

CENTRE FOR EVIDENCE BASED CONSERVATION

Systematic review No. 4

Working title: the effects of wind turbines on birds

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Review Protocol

1. Background

The broad weight of current scientific opinion supports the view that anthropogenically caused climate change is a reality. To minimise gaseous emissions linked with climate change, the energy production industry is moving increasingly toward renewable sources. Wind energy is set to make a substantial contribution to the generation capacity of many European countries. The UK Government has set a target to generate 10% of the UK's electricity from renewable sources of energy by 2010 and 5% by 2003. Wind energy is now recognised as the fastest growing energy technology in the world, with the yearly growth rate estimated at 30%. In the UK alone there are currently 1060 turbines in 83 wind energy installations, and many more with planning consent (BWEA 2004).

A typical wind farm of 20 turbines might extend over an area of 1 square kilometre. It is generally agreed that the ideal position for a wind turbine generator is a smooth hill top, with a flat clear fetch, at least in the prevailing wind direction. Wind farms are sited in exposed areas to ensure high average wind speeds to maximise energy capture, a requirement commonly but not exclusively met in coastal, upland and offshore areas. Such locations often comprise some of the most important and sensitive habitats and therefore wind energy developments have potentially deleterious environmental impacts, including those on bird species.

Langston and Pullan (2003), the most recent of the four previous reviews on the subject (Crockford 1992; Gill *et al.* 1996; SGS Environment 1996, Langston and Pullan 2003), identified the main potential hazards to birds from wind farms as disturbance leading to displacement or exclusion from areas of suitable habitat, collision mortality and loss of, or damage to, habitat resulting from wind turbines and associated infrastructure. Bird groups identified as of particular concern were raptors (order Falconiformes, families Pandionidae, Accipitridae, Falconidae) breeding waders (uplands), swans, geese, coastal waders, common scoters *Melanitta nigra* at sea, and sea ducks in general.

Environmental Impact Assessments for proposed wind energy projects currently include evaluation of potential adverse effects on the biological environment, including bird species. However, there has been no systematic assessment of evidence for the impact of existing facilities on birds at a population level.

2. Specific objective of the review

To evaluate the effects of wind turbines on bird species and answer the following questions:

2.1. Primary question

“Do wind energy installations negatively affect the size, distribution or dynamics of bird populations?”.

This question is based upon table 1. The question deals with ultimate effects at population level.

Table 1. Definitions of components of the primary systematic review question

Population	Intervention	Outcomes	Designs
Bird species (Groups of particular concern: Raptors [order Falconiformes, families Pandionidae, Accipitridae, Falconidae] Breeding waders [uplands] Non-breeding swans, geese, coastal waders, seaducks in general, and common scoters at sea)	Wind turbine developments (wind turbines, wind farms, wind parks, wind installations, offshore, onshore) vs. pre-development baseline or reference sites	Population size Population distribution Breeding success Mortality rates Recruitment rate Turnover rate Immigration rate Emigration rate Demography Dispersal behaviour	Primary, quantitative studies with comparators as defined in intervention column

2.2. Secondary question

“Do the direct impacts of wind energy installations on bird species vary with their location, siting or design?”

This question is based upon table 2. Due to the large numbers of confounding factors involved in investigating the effects of turbine design, siting and location, only experimental studies with appropriate controls will be accepted.

Table 2. Definitions of components of the secondary systematic review question

Population	Intervention	Outcomes	Designs
Bird species (Groups of particular concern: Raptors [order Falconiformes, families Pandionidae, Accipitridae, Falconidae] Breeding waders [uplands] Non-breeding swans, geese, coastal waders, seaducks in general, and common scoters at sea)	Wind turbine developments (wind turbines, wind farms, wind parks, wind installations, offshore, onshore) Comparators are different turbine designs, different locations and different siting arrangements	Collision mortality Displacement disturbance Movement impeded Habitat loss or damage	Primary, quantitative studies

3. Methods

3.1. Search strategy

3.1.1 Computerised database searches:

- English Nature's "Wildlink"
- JSTOR
- Index to Theses Online (1970 to present)
- Internet search – Dogpile meta-search engine
- SCIRUS
- COPAC
- ISI Web of Knowledge, comprising:
 - ISI Current Contents: 1997 to present
 - ISI Proceedings: 1990 to present
 - ISI Web of Science: 1975 to present

3.1.1.1 English language search terms

3.1.1.1.1 Non-internet searches

The following terms will be used, (where * denotes a wildcard):

1. bird* AND windturbine*
2. bird* AND windfarm*
3. bird* AND windpark*
4. bird* AND wind AND turbine*
5. bird* AND wind AND farm*
6. bird* AND wind AND park*
7. bird* AND wind AND installation*
8. raptor* AND wind*
9. wader* AND wind*
10. duck* AND wind*

11. swan* AND wind*
12. geese AND wind*
13. goose AND wind*

Although the term “wind*” would encompass the terms “windturbine*”, “windfarm*” and “windpark*”, in addition to all strategies using the word “wind”, initial trials have proven that the number of hits becomes unmanageable when using this strategy in conjunction with the term “bird*”, and exceeded the JSTOR database limit of 2500, for example.

3.1.1.1.2 Internet search

We will search internet in English using the Dogpile meta-search engine advance search facility, and the term “bird AND wind AND turbine”.

3.1.1.2 Foreign language

Dogpile meta-search engine strategies:

- German “Vögel AND Windturbinen”
- French “oiseaux AND turbines AND éoliennes”
- Spanish “pájaros AND turbinas AND viento”
- Dutch “vogels AND windturbinen”
- Norwegian “fugle AND vindkraft”
- Danish “fugle AND vindkraft”
- Finnish “lintu AND vindkraft”
- Swedish “fåglar AND vindkraft”
- Italian “uccelli AND vento AND turbina”
- Portuguese “pássaros AND vento AND turbina”

These languages cover the following countries with wind energy developments, according to AWEA (2003): Germany, Spain, Denmark, Italy, Netherlands, UK, Sweden, France, Portugal, Austria, Ireland, Belgium, Finland, Norway, Switzerland, Australia, Morocco and others with one of these languages in official use. Internet searches are unavailable in languages of other significant wind power nations including India, Japan, Greece, China and the Ukraine. However, the English language search may retrieve English language translations from these countries.

3.1.2 Other sources

We will hand-search the **RSPB library**. In addition, we will search **bibliographies** in articles accepted for full text viewing and those in otherwise relevant secondary articles. Where appropriate, we will **contact authors** for any “missing” data. We will also **contact recognised experts** and **current practitioners** in the fields of applied avian ecology and renewable energy technology, a) at the search stage, to identify possible sources of primary data, and b) at the later stages, to verify the thoroughness of our literature coverage.

3.2. Study inclusion and exclusion criteria

For internet searches of relevant sites, we will perform “hand” (following links) or, where available, electronic site searches of the first 100 “hits” for each search engine within the meta-search. Articles identified by this process will then be assessed in the same manner as other articles.

- **Relevant subject** any bird species
- **Type of Intervention** commercial wind installations: wind farms and turbines
- **Type of comparator**
 - Primary question:** appropriate controls (e.g. reference areas) or pre-development comparators
 - Secondary question:** none
- **Type of outcome**
 - Primary question:** population size or distribution, breeding success, population mortality rate, recruitment rate, turnover rate, immigration rate, emigration rate, demography, dispersal behaviour.
 - Secondary question:** collision mortality, displacement disturbance, movement impeded, and habitat loss or damage
- **Type of study** any primary, quantitative studies

Two reviewers will independently screen search results for inclusion at full text stage. Titles and abstracts will be assessed by one reviewer, with reference to a second opinion in cases of uncertainty.

3.3 Study quality assessment

At full text viewing stage, two independent reviewers will assess quality and suitability for inclusion in the review on a consensus basis.

3.4. Data extraction strategy

Study and evidence details will be extracted using an appropriate recording form (appendix 2). Two independent reviewers will make decisions regarding what data are extracted, again by consensus.

3.5. Data synthesis

Where valid, studies will be combined in a meta-analysis of effect size. If study quality is insufficient and/or pooling data is invalid, a narrative synthesis will be produced.

4. Potential conflicts of interest and sources of support

No conflicts of interest declared. Systematic Review funded by English Nature.

5. References

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