

Scottish Natural Heritage

Assessing the cumulative impacts of onshore wind farms on birds

Guidance

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Purpose

The individual and combined (cumulative) impacts of developments on the natural heritage need to be carefully considered in the planning process. This guidance sets out our advice for developers, and their ecological consultants, on assessing cumulative impacts of onshore wind farms on birds.

Although it concentrates on assessing the cumulative impacts from wind farms, impact assessments should not be restricted to these but should include all plans or projects in the area, such as mineral extraction, built development, power lines, telecommunications masts, forestry or recreational pressures. The methods presented in this guidance may be helpful when considering these also. Any associated development (i.e. grid connections or track construction) should be considered within the cumulative impact assessment.

This guidance is restricted to onshore wind farms (or other onshore developments) and complements our other advice on the ornithological assessment of onshore wind farms which can be found on our [website](#). In addition, the Scottish Wind Farm Bird Steering Group published a review of cumulative impact assessments in the context of the onshore wind farm industry ([Humphreys et al. 2016](#)).

Background to wind farm impacts on birds

Operational wind farms are known to have a number of impacts on birds and bird populations. These impacts have been documented at wind farms both onshore and offshore, and can apply to one or more bird species. These are well described in the scientific literature and include:

- collision with turbine towers, blades (moving or stationary) and/or associated infrastructure;
- displacement of birds due to loss of suitable feeding and/or breeding/wintering habitat;
- disturbance within and around the turbine envelope; and
- creating a barrier to dispersal, regular movements or migration.

The impacts on all sensitive bird species that are present on, or adjacent to, the proposed wind farm site are usually addressed in an Environmental Impact Assessment ([EIA](#)). Guidance, for example '[Recommended survey methods to inform impact assessment of onshore wind farms](#)', published on our website identifies which species should be prioritised for assessment. This is mainly based on species' legal and conservation status, both nationally and internationally.

Collision risk for sensitive species is usually calculated for onshore wind farm applications using the Band Model (Band *et al.*, 2007). Collision Risk Modelling (CRM) produces indicative figures for annual losses (individuals per annum) or a total sum over the lifetime of the wind farm (typically 25 years). To estimate cumulative impacts, CRM values are summed for each species across all the relevant wind farms. To adjust for the different timescales over which wind farms will be developed it is important that comparison is made on annual rates of collision mortality and not total estimated mortality.

Displacement occurs when a bird changes its range use, territory use or flight pattern between roosting areas and feeding areas over time so that the range use (or flight paths) no longer brings birds into the vicinity of an operational wind farm. Displacement effects result in a loss of habitat for a species, and this is likely to be long term unless birds habituate to the development. We differentiate between displacement and disturbance, the latter being short term and may occur primarily during construction.

The level of **disturbance** caused to birds is more difficult to assess because it relies on predictions of how birds will respond behaviourally. Since the potential for habituation is rarely taken into account, predicted losses from the development area may exceed reality. Birds may also tolerate levels of disturbance up to a critical disturbance threshold above which they will avoid the development area. Qualitative assessments may be all that is possible in these situations.

Wind farms may act as a **barrier** to species that commute between a roost site or breeding area and a feeding locality. Under this scenario birds may be forced to move round the wind farm (e.g. Masden *et al.*, 2009), or gain altitude and fly well above turbine height. Regularly undertaking such movements has an energetic cost.

The nature of cumulative impacts

Cumulative impacts arise when there are effects from two or more developments. These may be:

- additive; or
- antagonistic (i.e. the cumulative impact is less than the sum of the multiple individual effects); or
- synergistic (i.e. the cumulative impact is greater than the sum of the multiple individual effects e.g. CEFAS (2001), Foden *et al.* (2010)).

While antagonistic or synergistic effects may occur, the approach adopted in this guidance is the simpler additive model which sums impacts from different developments. The Scottish Wind Farm Bird Steering Group's review ([Humphreys *et al.*, 2016](#)) looked at five approaches: i) qualitative descriptions; ii) simple summation of quantified site-based impacts across multiple sites; iii) the conversion of site-based impacts into a basic demographic model; iv) more complex demographic models including site-specific parameters, density dependence and dispersal and; v) Individual- or Agent-Based models which model individual behavioural responses to predict population-level impacts. It concluded that the most appropriate technique to use would depend on the species and circumstances under consideration and that demographic modelling approaches are likely to be preferable in most circumstances. Whilst simple summation approaches may not reflect biological realism for many species they are often the most usable approach. Summing impacts can, however, lead to individual errors being compounded and in some cases correction may be needed when receptor populations are small. Where a cumulative impact of national or regional significance is possible we are likely to require population viability analyses to be undertaken. Further information on how to correct cumulative mortality calculations for losses is available in Maclean & Rehfisch (2008).

It is important that impacts on birds are quantified in order to provide comparable data that can be combined to investigate cumulative impacts. In practice, however, some effects such as disturbance or barrier effects may need considerable additional research work to assess impacts quantitatively. A more qualitative process may have to be applied until quantitative

information becomes available for developments in the area, e.g. from post-construction monitoring or research.

The following assumptions are made when calculating cumulative impacts:

- Impacts remain constant over the life-time of the development;
- Impacts are independent of changes in population size or species distribution (N.B. this can be partially addressed through population modelling); and
- Collision risk estimates are independent of collision risk estimates of nearby wind farms.

The scale at which impacts should be assessed

The impacts of wind farm (and other) developments on any species population can be assessed at a number of scales, ranging from the very local (e.g. on the wind farm site, designated site, etc.); at a regional scale, such as a Natural Heritage Zone (NHZ); and at a national (i.e. Scottish) scale. The issue of scale at which impacts are assessed has been dealt with in other SNH guidance, outlined below, and will not be discussed in detail here.

Developments that are [likely to have a significant effect](#) (LSE) on Special Protection Areas (SPA) or Ramsar sites, either alone or in combination with other plans or projects, require a Habitats Regulations Appraisal (HRA) in line with [the requirements of the 'Habitats Regulations'](#). If there is an LSE, the HRA must include an [appropriate assessment](#) of the impacts of the project. This should be carried out by the competent authority, with information provided by the developer, and be conducted in relation to the conservation objectives of the SPA.

Our prime aim is to maintain the conservation status of the species population at the national scale. We assess impacts on a species' population size, its population trend and its natural range within Scotland either nationally or regionally, where regional impacts have national implications (for example where a specific region holds the majority of the national population). For wind farms which do not have an impact on designated sites, our guidance on ['Assessing significance of impacts from onshore windfarms on birds outwith designated sites'](#) highlights the relevance of the Natural Heritage Zone (NHZ) as the basis for the geographical range selection.

Recording cumulative impacts

Cumulative impacts should be summarised in a table or a spreadsheet, with a separate worksheet for each species. An example is given in **Annex I**. The benefit of a spreadsheet is that the table of impacts can be updated as additional wind farms are added, and various permutations of wind farm order can be developed (see later). We hold some of the required data, but it will be for the person undertaking the assessment to source and verify all data required.

Additional information, such as the date the consent was given or planning application was formally submitted, the turbine number, and total turbine area (with buffer) should be included in the table.

Cumulative assessment is an ongoing process. These tables or spreadsheets must take account of new information or changes in important parameters (such as avoidance rates).

As post-construction studies are completed and published, generic conclusions should also be factored in where these have a material effect on earlier cumulative assessments

The order in which developments should be factored in when considering cumulative impacts is set out below:

- Developments that are already operational, and those that are consented, and likely to be built should be considered first as the impacts arising from these (once mitigation has been factored in) are unavoidable.
- Applications that have been formally submitted to a planning authority or Scottish Government but have yet to be determined, consented and built developments applications should then be factored in. Confidential data (e.g. on Schedule 1 species) from such assessments will not necessarily be in the public domain.

The same principles apply to other developments though they may not have the same range of impacts identified for wind farms. For example, a new power line may increase collision risk, unless birds avoid the power line altogether, but may present little additional disturbance or habitat loss.

Judgements on cumulative impacts should also take into account mitigation or enhancement measures which are provided to offset some of the resulting adverse impacts arising from wind farm construction but only when the benefits are demonstrable or there is a high degree of confidence that they will lead to such benefits.

Data Needs

Under normal circumstances, we will expect the developer to undertake the cumulative impact assessment as part of the EIA process. However, it is recognised that developers will need access to data for such assessments, and that access to such data will not always be possible.

Data for cumulative impact assessments will generally be derived from Environmental Statements. Unless there is good reason not to do so, figures will be accepted as presented in the various source Environmental Statements. Developers should also refer to our response letters to ensure they have the agreed figures, as there are occasions where we disagree with the information presented in Environmental Statements.

We can also help to identify, at scoping, those developments that need to be incorporated in to the cumulative assessment.

In some cases it may be necessary to consider offshore developments where these may have an impact on terrestrial species' populations (e.g. some gulls that use inland and coastal habitats).

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Versions

First issued August 2003
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- Summary of key changes: separated from cumulative landscape impacts guidance, no substantive changes, key references and guidance documents updated, revised format.

References

- CEFAS (Centre for Environment, Fisheries and Aquaculture Science) (2001). *Cumulative environmental impacts of marine aggregate extraction*. Project Code AO903. Department for the Environment, Food and Rural affairs (Defra) London. Available from <http://dx.doi.org/10.1016/j.marpolbul.2008.08.017>
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- Masden, E.A., Haydon, D.T., Fox, A.D., Furness, R.W., Bullman, R & Desholm, M. (2009). Barriers to movement: impacts of wind farms on migrating birds ICES Journal of Marine Science. 66: 746-753. Available from <http://icesjms.oxfordjournals.org/content/66/4/746.abstract?keytype=ref&ijkey=kVbb66JDoOyQX7a>
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Annex I. Cumulative impact assessment for bird species - Example matrix

Cumulative Impact Assessment for {development name}											
Species						NHZ					
						Designated Sites(s)					
Site	Date	Collision mortality		Displacement effects		Barrier effects		Habitat loss		Turbine number	Turbine Area
			Σ		Σ		Σ		Σ		
Cumulative Effect (Σ)											