Collision, displacement and barriers effects – combining multiple effects for Environmental Impact Assessments

Report carried out on behalf of Natural England

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BTO

Objective 1 – Summarise the evidence for collision, displacement , and barrier effects, then identify where two or more effects could operate together.

- 54 species considered.
- Scores derived for:
  - Collision risk - flight characteristics (Bradbury *et al.* 2014).
  - Displacement - species ecology (Bradbury *et al.* 2014).
  - Barrier effects - ? Other reviews (Langston 2010)

- RESULT: None of the species on assessed, on this basis, required the effects to be combined.

Objective 2 – Collate how collision, displacement and barrier effects have been combined by OWF project applications.

- Effects not combined – adult mortalities calculated separately for collision and displacement (e.g. Hornsea).
- Effects combined by simple addition of calculated adult mortalities for collision and displacement (e.g. Navitus Bay Wind Park).
- Effects combined by use of the **Displacement as Habitat Loss** for adult mortality – corrected population density then used to calculate annual aduly collision mortality (e.g. Dogger Bank Creyke Beck).
- Effects combined by calculating reduced breeding success for all displaced birds and mortality for collision for all age classes (e.g. MORL and BOWL).

Objective 3 – Derive potential methodologies for combining the effects of collision, displacement and barrier effects into a single metric of impact.

Impacts of displacement/barrier effects

- Increased chick mortality (decrease in productivity)
- Increased juvenile mortality
- Increased immature mortality
- Increased adult mortality
- Breeding adults become non-breeders

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STAGE 1

Decide which demographic rate is likely to be affected by each effect and to what extent – "matrix approach" taking into account relevant studies/expert opinion?

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STAGE 1 - continued

Table 1. Potential age-related demographic impacts needing to be considered in combination.

Impact	**Displacement/barrier effect**	**Collision effect**
Increased chick mortality	Y	Y (as juvenile)
Increased juvenile mortality	Y	Y
Increased immature mortality	Y	Y
Increased adult mortality	Y	Y
Breeding adults stop breeding	Y	-

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STAGE 2

Choose between two main options:

1) Additive Mortality

$$\sum \text{combined impacts} = \sum \text{collision mortality} + \sum \text{displacement/barrier effects mortality}$$

2) Displacement/Barrier Effect Corrected Additive Mortality

$$\sum \text{combined impacts} = \sum \text{corrected collision mortality} + \sum \text{displacement/barrier effects mortality}$$

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STAGE 3

Decide whether the impacts on demographic rates change over time as population size decreases (density dependence processes operating)?

Select which population modelling framework is the most appropriate:

- PVA
- PBR
- ABC
- IBM

Objective 4 . To identify key evidence gaps (OWFs)

Limited evidence for wind farm effects.

- Increasing information on displacement and to a lesser extent on barrier effects
- BUT nothing on collision mortality.

Lack of empirical data for population level consequences for these effects considered separately – let alone when combined .