

Guidelines for assessment of wind farms' impact on birds

Szczecin, March 2008



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- Polish Wind Energy Association (PWEA)
- Polish Bird Protection Society (OTOP)
- West Pomeranian Society of Practical Ecology (ZTEP)

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Finally consulted and edited on 9 March 2008.

Quotation:

PWEA (2008). Guidelines for assessment of wind farms' impact on birds. Szczecin.

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Glossary

Auxiliary Infrastructure	Additional technical facilities – underground power cables necessary to connect the Wind Farm to the grid, MSP Transformer Station and access roads connecting the Wind Turbine sites with public roads, necessary to ensure proper operation of the Wind Turbines
Birds Directive	Directive 79/409/EEC (the Birds Directive)
EIA Report	Project's EIA Report under Article 52 of the EPL
Environmental Decision	The decision on environmental determinants of permission for project realization under Article 56 of the EPL
Environment Protection Authorities	The authorities under Article 91 of the NCA
EPL	Environment Protection Law of 27 April 2001, as amended
FCS	Favourable population/species Conservation Status defined as the situation, whereby the following 3 conditions are jointly met: (i) the population does not continuously decrease, (ii) there exist sufficient area of habitats necessary to maintain stable population, (iii) the range (breeding and non – breeding) does not decrease continuously. The term is used in the Birds Directive and the Liability Directive and is implemented in the NCA.
Habitats Directive	Directive 92/43/EEC (the Habitats Directive)
Liability Directive	Directive 2004/35/CE (the Liability Directive)
NCA	Nature Conservation Act of 16 April 2004, as amended
Regulation on projects likely to significantly affect the environment	The Council of Ministers Regulation of 9 November 2004 determining the types of projects likely to significantly affect the environment and the detailed criteria for qualifying projects for making environmental impact assessments, as amended.
SAC	Special Area of Habitat Conservation, established under the Birds Directive; one of two (next to SPAs) types of areas conserved within the Natura 2000 network.
SPA	Special Birds Protection Area, established under the Birds Directive; one of two (next to SACs) types of areas conserved within the Natura 2000 network
Wind Farm	Wind park – a group of wind turbines together with Auxiliary Infrastructure
Wind Project	Wind turbine or wind farm construction project
Wind Turbine	Wind generator – a device used to produce electricity from wind

I. Introduction

The practice of creating guidelines for environmental monitoring, but also for other aspects of investment development, is well – founded in a number of countries. Usually, the guidelines are considered to be some kind of good practice, application whereof is recommended either by some professional groups or industry or ecological organizations. Acting in accordance with such guidelines gives participants of certain procedures more certainty that their acts comply with the principles deemed by a wider group of experts as legitimate and allowing for achieving the best effects of the planned investment with simultaneous care for its environment.

Polish Wind Energy Association, meeting the expectations of its Members and demands of ecological organizations and ornithologists, initiated a discussion on the need to create the *Guidelines* for environmental impact of wind turbines in March 2007, after the 2nd “Wind Energy Market in Poland” Conference. The – then low number of completed wind projects, earlier changes in the law (establishment of NATURA 2000 areas, introduction of the need to acquire environmental decisions, etc.) and relatively low number of experts dealing with wind farms’ impact on birds led to a significant distrust of wind projects among the ornithologists. The ornithological associations managed internal discussions concerning the monitoring methodology, however without participation of representatives of investors.

PWEA recognized the necessity to develop and publish a material document accepted by both Parties. The Association invited the Polish Bird Protection Society (PBPS) to cooperate in development of the draft *Guidelines*. The initial draft was presented during the 9th Wind Energy Forum in November 2007 and sparked a wide discussion concerning the legitimacy of the proposed *Guidelines* and the proposed methodology for carrying out assessments of wind farms’ impact on birds. The final version of the *Guidelines* was developed in cooperation with a group of experts, who together with representatives of PWEA and PBPS decided to simplify the initial text.

The consulted text of the *Guidelines* will be dispatched for further consultation to ecological organizations and provided to environmental protection authorities empowered to issue environmental decisions. Moreover, the *Guidelines*, in accordance with findings of the experts developing its contents, will be verified after 2 years from the date of announcement. The time shall be dedicated to on – site testing of the proposed methodology and registration of data from investment monitoring, what will allow for assessing the legitimacy of particular study modules in the extent proposed by the *Guidelines*. If the period does not allow for gathering sufficient amount of monitoring data, the Parties will continue development of the document later.

The *Guidelines* in the verified form will be presented on the PWEA „Wind Energy Market in Poland” Conference and published on the following website: <http://www.psew.pl/>, as well as on websites of other organizations that decide to recommend the document.

II. Preamble

Whereas:

Recognizing the increase in use of renewable energy a necessity caused by limited fossil fuel resources and the need to countermeasure climate change;

Acknowledging that wind turbines constitute an environmentally – friendly electricity generation technology, allowing for reducing atmospheric carbon dioxide, sulphur dioxide, nitrogen oxides and dust emissions, avoiding production of solid and gaseous waste, odours and sewage as well as contamination of soil and degradation of the land accompanying production of energy in conventional sources;

Bearing in mind that development of wind projects is likely to adversely affect the environment, particularly in case of poorly located projects;

Having regard to the fact that conservation of biodiversity is a priority as important as development of renewable energy sources, meaning that wind investments cannot be realized without due regard to bird protection priorities;

The representatives of wind project investors and developers, as well as ornithologists and non – governmental ecological organizations, recommend applying these Guidelines to selection of wind farm project locations and assessment of wind projects' impact on birds in the case of new and existing investments.

Moreover, the representatives of wind project investors and developers, as well as ornithologists and non – governmental ecological organizations request administration authorities to take into account in the environmental decision consultation and issuance process the results of assessment of wind farms' impact on birds carried out in accordance with these Guidelines.

Representatives of the Parties commit to publish and promote the Guidelines within their circles as a kind of good practice, exceeding the requirements for EIA established by the law.

They also declare the will to continue development of the Guidelines after recording representative amount of data concerning the actual effects of wind farm projects completed in Poland on birds, as well as to verify the usefulness of the methodology for on – site works proposed in the Guidelines. The Parties agree March 2010 as the time for first verification of the document.

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III. Purpose and scope of application

1. The purpose of the *Guidelines* is to:
 - a. Provide methodological guidelines to individuals planning to carry out and carrying out on – site studies aimed at selecting locations for wind projects and assessment of wind farms' impact on birds, in particular to:
 - i. Indicate the scope of information necessary to reliably assess the planned wind farms' impact on birds,
 - ii. Present the study methodology allowing for acquiring necessary information required to carry out such assessment;
 - b. Increase investors' certainty concerning the validity of environmental impact assessment of their projects;
 - c. Increase transparency of the decision – making process related to issuance of environmental decisions for wind projects by competent administration authorities;
 - d. Standardize and uniform the methodology approach applied by different subjects during verification of potential wind farm sites in terms of their impact on birds;
 - e. Increase comparability of data from bird observations acquired during on – site studies in different locations.
 2. The *Guidelines* constitute a code of good practices for assessment of wind farms' impact on birds, going beyond legislative requirements for EIA. Adoption of such stems from the will to develop wind projects with regard to the role and importance of bird protection.
 3. The *Guidelines* shall apply to onshore projects. Offshore projects often require specific approach, which, although not being contrary to the recommendations proposed in this document, goes beyond the framework thereof.
 4. The document shall not apply to wind projects, whereby the environmental decisions (under Article 56 of the EPL) have already been issued, and/or projects, where pre – investment monitoring, based on at least one – year observation cycle designed and carried out by ornithology experts, is in progress.
 5. The *Guidelines* do not provide tools for assessing the wind turbines' impact on other elements of the environment, such as landscape, bats, flora, or noise or electromagnetic field emission studies. These issues, although cannot be omitted in the EIA process, must be studied using a different methodology. Therefore the *Guidelines* shall not apply to the entire EIA procedure, but only to the element thereof, that is to assessment of wind turbines' impact on birds. This means that application of the *Guidelines* does not substitute the necessity to carry out the EIA procedure for wind projects as required by the law.
 6. The *Guidelines* are addressed primarily to:
 - a. Developers and investors designing and realizing wind farm projects;
 - b. Contractors for environmental expert's opinions and on – site studies concerning the wind farms' impact on birds;
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- c. Environmental protection authorities responsible for consulting investments in environmental terms and issuing environmental decisions.

IV. Potential wind farms' impact on birds

1. Wind turbines are among the so – called clean (zero – emission) electricity sources. Therefore, their use decreases adverse environmental effects of the energy sector. Hence, realization of wind projects is an action insofar as climate protection, air protection and soil protection, which directly affect the population of flora and fauna.
 2. Use of wind turbines to produce energy affects the environment to a definitely lesser extent than use of other energy sources (conventional, nuclear, or even some renewable technologies). However, this does not mean that wind power development – similarly to any other form of human activity – does not leave any fingerprint in the environment.
 3. Scientific research conducted in different parts of the world proves that properly sited and located wind turbines do not significantly adversely affect the environment, including avifauna. However, one shall remember that improper wind turbine siting may deteriorate condition of the environment, including bird populations.
 4. Development of wind projects is likely to cause:
 - a. Bird mortality caused by collisions with operating turbines and/or elements of auxiliary infrastructure, in particular overhead power lines;
 - b. Decrease in population due to loss and fragmentation of habitats caused by deterring effect of the wind turbines and/or development of communication and energy infrastructure related to operations of the wind turbines,
 - c. Disturbance to populations, in particular to short- and long - range bird migrations (the barrier effect).
 5. Mortality caused by collisions and loss of habitats are key in terms of likely adverse effects on birds populations.
 6. The extent of effects on bird population is diversified, depending mainly upon the location of the wind turbines – from almost no or negligible effects on life expectancy of bird population, to significant effects with significant loss of habitats and high mortality caused by collisions.
 7. The type of wind turbines used in a project (tower height, rotor diameter, lighting, linear speed of rotor blade tips), number of turbines within the farm, layout of the farm (relative to each other and elements of the environment) or presence of other wind farms in the vicinity (cumulated effects) also affects the type and magnitude of the effects. The last element will grow more important as the density of wind farm location increases.
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8. In general, the risk of adverse effects on birds is higher if a wind farm is located on an area extensively used by birds. Investments located in such areas, in particular areas with high intensity of bird migrations in the airspace, have greater potential for adverse effects than projects developed in locations of low intensity of birds' use of the airspace. Conversely, the areas with low migration intensity are characterized by lower risk of adverse effects.
9. However, the way birds use the airspace (migration altitude, time and way of land use – is it a sleeping, feeding or breeding ground) and species composition observed in the particular site (studies prove that the risk of collisions with wind turbines is different for different species) also matter.
10. Nonetheless, appropriate site selection is of primary importance for minimizing possible adverse effects on birds, especially avoiding locating wind turbines:
 - a. in areas extensively used by birds,
 - b. in areas of concentration of collision-sensitive species, such as for instance: raptors (*Falconiformes*), gulls and terns, night migrants, owls and certain air – mating species;
 - c. in areas of concentration of *Anseriformes* and *Charadriiformes*, known to have the most intense wind farm avoidance reactions, leading to loss of habitats;
 - d. in areas particularly valuable to breeding avifauna.

V. Legislative environment

1. The requirements applicable to carrying out EIAs are stipulated by the EPL, imposing on the investors the obligation to:
 - a. Acquire the environmental decision;
 - b. Make the EIA report (if required).
 2. In accordance with the Regulation on projects likely to significantly affect the environment wind farms are considered projects likely to significantly affect the environment if the project's capacity exceeds 100 MW, or in the case of all offshore projects. Therefore, all such wind projects always require making EIA report and carrying out full EIA procedure (including acquisition of the environmental decision).
 3. Wind projects may require making EIA report if the total height of the wind turbines exceeds 30 m. Whether it is necessary to make the EIA report and what scope it shall cover is decided by a competent environment protection authority, empowered to issue the environmental decision, which the investor may address with an appropriate inquiry.
 4. Therefore, the national law vests the decision concerning the need to make the EIA report for the planned project in the empowered administration authority, what means that only the projects, whereupon the authority did not impose the
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obligation to carry out the full EIA procedure, including making of the EIA report, may be approved for realization. However, it is a recommended good practice to each time perform assessment of the wind project's impact on birds, the scope whereof shall be adapted to the specificity of the project and its location.

5. The regulations also provide for special EIA procedure for projects likely to significantly affect NATURA 2000 areas:
 - a. Projects likely to significantly affect Natura 2000 areas, including the species, for the protection whereof the particular SPAs and SACs have been established, are mandatorily subject to a special EIA procedure under Article 6 of the Habitats Directive (the so-called habitats assessment), implemented in Articles 33 and 34 of the EPL.
 - b. Location of investments relative to the boundaries of a Natura 2000 area (whether within the boundaries, on the boundaries, or in the vicinity thereof) is of no decisive importance for the imperative to make the assessment under Article 6 of the Habitats Directive or does not determine the scope or intensity of likely adverse effects of the investment on the subject of area conservation within the boundaries of the SPA. Such assessment must be made for each project likely to significantly adversely affect the avifauna of the SPA, including projects located outside the boundaries of the protected area. Likelihood of adverse effects on SPAs caused by projects located outside the boundaries of Natura 2000 areas is determined by a competent State administration authority on the basis of the EIA report.
 - c. Projects located within the boundaries of SPAs are usually likely to have much higher potential for adverse effects on avifauna of the protected area than projects located far from boundaries thereof. Nonetheless, it must be emphasized that wind farm projects located outside SPAs, but relatively close thereto (up to a couple of km) may affect the subject of area conservation within the boundaries of a SPA. Determination of likelihood of project's impact on a nearby Natura 2000 area must be subject to individual assessment, adapted to the specificity of location and project characteristics. In particular, it is imperative what protected species are to be found on the nearby Natura 2000 area and what patterns of use of areas adjacent thereof do they exhibit. It shall be taken into account that specimens of some species, for the protection whereof the particular area has been established (indicated in the standard data form of the particular SPA), may for instance feed on areas not subjected to formal protection. If the areas used by such species are designed to be used for a planned project, the effects of such project on the protected species shall be subject to assessment under Article 6 of the Habitats Directive.
 - d. Investments, whereby significant adverse effects on NATURA 2000 areas, that is on the species, for the protection whereof the particular NATURA 2000 area has been established, may not be excluded shall not be realized, unless the 3 conditions are jointly met:
 - i. There are no alternative ways to achieve the project's goals;
 - ii. There is imperative, permanent public interest related to completion of the project;
 - iii. Appropriate compensating measures are applied.
 - e. In case of wind farms the likelihood of meeting the first of the above conditions is very low. Therefore, in practice, wind farm projects where the

likelihood of significant adverse effects on conservation purposes of the Natura 2000 area may not be excluded shall not be realized.

6. The provisions of the Liability Directive introduce the obligation to maintain FCS in relation to protected species indicated in Article 4(1) of the Birds Directive (and listed in Annex I thereto), or in Annexes II and IV to the Habitats Directive, as well as outside Natura 2000 areas (that is outside SPAs and SACs).
7. The responsibility for damages caused to protected species and in natural habitats shall not include previously identified adverse effects related to realization of the investment, if such were allowed in the final environmental decision.
8. Issuance of environmental decision by the competent authority without full recognition of ornithological values renders precise determination of environmental protection requirements impossible, hence exposes the investor to liability under the provisions of the Liability Directive.

VI. Purpose and structure of assessment of wind projects' impact on birds

1. The procedure for assessment of wind turbines' effects on avifauna shall be conducted as a sequence of 3 stages:
 - a. Screening;
 - b. Pre – investment monitoring;
 - c. Monitoring (after-construction monitoring).
2. The risk is initially estimated on the basis of environmental information (screening and pre - investment monitoring. Assessment of this risk forms the basis for an expert's opinion concerning the admissibility of a particular investment in the analyzed location. The after-construction monitoring is to confirm the legitimacy of the assessment or verify it.
3. The fundamental purpose of assessment of the farms' impact on avifauna is to estimate the risk of significant adverse effects of the completed investment on bird population; primarily on key bird species (a list of key species is included in Annex no. 1).
4. A significant adverse effect on avifauna is the situation, when the population of key bird species observed within the investment's impact range demonstrates changes leading to loss of favourable conservation status.
5. The conservation status is deemed „favourable”, if:
 - a. The data concerning the dynamics of population of a particular specie indicate that the specie maintains its long – term ability to independently survive as an element of their habitats,
 - b. The natural range of the population does not decrease and is not likely to decrease in the predictable future,

- c. There exists and in the future is likely to exist area of habitats large enough to maintain its population in the long - term.
6. The assessment shall include cumulated effects, in particular effects of other wind farm project (existing or planned, known to the investor) likely to affect key bird species. The spatial scope of sites to be considered in assessment of cumulated effects shall be adapted to ecology of local bird species. In case of large breeding species (raptors, Black Stork) and concentrations of feeding migrants (goose, cranes) the assessment of cumulated effects shall take into account all other farms within the radius of 5 km and 20 km accordingly.
7. In case of an assessment concerning Natura 2000 areas (the procedure under Article 6 of the Habitats Directive) the purpose is to estimate the risk of loss of Favourable Conservation Status (FCS) by local population of any of the species, for the conservation whereof the particular NATURA 2000 area has been established. A list of such species is contained in a Standard Data Form (SDF) – the document constituting the basis for the establishment of a Natura 2000 area.

VII. Screening

1. The general purpose of *screening* is to assess the sensitivity of a site in terms of likelihood of adverse wind farm's impact on avifauna.
 2. *Screening* is a study carried out by an ornithology expert. Its purpose is primarily to identify the sites, where the risk of significant effects on population of key bird species is likely to be deemed high without carrying out pre-investment monitoring (on the basis of available data). Therefore, *screening* allows for excluding the sites, where the likelihood of significant adverse effects on key species is very high.
 3. However, *screening* does not allow for claiming particular site relatively safe for birds (that is whether the risk of significant adverse effects is low). The above asymmetry of logic stems from interpretation of previously existing information (available without additional studies) concerning the presence of certain bird species. Lack of information about findings of key species may be the consequence of both actual non – existence of the species in a particular location as well as of non – performance of appropriate studies aimed at detecting such studies.
 4. *Screening* allows for qualifying the site by ornithology expert to one of 3 paths of pre – investment monitoring, differing in the number of on – site visits (Annex no. 3). Within each of the paths the scope of studies described in Annex no. 4 shall be carried out.
 5. The plan of on – site works carried out during the pre – investment monitoring, indicating the detailed purpose of the works, dates of visits, observation
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methodology, etc. shall be developed by an ornithology expert using the framework schemes provided in Annexes 3 and 4 and having regard to the outcome of the screening (for instance, in locations with high level of risk in migration periods the observations may be more intense during that period; this may apply to both or only one of two migration periods; in locations with high level of risk during breeding period the observations may be more intense in that period). In justified cases new elements may be introduced to the scope of studies presented in the *Guidelines* to clarify additional aspects important in a particular site.

6. *Screening* shall be performed on the basis of available information concerning bird observations, geographic location and physiographic of the site, surface forms of nature conservation existing in the vicinity and a on – site visit.
7. Data sources to be considered during the *screening* include:
 - a. Published data on occurrence of rare and endangered bird species on the area of the study:
 - i. National studies (e.g. Tomiałojć & Stawarczyk 2003, Sikora *et al.* 2007);
 - ii. Regional studies (e.g. Wójciak *et al.* 2005);
 - iii. Studies presenting the data concerning the distribution and population of species in more limited geographic scale (e.g. Pugacewicz 1997);
 - iv. Expert's opinions, assessments, results of natural reviews and other documents;
 - b. Unpublished data on occurrence of key bird species (regional faunistic catalogues, data bases of certain research programmes, consultations with local experts);
 - c. Information on existence of area forms of nature conservation in the vicinity (Natura 2000 areas, national parks, landscape parks, nature reserves, Ramsar areas);
 - d. Information on existence of important bird areas of EU importance (as defined by *BirdLife International*; Sidto *et al.* 2004);
 - e. Data from the on – site visit concerning the preliminary recognition of potential breeding and feeding habitats of key species, occurrence of migration router and ecological corridors;
 - f. Analysis of land physiography – presence of elements of land topography favouring concentration of local and national migration routes (river valleys, maritime shore zone, sandbars and peninsulas, mountain ridges, passes).
8. The ornithology expert, carrying out the *screening* of a particular site shall take into account:
 - a. Population (breeding or non - breeding) of species indicated in Article 4(1) and Annex I to the Birds Directive,
 - b. Concentration of breeding or non - breeding (wintering, migrating) raptors,
 - c. Population of particularly collision – prone species (for instance Red Kite, White – tailed Eagle, Golden Eagle, Corn Bunting),
 - d. Presence of non – breeding concentrations of feeding or sleeping large *Anseriformes*,,
 - e. Breeding colonies of large and – medium sized birds in the vicinity of the site (gulls, terns, cormorants, herons),
 - f. Distance to SPAs or IBAs,

- g. Distance to SACs established to protect bat populations of local importance described in the SDF as A, B or C,
 - h. Distance to national parks, nature reserves, landscape parks or Ramsar areas,
 - i. Distance to the maritime shore zone, sandbars or peninsulas,
 - j. Distance to large river valleys, swamps and water reservoirs,
 - k. Site located on or in the vicinity of passes,
 - l. Distance to conservation zones established to protect the so – called "zone species" (listed in Annex 5 to the Minister for the Environment Regulation of 28.09.2004; Journal of Law 220, Item 2237),
 - m. Distance to migration corridors and local and long –range migration routes,
 - n. Degree of site recognition in terms of avifauna,
 - o. Degree of human land transformation,
 - p. Land use structure (including presence of mid – field trees and bushes),
 - q. Number of turbines in the project,
 - r. Distance to other wind projects.
9. The ornithology expert's classification of key location parameters (defined in Annex no. 2) „low”, „medium”, high” or „very high” category, reflecting the estimated likelihood of adverse effects of a particular element on birds, shall decide on assignment of a wind project to one of the monitoring paths listed in Annex no. 3.
10. Assignment to paths shall be done by the ornithology expert, who is also responsible for drawing up a detailed monitoring plan, according to the selected monitoring path construction, embracing all scopes specified in Appendix no. 4.
11. Reassuming, having performed the *screening* the investor shall make one of two available decisions:
- a. To continue on – site studies, that is pre – investment monitoring, in accordance with the monitoring path laid down by the ornithologist (Annex no. 3) and the framework methodology described in Annex no. 4,
 - b. To abandon wind project in a particular location.

VIII. Pre – investment monitoring

1. The purpose of pre – investment monitoring is to formulate an initial assessment of wind project's impact on bird population.
2. The data collected within the pre – investment monitoring is to provide basic, quantitative information about avifauna of the site and directly adjacent areas. The information includes:
 - a. Species composition and population of avifauna in the yearly cycle;
 - b. Population of key species;
 - c. Density of all bird species in main seasons of the year;
 - d. Intensity and way of airspace use by birds, in particular by:

- i. Raptors and other large – sized species,
 - ii. Long – range migrants,
 - iii. Species forming local feeding and sleeping concentrations.
 - 3. Pre – investment monitoring shall be based on more or less extensive on – site studies (using paths presented in Annex no. 3), managed for at least one year to acquire quantitative characteristics of birds' use of the land during all periods of their yearly life cycle: breeding, post – breeding dispersion, autumn migration, wintering, and spring migration.
 - 4. The framework scheme of pre – investment monitoring includes four categories of study scopes (Annex no. 4), aimed at quick and reproducible acquisition of data listed in Paragraph 2.
 - 5. The pre – investment monitoring and the results thereof shall be carried out and interpreted before acquisition of the environmental decision. Therefore it is not possible to issue the environmental monitoring without completing full pre – investment monitoring. The result of the pre – investment monitoring shall be the assessment of the planned wind turbines' impact on birds.
 - 6. Assessing the predicted project's impact on birds the ornithology expert shall take into account:
 - a. The likelihood of infringing the favourable conservation status of local birds using the Natura 2000 area, being the species, for the conservation whereof the area has been established, and of local species, listed in Article 4(1) of the Birds Directive;
 - b. The likelihood and magnitude of bird collisions with turbines;
 - c. Concentration of key breeding species;
 - d. Concentration of non – breeding large species;
 - e. Concentration of non – breeding raptors;
 - f. Intensity of airspace use by raptors up to the extreme height of the rotor;
 - g. Intensity of daytime airspace use by birds during the migration period;
 - h. Intensity of nighttime airspace use by birds during the migration period;
 - i. Nesting species included in zone protection of habitats;
 - j. Likely (predicted) decrease in concentration of any species stemming from the farm's deterrence effect;
 - k. Species diversity in breeding and non – breeding periods.
 - 7. The forecast of bird mortality caused by collisions with turbines shall be jointly based on:
 - a. Data concerning the observed concentration of birds using the airspace in the location of the planned farm and the way these birds use the airspace;
 - b. Data concerning the risk of collision estimated on the basis of empirical data from other sites or forecasting models.*

* The expert panel will discuss possible to use forecasting models and recommend selected ones in the final version of the *Guidelines*, which will be published on the PWEA's website <http://www.psew.pl/>, as well as on websites of other organizations that decide to recommend the *Guidelines*.
 - 8. Representative empirical data concerning the number of collisions of particular species are published in a number of scientific papers in the form of:
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- a. General annual mortality estimators per turbine or megawatt of installed capacity (fatalities /turbine/year or fatalities /MW/year accordingly) (e.g. Lekuona 2001, NWCC 2004, Smallwood & Thelander 2004, Hotker i in. 2005, Krijgsveld & Dirksen 2006);
 - b. Functional estimators presenting mortality as a function of concentration of birds using the airspace (for instance for raptors: Erickson 2006; European shore locations: Everaert & Strien 2007, Everaert 2003, Winkelman 1992).
9. Because raptors are more collision – prone, mortality forecasts for raptors shall be formulated separately, with regard to published data concerning collision intensity of this group.
 10. Given the wide variability of collision risk parameters, both expected values (average) and values characterizing the entire variability range (including extreme distribution values) shall be used in the forecasts.
 11. Having carried out the pre – investment monitoring, depending upon the initial assessment of impact on avifauna, the investor shall make one of the following steps:
 - a. Apply to competent administration authorities for issuance of the environmental decision;
 - b. Modify the project (in accordance with the recommendations of the ornithology expert) and apply for issuance of the environmental decision for the modified project;
 - c. Abandon wind project in a particular location.
 12. The information acquired during the pre – investment monitoring shall be confirmed and/or verified during the monitoring carried out in accordance with the BA (*before-after*) or BACI (*before-after/control-impact*) principle.

IX. Monitoring (after-construction monitoring)

1. The purpose of monitoring is to verify the initial assessment of farm's effects on bird populations, in particular to:
 - a. Assess the changes in intensity of land use by birds compared to the pre – investment period with regard to baseline;
 - b. Estimate bird mortality caused by collisions.
2. The analysis of the wind farm's impact on land use by birds shall use two study tools:
 - a. BACI (*before – after/control – impact*) (described in Annex no. 5) or, given lack of reliable data from control areas or systems, BA (*before – after*) comparing the data from the same points and transects before and after realization of the investment;
 - b. Impact gradient analysis applied to post – investment data and carried out in gradient of distance to the wind turbines.

3. Monitoring shall include a 1 – year cycle replicating the pre – investment monitoring and shall be repeated three times during the 5 - year period after the wind farm is commissioned in period selected by ornithology expert (for instance, in years 1, 2, 3 or 1, 3, 5) due to time – lag of effects. It is recommended to monitor the effects on space use in parallel with collision mortality studies. This shall allow for better understanding the reasons of time – variability of collision intensity.
4. The results of monitoring shall be used by competent administration authorities to update the decisions concerning further operation of the farm. In case of finding effects exceeding in its magnitude the predictions formulated in the EIA report being the basis for issuance of the environmental decision, the authority shall cause:
 - a. Implementation of measures mitigating the observed effects (species – oriented mitigating measures, for instance: modifications to turbines' night lighting system, change in structure of land use, temporary shutdown of wind turbines);
 - b. Application of compensating measures;
 - c. Permanent decommissioning of selected turbines.
5. The imperative to implement appropriate programme of mitigating and compensating measures shall be conditionally stipulated in the environmental decision acquired by the investor. The conditions for managing such programme shall be clearly established using measurable criteria, having regard to the monitoring data.
6. The monitoring results shall be publicly available (for instance on dedicated websites) both in the form of yearly reports and final reports.

References

- Band W., Madders M. & Whitfield D.P. 2007. Developing field and analytical methods to assess avian collision risk at wind farms. Pp. 259-275 In: De Lucas M., Janss G.F.E. & Ferrer M. (eds). *Birds and Windfarms: Risk Assessment and Mitigation*. Quercus, Madrid.
- Bibby C.J. 2004. Bird diversity survey methods. Pp. 1-15 In: Sutherland W.J., Newton I. & Green R.E. (eds). *Bird Ecology and Conservation: A Handbook of Techniques*. Oxford University Press, Oxford.
- BirdLife International 2004. *Birds in Europe: population estimates, trends and conservation status*. BirdLife International, Cambridge, UK.
- Buckland S.T., Anderson D.R., Burnham K.P., Laake J.L., Borchers D.L. & Thomas L. 2001. *Introduction to Distance Sampling*. Oxford University Press, Oxford.
- Chamberlain D., Freeman S., Rehfisch M., Fox, T. & Desholm M. 2006. *Appraisal of Scottish Natural Heritage's wind farm collision risk model and its application*. BTO research report 401. Thefford, UK.
- Chylarecki P., Jawińska D. & Kuczyński L. 2006. *Monitoring Pospolitych Ptaków Lęgowych – raport z lat 2003-2004*. OTOP, Warszawa.
- Erickson W. 2006. Pre-construction avian studies for wind projects: objectives, methods, metrics. Prezentacja, Audubon California & American Wind Energy Association Conference; Los Angeles, CA; 10-11 January 2006.

- Everaert J. & Stienen E.W.M. 2007. Impact of wind turbines on birds in Zeebrugge (Belgium): Significant effect on breeding tern colony due to collisions. *Biodiversity and Conservation* 16: 3345-3359.
- Everaert J. 2003. Windturbines en vogels in Vlaanderen: voorlopige onderzoeksresultaten en aanbevelingen. *Natuur.oriolus* 69(4): 145-155.
- Głowaciński Z. (red.) 2001. *Polska czerwona księga zwierząt - kręgowce*. PWRiL, Warszawa.
- Hagemeijer W.J.M. & Blair M. (eds) 1997. *The EBCC Atlas of European Breeding Birds: Their Distribution and Abundance*. T. & A.D. Poyser, London.
- Lekuona J., Ursua C. 2007. *Avian mortality in wind power plants of Navarra (Northern Spain)* in: *Birds and wind farms. Risk Assessment and Mitigation*. Quercus, Madrid.
- Pugaczewicz E. 1997. *Ptaki lęgowe Puszczy Białowieskiej*. PTOP, Białowieża.
- Sidło P.O., Błaszowska B. & Chylarecki P. (red.) 2004. *Ostoje ptaków o randze europejskiej w Polsce*. OTOP, Warszawa.
- Sikora A., Rohde Z., Gromadzki M., Neubauer G. & Chylarecki P. (red.) 2007. *Atlas rozmieszczenia ptaków lęgowych Polski 1985-2004*. Bogucki Wydawnictwo Naukowe, Poznań.
- SNH [=Scottish Natural Heritage] 2000. *Guidance: Windfarms and birds – Calculating a theoretical collision risk assuming no avoiding action*. SNH.
- Stewart G.B., Pullin A.S. & Coles C.F. 2007. Poor evidence-base for assessment of windfarm impacts on birds. *Environmental Conservation* 34: 1-11.
- Tomiałojć L. & Stawarczyk T. 2003. *Awifauna Polski: rozmieszczenie, liczebność i zmiany*. PTPP "pro Natura", Wrocław.
- Tucker V.A. 1996. Using a collision model to design safer wind turbine rotors for birds. *Journal of Solar Energy Engineering* 118: 263-269.
- Winkelman J. 1992. *De invloed van de Sep-proefwindcentrale te Oosterbierum (Fr) op vogels, 1: aanvaringslachtoffers, 2: nachtelijke aanvaringskansen, 3: aanvliegedrag overdag, 4: verstoring*. RIN rapport 92/2-5. Instituut voor Bos- en Natuuronderzoek (IBN-DLO), Arnhem.
- Wójciak J., Biaduń W., Buczek T. & Piotrowska M. (red.) 2005. *Atlas ptaków lęgowych Lubelszczyzny*. LTO, Lublin.

Annex no. 1. Key bird species

For the purpose of the *Guidelines* the species shall be deemed key species if meeting one of the following criteria:

- a. Species indicated in Article 4(1) of the Birds Directive and listed in Annex 1 to the Birds Directive;
- b. Species listed in the Polish Red Book of Animals (Głowaciński 2001);
- c. SPEC (*Species of European Conservation Concern*) category 1-3 (BirdLife International 2004);
- d. Species included in zone protection of habitats;
- e. Species with breeding density <10% (estimated in a 10x10 km grid; Sikora *et al.* 2007);
- f. Species with national population of <1000 breeding pairs.

Annex no. 2. List of parameters to be considered in screening – location card

Site parameter/likelihood of adverse effects	Low	Medium	High	Very high
Breeding raptors (forecasted or published concentration) ¹				
Wintering raptors (forecasted or published concentration) ²				
Other large breeding species (cranes, storks) (forecasted or published concentration) ¹				
Presence of species with unfavourable conservation status ²				
Species nesting in colonies (forecasted or published data about colony size) ³				
Population of migrants (forecasted intensity of airspace use)				
Likelihood of migration route bottlenecks ⁴				
Likelihood of large non – breeding concentrations and/or regular local migrations				
Effects on Natura 2000 SPAs (stemming from the distance to boundaries of an area and species composition)				
Effects on other surface forms of nature conservation (stemming from the distance to boundaries of an area and species composition)				
Number of turbines in the project ⁵				

1. The

ornithology-expert evaluates the key location parameters and classifies them into categories - „low”, „medium”, „high”, „very high” – which reflect the estimated likelihood of adverse effect of this parameter on birds. The classification is made by putting a “x” in the right column.

2. Based on collected results and their evaluation, the ornithology-expert qualifies the project to one of the monitoring paths.
3. The location's card presenting the results of screening should be included in the EIA documentation.

¹ Estimated in relation to distribution (or average) of parameter values for a particular species, defined in the national scale.

² Species listed in Annex I to the Birds Directive, SPEC Category 1 – 3 species (BirdLife International 2004), species listed in the Polish Red Book of Animals (Głowaciński 2001).

³ Gull, Tern, Cormorant, Grey Heron, Black – crowned Night Heron, Rook, Sand Martin.

⁴ Such as peninsulas, sandbars, passes.

⁵ Projects comprising of <1,5> turbines - low; (5, 15> - medium; (15,25> - high; <25,...) – very high.

Annex no. 3. Pre – investment monitoring paths

Path name		Number of observations in Modules 1.1 (transect population studies) and 1.3 (intensity of airspace use studies) – see Annex no. 4
Path (simplified)	A	<20-30≥ observations per year in accordance with the monitoring plan developer by an ornithology expert
Path B (standard)		<31-40≥ observations per year in accordance with the monitoring plan developer by an ornithology expert; optimally every 10 (7-14) days, possibly more often during migrations and less often during wintering periods
Path (extended)	C	≤41-60≥ observations per year in accordance with the monitoring plan developer by an ornithology expert

Annex no. 4. Scope of pre – investment monitoring and monitoring

1. Pre – investment monitoring

- a. Duration: 1 year including all phenologic periods.
- b. Subject of observation: species composition and population; in relation to birds observed in flight also flight altitude classified into one of 3 categories (below rotor range, in rotor range, above rotor range) and flight direction.
- c. Scope: 4 modules.

1.1. Transect population and species composition studies

- a. Purpose: to acquire basic information about species composition of avifauna using the area and the way land is used by birds, density of particular species and variability of both parameters during the yearly cycle.
- b. Sample areas: transects with total length of 3-15 km, evenly covering the area of the planned farm.
- c. Each transect controlled every 6 - 18 days, depending upon the monitoring path – A, B or C (as described in Annex no. 2).
- d. Counting of all visible and heard birds in accordance with standard methodology (Buckland *et al.* 2001).

1.2. MPPL studies

- a. Purpose: to study the species composition and concentration of particular bird species using the area during the breeding period. Application of methodology used every year since 2000 on >400 areas representative for the entire country (MPPL programme; Chylarecki *et al.* 2006) allows for simple and precise determination of values of breeding period avifauna in relation to reference data representative for the national situation.
- b. Sample areas: 1 x 1 km grid, with 2 parallel transects having the length of 1 km each, lying approximately 500 m apart, designated within each grid square.
- c. 2 observations/square during the breeding season (April - June).
- d. Counting of all visible and heard birds in accordance with established MPPL methodology.

1.3. Intensity of airspace use by birds studies

- a. Purpose: to estimate intensity of bird migrations (local and long – range) in the airspace with particular regard to collision - prone species (raptors, other large birds); to study the variability of these parameters during the yearly cycle.
- b. Sample areas: Observation points lying at least 1.5 km apart, quite evenly covering the area of the planned wind farm. Depending upon the size of the area approximately 1-5 points (usually 2-3) per wind farm.
- c. Each point controlled every 6-18 days depending upon the monitoring path (A, B or C), at least 1 h of observations/point; in case of coastal locations with large number of migrants, it may be necessary to control each point every 5 – 7 days during the migration period (March – April, October – November).

- d. Counting of all visible and heard birds in accordance with migration altitude.

1.4. Qualification of rare and average population species

- a. Purpose: to estimate the population and distribution of rare and large – sized⁶ breeding species (in particular: raptors, storks, cranes, swans) on the area of the planned farm and in its direct neighborhood.
- b. Sample area: Wind farm area plus 2 km (500 m in forest area) buffer zone around it.
- c. Observations: 2-3 all – day observations of the entire area during the breeding period (April – mid June) plus opportunity observations during other studies; counting of White Stork population and breeding success thereof during the first days of July (a couple of hours). The qualification shall be supplemented with additional night counting (first days of June) directed to detecting Corncrake and other *Rallidae*, Quail and Owls.
- d. Counting and recording of all birds from pre – defined list of species exhibiting breeding behavior (in general the „likely breeding” and „certainly breeding” categories in accordance with atlas observation standards; Hagemeijer & Blair 1997, Bibby 2004, Sikora *et al.* 2007).

2. Monitoring

- a. Duration: 3 years including all phenologic periods.
- b. Subject of observation: species composition and population; in relation to birds observed in flight also flight altitude classified into one of 3 categories (below rotor range, in rotor range, above rotor range) and flight direction, plus mortality caused by collisions.
- c. Scope: modules 1 – 4 above plus mortality monitoring.

2.1. Mortality monitoring

- a. Purpose: to estimate the magnitude of bird collisions with turbines, species composition of victims and variability of these parameters in the yearly cycle.
- b. Observation: every 10-18 days, all turbines at once (farms of up to 15 turbines), at least 15 turbines (farms of 15-50 turbines), 1/3 of turbines (farms >50 turbines); if not all turbines are monitored at once, the *rotating panel survey* shall be applied to control each turbine at least once per 3 observations.
- c. Counting of all dead birds and carcasses thereof in accordance with species, recording position thereof (GPS) or distance to turbine base.
- d. At least a couple of experiments allowing for estimating:
 - i. Detectability of collision victims,
 - ii. Rate of decay of carcasses.

⁶ Large – sized species (usually more prone to collisions) are often locally average – populated or rare, that is with population density of <100 pairs/100 km².

(Carrying out these experiments is imperative to estimate the uncertainty (error) of mortality estimates).

- e. Observations of birds avoiding collisions with turbines may be carried out optionally.

Annex no. 5. Description of BACI (before - after /control – impact) studies

1. The ability to reliably measure the effects of the investment on environmental elements depends upon the assumed target parameter (in this case: bird population) spatial and temporal distribution scheme, that is upon the so – called study plan. Appropriately selected study plan (also known as experimental system) provides for reliable, statistically correct assessment of the farm's impact on birds. Conversely – accidental observations, not subjected to an appropriate study plan usually do not allow for drawing unambiguous, scientifically reliable conclusions. The effects of wind farm construction on birds are best analyzed in accordance with the BACI (*before-after-control-impact*) principle. This entails the need to make measurements (in this case: observe the bird population):
 - a. Both before and after the wind farm is constructed,
 - b. In areas of likely effects (experimental area; in this case: wind farm) as well as in areas, where the effects will not occur (control area; in this case: outside the wind farm).
2. Assessment of the farm's impact on bird population in accordance with this principle shall be based on comparing the values observed on the area of the farm after commissioning thereof with two sets of reference data:
 - a. From the same area before commissioning,
 - b. From control area before and after commissioning.
3. Application of such double reference system allows for separating the actual effects of the investment from general effects that is changes occurring in parallel in a wide geographic perspective, irrespective of the wind farm's construction.

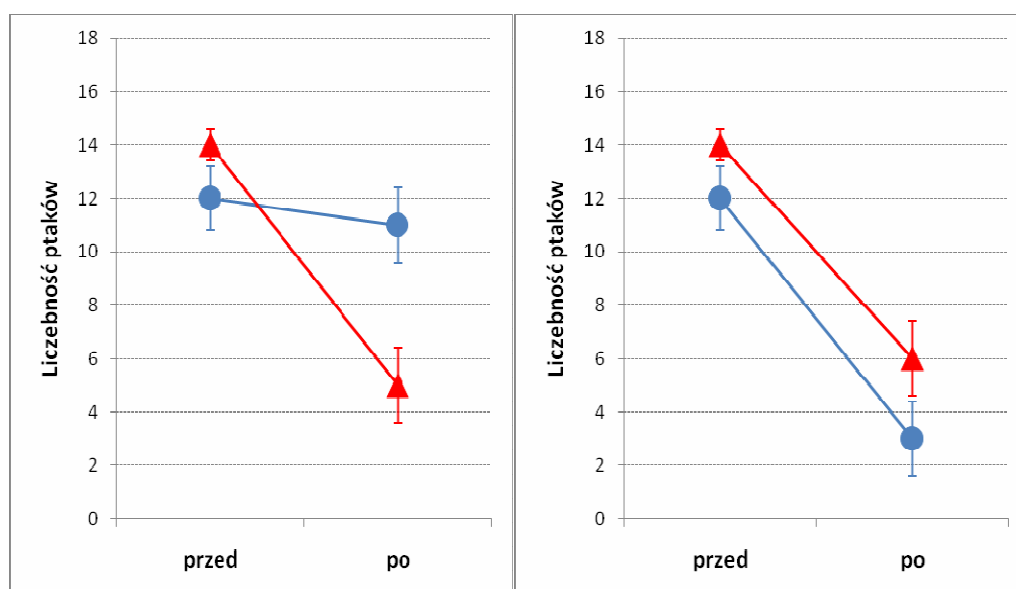


Figure 1. Application of the BACI principle to assess the wind farm's impact on bird population. The birds were counted on experimental areas within the farm (red) and on control areas outside the farm (blue). The observations were carried out before and after commissioning of the wind farm. The left panel presents the situation when decrease in population on the investment area (red) is not accompanied by a similar decrease on control areas (blue), what indicates significant adverse

effects of the wind farm on bird population. The right panel presents the situation when a similar decrease in population on the area of the wind farm is accompanied by a similar decrease on control areas. In such circumstances there is no basis to claim adverse effects of the farm. Existence of data from control areas is crucial to distinguish the effects caused by the investment from changes taking place irrespective of its existence.

4. In the studies carried out to assess the wind farms' impact on birds the experimental data is obviously the result of monitoring, compared to pre – investment monitoring data recorded in the same way). A source of referential data may be the same studies carried out in parallel on control areas. However, in practice it is best to use data from national or regional monitoring programmes, providing for more reliable picture of general changes of population in time on areas not affected by the investment. After normalization both data sets may be jointly analyzed in accordance with the BACI principle.