Environmental Assessment Studies on wind turbines and bat populations - a step towards best practice guidelines

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Introduction

As climate change represents one of the key threats to biodiversity, there is increasing focus on the development of alternative energies. Wind energy is actually the most prominent form of alternative energy being developed in Europe as it seems to help to reduce pollution from fossil fuels. However, it has also a high potential to cause damage to parts of the ecosystem, especially if cumulative developments in the areas of installation increase these effects. The recent development of wind energy in Europe has given rise to concern to nature conservation interests, especially against the background of evident damage to flying birds and bats and some lack of administrative guidance in planning, installation, impact and monitoring studies.
Some of these problems have been recognised at international level as by the Bern Convention with their report on “Windfarms and birds” (T-PVS/Inf (2003) 12). Currently an Intersessional Working Group (IWG) of EUROBATS is working at guidelines for wind turbines and bats which will be proposed to the next Meeting of the Parties in 2006 (see also: www.eurobats.org).

Actually, only few guidelines for wind farm developers or for nature conservationists during the planning and installation process or on the minimization or mitigation of effects on wind turbines on bat populations are available, although there is an urgent need for both sides (NLT, 2005; Rahmel & Bach, 2004). The development of wind farms is currently in full expansion within all of Europe and the possible negative impacts of wind turbines on bats are evidenced. Although there is still an ongoing need for further detailed research, bat conservation must start to collate all available information and knowledge to come up with best practice guidelines for planning, installation, environmental impact assessment as well as long-term monitoring studies.

This article gives a short overview of the situation in Germany and will try to give suggestions for an english guideline. It should not be taken as a final and consensed version since this task still has to be carried out. We also greatly acknowledge the important work of all bat workers who contributed to this synthesis.

The impact of wind turbines on bats

Several studies in Europe and the US have shown that wind turbines can have several impacts on bats, depending on site selection, season and species. The most important problems are:

- bat collision
- loss of foraging habitat
- barrier effect of commuting routes
- emission of ultrasound by wind turbines

Bat collision is the most prominent impact and the most difficult to prove in the field. We know from several studies (e.g. summarized in Dürr & Bach, 2004) that migrating as well as high-foraging bats are mostly affected by collision mortality and most cases occur during end of July to end of September (dependent on geographical regions). In western Europe, 15 bat species were found to be affected by collision mortality and the species most concerned were the two noctules *Nyctalus noctula* and *N. leisleri*, and the pipistrelles *Pipistrellus pipistrellus* and *P. nathusii.* Altogether 20 of the 45 European bat species are considered to be potentially affected due to their ecological requirements (Eurobats IWG).

The site selection of the wind turbines is obviously a crucial factor, since most dead bats were found in highly structured landscapes, for example where hedgerows lead to and from the turbines (Dürr &

Bach, 2004) or around turbines within forests (Arnett et al., 2005; Behr & Reisinger, 2005). The latter authors showed that increased foraging activity of pipistrelles at the nacelle height of wind turbines was correlated with a high mortality at those sites.

The impacts of off-shore wind parks on bat populations are not yet well studied, mainly due to methodological problems. Recent studies however show, that several bat species forage as far as 5 km from the coastline (Bach, pers. data) and migrating bats such as Nathusius pipistrelles or noctules are known to fly far off-shore during their long-distance flights.

Any loss of foraging habitat should be discussed according to the site and the bat species present. As Bach (2002) showed during his studies in Germany, serotine bats (*Eptesicus serotinus*) avoided wind parks as foraging habitat and thus lost previously used habitats. Pipistrelle bats (*P. pipistrellus*) however used their foraging habitats independently from the wind turbines and some habituation can occur. The situation is more critical in forests, where bats forage at or over canopy level and are likely to encounter the rotating blades. Leisler's bats and noctules as well as pipistrelles are among the species the most affected. The loss of tree roosts and foraging habitats by the installation of the wind turbines adds to this problem. However there is still a need for systematic and long-term studies to quantify the problem of site selection and loss of habitats.

Wind parks can also potentially interfer with commuting routes of local bat populations or with migration routes of long-distance migrating bats. Little information is currently available on this problem, especially about the secrets of bat migration. It is not yet known how bats exactly orientate during their long-distance migration: do they use vision and echolocation and to which extent, or even some other navigation cues (e.g. magnetism). The finding of dead migrating bats at wind turbines however indicates the problem. Large wind farms situated at migration routes might act as barriers. Such critical places are for example mountain passes used by migrating birds and bats, ridges along large river valleys used as corridors or coastlines. But also short-distance migrating local populations migrate from their summer to their winter roosts and thus can be affected as well.

The influence of ultrasound noise emitted by the rotating turbines is thought to potentially disturb foraging bats since some wind turbine types were found to emit noises at around 30 kHz (Schröder, 1997), a frequency used by several species of echolocating bats. Until now there is no evidence of such an influence. But bats can also be attracted by ultrasound noise. Up to now no studies were yet undertaken.

From the present studies and findings of dead bats, we know about some of the problems but there is also increasing awareness about a huge research need in this context.

Site Selection Guidelines and Environmental Impact Assessment (EIA) Studies

In some European countries, wind farm developments that have the potential for damaging effects on birds or the natural environment, require a EIA study. Few countries however ask specifically for EIA on bats as this problem is not yet fully known by planning authorities. In order to synchronize the development of EIA studies on bats, several competent bodies are actually involved in working out standarts for the methodology and study design. On European level, EUROBATS as well as the EU Commission (Ad Hoc Working Group for development of guidelines on wind energy and nature conservation) are currently developing such guidelines. Several Non-Governmental Organisations (NGO's) are contributing to this by synthesizing the knowledge of their bat researchers, as for example the BCT (Survey Standards Workshop, December 2004), several German NGO's or the French SFEPM.
In order to compare the studies and to objectively assess the impacts of a wind turbine setting on bat populations, the development of a standard survey method - adjusted to local geographical variations in timing - is most important.

From our experience, we recommend the following procedure (see also Rahmel et al., 2004):

Site selection

According to our present knowledge it is advisable to select sites which are not attractive to foraging or migrating bats. Following the precautionary principle, wind turbines should stay away from:

- Narrow bat migration routes, including local, regional and long-distance migration routes.
- Commuting routes of relevant species. A buffer distance of **200m** is proposed.
- Important foraging habitats. A buffer distance of **200 m** is proposed..
- Known summer and winter roosts, swarming sites. A buffer distance of **500 m** is proposed.
- Forests. A buffer distance of **200 m** is proposed.
- Mountain passes used by migrating bats.

Ideally, important bat habitats should be identified as no-go areas for WT installations.

Pre-survey assessment

Since the potential impacts on bat populations are greatly dependent on species composition and natural surroundings, a pre-survey should be undertaken during the planning process. It should comprise the following points:

- Collation and review of existing literature and data on distribution, roosts, bat sightings, migration routes.
- Consultation of local / regional bat groups, Natural History Museums, Nature Administrations and other competent bodies.
- Identify potential impacts on foraging habitats, commuting or migration routes, collision risk, disturbance or loss of roosts.

EIA study

The definition of the study area should be correlated to the size of the planned number of wind turbines.

- Single WT: 10 fold the height of the WT
- > 2 WTs: 1000 m from the outer sites

Concerning the study design, the impact on local as well as on migrating bats has to be assessed and it is recommended to split the assessment accordingly. A minimum of a 12 months field survey is therefore required.

- spring migration: mid April to mid May: 4 half nights = once per week
- local populations: May to end July/August: 5 full nights (the May field survey can be combined with the last May migration field survey)
- autumn migration, mating period: August to September/ early October: 10 to 14 half nights; in August: full nights (= once per week). From about mid September, the survey should start well before sunset, since some species such as noctules start their foraging activity and migration flights earlier due to cold nights.

The materials used include the following devices:

- Ultrasound detector with time expansion facility and recording of sounds for subsequent analysis – walk/cycle transects at different times of the night
- Automatic ultrasound registration unit – one unit to be used per WT site per study night
- Mist-netting (in case of forest sites or highly structured areas)
- Roost checks if approriate

Additionally the use of infrared cameras or night vision scopes are very useful to monitor bat activity at height, where bat detectors fail to register whispering bats. For more sophisticated users, thermal imaging or the registration of bat sounds in height, for example by using a balloon are useful tools. The first is especially advisable for offshore WT, were traditional methods are difficult to use, but are also important for WT settings in forests to register bat activity above the canopy (balloon).

If WTs are already installed, searching for dead bats around the site should be done twice per week, in the early morning from mid July til mid October.

Assessment of the impact

The evalution of the impact is dependant on local distribution and population level of occurring bat species. Important criterias to include are regional / national Red Data Books, the stipulations of Eurobats, the Habitats Directive, and national laws on protected species. For further planning, evaluation and mitigation measures, it is important to produce separate maps for each study period and to assess the impact accordingly. The main criteria for the assessment are:

- loss of foraging habitat,for each species separatly
- collision risk
- barrier effect (migration or commuting routes, roosts)
- importance of single effects on the bat population (significant - not significant)
- cumulative effects with other plans and projects in the area

At last, possible mitigation and compensation measures should be proposed. First, the principles of precautionary site selection should be applied. Then mitigation aspects should be shown. If not entirely possible, specific compensation measures, such as the improvement of potential foraging habitats or roosts away from the WT area, or increase of the buffer distance, are to be developed. In case of an increased collision risk during migration, where bat collision is not possible to avoid, turning off critical WTs during risky periods at night should be taken into consideration.

After the installation of WTs, long-term monitoring is needed to assess and differentiate the actual short-term and long-term effects of WTs on the local and migratory bat fauna.

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Recommended literature (including further important literature):

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www.eurobats.org : > report of the 10 Advisory Committe Meeting > report of the Intersessional Working Group on wind turbines and bat populations.