Avoiding ecological 'constraints' in wind energy

Genevieve Hayes[1], Dr. Benedict Gove[2] and Samir Whitaker[3]

Abstract: *Significant investment in wind energy has been planned on a global scale. While the extent and rate of the development of this sector raises challenges for the industry, with careful planning the needs of society could be met through wind energy without developing in areas where significant environmental damage could occur. This paper will focus on the potential to avoid impacts of wind farm developments on avian fauna through strategic planning, site selection, environmental impact assessment, mitigation (including shut-down-on-demand) and collaboration to help the industry achieve ecological sustainability. We will focus on the work of BirdLife International and the Royal Society for the Protection of Birds, and draw on case studies from research by these two organisations within the European context. While much data exists to guide planning and siting of wind farms, better collaboration between developers, national and local governments, consultants, and Non-Government Organisations is needed in order to share data and increase the degree to which it is incorporated into planning decisions.*

Introduction:

The global capacity of renewable energy has doubled in the period from 2000 to 2013, with onshore wind accounting for 18% of the 1,682 GW of renewable electricity produced in 2013, with 0.4% provided by offshore wind. The proportion of the total renewable energy generated by onshore wind has increased 9-fold since 2000, when it accounted for just 2.1% (IRENA, 2014). The fact that wind energy has increased in capacity faster than any other form of renewable energy (REN21 report, 2013) presents both challenges and opportunities for the industry to lead the way as an ecologically sustainable source of energy. However, impacts of wind farms on avian fauna can include habitat loss, collisions with wind turbines and infrastructure, disturbance/displacement, barrier effects and indirect impacts (Langston and Pullan, 2003; Gove et al. 2013). Species groups which may be especially at risk of collision include migratory soaring bird species such as storks and cranes, birds of prey such as eagles and hawks, and some species of sea birds (Ledec et al. 2011). However, habitat displacement is also a key threat for species in open country, such as breeding waders (Pearce-Higgins et al., 2009, 2012), geese and swans (Rees, 2012) and Prairie grouse (Obermeyer et al. 2012).

This paper will focus on how wind farm development relates to the mitigation hierarchy, which requires that developments first avoid impacts, minimise those which cannot be avoided, restore areas where possible and offset residual impacts (BBOP, 2012). The avoidance stage is essential, and should be implemented from the outset during planning and design (EC, 2010). This paper will focus on the potential means of avoiding impacts of wind farm developments on avian fauna through strategic planning, environmental impact assessments, mitigation and collaboration (Gove *et al*., 2013). Information discussed here was gathered through discussions with key experts at BirdLife International and the RSPB, as well as literature analysis.

[1] Research Assistant at BirdLife International (Cambridge, UK) genevieve.hayes@birdlife.org
[2] Senior Conservation Scientist at the RSPB Centre for Conservation Science (Sandy, UK) Benedict.Gove@rspb.org.uk
[3] Programme Manager at BirdLife International (Cambridge, UK) Samir.Whitaker@birdlife.org

1. Strategic planning and site selection:

In order to most successfully avoid the negative impacts of wind farms, location is of critical importance (Langston and Pullan, 2003; Gove *et al*., 2013). Taking a strategic approach at the landscape scale early in the planning stage will both avoid impacts to biodiversity and reduce the risk to developers (EC, 2010; Northrup and Wittemyer, 2013). Guidance in this area should be based on developing databases and mapping tools which allow developers to identify vulnerable species and populations, important flight paths, and sensitive habitats (Bright *et al*. 2006, 2008). This will allow the effective allocation of resources on assessing impacts on target species. Sensitivity maps may be developed at the local, national or regional level depending on data, scale of impacts, and intended purpose (Gove *et al*., 2013).

A precautionary approach should be taken when defining areas as either suitable or unsuitable for wind farm development, especially with regard to those near to, or within, protected areas and flyways[4]. Avoidance based on legal designations and the distribution of sensitive species is currently easier for onshore wind projects than those offshore, as data is still lacking for the marine environment. The Future of the Atlantic Marine Environment (FAME) project, and the more recent Seabird Tracking and Research (STaR) project, have advanced the use of GPS tags for multi-colony tracking of seabirds and are using oceanographic data to interpret distributions and behaviour at sea (e.g. to identify hotspots of seabird activity to determine the most sensitive areas) (spea, 2010). Satellite tracking of specific species (e.g. Northern Gannet) has also highlighted areas of overlap between offshore wind farms and foraging/breeding areas (Langston et al., 2013). This data will ensure better planning and fewer risks to biodiversity, as well as aiding cumulative assessments of offshore energy developments and management of marine protected areas.

The BirdLife Soaring Bird Sensitivity Map for the Red Sea/Rift Valley flyway region (tinyurl.com/MSBmap) can be used to investigate the sensitivity of a potential wind energy site for collision, displacement or barrier effects. The tool draws together spatial data on the distribution and abundance of soaring bird species that are particularly vulnerable to turbine collision (BirdLife MSB Project, 2013). The distribution of thousands of soaring birds has been documented alongside hundreds of satellite tracking routes of individual birds. The tool also provides a sensitivity value based on an analysis of the available soaring bird data, generates tailored reports for each search, and provides additional best practice guidance material.

At the national scale, the Scottish 'Birds and wind farms' sensitivity map has been produced by RSPB Scotland (BirdLife UK) and Scottish Natural Heritage (Bright *et al*., 2006; 2008). For each of the 18 species identified as sensitive to wind farm development, evidence on foraging ranges, collision risk and disturbance was reviewed to determine appropriate buffering distances. The findings were used to create a map of Scotland with each 1 km square classified as 'high', 'medium' or 'low/unknown' sensitivity. The Highland Council and Scottish Natural Heritage have

[4] *The BirdLife Flyways Programme is working on the ground to protect chains of Important Bird Areas that are critical for migratory birds, and to reduce threats along these routes."* (BirdLife, 2015)

since used these maps to inform deployment strategies and produce location guidance, and some developers have used them for site selection or to identify key species.

2. Environmental Impact Assessments (EIAs) and Strategic Environmental Assessments (SEAs)

While the tools mentioned above are useful, sensitivity mapping cannot replace EIAs and SEAs (Marques *et al*. 2014). Sensitivity maps can only provide a broad evaluation of potential risk and data deficiency. They cannot be comprehensive, or assess the impacts on a population of a particular development. EIAs are therefore an essential part of impact avoidance and conflict mitigation. They should be carried out at the appropriate geographic scale for the species being assessed to identify key species distributions and habitat use, and outline potential impacts including displacement, barrier effects and collision risk. EIAs can also highlight the need for pre-construction surveys and post-construction monitoring (Gove *et al.* 2013).

Within the EU, the requirement for EIA comes from European Directive 85/33/EEC (as amended by 97/11/EC and 2003/35/EC), which requires an Environmental Statement describing the predicted effects of a development and proposed mitigation measures (EC, 2003). The 'SEA' Directive (2001/42/EC) also requires "*an environmental assessment is carried out of certain plans and programmes which are likely to have significant effects on the environment*" (European Parliament, 2001). Assessment of direct and indirect forms of mortality, both additive and compensatory, should be included. Within Natura 2000 sites, Member States must maintain habitats and species for which the site has been designated (Habitats Directive, 92/43/EEC, Article 6.1) and avoid activities that could significantly disturb these species or result in deterioration of the habitats (Article 6.2) (EC, 2015). Articles 12 and 13 of the Habitats Directive require Member States to protect listed species and Article 5 of Birds Directive (2009/147/EC) requires Member States to establish a general system of protection for all wild bird species throughout their natural range (within Europe). Together, the Habitats and Birds Directives require that wind energy developments do not cause significant damage or disturbance to species or habitats covered by the Directives.

However, EIAs are not perfect many simply record the abundance of sensitive species (Thompson et al. 1997) and cumulative impacts are rarely considered in sufficient depth (Cooper and Sheate 2002). De Lucas *et al*. (2008) argues bird abundance and collision mortality are not necessarily closely related, and Ferrer *et al*. (2012) found no relationship at all between the number of birds observed during pre-construction EIAs and the number of subsequent post-construction bird fatalities. Collision risk modelling may be required within EIAs to assess risk based on species flight height and behaviour, as well as turbine characteristics (Band *et al*. 2007). However, collision risk model predictions may not always match observed fatalities as accounting for all potential factors would be unfeasible (Ferrer *et al*. 2012). There may be numerous factors that determine the likelihood of collisions and these will be highly species and site specific (Gove et al. 2013). Thus sensitivity maps and EIAs must be interpreted with care.

3. Mitigation

There are a variety of mitigation measures that can be implemented to avoid impacts. These include micro-siting of individual turbines and infrastructure to avoid areas occupied or used by sensitive species, orientation of turbines in parallel to common flight lines, undergrounding of associated power lines or marking of overhead wires, modifying turbine type and operation (e.g. increasing cut-in speeds or shut-down-on-demand, taller or shorter towers), and avoiding the use of guy lines (Marques et al. 2014). Land management (both on and off-site), can be important to dissuade sensitive species from using areas or to encourage continued/increased use by species which are not vulnerable to collision. Buffer zones around nests will also help to avoid disturbance and collision with foraging birds, or juveniles. Construction, maintenance and movement of staff and vehicles/boats, can be timed to avoid disturbance during key periods, such as breeding and roosting. Shut-down-on-demand is increasingly being used as a method of avoiding impacts during key migratory periods due to improvements in technology. Radar based systems such as MERLIN provide data on bird activity around proposed wind farms that can be used for pre-construction collision risk assessments and for operational monitoring and mitigation. The MERLIN system can also be used to provide advance detection of bird activity, allowing the engagement of mitigation actions including idling of turbines. However, due to the highly idiosyncratic nature of bird collisions there are few generic mitigation prescriptions. Mitigation is an inherently risky course of action and should only be pursued as a last resort.

4. Conventions, collaboration and strategic planning

Co-operation, collaboration, and agreed declarations between different stakeholders are necessary to ensure successful development of wind energy while avoiding harm to biodiversity. For example, within the wider area covered by the Bern Convention, the Emerald Network is made up of Areas of Special Conservation Interest (ASCI) which are assessed at a bio-geographical level and are adopted in order to ensure the survival of species covered by the Convention (Gove *et al.* 2013). Once adopted these sites need to be designated and managed at national level. The Convention on Migratory Species also urges Parties and encourages non-Parties to: apply appropriate SEA and EIA procedures and avoid protected areas and other sites of importance to migratory species; undertake appropriate survey and monitoring both before and after development; and apply appropriate cumulative impact studies to describe and understand impacts at larger scale (e.g. at a flyways scale for birds) (Lyster, 1985).

A lack of strategic planning, collaboration and shared understanding can lead to increased project costs and delays, unnecessary duplication of data collection, and increased risks to biodiversity. There is also a reputational risk to the sector if these impacts are not incorporated into planning considerations without due care and attention. A case study of London Array illustrates the importance of post-construction monitoring: Phase 1 and Phase 2 of the project were both consented at the outset. However Phase 2 was subject to a Grampian condition[5] requiring that monitoring of the first phase of deployment would be undertaken to inform an improved risk assessment of the additional turbines. This was to ensure that there would not be

[5] "A Grampian condition is a planning condition attached to a decision notice that prevents the start of a development until off-site works have been completed on land not controlled by the applicant" (Landmark practice, 2015).

detrimental impacts to the Red Throated Diver populations within the Thames Estuary SPA. Post-construction monitoring of Phase 1 revealed the effects of the turbines were in line with worst-case-scenario predictions, and Phase 2 was dropped (London Array, 2015).

Conclusion

To conclude, the evidence illustrates that the deployment of wind power does not have to threaten biodiversity, but appropriate siting is critical and must be the primary focus at the early stages of the planning process. The development of efficient, complementary techniques that minimise mortality (of birds and bats, for example), and establish a balance between energy production and implementation costs is therefore a high priority. Although shutdown-on-demand and other such mitigation measures may be promising avoidance strategies, evidence as to their effectiveness is lacking and is likely to be location and species-specific. Finally, it is important to ensure that monitoring programs are actually implemented and that they provide robust and comprehensive results. The results of these monitoring programs, regarding both information on impacts and the effectiveness of mitigation measures, should be published and accessible (Subramanian, 2012). The renewable energy industry and planning authorities urgently need access to accurate ornithological information. This will increase the transparency and rigour of the decision making process and allow Governments to meet renewable energy targets with minimal damage to biodiversity.

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