GUIDANCE DOCUMENT

Wind energy developments and Natura 2000

nature

EUROPEAN COMMISSION

environment

FINAL DRAFT DOCUMENT

This document reflects the view of the Commission services and is not of a binding nature.

European Commission, March 2010

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This document has been prepared with the assistance of Ecosystems LTD (part of the N2K Group EEIG) under contract to the European Commission (contract N° 070307/2008/513837/SER/B2). It has also greatly benefitted from discussions with and information supplied by experts from Member States and key stakeholder groups, within the framework of an ad hoc group on wind energy and nature conservation that has met on three occasions.

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PURPOSE OF THIS GUIDANCE

Background

In December 2008, the EU adopted an ambitious and far-reaching 'climate change and energy' package which, amongst others, commits the EU-27 countries to increasing the share of renewable energy to 20% of Europe's total energy production by 2020. As a clean, renewable source of electricity, wind energy is destined to make a significant contribution to achieving this 20% target.

Wind energy in Europe has already grown rapidly over the last decade. In 2008, it accounted for around 4% of the EU's total electricity supply. This share is expected to at least triple by 2020. It is clear therefore that the number of wind farm installations across the EU is likely to increase radically in the short to medium term. It will be important to ensure that such a rapid expansion is sustainable in all respects and is done in accordance with EU environmental legislation, including the Habitats and Birds Directives.

Evidence to date shows that, although wind farms are much less of a danger to biodiversity than conventional power generation installations, poorly sited or designed wind farms can nevertheless pose a significant threat to some vulnerable species and habitats, such as certain types of birds, bats, marine mammals and fragile habitat types like blanket bogs, all of which are protected under the Habitats and Birds Directives in view of their poor conservation status.

Purpose of this Guidance document

The purpose of this document is to provide guidance on how best to ensure that wind energy developments are compatible with the provisions of the Habitats and Birds Directives. It focusses in particular on the procedures to follow under Article 6 of the Habitats Directive when dealing with wind farm plans and projects which could affect a Natura 2000 site and provides clarifications on certain key aspects of this approval process.

As such, the document is designed principally for use by competent authorities and developers, as well as consultants, site managers and other practitioners who are involved in the planning, design, implementation or approval of wind farms plans or projects. It is hoped that it will also be of interest to other organisations such as NGOs and international bodies.

Structure and Contents

The document is made up of 5 main sections:

- **Chapter 1** provides an overview of wind energy development in Europe and of the policy framework at EU level;
- **Chapter 2** introduces the key provisions of the EU's biodiversity policy and the Habitats and Birds Directives in particular. It also explores the relationship between Strategic Environmental Assessments under the SEA Directive, Environmental Impact Assessments under the EIA Directive and Appropriate Assessments under the Habitats Directive.

- **Chapter 3** reviews the potential impacts wind energy developments might have on various species such as birds, bats, marine mammals, and habitats, such as blanket bogs, that are particularly vulnerable to the construction or operation of wind farms and their associated infrastructures. The information presented here is derived from an extensive review of existing scientific literature and other recognised sources of information.

- **Chapter 4** examines the benefits of strategic planning in wind farm developments as a means to achieving a more efficient and integrated decision-making process that helps to avoid and/or minimise conflicts later on at the project level and to encourage a appropriate siting of wind farms in areas of potentially low or no conflicts for wildlife. Various good practice examples are given of how this has been achieved in different parts of the EU;

- **Chapter 5:** focusses specifically on the provisions of Article 6 of the Habitats Directive and offers a step-by-step guide to the procedures to follow when assessing wind farm plans or projects that might affect Natura 2000 sites in particular. It provides advice and guidance on how to carry out an Appropriate Assessment and how to ensure that there is a sufficiently sound scientific information base upon which to determine whether or not the project is likely to have an adverse effect on the integrity of a Natura 2000 site.

Limitations of the document

This guidance document is intended to be bound by and faithful to the text of the Birds and Habitats Directives and to the wider principles underpinning EU policy on the environment and renewable energies. It is not legislative in character, it does not make new rules but rather provides further guidance on the application of those that already exist. As such, it reflects only the views of the Commission services and is not of a legally binding nature.

It rests with the EU Court of Justice to provide definitive interpretation of a Directive. Wherever relevant, existing case law has been included when clear positions have already been taken by the Court

The document also does not replace the Commission's existing general interpretative and methodological guidance documents on the provisions of Article 6 of the Habitats Directive[1]. Instead, it seeks to clarify specific aspects of these provisions and place them in the context of wind farm development in particular. The present guide must therefore always be read in conjunction with the existing general guidance and the two Directives.

Finally, the guidance recognises that the two nature Directives are enshrined by the principle of subsidiarity and it is for Member States to determine the procedural requirements deriving from the Directives. The good practice procedures and proposed methodologies described in this document are not prescriptive in their intent, rather they aim to offer useful advice, ideas and suggestions based on an extensive review of existing experiences and good practices across the EU and beyond. For further reading, references to various national guidance documents and other sources of information are provided in the annexes.

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[1] "Managing Natura 2000 sites. The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC". "Assessments of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC". "Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC".
http://ec.europa.eu/environment/nature/natura2000/management/guidance_en.htm

1. WIND ENERGY DEVELOPMENTS IN THE EU

- *In December 2008, the EU adopted an ambitious and far-reaching 'climate change and energy' package which, inter alia, commits the EU-27 countries to increasing the share of renewable energy to 20% of Europe's total energy production by 2020;*
- *As a clean, renewable source of electricity, wind energy is destined to make a significant contribution to achieving this 20% target. It will also help to substantially reduce greenhouse gas and air pollutant emissions, as well as freshwater consumption associated with conventional power generation in the EU;*
- *Wind energy has already grown rapidly over the last decade. In 2008, it accounted for some 4 % of the EU's total electricity supply. This is expected to at least triple by 2020. This could imply an annual expansion in wind farms, both onshore and offshore, of more than 10 GW per year until 2020;*
- *A minority of Member States are currently responsible for the bulk of the EU's wind power. While this is likely to remain the case due to variations in wind resources and the availability of other renewable energy sources on the one hand and different national priorities on the other, wind energy is likely to grow siginifcantly in most if not all countries;*
- *The latest EU commitments towards renewable energy create a favourable legislative environment for wind power development whilst ensuring that it is done in accordance with EU environmental legislation.*

1.1 Wind energy in Europe – 20 years of sustained growth

Thanks to recent technological advances, the wind energy sector in Europe has undergone a rapid and sustained growth over the last 20 years. In 2008, some 4% of the EU-27's total electricity supply was provided by wind energy.

An important driver behind this fast growth is the need for Europe to have a secure supply of energy that is not reliant on external sources of gas and oil. A second major driver is the significant contribution wind energy can make in reducing greenhouse gas emissions. As a clean, renewable resource, wind energy is already playing - and will continue to play - an important role in mitigating against climate change, while at the same time bringing benefits in terms of reductions in air pollutant emissions and cooling water consumption associated with many conventional power generation technologies.

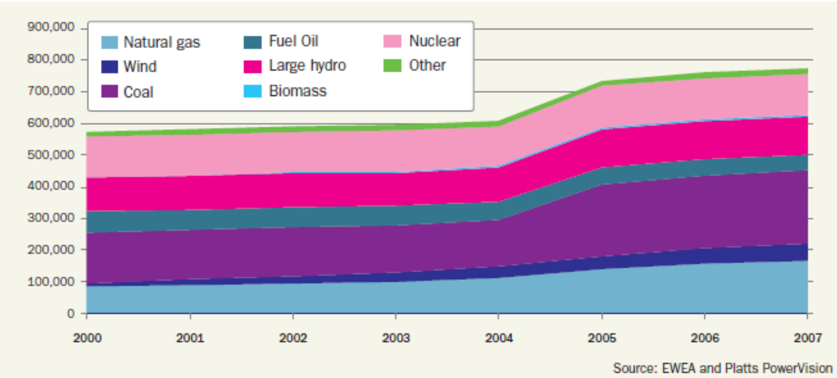

Figure 1: Installed power capacity EU 2000-2007 (MW) - EWEA 'Pure Power', March 2008

1.2 The EU Policy Framework for promoting renewable energy sources

Climate change and renewable energy are both high on the EU political agenda. The EU's renewable energy policy goes back to 1997 with the adoption of the Commission's White Paper entitled: '*Energy for the future: renewable sources of energy*'[2]. It recommended that the share of renewable energy in gross energy consumption be doubled to 12% by 2010. This was translated into law in 2001 through the adoption of Directive 2001/77/EC on the '*promotion of electricity from renewable energy sources*'[3] and Directive 2003/30/EC "*on the promotion of the use of biofuels or other renewable fuels for transport*"[4].

However, progress was found to be too slow and, in 2007, the Commission, proposed a new '*Renewable Energy Roadmap*'[5] in which it recommended that the renewable energy target become mandatory on Member States and be increased to 20% of the total EU energy consumption by 2020.

This recommendation was taken up in an ambitious and far reaching '*Climate Change and Energy Package*' proposed by the Commission in January 2008 and agreed politically by the EU Heads of State in December 2008[6].

The package commits the EU Member States to the following targets:
- Cutting greenhouse gas emissions by at least 20% by 2020 compared to 1990 levels (rising to 30% if other developed countries make comparable efforts in the framework of a new global climate change agreement)[7];
- Increasing the use of renewable energy sources to 20% of Europe's gross final energy consumption by 2020, including a specific target of 10% renewables in transport;
- Cutting energy consumption by 20% of projected 2020 levels by improving energy efficiency[8].

As a follow up, in April 2009, Directive 2009/28/EC[9] *on the promotion of the use of energy from renewable sources* (the 'RES' Directive) was adopted which set mandatory national targets for each Member State to ensure the delivery of the overall EU target of 20% energy from renewable energy sources (see Table 1).

Under the RES Directive, each Member State will be required to draw up a clear action plan to demonstrate how they intend to achieve their renewable energy targets. These *National Renewable Energy Action Plans* (NREAPs) are due to be adopted by 30 June 2010 and shall contain details about national sectoral targets and support schemes, amongst others.

They should also provide an assessment of the role that different technologies will play in reaching the targets for that country and outline the measures that will be taken to increase the use of renewable energy e.g. by reducing administrative barriers and improving access conditions to electricity grids.

[2] Com (1997) 599 final
[3] OJ L 283; 27.10.2001, p 33
[4] OJ L 123; 17.05.2003, p.42
[5] Com (2006) 848 final
[6] http://ec.europa.eu/environment/climat/climate_action.htm
[7] Includes a revision of the Emissions Trading System
[8] In contrast to the other targets, this target is as yet only political, i.e. not legally binding.
[9] OJ L 140; 5.6.2009, p 16

Table 1: Annex I of the RES Directive 2009/28/EC National overall share and targets for the share of energy from renewable sources in gross financial consumption of energy in 2020

	Share of energy from renewable sources in gross final consumption of energy, **2005**	Target for share of energy from renewable sources in gross final consumption of energy, **2020**
Belgium	2,2 %	13 %
Bulgaria	9,4 %	16 %
The Czech Republic	6,1 %	13 %
Denmark	17,0 %	30 %
Germany	5,8 %	18 %
Estonia	18,0 %	25 %
Ireland	3,1 %	16 %
Greece	6,9 %	18 %
Spain	8,7 %	20 %
France	10,3 %	23 %
Italy	5,2 %	17%
Cyprus	2,9 %	13%
Latvia	32,6 %	40 %
Lithuania	15,0 %	23 %
Luxembourg	0,9 %	11%
Hungary	4,3 %	13 %
Malta	0,0 %	10 %
The Netherlands	2,4 %	14 %
Austria	23,3 %	34 %
Poland	7,2 %	15 %
Portugal	20,5 %	31 %
Romania	17,8 %	24 %
Slovenia	16,0 %	25 %
The Slovak Republic	6,7 %	14 %
Finland	28,5 %	38 %
Sweden	39,8 %	49 %
United Kingdom	1,3 %	15 %

Renewable energy sources

Renewable energy sources come in a variety of forms: wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, biowaste and biogasses. They are also used in a variety of ways: to produce electricity, heating and cooling or fuel for transport.

Wind power is used specifically to generate electricity. Electricity is just one of several types of energy used in the EU. The 20% renewable energy target covers all forms of energy.

1.3 Wind power development: predictions for 2020 and beyond

It is clear that the new EU targets will require a significant step change in renewable energy development over a relatively short period of time.

According to the Commission's Renewable Energies Roadmap, 34% of all electricity consumption in 2020 is expected to come from renewable sources by 2020, and around 12% could be generated by wind power alone. This would entail a threefold increase in the current share that wind power has in the EU's electricity supply (some 4% in 2008).

One of the reasons why wind power is expanding so rapidly is that wind power technology has evolved significantly in the past 20 years. Turbine size onshore has increased from less than 50 KW in the 1980s to more than 1 MW today. Rotor diameter has also increased from an average of 15m to 60-80m or more.

Nowadays, 3 bladed upwind, variable speed, pitch regulated turbines generating between 750 -2500 KW are predominant, representing around 90% of the EU market[10]. The cost of installing wind turbines has also dropped substantially over the years[11] which has not only made wind farm developments more affordable but also more attractive to investors.

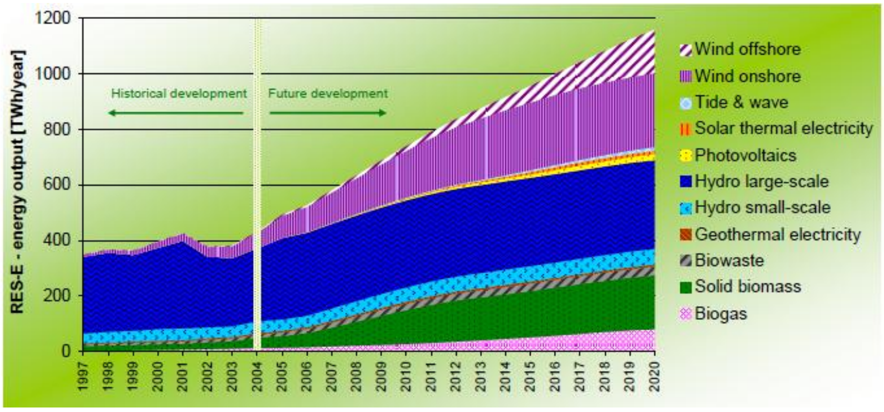

Figure 2: Renewables growth: electricity projections by 2020[12]

Overall wind power capacity in Europe has increased more than a hundred fold in the past 11 years from 4,753 MW in 1997 to 64,949 MW in 2008 (EWEA). In 2008, over 40% of all new electricity generating capability added to the European grid came from wind power.

In its 2nd Strategic Energy Review[13], the Commission estimates that wind power will expand even further in the short to medium term, and, according to some of the scenarios used for the impact assessment of the climate-energy package, the total capacity could exceed 161 GW by 2020. EWEA predictions are even higher, with a target of 230 MW by 2020, including 40 GW offshore.

1.4 Wind energy development in different Member States

Europe is now the world leader in wind energy technology and development. Ten European countries had more than 1000 MW of wind power installed on their territory by the end of 2008 (Germany, Spain, Denmark, Italy, France, Portugal, Netherlands, Sweden, Ireland and UK) and five of them (Denmark, Spain, Portugal, Ireland, Germany) have more than 5% of their total electricity demand covered by wind power.

This does not mean that wind energy will play an equally important role in all countries. In fact, wind resources differ significantly from country to country as does the availability of alternative renewable energy sources such as biomass or geothermal energy.

[10] Small and very small turbines are still also used to meet specific needs, for instance as a traditional part of rural electrification eg to power isolated homes, boats and telecommunication facilities. Micro generation may become more popular in urban areas but for the moment they represent only a small share the market.

[11] The average wind turbine in Europe costs 1.23 mil/MW onshore and 2-2.2 mi/MW offshore.

[12] Commission Communication COM(2006) 848 final, 10.1.2007 'Renewable Energy Road Map'

[13] Com (2008) 738 final, 13.11.2008

The capability of current transmission networks and other generation plants to integrate large amounts of wind energy also varies and depends to some extent on historical developments. All these and other factors will be important in the strategic planning of wind farm development across the EU and for determining the contribution that wind energy will make in different Member States to reaching their targets under the RES Directive.

1.5 Offshore wind power

In contrast to onshore wind power, offshore wind power is still in its infancy and only accounts for about 2% of the total installed wind power capacity in Europe. Most of the development so far has been in the North Sea and in the Baltic Sea, mostly in shallow waters less than 20 m deep and less than 20 km from the shore.

Compared to onshore wind farms, offshore installations are more complex and costly to put into place. The technology is subject to greater requirements given the harsher and less accessible operational environment and there are still significant bottlenecks to overcome in the supply chain (lack of installation vessels or harbour facilities, lack of skilled work force) and in gaining access to the electricity grid.

Nevertheless, considering that the average turbine size is expected to be significantly bigger offshore (ca 5 MW), the potential for offshore wind energy to grow as technology evolves is considerable.

In its Communication of November 2008[14], entitled '*Offshore wind energy: action needed to deliver on the Energy Policy Objectives for 2020 and beyond'*, the Commission estimates the potential for wind power offshore by 2020 is likely to be some 30-40 times the capacity installed at that time (some 1,1 GW by end of 2007, which had grown to 1,5 by the end of 2008).

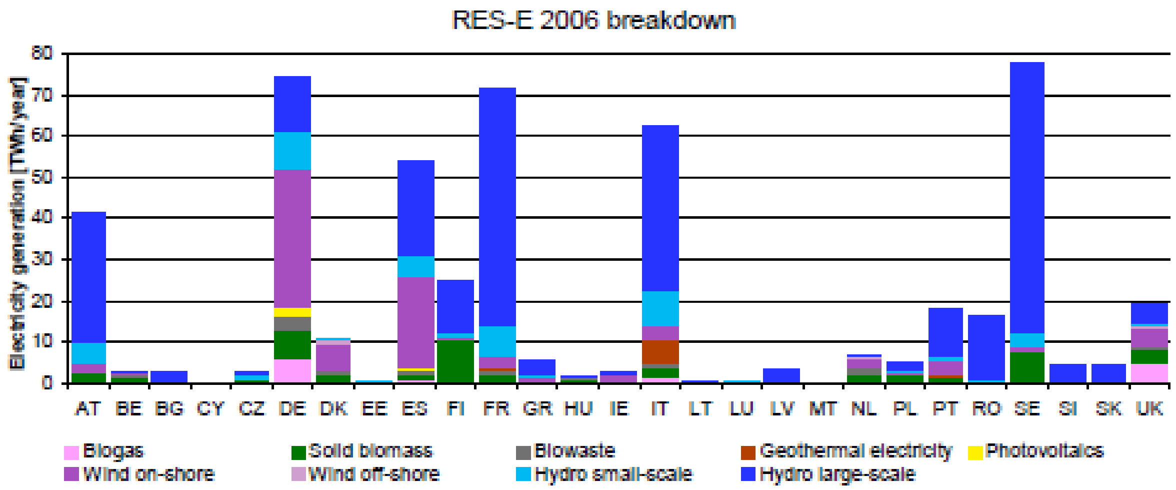

Figure 4: promotion and growth of renewable energy sources and systems across EU[15].

[14] Com (2008) 768 final

[15] From Commission's Renewable Energy progress report, COM(2009) 192 final

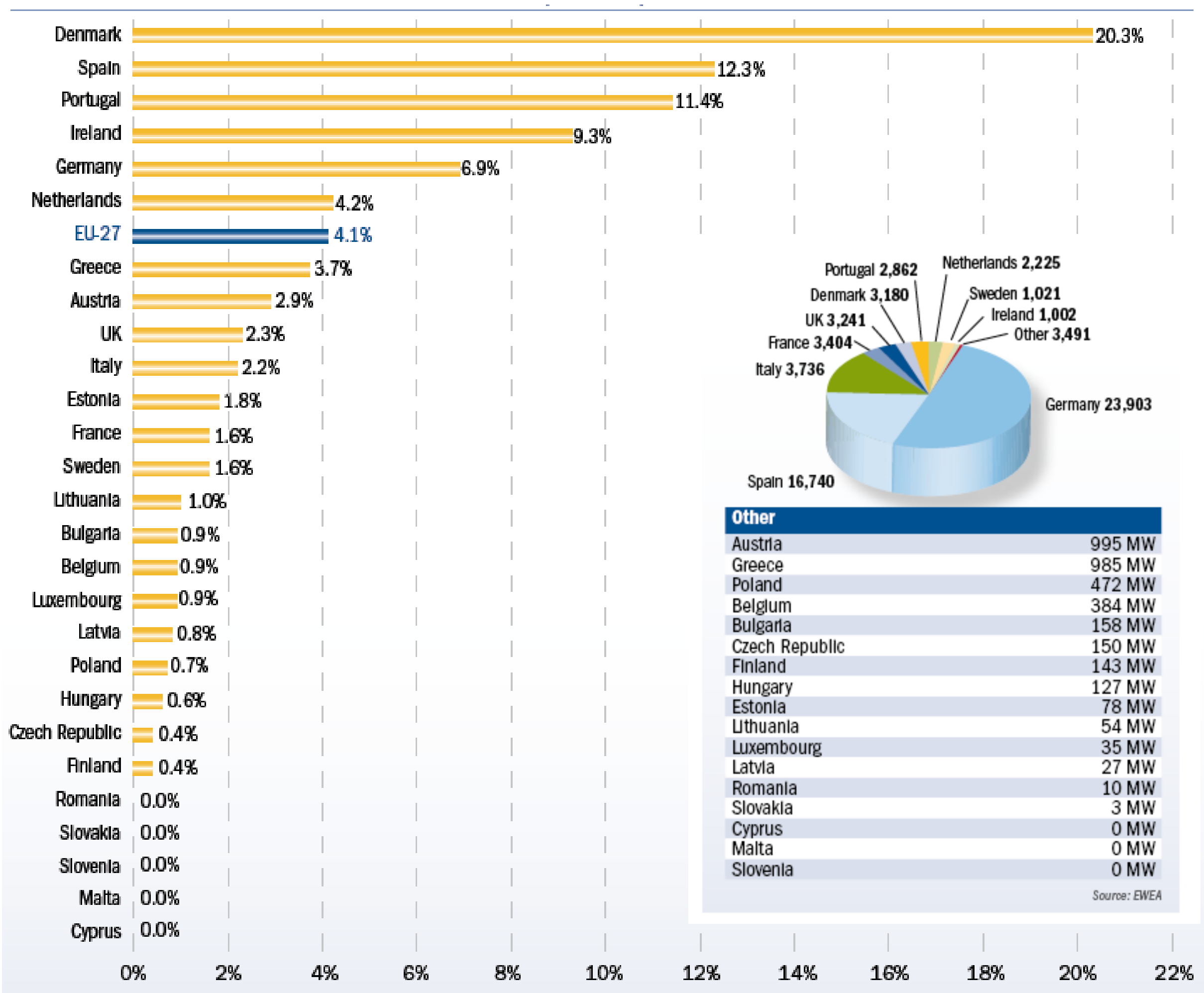

Figure 5 (above): wind power's share of electricity demand
Figure 6 (right): End 2008 Member State share of total capacity of wind power (EWEA)[16]

1.6 Balancing wind farm developments with broader societal needs

The rapid expansion of wind farm installations in the coming years will bring many benefits to society, not least in reducing greenhouse gases. But, like all developments, this expansion needs to be in balance with other broader social, economic and environmental concerns to ensure it grows in a sustainable manner and is publicly acceptable.

From an economic perspective there are still a number of hurdles to overcome in order for wind energy to play a role that is commensurate to its potential. Amongst others, this means ensuring better access to the electricity grid, removing administrative barriers to the use of renewable energy over other more traditional forms of energy, and improving the technology, especially for offshore developments.

From a social perspective, apprehensions over wind farm developments vary significantly and will need to be addressed on a case by case basis to ensure that local interests are properly considered. Typical concerns include the level of noise generated by wind farms, visual impacts, issues of safety, effects on the landscape, archeology, heritage, as well as possible interference with aviation or shipping navigation etc…

[16] EWEA Pure power : wind energy targets for 2020 and 2030, p26 and 23 (Dec 2009)

There is also a genuine concern over the impact of poorly sited wind farms upon nature and wildlife which, in view of the scale of development foreseen, cannot be ignored. The EU's environmental legislation provides a common legal framework applicable across all Member States to address these concerns. The mechanisms established by the existing EU's environmental legislation can ensure that wind farm developments are done in a way that is both sustainable and minimises its impact on the natural environment.

These procedures and the potential impacts of wind farms on nature and wildlife are examined further in this guidance document. But it is important to bear in mind that potential conflicts with nature and wildlife are just one of a range of possible constraints that a wind farm developer may face depending on the local context. A clear distinction must therefore be made between these different constraints so that each can be analysed in its proper context and not mistakenly used as a reason for objecting to developments on other grounds.

This requires a clear understanding of the type of potential impacts of wind farms on nature and wildlife as well as the legal obligations that must be respected when planning and executing wind farm developments.

2. THE EU'S POLICY FRAMEWORK AND LEGISLATION FOR NATURE AND BIODIVERSITY

- *Like climate change and renewable energy, biodiversity conservation is a high political priority. The EU is committed to halting the decline in biodiversity in the EU and this commitment is now firmly embedded in all aspects of EU policy.*
- *The EU 'Habitats' and 'Birds' Directives are the cornerstones of the EU's biodiversity policy. They enable all Member States to work together to protect and ensure the survival of Europe's most endangered and vulnerable species and habitat types.*
- *Central to the two Directives is the creation of the Natura 2000 Network, an ecological network of sites spanning 27 EU countries. 25,000 sites are included in the Network so far, covering almost 18% of the EU's land area. There are additionally significant marine areas but this component of the Network is not yet complete.*
- *Wind farms likely to have an adverse effect on a Natura 2000 site must be subject to an appropriate assessment in light of the sites conservation objectives. Such developments may proceed within Natura 2000 sites under certain conditions where the procedural safeguards foreseen by the two nature Directives are respected.*
- *Outside Natura 2000 sites, the two Directives also require that wind energy developments do not cause any significant damage or disturbance to species of Community interest (i.e. those covered by the Directives) or their key habitats;*
- *New wind farm plans and projects may also be subject to the provisions of the SEA and the EIA Directives but these are distinct, and different, from the appropriate assessment undertaken under the Habitats Directive.*

2.1 Introduction

It is clear that the number of wind farm installations in the EU is likely to grow at a very significant rate in the short to medium term in some parts of Europe. Given that wind power is universally recognised as a source of clean, renewable energy and is, as such, also a major contributor in climate change mitigation, it will be important to ensure that its expansion is sustainable in all respects and is achieved without unnecessary damage to the natural environment and Europe's natural heritage.

Like any other industrial activities entailing the use of land or sea, wind energy development inevitably has an ecological footprint and, although environmental impacts are generally substantially lower compared to conventional power generation installations, they still need to be considered and addressed where relevant.

This chapter outlines the EU's key environmental laws and international commitments that need to be respected when developing wind farms in the EU. Chapter 5 provides further detailed guidance as regards developments affecting Natura 2000 sites in particular.

2.2 The EU's commitment to halting biodiversity loss

Like climate change and renewable energy, biodiversity conservation is high on the EU political agenda. At the European Summit in Gothenburg in 2001, the European Union set itself the goal "*to halt the decline of biodiversity in the EU by 2010*" and to restore habitats and natural ecosystems in response to the rapid global decline in wildlife.

This commitment is now firmly embedded in all aspects of EU policy. Biodiversity conservation is identified as one of the key operational objectives of the Sustainable Development Strategy (SDS)[17] and the Lisbon partnership for growth and jobs.

The 6th Environment Action Programme (6th EAP)[18], which sets out the framework for environmental policy-making in the EU for the period 2002-2012, has 'nature and biodiversity' as one of four priority areas for action. The 6th EAP also advocates full integration of environmental protection requirements, including those related to biodiversity conservation, into all other Community policies and actions.

The details of how this is to be achieved are laid down in the European Commission's EU Biodiversity Action Plan adopted in 2006[19]. The EU Action Plan represents an important new approach for EU biodiversity policy as it is the first time that all the relevant economic sectors and policy areas are addressed in a single strategy document and apportioned a share of the responsibility in its implementation. It recognises that change will only happen if there is a concerted effort from all economic sectors to help deliver the 2010 target.

The EU Plan also stresses the important ecosystem services that nature provides and upon which our economy and social wellbeing depends. Healthy ecosystems help purify the air and water, and regulate the climate. They also provide basic goods such as food, fibre and wood. As such, they will have a major role to play in mitigating the effect of climate change in years to come.

Biodiversity and climate change

The Intergovernmental Panel on Climate Change (IPCC) predicts that average surface temperatures across the globe will rise by 2–6.4°C by 2100 compared to pre-industrial levels. The impact on biodiversity and ecosystems is hard to estimate but is expected to be very considerable. Already studies show that many species are experiencing difficulties in adapting to the changing climate and that this is exposing them to an even greater risk of extinction.

Climate change also puts at risk the valuable ecosystems upon which society depends for important goods and services, such as flood prevention or carbon storage. Healthy ecosystems are an essential component of any climate mitigation strategy but, like wildlife, they are under significant pressure from habitat loss and degradation. According to the Millennium Ecosystems Assessment, ecosystems have suffered more human induced fragmentation in Europe than in any other continent.

The abilities of ecosystems and species to respond to the demands of climate change will be largely determined by how effectively they are safeguarded from inappropriate development, including poorly sited or designed wind energy farms.

[17] COM (2001) 264 final; Renewed EU Sustainable Development Strategy adopted June 2006.
[18] Decision No 1600/2002/EC, OJ L 242, 10.9.2002,
[19] COM/2006/0216 final. http://ec.europa.eu/environment/nature/biodiversity/comm2006/index_en.htm

2.3 The Habitats and Birds Directives

Threatened habitats and species form part of the European Union's shared natural heritage and as the threats to them are often of a transboundary nature, the adoption of conservation measures is a common responsibility of all Member States.

The Birds and Habitats Directives are the cornerstones of the EU's biodiversity policy. They enable all 27 EU Member States to work together, within a common appropriate legislative framework, to protect Europe's most valuable species and habitats across their entire natural range within the EU, irrespective of political or administrative boundaries.

The Directives have two main objectives:

- they protect species in their own right across the EU (through species protection provisions);
- they conserve the core habitats of certain rare and endangered species in order to ensure their continued survival (through habitat protection provisions leading to the establishment of the Natura 2000 Network)

In the case of the latter, it is important to note that the Natura 2000 Network is not a system of strict nature reserves where all human activities are excluded. Instead, the two Directives provide a common legislative framework, applicable in all EU countries which ensures that human activities – *inter alia* wind energy activities – are undertaken in a way that does not adversely affect the integrity of Natura 2000 sites.

Article 6 of the Habitats Directive lays down procedural safeguards to be followed in the case of new developments. Its provisions are explained in greater detail in subsequent chapters. But first it is useful to understand the general purpose of the two Directives.

2.3.1 Overall objectives of the Birds and Habitats Directives

The overall objective of the Birds Directive[20], adopted in 1979, is to maintain and restore the populations of naturally occurring wild bird species present in the EU (ca 500 species) at a level which will ensure their survival over the long term. This should '*correspond in particular to their ecological, scientific and cultural requirements, or to adapt the population of these species to that level' (cf Article 1)*.

The Habitats Directive[21], adopted in 1992, has similar objectives to the Birds Directive but covers species other than birds as well as habitat types in their own right. Its aim is to ensure the conservation of around 1000 species of endangered, rare, endemic or vulnerable wild animals and plants listed in its annexes as well as a further 230 habitat types which are in danger of disappearing.

It should be noted that the Directives do not cover *every* species of plant and animal in Europe (ie not all of the EU's biodiversity). Instead, it focuses on a sub-set of around 1500 species - often referred to as species of Community interest (or species of European importance) - which need protection in order to ensure their long-term survival within the EU.

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[20] Directive 2009/147/EC of the European Parliament and of the Council (codified version of Council Directive 79/409/EEC on the conservation of wild birds, as amended) – see http://ec.europa.eu/environment/nature/legislation/index_en.htm

[21] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, consolidated version reference 01992L0043 of 01.01.2007 - see http://ec.europa.eu/environment/nature/legislation/index_en.htm

2.3.2 A general system of strict protection for species

As regards species protection, both Directives require that Member States establish a general system of protection for all wild bird species in the EU and for species listed in Annex IV of the Habitats Directive throughout their natural range within the EU. These provisions apply both inside and outsite protected sites.

The exact terms are laid down in article 5 of the Birds Directive and Article 12 (for animals) and Article 13 (for plants) of the Habitats Directive:

Article 5 of Birds Directive

Member States should take the requisite measures to establish a general system of protection for all wild bird species throughout their natural range within the EU. In particular they should prohibit the following:

- *deliberate killing or capture by any method;*
- *deliberate destruction of, or damage to, their nests and eggs or removal of their nests;*
- *taking their eggs in the wild and keeping of eggs;*
- *deliberate disturbance of these birds particularly during the period of breeding and rearing, in so far as this would have a significant negative effect on the birds;*
- *keeping the birds in captivity and their sale.*

Article 12 and 13 Habitats Directive

Member States should take the requisite measures to protect the species listed in Annex IV throughout its natural range within Europe.

In the case of ***protected animals*** *this means prohibiting the:*

- *deliberate killing or capture by any method;*
- *deliberate disturbance, particularly during breeding, rearing, hibernation and migration;*
- *deliberate destruction or taking of eggs in the wild;*
- *deterioration or destruction of breeding sites or resting places;*
- *the keeping, sale and transport of specimens the from the wild.*

In the case of ***protected plants*** *this mean prohibiting:*

- *the deliberate picking, collecting, cutting, uprooting or destruction of such plants in the wild;*
- *the keeping, transport of sale of such species taken from the wild.*

Derogations are allowed in some circumstances (e.g. to prevent serious damage to crops, livestock, forests, fisheries and water) provided that there is no other satisfactory solution and the consequences of these derogations are not incompatible with the overall aims of the Directives.

The conditions for applying derogations are set out in Article 9 of the Birds Directive and Article 16 of the Habitats Directive. With reference to wind farms, it is primarily reasons related to ‘the interests of public health and public safety, or for ‘other imperative reasons of public interest’ (ref. Article 16(1c) that might apply. The Commission has produced guidelines on the strict species protection provisions for animals protected under the Habitats Directive[22].

As birds, bats and whales have all been found to be vulnerable to wind farms, these provisions may also need to be taken into account by developers and planners as they may influence their plans and projects. The measures to be taken under these species protection provisions are not limited to the prohibition of various activities. They also include the need for preventive measures in order to anticipate threats and risks related to disturbance.

[22] Guidance document on the strict protection of animal species of Community interest under the 'Habitats' Directive 92/43/EEC http://ec.europa.eu/environment/nature/conservation/species/guidance/index_en.htm

For wind farms, this might include the refusal of individual projects on the grounds that their proposed location could lead to significant disturbance to migratory birds or bats, for instance a key location along a species migration route, or could lead to the destruction of breeding sites and resting places for bats or whales.

In less extreme cases, it could simply mean that certain safeguards or mitigation measures are introduced into the permit. This might involve, for instance, shutting down the wind farms at times when there is a high risk of disturbance (eg in Germany, one wind farm turns its turbines off for a couple of hours around dusk during August and September when there is a peak migration/dispersal period amongst local bat popualtions). Whatever measures are applied, they must be proportionate in relation to the assessed impact on the conservation status of the species concerned.

2.3.3 Habitat protection provisions: the Natura 2000 Network:

Some species and habitat types are so endangered and rare that they require their habitats to be protected as well. Collectively, these sites make up the Natura 2000 Network, spanning all 27 EU countries.

Under the Habitats Directive, core sites need to be protected for the habitat types listed in annex I and species in annex II[23]. The first step is for Member States to propose their national list of possible Natura 2000 sites. These are then examined at a biogeographical level[24] to ensure that they offer sufficient coverage for the species or habitat types concerned. It is important to note that the selection of SCIs must be done on scientific grounds only. Member States may not take economic aspects into account at this stage.[25]

Once a site becomes an SCI it is included in the N2000 Network and Member States then have six years to designate it as a Special Area of Conservation (SAC). They must also establish the necessary conservation measures to maintain and restore the habitats and species at a favourable conservation status.

Under the Birds Directive, sites need to be classified for ca 190 species of birds listed in Annex I of the Directive. Member States must also classify sites for other regularly occurring migratory bird species not listed in Annex I, bearing in mind the need to protect their breeding, moulting and wintering areas and staging posts along their migration routes, eg wetlands of international importance. These sites are called Special Protection Areas (SPAs) and are included directly into the European Natura 2000 Network[26].

By December 2008, some 25,000 SCIs were included in the Natura 2000 Network[27]. Together, they cover around 17% of the land area in the EU-27[28]. In addition, 1300 SCIs and 533 SPAs have been designated in marine waters but further sites will need to be protected to complete the marine component of the network. This should be achieved by 2012.

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[23] There is considerable overlap between the species listed in annex II and those listed in annex IV but not all Annex IV species require specific site protection under Natura 2000 so they are not all listed in annex II.

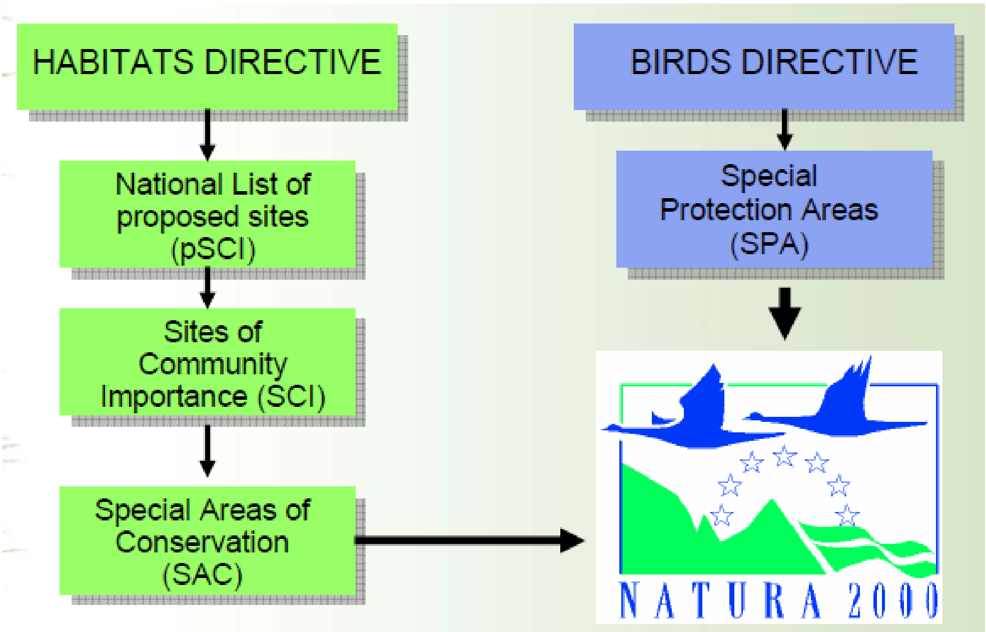
[24] The EU has 9 biogeographical regions, each with its own characteristic blend of vegetation, climate, topography and geology. Working at this level makes it easier to check species and habitat conservation trends under similar natural conditions, irrespective of national boundaries.

[25] ECJ Ruling C-371/98, First Corporate Shipping LTD.

[26] In contrast to the Habitats Directive, there is no intermediary step of selecting sites according to biogeographical region in the case of SPAs. These are included directly into the Natura 2000 Network

[27] European Commission, http://ec.europa.eu/environment/nature/natura2000/barometer/index_en.htm

[28] There is sometimes considerable overlap between SPAs and SCIs so the figures are not cumulative



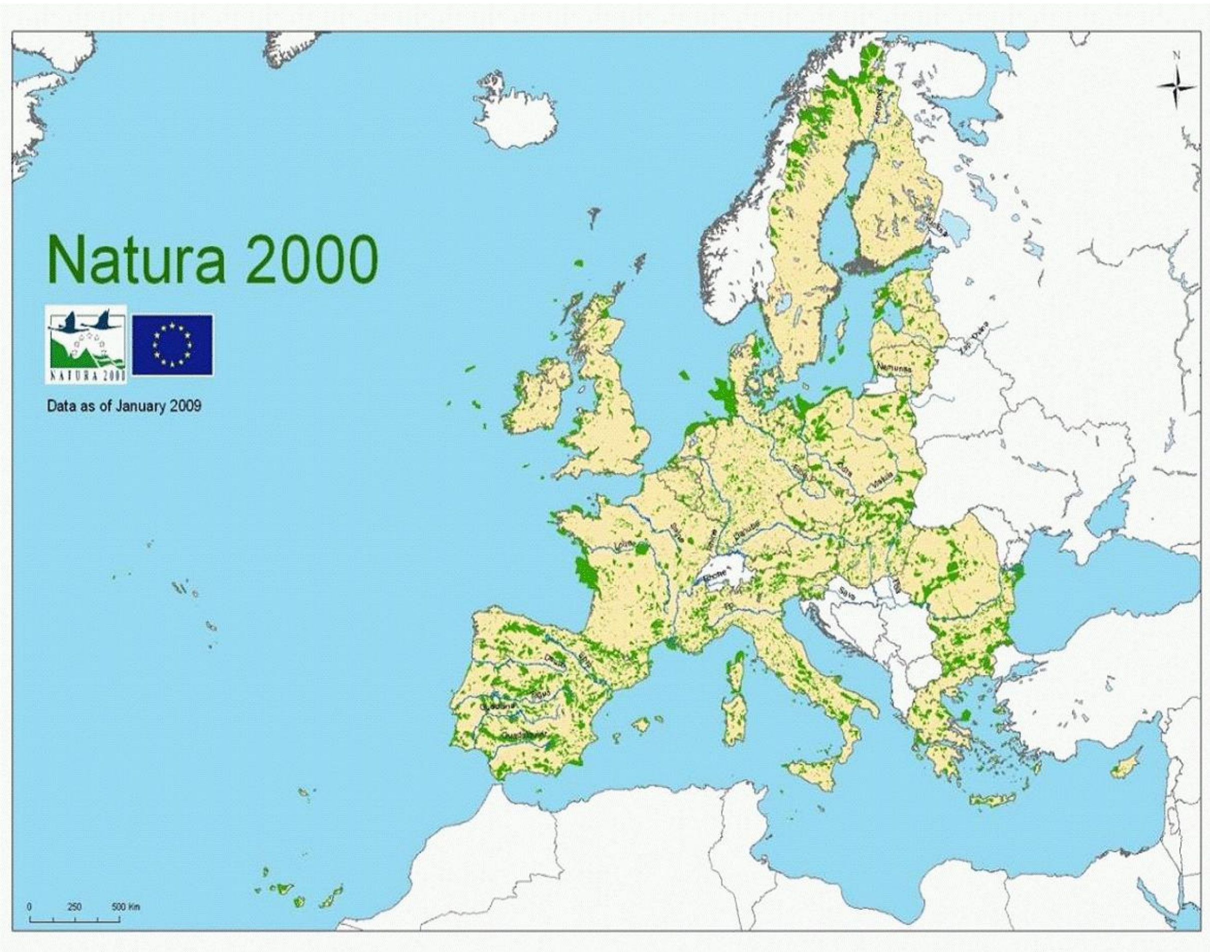


Figure 7: the European Natura 2000 Network across EU-27, status January 2009

2.3.4 Managing and conserving Natura 2000 sites

Within Natura 2000 sites, Member States must:

- take appropriate conservation measures to maintain and restore the habitats and species *for which the site has been designated* to a favourable conservation status (Article 6.1).

- avoid damaging activities that could significantly disturb these species or deteriorate the natural habitat types or habitats of the protected species (Article 6.2);

The competent authorities in each country should identify the conservation objectives for Natura 2000 sites at the latest 6 years after the adoption of the site as Site of Community Interest (or in the case of SPA immediately upon classification). These conservation objectives are to be based on the status and ecological requirements of the habitats and species for which the site is designated Natura 2000. The ultimate objective is to ensure that the species and habitat types are maintained or restored to a favourable conservation status across their natural range.[29]

What does favourable conservation status mean in practice?

The ultimate objective of the Habitats Directive is to ensure that the species and habitat types covered reach what is called a 'favourable conservation status' and that their long-term survival is deemed secure across their entire natural range within Europe.

In the case of the species covered by the Directive (ref Article 1(i)) this means that:
- *populations are maintaining themselves over the long term and are no longer showing signs of continuing decline;*
- *their natural range is not being reduced;*
- *there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.*

In the case of a habitat type, a favourable conservation status (ref Article 1(e)) is achieved when:
- *its natural range and the areas it covers within that range are stable or increasing; and*
- *the specific structure and function which are necessary for its long-term maintenance are present and are likely to continue to exist in the foreseeable future;*
- *the conservation status of typical species that live in these habitat types is favourable as well.*

To help decide which conservation measures should be undertaken on individual N2000 sites, the Habitats Directive encourages the development of management plans which are specifically designed for the site in question or integrated into other development plans.

These management plans, where they exist, can be a useful source of information for developers wishing to carry out activities in and around Natura 2000 sites because:
- they record the conservation needs of the habitats and species for which the site has been designated so that it is clear to all what is being conserved and why;
- they analyse the socio-economic and cultural context of the area and the interactions between different land-uses and the species and habitats present;
- they spell out the conservation objectives for the site;

[29] The concept of Favourable Conservation Status is not mentioned in the Birds Directive but there are analogous requirements, i.e. all SPAs must still be subject to special habitat conservation measures in order to ensure the survival and reproduction of the Annex I birds in their area of distribution.

- they can provide an excellent mechanism to engage stakeholders and an open forum for debate amongst all interest groups and thus help build a consensus view on the long term management of the site;
- they identify practical management solutions that can help integrate conservation activities with other land-use practices.

Whether or not management plans are drawn up, the competent authorities in each country must establlish the conservation objectives for each Natura 2000 site based on the status and ecological requirements of the habitats and species for which the site is designated a Natura 2000 area.

2.3.5 New developments affecting Natura 2000 sites

Whereas Article 6(1) and (2) of the Habitats Directive concern the day-to-day management and conservation on Natura 2000 sites, Articles 6(3) and 6(4) lay down the procedure to be followed when planning new developments that might affect a Natura 2000 site[30].

This stepwise procedure is examined in detail in chapter 5 but, in essence, it requires that a plan or project having a potentially significant negative effect on a Natura 2000 site undergoes an 'Appropriate Assessment' to study these effects in detail and to see how they relate to the site's conservation objectives.

Depending on the findings of the Appropriate Assessment, the competent authority either agrees to the plan or project as it stands if it has ascertained that it will not adversely affect the integrity of the site concerned, or it depending on the degree of impact it may require one or more of the following:
- certain mitigation measures are introduced to remove the negative effects;
- certain conditions are respected during construction, operational or closure phases of the project, again to remove the likelihood of negative effects or to reduce them to an insignificant level where they no longer affect the integrity of the site;
- alternative options are explored instead.

In exceptional circumstances, a plan or project may still be allowed to go ahead under certain conditions, in spite of being assessed as having negative effects on the site provided the procedural safeguards laid down in the nature Directive are followed. This may be possible, for instance, if the plan or project is considered to be of overriding public interest and there are no alternatives available. In such cases, compensation measures will need to be introduced to ensure that the overall coherence of Natura 2000 is protected.

2.3.6 Improving the ecological coherence of the Natura 2000 Network

In addition to designating core sites under the Natura 2000 Network, Article 10 of the Habitats Directive also requires Member States to endeavour, through land use planning or development policies, to improve the ecological coherence of the network by maintaining and, where appropriate developing, features of the landscape which are of major importance for wild fauna and flora, such as wildlife corridors or stepping stones, which can be used during migration and dispersal.

[30] This applies to SCIs, SACs and SPAs and concerns not just plans or projects inside a Natura 2000 sites but also those that are outside but could have a significant effect on the conservation of species and habitats within the site. For instance a dam constructed upstream on a river that could alter or stop the regular flooding of an important wetland for birds within an SPA further downstream.

2.4 The EU nature Directives and wind farm development

As regards wind farm developments, there are two aspects of the EU Directives to bear in mind in particular, depending on the location of the development:

- *In and around Natura 2000 sites:* any wind farm development that is likely to affect one or more Natura 2000 sites has to undergo a step-by-step Appropriate Assessment procedure and, where necessary, apply the relevant safeguards for the species and habitat types of Community interest as described above (and in detail in chapter 5)

- *Anywhere within the EU*: the two Directives also require that Member States protect species of Community interest *throughout their natural range within the EU* (cf. Article 5 of Birds Directive and Article 12 of Habitats Directive – see above). Thus any wind farm development must also take account of its potential impacts on species of Community interest (covered by the two Directives) *outside* Natura 2000 sites as well.

2.5 **The SEA Directive and the EIA Directive**

Two other key pieces of EU environmental legislation are directly relevant to wind farm developments:

- Directive 2001/42/EC on the evaluation of the effects of certain plans and programmes on the environment (commonly referred to as 'SEA' Directive)[31]

- Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment, amended in 1997 (97/11/EC) and 2003 (2003/35/EC) – commonly referred to as the 'EIA' Directive[32].

2.5.1 The SEA Directive

The purpose of the SEA Directive 2001/42/EC is to ensure that the environmental consequences of ***certain plans and programmes*** are identified, assessed and taken into account during their preparation and before their adoption.

In this respect, Member States are required to:

- prepare an environment report which identifies and assesses the likely significant environmental effects of the plans and programmes, and of any reasonable alternatives.

- provide certain authorities and the general public with an opportunity to express their opinion on the environmental report as well as on the draft plan or programme. Consultation not only helps to ensure that the information supplied for the assessment is comprehensive and reliable but also provides more transparency in the decision making process.

Ultimately, the SEA aims to encourage a more integrated and efficient approach to territorial planning where environment, including biodiversity considerations, are taken into account much earlier on in the planning process and at a much more strategic level. If this is done, it usually translates itself into fewer conflicts further down the line at the level of individual

[31] OJ L 197, 21.7.2001, p. 30–37 – see http://ec.europa.eu/environment/eia/home.htm
[32] OJ L 156, 25.6.2003, p. 17 – see http://ec.europa.eu/environment/eia/home.htm

projects. It also allows for a more appropriate siting of future developments away from areas of potential conflict with nature conservation.

A Strategic Environmental Assessment is mandatory for a variety of plans and programmes (i.e. prepared for agriculture, forestry, fisheries, energy, industry, transport, waste management, water management, telecommunications, tourism, town and country planning or land use) which set the framework for future development consent of projects listed in the 'EIA Directive'. An SEA should also carried out on any plans or programmes, which, in view of the likely significant effect on sites, have been determined to require an assessment pursuant to Article 6 or 7 of the Habitats Directive.

2.5.2 Environmental Impact Assessment

While the SEA process operates at the level of public plans and programmes, Environmental Impact Assessments (EIA) operate at the level of individual public and private projects. Thus, development consent for projects[33] which are likely to have significant effects on the environment should be granted only after an assessment of the likely environmental effects of the project has been carried out.

The EIA Directive distinguishes between projects requiring a mandatory EIA (so-called Annex I projects) and those where Member State authorities must determine, in a procedure called "screening", if projects are likely to have significant effects, taking into account criteria in Annex III of the Directive (so-called Annex II projects).

Wind power developments are listed in Annex II.3.i of the EIA Directive[34].

Environmental Impact Assessments process (EIA)

The typical EIA procedure includes the following stages:

- *Screening (Article 4 and Annex III of the EIA Directive): to determine whether an EIA is required. Screening is required for any type of project listed in Annex II (including wind farms). The screening decision of the competent national authority is made available to the public.*
- *Scoping (Article 5): is the stage of the EIA process that determines the content and extent of the matters to be covered in the environmental information to be submitted by the developer(?) to a competent authority.. The scoping stage is an important feature of an adequate EIA regime, mainly because it improves the quality of the EIA.*
- *Preparation of an Environmental Statement or report (Article 5), presenting the following necessary environmental information: description of project, description of measures to avoid or reduce significant adverse effects, data required to identify and assess the main effects on the environment, an outline of the main alternatives studied by the developer, and an indication of the reasons for the preferred choice, taking into account the environmental effects identified.This should be made publicly available.*
- *Consultation: (Articles 6, 7 & 8) The public, the environmental authorities and Member States concerned must be informed and consulted before the decision on the request for development consent is taken. The results of consultations and the information gathered must be taken into consideration in the development consent procedure.*

[33] The EIA Directive defines 'project' as the execution of construction works or of other installations, schemes, or interventions in the natural surroundings and landscape.
[34] The annex refers to *"installations for the harnessing of wind power for energy production (wind farms)"*.

- *Explanation of the Decision: (Article 9), When a decision to grant or refuse a development consent has been taken, the national authorities are obliged to make available to the public specific information, such as the content of the decision and any conditions attached thereto, the main reasons and considerations on which the decision is based, including information about the public participation process, a description, where necessary, of the main mitigation and compensatory measures.*

The EIA should address direct and indirect effects on (Article 3):

- *human beings, **fauna and flora,***
- *soil, water, climate and the landscape,*
- *material assets and the cultural heritage,*
- *the interaction between the factors mentioned in the above indents.*

Both positive and negative effects should be considered.

2.5.3 The relationship between SEA, EIA and Appropriate Assessments

There are many similarities between the procedures for SEA and EIA, and the Appropriate Assessments carried out for plans or projects affecting Natura 2000 sites under the Habitats Directive. But this does not mean they are one and the same, there are some important distinctions too (see table). Therefore, **an SEA and EIA cannot replace, or be a substitute for, an Appropriate Assessment as neither procedure overrides the other**.

They may of course run alongside each other or the Appropriate Assessment may form part of the EIA/SEA assessment[35] but, in such cases, the Appropriate Assessment should be clearly distinguishable and identifiable in the SEA's Environmental Report or in the EIA's Environmental documentation, or should be reported on separately so that its findings can be differentiated from those of the general EIA or SEA[36].

One of the key distinctions between SEAs/ EIAs and Habitats Directive's Appropriate Assessments, apart from the fact that they measure different aspects of the natural environment and have different criteria for determining 'significance', is that how the outcome of the Assessment is followed. In this regard, the assessments under the SEA and EIA lay down essentially procedural requirements and do not establish obligatory environmental standards; on the contrary, the assessment under the Habitats Directive lays down obligations of substance, mainly because it introduces an environmental standard, i.e. the conservation objective of a Natura 2000 site and the need to preserve its integrity.

In other words, if the Appropriate Assessment determines that the plan or project will adversely affect the integrity of a Natura 2000 site, the authority cannot agree to the plan or project as it stands unless, in exceptional cases, they invoke special procedures for projects which are deemed to be of overriding public interest.

The SEAs/ EIAs on the other hand are designed to make the planning authorities fully aware of the environmental implications of the proposed plan or project so that these *are taken into account* in their final decision.

[35] Doing an Appropriate Assessment at the level of a plan also does not remove the need to apply the Article 6(3)-(4) procedure to individual projects as well. Of course if the Appropriate Assessment of a plan results in a development being zoned into areas of low or no potential conflicts with Natura 2000 sites then it is likely that fewer projects resulting from the plan will require an Appropriate Assessment at a project level.

[36] "Assessments of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC".

Table : Comparison of procedures under AA, EIA and SEA

	AA	EIA	SEA
Which type of developments are targeted ?	Any **plan** or **project** which - either individually or in combination with other plans/projects - is likely to have an adverse effect on a Natura 2000 site (excluding plans or projects directly connected to the management of the site)	All **projects** listed in Annex I. For projects listed in Annex II the need for an EIA shall be determined on a case by case basis and depending on thresholds or criteria set by Member states (taking into account criteria in Annex III)	Any **Plans** and **Programmes** which are (a) prepared for agriculture, forestry, fisheries, energy, industry, transport, waste management, water management, telecommunications, tourism, town and country planning or land use and which set the framework for future development consent of projects listed in Annexes I and II to Directive 85/337/EEC, or (b) which, in view of the likely effect on sites, have been determined to require an assessment pursuant to Article 6 or 7 of Directive 92/43/EEC.
What impacts need to be asssessed relevant to nature?	The Assessment should be made in view of the site's conservation objectives (which are set in function of the species/ habitat types for which the site was designated.) The impacts should be assessed to determine whether or not they will adversely affect the integrity of the site concerned.	Direct and indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative significant effects on ….'fauna and flora'	Likely significant effects on the environment, including on issues such as biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationship between the above factors;
Who carries out the Assessment?	It is the responsibility of the competent authority to ensure that the AA is carried out. In that context the developer may be required to carry out all necessary studies and to provide all necessary information to the competent authority in order to enable the latter to take a fully informed decision. In so doing the competent authority may also collect relevant information from other sources as appropriate.	The developer	The competent planning authority
Are the public/ Other authorities consulted?	Not obligatory but encouraged 'if appropriate'	Compulsory –consultation to be done before adoption of the development proposal Member States shall take the measures necessary to ensure that the authorities likely to be	Compulsory –consultation to be done before adoption of the plan or programme. The authorities and the public shall be given an early and effective opportunity within appropriate time frames to express their opinion on the draft plan or programme and the accompanying environmental report before the adoption of the plan or

		concerned by the project by reason of their specific environmental responsibilities are given an opportunity to express their opinion on the request for development consent Ditto for the public	programme or its submission to the legislative procedure Member States must designate the authorities to be consulted which, by reason of their specific environmental responsibilities, are likely to be concerned .
How binding are the outcomes ?	Binding. The competent authorities can agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site .	The results of consultations and the information gathered as part of the EIA ***must be taken into consideration*** in the development consent procedure.	The environmental report, as well as the opinions expressed ***shall be taken into account*** during the preparation of the plan or programme and before its adoption or submission to the legislative procedure

2.6 Relevant international nature and biodiversity Conventions and Agreements

The European Union and its Member States, as well as most other European countries are contracting parties to various relevent international environmental Conventions and Agreements. Thus, European and national legal frameworks on nature and biodiversity conservation must take full account of the commitments entered into under these Conventions and Agreements as well.

These Conventions have helped to shape the legal framework for biodiversity policy and legislation within the EU and also helped define the relationship between the EU and other countries. The following outlines the most relevant in the context of renewable energies - such as wind energy - and nature conservation in Europe. Several have also adopted specific recommendations and resolutions on wind farms and wildlife. These are listed in annex I to this guide:

- The **Convention on Biological Diversity**[37] (CBD) is a global treaty, adopted in Rio de Janeiro in June 1992. It widened the scope of biodiversity conservation from species and habitats to the sustainable use of biological resources to the benefit for mankind. To date, 189 parties have ratified the convention;

- The **Convention on the Conservation of European Wildlife and Natural Habitats**[38] ('Bern Convention') came into force in 1982. It has played a significant role in strengthening the work on biodiversity conservation in Europe. It has been signed by 42 Member States of the Council of Europe, as well as the European Community and four countries in Africa. An important objective of the convention is the creation of the **Emerald Network**[39] of Areas of Special Conservation Interest (ASCIs). This operates alongside the EU Natura 2000 Network. A resolution on effects of wind turbines on migratory species of mammals and birds was adopted in 2002.

[37] http://www.cbd.int.
[38] http://www.coe.int/t/dg4/cultureheritage/conventions/bern/default_en.asp.
[39] http://www.coe.int/t/dg4/cultureheritage/regional/econetworks/emeraldnetwork_en.asp.

- The **Convention on the Conservation of Migratory Species of Wild Animals**[40] (CMS, 'Bonn Convention') aims to preserve migratory species throughout their natural range. It entered into force in 1983 and has now been signed by more than 100 parties. Several agreements signed under this Convention are relevant to the management of conflicts between migrating animals and wind farms:
  - *Agreement on the Conservation of African-Eurasian Migratory Waterbirds*[41] (AEWA) calls for coordinated action throughout the migration routes or flyways. It came into force in 1999. The agreement covers 119 countries and 235 species of waterbirds. The European Community ratified AEWA in 2005.
  - *Agreement on the Conservation of Populations of European Bats*[42] (EUROBATS) concerns the protection of all 45 species of bats found in Europe. It entered into force in 1994. Currently 31 countries have signed up. Implementation of common conservation strategies and international experience-sharing are its main activities. Under this agreement, guidelines were published in 2008[43] for the consideration of bats in wind farm projects.
  - *Agreement on the Conservation of Small Cetaceans of the Baltic and North Sea*[44] (ASCOBANS): this aims to co-ordinate measures to reduce negative impact of by-catches, habitat loss, marine pollution and acoustic disturbances among the ten parties. It was launched in 1991. A resolution on adverse effects of sound on small cetaceans, and with relevance for potential impact from wind farms, was adopted in 2006 (Annex I).
  - *Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic area*[45] (ACCOBAMS) is a cooperative framework for the conservation of marine biodiversity in the Mediterranean and Black Seas. Its main purpose is to reduce the threat to and improve knowledge about cetaceans in these seas. The agreement came into force in 2001.

- The **Convention of Wetlands of International Importance**[46] ('Ramsar Convention') is an intergovernmental treaty providing a framework for national action and international cooperation for the conservation and wise use of wetlands. It was adopted in 1971 and amended in 1982 and 1987. There are to date 158 parties and so far 1723 sites worldwide have been added to the 'Ramsar' list of wetlands of international importance. The Convention does not foresee ratification by supra-national bodies such as the European Union but all Member States of the EU are contracting parties.

- The **Convention for the Protection of the Marine Environment of the North-East Atlantic**[47] (OSPAR) guides international cooperation on a range of issues including the conservation of marine biodiversity and ecosystems, the impact of eutrophication and hazardous substances, and monitoring and assessment. It was launched in 1992, following of the merger of the previous Oslo and Paris Conventions (from 1972 and 1974). Several studies of potential impact of off-shore wind farms on the marine environment have been initiated under the auspices of this Convention.

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[40] http://www.cms.int.
[41] http://www.unep-aewa.org
[42] http://www.eurobats.org
[43] Rodrigues et al. (2008), available via http://www.eurobats.org/publications/publication_series.htm.
[44] http://www.ascobans.org.
[45] http://www.accobams.org.
[46] http://www.ramsar.org
[47] http://www.ospar.org.

- The **Convention on the protection of the marine environment of the Baltic Sea Area**[48] (HELCOM, 'Helsinki Convention') covers the Baltic Sea basin plus all inland waters in its catchment area. It was adopted in 1980 and revised in 1992. All countries around the Baltic Sea plus the EU are contracting parties.

- The **Convention for Protection against Pollution in the Mediterranean Sea**[49] ('Barcelona Convention') aims primarily to regulate and reduce the negative impact of all kinds of pollutants in the Mediterranean basin. It was set up in 1976 and last amended in 1995. Most countries bordering the sea have signed up to it.

[48] http://www.helcom.fi
[49] http://www.unep.ch/regionalseas/regions/med/t_barcelona.htm.

3. POTENTIAL IMPACTS OF WIND ENERGY DEVELOPMENTS ON NATURE AND WILDLIFE

- *Wind energy is generally not a major threat to biodiversity when compared to many other anthropogenic activities or conventional power production technologies,*
- *However, potentially negative impacts may arise from wind farm developments, and may be linked to the wind turbines themselves or to any associated infrastructures. They may occur during the construction, operation, repowering or decommissioning phases of the project.*
- *Studies indicate that various species of birds, bats and marine animals are particularly vulnerable to poorly sited or designed wind farms developments. Typical impacts can include: collision mortality, disturbance and distancing, barrier effects as well as habitat loss and degradation;*
- *The effects will depend very much on the species and habitat types present as well as on the size, location and design of the wind farm development. Each wind farm development has therefore to be evaluated on a case by case basis.*
- *Whilst the knowledge base on potential impacts of wind farms on certain categories of species (in particular birds) is growing fast, it is recognised that the evidence base remains low and that more studies are required, especially for the marine environment and for bats;*
- *Scientific studies and monitoring work undertaken in relation to existing and future wind farm developments are therefore an invaluable source of such information and wind farm developers as well as planners, scientists and NGOs have a key role in building up the information base.*
- *The benefits are manifold, not just for scientists but also for the industry itself: a better scientific knowledge base will ultimately lead to better and faster decision making.*

In general, wind energy is not a major threat to biodiversity when compared to many other anthropogenic impacts[50]. Recent preliminary studies also indicate that wind per unit of energy produced is far less damaging than fossil fuels or nuclear energy[51].

Nevertheless, there is increasing evidence that poorly sited or designed wind farms may pose a significant threat to certain vulnerable species and habitats. Considering that the key focus of this document is to provide guidance on how to avoid significant impacts on species and habitat types that are protected under the Habitats and Birds Directives in particular, it was deemed important to review the existing evidence of potential impacts on wildlife.

Even if wind farms make only a relatively modest contribution to wildlife mortality overall compared to other anthropogenic activities, it does not mean that the risks should not be taken seriously in the context of individual projects, especially when the impacts could affect rare and threatened species or habitats of European importance.

[50] E.g Erickson et al. (2005), NRC (2007)
[51] E.g. Sovacol (2009)

3.1 Potential impacts during different phases of wind farm development

When assessing the potential impacts of wind energy developments on nature and wildlife it is important to bear in mind that these impacts may not concern just the wind turbines themselves, but also all associated installations such as access roads, site access (e.g. for maintenance works or during constuction), anemometer masts, construction compounds, concrete foundations, temporary contractors facilities, electrical cabling (e.g. overhead wires) for access to the grid, spoils, and/or possible a sub-station, control building etc…

They also concern all phases of the wind farm development from the initial construction phase to the actual operation and management and, on to the re-powering or decommissioning phases. As a result, the impact may be temporary or permanent, on-site or off-site and may come into play at different times during the project cycle.

Although this chapter concentrates mainly on impacts resulting from wind turbines, all these other factors should also be taken into consideration during the impact assessment and, where necessary, avoidance or mitigation measures introduced into the planning agreements and accompanying planning permits to eliminate, or at least minimise, the effects of the proposed plan or project on wildlife.

3.2 An overview of potential impacts

The type and scale of impact is very much dependant on the species involved, their ecology and state of conservation as well as the location, size and design of the wind farm plan or project but the type of impacts that appear most frequently include the following:

- *Collision risk:* Birds and bats may collide with various parts of the wind turbine or with associated structures such as electricity cables and meteorological masts. The level of mortality depends very much on site location and varies from one species to the next. Poorly sited wind farms can cause substantial mortalities whereas those that are located away from areas harbouring concentrations of wild animals or areas that are important for wildlife have relatively low rates of mortality. Species that are long lived and/or that are rare or are already in a vulnerable conservation state (such as eagles, vultures and various species of bats) may be particularly exposed;

- *Disturbance and distancing*: Disturbance can lead to displacement and exclusion, and hence loss of habitat use. This risk may be relevant for birds, bats and marine mammals. The species may be displaced from areas within and surrounding wind farms due to visual, noise and vibration impacts. Disturbance may also arise from increased human activity during construction work and maintenance visits and from infrastructure improvements that facilitate access to the site. The scale and degree of disturbance determines the significance of the impact, as does the availability and quality of other suitable habitats nearby that can accommodate the displaced animals.

- *Barrier effect*. Wind farms, especially large wind farms with tens of individual wind turbines, may force birds or mammals to change direction, both during migrations and regular foraging activities. Whether or not this is a problem will depend on the size of the wind farm, the spacing of turbines, the extent of displacement of species and their ability to compensate for increased energy expenditure, and the degree of disruption of linkage between feeding and breeding sites.

- *Habitat loss or degradation.* The scale of direct habitat loss resulting from constructing a wind farm and associated infrastructures depends on the size, location and design of the project. The effects may be more widespread where developments interfere with hydrological patterns or geomorphological processes. The significance of loss depends on the rarity and vulnerability of the habitats affected (e.g. blanket bogs or sand dunes) and/or of their importance as a feeding, breeding or hibernating place for species, especially for species of European conservation concern. Also, the potential role of some habitats as components in corridors or stepping stones important for dispersal and migration, as well as for more local movements between e.g. feeding and nesting sites, has to be taken into account.

Environmental benefits of wind power

This chapter looks at the potential negative impacts of wind farms on biodiversity, but it is clear that wind power also has a number of important positive impacts for the environment. Wind power:

- *Provides a clean source of energy that does not pollute the air;*
- *Does not produce any emssions of greenhouse gases;*
- *Is entirely renewable.*

The expansion of wind power at the expense of traditional fossil fuels also means that substantial quantities of CO_2 emissions and other air pollutants can be avoided. EWEA estimates that the 65 GW of wind energy installed by the end of 2008 represented the avoidance of 91 Million tonnes of C02 emissions. By 2020, if the EWEA predictions of 230 GW of wind energy come true, this amount of energy would avoid the emission of 333 Mt of CO2 (EWEA "Pure Power", Dec. 2009). In addition power generation from wind energy needs no cooling water and thus may reduce the pressure on freshwater resources.

3.3 Potential impact of wind farms on selected species and habitats

The following sections describe the impacts that wind farms can have on specific categories of species such as birds, bats and marine mammals as well as on certain vulnerable habitat types. The information is derived from a comprehensive analysis of the latest scientific literature. Overview tables are given in Annex II-IV of those species of birds, bats and marine animals that are considered to be particularly vulnerable to wind farms. Annex V provides more detailed information on the potential or confirmed impacts on certain species.

Whilst the knowledge base on potential impacts, or absence of such, of wind farms on certain species (particularly birds and bats) is growing fast and there is now an important body of research available, it has to be recognised that the evidence base remains low[52], and there is still a lack of long-term studies upon which to carry out risk and impact assessments. Wind energy is after all still a very young industry. An important part of the information will come from the studies and monitoring work undertaken in relation to existing and future wind farm developments.

Like conservation NGOs and scientists, wind farm developers and planners have a key role to play in building the knowledge base on the biodiversity impacts of wind farms and how to avoid or mitigate them. The benefits of such cooperation and information sharing are manifold, not just for scientists but also for the industry itself: a better scientific knowledge base will ultimately lead to better and faster decision making.

[52] E.g. Stewart et al. (2007).

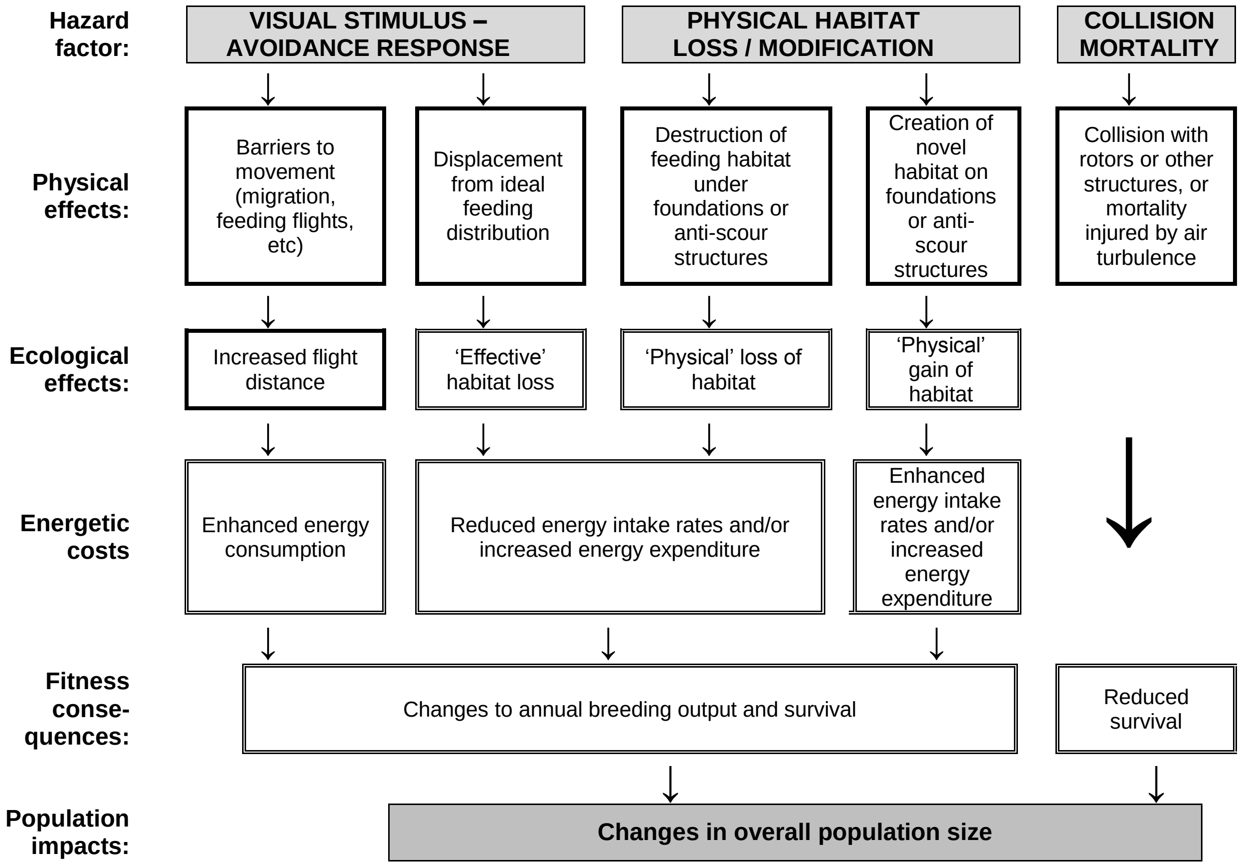

Figure 9: Flow diagram describing how three major hazard factors (shaded boxes) caused by wind farms affect birds and how they may affect survival and reproductive output, and eventually cause changes to the overall population size. The boxes with a heavy solid frame indicate potentially measurable effects, and the double framed boxes indicate processes that need to be modelled. Although the diagram focusses on birds in the offshore environment, the approach can be more widely applied. From Fox et al. (2006).

3.3.1 Potential impact of wind farms on birds

The potential impact of wind farms on birds is perhaps the most studied and the one that has attracted the most public attention. As outlined above they tend to fall into a number of main categories of impact:

- ***Collision fatalities***

Risks of lethal injury or mortality are mostly thought to be related to collisions with rotors, although results from recent modelling studies also indicate that the hub might be the most dangerous part[53].

High mortality rates are primarily related to topographical bottlenecks where migrating or local birds fly through a relatively confined area, for example mountain passes or land-bridges between water-bodies. Other susceptible locations are slopes with rising winds where the birds gain lift and near wetlands or shallow seas that attract large numbers of

[53] Kikuchi (2008). Collision can also occur with overhead cables installed to provide access the electricity grid. Aspects related to bird strikes and power lines are discussed by Drewitt & Langston (2008).

feeding or resting birds. Flight corridors between feeding areas, roosting sites or breeding sites are also particularly susceptible[54].

Peaks in mortality may also be seasonal, for instance during spring and autumn migration when bird concentrations tend to grow significantly, or during the period of pre-nuptial display flights in spring, defence of breeding territories or the provisioning of food to nestlings.

Other factors that could influence collision risks include the species behaviour, weather conditions, topography and the design of the wind turbines. Collision risk is generally higher in poor visibility or during fog and rain, although this effect may be partly offset by lower flight activity in such conditions[55].

Studies indicate that some species are more at risk than others. In particular, the potential impact of additional mortality caused by wind farms can be significant for long-lived species with low annual recruitment and slow maturation rates, such as raptors and sea-birds. Special consideration must also be given to populations of scarce and vulnerable species already under threat from other human-induced factors such as habitat loss[56]. This include species listed in annex I of the Birds Directive. There is also increasing concern (but as yet insufficient evidence) for night-migrating passerines[57].

Effects are likely to lie somewhere in the continuum between the extremes of *additive* - increasing overall mortality - or *compensatory* - replacing other causes of mortality. Results from population simulations indicate that even a quite small additive annual mortality of a magnitude of 0.1-0.5% may have an impact on the population size[58]. A demographic study of Golden Eagle *Aquila chrysaetos* in the Altamont Pass Wind Resource Area in California indicated that mortality caused by collision was additive to other lethal agents[59].

Collision mortality is usually measured through carcass search but this may lead to an under-estimate, especially for small birds, because corpses are quickly removed by scavengers or may be overlooked. Using models may help to get more accurate estimates, although they are very dependant on reliable field data and correct assessments of avoidance by birds[60]. Recently, collision risk per megawatt (MW) has been proposed as an indicator. In view of the increasing size of wind turbines this may turn out to be a more relevant or useful measure[61].

Monitoring and assessing offshore mortality due to collision is even more difficult than for onshore locations, due to the obvious fact that carcasses are hardly ever found. Instead, techniques such as radar, thermal animal detection systems (TADS) and acoustic detection have been tested[62]. An alternative approach to overcome this problem is to assess ‘sensitivity indices’ for the species concerned[63].

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[54] E.g. EEA (2009) and references therein.
[55] E.g. Drewitt & Langston (2006) and references therein.
[56] E.g. Drewitt & Langston (2008).
[57] E.g. Sterner et al. (2007) ; Drewit & Langston (2008) see also annex 5
[58] Hötker et al. (2005, 2006).
[59] Hunt &Hunt (2006)
[60] Band et al. (2007), Chamberlain et al. (2006).
[61] E.g. Drewitt & Langston (2008).
[62] E.g. Desholm et al. (2006).
[63] E.g. Garthe & Hüppop (2004), Desholm (2009).

Examples of wind farm developments that have caused collision fatalities amongst raptors
Studies have indicated that raptors are particularly at risk of mortality due to collision in inappropriately sited wind farms. High levels of mortality have been recorded for Eurasian Griffon Vulture (Gyps fulvus) and Common Kestrel (Falco tinnunculus) at wind farms in Spain[64], for White-tailed Eagle (Haliaeetus albicilla) in Germany and Norway and for Red Kite (Milvus milvus) in Germany[65]. As some of these species are already rare or in decline, there are added reasons for concern with reference to any additional mortality linked to collision fatalities.

Smøla Archipelago, Norway
The Smøla Archipelago on the coast of Norway harbours one of the highest breeding densities of White-tailed Sea-eagle in the world. Most of the pairs breed on the ground on a low and barren landscape of heaths and mires. Although the site was listed as an Important Bird Area (IBA) in 1989, a license for the development of a wind farm on Smøla Island was given in 2000, involving the establishment of a total of 68 turbines of 2-2.3 MW, to be built in two stages during 2002-2005.

Monitoring, which started up in 2003, and continued between autumn 2005 and spring 2009, found 26 sea eagle fatalities, most of them in spring. When construction work started 19 pairs were breeding or holding permanent territories in a 2 km zone around the wind farm. At least five of these pairs have since left their territories, without any sign of re-establishing elsewhere in the Smøla area. The reproduction rate both within the 2 km-zone and in other parts of the Smøla area is also lower than before and there was no successful breeding in 2009. In order to improve the accuracy in the monitoring of bird fatalities, a standardised method, using especially trained dogs, has been developed[66].

Navarra, Spain[67]
Another cluster of wind farms, which were poorly sited in an important area for migrating birds, has led to substantial collision mortality in Navarra, in Spain. Studies of bird use, collision risk and collision mortality in the area of 400 turbines (but not including the power lines and other associated infrastructure), found that raptors and migratory passerines were particularly affected. The high collision mortality of raptors comprised mostly griffon vultures at one of the wind farms, Salajones. Other species among the collision victims were golden eagle, eagle owl, booted eagle, sparrow hawk and common kestrel. Most of these species are listed in Annex I of the Birds Directive in view of their vulnerable conservation status.

After applying correction factors for search efficiency, scavenger removal etc… (which was found to be particularly high at this site) the study estimated at least 8 vultures were killed per turbine per annum (22 birds of all species/turbine/year) at Salajones. Mortality of migrating passerines was especially noted during autumn passage at El Perdon, estimated to be 64 collisions per turbine per year.

- ***Disturbance and distancing***

Bird disturbance, leading to displacement or exclusion, and hence loss of habitat use, is a matter which may be of concern both for onshore and offshore wind developments. Such sub-lethal effects can lead to loss of body condition which is in some respects more insidious than direct mortality for a population as a whole. There may therefore be a delay before any population-level impact is detected[68].

[64] E.g. Barrios & Rodrígues (2004, 2007), Lekuona & Ursúa (2007).
[65] Hötker et al. (2005, 2006), also Follestad et al. (2007) for White-tailed Eagle along the coast of Norway.
[66] Follestad et al. (2007), Bevanger et al. 2008), Falkdalen (2009).
[67] Lekuona (2001), summarised in the Bern Convention report 'wind farms and birds (Langston 2003).
[68] Langston & Pullan (2003).

Disturbance can be caused by the sight, noise or vibration of the wind turbines themselves and/or by other activities related to wind farm maintenance, involving for instance vehicle, boat or helicopter usage. Effects are variable and specific to individual species, seasons and sites. They also depend on the importance of the site for that species and the availability of other suitable habitats in the vicinity that can accommodate the displaced birds.

Generally speaking, breeding birds have been assumed to be less affected than feeding or roosting birds[69], although this statement may need to be revised in the light of results of recent studies[70]. Some studies show a tendency for open-nesting waders to be displaced by wind farms while others do not. Waders are often long-lived and site-faithful, implying that their attachment to a location may outweigh any potential response to change. Hence, the true impact may not be evident until new recruits replace the old birds.

For non-breeders, significant negative effects on local populations have been demonstrated in a number of species of, e.g. geese and waders. Several studies indicate negative effects up to 600m from wind turbines but displacement distances vary between studies and may be much smaller. In a large wind farm, however, even relatively small exclusion areas around individual turbines may amount to a significant exclusion area or area of reduced use overall.

More long-term studies are needed regarding the potential for different species to habituate and recover. The first systematic reviews indicated local population declines over time for various species (e.g. among waterfowl and waders at staging and wintering sites) and no signs of habituation[71], while more recently published long-term studies indicate that various species may habituate, both at onshore and offshore locations[72]. More follow-up studies are needed before any more conclusive statements can be made.

On the basis of current knowledge it is evident that disturbance leading to displacement may need to be considered in impact assessments of wind farms, depending on the species present as well as the location. Even if areas affected around single wind farms may be small in relation to the total availability of habitats for breeding, foraging, staging or wintering, the cumulative effect of a series of wind farms in the same general area may be significant.

- ***Barrier effect***

Wind farms may act as barriers if located along migration routes or flyways, or, at a more local level, along regular flight routes between feeding areas and resting or breeding sites. Avoidance of wind farms has been documented among a wide range of bird species, particularly waterfowl and passerines. Responses are highly species-specific. During daylight, they may occur in a distance interval of 100-3000 m, whereas at night the distances are likely to be closer[73].

Although the short-term benefit of avoidance is obvious in that the risk of injury or mortality due to collision is eliminated, detours may involve increased expenditures in terms of energy and time which might in theory, in the long-term, affect fitness related parameters such as survival and reproductive capacity. However, reviews of available literature suggest that the barrier effect has not been proven to significantly impact on the fitness of bird populations[74].

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[69] E.g. Hötker et al. (2005, 2006).
[70] E.g. Pearce-Higgins et al. (2009)
[71] Stewart et al. (2004)
[72] E.g. Petersen & Fox (2007), Madsen & Boertmann (2008).
[73] E.g. Drewitt & Langston (2006) and references therein.
[74] E.g. Drewitt and Langston (2006)

The risk of causing barrier effects may also be influenced by the design of the wind farm – for instance, its size and/or the alignment of the turbines or the spacing between them. Altering the design of the wind farm may therefore be a potentially important mitigation measure.

- ***Habitat loss and degradation***

Loss of or damage to bird habitats, depends on local circumstances and the scale of land-take required for the wind farm and associated infrastructures. Direct habitat loss may also be additive to disturbance exclusion.

Onshore infrastructure including turbine bases, substations and access roads etc could, if placed inappropriately, involve the direct loss of breeding or feeding habitats for certain birds[75]. Offshore, direct habitat loss is generally small-scale. However, increasingly large wind farms, especially on bird feeding areas such as sandbanks in shallow waters, may give cause for concern for certain species, especially in periods of high bird concentrations during spring or autumn migrations[76].

3.3.2 Potential impacts of wind farms on bats

Mortality caused by collision appears to be a more serious problem for bats than for most birds[77], and barotrauma caused by rapid air-pressure reduction near moving turbine-blades has recently been identified as one of the main reasons for this higher susceptibility[78].

Among the 35 bat species occurring in Europe, around 20 have been assessed to be at particular risk - a third of these are migratory species Bats have a low annual reproductive output and a long life expectancy, so they may be susceptible to even small additional mortality. An overview of the kinds of impacts related to siting and operation of a wind farm is given in Table 2, and species level details are summarised in Annex IV.

A typical year in the life of bats involves a period when they are active (April – October) and a period when they are usually less active or in hibernation (November- March). Bats mostly commute or migrate between summer roosts and hibernation sites. Timing varies for each species according to geographical location and from one year to the next depending on weather conditions but several studies have shown that there is a peak in mortality in late summer and autumn during dispersal and migration, and that migrating species are most susceptible[79]. A common assumption has been that bats use echolocation to avoid wind turbines but they may not do so for energy-saving reasons when travelling over long distances in open areas[80].

The highest collision rates have been found in wind farms near forests but bat collisions have also been reported from turbines in open areas and even at offshore wind farms. Potential siting in important hibernation areas where large numbers of bats forage before

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[75] E.g. Pearce-Higgins et al. (2009).

[76] 2-5% of the total development area around Danish off-shore wind turbines (Fox et al. 2006), although indications of recent recovery (Petersen et al. 2007).

[77] E.g. Barclay et al. (2007).

[78] Baerwald et al. (2008). Barotrauma involves tissue damage to air-containing structures caused by rapid or excessive pressure change; pulmonary barotrauma is lung damage due to expansion of air in the lungs that is not accommodated by exhalation

[79] Rodrigues et al. (2008) and references therein.

[80] Keeley et al,(2001).

and after hibernation should be carefully evaluated, and are best avoided if it is determined that this will result in a significant negative impact.

Possible impacts on bats related to siting		
Impact	**Summer time**	**During migration**
Loss of hunting habitats during construction of access roads, foundations etc..	*Small to medium impact, depending on the site and species present at that site.*	*Small impact.*
Loss of roost sites due to construction of access roads, foundations etc..	*Probably high or very high impact, depending on the site and species present at that site.*	*High or very high impact, e.g. loss of mating roosts.*
Possible impacts related to operating the wind farm		
Impact	**Summer time**	**During migration**
Ultrasound emission.	*Probably a limited impact.*	*Probably a limited impact.*
Loss of hunting areas because the bats avoid the area.	*Medium to high impact.*	*Probably a minor impact in spring, a medium to high impact in autumn and hibernation period*
Loss or shifting of flight corridors.	*Medium impact.*	*Small impact.*
Collission with rotors.	*Small to high impact, depending on the species*	*High to very high impact.*

Table 2: Overview of impacts on bats (extract from the Eurobats guidelines for consideration of bats in wind farm projects)[81]

A variety of landscape features important for concentrations of various bat species should also be considered with reference to collision risks. This should include linear landscape elements such as woods[82], hedgerows and watercourses, wetlands, marshlands and wet meadows with adjacent shallow marine or freshwater lake areas[83]. These may be used as habitat corridors for movement between feeding, breeding and roosting areas.

Habitat loss and degradation can occur if the wind turbine is sited in or near a forest occupied by bats, as well as in more open landscapes used for foraging. Not only does the removal of trees for the installation of the wind tubine and associated structures lead to potential loss of habitat for bats but it may also create new linear features which attract bats to forage right next to the wind turbine.

Various hypotheses have been proposed for why bats may actually be attracted to wind turbines[84]. The most widely accepted explanation is that insects may concentrate around wind turbines, both at onshore and offshore locations, attracted by the heat radiation from

[81] Rodrigues et al. (2008).
[82] A 200 meters zone along forest edge has been recommended (Rodrigues et al. 2008).
[83] E.g. Brinkmann et al. (2006), Ahlén (2008), Rodrigues et al. (2008).
[84] E.g. Kunz et al. (2007a).

the wind turbine. In certain weather conditions bats, as well as several species of insectivorous passerine birds, may be attracted to these concentrations of insects[85].

The timing of the construction of the wind farm has also a potentially important impact for certain species of bats if it interferes, for instance, with their foraging behaviour or if it occurs at times of migration and dispersal. This requires local knowledge about bat species and an understanding of their annual life cycle[86].

3.3.3 Repowering of wind farms

There is still only limited evidence about how risks related to collision fatalities may change with reference to repowering, i.e. to replace existing turbines with fewer but larger and more power-effective ones. So far, experiences both in Europe and North America indicate that repowering reduced the collision risk among birds but increased the risk for bats[87]. Increased height of the turbine tower does not seem to have any effect on birds, but the risk for bats may increase, i.e. nocturnally migrating bats may fly at a lower height than birds, and newer and larger turbines may interfere with the airspace used by bats.

3.3.4 Potential impacts of wind farms on marine animals

Marine mammals (seals and cetaceans) may be affected by offshore wind farms in several ways. Marine noise pollution has attracted much attention as it has the potential to displace animals, interfere with normal behaviour and, at very high levels, cause physical damage. During the construction phase, noise and vibration from pile driving and other works may exclude the animals from a large area, up to 80 km in the case of harbour porpoises *Phocoena phocoena*[88]. The emitted energy from pile driving is most certainly high enough to impair the hearing of porpoises and seals in the surrounding area[89].

Monitoring of seals at the Nysted and Horns Rev wind farms, Denmark, showed that pile driving temporarily expelled animals from the wind farm area. Later in the construction phase and during operation the abundance of seals in the area was unaffected. This may be because both wind farms are part of much larger areas used by seals and all haul-out sites are at least 4–5 km from the wind farm[90].

Harbour porpoises were monitored in the same areas, mainly by automatic sound detectors. At both wind farms, a substantial but short-lived effect of pile driving was observed. At Horns Rev, a slight decrease in porpoise abundance was found during construction and no effect during operation. At Nysted, a clear decrease was found during construction and operation, and this effect still persisted after two years of operation, albeit with indications of a slow, gradual recovery[91].

During operation, sound and vibration continue to be emitted into the water body, potentially disturbing the communication and foraging behaviour of the animals. Harbour porpoises and other cetaceans rely heavily on echolocation for navigation and foraging. Long term impacts

[85] E.g. Ahlén (2003), Ahlén et al. (2007).
[86] Rodrigues et al. (2008)
[87] E.g. Hötker (2006), Barclay at al. (2007), Smallwood & Karas (2009).
[88] E.g Thomsen et al (2006), Nedwall et al (2007), Diedrichs et al (2008)
[89] OSPAR, 2004
[90] Teilmann et al. (2006).
[91] Teilmann et al..(2008)

seem to vary between different sites. The operational noise of wind farms will be clearly audible to some sea mammals, but, unlike pile-driving, the impacts of this noise on sea mammals are expected to be small and localised[92], although it is difficult to make generalised statements on the basis of the still limited number of studies undertaken.

Some wind farm related effects of potential relevance for marine mammals

- Intense noise during piling-driving, drilling and dredging operations;
- Increased vessel activities during exploration, construction and maintenance operations;
- Increased turbidity and re-suspension of polluted sediments due to construction;
- The presence of structures (including artificial reef effects causing habitat alterations) and, potentially, changes to prey and food webs;
- The continual operational noise and vibrations emanating from the wind turbines;
- Electromagnetic impacts due to cabling that may impact navigation (this may be of particular concern for elasmobranchs);
- Effects on prey, such as changes to fish behaviour.

Extracted from proceedings of the ASCOBANS/ECS Workhop, April 2007 (Evans 2008)

Another possible major impact of wind turbines on marine biodiversity is the so called ‘reef’ effect. Underwater constructions may function as artificial reefs, and the foundations may be colonised by algae and epifauna. This may completely alter the characteristics of local species composition and biological structure at a local level[93]. Consequently, the abundance and distribution of seals and porpoises, as well as fish, may also be affected by changes in the distribution of their food resource.

The rate of colonisation appears to be dependent on the distance to other natural or anthropogenic hard substances. The reef effect is mostly considered as positive in terms of increased diversity although concern has been expressed, for those areas that have no natural occurrence of hard substrata. In such cases, new species may disrupt local ecological conditions[94].

Temperature increase around cables has also attracted attention, with reference to the impact on benthos as well as increased risk of botulism infection. However, impact should normally be negligible as cables are generally buried at a maximum depth of 3 metres in the seabed. Most benthic animals dwell in the upper 5-10 cm in open waters and the top 15 cm in intertidal area where temperature increase is small (<1ºC), provided that the burial depth of the cable is sufficient (although some animals will burrow deeper)[95].

Finally, the transmission of electricity through cables within the wind farm and to shore creates electromagnetic fields that may also interfere with short- and long-range orientation systems. Disturbance effects could be particularly pronounced in elasmobranchs (sharks and rays) that are highly sensitive to magnetic fields. However, except for a few metres around cables and other devices, field strength is well below that of the earth's geomagnetic field. Studies so far have judged the impact to be small although available results are not entirely conclusive.[96]

[92] Madsen et al. (2006)
[93] Petersen and Malm (2006).
[94] E.g. Hammar et al. (2008).
[95] Data from studies at Nysted Offshore Wind Farm, Denmark, referenced by OSPAR (2008).
[96] E.g. Petersen & Malm (2006), Meissner & Sordyl (2006)

3.3.5 Potential impacts of wind farms on rare and vulnerable habitat types

The poor siting or design of a wind farm can also cause the loss or deterioration of certain habitat types in their own right, such as blanket bogs or raised mires, wetlands, sand dunes and shallow sand banks. The concern is not just over the direct loss of an area of habitat, but over potential damage caused, during construction and operation, to the habitat's structure and ecological functioning. Such damage can have a significant impact over a much larger area than the direct land-take.

Peatlands can be damaged by the inappropriate siting of wind farms or their associated infrastructures. The damage is often caused because developments have not taken sufficient account of the underlying hydrology of the peatland. So, whilst the actual amount of peat lost may be small, the damage caused to the natural drainage system of the peat (for instance through drainage ditches, access roads, etc…) may have repercussions over a much wider area and can ultimately lead to the deterioration of a significant area of peatland and other related habitats, such as streams and other water courses located down-stream[97].

Peatlands are also an important carbon sink and are, as a result, an important part of Europe's climate change mitigation strategy. Wind farms sited on peatlands which hold large stocks of carbon have the potential to greatly increase overall carbon losses which would undermine the expected carbon savings associated with the wind farms. Scottish National Heritage has developed a method to determine potential carbon losses and savings associated with wind farm developments on peat land taking into account peat removal, drainage, habitat improvement and site restoration[98].

Wind farm construction on sloping peatlands and deep peat – the Derrybrien case

In October 2003, an estimated 450 000 m^3 of peat slid down the southern side of Cashlaundrumlahan Mountain in Galway County on Western Ireland, travelling almost 5 kms before plunging into a small river which carried the peat a further 30 km downstream into Loch Cutra. This not only caused the death of more than 100,000 fish but also lead to the loss of an important water supply for local residents[99]. In later investigations the cause of the bog slide was traced back to the construction works being carried out on a new wind farm on the peatland. It is thought that two of the wind turbines and a proportion of the access roads that had been built across the peat had disrupted the bog's hydrology and consequently destabilised the peat layer.

A similar landslide occurred in August 2008, at the site of another wind farm development project in the Stacks Mountains in County Kerry,Ireland. The peat slid into North Kerry's main river sources, causing a temporary loss of water supply to local villages and major damage to fishstocks and the aquatic environment. Again, it was found that the landslide was linked to the inappropriate siting of the access roads on the peatland leading up to the wind farm.

The Derrybrien case was later taken to the European Court of Justice following an independent investigation into the construction of the wind farm. In July 2008, the European Court of Justice[100] which ruled that '*Ireland has failed to take measures to ensure that checks are made to ascertain whether proposed works are liable to have significant effects on the environment in accordance with Article 2(1) of the EIA Directive'*. Wind farm developers have since been urged to carry out full scale peatland risk assessments when developing project proposals for wind farms on peatlands.

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[97] E.g. Fagúndez (2008) and Fraga et al. (2008) with reference to impact on blanket bog vegetation in Spain.

[98] Scottish Natural Heritage (SNH) has developed a method to determine potential carbon losses and savings associated with wind farm developments on peatland (Nayak et al. 2008); see also Grieve & Gilvear (2008) and Azkorra et al. (2008) for site-specific studies in Scotland and Spain, respectively.

[99] A detailed study of the Derrybrien case was done by Lindsay & Bragg (2004), and a more concise summary is given by Bragg (2007).

[100] ECJ ruling C-215/06.

Other dynamic habitat systems, such as sand dunes, wetlands or partially submerged sand banks are also vulnerable to any changes in their structure and functioning. This could be caused for instance by soil compaction, clearance of vegetation, drainage, reprofiling, etc.. which may lead to severe erosion and habitat degradation over a wider area. The scale of damage or deterioration to the habitats depends on the size of the development and on the precise location of the wind farms and their associated infrastructures.

3.4 Distinguishing between significant and insignificant effects

Identifying the species and habitats that are likely to be affected by wind farm developments is only the first step of any impact assessment. After that, it is necessary to determine whether the impact is significant or not. The legal procedure for determining 'significance' in any plans or projects affecting Natura 2000 sites is described in chapter 5. Here, the technical aspects are outlined.

Clearly, the assessment of significance needs to be done on a case-by-case basis, in function of the species and habitats affected (and for which the site has been designated Natura 2000). The loss of a few individuals may be insignificant for some species but may have serious consequences for others, like eagles and vultures. Similarly, the displacement of animals may significantly reduce the fitness, and ultimately the survival rate of certain species, but have only a limited impact on other species, which may, for instance, have enough alternative habitats in the vicinity. Hence, population size, distribution, range, reproductive strategy and life-span will all influence the significance of the effects.

The assessment of significance should also be considered over an appropriate geographical scale. For migratory species that travel over very long distances during their annual life-cycle, the impact at a specific site may have consequences for the species over a larger geographical area. Likewise, for resident species with large territories or changing habitat uses, it may still be necessary to consider potential impacts on a regional, rather than local, scale.

Significance will vary depending on:

- Magnitude of impact
- Type
- Extent
- Duration
- Intensity
- Timing
- Probability
- Cumulative effects

A common means of determining the significance of effects is through the use of key indicators (e.g. identified using the approach shown in Figure 9 earlier in this chapter). Some indicators, such as percentage of habitat lost, may be more significant for priority habitat types or habitats with a limited distribution than for others because of their status.

The flow chart in Figure 9 describes the interconnectivity of factors that could potentially and *significantly* influence for example a bird population. It demonstrates how *physical effects* such as barriers to movements, displacement from feeding areas, modification of habitats and mortality due to collisions cause *ecological effects* such as increased flight distances and changed access to habitats. This leads to *costs in terms of changes in energy expenditure and food intake*, potentially affecting fitness related parameters such as survival and reproductive output and thus the overall *population size*[101].

It is clear that any impact assessment should be based on the best available data. This may be data from dedicated field surveys or various types of predictive population models. In special cases such data may also be available from comprehensive, "research type"

[101] The process is elaborated in more detail by Fox et al. (2006)It is presented as a "model approach" and not used on a regular basis by the planning authorities in Denmark.

monitoring programmes. The example below shows how such a programme was carried out for some of the first major offshore wind farms in Denmark.

Offshore wind farm establishments in Denmark: impacts and environmental monitoring

Together with Germany and the United Kingdom, Denmark is one of the leading countries in the large-scale establishment of offshore wind farms in Europe. By 2009, nine offshore wind farms were in operation; with a total of 305 turbines and a total capacity of 631 MW. More than 70% of the turbines are concentrated in three large establishments: two at Horns Rev in the North Sea, 15-30 km from the western coast of Jutland, and the other at Nysted in the Baltic Sea around 10 km S the town of Nysted on Lolland Island. Each covers an area of 20-35 km^2.

Screening work was initiated in 1999, the EIAs were approved in 2001 and construction started in 2002. The first two wind farms were operational by 2003. As part of this process an ambitious research and monitoring programme was launched for these two wind farms.

The studies undertaken so far have included:
- Benthic fauna and flora (with particular emphasis on the establishment of artificial hard-bottom substrates at turbines foundations).
- Distribution of fish (incl. effects of electromagnetic fields).
- Numbers and distribution of feeding and resting birds.
- Migrating birds (incl. risks for collision).
- Behaviour and reactions by marine mammals (seals and porpoises).
- Coastal morphology.

Results of the monitoring work up to the end of 2006 can be very briefly summarised as follows[102]:
- Abundance and biomass of the benthic fauna have changed, with local biomass increases of 50-150 times, primarily related to the increased habitat heterogeneity related to the introduction of hard bottom substrates onto seabeds that almost exclusively consisted of sandy sediments.
- Despite this there were no indications of attraction related to ‘reef effects’. An interesting finding was that sand eels (*Ammodytes* spp.), which are sensitive to changes in the composition of sediments and an important prey for piscivorous fish as well as for birds, were not affected.
- For marine mammals, clear pile driving effects were recorded, a decrease in porpoises was recorded during construction and, so far there are indications of only a slow recovery at one of the farms. Harbour seals and grey seals on the other hand showed no general changes in behaviour;
- Very low collision rates, but clear indication of a barrier effect, were recorded for various bird species, including Eider ducks. Displacement effects, up to at least 2 km were found for some waterbirds.

A variety of new and advanced monitoring technologies have also been tested and applied, e.g.:
- Hydroacoustic equipment for fish surveys.
- A special setup and fishing gear to study impact of electromagnetic fields.
- Acoustic monitoring of marine mammals, using stationary data-loggers, combined with remotely controlled video monitoring and tagging of animals with satellite transmitters; complemented by spatial modelling of the distribution of marine mammals on the basis of field survey data.
- Improved radar and infra-red video monitoring techniques for monitoring of bird movements.

Overall, the Danish studies have increased our knowledge of the short-term impacts on various species and marine habitats of large offshore establishments. In addition to the improved knowledge about environmental impacts, the Danish experiences have also contributed to enhanced know-how about monitoring methodologies. As such it provides a very useful example of how a scientific framework can be applied in the spatial planning of other future large-scale projects[103].

[102] Background reports can be downloaded from http://www.ens.dk/sw42552.asp (Nysted) and http://www.ens.dk/sw42556.asp (Horns Rev).

[103] The Danish Energy Authority (together with DONG Energy, Vattenfall and the Danish Forest and Nature Agency) has published an overview of the experiences and monitoring results (until 2006) from the Horns Rev and Nysted establishments, titled “Danish offshore wind – key environmental issues”, that can be ordered from http://ens.netboghandel.dk.

3.5 Cumulative effects

Cumulative effects may arise when several wind farms are present within an area or along a flyway corridor, or as the result of the combined impacts of wind farms and other types of development (e.g. forestry or other industrial developments). The cumulative effect is the combined effect of all developments taken together but this does not mean that it is simply a sum of the effect of one wind farm plus the effect of a second wind farm. It may be more, it may be less.

For instance, the first wind farm may give rise to a small but acceptable level of bird mortality, which lies well within the capacity of that bird population for regeneration and hence has little effect on the overall population level. But the level of bird mortality occasioned by several wind farms taken together may exceed the capacity of the population for regeneration, in which case the bird population would go into decline. In this case, whereas the impact of the first and second projects, each on their own, is not discernable, the impact of both taken together could cause the bird population to collapse. This influences the planning decision for both project proposals.

The key is to determine at what point do accumulated habitat loss (including effective habitat loss due to exclusion), barrier-effect induced increases in energy costs and collision mortality, acting in concert, impact significantly on population size.

It also depends on the cumulative impact of that project combined with other developments in a given area. The effect of a single project may be insignificant but when combined with other projects the cumulative effect may turn out to be significant. Habitat fragmentation may also need to be considered during the assessment of cumulative effects as this can have a deleterious impact on population structure and dynamics among a wide range of species.

4. THE IMPORTANCE OF STRATEGIC PLANNING IN WIND FARM DEVELOPMENT

- *Planning wind farm developments in a strategic manner over a broad geographical area is one of the most effective means of minimising the impacts of wind farms on nature and wildlife early on in the planning process. It not only leads to a more integrated development framework but should also reduce the risk of difficulties and delays at later stages at the level of individual projects.*
- *Evidence to date illustrates that wind power does not have to threaten wildlife but appropriate siting is critical and must be a first goal of the planning process.*
- *A recent EEA report investigated Europe's wind potential and concluded that even if all Natura 2000 and other areas designated for nature protection were theoretically excluded from wind energy development, there would still be enough wind energy available to supply 3-7 times the total estimated energy demand in 2020 and 2030.*
- *Developing wildlife sensitivity maps at the strategic planning stage enables areas to be identified where wind farm development might be considered a low, medium or high risk in terms of nature and wildlife. Several Member States have demonstrated how this can be done with success.*
- *Such wildlife sensitivity maps will also help to avoid potential conflicts with the provisions of article 5 of the Birds Directive and 12&13 of the Habitats Directive as regards the need to protect species of EU importance throughout their entire natural range within the EU (ie also outside N2000 sites).*

4.1 Strategic planning: a way to ensure more efficient, integrated decision-making

Strategic planning is a useful tool for ensuring that a rapid deployment of wind energy over a large area can be achieved whilst simultaneously protecting vulnerable wildlife from inappropriate development[104]. Strategic planning not only helps to identify the most appropriate locations and scales for expansion in function of wind energy capacity, grid access etc. but also helps to avoid and reduce the impacts on the natural environment at a very early stage in the planning process.

Evidence from Germany, Denmark and the UK illustrates that wind power does not have to threaten wildlife but appropriate siting is critical and must be a first goal of the planning development process from a conservation perspective. Despite the range of concerns, most threats can be minimised by avoiding sites with sensitive habitats and key populations of vulnerable species. Good site location will also help developers avoid costly investments in inappropriate sites.

Drawn up by public authorities, these plans usually cover a broad geographical area, be it at the level of a municipality, region or country. This scale, combined with the spatial nature of the plans, enables strategic decisions to be made about the capacity and location of wind developments over a broad area. They also provide an opportunity to explore various

[104] 'Positive planning for onshore wind: expanding onshore wind energy capacity while conserving nature', report by IEEP commissioned by RSPB, March 2009

alternative, and potentially less environmentally, damaging options as well as to consult early on with industry and other interested bodies.

The whole process should ideally result in a more integrated and sustainable form of spatial planning which takes on board wider societal concerns at an early stage. This in turn should provide the industry itself with a more transparent and stable framework for growth and expansion.

Strategic planning is equally relevant for wind energy development offshore. In contrast to spatial planning on land, Member States generally have only limited experience in integrated spatial planning in the marine environment. The Commission therefore strongly advocates, in its Communication on offshore wind energy of November 2008[105], that Member States adopt a more strategic approach to offshore development in order to ensure that it is both cost-effective and entirely sustainable.

4.2 Determining suitable locations for wind farm development

A crucial first step in developing a spatial vision for wind farm development that is compatible with nature conservation interests is to determine within a given area both:

- the capacity for wind farm development - for instance in function of wind speed, access to grid, and other physical or economic constaints - and
- their suitable location in function of other land-uses and restrictions and other societal constraints, including nature conservation interests.

With the benefit of geographical Information systems (GIS) data collected on these aspects at a strategic level can be used to develop useful overlay maps which can help authorities to identify, within a given region, potentially low-risk areas – ie areas of high value for wind farm development but that also present little or no risk from a nature conservation perspective or potential high-risk areas that are best avoided or where mitigation measures are likely to be required.

These aspects should be investigated as part of the initial development plan proposal and should also be further developed through the Strategic Environmental Assessment[106] or Appropriate Assessment ,where this is required, and/or through consultation with developers and other interested parties. This will not only ensure that the final result is more integrated and acceptable to all concerned but should also reduce the risk of unforeseen difficulties and delays at later stages.

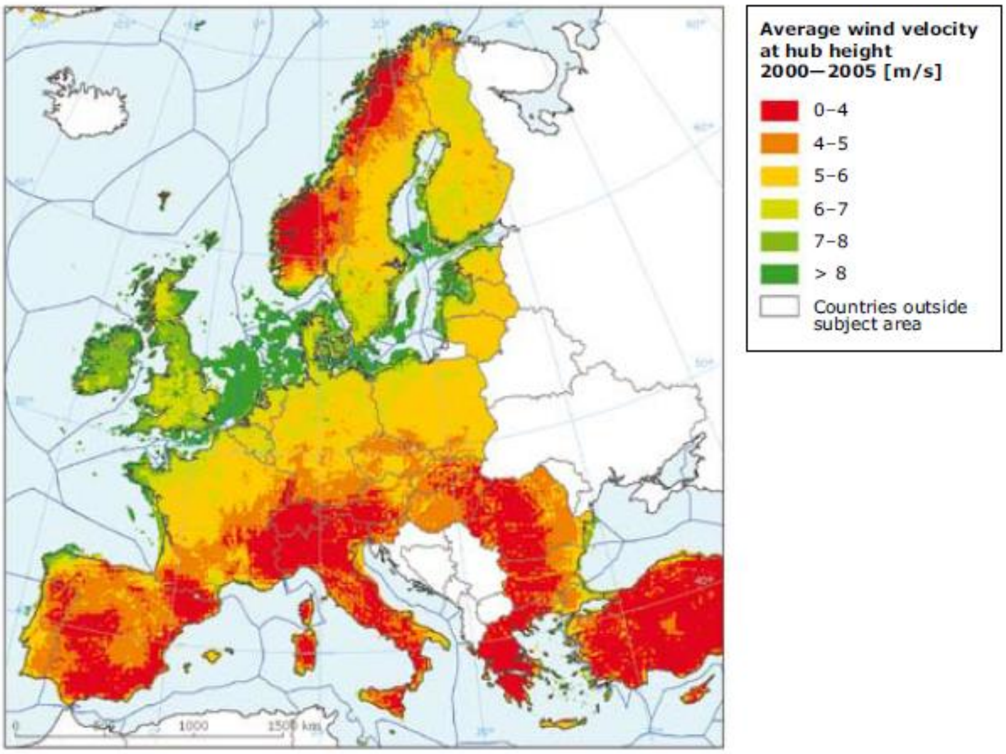
4.2.1 Europe's wind energy potential

In its recent report entitled '*Europe's onshore and offshore wind energy potential*'[107] The European Environment Agency (EEA) analysed in detail the local wind resources across the EU (based primarily on wind speed) in order to provide a Europe-wide resource assessment of onshore and offshore wind potential in a geographically explicit manner and to help Member States identify the most suitable locations for wind energy generation.

[105] COM(2008) 768 final/2; 12.12;2008 (corrigendum replacing COM 768 of 13.11.2008).
[106] See chapters 3 and 6
[107] EEA technical report N°6/2009 of June 2009 (EEA 2009).

It confirms that the wind energy resources in Europe are potentially immense, but they do also vary significantly across the EU due to variations in topography and meteorology (Figures 11,12). According to the EEA report, onshore wind energy potential is concentrated in particular in agricultural and industrial areas of north-western Europe.

Likewise, the largest offshore potential can be found in low depth areas in the North Sea, the Baltic Seas and the Atlantic Ocean with some local opportunities in the areas of the Mediterranean and Black Seas.



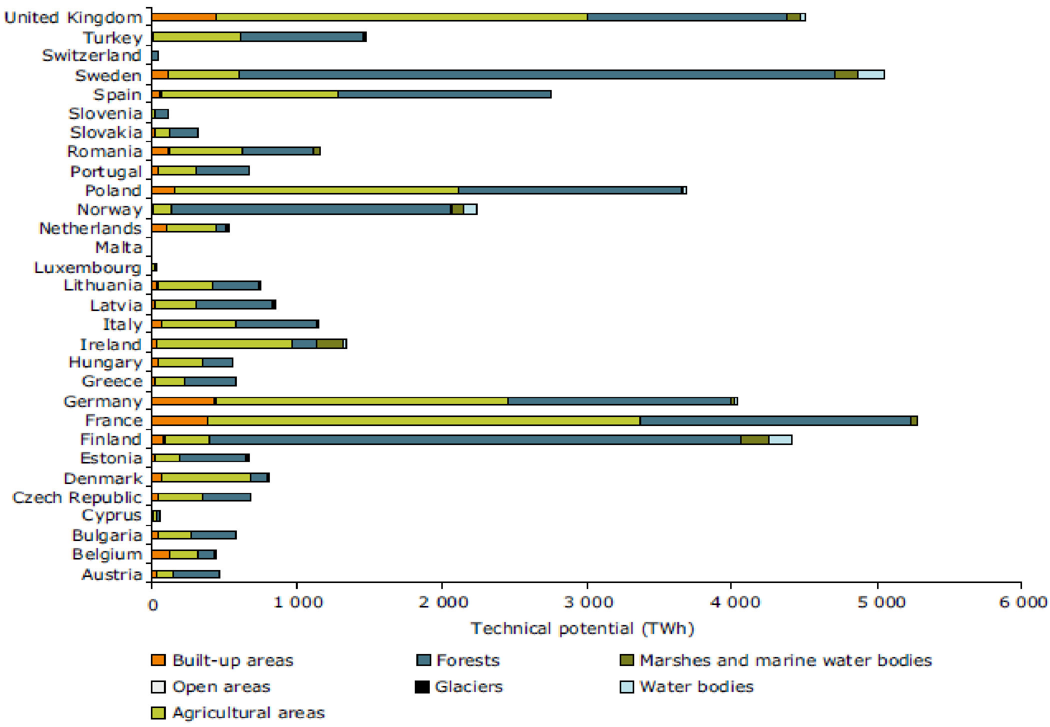
Source: EEA, 2008.

Figure 11 Wind field data after correction for orography and local roughness (based on estimated average wind speed of 80 m onshore, 120 m offshore – from EEA technical report N°6/2009 (EEA 2009).

From a Member State perspective the unrestricted potental for onshore wind energy also highlights very significant differences between countries (see next table).

However, raw unrestricted 'technical potential' is only part of the equation. There are also cost considerations and potential socio-environmental constraints to take into account. In the case of the former, the EEA has estimated the 'economically competitive potential' of wind energy development based on the forecasted costs of developing and running wind farms in 2020 and 2030 relative to projected average energy generation costs derived from the Commission's baseline scenario[108]. Again there are marked differences between different regions and countries of the EU (Figure 13).

[108] In the EEA report 'technical potential' refers to the highest potential level of wind energy generation, based on overall resource availability and the maximum likely deployment density of turbines, using existing technology or practices. 'Economically competitive potential' describes the proportion of technical potential that can be realised cost-effectively in the light of projected average energy costs in the future.



Source: EEA, 2008.

Figure 12: Unrestricted technical potential for onshore wind energy up to 2030, based on estimated 80 m average wind speeds 2000-2005 from EEA – from EEA technical report N°6/2009 (EEA 2009).

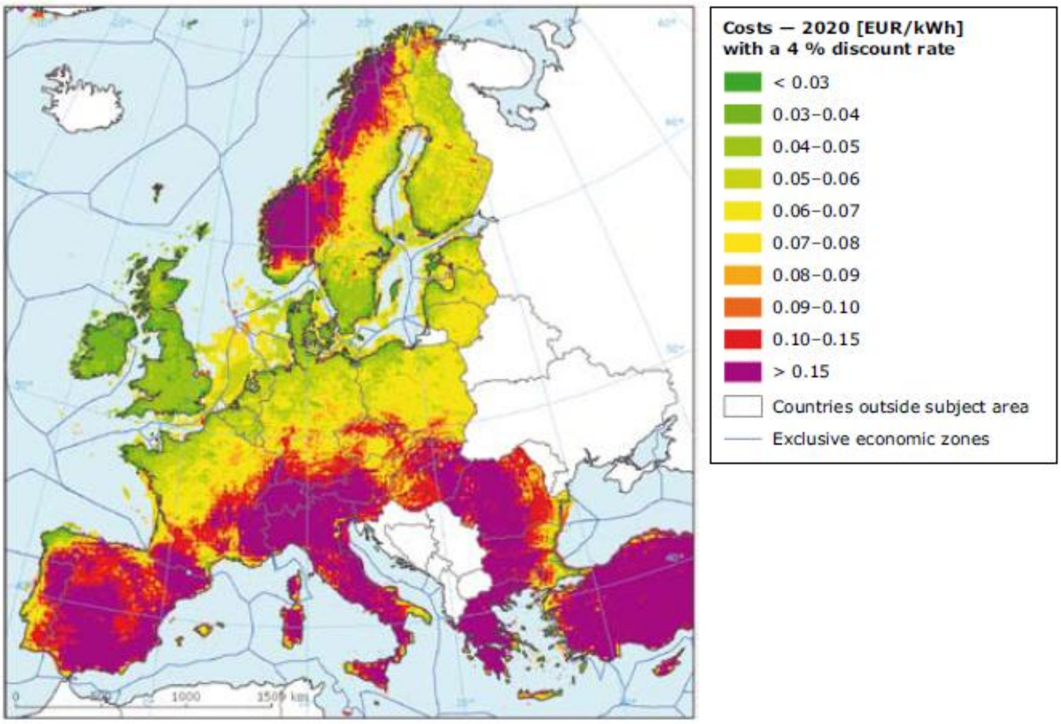


Figure 13: Generation cost for wind energy in Europe (to 2020) at 4% interest rate

The EEA also made an analysis of wind energy potential where all Natura 2000 and other protected areas are excluded from the calculations. As explained before there is no automatic presumption against wind farm development in Natura 2000 sites but such developments must respect the procedural safeguards laid down in the Habitats Directive.

The EEA's exercise illustrates that if all Natura 2000 and other areas designated for nature protection were theoretically excluded from wind energy developments, and assuming that the excluded areas are spread equally over all land cover classes, this would have only a limited impact on wind energy potential (a decrease of ca 13.7% of onshore technical potential).

To put this in perspective, the total economically competitive EU wind energy potential was estimated to be equivalent to 3-7 times the total energy demand by 2030 and 2020.

It must however be noted that the assumption that the wind potential is equally distributed between protected and non-designated areas is not necessarily appropriate. The actual effect, especially at a particular regional or national level, of a complete exclusion of wind energy development in protected areas could therefore be more or less severe than the EEA study seems to suggest. Nonetheless, the EEA study clearly demonstrates the value of undertaking such spatial analysis as part of a strategic assessment of wind farm development.

4.2.2 Grid connections and road access

Grid connection and road access are both crucial issues for the location of wind farms. Consequently, the relationship between wind farm developments and existing grid or road infrastructures is also a key aspect of spatial planning. As both associated infrastructures are capable of having a significant impact on nature and biodiversity values, this is also best considered early on during the planning stages.

For offshore wind farms, an international perspective to grid access is strongly encouraged as it might provide more efficient and coordinated solutions, with reference to the onshore grid systems as well as underwater cables. By mapping the grid connections and capacities available, optimised locations can be determined, and the need for new grid connections and additional impact can be minimised[109].

4.2.3 Wildlife sensitivity maps

Analysing the capacity and means for a region to develop wind farms is only part of the equation. A strategic development plan should also consider other land-uses and restrictions or other societal constraints at a very early stage in the planning process.

Wildlife sensitivity maps are useful tools in helping to place wind farm developments in areas that are compatible with nature conservation requirements. Sensitivity maps can be developed for selected categories of species (eg species of birds, bats, marine mammals of European importance) or for valuable wildlife in general over a pre-determined area – for instance an entire region.

[109] COM(2008) 768 final/2; 12.12;2008

When wildlife sensitivity maps are then super-imposed over the wind capacity maps for instance, areas of potential 'higher-risk' can be identified where particular species of conservation concern are to be found either year-round or seasonally (eg during migration). They can also highlight potential cumulative impacts of wind farm developments in a particular region and assist in establishing the likely carrying capacity of that region as regards the number of wind farm developments it can sustain.

The public resources spent for the development of these kinds of maps are likely to be more than compensated for in terms of smoother and less complicated and time-consuming site-related assessments - costs which are normally borne by the developer.

However, sensitivity maps can only provide a broad orientation of areas of potentially high-, medium- (where mitigation measures may be possible), and low risk areas (where the impact is expected to be limited or low). As such they are not a substitute for Environmental Impact Assessments (EIA) or Appropriate Assessments (AA) at project level. These may still need to be undertaken for individual wind farm development projects.

Comprehensive species surveys within the EIA or AA at individual site level will be able to determine more precisely for each site what the specific nature values and risks of impact are. In this context, the strategic level maps can already help to indicate the required level of assessment that would be needed for more detailed and stringent baseline studies at individual project level.

The other significant advantage of wildlife sensitivity maps over larger scales is that they help pre-empt any potential conflicts with Articles 5 of Birds Directive and 12&13 of Habitats Directive. As explained in chapter 3, these provisions aim to ensure the protection of species of European Importance across their entire natural range in the EU, i.e. also outside Natura 2000 sites. Wind farm developers or planners must therefore be able to demonstrate that they have taken the necessary precautions to avoid compromising this species protection regime.

Wildlife sensitivity maps of species of EU interest can help planners and developers, for instance, to avoid areas outside Natura 2000 that are particularly important for these rare and endangered species, such as bottleneck migration routes for birds and bats as well as sites of importance for bats and marine mammals covered by Article 12 of the Habitats Directive.

In general there is a clear need for more detailed surveys and research into the spatial distribution of vulnerable species across the EU. This is best done at a supranational level so that the entire natural range of the species can be covered.

Two new EU funded initiatives are currently underway (INSPIRE[110] and GMES[111]) which, although not yet fully developed, demonstrate the importance of geographical information and the value of Member States pooling their resources. In due course they should become powerful tools for developing the overlay maps mentioned above that include several variables.

[110] More information about INSPIRE available under http://www.ec-gis.org/inspire
[111] More information about GMES available under http://www.gmes.info/

4.2.4 Natura 2000 maps

Maps of Natura 2000 sites will also help to show the location of key sites for species and habitat types that are considered to be of European importance. However, such maps only give the boundaries of the sites sites included in the Natura 2000 Network. They do not show which parts of the area are occupied or used by the species and habitat types of EU importance for which it has been designated. This information may be available – for instance as part of a management plan for the site.

Nevertheless, the Natura 2000 map will allow planners and developers to identify at a very early stage in the process where additional planning procedures are likely to apply (for instance, under article 6 of the Habitats Directive) and whether more detailed site level mapping may be needed at project level.

Offshore, the situation is rather more complex as there is still a major gap in the designation of marine Natura 2000 sites. This is partly due to poorer scientific knowledge about species and habitats, including marine mammals in the marine environment. In this respect, it will be important to ensure that Member States designate marine protected areas under the Habitats and Birds Directive as soon as possible in order to remove legal uncertainties about the potential suitability of a given marine site for wind farms.

The Natura 2000 online viewer:

With the assistance of the European Environment Agency, the European Commission has developed a public Natura 2000 viewer which makes it possible to explore Natura 2000 sites in every part of the EU at the press of a button. Built on state of the art GIS technology, the public viewer is an interactive and user-friendly tool that allows the user to view Natura 2000 sites over different types of backgrounds (street maps, satellite imagery, bio-geographical regions, Corine Land Cover, etc.) and to quickly locate any related information on species and habitats of interest.

The Natura 2000 v*iewer is available under http://natura2000.eea.europa.eu/*

4.3 Good practice examples of planning wind farm developments strategically to ensure appropriate siting from a conservation perspective

Experience in several countries has already shown that in practice such wildlife sensitive maps are a very useful part of the strategic planning process. The five examples presented below demonstrate this and help to illustrate further the kind of the approaches that have been used for creating and using wildlife sensitivity maps. They concern both onshore and offshore plans.

Scotland: Strategic Locational Maps for onshore wind farms in respect of natural heritage

Scotland is likely to see a rapid expansion in wind energy in coming years in response to the region's ambitious target of 50% of Scotland's electricity coming from renewable energy sources by 2020. To plan for this increase in an efficient and proactive manner, the Scottish government has adopted a strategic approach to wind farm development. It requires planning authorities to develop spatial frameworks for windfarms identifying areas which are afforded significant protection, broad areas of search and other areas where criteria will apply.

To assist planning authorities in this process, Scottish Natural Heritage (the statutory body responsible for nature conservation and biodiversity) has adopted a strategic locational guidance note for onshore wind farms in March 2009 which includes a series of sensitivity maps. The aim of these is to 'guide wind development towards the locations and the technologies most easily accommodated within Scotland's landscapes and habitats without adverse impact, and which safeguards elements of the natural heritage which are nationally and internationally important'. As such, it offers a strategic view of the sensitivities of the natural heritage across Scoland and a broad steer over which parts of the country are most suited to wind farm development.

Altogether 5 maps have been developed. Maps 1 and 2 describe sensitivity associated with landscape and recreation interests, covering designated areas and wild land issues respectively. Maps 3 and 4 describe sensitivity arising from biodiversity and earth science interests, covering designated areas and non designated habitats and species respectively. The final map, Map 5, combines these sensitivities into three broad zones representing relative levels of opportunity and constraint:

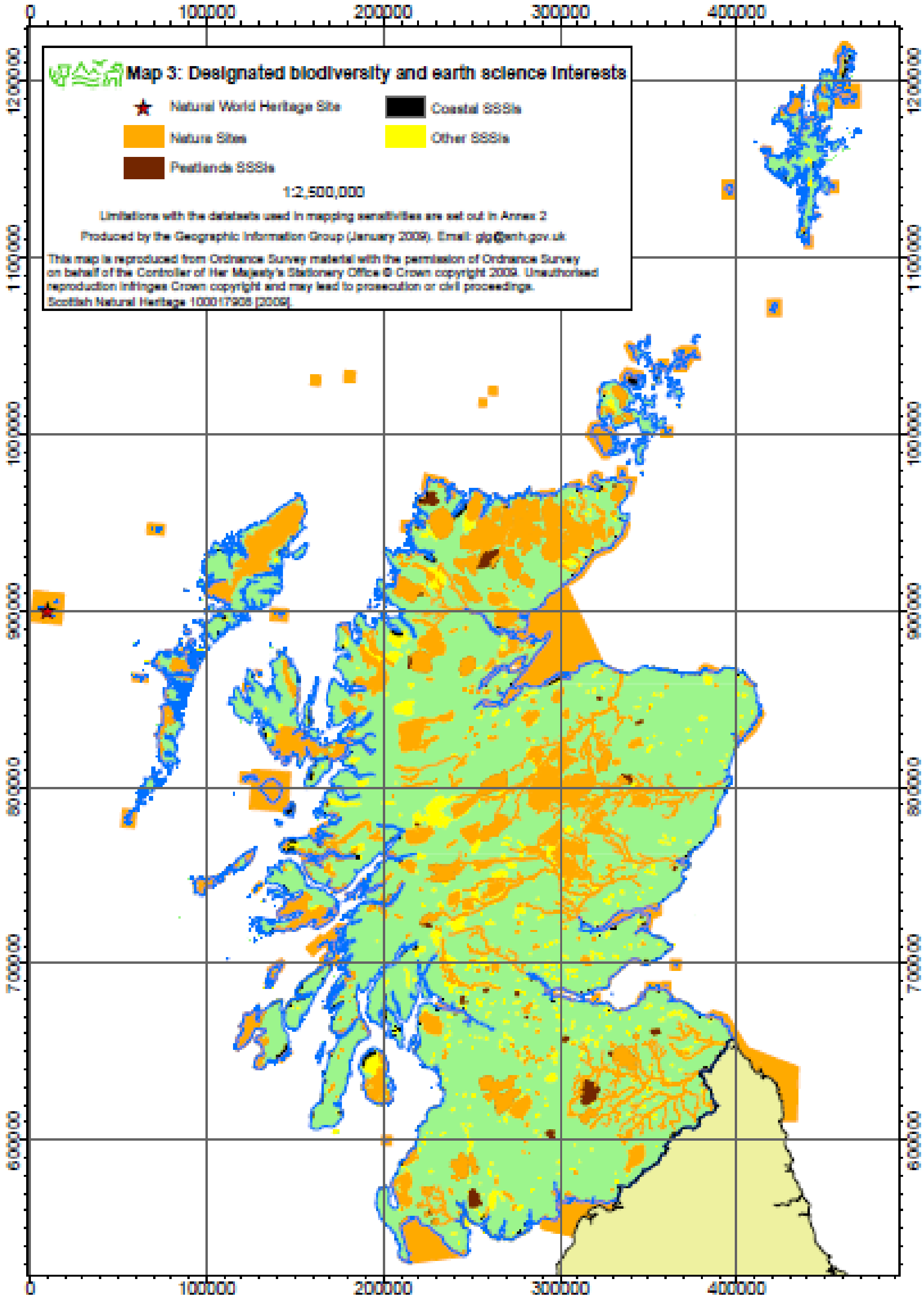
- ***Zone 1:** Lowest natural heritage sensitivity - identifies areas at the broad scale with least sensitivity to wind farms, with the greatest opportunity for development, within which overall a large number of developments could be acceptable in natural heritage terms, so long as they are undertaken sensitively and with due regard to cumulative impact.*
- ***Zone 2:** Medium natural heritage sensitivity - identifies areas with some sensitivities to wind farms. However, by careful choice of location within these areas there is often scope to accommodate development of an appropriate scale, siting and design (again having regard to cumulative effects) in a way which is acceptable in natural heritage terms.*
- ***Zone 3**: High natural heritage sensitivity (including Natura 2000 sites) - identifies areas of greatest sensitivity to wind farms, which place the greatest constraint on their development, and where, in general, proposals are unlikely to be acceptable in natural heritage terms. There may, however, be some sites in this zone where wind farm development of appropriate scale and careful design could be accommodated if potential impacts on the natural heritage are fully explored and guarded against by employing the highest standard in siting and design.*

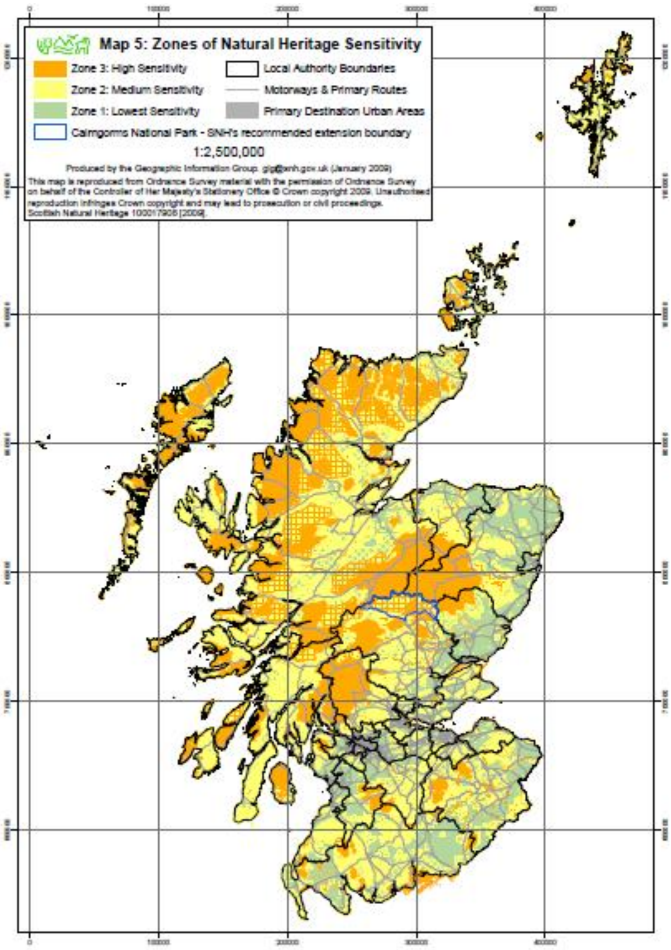
Map 4 on sensitive bird areas was developed jointly by SNH and the conservation NGO, RSPB. It focuses on species listed in annex I of the Birds Directive that are present in Scotland and provides data at 2kmx 2km resolution.

Overall the maps provide a broad overview of where there is likely to be greatest scope for wind farm development and where there are the most significant constraints, in natural heritage terms. There are however a number of caveats to bear in mind. As they are drawn at a strategic scale, they cannot be relied upon to provide guidance on the acceptability of any particular proposal in any given location. This is because the broad scale does not allow the presence of important species and habitats to be presented in detail which means that some areas may have a higher sensitivity than indicated in these overview maps.

Scotland faces particular challenges in relation to the extensive area of peatland landscapes, which are highly sensitive to hydrological disruption arising from wind farms and its ancillary developments. Notwithstanding, the maps are to be used as information tools alongside the detailed guidance but they have no status as a planning tool.

More details available on SNH website. The SNH 'Strategic Locational Guidance for Onshore Wind farms in respect of the natural Heritage' is available from http://www.snh.org.uk/strategy/pd02b.asp. The RSPB bird sensitivity map (Bright et al 2006) and the research report N°20 is available from www.rspb.org.uk/Images/sensitivitymapreport_tcm9-157990.pdf




Map 5: Zones of Natural Heritage Sensitivity
Zone 3: High Sensitivity
Zone 2: Medium Sensitivity
Zone 1: Lowest Sensitivity
Local Authority Boundaries
Motorways & Primary Routes
Primary Destination Urban Areas
Cairngorms National Park - SNH's recommended extension boundary
1:2,500,000
Produced by the Geographic Information Group. gig@snh.gov.uk (January 2009)
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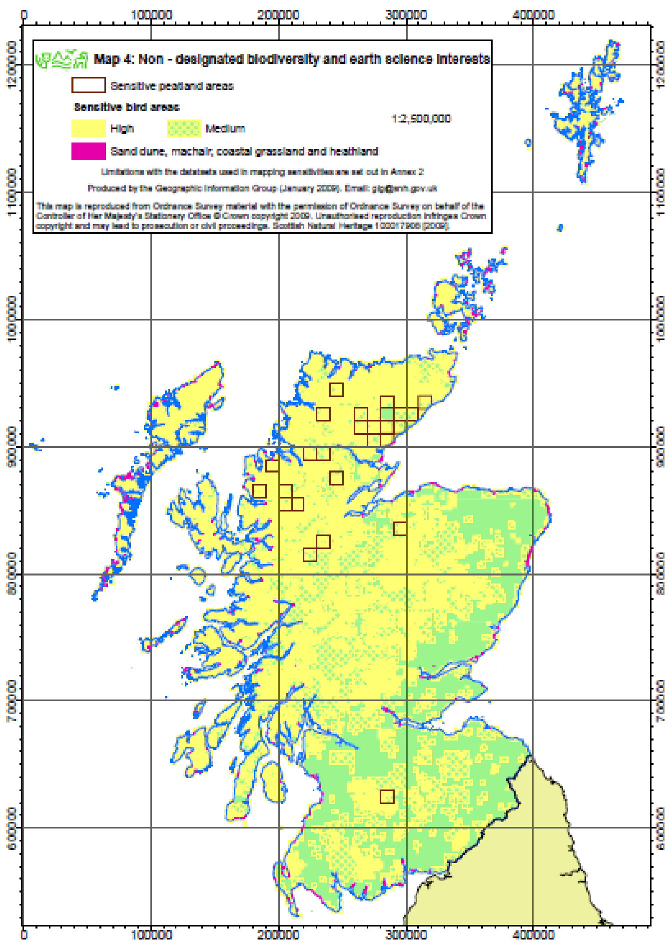
Scottish Natural Heritage 100017908 [2009].


0
100000
200000
300000
400000
1200000
1100000
1000000
900000
800000
700000
600000
Map 4: Non - designated biodiversity and earth science interests
Sensitive peatland areas
Sensitive bird areas
High
Medium
Sand dune, machair, coastal grassland and heathland
1:2,500,000
Limitations with the datasets used in mapping sensitivities are set out in Annex 2
Produced by the Geographic Information Group (January 2009). Email: gig@snh.gov.uk
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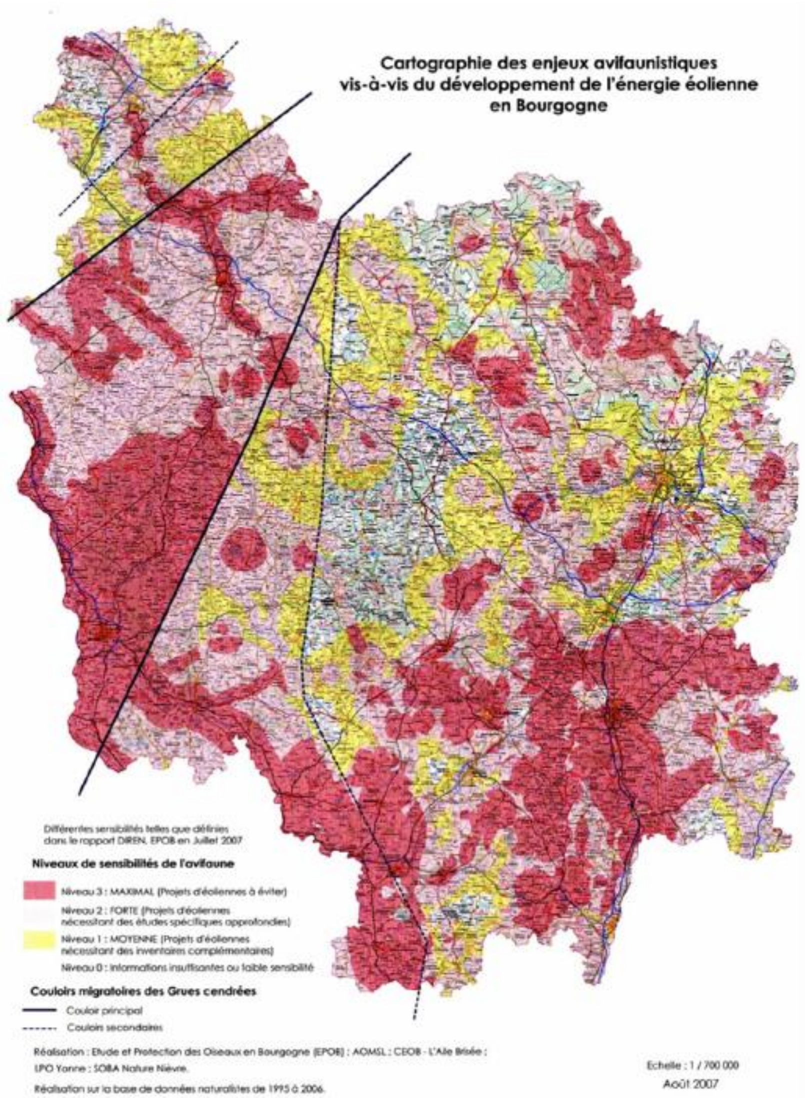


Figure 4.6. Zoning system for guiding of localisation of wind farms, with reference to susceptibility for birds, in Bourgogne, France. Level 3 = maximum sensitivity, level 2 = strong sensitivity, level 1 = moderate sensitivity, and level 0 = insufficient information for any classification. Migration corridors for Common Crane (*Grus grus*) are indicated with continuous or broken lines for main and secondary routes, respectively (from DIREN Bourgogne 2007).

Zoning system with reference to sensitivity for birds in Bourgogne, France.

In the region of Bourgogne (32,000 km^2) in France, a mapping study combined with guidelines for impact assessments related to birds was prepared by the Regional Environmental Direction in 2006, with the aim to guide decision-makers, administrators and developers.

For the purpose of the study, 20 bird species and seven different types of habitats and landscape elements potentially susceptible to wind farm developments were identified, and a zoning system proposed (Figure 4.6). Four levels of sensitivity areas were identified:

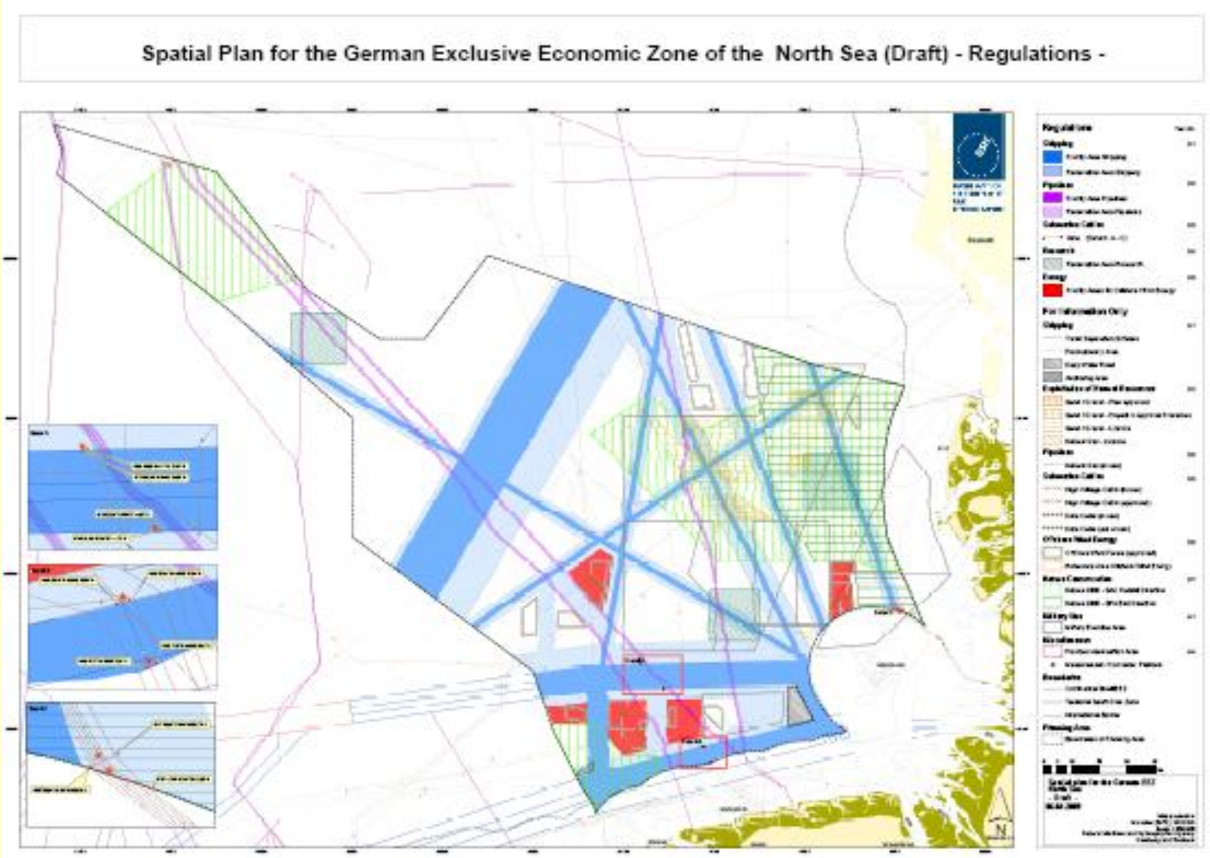
- *Level 3 = maximum sensitivity, with strict avoidance of wind farms,*
- *Level 2 = strong sensitivity, where specific studies of the bird species concerned are needed in case of developments of wind farms,*
- *Level 1 = moderate sensitivity, to be specified during the impact assessment,*
- *Level 0 = insufficient information for any classification with reference to sensitivity.*

Spatial planning in the German EEZ of the North Sea.

The German EEZ of the North Sea attracts a lot of activities such as shipping, fishery, mariculture, expolitation of raw materials, energy production (especially wind energy) and marine scientific reserach; all of which take place within a geographically limited marine area which also harbour important bioresources and nature values.

After major efforts in terms of surveys and research to identify marine sites of high nature value and potential conflict areas with reference to other activities and developments, including wind farms, the German Cabinet approved Europe's first maritime spatial plan in September 2009. In this plan areas and zones for various activities and infrastructure have been indentified, including sites designated for protection within the Natura 2000 network with reference to habitats, marine mammals and birds[112]*.*

A similar plan is in preparation for the German EEZ of the Baltic Sea.



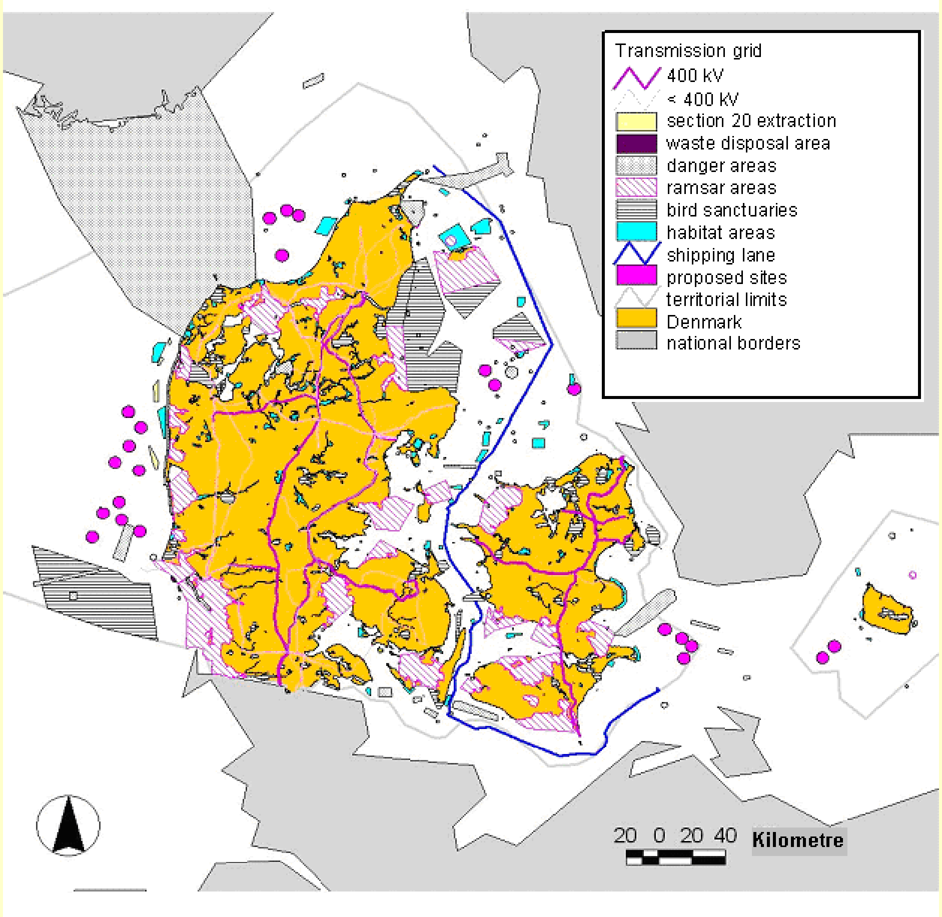
Spatial plan for the German EEZ of the North Sea.

[112] http://www.bsh.de/en/Marine_uses/Spatial_Planning_in_the_German_EEZ/index.jsp for further information about the work approach (with links to maps etc).

Locational mapping of offshore wind farms in Denmark

For Denmark, an offshore wind turbine action plan from 1997 was updated in 2007, within the framework of a long-term national energy policy with the goal to have a share of renewable energy covering at least 30% of the gross energy demand by 2025[113]. For wind energy, a proposal of 23 offshore wind farm locations (within 7 larger areas) with an installed capacity of 4,600 MW in total was proposed, corresponding to a total energy production of 18 TWh or just over 8% of the total energy consumption and 50% of the electricity consumption in Denmark.

Locations have been selected within the frame-work of strategic planning approach, taking into account, inter alia, wind conditions, nature values (incl. Natura 2000 designations), visibility, and grid connections. The map below illustrates the proposal of 23 wind farm locations in the Danish EEZ, taking into account various kinds of planning constraints (incl. bird sanctuaries, Ramsar areas and habitat areas) within a strategic planning approach[114].



[113] Future Offshore Wind Power Sites – 2025, submitted by The Committee for Future Offshore Wind Power Sites under The Danish Energy Authority, April 2007; http://www.ens.dk/graphics/Publikationer/Havvindmoeller/Frentidens_%20havvindm_UKsummery_aug07.pdf

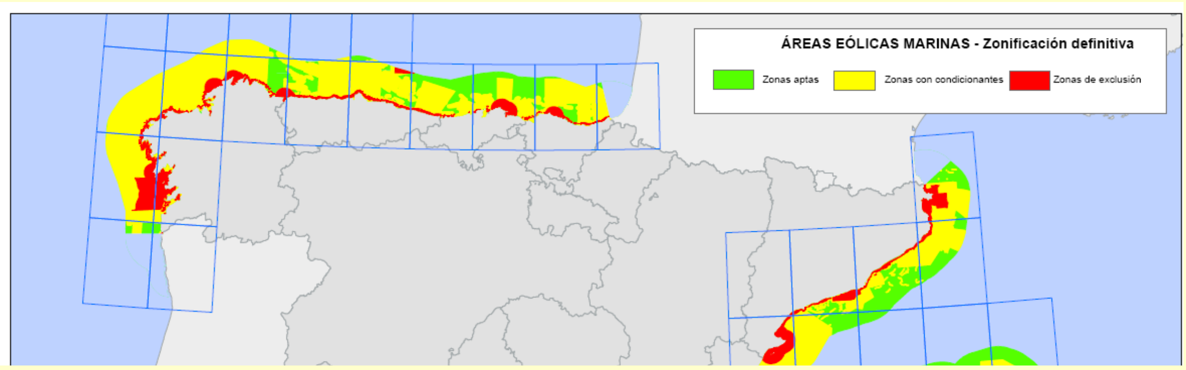
[114] From "Future Offshore Wind Power Sites – 2025", submitted by The Committee for Future Offshore Wind Power Sites under The Danish Energy Authority, April 2007; http://www.ens.dk/graphics/Publikationer/Havvindmoeller/Fremtidens_%20havvindm_UKsummery_aug07.pdf.

Spain : Zoning map for offshore wind farm development in territorial waters

In Spain, the authorisation for the installation of wind farms in the territorial waters is regulated by a Royal Decree from 2007. This decree also established the need to elaborate an environmental study of the Spanish coast with the objective of assessing the suitability of the marine area for the installation of offshore wind farms.

A study was carried out by the Ministry of Industry, Tourism and Trade, the Ministry of Environment and the Ministry of Agriculture, Fisheries and Food and covered a marine zone 24 nautical miles from the coast. It included an overview of potential impacts (in the different phases of a project) and provided environmental criteria for the design of the projects. It also analysed the position of the different regional governments with regard to the production of energy from wind turbines located in the sea.

The study resulted in a zoning system including "suitable areas" (green areas in the map),"areas subject to environmental conditions" (yellow) and "exclusion zones" (red).



Zoning of the marine zone of 24 nautical miles along the coastlines of Spain. Green = sutable areas, yellow = areas subjected to environmental conditions, and red = exclusion zones.

5 . STEP-BY-STEP PROCEDURE FOR WIND FARM DEVELOPMENTS AFFECTING NATURA 2000 SITES

- *Paragraphs 3 and 4 of Article 6 of the Habitats Directive set out a series of procedural and substantive safeguards that must be applied to plans and projects that are likely to have an adverse effect on a Natura 2000 site; Each procedure must be carried out in stages.*
- *The first stage – screening – is intended to determine whether a plan or project should undergo an appropriate assesment. If it cannot be excluded that there will be a significant effect upon a Natura 2000 site then an Appropriate Assessment (AA) must be undertaken.*
- *The purpose of the AA is to assess the implications of the plan or project in respect of the site's conservation objectives, individually or in combination with other plans or projects. The conclusions should enable the competent authorities to ascertain whether or not the plan or project would adversely affect the integrity of the site concerned.*
- *The appropriate assessment should focus on the species and habitats that have justified the site designation and all the elements that are essential to the functioning and the structure of the site. The appraisal of effects must be based on objective information.*
- *The outcome of the AA is legally binding. If it cannot be ascertained that there will be no adverse effects on the integrity of the Natura 2000 sites, even after the introduction of mitigation measures or conditions in the development permit, then the plan or project cannot be approved unless conditions of Article 6 (4) are met.*

5.1 Introduction

The previous chapter outlined the benefits of strategic and proactive planning as a means of avoiding potential impacts of wind farm developments on nature and wildlife at an early stage in the planning process, for instance through the appropriate siting of wind farm developments.

The present chapter looks specifically at what happens when Natura 2000 sites are likely to be affected either at the planning level or at the individual project level. It provides guidance on the procedures to follow in accordance with Article 6(3)-(4) of the Habitats Directive and offers practical advice on how to apply these requirements in the case of wind farm developments in particular.

The chapter is based largely on the guidance that already exists on article 6 of the Habitats Directive. It is strongly recommended that the following three guidance documents are read in conjunction with the present document[115]:

- Managing Natura 2000 sites: the provision of Article 6 of the 'Habitats' Directive 92/43/EEC
- Assessment of plans and projects significantly affecting Natura 2000 sites: methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC.

[115] available at http://ec.europa.eu/environment/nature/natura2000/management/guidance_en.htm

- Guidance document on Article 6(4) of the Habitats Directive 92/43/EEC: clarification of the concepts of alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, Opinion of the Commission.

Because Natura 2000 concerns Europe's most valuable and endangered habitat types and species, it is only logical that the procedures for approving such developments are sufficiently rigorous to avoid undermining the overall objectives of the Birds and Habitats Directives – that of safeguarding Europe's most vulnerable wildlife and nature.

Particular attention is therefore given to the need for decisions to be taken on the basis of sound scientific information and expertise. Delays during the decision making process are often caused by the lack of information or poor quality assessments that do not allow the competent authorities to make a clear judgement on the potential impacts of the proposed plan or project.

5.2 Article 6 of the Habitats Directive : a step-by-step approach

Article 6 of the Habitats Directive is one of the most important articles in the Directive as it determines the relationship between conservation and land-use. Paragraphs (3) and (4) set out a series of procedural and substantive safeguards that must be applied to plans and projects that are likely to have a significant effect on a Natura 2000 site. The proposed development does not have to be located within the Natura 2000 site in order to trigger the need for an AA as plans and projects outwith the site may equally carry the likelihood of significant adverse effects.

This Article 6 procedure is designed to:

- Fully assess the impacts of plans or projects that are likely to have a significant effect on a Natura 2000 site by means of an Appropriate Assessment;
- Avoid or minimise the likely damage, or risk of damage, from these plans or projects on Natura 2000 sites through the introduction of appropriate mitigation measures designed to ensure the integrity of the Natura 2000 site remains unaffected;
- Provide a mechanism for dealing, in exceptional circumstances, with plans or projects that are considered to be of overiding public interest but where no suitable alternatives exist and where the damage cannot be avoided (cf Art 6.4)

ARTICLE 6 (3) and (4) OF THE HABITATS DIRECTIVE

- *6(3). Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.*

- *6(4). If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted.*

- *Where the site concerned hosts a priority natural habitat type and/or a priority species, the only considerations which may be raised are those relating to human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest.*

The procedures laid out in Article 6(3) and 6(4) should be carried out in stages. Every stage determines whether a further stage in the process is required. For instance if, after stage one, it is concluded that there will be no significant effects on the Natura 2000 site, then the plan or project can be approved without the need for further assessment:

- **Stage one: Screening –** this initial evaluation is intended to determine whether a plan or project has to undergo an Appropriate Assessment. If it cannot be excluded, on the basis of objective information, that there will be significant effects upon a Natura 2000 site, then an Appropriate Assessment should be undertaken.

- **Stage two: Appropriate Assessment** – once it has been decided that an Appropriate Assessment is required, further detailed information should be gathered on the site's ecological features and conservation objectives, and on the potential impacts of the plan or project on these conservation objectives. This will enable an assessment to be made on whether or not the plan or project, alone, or in combination with other plans or projects, will have an adverse impact on the integrity of the Natura 2000 site. The burden of proof is on demonstrating that there will be no adverse affects on the integrity of the site.

  In practice, the Appropriate Assessment will often be an iterative process, allowing for improvements to the plan or project in order to avoid adverse effects on the integrity of the Natura 2000 sites concerned. Thus, depending on the assessment's findings, the authorities should also consider if mitigation measures can be introduced or restrictions should be applied to the permit in order to avoid or reduce the effects to an acceptable level.

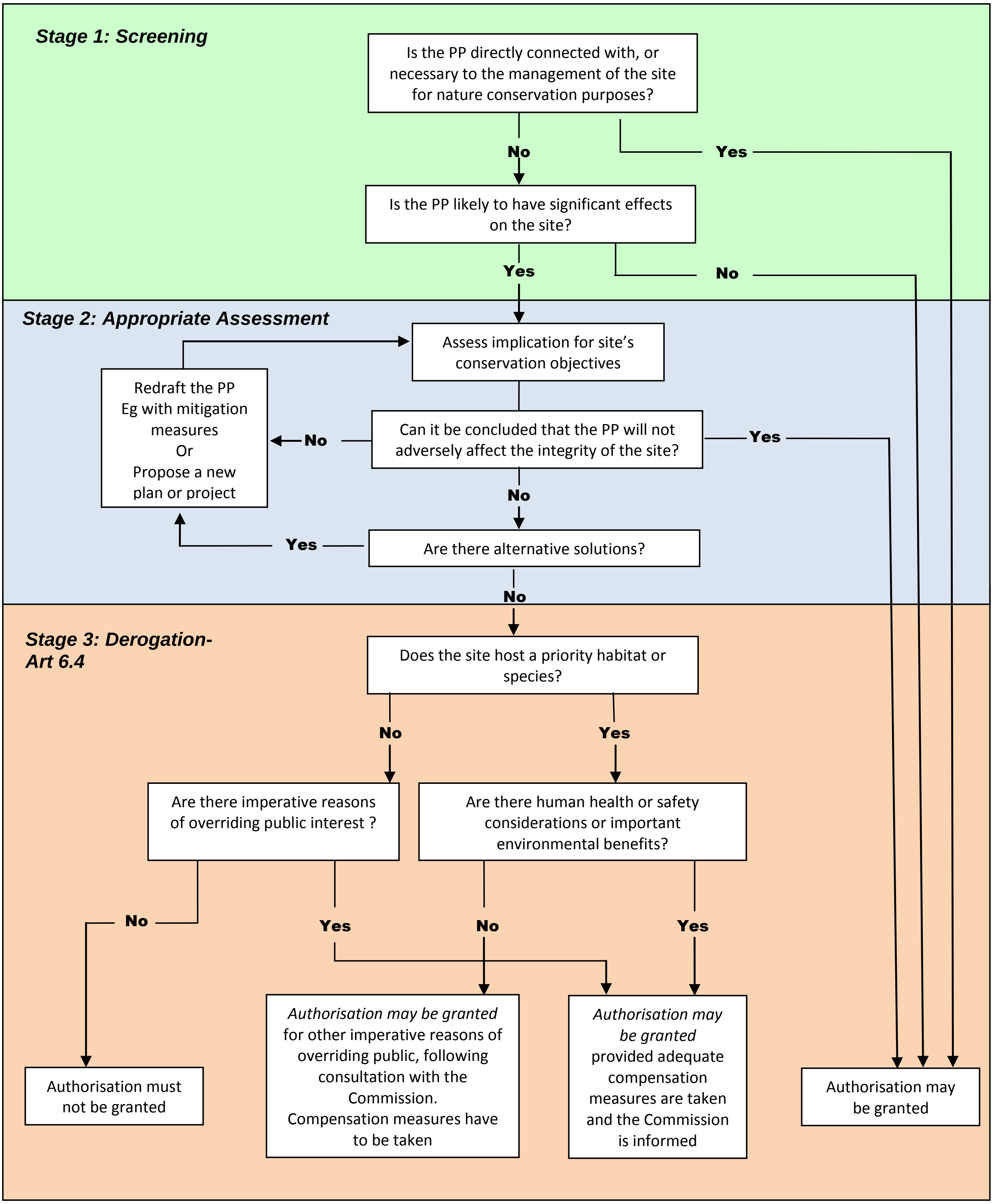
  The authorities will also have to examine viable alternatives to the plan or project. But at the end of the day, the plan or project can only be authorised if it has been demonstrated that there is no adverse effect on the integrity of the site. If these cannot be ruled out, then the authorities must refuse its authorisation or apply the derogation test (Stage 3) under Article 6.4.

- **Stage three: derogation procedure in the absence of alternatives and for imperative reasons of overriding public interest:** If no alternative solutions exist and the adverse effects cannot be removed through mitigation, then, in exceptional cases, the authorities can decide if the plan or project should still proceed on the grounds of imperative reasons of overriding public interest (IROPI). If it agrees to this, then appropriate compensation measures must be identified and implemented to ensure that the overall coherence of Natura 2000 is protected.

It is clear from the above that this decision-making process is underpinned by the precautionary principle. The emphasis should be on objectively demonstrating, with reliable supporting evidence, that there will be no adverse effects on the Natura 2000 site. For this reason, the lack of scientific data or information on the potential risk or significance of impacts cannot be a reason to proceed with the plan or project.

The following flow chart demonstrates how these stages are applied and how decisions are reached on the authorisation or rejection of a plan or project. Subsequent sections examine each of the stages in turn and provide advice on how they should be carried out in the context of wind farm developments in particular.

Flow chart of Article 6(3) and (4) procedure (based on Commission Art 6 methodological guide



STAGE 1: SCREENING

5.3 when is an Appropriate Assessment needed ?

The first step is designed to determine whether or not an Appropriate Assessment is needed. If it can be determined with certainty that the plan or project is not likely to have a significant effect, either individually or in combination with other plans or projects, then the plan or project can be approved without further assessment.

If there is any doubt, then an Appropriate Assessment will need to be undertaken so that these potential effects can be studied in full before a decision is made on the plan or project. It is ultimately for the competent authority to decide, in the light of screening, whether or not an AA is required.

Screening is required for :

- Both *plans* that serve as a framework for development consents and individual *projects*. This ensures that the potential impacts on Natura 2000 are taken into account at both the strategic planning level and at the level of each individual project[116].
- Plans or projects affecting sites classified under the *Birds Directive* and sites designated or proposed to be designated under the *Habitats Directive.* They are both part of the Natura 2000 network.[117]
- Plans or projects both *inside* and *outside* the Natura 2000 site if they are likely to have a significant effect on the Natura 2000 site. For instance, a wind farm development located outside a Natura 2000 site could still have a significant effect on certain species for which the site is designated (such as bats) because they cause the species to be displaced from their habitual breeding or foraging areas within the site.

5.3.1 Gathering sufficient information

The screening exercise is carried out by the competent authority responsible for the adoption of the plans or approval/rejection of development applications. Most often they will seek the assistance of, and base their evaluation on the information received from, the developers, environmental authorities or contracted experts.

[116] Case C-6/04: 20 October 2005

[117] **For Potential SPAs** (IBA) Article 6(3)-(4) is not applicable but Article 4(4) of the BD is applicable. Areas which have not been classified as SPAs but should have been so classified continue to fall under the regime governed by the first sentence of Article 4(4) of the Birds Directive. [Commission/France, Basses Corbières, C-374/98]

For potential pSCIs (eg marine sites): the MS are required to take protective measures that are appropriate, from the point of view of the Directive's conservation objective, for the purpose of safeguarding the relevant ecological interest which those sites have at national level. [Dragaggi, C-117/03. [Bund Naturschutz, C-244/05].

[117] Case C-98/03 paragraph 32: "…In its definition of measures to be subject to an assessment of the implications, the Directive does not distinguish between measures taken outside or inside a protected site."

[117] Case C-201/02 para.53: "….the decisions adopted by the competent authorities, whose effect is to permit the resumption of mining operations, comprise, as a whole, a 'development consent' within the meaning of Article 1(2) of that directive (85/337), so that the competent authorities are obliged, where appropriate, to carry out an assessment of the environmental effects of such operations…"

To carry out the screening exercise, sufficient information is needed both on the wind farm plan or project and on the Natura 2000 site(s) that might be affected. In the case of the plan or project, this information should include data on the location of the wind farm and associated infrastructures in relation to Natura 2000 site(s) in the area as well as details on the scale and design of the wind farms and its associated infrastructures. It should also include details of all activities that are expected to be undertaken during each stage of the project's cycle – i.e. during the construction, operation and decommissioning /repowering phases.

As regards the Natura 2000 site, information should be gathered on the species and habitat types for which it has been designated, their conservation state and on the overall conservation objectives of the site. Part of this information can be found in the Natura 2000 Standard Data Forms or in the site designation or management plans where available.

The collaboration of competent authorities, especially those responsible for nature conservation, in the screening of plans and projects may be crucial, as they should be able to provide useful information which should be taken into account at this stage. It is also recommended to keep an audit trail of the decision making process.

It is worth recalling that the initial screening undertaken here is not the same as a full-scale Appropriate Assessment – it only requires sufficient information to be able to decide if there is likely to be a significant effect or not.

Natura 2000 Standard Data Form
The Standard Data Forms which have been compiled for each site contain information about the surface area, representativity and conservation status of the habitats present in the site, as well as the global assessment of the value of the site for conservation of the natural habitat types concerned. For the species present in the site, information is provided on their populations, status (resident, breeding, wintering, migratory) and on the site value for the species in question.

Conservation status of habitats and species
According to the provisions of Article 17 of the Habitat Directive, the EU 25 Member States (i.e. excluding Romania and Bulgaria) reported, in 2008, on the conservation status of all the species and habitats listed in the annexes of the Habitats Directive which occur in their territory. On the basis of this, the Commission produced a consolidated report on the conservation status of each species and habitat type at a biogeographical and EU level. These reports provide useful contextual information[118]

Natura 2000 Management plans
Some sites have a Natura 2000 management plan which can include important elements such as the conservation objectives for the site, the species and habitats, theirs status, threats, etc, which can be useful for the screening stage and for the Appropriate Assessment.

[118] *All reports are available at: http://biodiversity.eionet.europa.eu/article17 and http://ec.europa.eu/environment/nature/knowledge /rep_habitats/index_en.htm*

Pre-screening by developers: preparing the ground for a smoother decision making process

It is strongly recommended that developers already gather information on the Natura 2000 sites before starting to design their plan or project (i.e. even before the screening stage) so that they can be aware of the possible sensitivities regarding nature and wildlife and can take these into consideration during the preparation of their development proposal. This could, for instance, influence the choice of location for the wind farm as well as its actual design so that only the most appropriate sites are taken forward.

It is also very useful, at an early pre-screening stage, for developers to hold initial discussions with their planning authority and with the statutory nature conservation authorities to learn more about the potential environmental constraints the project might face and how these might be best avoided. This could also help to identify any potential issues to watch out for or any gaps in scientific knowledge that might need further investigation before the plan or project is approved. Experience has shown time and again that good research and consultation right from the start before work begins on the development proposal helps to avoid unnecessary time and expense on unsuitable sites later on.[119]

5.3.2 Determining if there is a 'significant effect'

Every plan or project that could potentially affect a Natura 2000 site(s) should initially be considered as a candidate for Appropriate Assessment. But an Appropriate Assessment will only be required for those that are '….*likely to have a significant effect ..'*.

When doing this initial evaluation it is important to recall that the emphasis is on there being a 'likelihood' of potentially significant effects – not a certitude. This shows the precautionary nature of this initial test. If there is any doubt over whether the effects are likely to be significant or not then an Appropriate Assessment must be undertaken to ensure that these potential effects can be studied in full. The lack of information or data cannot be used as a reason for not carrying out an Appropriate Assessment (as confirmed by the the European Court of Justice in its ruling C-127/02 Waddensea).

The 'likelihood' of potentially significant effects should be considered in the light of the conservation objectives, the characteristics and the specific environmental conditions of the site. Plans or projects likely to undermine the site's conservation objectives must be considered likely to have a significant effect on that site.

Likely effects
Likely effects on the site should first be identified at this stage. The biodiversity elements liable to be affected (habitats, species, ecological processes) should be determined, taking into account their sensitivity in relation to the planned activities. Risks of effects must be identified using a precautionary approach. Where preliminary scientific evaluation indicates that there are reasonable grounds for concern as to the absence of significant effects, an appropriate assessment has to be carried out.

Significant effect
The significant nature of the effects on a site of a plan or project not directly connected with or necessary to the management of the site is linked to the site's conservation objectives. So, where such a plan or project has an effect on that site but is not likely to undermine its conservation objectives, it cannot be considered likely to have a significant effect on the site concerned. Conversely, where such a plan or project is likely to undermine the conservation objectives of the site concerned, it must necessarily be considered likely to have a significant effect on the site. In assessing the potential effects of a plan or project, their significance must be established in the light, inter alia, of the characteristics and specific environmental conditions of the site concerned by that plan or project (Case C-127/02 para. 46-48).

[119] European Best Practice Guidelines for wind energy development, EWEA 2002. Available from http://ec.europa.eu/energy/renewables/studies/wind_energy_en.htm

The screening itself involves looking at all the aspects of the plan or project that could cause a significant effect on the Natura 2000 site. Each feature of the plan or project should be studied separately at first (e.g. the layout of the wind turbines, the access roads to the site, the infrastructure needed for grid connections etfc..) and its potential effects examined for each of the species and habitat types of European interest that are present and in the context of the overall conservation objectives of the site.

For example, a wind farm project proposes to locate 10 wind turbines in a degraded grassland at the top of a hill away from any bird or bat interest within the Natura 2000 site but also proposes to construct an access road to the wind turbine site that will run across rare habitat types such as blanket bogs and natural forests. In such a case, the wind turbines themselves may be unlikely to cause any significant impact but the access road probably will, and so an Appropriate Assessment will be needed.

Thereafter, the effects of the different features within the plan or proposal should be looked at together, and in relation to each other, so that the interactions between them can be identified. For instance, it may be that the risk of collision mortality with the wind turbines alone is not likely to be significant but if it is taken in combination with the installation of overhead cables, which could also cause collision mortality, then the effects could become significant.

If there are several Natura 2000 sites that could be affected, as in the case of a development plan for instance, the impacts on each should also be studied seperately at first as they may have been designated for different species or habitat types and may have different conservation objectives.

Key questions to be considered at the stage of screening:

- Identify the geographical scope of the plan or project, and its main characteristics (e.g. extraction methods, minerals to be extracted etc.)
- Identify all Natura 2000 sites that might be affected by the plan or project. Identify the qualifying interests of the Natura 2000 sites concerned (i.e. the habitats and species for which the sites are designated) and the sites' conservation objectives.
- Determine which of those species and habitats could be significantly affected by the planned activities.
- Analyse other plans or projects which could, in-combination with the planned activities, give rise to a likely significant effect on Natura 2000 sites (e.g. it is important to consider all other planned or existing extraction activities).
- Analyse the possible interactions between the plan or project activities, either individually or in combination with other plans or projects, and the qualifying interests, the ecological functions and processes that support them.

5.3.3 Looking at potential cumulative effects

The screening process also applies to plans or projects *in combination with other plans or projects*. It may be that one wind farm project alone might not have a significant effect but, if taken in combination with other plans or projects (wind farm or other developments) within the area, the cumulative effects may turn out to be significant.

Other plans or projects to be considered in this case include those that have already been completed, those that are approved by the planning authorities, or those that are currently undergoing planning approval.

The geographical scale over which these cumulative effects need to be considered will depend on the exact circumstances and scale of the plan or project being studied but should cover a sufficiently large area to capture any cumulative effects that may arise with the project under assessment. Again, the competent nature conservation authorities will be able to help identify the possible plans or projects that need to be considered as part of the in-combination test.

5.3.4 Recording the screening decision

Finally, as screening is a legal requirement, the reasons for the final decision as to whether or not to carry out an Appropriate Assessment should be recorded and sufficient information should be given to justify the conclusion. Given that the nature protection assessments often run in parallel with the EIA/SEA procedures, common information procedures to the public could be envisaged.

STAGE 2: CARRYING OUT THE APPROPRIATE ASSESSMENT

5.4. Purpose of Appropriate Assessment

The purpose of the Appropriate Assessment is to assess the implications of the plan or project in respect of the *site's conservation objectives*, individually or in combination with other plans or projects. The conclusions should enable the competent authorities to ascertain whether or not the plan or project would adversely affect the integrity of the site concerned.

The focus of the Appropriate Assessment should therefore be specifically on the species and/or habitat types for which the site is designated Natura 2000, and on the possible effects of the plan or project on them. This should also include any indirect effects on these species and/or habitat types, for instance on their supporting ecosystems and natural processes.

In summary, the term 'appropriate' essentially means that the assessment needs to be appropriate to its purpose under the Habitats and Birds Directives – ie that of conserving rare and endangered species and habitat types of European interest. 'Appropriate' also means that the assessment has to be a *reasoned* decision. If the record of the assessment does not disclose the reasoned basis for the subsequent decision, then the assessment does not fulfil its purpose and cannot be considered 'appropriate'.

In this respect, it is important to recall that, in contrast to the EIA or SEA, the outcome of the Appropriate Assessment is legally binding for the competent authority and conditions its final decision[120]. Thus, if it cannot be ascertained that there will be no adverse effects on the integrity of the Natura 2000 site, even after the introduction of mitigation measures, then the plan or project cannot be approved, unless the conditions of Article 6(4) are met. This applies also in case of doubt over the impacts.

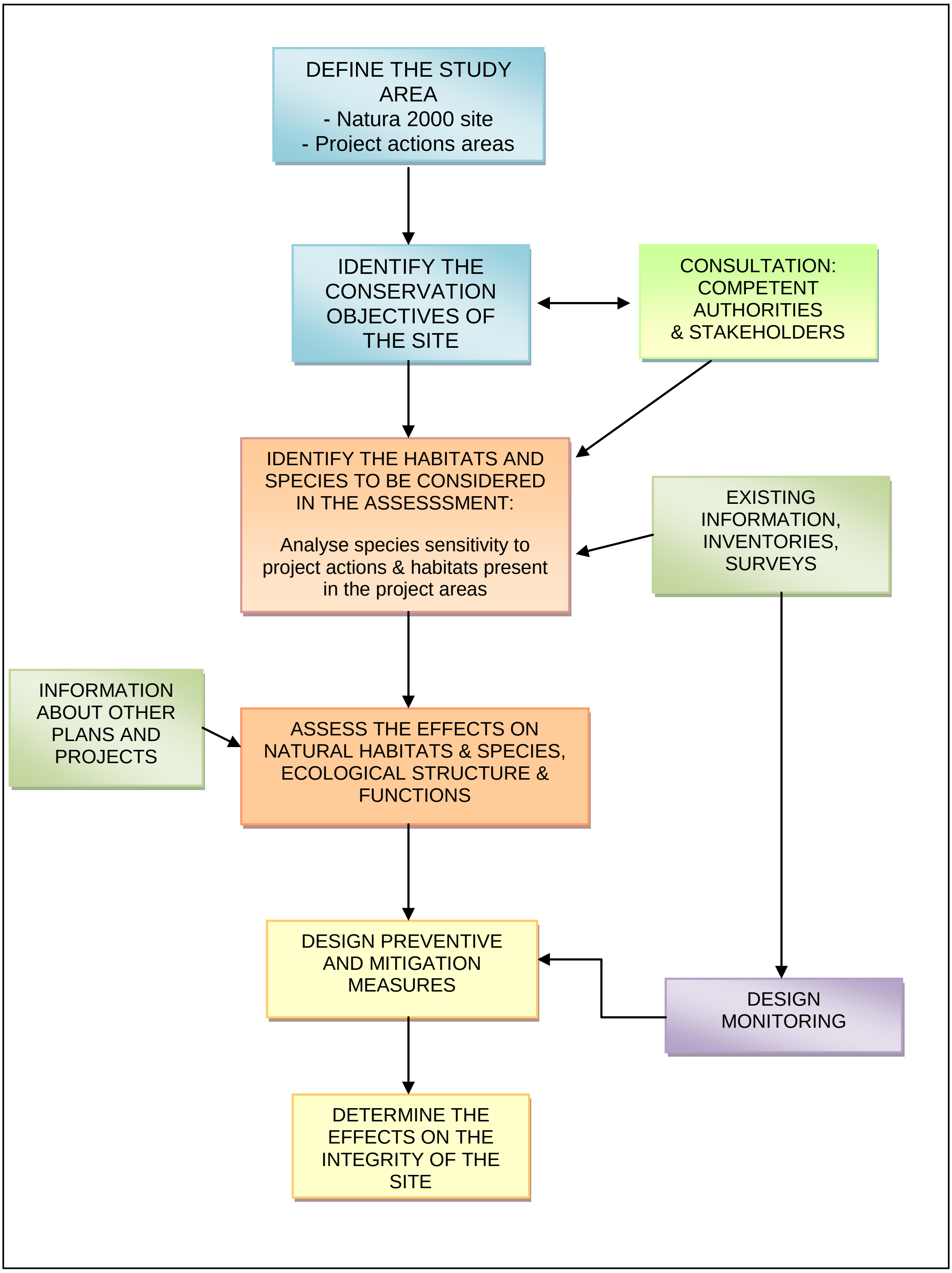
There are several basic steps to follow when carrying out an Appropriate Assessment. These are illustrated in the following table and described further in the following sections.

It is the responsibility of the competent authority to ensure that the AA is carried out. In that context the developer may be required to carry out all necessary studies and to provide all necessary information to the competent authority in order to enable the latter to take a fully informed decision. In so doing the competent authority may also collect relevant information from other sources as appropriate.

The Appropriate Assessment must be undertaken before the competent authority decides whether or not to undertake or authorise the plan or project. The EU Court of Justice has confirmed that as regards the concept of 'appropriate assessment' within the meaning of Article 6(3) of the Habitats Directive, the provision does not define any particular method for carrying out such an assessment. Nonetheless, according to the wording of that provision, an appropriate assessment of the implications for the site concerned of the plan or project must precede its approval [121].

[120] See chapter 2 for details on the relationship between SEA, EIA and AA
[121] C-127/02, paragraphs 52-53.

Figure 5: Steps to be undertaken as part of the appropriate assessment



5.5 Steps for an Appropriate Assessment of wind farm projects

Where a *project* is likely to have a significant effect on the qualifying interests of a Natura 2000 site, an appropriate assessment of the implications for the site concerned by the project must precede its approval and take into account the cumulative effects which result from the combination of that project with other plans or projects in view of the site's conservation objectives.

For a wind energy project, the AA is the key tool for ensuring that adverse effects on the integrity of the sites concerned are prevented or mitigated during design of the project.

Integrity of the site

Biological integrity can be defined as all those factors that contribute to the maintenance of the ecosystem, including structural and functional assets. In the framework of the Habitats Directive, the "integrity"' of the site is linked to the conservation objectives for which the site was designated as part of the Natura 2000 Network (EC 2007b). It has been usually defined as "the coherence of the site's ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or populations of species for which the site is classified" (EC 2000b, ODPM 2005). As regards the meaning of 'integrity', this can be considered as a quality or condition of being whole or complete. In a dynamic ecological context, it can also be considered as having the sense of resilience and ability to evolve in ways that are favourable to conservation. (EC 2000b).

A site can be described as having a high degree of integrity where the inherent potential for meeting site conservation objectives is realised, the capacity of self-repair and self-renewal under dynamic conditions is maintained, and a minimum of external management is required. When looking at the "integrity of the site", it is therefore important to take into account a range of factors, including the possibility of effects manifesting themselves in the short, medium and long-term (EC 2000b).

Authorisation of a plan or project granted in accordance with Article 6(3) of the Habitats Directive necessarily assumes that it is considered not likely to adversely affect the integrity of the site concerned and, consequently, not likely to give rise to deterioration or significant disturbances within the meaning of Article 6(2) (ECJ ruling on case C-127/02 para. 36).

5.5.1. Scoping and further information gathering

Scoping will ensure that the Appropriate Assessment is well focussed and provides clear terms of reference for evaluating the potentially negative effects of the wind energy project on the Natura 2000 site(s). Its aim is to identify more precisely what impacts the Appropriate Assessment should cover and to ensure that all necessary information is gathered to enable these impacts to be assessed correctly.

This builds on the information already gathered under the screening exercise but, this time, any gaps in knowledge should also be filled as far as possible so that the assessment can be made on sound scientific grounds. Sound baseline data is of vital importance as the Appropriate Assessment has to be able to ascertain ***with certainty*** that the proposal will not affect the integrity of the site concerned. If there is some degree of doubt, the competent authorities may require further field work to be carried out or may refuse the project as it stands on the grounds of uncertainty over the impacts.

The EU Court of Justice confirmed this position in the Waddensea case (C-127/02) where it stated that '*such an (appropriate) assessment of the implications implies that, prior to the approval of the plan or project, all the aspects of the plan or project which can, by themselves or in combination with other plans or projects, affect the site's conservation objectives must be identified in the light of the best scientific knowledge in the field.*'

Once again, in addition to requesting the developer to provide any relevant assessments, impact studies and surveys etc… that may be reasonably required of them, it is strongly recommended that the competent authorities also consult with, and seek the advice and guidance of, the statutory nature authorities, as early as possible during the scoping stage.

They will be able to provide details about the Natura 2000 site and its conservation objectives. They can also provide scientific advice on the likely ecological effects that a wind energy project could have on the site.

Other bodies such as conservation NGOs, research institutions or local stakeholder groups can also be contacted to help provide further local knowledge and ecological information. Consulting these organisations already during the scoping exercise will help ensure that as complete a picture as possible is built up about the site, the species/habitats present and the potential impacts of the plan or project on these. It can also lead to a smoother decision making process if all interest groups are collaborating from the start in finding solutions that are acceptable to all.

Information gathering is necessarily an iterative process. If the first identification and analysis of effects reveals that there are important gaps in knowledge, then further surveys and monitoring work will need to be undertaken in order to complete the picture. This will ensure there is a sufficient basis of scientific knowledge to be able to make a reasoned decision.

All the aspects of the project which can, either individually or in combination with other plans or projects, affect the site's conservation objectives must be identified in the light of the best scientific knowledge in the field. (ECJ ruling C-127/02, EC 2006a;). The appropriate assessment should consider the elements contributing to the site's integrity in view of its conservation objectives. The decision as to whether it is adversely affected should focus on those objectives (EC 2000).

Conservation objectives of Natura 2000 sites

The conservation objectives for a Natura 2000 site are determined at member state level.

The Natura 2000 Standard Data Forms (SDF), which have been compiled for each designated site, contain information about the habitats (e.g. surface area, representativity and conservation status) and the species (populations, status) and the value of the site for the habitats/species for which the site has been designated. The SDF therefore provides information regarding the qualifying interests of a Natura 2000 site and in the absence of more detailed definition of conservation objectives for a Natura 2000 site, they can be considered as such. Some countries have developed in detail the conservation objectives for their Natura 2000 sites. Some sites may also have management plans or management objectives that provide clear indications about the conservation objectives to be attained.

The Habitats Directive (Article 4.4) establishes that once a site of Community importance has been adopted, the Member State concerned shall designate that site as a special area of conservation as soon as possible and within six years at most, establishing priorities in the light of the importance of the sites for the maintenance or restoration, at a favourable conservation status, of natural habitat types in Annex I or species in Annex II and for the coherence of Natura 2000, in the light of the threats of degradation or destruction to which those sites are exposed

The Appropriate Assessment should focus on the species and habitats of Community interest that have justified the site designation (the qualifying interests of the site). However, these qualifying interests interact with other species and habitats in complex ways; it is therefore important to consider all the elements that are essential to the functions and the structure of the site, its qualifying interests and its conservation objectives. Furthermore, other speciescan also be relevant for determining potential effects on protected habitats if they constitute typical species of the habitat in question.

The assessment should be based on the best available scientific knowledge of the following main elements as they relate to the qualifying interests of the site (EC 2007b):

- Structure and function, and the respective role of the site's ecological assets.
- Area, representativity and conservation status of priority and non-priority habitats in the site.
- Population size, degree of isolation, ecotype, genetic pool, age class structure, and conservation status of species under Annex II of the Habitats Directive, Annex I of the Birds Directive, and regularly occurring migratory species not listed in Annex I Birds Directive present in the site.
- Role of the site within the biogeographical region and in the coherence of the Natura 2000 network.Any other ecological assets and functions that are essential for meeting the site's conservation objectives.

Information gathering during scoping

The **information about the plan or project** should contain details of all elements that are relevant for the assessment. They should include, for instance, the folllowing:

- Detailed maps of precise location of the wind turbines and the associated infrastructures in relation to the Natura 2000 site(s) in the given area;
- The scale and design of the wind farm, e.g. the number and size of wind turbines, their layout and design, etc..
- Similar details for all associated infrastructures;
- Activities foreseen during construction works and their duration / timing;
- Activities foreseen during operation and management;
- Provisions for repowering and decommissioning;
- Details of any other plans or projects in the area that could, if taken in combination with this plan or project have a significant cumulative effect on the Natura 2000 site

The **information about the Natura 2000 site** should contain, for instance, the following:

- Details on each species and habitat type for which the site is designated and ecological maps of their location within and around the site over time (eg over an annual lifecycle);
- Data on their overall usage of the site for activities such as foraging, breeding, resting, staging or hibernating;
- Data on their representativity and conservation status both within that site and within the area in general (including, inter alia, data on population size, degree of isolation; ecotype, genetic pool; age class structure..);
- Data on ecological structure and functioning of the site and its overall conservation state;
- Detailed of the conservation objectives of the site (incl any management plans etc);
- The role of the site within the biogeographical region[122] and the Natura 2000 network;
- Any other aspects of the site or its wildlife that is likely to have an influence on its conservation state and objectives (eg current management activities, other developments..)

[122] The lists of Sites of Community Importance (SCI) within the Natura 2000 network, are adopted by biogeographical region. For further information and links to maps go to http://www.ec.europa.eu/environment/nature/natura2000sites_hab/biogeog_regions/index_en.htm;

Fictitious example of further information requirements identified during scoping.

Wind farm project with twelve turbines on edge of a woodland			
1. Possible likely significant effect	**Collision mortality**	**Disturbance and displacement**	**Habitat loss and degradation**
2. Information about species and habitats at the Natura 2000 site	Ecological data on the bat and bird species of European interest and at potential risk at the site.	Data on habitat requirements for species of European interest and at potential risk at the site.	Location of key habitats in or around the site.
3. Potential impacts to be assessed	Collision mortality rates during different parts of the species life cycle, e.g. during breeding or migration periods	Habitat usage and lines of access across the site	Location of core roosting, breeding or foraging sites, and location of movement routes between these.
4. Data needed for these assessments	Field data over at least one annual cycle, for risk assessments, using modeling or sensitivity indices.	Field data on local dispersal patterns inside and around the site over at least one annual cycle.	

Experience has shown that many of the delays or problems encountered during the Appropriate Assessment are caused by the fact that the information gathered for the Appropriate Assessment is incomplete. As a result, the authorities are unable to confirm that there be no adverse effects on the integrity of the site and the whole assessment process has to be put on hold whilst the missing information is being gathered.

Therefore, to help developers better prepare their project applications, the following boxes provide an overview of possible survey methods that have been used to identify and assess the likely effects of wind farms. These are based on a review of existing good practices and may therefore provide useful ideas and suggestions for future development proposals.

When field surveys are required, consideration should be given to the "Before-After/Control-Impact" (BACI) [123] approach whenever possible (although other approaches are available[124]). Sampling methods should be repeatable, and wherever possible, quantitative data should be obtained.

Good practice methodologies for survey work on the likely effects of wind

The Appropriate Assessment will need to be based on sound scientific and objectively verifiable information. This can sometimes require additional survey work to be carred out before the plan or project is approved. The following section provides a series of possible methodologies for carrying out further surveys on the likely effects of wind farms on species of European interest. They are derived from a range of sources and are indicative of the kind of information that may need to be gathered for onshore or offshore wind farms.

There are no legal stipulations about the length or extent of the pre-construction surveys, this has to be decided case-by-case. However, some indications can be given on the basis of existing experience and knowledge. For onshore locations, a 12-month survey before implementation has been proposed in order to cover at least one full annual cycle for birds[125] and for bats (including maternity and hibernating seasons as well as spring and autumn migration[126]).

[123] The BACI approach is a classical method for measuring potential impact, i.e. by studying conditions before a plan or project is realised and then comparing the findings after or when e.g. a wind farm is in operation. Preferably, studies in parallell should be done at reference sites.
[124] E.g. Diederichs et al. (2008),
[125] SNH (2005b).
[126] Rodrigues et al. (2008) for the elements to be included in a monitoring programme for bats.

For offshore wind farms, year around studies over a period of 1-2 years have been recommended for marine mammals[127]

Field surveys have also to be designed to provide data that can be used for reliable and robust statistical analyses for comparisons, for instance, between before and after construction, between sites, or between a wind farm site and a reference area with similar environmental characteristics as regards habitats or climate for instance

A non-exhaustive overview of the most common techniques used so far is given in the following table. They include a mixture of techniques based on direct visual observation (e.g. birds and bats), sampling methods (e.g. for marine fish and benthic fauna) and remote techniques such as radar and sonar. It has to be kept in mind, however, that as the understanding of the potential impacts improves, the recommended methodologies may change.

Visual observations are frequently used for studying bird abundance and distribution in zones around proposed wind farm locations in order to investigate potential displacement effects[128]*. Recordings of flight movement, e.g. along frequently used migration corridors for birds or bats, is a common monitoring technique for collecting data needed for assessing collision risks and potential barrier effects. For studies of potential displacement effects by birds around onshore locations, traditional territory mapping and line transect counts are useful tools*[129]*. Offshore, ship-based surveys are generally better for species identification and behavioural observations, while aerial surveys have the advantage of enabling relatively rapid coverage of large sea areas.*

Records of flight calls has been found to be a useful complement, both to visual observations and remote techniques, e.g. for species identification

Carcass collection is included in many monitoring programmes for onshore locations. Although the method suffers from the obvious difficulty that carcasses can be overlooked or already removed by scavengers, it may still provide useful complementary and qualitative information about species killed by collision. Preferably, the search should be done in a standardised way that makes it possible to relate the number of findings to search effort, and (if needed) with correction factors for e.g. observer efficiency and scavenging rates[130]*. For offshore locations, constructions of floating bunds and/or nets to retain corpses at wind farms have been considered but in most cases found to be impractical and not yielding reliable information*[131]*.*

Sampling of fish and marine fauna: Sampling methods such as trawling for fish and epifauna, and grab sampling for infauna are can be useful in combination with various remote techniques.

Remote techniques have been found to be very useful tools for collecting the data needed for impact assessments. Radar has a wide application and can be used to record movements (elevation as well direction) by birds and bats at night and in poor visibility. It is best used in combination with visual observations and/or records of flight calls to help with species identification etc. Thermal Animal Detection Systems (TADS) is a more recent, infra-red based technology with the potential to provide information about avoidance behaviour, flock size and flock altitude by birds and bats in close proximity to the rotor blades[132]*. High Definition Video Surveys is an airplane-based technique for surveys of birds in marine environments, still under development*[133]*. Microphones for automatic registration of flight calls may also be a useful complement to species identification as well as quantitative estimates*[134]*. Hand-held or automatic bat detectors are necessary tools if the occurrence of bats is a key element in the surveillance programme.*

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127 E.g. Diederichs et al. (2008) and primarily with reference to Harbour Porpoise (*Phocoena phocoena*).
128 E.g Petersen et al. (2006), see also BSH (2007) and DEFRA (2005) for detailed descriptions.
129 Useful references in SNH (2005b).
130 E.g. Morrison et al. (2007).
131 E.g. Desholm et al. (2006).
132 E.g. Desholm et al. (2006) and Hüppop et al. (2006), and references in these publications.
133 E.g. Mellor & Maher (2008).
134 E.g. Hüppop et al. (2006).

For marine environments, a large variety of techniques can be applied. For surveys of marine mammals, click detectors and towed hydrophones have been applied. "Passive Acoustic Monitoring" (PAM) systems, like T-Pods for surveys of whales and dolphins have been on the market for many years, and more advanced technologies, such as C-pods, are under development. Visual methods such as ship-based or aircraft surveys are useful complementary methods. – Remotely Operated Video (ROV) techniques are used for monitoring sediment characteristics and marine epifauna. For sediment processes hydro-acoustical techniques such as side scan sonar can be applied.

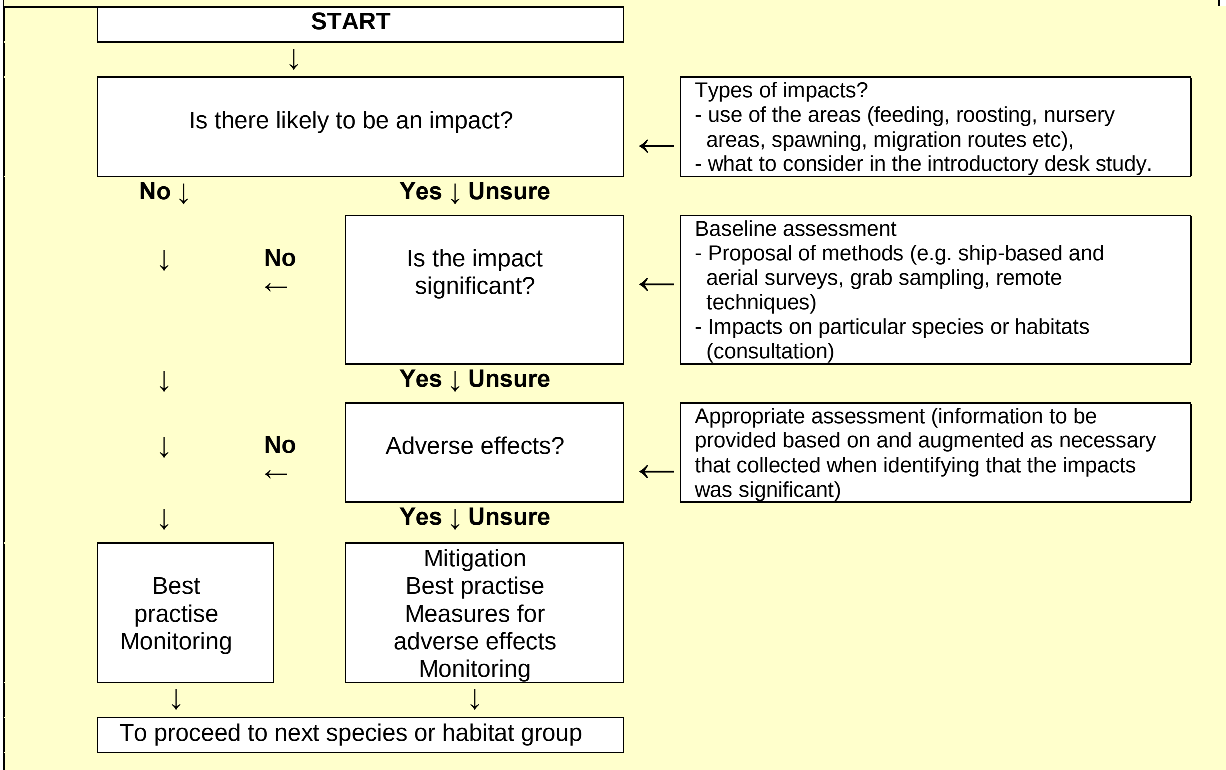
Study method	Disturbance & distancing - onshore	Disturbance & distancing - offshore	Collision	Barrier effect	Change in habitat structure
Visual observations (primarily birds)					
- Ship-based transect counts		X			
- Aircraft surveys		X			
- Records of flight movements			X	X	
- Territory mapping	X				
- Line transect counts	X				
Visual obs (marine mammals)					
- Ship-based transect counts		X			
- Aircraft surveys		X			
Carcass collection (birds, bats)			X		
Bat detector	X	X	X		X
Trawling (fish, marine epifauna)		X			
Grab sampling (marine infauna)		X			X
Photo-sampling (marine epifauna)		X			X
Recording of flight calls (birds)	X	X	X	X	
Radar surveys (birds, bats)			X	X	
Microphone registration (birds)			X		
Thermal Animal Detection System (TADS) post construction.			X	X	
Beam trawl (marine fish, marine epifauna)		X			
Passive acoustic monitoring (PAM; T-pods etc; marine mammals)		X			
Towed hydrophones (marine mammals)		X			
Ship-based acoustics (marine fish)		X			
Hydro-acoustic techniques (Side scan sonar etc.; marine sediments)		X			X
Video transects, e.g. remotely operated video (ROV; marine sediments, marine epifauna)		X			X
Hydrological surveys	X				X
Noise emission from turbines	X	X			X

UK guidelines for assessing impacts on Natura 2000 sites of offshore wind farm development.

Guidelines and standards for EIAs and assessments of impacts on Natura 2000 sites, in accordance with Article 6 of the EU Habitats Directive, have been prepared by many Member States[135]. They differ in approach and degree of details, from outlines of the administrative procedures[136] to proposals of more detailed lines of action and appropriate methodology[137]. The approach proposed by the United Kingdom Department for Environment, Food and Rural Affairs[138] for assessments of impacts on marine Natura 2000 sites of offshore wind farm development has a wider application potential, also with reference to onshore locations and for other groups of species and habitats than the ones mentioned below.

The assessments are proposed to be done stepwise for various groups of species and habitats, e.g. as follows (flowchart below):
- Birds
- Marine mammals
- Fish and shellfish
- Subtidal benthos
- Intertidal benthos
- Terrestrial and coastal habitats
- Coastal and sedimentary processes

The guidance document includes proposals about relevant methodology for the various groups of species and habitats, with references to further studies and more detailed information. It is to be considered as a working document and it will be revised as the understanding of issues develops and new information becomes available.



[135] A selection of national guidelines are listed in Annex VI.
[136] E.g. the brief Swedish guidelines, "Vindkraft – tillståndsprocessen och kunskapsläget" (2007), edited by the Swedish Energy Agency.
[137] E.g. BSH (2007) for offshore wind farms in Germany, Scottish Natural Heritage (SNH 2005b) with reference to impacts birds of onshore wind farms and DEFRA (2005) for offshore wind farms in UK.
[138] DEFRA (2005).

5.5.2. Assessing the impacts on the Natura 2000 site

Once all the information needed to make a reasoned assessment of impacts has been collated, the next stage of the assessment can begin in earnest: that of on identifying the likely effects of the wind farm development proposal on the site's integrity in light of its conservation objectives.

This impact assessment has to be made in light of:
- the best scientific knowledge in the field (ECJ Waddensea ruling – see above)
- the Natura 2000 site's conservation objectives, as defined in the relevant national legislative framework and

  the potential impact on the site's integrity

Chapter 3 gives an overview of the kind of effects that are most frequently associated with wind farm developments and identifies the species or habitat types that have proven to be particularly vulnerable to this form of development. This provides a good starting point on what to look out for as it is based on current experiences and scientific studies.

But the effects of each project will be unique and must be evaluated on a case-by-case basis. According to the same ECJ Waddensea ruling (see above): *in assessing the potential effects of a plan or project, their significance must be established in the light, inter alia, of the characteristics and specific environmental conditions of the site concerned by that plan or project.*

In this context, it is important that each element of the project (wind turbines, other constructions etc..as well as effects during construction, maintenance and operation etc…) is examined in turn and that the potential effects of that element is considered in relation to each of the species or habitat types of European interest within the Natura 2000 site. This is because each species has different conservation requirements. Also, the impacts on the same species may vary from one site to another depending on its conservation state and the underlying ecological conditions of the site.

Predicting the likely impacts can be difficult as one should have a good understanding of ecological processes and conservation requirements of particular species. It is therefore strongly recommended that the competent authorities secure the necessary expert advice and support in carrying out the impact assessment.

As with all impact assessments, the appropriate assessment should be undertaken within a structured framework to ensure that the predictions can be made as objectively and accurately as possible.

For this purpose, impacts are often categorised into the following types:
- Direct and indirect effects;
- Short and long-term effects;
- Effects during different stages of the project (construction, operation, decommissioning..)
- Isolated and interactive effects
- Cumulative effects

For each effect identified, the *significance* of the impact will depend on:
- The magnitude of the impact
- The type of impact
- The extent
- Duration
- Intensity

- Timing
- Probability

Impacts should be predicted as precisely as possible, and the basis of these predictions should be made clear (this means also including some explanation of the degree of certainty in the prediction of effects). Wherever possible, predictions should be presented in such a way as to make them verifiable, as the outcomes of the tests can then be directly linked to a future monitoring programme (this may be one of the conditions placed in the planning permission – see below).

The impact assessment should also apply the best available techniques and methods to estimate the extent of the effects. Some of the techniques commonly used are listed in the following box.

Commonly used methods for predicting impacts:

- *Direct measurements*, for example of areas of habitat lost or affected, proportionate losses from species populations, habitats and communities.
- *Flow charts, networks and systems diagrams* to identify chains of impacts resulting from direct impacts; indirect impacts are termed secondary, tertiary, etc. impacts in line with how they are caused. Systems diagrams are more flexible than networks in illustrating interrelationships and process pathways.
- *Quantitative predictive models* to provide mathematically derived predictions based on data and assumptions about the force and direction of impacts. Models may extrapolate predictions that are consistent with past and present data (trend analysis, scenarios, analogies which transfer information from other relevant locations) and intuitive forecasting. Normative approaches to modelling work backwards from a desired outcome to assess whether the proposed project will achieve these aims.
- *Geographical information systems (GIS)* used to produce models of spatial relationships, such as constraint overlays, or to map sensitive areas and locations of habitat loss. GIS are a combination of computerised cartography, storing map data, and a database-management system storing attributes such as land use or slope. GIS enable the variables stored to be displayed, combined, and analysed speedily.
- *Information from previous similar projects* may be useful, especially if quantitative predictions were made and have been monitored in operation.
- *Expert opinion and judgment* derived from previous experience and consultations on similar wind farms.
- *Description and correlation*: physical factors (water regime, noise) may be directly related to distribution and abundance of species. If future physical conditions can be predicted then it may be possible to predict future abundance on this basis.
- *Carrying capacity analysis* involves identifying the threshold of stress below which populations and ecosystem functions can be sustained. Carrying capacity analysis involves the identification of potentially limiting factors, and mathematical equations are developed to describe the capacity of the resource or system in terms of the threshold imposed by each limiting factor.
- *Ecosystem analysis* This approach aims to provide a broad regional perspective with a holistic framework. Three basic principles of ecosystem analysis are (i) taking the 'landscape level' view of ecosystems, (ii) use a suite of indicators including community level and ecosystem-level indices and (iii) taking into account the many interactions amongst ecological components which are involved in maintaining ecosystem function.

Adapted from: Assessment of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC; http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/natura_2000_assess_en.pdf.

5.5.3. Assessing whether there are no adverse effects on site integrity

Once the potential effects of the plan or project have been predicted as accurately as possible, the Appropriate Assessment can move onto the next stage which is to determinine whether the impacts will adversely affect the integrity of the Natura 2000 site, either alone or in combination with other plans or projects.

Again, it is important to bear in mind that the focus of the assessment should be on objectively demonstrating, with supporting evidence, that there will be **no adverse effects** on the integrity of the Natura 2000 site, in light of its conservation objectives. Thus, the competent authority has to be sure that there is no reasonable scientific doubt. If the adverse effects cannot be ruled out or if there is too much scientific doubt, the adverse effects must be assumed.

It is clear from the purpose of the Directive that the 'integrity of the site' relates directly to the site's conservation objectives. Determining whether the integrity of the site is affected mean determining whether the plan or project will adversely affect the:
- the coherence of the site's ecological structure and function, across its entire area, or
- the habitats, complex of habitats and/or
- populations of species for which the site is or will be classified.

The integrity of the site has usefully been defined as '*the coherence of the site's ecological structure and function, across its whole area, or the habitats, complex of habitats and/or populations of species for which the site is or will be classified*'[139]

A site can be described as having a high degree of integrity where the inherent potential for meeting site conservation objectives is realised, the capacity of self-repair and self-renewal under dynamic ecological conditions is maintained, and a minimim of external management support is required[140].

The focus is also on the specific site. Thus, it is not possible to accept a plan or project with significant adverse effects on the grounds that the conservation status of the habitat types and species it hosts will anyway remain favourable within the Member State or the EU as a whole.

To sum up, there are two possible conclusions that can be drawn from this first impact assessment:
- there is no adverse effect and the project or plan can be approved as it stands;
- there will be definite adverse effects or adverse effects cannot be ruled out.

The latter does not necessarily mean that the plan or project is automatically refused. The competent authority has the choice to either conclude its Appropriate Assessment and proceed to stage 3 and 4 of the Article 6 procedure, or, having identified which potential adverse effects exist, they can consider what measures can be introduced to avoid the predicted adverse effects.

This would then normally imply a second evaluation round in the Appropriate Assessment to ensure that the mitigation measures/safegaurds are indeed sufficient. This is discussed further in the next section.

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[139] PPG 9, UK Department of the Environment, October 1994 quoted on page 39 of the Commission's article 6 guide on "Managing Natura 2000 sites". The concept of 'integrity of the site' is further elaborated on page 79.

[140] Ref again to Art 6 guide needed ?

5.5.4. Considering how to mitigate adverse effects on the Natura 2000 site

Mitigation measures are measures which are introduced into the plan or project to eliminate the potential negative effects on the conservation objectives of the Natura 2000 site, or to reduce them to a level where they will no longer adversely affect the integrity of the site.

As such, they should be directly linked to the likely negative effects which have been identified during the impact assessment described above. The competent authority, upon the advice of its ecological experts or the statutory nature authorities, should determine the level of mitigation required.

It can then ask the developer/planner to propose suitable mitigation measures (e.g. changes to the siting, design, scale of the wind farm and its associated instrastructures) or it can set certain conditions or restrictions in the development permit as a pre-condition for approving the plan or project (eg as regards the timing of the construction works or restrictions on the operation of the wind turbines, for instance during peak dispersal and migraiton periods).

Either way each mitigation measure should contain:
- details of the measure proposed and an explanation of how it will avoid or reduce the adverse impacts which have been identified;
- evidence of how they will be implemented and by whom;
- a timetable for implementation relative to the plan or project (some may need to be put in place before the development can proceed);
- details of how the measure will be monitored and how the results will be fed back into the day to day operation of the wind farm (adaptive management – see below).

This will enable the competent authority to evaluate the mitigation measures as part of the Appropriate Assessment (second round) and determine whether or not they are sufficient or suitable for eliminating or removing the adverse effects which have been identified (and do not inadvertently cause other adverse effects on the species and habitat types in question). If the mitigation measures are deemed sufficient, they will become an integral part of the specification of the plan or project.

In the case of wind farm plans or projects, the most obvious mitigation measure is to adjust the location of wind farm away from areas where it can cause conflicts with the species and habitat types for which the site has been designated (e.g. foraging paths, flyways, migration routes, vulnerable areas such as breeding sites or foraging area). Evidence to date shows that the inappropropriate siting of wind farms and their associated structures is one of the most frequent and common causes of impact.

This is especially relevant when carrying out an Appropriate Assessment of a wind farm plan. If these issues can be addressed already at the strategic planning stage, it should result in fewer difficulties later on at the project level (see chapter 5).

But mitigation measures can also involve modifications to the size, design and the configuration of wind farms and to the construction of turbines and associated infrastructures. Or they can introduce temporal adjustments of activities during construction and operation. For instance, they can involve:

- A change in the design of the wind farm – for instance by changing the size of the wind turbines or their configuration that they are not placed perpendicular to the main flight direction of migrating birds or bats, or by reducing the number of turbines or altering the spacing between them to avoid a barrier effect etc…;

- A change in the design or location of the associated infrastructure – such as changing the type or orientation of the access roads or burying overhead electricity cables to avoid collision mortality;

- Adjustments in the timing, duration and nature of the construction works to avoid peak migration or breeding times for vulnerable species, or to allow marine mammals to cope with or move away from noise generated by driving pilons into the seabed;

- Requiring wind turbines to be shut down at certain times of the year for instance for a couple of hours around sunset during August or September to reduce the mortality of bats or birds during peak periods of dispersal and migration;

- Introducing habitat management measures to restore and actively manage other suitable areas for the species and/or habitat types of EU importance within the Natura 2000 so that they can accommodate the species concerned and bring about a more rapid progression towards a favourable conservation state for the species or habitat type;

The following box provides an overview of some of the mitigations that have been used in the case of wind farm developments in particular and which may provide useful ideas or suggestions for future developments.

Possible mitigation measures that have been used or proposed for wind farms so far

The list below provides an overview of possible mitigation measures that have been proposed or applied with reference to wind farms:

***Configuration of wind farms**:*

Wind farms should be carefully planned having regard to the flight paths of birds and bats in particular. It has been proposed that grouping turbines in rows that run parallel – instead of perpendicular - to the main flight direction of certain birds can be an effective mitigation measure.[141] In addition, locating turbines in blocks to create corridors can create safety zones through which birds can pass. Adjustments of the configuration of wind farms may also be considered when old turbines are replaced by new and larger ones.

***Construction of turbines and associated infrastructures**:*

A variety of technical adjustments to wind turbines have been proposed to reduce the collision risk. This concerns in particular the turbine's height and the rotor-sweep[142].

- Resting and perching places: In the past, wind turbines sometimes provided attractive perching sites for birds. Modern turbines should be designed to remove any possible perches. If this is not possible then various kinds of anti-perching devises should be introduced, such as enclosing the nacelles, avoiding lattice constructions and eliminating guy wires to support the turbines[143]. The junction between nacelle and tower should also be well sealed, and the nacelle closed, in order to avoid offering a roost for bats.
- Design of rotor blades: On the basis of theoretical modelling of collision risks among birds, it has been proposed that fewer rotor blades and low tip speed can lower collision risk[144], but there is some conflicting evidence whether turbines with a larger rotor-swept area may have similar or even smaller avian fatality than turbines with smaller rotor-swept areas.

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[141] E.g. Drewitt & Langston (2006, 2008).
[142] But the evidence for this is still anecdotal and lacks adequate data E.g. Johnson et al. (2007), Drewitt & Langston (2008).
[143] E.g. Johnson et al. (2007).
[144] Tucker (1996a, 1996b).

- Increasing rotor visibility: Birds may be unable to see rotors when they get close (motion smear) and this phenomenon may at least partly explain collision even in times of good visibility[145]. Various tests whether increasing the visibility of rotors by painting high-contrast patterns (e.g. black and white bands) may help to reduce the collision risk have so far yielded mixed results, and the same applies for on-going test with UV-painted rotor blades[146].
- Using fewer but larger turbines: There are increasing evidence that fewer but larger and more power-efficent turbines may produce fewer collision risks for large-sized birds, while there is more concern with reference to bats[147].

Associated infrastructure

- Inter-array cable installations and grid infrastructure: Where possible, inter-array cables (e.g. between turbines and substations) should be buried underground while taking into account relevant considerations e.g. to habitat sensitivity.
- Lighting of wind farms: There is broad consensus that lighting of turbines is to be avoided to reduce the risk of fatalities, for onshore as well as offshore locations. If lighting cannot be avoided, e.g. for safety or navigation purposes, flashing white strobe light has been proposed to be less attractive for birds than e.g. solid or pulsating red light[148]. But these must still be in compliance with national and international regulations on health and aviation/shipping safety.
- Reduction of the electro-magnetic fields around cables from offshore turbines: Impact recommended to be reduced by choice of cable type, burial of at least 1 m and/or conversion to higher voltage[149].
- Appropriate choice of foundations for offshore locations[150]; to the extent possible as the choice of foundation is primarily related to the geological conditions.

Measures in order to reduce risks during construction period

- Timing of construction work: Certain risks are concentrated at critical times of the year, such as reproductive or moulting periods of marine mammals and breeding or migration periods for sensitive bird species. The first option for mitigation would be to avoid these sensitive periods altogether, and plan the construction to take place at other times of the year (eg in winter for hibernating bats). Appropriate seasons (time windows) should be identified in order to reduce disturbance at potentially sensitive life stages of species.

  This may not always be possible in particular for offshore projects where time windows for construction can already be quite limited for practical/safety reasons and therefore this needs to be analysed on a case-by-case basis. Many of these issues will be site-specific. The time periods in which construction work is recommended to be avoided depends on the affected species' main periods of foraging, resting and breeding.

  If this is not feasible then restrictions in construction work may need to be considered. The potential benefits of temporary and short-term breaks, e.g. in terms of reduced risk of collision fatalities or disturbance, should however be weighed on case-by-case basis against any drawbacks linked to prolonged construction periods.

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145 E.g. Drewitt & Langston (2008) and references therein.
146 E.g. Drewitt & Langston (2006). In addition, painting rotor-blades or turbines might be questionable due to landscape and visual effects.
147 E.g. Hötker (2006), Barclay at al. (2007), Smallwood & Karas (2009).
148 E.g. Johnson et al. (2007).
149 A conversation from 33 kV to 135 kV reduces the induced field by a factor of 4 (but may turn out to be unpractical in many cases; DEFRA 2005).
150 E.g. Hammar et al. (2008) for comparisons between different types of foundations.

- Noise and vibration during construction work: In respect to offshore wind farms, and in order to minimise impact from noise and vibration on both fish and mammals, it is recommended to start pile driving gently to allow individuals to move away from the noise source (i.e. soft-start). This may be combined with the use of passive acoustic monitoring and marine mammal observers to minimise the risk of animals being in the area when piling commences. Other proposed methods, including specifically engineered solutions such as bubble curtains and piling cushions, are under development. “Scrammers” and “pingers” may provide additional deterrence to marine mammals entering the construction area.

Measures in order to avoid risks during operation

Similar considerations may also be required during the operation phase and on a more long-term basis to avoid risks during critical times of the year. For bats, many of the above proposed technical modifications may be inadequate, and shutting down turbines during critical periods of limited duration is so far a primary mitigation measure to reduce the risk fatalities, e.g. during migration periods in spring and autumn (especially August-October) or during periods of calm weather when insect prey are concentrated around turbines (and energy producing capacity might be low in any case)[151].

Temporary halting of the operation or reducing rotor speed may also be considered in order to avoid fatalities e.g. during peak migration periods or main display periods by birds, or disturbance during or spawning seasons by fish. Radar initiation of temporary breaks in turbine operation during periods of intensive activity by birds or bats is a potential future measure that might help to reduce the periods of shutdown to a minimum.

Habitat management

There are single examples - both in Europe and North America - of birds (especially raptors) having been attracted to the areas surrounding wind turbines, as habitat changes related to the wind farm establishment has lead to increased abundance of rodent prey. Habitat management, in order to attract the birds to land outside the “risk area” through increased abundance of prey, has been proposed and tested in some North American studies[152].

5.5.5. Long term monitoring requirements and adaptive management

Although the potential impacts of the proposed plan or project may have been judged to be insignificant, the Appropriate Assessment may still consider it necessary to monitor the long term impacts of the plan or project and the effectiveness of the mitigation measures foreseen. In such cases, the planning application may require that a post construction monitoring programme be implemented to continue monitoring potential impacts of the wind farm on the species and habitats of European interest during its operation.

This can help validate the findings of the Appropriate Assessment and/or act as an early warning system if the predicted impacts are worse than expected. This requires the monitoring programme to be ‘fit for purpose’ and able to identify any problems as early as possible. However, due to the costs of monitoring programmes and the possible impacts on project viability, it is essential that any requirements of such programmes are duly justified by specific, objective concerns.

If it turns out that the impacts are more significant than originally foreseen or that new unforeseen impacts arise, the feedback from the monitoring work will make it possible to determine what further mitigation measures are required or if the current management measures need to be adapted. This can then lead to the implementation of an adaptive management strategy which aims to remedy, reduce or eliminate, where possible these unforeseen adverse impacts.

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[151] E.g. Rodrigues et al. (2008), Ahlén et al. (2008), Baerwald et al. (2009).
[152] E.g. Johnson et al. (2007).

5.5.6. Recording the results of the Appropriate Assessment

Once these mitigation measures and possible safeguards/conditions have been identified and assessed, the competent authority will finally be in a position to determine conclusively whether the plan or project can be approved or not, and if any conditions apply. Whatever the results, they should be clearly recorded. In this respect, the Appropriate Assessment report should be sufficiently detailed to demonstrate how the final decision was reached, and on what scientific grounds the decision was made.

This is confirmed by an ECJ ruling: *The appropriate assessment should contain complete, precise and definitive conclusions capable of removing all reasonable scientific doubt as to the effects of the works proposed on the site concerned*. (Commission/Italy, C-304/05).

The report should:
- describe the project or plan in sufficient detail for members of the public to understand its size, scale and objectives; (reference: non-technical summary is part of the obligations under the SEA/EIA)
- describe the baseline conditions and conservation objectives of the Natura 2000 site;
- identify the adverse effects of the project or plan on the Natura 2000 site;
- explain how those effects will be avoided through mitigation;
- set out a timescale and identifies the mechanisms through which the mitigation measures
- will be secured, implemented and monitored.

Following the Appropriate Assessment, and despite the application of mitigation measures, if the competent authority considers that adverse effects remain, then the project or plan may not proceed until after a Stage Three of the Article 6 assessment procedure has been completed and it has been objectively concluded that there is an absence of alternative solutions.

STAGE 3: DEROGATION PROCEDURE: ARTICLE 6.4

5.6 The derogation procedure of Article 6.4 of the Habitats Directive

5.6.1 The scheme of Article 6.4

If, on the basis of the Appropriate Assessment, it cannot be ascertained that a plan or project will not adversely affect the integrity of the site concerned, the provisions of Art. 6(4) of the Habitats Directive apply to any subsequent decisions which are taken to continue with the project as proposed. Article 6(4) is only applicable under the strict conditions.

The requirements of Article 6(4) of the Habitats Directive establish a set of conditions, which must be met for the competent authority to authorise the plan or project in case the AA shows that the integrity of a Natura 2000 site will be adversely affected by it**.** Being an exception to Article 6(3), the fulfilment of the conditions under which it may be applied is subject to strict interpretation.

It falls on whoever wants to make use of Article 6(4) to prove, as a prerequisite, that the following conditions do indeed exist:

1. The alternative put forward for approval is the least damaging for the integrity of the Natura 2000 site in terms of its qualifying interests, and no other feasible alternative exists that would not adversely affect the integrity of any Natura 2000 site;
2. There are imperative reasons of overriding public interest (IROPI);
3. All necessary compensatory measures have been adopted .

The European Commission has published a Guidance Document on Article 6(4) of the Habitats Directive (EC 2007b) which provides clarification of the concepts of alternative solutions, imperative reasons of overriding pubic interest, compensatory measures, overall coherence and the opinion of the Commission required in some cases[153].

5.6.2 The absence of alternative solutions

The search for alternatives can be quite broad and should be linked to the objective of the plan or project. It could involve alternative locations, different scales or designs of development, or alternative processes. If the intention is to increase the renewable energy capacity by a certain amount, the question is then: can this be achieved in a less damaging way, for instance, by selecting a more appropriate site for wind farm development elsewhere or by resizing or scaling down the plan or project.

In practice, alternatives should normally already have been identified within the framework of the initial assesment under Article 6(3). They are part of the iterative process seeking to improve the siting and design of a plan or project at the earliest stages.

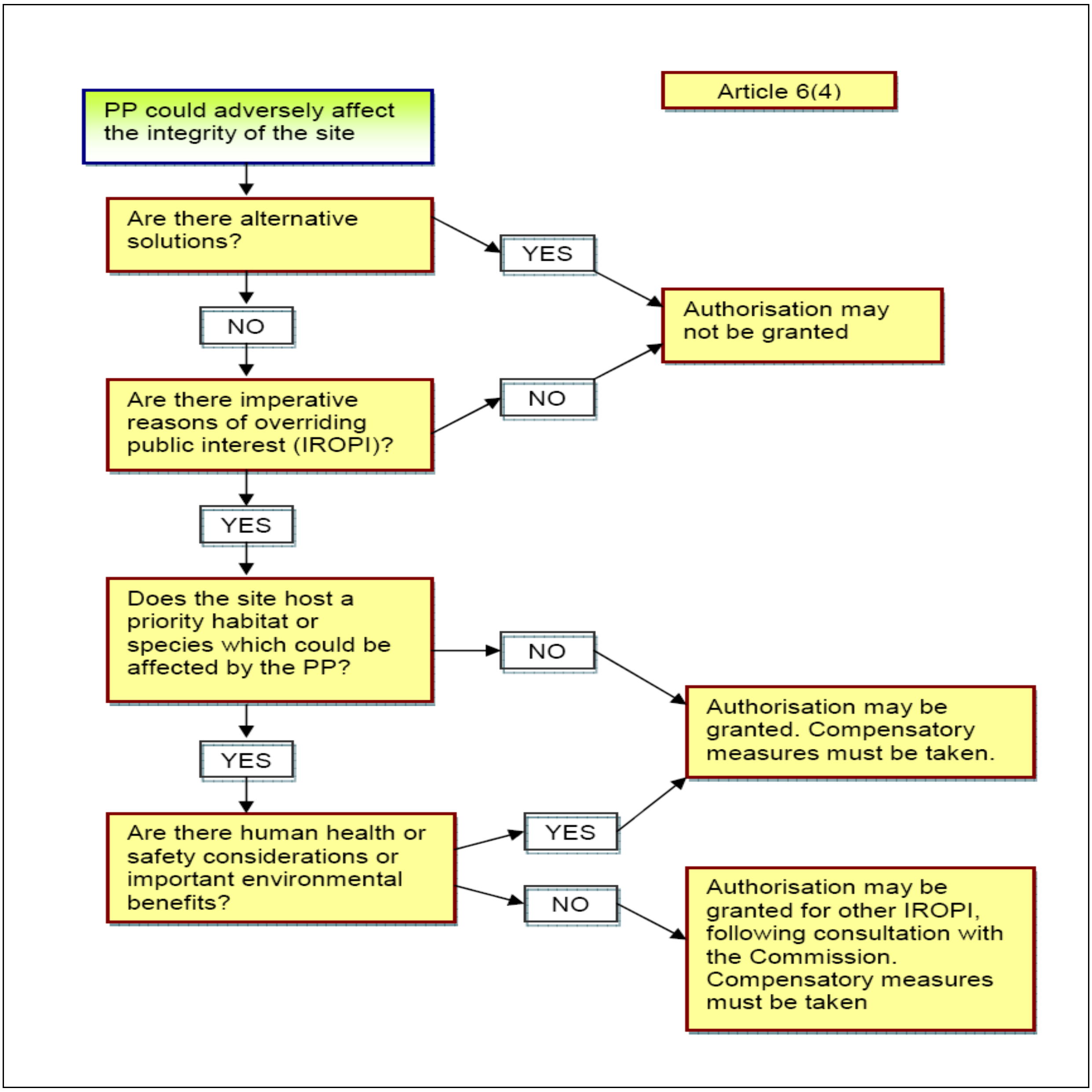
To fulfil the requirements of Article 6(4), the competent authority must be the ones to assess alternative solutions, once the appropriate assessment stage has concluded that it cannot be ascertained that the plan or project will not have adverse effects on the integrity of the site concerned, even after mitigation measures have been introduced. The competent authorities have also to analyse and demonstrate first the need of the plan or project concerned. Thus, the zero option should also be considered at this stage (EC 2000, 2007b).

[153] http://ec.europa.eu/environment/nature/natura2000/management/guidance_en.htm

They should also make comparisons between various possible alternatives but It should be stressed that the reference parameters for such comparisons deal with aspects concerning the conservation and the maintenance of the integrity of the site and of its ecological functions. This means that the conservation objectives and status of the Natura 2000 should be weighted against any consideration of costs, delays or aspects of an alternative solution, following the procedures prescribed in Article 6(4).

The alternatives chosen should also in principle undergo the same screening exercise as the original plan or project and could be subject to a new Appropriate Assessment for, although the alternative is less damaging, it could still have an adverse effect on the integrity of the same or another Natura 2000 site. Usually, if the alternative is similar to the original proposal, the Appropriate Assessment may be able to draw a lot of the information needed from the first Appropriate Assessment.

Figure. Flow chart of the Article 6(4) conditions



5.6.3. Imperative reasons of overriding public interest (IROPI)

It is clear from the wording of Article 6(4) that only public interests, irrespective of whether they are promoted either by public or private bodies, can be balanced against the conservation aims of the Directive. Thus, projects developed by private bodies can only be considered to meet this condition of Article 6(4) where such public interests are served and demonstrated (EC 2007b).

Such public interests may include human health, public safety, beneficial consequences of primary importance for the environment, and other interests of a social (e.g. employment) or economic nature[154].

To fulfil the requirements of Article 6(4) of the Habitats Directive, the competent national authorities have to make their approval of the plans and projects in question subject to the condition that the balance of interests between the conservation objectives of the Natura site(s) affected by those initiatives and the above-mentioned imperative reasons weighs in favour of the latter. This should be determined according to the following considerations:

a) The public interest must be **overriding**: it is therefore clear that not every kind of public interest of a social or economic nature is sufficient, in particular when seen against the particular weight of the interests protected by the Directive (see e.g. its 4th recital stating *"Community's natural heritage"*).
b) In this context, it seems also reasonable to assume that the public interest can only be overriding if it is a long-term interest; short term economic interests or other interests which would only yield short-term benefits for the society would not appear to be sufficient to outweigh the long-term conservation interests protected by the Directive. Overriding interests, as long-term, fundamental social interests, may be properly identified beforehand by published policies, and land-use, mineral and other plans.

It is reasonable to consider that the "*imperative reasons of overriding public interest, including those of social and economic nature*" refer to situations where plans or projects envisaged prove to be indispensable:
- within the framework of actions or policies aiming to protect fundamental values for the citizens' life (health, safety, environment);
- within the framework of fundamental policies for the State and the Society;
- within the framework of carrying out activities of economic or social nature, fulfilling specific obligations of public service.

It should be noted that the conditions of overriding public interest are even stricter when it comes to the realisation of a plan or project likely to adversely affect the integrity of a Natura 2000 site that hosts qualifying *priority* habitats and/or species, where those habitats and/or species are affected.

These can only be justified if the imperative reasons of overriding public interest concern
- human health and public safety or
- overriding beneficial consequences for the environment, or,
- for other imperative reasons if, before granting approval to the plan or project, the opinion of the Commission has been given (EC 2007b).

[154] In this regard, relevant aspects set out in the Communication on the Raw materials Initiative (COM(2008) 699 final, SEC(2008) 2741) can be taken into account.

5.6.4. The adoption of all necessary compensatory measures

Compensatory measures, as described in Article 6(4) of the Habitats Directive, constitute the "last resort" and are used only when the decision has been taken to proceed with a plan or project having an adverse effect on the integrity of the Natura 2000 site because no alternatives exist and the project has been judged to be of overriding public interest under the conditions described above.

The compensatory measures constitute measures specific to the unavoidable adverse effects of a project or plan. They aim to ensure that the overall coherence of Natura 2000 is protected, and should provide compensation corresponding precisely to the negative effects on the species or habitat concerned. There is little experience with the implementation of compensation measures under Article 6(4) of the Habitats Directive in the context of wind energy projects.

To ensure that the overall coherence of Natura 2000 is protected, the compensatory measures proposed for a plan or project should:

a) contribute to the conservation of natural habitats and species of Community Interest "within the biogeographical region concerned", in order to ensure the maintenance of the overall coherence of the Natura 2000 Network (for sites designated under the Habitats Directive), or within the same range, migration route or wintering area for bird species (i.e. sites designated under the Birds Directive) in the Member State concerned.

b) address, in comparable proportions, the habitats and species of Community Interest negatively affected;

c) provide functions comparable to those which had justified the selection of the original site, particularly regarding the adequate geographical distribution

It is considered good practice to take compensatory measures as close as possible to the affected area in order to maximise chances of protecting the overall coherence of the Natura 2000 network. Therefore, locating compensation within or nearby the Natura 2000 site concerned in a location showing suitable conditions for the measures to be successful is the most preferred option. However, this is not always possible and it is necessary to set a range of priorities to be applied when searching locations that meet the requirements of the Habitats Directive.

As a general principle, the compensatory measures should be in place and working before the work on the plan or project has begun. This is to help buffer the damaging effects of the project on the species and habitats by offering them suitable alternative locations in the compensation area.

If this is not fully achievable, the competent authorities should require extra compensation for the interim losses that would occur in the meantime. Member States should pay particular attention when the negative effects of a plan or project are produced in rare natural habitats or in natural habitats that need a long period of time to provide the same ecological functionality (EC 2007b). Under these circumstances, the likelihood of long-term success is best evaluated by peer-reviewed scientific studies of trends.

The information on the compensatory measures should be submitted to the Commission before they are implemented and indeed before the realisation of the plan or project concerned. It is therefore advised that compensatory measures should be submitted to the Commission as soon as they have been adopted in the planning process in order to allow the Commission, within its competence of guardian of the treaty, to assess whether the provisions of the Directive are being correctly applied (EC 2007b).

The Commission will deliver an opinion when priority habitats and/or species might be adversely affected. In delivering its opinion, the Commission will check the balance between the ecological values affected and the invoked imperative reasons, and evaluate the compensation measures. The opinion is not binding but in case of non-conformity with Community law, legal action may be taken.

According to existing EC guidance (EC 2007b), compensatory measures under Article 6(4) can consist of one or more of the following:

- **Restoration or enhancement** within existing Natura 2000 sites: restoring the habitat to ensure the maintenance of its conservation value and compliance with the conservation objectives of the site or improving the remaining habitat in proportion to the loss due to the plan or project on a Natura 2000 site;

- **Habitat Recreation**: recreating a habitat on a new or enlarged site, to be incorporated into Natura 2000;

- **Designation of new sites** under the Birds and Habitats Directive, in association with other works, as described above. As regards compensatory measures for designated sites under the Birds Directive (SPA), any new habitat created as compensation for damage to an SPA should be designated as an SPA once it meets its objectives in order to maintain the overall coherence of the network.

Key issues to address in designing compensatory measures include:

- Targeted objectives to address the unavoidable adverse effects and to ensure that the overall coherence of Natura 2000 is protected
- Ensuring the compensation is feasible and effective i.e. level of risk of failure;
- Assessment of technical feasibility;
- Extent of compensatory measures;
- Location in relation to damage;
- Timing in relation to damage;
- Long-term implementation.

ANNEX I:

Recommendations and resolutions adopted by international conventions on the potential impact of wind farms on wildlife and habitats

Different international biodiversity Conventions and Agreements have adopted measures that relate to wind farm developments.

Bern Convention on the Conservation of European Wildlife and Natural Habitats.

On behalf of the Bern Convention, BirdLife International presented in 2003 an analysis of effects on birds and guidance on environmental assessment criteria and site selection issues, based on a literature overview[155]. This initiative was followed up with a resolution "on minimising adverse effects of wind power generation on wildlife", adopted by the Convention Standing Committee in December 2004[156] . The Contracting Parties are recommended to take appropriate measures to minimise the potential adverse effects of wind turbines on wildlife, to involve the industry sector and to ensure adequate monitoring and surveillance to improve the understanding of the impact of wind farms.

Bonn Convention on the Conservation of Migratory Species of Wild Animals (CMS)

The Conference of the Parties of the Bonn Convention adopted a resolution on wind turbines and migratory species in 2002[157]. The resolution calls upon the Parties, *inter alia* to identify areas where migratory species are vulnerable to wind turbines and where wind turbines should be evaluated to protect migratory species. They should also apply and strengthen comprehensive strategic environmental impact assessments where major developments of wind turbines are planned, and take full account of the precautionary principle.

The Agreement of the Conservation of Populations of European Bats (EUROBATS)

As a follow up to the above mentioned resolution the Bonn Convention adopted a resolution on the potential impact of wind farms on bats in 2003[158]. This includes a request to the Advisory Committee to assess the evidence of the impacts, and if appropriate, to develop guidelines for assessing potential impacts. These guidelines were published in 2008[159].

The Agreement of the Conservation of Small Cetaceans of the Baltic and North Sea (ASCOBANS)

Also as part of the agreement under the Bonn Convention (CMS), a resolution was adopted on "adverse effects of sound, vessels and other forms of disturbance on small cetaceans" in 2006[160]. Parties and Range States are invited to conduct further research into the effects on small cetaceans of e.g. "extractive and other industrial industries, including windfarms", and to include physical and behavioural effects both at the individual and population levels. Parties and Range States are also invited to develop appropriate management measures, guidelines and technological adaptations to minimise adverse effects on small cetaceans; and to implement procedures to assess the effectiveness of any guidelines and management measures. A workshop on impacts and methodologies for assessing impacts of offshore wind farms on marine mammals took place in 2007[161]

[155] Langston & Pullan (2003), Council of Europe T-PVS/Inf (2003) 12,
[156] Recommendation No. 109 (2004) of the Standing Committee
[157] Resolution No. 7.5,
[158] Resolution No. 4.7, available via http://www.eurobats.org/documents/pdf/MoP4/Record_MoP4_complete.pdf.
[159] Rodrigues et al. (2008), available via http://www.eurobats.org/publications/publication_series.htm.
[160] Resolution No. 4, available via http://www.service-board.de/ascobans_neu/files/mop5-final-4.pdf.
[161] Proceedings (Evans 2008, ed)

ANNEX II:

Bird species considered to be particularly vulnerable to wind farms [162]

XXX = Evidence on substantial risk of impact, XX = Evidence or indications of risk or impact, X = Potential risk or impact, x = small or non-significant risk or impact, but still to be considered in assessments. This is an indicative list for guidance, and any potential impacts will be site-specific.

Species / Species group	Conserva-tion status in Europe[163]	Listed in Annex I of the EU Birds Directive	Habitat displacement	Bird strike / collision	Barrier effect	Change in habitat structure	Proposed buffer zones[164]	Potential positive impact
Gavia stellata (breeding)	(Depleted)	YES	X	X	X		1 km around nest sites, and flight corridors between nesting and feeding areas.	
Gavia stellata (wintering)	(Depleted)	YES	XXX	X				
Gavia arctica	(Vulnerable)	YES	X	X			1 km around nest sites	
Grebes (Podicipedidae)			X					
Podiceps auritus	(Declining)	YES	X	X			1 km around lakes with pair(s) present.	
Morus bassanus	Secure	NO	X	X				
Phalacrocorax carbo	Secure	NO	X	x	x		1 km (4km) around breeding colonies.	
Phalacrocorax aristotelis	(Secure)	NO[165]				X		
Herons and storks (Ciconiiformes)				X			1 km (4 km) around breeding colonies	
Botarus stellaris	Depleted	YES					1 km (4km) around nest sites.	
Ixobrychus minutus	(Depleted)	YES					1 km (4km) around nest sites.	
Ciconia nigra	Rare	YES			x		3 km (10 km) around nest sites.	
Ciconia ciconia	Depleted	YES		x	X			
Cygnys cygnys	Secure	YES	X	X				
Geese (Anserini)					XX			
Anser fabalis (wintering)	Secure	NO	X				0.6 km around foraging fields	
Anser brachyrhynchos	Secure	NO	See foot-note[166]	X				

[162] Primarily based on information from Barrios & Rodrígues (2007), Bevanger et al. (2008), Bright et al. (2006), de Lucas et al. (2007b), Devereux et al. (2008), Dirksen et al. (2007), Everaert & Stienen (2007), Hötker et al. (2005, 2006), Kruckenberg & Jaene (1999), Langston & Pullan (2003), Larsen & Madsen (2000), Lawrence et al. (2007), Lekuona & Ursúa (2007), Madsen & Boertmann (2008), Madders & Whitfield (2006), Pearce-Higgins et al. (2008, 2009), Petersen et al. (2006), Petersen & Fox (2007) and Thelander & Smallwood (2007).

[163] Ref. BirdLife International (2004).

[164] Ref. Bright et al. (2006), LAG-VSW (2007) etc. Indicative figures of guidance character, not reflecting any legal prescriptions. Proposed radius for check of feeding areas are given in parentheses.

[165] Except for *P.a. desmarestii.*

[166] Initial displacement effects, but indication of long-term habituation (e.g. Madsen & Boertmann 2008).

Species / Species group	**Conservation status in Europe**[167]	**Listed in Annex I of the EU Birds Directive**	**Habitat displacement**	**Bird strike / collision**	**Barrier effect**	**Change in habitat structure**	**Proposed buffer zones**[168]	**Potential positive impact**
Anser albifrons (wintering)	Secure	NO[169]	XX	X				
Branta leucopsis	Secure	YES	X	X				
Branta bernicla	Vulnerable	NO	X	X				
Ducks (Anatinae)					x			
Anas penelope (non-breeding season)	Secure	NO	XX		x			
Aythya ferina (flights between feeding and roosting sites in winter)	(Declining)	NO		x	X			
Aythya fuligula (flights between feeding and roosting sites in winter)	(Declining)	NO		x	X			
Aythya marila (flights between feeding and roosting sites in winter)	(Declining)	NO		x	X			
Somateria mollissima	Secure	NO	X	X	X	X		
Somateria mollissima (staging, wintering)	Secure	NO	X	x				
Clangula hyemalis (wintering)	(Secure)	NO	XX	X	X	X		
Melanitta nigra (breeding)	(Secure)	NO	X				1 km around nest sites	
Melanitta nigra (wintering)	(Secure)	NO	XX[170]	X	X	X		
Bucephala clangula (flights between feeding and roosting sites in winter)	(Secure)	NO		x	x			
Mergus serrator	(Secure)	NO						x[171]
Raptors (Falconiformes)				X	XX			
Pernis apivorus	(Secure)	YES			x			
Milvus migrans	(Vulnerable)	YES	X	X	X		1 km (4 km) around nest sties.	
Milvus milvus	Declining	YES	X	XXX	x		1-3 km (4 km) around nest sites, 5 km around roost sites.	
Haliaeetus albicilla	Rare	YES	XXX	XXX			3-5 km (6 km) around territory centres and nest sites.	
Gypaetus barbatus	(Vulnerable)	YES	X	X				
Gyps fulvus	Secure	YES	X	XXX[172]	X			
Circaetus gallicus	(Rare)	YES	X	X	X			
Circus aeroginosus	Secure	YES	X	x	x		1 km (6 km) around nest sites.	
Circus cyaneus	Depleted	YES	XX	X	x		1-2 km (6 km) around sightings and nest locations.	

[167] Ref. BirdLife International (2004).
[168] Ref. Bright et al. (2006), LAG-VSW (2007) etc. Indicative figures of guidance character, not reflecting any legal prescriptions. Proposed radius for check of feeding areas are given in parentheses.
[169] Except for *A.a. flavirostris.*
[170] Initial avoidance, recovery within 3-5 years (Petersen & Fox 2007).
[171] Indications of increased attraction to areas around wind turbines (Petersen et al. 2006).
[172] 63.1% of all bird and bat fatalities in a study in Navarra, Spain, 2000-2002 (13 wind power plants, 741 turbines, 360 fatalities in total, Lekuona & Ursúa 2007).

Species / Species group	**Conservation status in Europe**[173]	**Listed in Annex I of the EU Birds Directive**	**Habitat displacement**	**Bird strike / collision**	**Barrier effect**	**Change in habitat structure**	**Proposed buffer zones**[174]	**Potential positive impact**
Circus pygargus	Secure	YES	X				1 km (6 km) around nest sites.	
Accipiter gentilis	Secure	NO[175]			x			
Accipiter nisus	Secure	NO[176]		x	x			
Buteo buteo	Secure	NO	XX	x	x			
Buteo lagopus	(Secure)	NO	X					
Aquila pomarina	(Declining)	YES					6 km around nest sites.	
Aquila heliaca	Rare	YES	X	X				
Aquila chrysaetos	Rare	YES	X	XXX			2.5-6 km around nest locations and territories.	
Hieraaetus fasciatus	Endangered	YES	X	X				
Pandion halietus	Rare	YES					1 km (4 km) around nest sites.	
Falco naumanni	Depleted	YES		x				
Falco tinnunculus	Declining	NO	X	XX	X			
Falco columbarius	(Secure)	YES			x			
Falco subbuteo	(Secure)	NO			x		1 km (4 km) around nest sites.	
Falco peregrinus	Secure	YES	X	X	x		1-3 km around nest locations and territories.	
Gallinaceous birds (Galliformes)								
Lagopus lagopus	Secure	NO[177]	X	XX				
Tetrao tetrix	Depleted	NO[178]	X	X	X	X	1 km around breeding sites, 1.5 km around lek sites.	
Tetrao urogallus	(Secure)	YES	X		X	X	1 km around breeding sites	
Alectoris rufa	(Declining)	NO	X	x				
Phasianus colchicus	(Secure)	NO	X	x				
Cranes, rails etc (Gruiformes)	Vulnerable	YES	X	X				
Crex crex	Depleted	YES	X	X			0.85-1 km around sites with singing males.	
Grus grus	(Depleted)	YES	X	X	x		1 km around nest sites.	
Bustards (Otidae)	Vulnerable	YES	X	X				
Waders (Charadriiformes)					x			
Pluvialis apricaria	(Secure)	YES	XX	X	X		1 km (6 km) around nest sites.	
Vanellus vanellus	Vulnerable	NO	XX	X	x			

173 Ref. BirdLife International (2004).
174 Ref. Bright et al. (2006), LAG-VSW (2007) etc. Indicative figures of guidance character, not reflecting any legal prescriptions. Proposed radius for check of feeding areas are given in parentheses.
175 Except for *A.g. arrigonii.*
176 Except for *A.n. granti.*
177 Except for *L.l. pyrenaicus* and *L.l helveticus*.
178 Except for *T.t. tetrix.*

Species / Species group	Conservation status in Europe[179]	Listed in Annex I of the EU Birds Directive	Habitat displacement	Bird strike / collision	Barrier effect	Change in habitat structure	Proposed buffer zones[180]	Potential positive impact
Calidris maritima (wintering site)	(Secure)	NO	X	x	x			
Calidris alpina	(Depleted)	NO[181]	X	X				
Calidris spp.					x			
Gallinago gallinago	Declining	NO	XX	X				
Limosa limosa	Vulnerable	NO	X	x	X			
Numenius arquata	Declining	NO	XX		X			
Gulls and terns				X	x		1 km (4 km) around breeding colonies.	
Stercorarius parasiticus	(Secure)	NO	X	X				
Larus minutus	(Depleted)	YES						x[182]
Larus argentatus	Secure	NO		x	x			x[183]
Sterna sandvicensis	Depleted	YES		XX	x			
Sterna hirundo	Secure	YES		XX	x			
Sterna hirundo / S. paradisea		YES	X					
Sterna albifrons	(Secure)	YES		XX	x			
Uria aalgle / Alca torda	(Secure)	NO[184]	XX	X		X		
Doves and pigeons (Columbidae)				x	x			
Cuculos canorus	Secure	NO		x				
Owls				X				
Bubo bubo	(Depleted)	YES		X			1 km (6 km) around nest sites.	
Asio otus	(Secure)	NO		x				
Caprimulgus europaeus	(Depleted)	YES	X	X			1-2.5 km around sites with churring males.	
Tachyparptis melba	Secure	NO		X				
Apus apus	(Secure)	NO		x				
Upupa epops	(Declining)	NO		x				
Passerines (several species)				X[185]	X[186]			
Alauda arvensis (winter)	(Depleted)	NO	X					
Anthus pratensis	(Secure)	NO	X					
Oenanthe oenanthe	(Decling)	NO	XX					
Acrocephalus schoenobaenus	Secure	NO						x[187]

[179] Ref. BirdLife International (2004).
[180] Ref. Bright et al. (2006), LAG-VSW (2007) etc. Indicative figures of guidance character, not reflecting any legal prescriptions. Proposed radius for check of feeding areas are given in parentheses.
[181] Except for *C.a. schinzii.*
[182] Indications of increased attraction to areas around wind turbines (Petersen et al. 2006).
[183] Indications of increased attraction to areas around wind turbines (Petersen et al. 2006).
[184] Except for *U.a. ibericus.*
[185] Especially nocturnal migrants (e.g. Langston & Pullan 2003).
[186] Excl. starling and crows (Hötker et al. 2005, 2006).

Pyrrhocorax pyrrhocorax	Declining	YES	X	x			1 km around nest sites.	
Sturnus vulgaris (non-breeding)	Declining	NO	XX		x			
Granivorous farmland birds (winter)[188]	See footnote[189]	NO	X					
Emberiza schoeniclus	Secure	NO						x[190]

[187] Indications of increased attraction to areas around wind turbines, presumably due positive response to habitat change around the studied wind turbines (Hötker et al. 2005, 2006).
[188] *Emberiza, citriniella, E. schoeniclus, Passer montanus, Miliara calandra.*
[189] *Emberiza, citriniella* and*, E. schoeniclus* are "secure", *Passer montanus* and *Miliara calandra* are declining.
[190] Indications of increased attraction to areas around wind turbines, presumably due positive response to habitat change around the studied wind turbines (Hötker et al. 2005, 2006).

ANNEX III:

Bat behaviour in relation to wind farms [191].

Species	Listed in Annex II of the EU Habitats Directive[192]	Hunting close to habitat structures	Migration or long-distance moving	High flight (<40 m)	Low flight	Possible disturbed by turbine ultrasounds	Attracted by light	Roosting inside nacelles	Known loss of hunting habitat	Risk of loss of hunting habitat	Known collision	Risk of collision
Rhinolaphus ferrumequinum	X	X			X							
Rhinolaphus hipposideros	X	X			X							
Rhinolaphus euryale	X	X			X							
Rhinolaphus mehelyi	X											
Rhinolaphus blasii	X											
Myotis myotis	X		X	X	X						X	X
Myotis blythii	X		X	X	X							X
Myotis punicus												
Myotis daubentonii		X		X	X						X	X
Myotis emarginatus	X	X	?	X	X							
Myotis natteri		X			X							
Myotis mystacinus		X			X							X
Myotis brandtii		X		X	X						X	X
Myotis alcathoe		X			X							
Myotis bechsteinii	X	X			X							
Myotis dasycneme	X		X	X	X						X	X
Myotis capaccini	X				X							
Nyctalus noctula			X	X		X	X	?		X	X	X
Nyctalus leisleri			X	X		X	X	?		X	X	X
Nyactalus lasiopterus			?	X		?				X	X	X
Eptesicus nilssonii				X			X				X	X
Eptesicus serotinus			?	X		X	X		(X)		X	X
Vespertilio murinus			X	X			X			X	X	X
Pipistrellus pipistrellus		X		X	X	?	X				X	X
Pipistrellus pygmaeus		X	X	X	X	?	X				X	X
Pipistrellus kuhlii		X		X	X	?	X				X	X
Pipistrellus nathusii		X	X	X	X	?	X				X	X
Hypsuogi savii		X		X	X	?	X				X	X

[191] From Rodrigues et al. (2008).
[192] In addition, 'Microchiroptera, all species' are listed in Annex IV(a) of the 'Habitats Directive' which means in practise that obligations following from Article 12 of the directive applies for all European bat species.

Plecotus auritus		X		X	X						X	X
Plecotus austriacus		X		X	X						X	X
Plecotus macrobullaris		?			X							
Plecotus kolombatovici												
Barbastella barbastellus	X	X			X							X
Miniopterus schreibersii	X	?	X	X	X		X				X	X
Tadarida tenoitis				X		X	X				X	X
Rousettus aegipticus[193]	X											

[193] No information on *Rousettus aegiptiacus* is given by Rodrigues et al. (2008).

ANNEX IV:

Aquatic species listed in Annexes II and/or IV(a) of the 'Habitats Directive' and recommended to be especially considered with reference to adverse impact from wind farms (list is non-exhaustive[194]).

Species, species group	Annex	Reason for consideration
Seals (Phocidae)		
Halichoerus grypus	II	• Disturbance (noise etc) from offshore wind farms, primarily during construction.
Monachus monachus	II (priority), IV(a)	• Although no information about impacts has been found, risk for disturbance (noise etc) from offshore wind farms during construction phase should nevertheless by considered, in analogy with findings for other marine mammals and concern for the overall unfavourable conservation status of this species.
Phoca hispida bottnica	II	• Although not studies with reference to potential impact from wind farms, risk for disturbance (noise etc) from offshore wind farms during construction phase should nevertheless by considered, in analogy with findings for other marine mammals and concern for the conservation status of this subspecies, endemic to the Baltic Sea.
Phoca vitulina	II	• Disturbance (noise etc) from offshore wind farms, primarily during construction.
Whales, dolphins and porpoises (Cetacea)		
All species	IV(a)	• Disturbance (noise etc) from offshore wind farms, primarily during construction, and possibly also during operation, in analogy with findings for *Phocoena phocoena.*
Phocoena phocoena	II	• Disturbance (noise etc) from offshore wind farms, primarily during construction, but also conflicting evidence on impact during operation.
Tursiops truncatus	II	• Disturbance (noise etc) from offshore wind farms, primarily during construction, and possibly also during operation, in analogy with findings for *Phocoena phocoena.*
Terrestrial mammals[195]:		
Lutra lutra	II, IV(a)	• Perceived indirect impact of changes in hydrology etc related to wind farm developments in upstream located wetlands (incl. peatlands).
Fish:		
Salmo salar	II	• Perceived indirect impact of changes in hydrology etc related to wind farm developments in upstream located wetlands (incl. peatlands).
Molluscs:		
Margaritifera margaritifera	II	• Perceived indirect impact of changes in hydrology etc related to wind farm developments in upstream located wetlands (incl. peatlands).

[194] Primarily based on information from Hötker et al. (2005, 2006), Lucke at al. (2006), Rodrigues et al. (2008) and Thomsen et al. (2006) with reference to bats and marine mammals.

[195] Ref. comments from Scottish and Irish *ad hoc* group members (August 2007).

ANNEX V

Some of examples of proposed or confirmed impacts of wind farm development on species and species groups

Kind of impact	Onshore	Offshore
Disturbance and displacement, birds	• For staging and wintering waterfowl there is evidence of disturbance, with ranges from zero up to around 800 m and with 600 m from the development as an often accepted "rule of thumb"[196], but also that staging waterfowl may habituate over time[197]. • Studies in wintering farmland birds in UK indicate only minimal effects[198]. • Breeding birds may been proposed to be more tolerant than staging and wintering birds[199], but this assumption needs to be further verified on the basis of long-term studies. For single bird species, however, there is evidence of displacement effects during the breeding periods[200]. • This was further confirmed in a study in upland habitats in northern UK, where breeding densities were reduced by 15-53% within a zone 500m around the wind turbines for 7 of 12 species[201].	• Danish studies at offshore developments, 1999-2007, indicated displacement as well as recovery of single bird species using waters around wind farms for staging or wintering[202]. Initial indications of avoidance of areas up to at least 2 km were reported for e.g. Red-throated Diver (*Gavia stellata*), Common Scoter (*Melanitta nigra*) and auks (*Uria aalge* and *Alca torda*). A clear recovery was reported 3-5 years after construction for Common Scoter, while still to clarify if this was related to change in food supply or habituation. For Red-throated Diver, no indications of recovery were recorded still 5-6 years after construction works.
Disturbance and displacement, marine mammals and fish	N.A.	• For marine mammals (seals, dolphins, whales) and fish impact of noise has been a main issue for study. • Construction work, especially pile-driving, may result in short-term but long-ranged impacts[203], with audibility extending 80 km for

[196] E.g. Drewitt and Langston (2006) and references therein.
[197] E.g. Madsen & Boertmannn (2008), with reference to Pink-footed Goose (*Anser brachyrhynchos*).
[198] Devereux et al. (2008).
[199] E.g. Hötker et al (2005, 2006) on the basis of a literature overview covering 127 studies.
[200] E.g. White-tailed Eagle (*Haliaeetus albicilla*, Follestad et al. 2007) and Eurasian Golden Plover (*Pluvialis apricaria*, Pearce-Higgins et al. 2008).
[201] Pearce-Higgins et al. (2009).
[202] E.g. Petersen et al. (2006), Petersen & Fox (2007) and references therein.
[203] E.g. Nedwall et al. (2007), Diederichs et al. (2008).

		Harbour Porpoise (*Phocoena phocoena*) and Harbour Seal (*Phoca vitulina*), and potential behavioural responses up to 15-20 km. In immediate vicinity, severe injuries of ramming activities cannot be excluded[204]. Impact during construction has been shown to more evident for porpoises than on seals[205]. • Noise during operation is generally low and mostly not exceeding variations which be encountered during the animals' normal course of activity. Impact (if any) is local but long-lasting[206], but may differ between sites[207]. • Electro-magnetic fields induced in the vicinity of under-water cables have been an issue of concern with reference to interference with electric fields used by some fish species for prey detection, spatial orientation etc, and magnetic fields used for navigation; especially with reference to sharks, rays and lampreys[208], although information available is not conclusive with reference to any major effects[209]. • For marine benthic animals, the static magnetic fields of sub-marine cables did not seem to have any clear influence on orientation, movement and physiology, when tested during artificial conditions, although further studies are needed to focus on a long-term perspective[210]. • For some fish species, including cod and herring, operational noise may be detectable up to 4 km distance, and up to around 1 km for some other species; with a risk of masking intraspecific communication. Behavioural and physiological stress is expected to be restricted to very close surroundings[211].

[204] Thomsen et al. (2006).
[205] Ref. results from monitoring during construction and two years of operation of the Horns Rev and Nysted offshore wind farms, Denmark; see also Box 3.2.
[206] E.g. Nedwall et al. (2007), Diederichs et al. (2008).
[207] E.g. with reference to Harbour Porpoise (*Phocoena phocoena*) and comparisons between the Nysted and Horns Rev offshore wind farms in Denmark (Teilmann et al. 2008).
[208] E.g. OSPAR (2006a).
[209] E.g. Meissner & Sordyl (2006).
[210] Bochert & Zettler (2006).
[211] E.g. Keller et al. (2006), Thomsen et al. (2006).

		• Offshore wind farms may function as combined artificial reefs and fish aggregations devices[212], and restrictions in fishery in the immediate surroundings may have an additional positive impact on the fish stocks[213].
Collision fatalities, birds	• Collision rates are overall very low, but with the noteworthy exception of high frequency of fatalities involving raptors. Special concern has to be raised for e.g. Eurasian Griffon Vulture (*Gyps fulvus*), White-tailed Eagle (*Haliaeetus albicilla*), Golden Eagle (*Aquila chrysaetos*), Red Kite (*Milvus milvus*) and Common Kestrel (*Falco tinnunculus*)[214]. • Single cases with high number of fatalities at various locations in e.g. California, Spain and Norway have attracted wide-spread publicity, but risks are highly site-specific[215]. • Birds making regular foraging flights between nesting and feeding areas may face enhanced risks[216].	• For offshore locations information about collision fatalities are still limited, but direct observations and radar studies as well as modelling indicate very low risks, as has been shown e.g. for Eider (*Somateria mollissima*)[217].
Collision fatalities, bats	• Higher mortality risks than for birds, primarily for migrating species (short and long distance) at both onshore and offshore locations[218]. • In a one-year study of operational impacts on bats in the Frieburg region in southern Germany, including standardsied seach of carcasses at 16 turbines, 50 daed bats were found, with a dominance of *Pipistrellus pipistrellus* and *Nyctalus leisleri,* while only 9 birds (of 5 species) were recorded. Most bats were found in late summer, and most fatalities were recorded in forests and none in open areas. At 2 turbines where acitvity was	• Higher mortality risks than for birds, primarily for migrating species at both onshore and offshore locations[220].

[212] E.g. Wilhelmsson et al. (2006).
[213] E.g. Fiskeriverket (2007).
[214] E.g. Barrios & Rodrígues (2004, 2007), Hötker at al. (2005, 2006), Lekuona & Ursúa (2007), Follestad et al. (2007) and Thelander & Smallwood (2007).
[215] Drewitt and Langston (2008), and references therein; see also Box 3.1.
[216] E.g. Everaert & Steinen (2007), with reference to a study of three species of breeding terns at coastal breeding site.
[217] E.g. Pettersson (2005), Petersen et al. (2006).
[218] E.g. Rodrigues et al. (2008).

	studied, using a thermal imaging camera, and around 25% of the bats showed evaise behaviour when approaching a rotor[219].	
Barrier effects	• From literature overviews it can be concluded that avoidance behaviour is a relatively common but still poorly understood phenomenon. E.g. most information refers to day-time observations while there is lack of data with reference to night-time, when much migration takes place[221].	• At an offshore wind farm (7 turbines) located at a frequently used flyway at Kalmarsund, SE Sweden, avoidance behaviour at a distance of 1-2 km was recorded among migrating waterbirds (primarily Eider, *Somateria mollissima*). In spring migration (but not autumn), the flight corridor as adjusted to a more easterly location. The total length of migration, and thus the energy expenditure was assessed to increase by 0.2-0.5%[222]. • Good evidence on avoidance behaviour among various species of waterbirds (incl. Eider) exists also from Danish offshore wind farms, with most bird flocks heading for the wind farm at 1.5-2 km distance, although responses were highly species-specific[223]. • No evidence of barrier effect among fish and marine mammals has been found[224]

[220] E.g. Rodrigues et al. (2008).
[219] Brinkmann et al. (2006).
[221] Hötker (2005, 2006).
[222] Pettersson (2005).
[223] E.g. Petersen et al. (2006).
[224] OSPAR (2006a), with references to studies at the Horns Rev and Nysted wind farms in Denmark.

ANNEX VI:

European and national guidance documents of relevance for impact assessments with reference to wind farms

This list of already existing EC and national guidance that might be of relevance with reference to impact assessments of wind farms plans and projects is non-exhaustive. For the national documents, it is primarily based on information provided by the *ad hoc* group members. The list also includes a few guidance documents prepared by NGOs.

Europe

The documents listed below have been developed by the EC. They provide detailed guidance on how to apply the EU nature legislation.

European Commission, (2000) Managing Natura 2000 sites: the provisions of Articles 6 of the habitats directive 92/43/EEC. Luxembourg: Office for official publications of the European Communities; http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/provision_of_art6_en.pdf

European Commission, (2002) Assessment of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of articles 6(3) and (4) of the Habitats Directive 92/43/EEC. Luxembourg: Office for official publications of the European Communities; http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/natura_2000_assess_en.pdf

European Commission, (2003), Implementation of Directive 2001/42 on the assessment of the effects of certain plans and programmes on the environment; http://ec.europa.eu/environment/archives/eia/pdf/030923_sea_guidance.pdf

European Commission (2007) Guidance document on article 6(4) of the 'Habitats Directive'92/43/EEC. Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the Commission; http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/guidance_art6_4_en.pdf

European Commission (2007) Guidance document on the strict protection of animal species of Community interest under the 'Habitats Directive'92/43/EEC. Final version, February 2007. http://ec.europa.eu/environment/nature/index.en.htm.

<u>Other guidance documents relevant on the supra-national level (selection)</u>

Diederichs, A., Nehlds, G., Dähne, M., Adler, S, Koschinski, S. & Verfuss, U. (2008) Methodologies for measuring and assessing potential changes in marine mammal behaviour, abundance or distribution arising from the construction, operation and decommissioning of offshore windfarms. – Commissioned by COWRIE Ltd.; http://www.offshorewindfarms.co.uk/Assets/Latest%20COWRIE_CHANGE_report_final.pdf

Kettunen, M., Terry, A., Tucker, G. & Jones, A. (2007) Guidance on the maintenance of landscape features of major importance for wild flora and fauna – guidance on the implementation of Article 3 of the Birds Directive (79/43/EEC) and Article 10 of the Habitats Directive (92/43/EEC). – Institute for European Environmental Policy (IEEP), Brussels; http://ec.europa.eu/environment/nature/ecosystems/docs/adaptation_fragmentation_guidelines.pdf.

OSPAR (2008) OSPAR guidance on environmental considerations for offshore wind farm development. – OSPAR Commission Reference Number 2008-3. http://www.ospar.org/v_measures/get_page.asp?v0=08-03e_Consolidated%20Guidance%20for%20Offshore%20Windfarms.doc&v1

Rodrigues, L., Bach, L., Duborg-Savage, M-J., Goodwin, J. & Harbusch, C. (2008) Guidelines for consideration of bats in wind farm projects. – EUROBATS Conservation Series No. 3 (English version), UNEP/EUROBATS Secretariat, Bonn; http://www.eurobats.org/publications/publication_series.htm.

Seeley, B., Parr, J., Evans, J. & Lear, D. (2008) Establishing best practice for the documentation and dissemination of marina biological data. - Commissioned by COWRIE Ltd. http://www.offshorewindfarms.co.uk/Assets/DATA_14_11_08_FINALREPORT.pdf

National

Finland

Ministry of Environment (2005) Tuulivoimarakentaminen (Development of wind power). – The Ministry of Environment, Helsinki (available in Finnish and Swedish); http:///www.ymparisto.fi/download.asp?contentid=42234%lan=sv

France

DIREN Bourgogne (2007) Définition et cartographie des enjeux avifaunistiques vis à vis du développement de l'énergie éolienne en Bourgogne. – Direction Régionale de l'Environnement, Bourgogne, Dijon. http://www.bourgogne.ecologie.gouv.fr/IMG/pdf_NOVEAU_rapport_eolien_avifaune_bourgogne2008.pdf.

Ministère de l'Ecologie, du Développement et de l'Aménagement Durables (2006) Guide de l'étude d'impact sur l'environnement des parcs éoliens; http://ecologie.gouv.fr/IMG/pdf/Guide_eolien.pdf.

Ministère de l'Ecologie, du Développement et de l'Aménagement Durables (2007) Les questions-réponses sur les zones développement de l'éolien (ZDE); http://www.industrie.gouv.fr/energie/renou/questions-zde.htm.

Germany

BSH (2007) Standard. Untersuchung der Auswiirkungen von Offshore-Windenergieanlagen auf die Meeresumwelt (StUK 3). Stand: Februar 2007. – Bundesamt für Seeschiffahrt und Hydrographie (Federal Maritime and Hydropgraphic Agency), Hamburg and Rostock; http://www.bsh,de/de/Produkte/Buecher/Standard/7003.pdf.

Ireland

SEI (2006) Wind Farm Planning Guidelines - Sustainable Energy Ireland, Dublin. http://www.environ.ie/en/Publications/DevelopmentandHousing/Planning/FileDownLoad,1633,en.pdf

Italy

Di Bene, A. & Scazzoni, L. (2006, eds.) Gli impianti eolici: suggerimenti per la progettazione e la valutazione paesaggistica. – Minestori per i beni e le attività culturali and Gangemi Editore, Rome; http://www.ording.cr.it/common/linee_guida/min_beni_imp_eolici.pdf

Sweden

Energimyndigheten (Swedish Energy Agency) (2007) Vindkraft – tillståndsprocessen och kunskapsläget. Energimyndigheten, Eskilstuna; http://www.swedishenergyagency.se/web/biblshop.nsf/FilAtkomst/ET2007_08.pdf/$FILE/ET2007_08.pdf?OpenElement

UK

BERR (2007) Onshore wind energy planning conditions guidance note. A report for the Renewables Advisory Board and BERR. – Department for Business, Enterprise & Regulatory Reform; http://www.berr.gov.uk/files/file35240.pdf.

BERR (2007) Atlas of the UK Marine Renewable Energy Resources. – Department for Business, Enterprise & Regulatory Reform; http://www.renewables-atlas.info.

BWEA, WWF, English Nature & RSPB (2001) Wind farm development and nature conservation- A guidance document for nature conservation organisations and developers when consulting over wind farm proposals in England. – British Wind Energy Association, London; http://www.bwea.com/pdf/wfd.pdf.

DEFRA (2004) Offshore Wind Farms. Guidance note for Environmental Impact Assessment in respect of FEPA and CPA requirements. http://www.mfa.gov.uk/environment/documents/Windfarm-guidance-note.pdf.

DEFRA (2005) Nature conservation guidance on offshore windfarm development. A guidance note on the applications of the EC Wild Birds and Habitats Directives for developers undertaking offshore windfarm developments. Version R1.9, March 2005. http://www.defra.gov.uk/WILDLIFE-COUNTRYSIDE/ewd/windfarms/windfarmguidance.pdf.

DTI (2004) Guidance notes. Offshore wind farm consent process. – Department for Trade & Industry, London; http://www.berr.gov.uk/files/file22990.pdf.

UK, Scotland

SNH (2009) Strategic locational guidance for onshore wind farms in respect to the natural heritage. – Policy Statement No. 02/02, update March 2009, Scottish Natural Heritage; http://www.snh.org.uk/strategy/pd02b.asp.

SNH (2005) Survey methods for use in assessing the impacts of onshore windfarms on bird communities – Scottish Natural Heritage; http://www.snh.org.uk/pdfs/strategy/renewable/bird_survey.pdf.

NGOs

Poland

PWEA (2008) Guidelines for assessment of wind farms' impact on birds. – Polish Wind Energy association (PWEA), Polish Bird Protection Society (OTPO) & West Pomeranian Society of Practical Ecology (ZTEP), Szczecin.

Spain

Atienza, J.C., Martin Fierro, I., Infante, O. & Vallis, J. (2008) Directrices para la ecaluación del impacto de los parques eólicos en aves y murciélagos (versión 1.0). – SEO/BirdLife, Madrid: http://www.seo.org/media/docs/MANUAL%20PARQUES%20E%C3%93LICOS%20para%20web.pdf.

UK

Bowyer, C., Baldock, D., Tucker, G., Valsecchi, C., Lewis, M, Hjerp, P. & Gantioler, S. (2009) Positive planning for onshore wind – expanding onshore wind energy capacity while conserving nature. – Institute for European Environmental Policy (IEEP) and the Royal Society for the Protection of Birds (RSPB); http://www.ieep.eu or http://www.rspb.org.uk

Add RSPB guide on Appropriate assessments of plans

REFERENCES

Ahlén, I. (2003) Wind turbines and bats – a pilot study. – Report to the Swedish National Energy Administration, Dnr 5210P-2002-00473, P-nr P20272-1.

Ahlén, I. (2008) Vindkraft ett hot för fladdermöss och fåglar. – Biodiverse 13(1): 10-11.

Ahlén, I., Bach, L., Baggøe, H.J. & Pettersson, J. (2007) Bats and offshore wind turbines studied in southern Scandinavia. – Naturvårdsverket Rapport 5571, 35 pages.

Azkorra, Z., Aizpurua, A., Riga, P., Heras, P., Ibargoitia, M., Gallejones, P., Gartzia, N., Gonzálz, A. & Camps Arbestian, M. (2008) Characterisation of organic carbon in mire and heath soils at the Elgea-Urkilla Wind Farm, northern Spain. – Mires and Peat 4 (2008/9), Article 05[225].

Baerwald, E.F., D'Amours, G.H., Klug, B.J. & Barclay, R.M.R. (2008) Barotrauna is a significant cause of bat fatalities at wind turbines. – Current Biology 18: 695-696.

Baerwald, E.F., Edworthy, J., Holder, M. & Barclay, R.M.R. (2009) A large-scale mitigation experiment to reduce bat fatalities at wind energy facilities. – Journal of Wildlife Management 73: 1077-1081.

Band, W., Madders, M. & Whitfield, D.P. (2007) Developing field and analytical methods to assess avian collision risk at wind farms. – Chapter 15 (pages 259-275) in de Lucas et al. (2007a).

Barclay, R.M.R., Baerwald, E.F., & Gruver, J.C. (2007) Variation in bird and bat fatalities at wind energy facilities: assessing the effects of rotor size and tower height. – Can. J. Zool. 85: 381-387.

Barrios, L. & Rodrígues, A. (2004) Behavioural and environmental correlates of soaring-bird mortality at on-shore wind turbines. – Journal of Animal Ecology 41: 72-81.

Barrios, L. & Rodrígues, A. (2007) Spatiotemporal patterns of bird mortality at two wind farms of Southern Spain. – Chapter 13 (pages 231-239) in de Lucas et al. (2007a).

Bevanger, K., Clausen, S., Dahl, E.L., Flagstad, Ø,Follestad, A., Gjershaug, O.G., Halley, D., Hanssen, F., Hoel, P.L., Jacobsen, K-O., Johnsen, L., May, R., Nygård, T., Pedersen, H.C., Reitan, O., Stenheim, Y. & Vang, R. (2008) Pre- and postconstruction studies of conflicts between birds and wind turbines in coastal Norway. Progress Report 2008 – NINA Report 409, 55 pp.

BirdLife International (2004) Birds in Europe: population estimates, trends and conservation status. – BirdLife Conservation Series No. 12, Cambridge.

Birklund, J. (2006) Surveys of the benthic communities in Nysted Offshere Wind Farm in 2005 and changes in the communities since 1999 and 2001. Final Report May 2006. – ENERGIE E2 A/S and DHI Water & Environment[226].

Bochert, R. & Zettler, M. (2006) Effect of electromagnetic fields on marine organisms. – Pages 223-234 in Köller at al. (2006).

Bragg, O. (2007) Derrybrien: where the question began. – International Mire Conservation Group (IMCG) Newsletter Issue 2007/4: 3-8.[227]

[225] Available via http://www.mires-and-peat.net/mpj3.html.
[226] Available via http://www.ens.dk/sw42552.asp.
[227] http://www.imcg.net/imcgnl/pdf/nl0704.pdf.

Bright, J.A., Langston, R.W., Bullman, R., Evans, R.J., Gardner, S., Pearce-Higgins, J. & Wilson, E. (2006) Bird sensitivity map to provide locatitional guidance for onshore wind farms in Scotland. – RSPB Research Report No 20.

Bright, J.A., Langston, R.W., Bullman, R., Evans, R.J., Gardner, S. & Pearce-Higgins, J. (2008) Map of bird sensitivities to wind farms in Scotland: A tool to aid planning and conservation. – Biological Conservation 141: 2342-2356.

Brinkmann, R., Schauer-Weisshahn, H. & Bontadina, F. (2006) Survey of possible operational impacts on bats by wind facilities in Southern Germany. – Final report submitted by the Administrative District of Freiburg, Department of Conservation and Landscape Management and supported by Naturschutzfonds Baden-Württemberg. Brinkmann Ecological Consultancy, Gundelfingen/Freiburg[228].

BSH (2007) Standard. Untersuchung der Auswiirkungen von Offshore-Windenergieanlagen auf die Meeresumwelt (StUK 3). Stand: Februar 2007. – Bundesamt für Seeschiffahrt und Hydrographie (Federal Maritime and Hydropgraphic Agency), Hamburg and Rostock[229].

Chamberlain, D.E., Rehfisch, M.R., Fox, A.D., Desholm, M. & Anthony, S.J. (2006) The effect of avoidance rates on bird mortality predications made by wind turbine collision risk models. – Ibis 148 (supplement): 198-202.

Couwenberg, J. & Joosten, H. (2007) The carbon balance of windfarms on peatland. – International Mire Conservation Group (IMCG) Newsletter Issue 2007/4: 15-16[230].

DEFRA (2005) Nature conservation guidance on offshore windfarm development. A guidance note on the applications of the EC Wild Birds and Habitats Directives for developers undertaking offshore windfarm developments. Version R1.9, March 2005.

De Lucas, M., Janss, G.F.E. & Ferrer, N. (2007a, eds.) Birds and wind farms – risk assessment and mitigation. – Quercus, Madrid.

De Lucas, M., Janss, G.F.E. & Ferrer, N. (2007b) Wind farm effects on birds in the Strait of Gibraltar. – Chapter 12 (pages 219-227) in de Lucas et al. (2007a)

Desholm, M. (2009) Avian sensitivity to mortality: Prioritsing migratory bird species for assessment at proposed wind farms. – Journal of Environmemtal Management 90: 2672-2679.

Desholm, M., Fox, A.D., Beasley, P.D.L. & Kahlert, J. (2006) Remote techniques for counting and estimating the number of bird-wind turbine collisions at sea – a review. – Ibis 148 (Supplement): 76-89.

Devereux, C.L., Denny, M.J.H. & Whittingham, M.J. (2008) Minimal effects of wind turbines on the distribution of wintering farmland birds. – Journal of Applied Ecology 45: 1968-1694 (doi 10.1111/j.1365-2664.2008.01560.x).

Diederichs, A., Nehlds, G., Dähne, M., Adler, S, Koschinski, S. & Verfuss, U. (2008) Methodologies for measuring and assessing potential changes in marine mammal behaviour, abundance or distribution arising from the construction, operation and decommissioning of offshore windfarms. – Commissioned by COWRIE Ltd.[231]

DIREN Bourgogne (2007) Définition et cartographie des enjeux avifaunistiques vis à vis du développement de l'énergie éolienne en Bourgogne. – Direction Régionale de l'Environnement, Bourgogne, Dijon.

[228] http://www.rp-frieburg.de/servlet/PB/show/11584/rpf-windkraft-fledermaeuse.pdf.
[229] http://www.bsh,de/de/Produkte/Buecher/Standard/7003.pdf.
[230] http://www.imcg.net/imcgnl/pdf/nl0704.pdf.
[231] http://www.offshorewindfarms.co.uk/Assets/Latest%20COWRIE_CHANGE_report_final.pdf.

Dirksen, S., Spaans, A.L. & van der Winden, J. (2007) Collision risks for diving ducks at semi-offshore wind farms in freshwater lakes: a case study. – Chapter 11 (pages 201-218) in de Lucas et al. (2007a).

Drewitt, A.L. & Langston, R.H.W. (2006) Assessing impacts of wind farms on birds. - Ibis 148 (supplement): 29-42.

Drewitt, A.L. & Langston, R.H.W. (2008) Collision effects of wind-power generators and other obstacles on birds. – Annals of the New York Academy of Sciences 1134: 233-266 (doi 10.1196/annals.1439.015).

EEA (2009) Europe's onshore and offshore wind energy potential. An assessment of environmental and economic constraints. – EEA Technical report No 6/2009.[232]

Erickson, W. P., Johnson, G. D. and Young, D. P. (2005) A summary and comparison of bird mortality from anthropogenic causes with an emphasis on collisions, - USDA Forest Gen. Tech. Rep. PSW-GTR-191.2005: 1029-1042.[233]

Evans, P.G.H. (2008, ed.) Proceedings of the ASCOBANS workshop offshore wind farms and marine mammals: impact & methodologies for assessing impacts. – ECS Special Publications Series No. 49[234].

Everaert, J. & Stienen, E.W.M. (2007) Impact of wind turbines on birds in Zeebrugge (Belgium). – Biodiversity and Conservation 16: 3345-3359.

Fagúndez, J. (2008) Effects of wind farm construction and operation on mire and wet heath vegetation in the Monte Maior SCI, north-west Spain. – Mire and Peat 4 (2008/9), Article 02[235].

Falkdalen, U. (2009) Örndöden på Smöla. – Vår Fågelvärld 2009(3): 28.

Fiskeriverket (2007) Revidering av kunskapsläget för vindkraftens effekter på fisket och fiskbestånden. – Fiskeriverket (The Swedish Board of Fisheries), Göteborg.

Follestad, A., Flagstad, Ø., Nygård, T., Reitan, O. & Schulze, J. (2007) Wind power and birds at Smøla 2003-2006. – NINA Rapport 248, 78 pages (In Norwegian, summary in English).

Fox, A.D., Desholm, M., Kahlert, J., Christensen, T.K. & Petersen, I.K. (2006) Information needs to support environmental impact assessment of the effects of European marine offshore wind farms on birds. - Ibis 148 (supplement): 129-144.

Fraga, M.I., Romero-Pedreira, D., Souto, M., Castro, D. & Sahuquillo, E. (2008) Assessing the impact of wind farms on the plant diversity of blanket bogs in the Xistral Mountains (NW Spain). - Mire and Peat 4 (2008/9), Article 06[236].

Garthe, S. & Hüppop, O. (2004) Scaling possible adverse effects of marine wind farms on seabird: developing a vilnerability index. – Journal of Applied Ecology 41: 724-734.

Grieve, I. & Gilvear, D. (2008) Effects of wind farm construction on concentrations and fluxes of dissolved organic carbon and suspended sediment from peat catchments at Braes of Doune, central Scotland. – Mires and Peat 4 (2008/9), Article 03[237].

[232] http://www.eea.europa.eu/publications/europes-onshore-andoffshore-wind-energy-potential.pdf.
[233] http://www.fs.fed.us/psw/publications/documents/psw_gtr191/Asilomar/pdfs/1029-1042.pdf
[234] http://www.service-board.de/ascobans_neu/files/Wind%20Farm_Workshop2007_final.pdf
[235] Available via http://www.mires-and-peat.net/mpj3.html.
[236] Available via http://www.mires-and-peat.net/mpj3.html.
[237] Available via http://www.mires-and-peat.net/mpj3.html.

Hammar, L., Andersson, S. & Rosenberg, R. (2008) Miljömässig optimering av fundament för havsbaserad vindkraft. – Naturvårdsverket (The Swedish Environmental Protection Agency), Stockholm; in Swedish, summary in English[238].

Heath, M.F. & Evans, M.I. (2000, eds.) Important Bird Areas in Europe: Priority sites for conservation. 2 vols. – BirdLife International (BirdLife Conservation Series No. 8), Cambridge.

Hötker, H. (2006) The impact of repowering if wind farms on birds and bats. – Michael-Otto-Institut im NABU, Bergenhausen (Research commissioned by Landesamt für Natur und Umwelt des Landes Schleswig-Holstein.

Hötker H., Thomsen K.-M. & Köster H. (2005) Auswirkungen regenerativer Energiegewinnung auf die biologische Vielfalt am Beispiel der Vögel und der Fledermäuse – Fakten, Wissenslücken, Anforderungen an die Forschung, ornithologische Kriterien zum Ausbau von regenerativen Energiegewinnungsformen. - BfN-Schriften 142, Bonn and Michael Otto-Institut im NABU, Bergenhausen.

Hötker H., Thomsen K.-M. & Jeromin, H. (2006) Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats – facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation. - Michael Otto-Institut im NABU, Bergenhausen.

Hunt, G. & Hunt, T. (2006) The trend of Golden Eagle territory occupancy in the vicinity of the Altamont Pass Wind Resource Area: 2005 survey. – California Energy Commission Public Interest Energy Research Final Project Report CEC-500-2006-056.

Huntley, B., Collingham, Y.C., Green, R.E., Hilton, G.M., Rahbek, C. & Willis, S.G. (2006) Potential impacts of climatic change upon geographical distribution of birds. - Ibis 148 (supplement): 8-28.

Huntley, B., Green, R.E., Collingham, Y.C., & Willis, S.G. (2007) A climatic atlas of European breeding birds. – Durham University, the RSPB and Lynx Editions, Barcelona.

Hüppop, O., Dierschke, J., Exo, K-M., Fredrich, E. & Hill, R. (2006) Bird migration studies and potential risk with offshore wind turbines. – Ibis 148 (supplement): 90-109.

Johnson, G.D., Strickland, M.D., Erickson, W.P. & Young, D.P.Jr (2007) Use of data to develop mitigation measures for wind power development impact to birds. – Chapter 14 (pages 241-257) in de Lucas et al. (2007a).

Keeley, B., Uogretz, S. & Strickland, D. (2001) Bat ecology and wind turbine considerations. – Pages 135-141 in Schwartz (2001).

Keller, O., Lüdemann, K. & Kafemann, R. (2006) Literature review of offshore wind farms with regard to fish fauna. – Pages 47-130 in Zucco et al. (2006).

Kettunen, M., Terry, A., Tucker, G. & Jones, A. (2007) Guidance on the maintenance of landscape features of major importance for wild flora and fauna – guidance on the implementation of Article 3 of the Birds Directive (79/43/EEC) and Article 10 of the Habitats Directive (92/43/EEC). – Institute for European Environmental Policy (IEEP), Brussels.[239]

Kikuchi, R. (2008) Adverse impacts of wind power generation on collision behaviour of birds and anti-predator behavious of squirrels. – Journal for Nature Conservation 16: 44-55 (doi 10.1016/j.jnc.2007.11.001).

[238] Available via http://www.naturvardsverket.se/bokhandeln.
[239] Available via http://ec.europa.eu/environment/nature/ecosystems/docs/adaptation_fragmentation_guidelines.pdf.

Köller, J., Köppel, J. & Peters, E. (2006, eds.) Offshore wind energy Research on environmental impacts. – Springer, Berlin.

Kruckenberg, H. & Jaene, J. (1999) Zum Einfluss eines Windparks auf die Verteilung weidender Blässgänse im Rheiderland (Landkreis Leer, Niedersachsen). – Natur und Landschaft 74: 420-427.

Kunz, T.K., Arnett, E.B., Erickson, W.P., Alexander, A.R.H., Johnson, G.D., Larkin, R.P., Strickland, M.D., Thresher, R.W. & Tuttle, M.D. (2007a) Ecological impacts of wind energy development on bats: questions, research, needs and hypotheses. – Front. Ecol. Environ. 5: 315-324.

Kunz, T.K., Arnett, E.B., Cooper, B.M., Erickson, W.P., Larkin, R.P., Mabee, T., Morrison, M.L., Strickland, M.D. & Szewczak, J.M. (2007b) Assessing impacts of wind-energy developments on nocturnally active birds and bats: a guidance document. – Journal of Wildlife Management 71: 2449-2486.

LAG-VSW (Länder-Arbeitsgemainschaft der Vogelschutzwarten, 2007) Abstandsregelungen für Windenergieanlagen zu bedeutsamen Vogellebensräumen sowie Brutplätzen ausgewählter Vogelarten. – Berichte Zum Vogelschutz 44: 151-153 (in German, Engish summary).

Langston, R.H.W., Fox, A.D. & Drewitt, A.L. (2006) Conference plenary discussion, conclusions and recommendations. - - Ibis 148 (supplement): 210-216.

Langston, R.H.W. & Pullan, J.D. (2003) Windfarms and birds: an analysis of the effect of windfarms on birds, and guidance on environmental assessment criteria and site selection issues. – Council of Europe T-PVS/Inf (2003) 12, 58 pages.[240]

Larsen, J.K. & Madsen, J. (2000) Effects of wind turbines and other physical elements on field utilisation by pink-footed geese (*Anser brachyrhynchos*): A landscape perspective. – Landscape Ecology 15: 755-764.

Lawrence, E.S., Painter, S. & Little, B. (2007) responses of birds to the wind farm at Blyth Harbour, Northumberland, UK. – Chapter 2 (pages 47-69) in de Lucas et al. (2007a).

Lekuona, J.M. (2001) Uso del espacio por la avifauna y control del la mortlidad de aves y murciélagos en los parques éolicos de Navarra. – Departementado de Medio Ambiente, Ordenación del Territorio y Vivienda del Gobierno de Navarra, Pamplona.

Lekuona, J.M. & Ursúa, C. (2007) Avian mortality in wind power plants of Navarra (Northern Spain) – Chapter 9 (pages 177-192) in de Lucas et al. (2007a).

Leonhard, S.B. & Pedersen, J. (2006) Benthic communities at Horns Rev before, during and after construction of Horns Rev Offshore Wind Farm. Final Report and Annual Report 2005. – Vattenfall A/S, D0c. No. 2572-03-005 rev[241].

Lindsay, R. (2007) Windfarms and peat: conflicts from a confluence of conditions. – International Mire Conservation Group (IMCG) Newsletter Issue 2007/4: 17-22.[242]

Lindsay, R. and Bragg, O. (2004). Wind farms and blanket mires: The bog slide of 16th October 2003 at Derrybrien, Co. Galway, Ireland. School of Health and Biosciences, University of East London.

Lucke, K., Storch, S., Cooke, J. & Siebert, U. (2006) Literature review of offshore wind farms with regard to marine mammals. – Pages 199-284 in Zucco et al. (2006).

---

240 http://www.coe.int/t/e/Cultural_Cooperation/Environment/Nature_and_Biological_Deiversity/Nature_Protection/sc23_inf12e.pdf?L=E.

241 Available via http://www.ens.dk/sw42556.aps.

242 http://www.imcg.net/imcgnl/pdf/nl0704.pdf.

Madders, M. & Whitfield, D.P. (2006) Upland raptors and the assessments of wind farm impacts. – Ibis 148 (Supplement): 43-56.

Madsen, P. T., Wahlberg, M., Tougaard, J., Lucke, K. and Tyack P. (2006). Wind turbine underwater noise and marine mammals: implications of current knowledge and data needs. - Marine Ecology Progress Series, 309: 279–295.

Madsen, J. & Boertmann, D. (2008) Animal behavioral adaptation to changing landscapes: spring-staging geese habituate to wind farms. – Landscape Ecology 23: 1007-1011 (doi 10.1007/s10980-008-9269-9).

McLean, I.M.D., Skov, H., Rehfisch, M.M. & Piper, W. (2006) Use of aerial surveys to detect bird displacement by offshore windfarms. – BTO Report No. 446 to COWRIE. BTO, Thetford.

McLean, I.M.D., Skov, H. & Rehfisch, M.M. & Piper, W. (2007) Further use of aerial surveys to detect bird displacement by offshore windfarms. – BTO Report No. 482 to COWRIE. BTO, Thetford.

Meissner, K. & Sordyl, H. (2006) Literature review of offshore wind farms with regard to benthic communities and habitats. – Pages 1-46 in Zucco et al. (2006).

Mellor, M. & Maher, M. (2008) Full scale trial of High Definition Video survey for offshore windfarm sites. – Commissioned by COWRIE Ltd (COWRIE HIDEF.03-08).

Michel, J., Dunagan, H., Boring, C., Healy, E., Evans, W., Dean, J.M., McGillis, A. & Hain, J. (2007) Worldwide synthesis and analysis of existing information regarding environmental effects of alternative energy uses on the Outer Continental Shelf. – U.S. Department of the Interior, Mineral Management Service, Herndon, VA, MMS OCS Report 2007-038. 254 pp.

Morrison, M.L., Sinclair, K.C. & Thelander, C.G. (2007) A sampling framework for conducting studies of the influence of wind energy developments on birds and other animals. – Chapter 5 (pages 101-115) in de Lucas et al. (2007a).

Nayak, D.R., Miller, D., Nolan, A., Smith, P. & Smith, J. (2008) Calculating carbon savings from wind farms on Scottish peat lands – a new approach. Final Report. – Project funded by Rural and Environment Research and Analysis Directorate of the Scottish Government, Science Policy and Co-ordination Division.

Nedwall, J.R., Parvin, S.J., Edwards, B., Workman, R., Brooker, A.G. & Kynoch, J.E. (2007) Measurement and interpretation of underwater noise during construction and operation of offshore windfarms in UK waters. – Subacoustic Report No. 544R0738 to COWRIE Ltd[243].

NRC. 2007 (US National Research Council) Environmental Impacts of Wind-Energy Projects. - National Academies Press, Washington, DC.[244]

OSPAR (2006a) Review of the current state of knowledge on the environmental impacts of the location, operation and removal/disposal of offshore wind-farms. – OSPAR Convention BDC 06/4/5-E.

OSPAR (2006b) Review of the current gaps in knowledge on the environmental impacts of offshore wind-farms. – OSPAR Convention BDC 06/4/7-E.

OSPAR (2008) Draft assessment of the environmental impact of offshore wind farms. – OSPAR Convention BDC 08/5/9-E.

Pearce-Higgins, J.W., Stephen, L., Langston, R.H.W. & Bright, J.A. (2008) Assessing the cumulative impacts of wind farms on peatland birds: a case study of golden plover *Pluvialis apricaria* in Scotland. – Mires and Peat 4: 1-13[245].

[243] http://www.offshorewindfarm.co.uk/Assets/Final20%noise20report%2022.02.08.pdf.
[244] http://books.nap.edu/catalog.php?record_id=11935

Pearce.Higgins, J.W., Stpehen, L., Langson, R.H.W, Baibridge, I.P. & Bullman, R. (2009) The distribution of breeding birds around upland wind farms. – Journal of Applied Ecology, in press; doi: 10.1111/j.1365-2664,2009,01715.x.

Petersen, I.K., Christensen, T.K., Kahlert, J., Desholm, M. & Fox A.D. (2006) Final results of bird studies at the offshore wind farms at Nysted and Horns rev, Denmark. – National Environmental Research Institute (NERI), Copenhagen (report request commissioned by DONG energy and Vattenfall A/S).

Petersen, I.K. & Fox, A.D. (2007) Changes in bird habitat utilization around Horns rev 1 offshore wind farm, with particular emphasis on Common Scoter. – National Environmental Research Institute (NERI), Aarhus (report request commissioned by Vattenfall A/S).

Petersen, J.K. & Malm, T. (2006) Offshore windmill farms: threats to or possiblities for the marine environment. – Ambio 35: 75-80.

Pettersson, J. (2005) Havsbaserade vindkraftsverks inverkan på fågellivet i södra Kalmarsund. En slutrapport baserad på studier 1999-2003. University of Lund and Swedish Energy Agency (In Swedish).

Rodrigues, L., Bach, L., Duborg-Savage, M-J., Goodwin, J. & Harbusch, C. (2008) Guidelines for consideration of bats in wind farm projects. – EUROBATS Conservation Series No. 3 (English version), UNEP/EUROBATS Secretariat, Bonn[246].

Rosenzweig, C., Karoly, D., Vicarelli, M., Neofotis, P., Qigang, W., Casassa, G., Menzel, A., Root, T.L., Estrella, N., Seguin, B., Tryjanowski, P., Liu, C., Rawlins, S. & Imeson, A. (2008) Attributing physical and biological impacts to anthropogenic climate change. – *Nature* 453: 353-358.

Schwartz, S.S. (2001, ed) Proceeding of the National Avian-Wind Power Planning Meeting IV, Carmel, CA, May 16-17, 2000. 179 pp.

Smallwood, K. S. & Karas, B. (2009) Avian and bat fatality rates at old-generation and repowred wind turbines in California. – Journal of Wildlife Management 73: 1062-1071.

SNH (2005a) Strategic locational guidance for onshore wind farms in respect to the natural heritage. – Policy Statement No. 02/02, Scottish Natural Heritage[247].

SNH (2005b) Survey methods for use in assessing the impacts of onshore windfarms on bird communities – Scottish Natural Heritage[248].

Sovacool (2009) Contextualizing avian mortality: A preliminary appraisal of bird and bat fatalities fromwind, fossil-fuel, and nuclear electricitym. - Energy Policy 37: 2241–2248.

Sterner, D., Orloff, S. & Spiegel, L. (2007) Wind turbine collision research in the United States. – Chapter 4 (pages 81-100) in de Lucas et al. (2007a).

Stewart, G.B., Pullin, A.S. & Coles, C.F. (2004) Effects of wind turbines in bird abundance. Summary Report. – Systematic Review No. 4, Centre for Evidence-based Conservation, Birmingham.

Stewart, G.B., Pullin, A.S. & Coles, C.F. (2007) Poor evidence-base for assessment of windfarm impacts on birds. – Environmental Conservation 34 (1): 1-11 (doi: 10.1017/S037682907003554).

[245] Available via http://www.mires-and-peat.net/mpj3.html.
[246] Available via http://www.eurobats.org/publications/publication_series.htm.
[247] http://www.snh.org.uk/strategy/pd02b.asp.
[248] http://www.snh.org.uk/pdfs/strategy/renewable/bird_survey.pdf.

Teilmann, J., Tougaard, J., Carstensen, J., Dietz, R. & Tougaard, S. (2006) Summary on seal monitoring 1999-2005 around Nysted and Horns Rev Offshore Wind Farms. – Technical Report to Energi E2 A/S and Vattenfall A/S. Ministry of Environment, Denmark.

Teilmann, J., Tougaard, J. & Carstensen, J. (2008) Effects from offshore wind farms on Harbour Porpoises in Denmark. – Pages 50-59 in Evans (2008).

Thelander, K. & Smallwood, K.S. (2007) The Altamont Pass Wind resource Area's effects on birds: a case study. – Chapter 1 (pages 25-46) in de Lucas et al. (2007a).

Thelander, K., Smallwood, K.S. & Rugge, L. (2003) Bird risk behaviors and fatalities at The Altamont Pass Wind Resource Area. – Report to National Renewable Energy Laboratory, Colorado.

Thomsen, F., Lüdemann, K., Kafemann, R. & Piper, W. (2006) Effects of offshore wind farm noise on marine mammals and fish. – biola, Hamburg on behalf of COWRIE, Ltd[249].

Tucker, V.A. (1996a) A mathematical model of bird collisions with wind turbine rotors. - Journal of Solar Energy Engineering 118:253-262.

Tucker, V.A. (1996b) Using a collision model to design safer wind turbine rotors for birds. - Journal of Solar Energy Engineering 118: 263–269.

Wilhelmsson, D., Malm, T. & Öhman, M. (2006) The influence of windpower on demersal fish. – ICES Journal of Marine Science 63: 775-784 (doi 10.1016/j.icesjms.2006.02.001).

Zervos, A. & Kjaer, C. (2008) Pure power – wind energy scenarios up to 2030. – European Wind Energy Association.[250]

Zucco. C., Wende, W., Merck, T., Köchling, I. & Köppel, J. (2006, eds.) Ecological research on offshore wind farms: international exchange and experience. – BfN-Skripten 186, Bundesamt für Naturschütz, Bonn[251].

[249] Available from www.offshorewind.co.uk.
[250] http://www.ewea.org/fileadmin/ewea_documents/documents/publications/reports/purepower.pdf.
[251] Available via www.dnl-online.de.