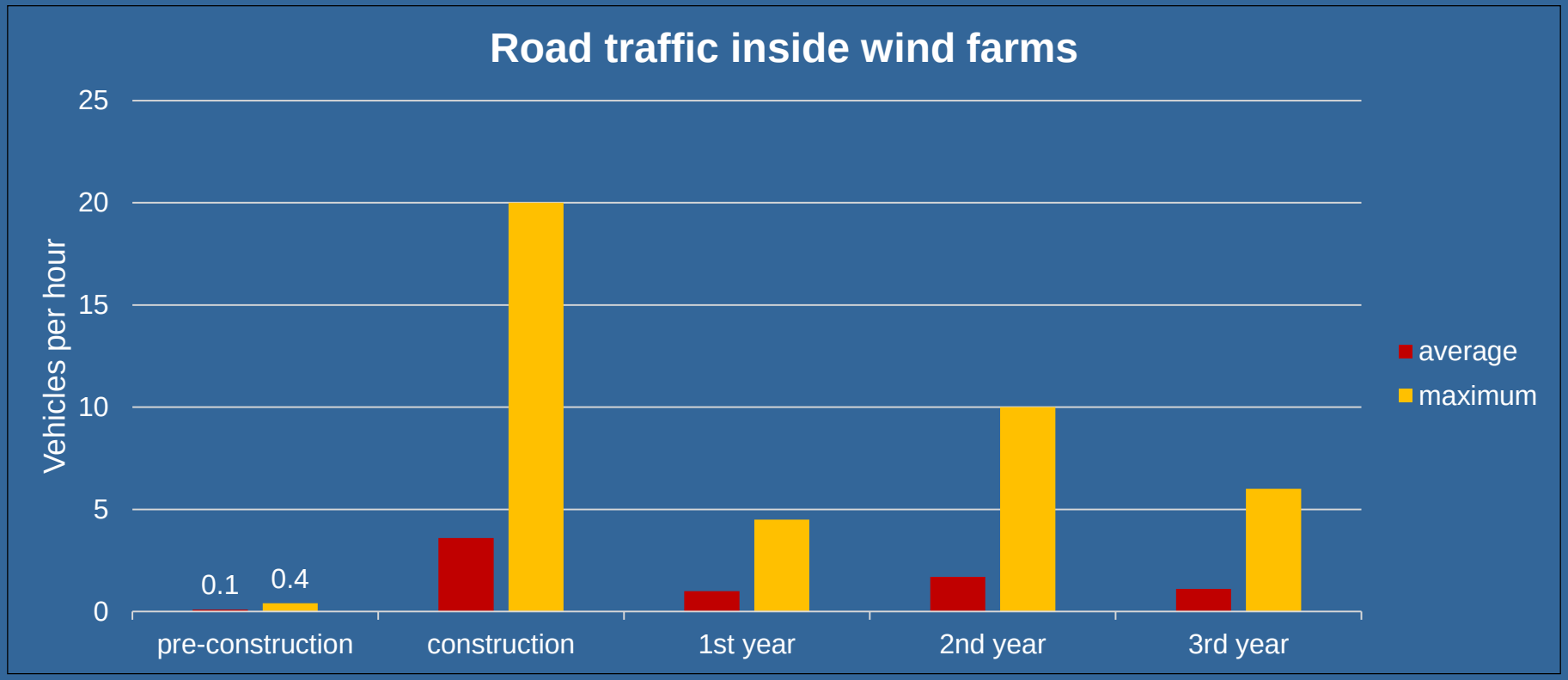
- presence/absence
- space use (relative abundance index – AKI)
- breeding location and success rate

Source: Ferrão da Costa et al. (2018). Biodiversity and Wind Farms in Portugal. Springer Publishing.

Human disturbance in windfarms

Construction: 20-60 fold increase in road traffic

Operation: 5-15 fold increase in road traffic

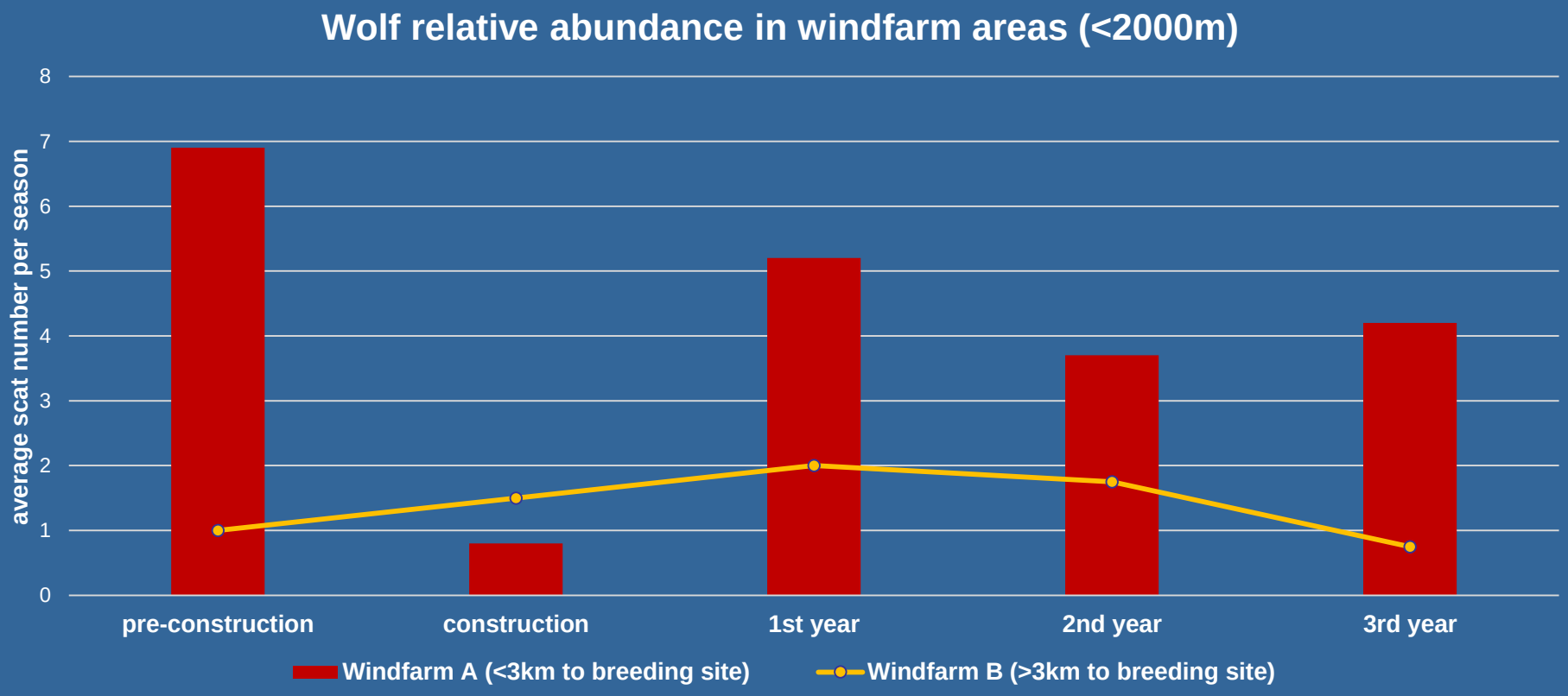


Source: Ferrão da Costa et al. (2018). Biodiversity and Wind Farms in Portugal. Springer Publishing.

Wolf behavioural responses to wind farms

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

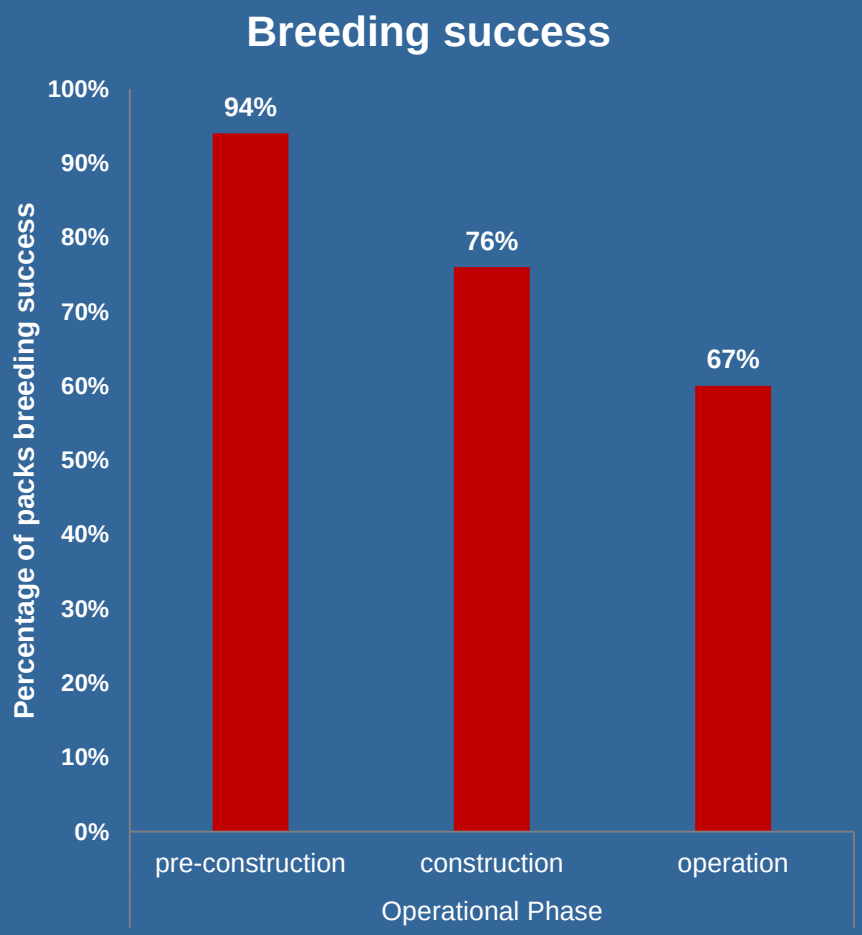
This effect is not so evident when windfarms are located far away from pack denning sites

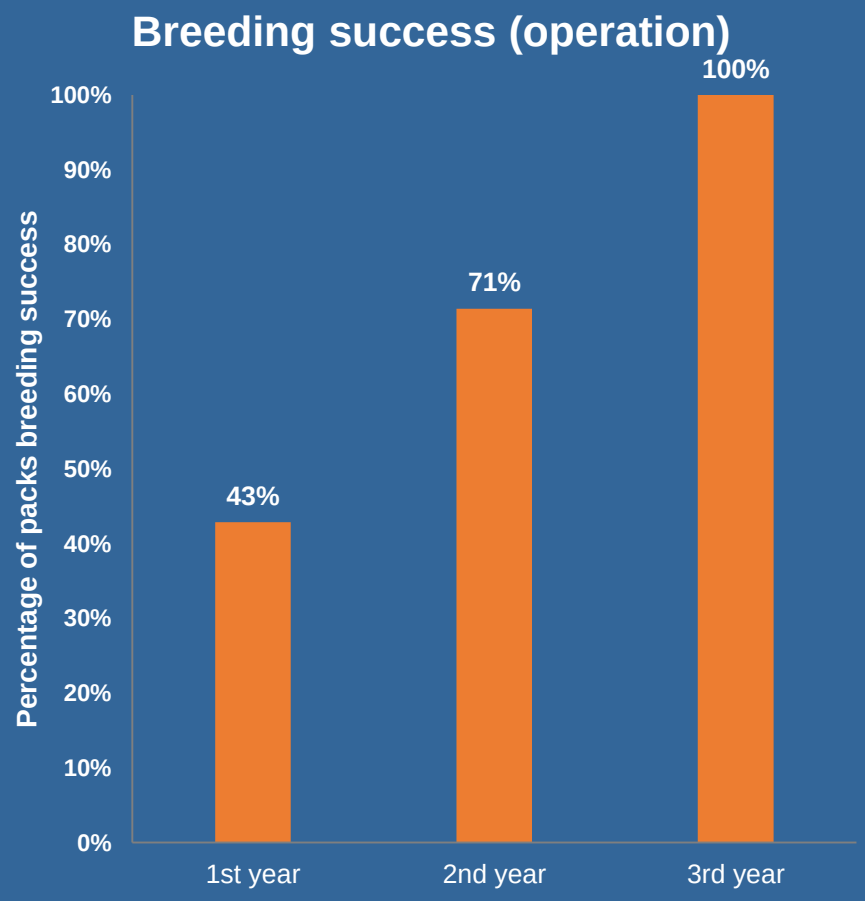


Source: Ferrão da Costa et al. (2018). Biodiversity and Wind Farms in Portugal. Springer Publishing.

Wolf behavioural responses to wind farms

Decrease in packs breeding success during construction and early operation

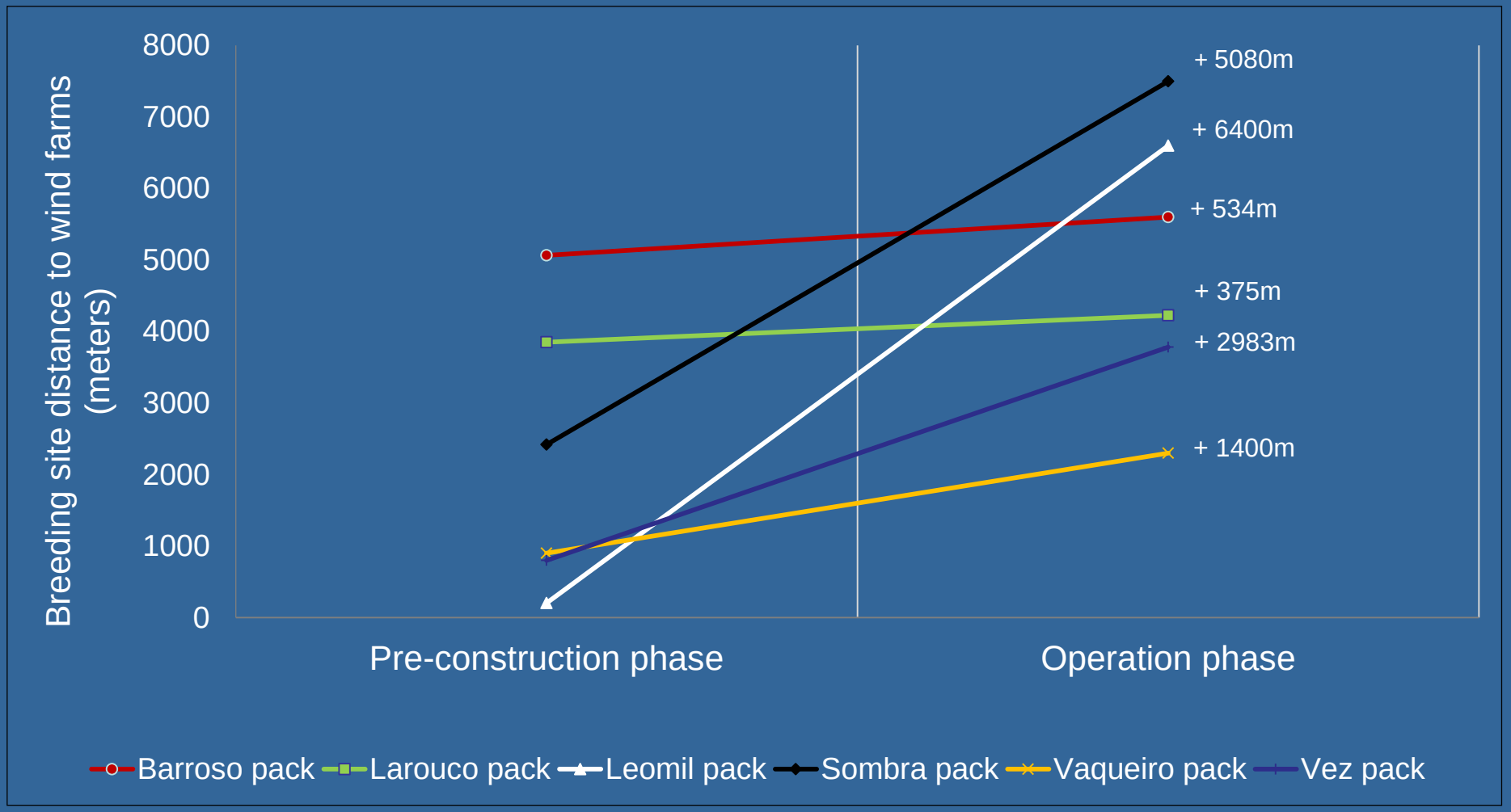




Source: Ferrão da Costa et al. (2018). Biodiversity and Wind Farms in Portugal. Springer Publishing.

Wolf behavioural responses to wind farms

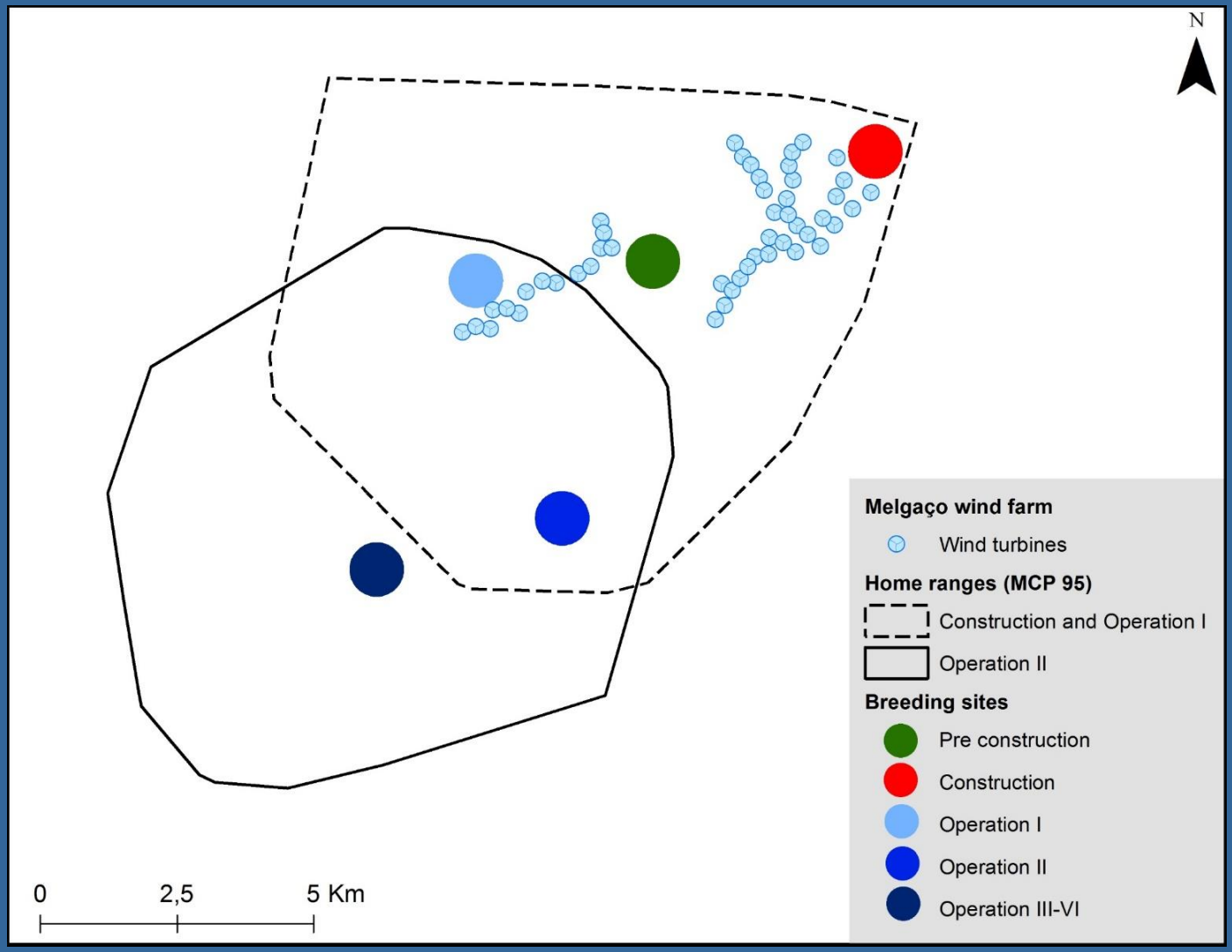
Wind farms induce a shift in breeding site location



Source: Ferrão da Costa et al. (2018). Biodiversity and Wind Farms in Portugal. Springer Publishing.

Wolf behavioural responses to wind farms

Wind farms lead to a shift in pack territory configuration



Source: Álvares et al. (2017). Wildlife and Wind farms. Pelagic Publishing.

Wolf behavioural responses to wind farms

Packs continue to be present and breed irregularly in territories containing up to 100 wind turbines (0.4 wind turbines/km2)

Decrease in wolf abundance and reproduction success during construction and early operation phases

Wolves abandon or do not regularly use breeding sites located ≤ 2km of wind turbines

Evidences of newly stablished packs breeding near existing wind farms (< 2km)

No apparent effect on pack size, pack occurrence and population viability

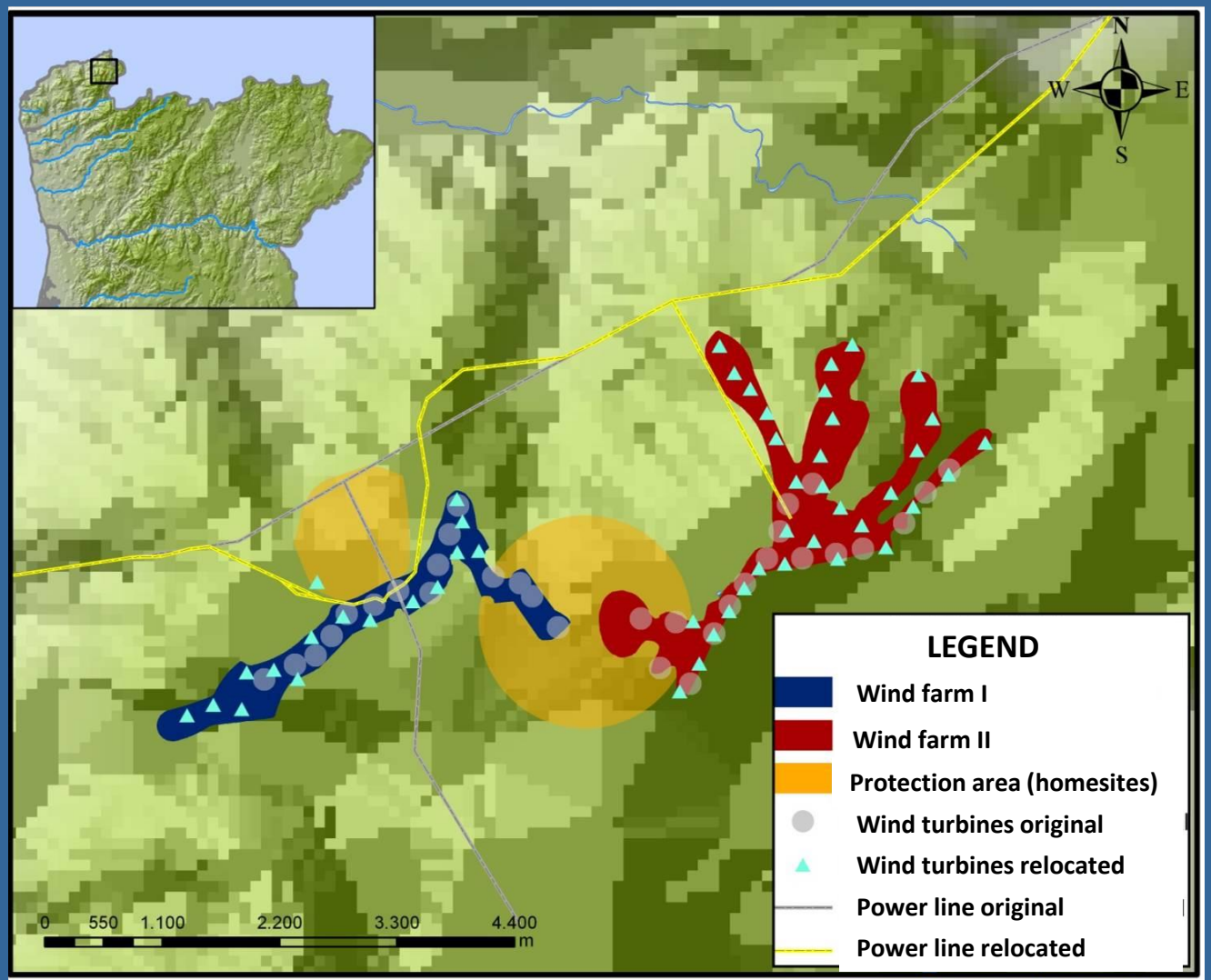
Potential cumulative effects from other sources of human or habitat disturbance (e.g. additional infrastructures, forestry, fires)

Based on these findings, several preventive mitigation and compensatory measures have been defined in EIA (for projects with > 9 wind turbines)

Source: Serronha et al. (2020). Thechnical report.

Mitigation measures

- Pre-construction phase: wind farm design and planning



No guidelines available for national level and assessment done separately for each wind farm

Buffer of 1 km radius around known wolf breeding sites as no-construction area (wind turbines, roads and powerlines)

Mitigation measures

- Construction phase:

Protection of nearby pack breeding sites (<3-4 km but no exact rule)

No work during birth and pup-rearing season (May-September)

No nocturnal work during periods with higher wolf activity (1h before sunset and 1h after sunrise)

- Operational phase:

Closing road net-work built for wind-power development to reduce traffic and direct human disturbance

Contracting vigilance personal to avoid traffic circulation not related to wind farm maintenance

Compensation measures

Compensatory measures focused mainly on habitat improvement and management for wolf conservation

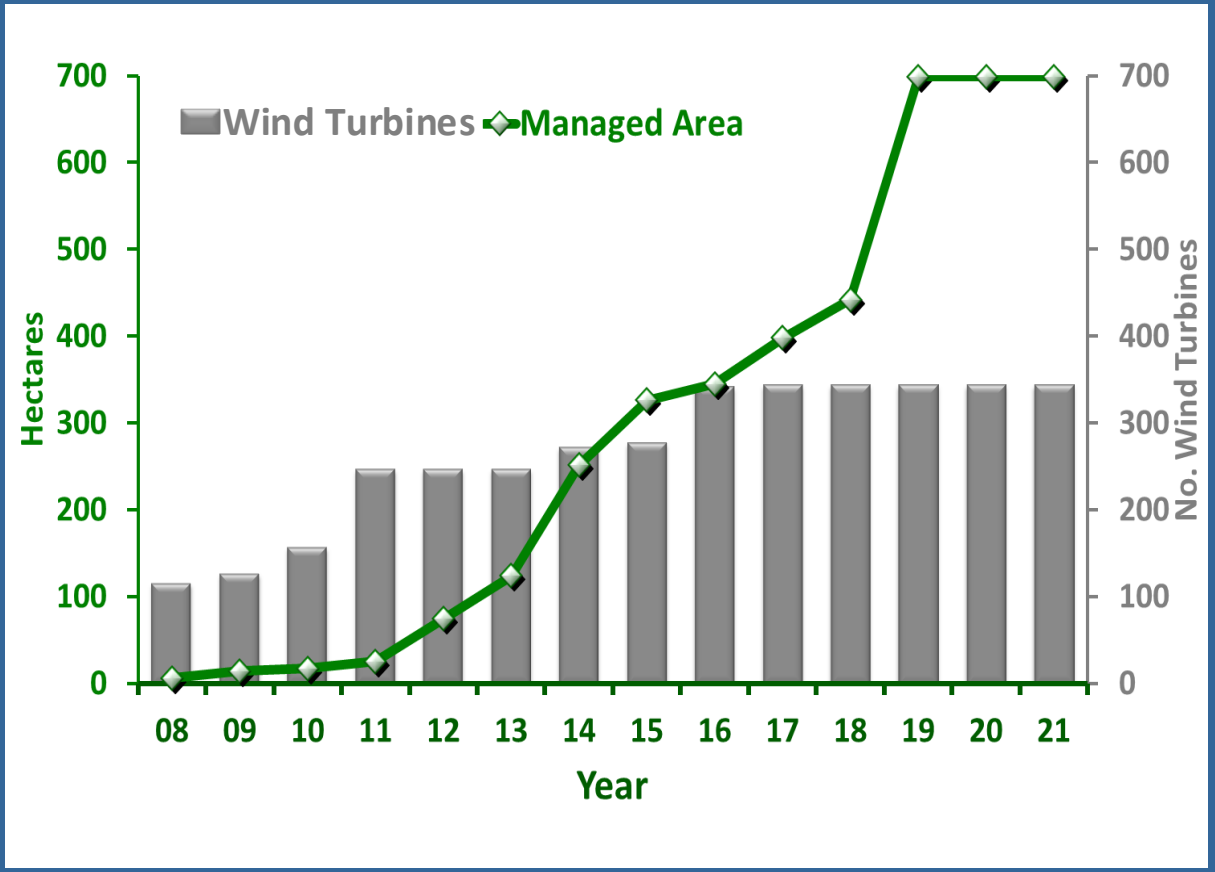
Mostly applied inside the pack territory directly affected by the wind farm but also at a regional level (adapted to local ecological conditions and requirements)

Cover a wide range of traits related to wolf habitat, namely:

- **Improve habitat suitability and refuge conditons (for both wolves and wildprey)**
- **Reduce human disturbance and human-cause mortality**
- **Increase wild prey availability**
- **Promote damage prevention measures**
- **Promote public awareness and education**

Compensation measures

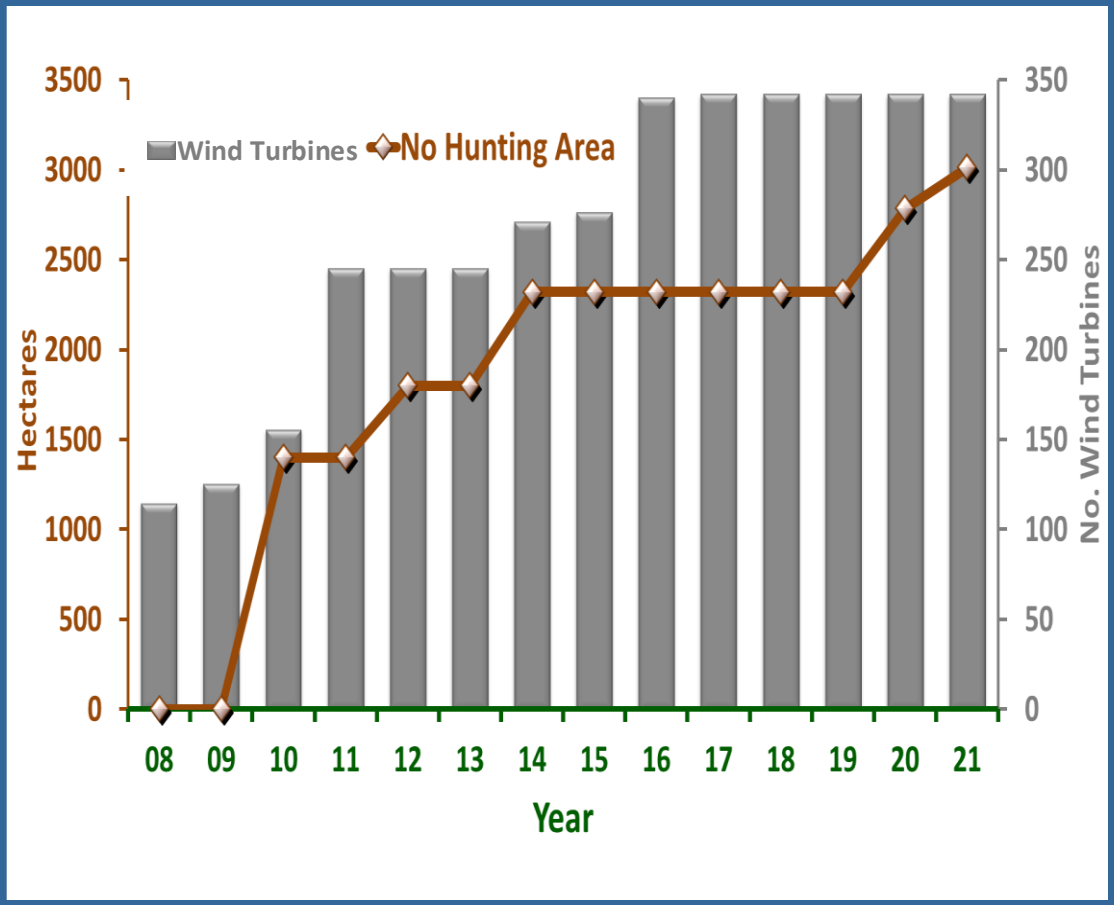
- Forest management



- Promote native forest for refuge of wolves and wild prey
- Total 700 ha (≈ 2 ha per wind turbine)
- 14 areas, ranging from 2.3 to 139 ha
- All interventions are on communal lands
- Long term agreements (10 to 20 years)

Compensation measures

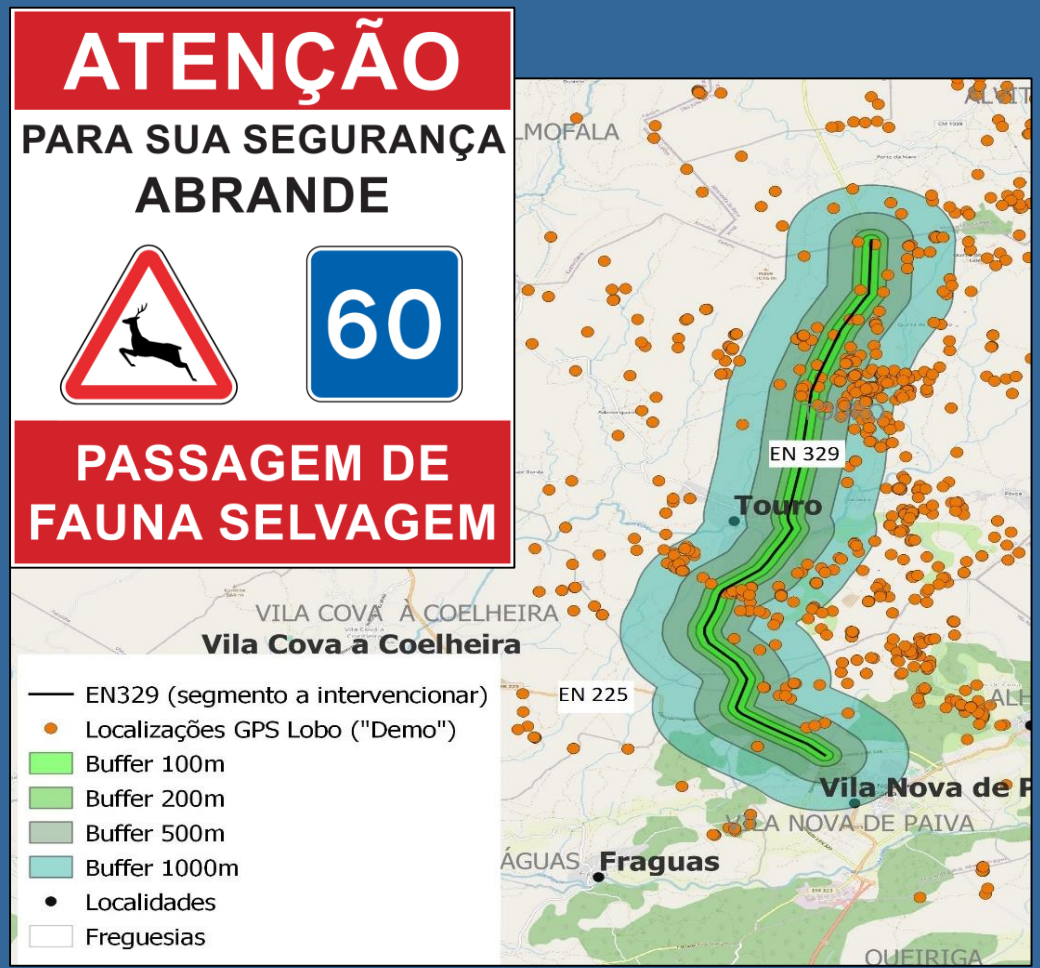
- Hunting management



- Implementation of no-hunting areas for refuge of wolves and wild prey
- Located in areas of high wolf activity and breeding sites
- Total 3013 ha (≈ 10 ha per wind turbine)
- Continuous areas of more than 400 ha
- Agreements with local game managers – promote small game habitat

Compensation measures

- Decrease human-caused mortality

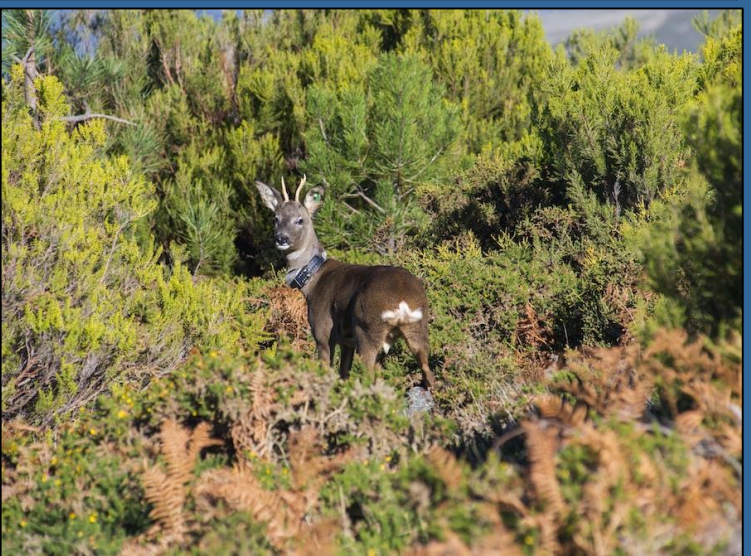


Mitigation of vehicle-wildlife collisions in known hotspots with road killed wolves

Delimitation of the road section to be intervened based on movements from GPS collared wolves and known road causalities with wildlife

Compensation measures

- Wild prey reintroduction



Promote wild prey as a natural and stable food resource for wolves

114 roe deer released since 2013, particularly in areas with wild prey scarcity (South Douro)

Established under IUCN guidelines

Post-release monitoring with GPS-telemetry and evaluation of consumption by wolves

Developed in articulation with other research institutes

cesam universidade de aveiro centre for environmental and marine studies

Compensation measures

- Damage prevention measures

Promote measures to prevent wolf attacks on livestock

Construction of wolf-proof fences for nocturnal confinement of cattle

77 livestock guarding dogs given to local shepherds since 2014

Regular evaluation of dog performance and sanitary conditions

Developed in articulation with other NGOs or research institutes

GRUPO LOBO

Compensation measures

- Public awareness and education

- Improve public knowledge and positive attitudes towards wolves
- Creation of an educational kit with games for school children
- Creation of a traveling exhibition with photos and text
- 7 sessions with local communities
- 14 sessions with local schools (more than 600 students)
- 7 public exhibitions within wolf range

Conclusions and Conservation implications

Wind farms appear to induce changes in large carnivore behaviour:

- **space use**
- **reproduction rates**
- **breeding site selection and fidelity**

These ecological responses may increase exposure to other threats or sources of disturbance, especially in highly humanized and heterogeneous landscapes such as southern Europe

Need for long-term monitoring during post-construction to access:

- possible effects on reproductive success and population viability,

- decrease in impact magnitude due to wolf habituation to wind farms

Mitigation and habitat management as important precautionary measures for a “wolf inclusive wind farm development” – the ACHLI example

Thanks!

Questions?

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Mónia Nakamura (CIBIO-UP)

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Raquel Godinho (CIBIO-UP)

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Carlos Fonseca (UA)

Rita Torres (UA)

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