Natural England Technical Information Note TIN051

Bats and onshore wind turbines *Interim guidance*

This note has been written to help planners and wind turbine operators consider the potential adverse impacts to bats when assessing proposals for wind turbine development. This guidance is not intended for use in respect of micro installations. The guidance in this note applies to bats and their activity in the wider countryside and does not specifically address turbines proposed near protected sites, particularly those designated due to important bat populations. Such situations will require more extensive work in order to assess impacts on those populations. This note will be updated as more evidence becomes available.

Background

The renewable energy industry is expanding rapidly, driven in part by concerns about climate change. Wind energy, generated by both onshore and offshore installations, is a major contributor, though it currently accounts for only a few percent of UK energy demand.

Government targets for renewable energy generation and extrapolation from current installation rates suggest that there may be between 1500-2000 onshore wind turbines by 2010. Little evidence is available to properly assess any adverse impacts on bats in the UK or set such risks in context with the environmental impacts of other methods of power generation.

In mainland Europe and North America, evidence of bat collisions has led to growing concern about the siting and operation of wind turbines. The most serious incidents have involved bat species that fly very high and for long journeys, particularly species on long distance migrations. In mainland Europe, noctules, common pipistrelles and Nathusius' pipistrelles are most frequently recorded as turbine casualties.

When assessing adverse impacts, we need to distinguish between (a) individual casualties and (b) mortality that affects populations. We are currently unable to say whether populations of bats are likely to be at risk from turbines in the UK because the evidence base is inadequate. Research, with support from the British Wind Energy Association, is now under way to address this issue.

Bats and their roosts are legally protected by domestic and international legislation. The purpose of the legislation is to maintain and restore protected species to a situation where their populations are thriving, and there is sufficient habitat to ensure this will continue.

Generic guidance on assessing the impact of wind turbines on bats has been developed at the European level under the Eurobats Agreement (Bonn Convention), to which the UK is a signatory, see *Further information* below.

The Eurobats Resolution, under which the guidance was developed, urges all Parties to develop national guidelines on bat surveys and risk assessment, drawing on the generic European ones. Such national guidelines should be tailored to the situation in a specific country, and reflect the best available evidence at the time.

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Similar issues apply to commercial, domestic and micro wind generation. However, these guidelines do not specifically cover micro wind generation.

Current state of knowledge and research needs

When generic guidelines are applied to specific countries, differences are likely to emerge. A key difference between the Eurobats guidelines and the recommendations here is the distance separating features used by bats and a turbine.

The Eurobats guidance proposes that the buffer surrounding woodland areas should be 200 m, while this document suggests a buffer zone of 50 m. One reason for the difference is that the European guidelines are catering for a greater diversity of species, some of which are known to fly very long distances, often in the open, away from woodland.

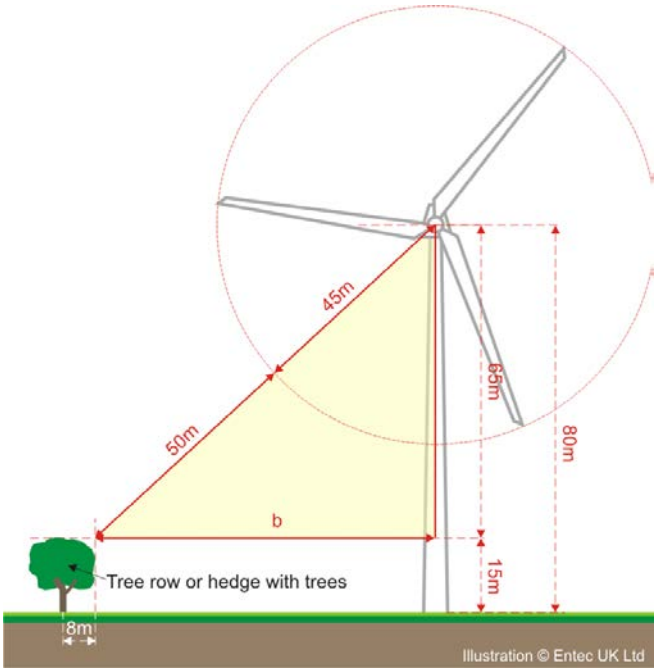
The use of linear features varies among species. Research found that serotines in Finland and Holland utilised linear features and open habitat. In Holland pipistrelle and serotine were known to cross gaps of 110-150 m in open and patchy landscapes, although pipistrelles did so infrequently. Traditional flight routes may explain why pipistrelles and other small bats will cross gaps up to 200 m.

However, the evidence in Britain is that most bat activity is in close proximity to habitat features. Activity was shown to decline when measured at fixed intervals up to 50 m away from treelines and at varying intervals up to 35 m from treelines. This decline occurred both when bats were commuting and when foraging, although the decline is greater when animals were commuting. Monitoring in Scotland showed that bats in mixed farmland preferred to remain close to habitat features when commuting. Occurrence declined the farther pipistrelles and serotines went from linear features.

To minimise risk to bat populations our advice is to maintain a 50 m buffer around any feature (trees, hedges) into which no part of the turbine intrudes. This means the edge of the rotor-swept area needs to be at least 50 m from the nearest part of the habitat feature. Therefore, 50 m should be the minimum stand-off distance from blade tip to the nearest feature.

It is incorrect to measure 50 m from the turbine base to habitat feature at ground level as this would bring the blade tips very close to the canopy of a tall hedgerow tree and potentially put bat populations at risk. Instead, it is necessary to calculate the distance between the edge of the feature and the centre of the tower (b) using the formula:

$$b = \sqrt{(50 + bl)^2 - (hh - fh)^2}$$



where: bl = blade length, hh = hub height , fh = feature height (all in metres). For the example above, b = 69.3 m.

The information currently available on bat behaviour in the UK is not sufficient to assess the threat that wind turbines may pose to populations. Anecdotal records of individual collisions exist but no quantified data at the colony or population level are available.

Research in the US and in other European countries indicates that wind turbines have a detrimental effect on some bat species such as tree roosting bats, aerial feeding bats and particularly migratory bat species. The extent to

which British bat species are migratory has not been quantified. However, some of the same tree roosting and aerial feeding species killed by wind turbines in other European countries also occur in the UK.

Building the evidence base

To help predict the risk and advise on mitigation, it would be useful to know more about:

- whether populations of bats in the UK migrate (autumn migration has been identified as the peak risk period in US and European studies);
- how high UK bats fly (when or where) and how bats use air space at higher altitudes (whether foraging, echolocating, commuting or migrating);
- how far bats travel from their roosts;
- the extent of bat mortality at wind turbine sites in the UK (which species are affected and in which habitats and whether the pattern of use of sites has been altered by the installation of the turbines); and
- how bats behave in the vicinity of turbines.

This evidence is required to inform both the risk assessment and mitigation proposals eg altering blade speed at high risk times. Some research on this is currently being undertaken in the US.

In the absence of the above data, statutory conservation agency staff, ecologists, developers, voluntary organisations and campaign groups are required to make judgements, and provide advice, about the likely impacts of turbines on bats. This interim note will help decide if harm is likely or avoidable. Note, there will always be bats in what appears to be unusual circumstances and which will behave differently.

Risk assessment for bats: possible factors

Flight behaviour of bats in the vicinity of turbine blades

- Turbine blades are usually 20-50 m long and turbine towers are currently between 50-125 m tall, (though its likely that taller masts will become available).
- Most bat species in the UK are unlikely to come into contact with the blades during their normal movements, because, to the best of our knowledge, these bats do not migrate at high altitude and rarely fly at heights that intersect with the blades. However, some species do regularly fly at such heights and therefore are at risk
- There is some (fragmentary) evidence that bats may investigate turbine towers either to feed on insects attracted by the heat generated by nacelles, or because they are simply attracted by moving blades. Such behaviours could put them at risk of collision.

Use of the landscape by bats

- Bats display a very flexible use of the landscape.
- Use of the landscape is linked to roost and food availability and is influenced by need, tradition and opportunism.
- Most species of bats have echolocation calls with a useful range of only a few metres and so prefer to fly close to habitat features such as hedgerows, woodlands, walls, rivers, and within and just above the tree canopy. These species are probably less likely to collide with a turbine.
- Some species of bats, particularly those with strong echolocation calls, will exploit open habitats and are more likely to be at risk from collision with turbines. Severance of flight paths of such species may be caused by the erection of turbines.
- There is some evidence to suggest that the further away from linear/habitat features, the greater the decline in activity, even for high flying bats like noctules that tend to fly in open areas.
- Bats of all species search for new roosts and so may investigate structures, including turbines. This could increase the risk to individuals.
- Modification of the habitat, eg by the creation of open areas or edge habitats within forested landscapes, may increase the likelihood of bats foraging close to turbines.

An analysis of existing information on flight patterns, foraging strategies and echolocation

calls was used to produce the table overleaf. Note, it does not take into account the behaviour of bats close to wind turbines as there is insufficient data to assess this.

Bats likely to be at risk from wind turbines

Low risk	Medium risk	High risk
Myotis species	Common pipistrelle	Noctule
Long-eared bats	Serotine	Leisler's
Horseshoe bats	Soprano pipistrelle	Nathusius' pipistrelle
	Barbastelle	

(See Appendix 1 for the risk assessment)

Given a relative population size for each species and the likely risk posed by turbines, it may be possible to determine the level of threat posed to populations of bats. Most effort should be expended on populations likely to be at high risk of collisions and that may be most threatened.

Populations likely to be threatened due to impacts from wind turbines

Low	Medium	High
Long eared bats	Serotine	Nathusius' pipistrelle
Myotis species	Barbastelle	Leisler's
Horseshoe bats		Noctule
Soprano pipistrelle		
Common pipistrelle		

(Based on relative population size from *Tracking Mammals Report*. See Appendix 2.)

Assessing risk from proposed wind development to bat species

In order to assess the risk to bats as part of a site assessment process, appropriate survey objectives need to be set. The following factors should be taken into consideration when setting objectives and selecting methodologies for planning applications or Environmental Impact Assessments:

- The primary objective is to determine whether the proposed site is used by, or is likely to be used by bats, at any time of the year.
- Efforts should focus on significant concentrations of bats, particularly those species identified as high risk, though all species using the site to any significant extent need to be identified.
- Early identification of sites used by significant concentrations of bats enables assessment of risk. Where risk of harm is likely and unavoidable, alternative sites should be considered.
- Establish bat activity across and within the site and locate any roosts on or close to the site. Bats become fairly well dispersed in the landscape within a few hundred metres of the roost, though this depends in part on the species and the type of roost.
- Investigate use of the site throughout the year at an early stage, with survey effort focussed principally on those periods when the highest concentrations of bats are likely (April-October in most situations).
- Bats change their activity across the year. Survey effort needs to be spread across the season to reflect this. Surveys may stretch across more than one year, especially if important roosts are in close proximity to the site.
- Emphasis should be placed on detecting important flight paths across the site and those likely to intersect with the turbines.
- Project planning needs to allow sufficient time to carry out the bat surveys appropriately.

Guidance on survey effort, timing and methodology is available in *Bat Surveys - Good*

Practice Guidelines, published by the Bat Conservation Trust (see *Further information* below). Natural England recommends that these and the guidance in *Bat mitigation guidelines* are applied appropriately and in a proportionate manner. The most useful survey methods include (but are not limited to):

- Desk studies to gather existing information and aid a walk-over survey, including the location of nearby roosts.
- Search for maternity roosts, swarming sites or significant hibernation sites close to the proposed site, as these are likely to have high concentrations of bats around them.
- Bat detector surveys at, and close to, the site. Both manual and automated survey systems may be appropriate.
- Take advantage of any opportunity to survey at height.

Until further evidence is available, we are unable to recommend prescriptive guidelines for survey effort. On a pragmatic, but risk informed basis, we advise basing it on whether a site is likely to fall into low or high risk. The categories are a simplification and in practice, most sites are likely to fall between the two.

Bat usage of site: Criteria to set survey effort

Risk	Low	High
Site size	Small	Small or large
Site feature	Windy, higher altitudes	Less windy
Habitat	Open, at least 100 m from suitable habitat (such as, but not restricted to, woodland, waterbodies or linear features)	Suitable habitat features (such as, but not restricted to, woodland, waterbodies or linear features) are on or adjacent to site
Roosts on or bounding site	Very few or none	Several. Risk will increase with significance of roost type or species, especially high risk species
Likely threat to bats	Low - medium	High

- Survey effort should be distributed as described above. As a rough guide, it may mean at least one visit per month, or using remote detectors during that period of time.
- In high risk situations more effort is required. This may mean increased number of visits during key times, or increased use of remote detectors, which may be left in situ for longer.

Good practice and recommendations to minimise harm

- Site selection is an important factor in avoiding impacts on wildlife, though it is likely that many other factors will influence site selection.
- The context of the development should be evaluated, taking into account the following factors: location and extent of wind farm, size and abundance of bat populations impacted, and their current use of landscape.
- Where harm has been predicted by appropriate surveys, this could be minimised

by altering locations of turbines within a site. For example, in many cases risk could be minimised by locating turbines so that their blade tips are at least 50 m from the highest part of hedges, tree-lines or woodland in the vicinity, as bat activity beyond this declines significantly. While bats are still active further away from linear features, the level of bat activity is likely to be so low that there is a very low risk of impact.

- If roosts have been identified close to, or on, a proposed site, turbines should be located as far away as possible from the roost and any identified flight paths. In practice, this may be covered if turbine blade tips are situated at least 50 m from any habitat features or structures suitable for roosts. This is most easily described by imagining a 50 m buffer or 3D corridor drawn round the feature (hedge, wood etc.) and ensuring no part of the turbine (tower or blade) intersects with this. Situations involving high or medium risk species (for example noctules or pipistrelles) will need to be assessed on a case by case basis.
- If high risk situations occur, and impacts are predicted on bat populations, altering the use of the turbines may reduce harm. For example, it may be possible to switch off a turbine for a period of time if surveys reveal important flight paths are used at a particular time of year. Other mitigation strategies are currently being explored.
- Standardised surveying/monitoring pre and post installation should be required in most high risk situations and welcomed everywhere. Detailed monitoring is required in sites where impacts are predicted. Such methods could include installation of remote detectors at height to record activity, and corpse searching. Such data can make a valuable contribution to the evidence base and help set the risk in context.

This guidance note will be revised in light of further research.

Further information

- Generic guidance on assessing the impact of wind turbines on bats under the Eurobats Agreement **www.eurobats.org/sites/default/files/documents/publications/publication_series/pubseries_no3_english.pdf**
- *Bat Surveys - Good Practice Guidelines* **www.bats.org.uk/pages/batsurveyguide.html**
- *Bat Mitigation Guidelines* **http://publications.naturalengland.org.uk/publication/69046**

Natural England Technical Information Notes are available to download from the Natural England website: **www.naturalengland.org.uk**. Other notes on wind farms and on bats include:

- TIN008 *Assessing ornithological impacts associated with wind farm developments: surveying recommendations.*
- TIN043 *Bats in Churches: a management guide*.

For further information contact the Natural England Enquiry Service on 0300 060 0863 or e-mail **enquiries@naturalengland.org.uk**.

Natural England's policy position on sustainable energy

Natural England propose to work proactively with the sustainable energy industry to identify areas of England where sustainable energy development can proceed in a manner that balances the long term benefits for the natural environment with any short term impacts, where this approach does not conflict with the statutory requirements of the Habitats Regulations.

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Appendix 1: Assessing risk posed by turbines by taking account of various factors including habitat preference and flight behaviour

	Risk of turbine impact		
Factor	**Low Risk**	**Medium Risk**	**High Risk**
Habitat preference	Bats preferring cluttered habitat	Bats able to exploit background cluttered space	Bats preferring to use open habitat
Echolocation characteristics	Short range High frequency Low intensity Detection distance ~15m	Intermediate – more plastic in their echolocation	Long range Low frequency High intensity Detection distance ~80m
Weight	Lightest	Medium	Heaviest
Wing shape	Low wing loading Low aspect ratio Broadest wings	Intermediate	High wing loading High aspect ratio Narrow wings
Flight speed	Slow	Intermediate	Fast
Flight behaviour and use of landscape	Manoeuvre well will travel in cluttered habitat Keeps close to vegetation Gaps may be avoided	Some flexibility	Less able to manoeuvre May avoid cluttered habitat Can get away from unsuitable habitat quickly Commute across open landscape
Hunting techniques	Hunt close to vegetation Exploit richer food sources in cluttered habitat Gleaners	Hunt in edge and gap habitat Aerial hawkers	Less able to exploit insect abundance in cluttered habitat Aerial hawker Feed in open
Migration	Local or regional movements.	Regional migrant in some parts of range	Long-range migrant in some parts of range
Conclusion	Myotis (most species) Long eared-bats Horseshoe bats	Common pipistrelle Soprano pipistrelle Serotine Barbastelle	Noctule Leisler's bat Nathusius' pipistrelle

Appendix 2: The risk of collision fatalities affecting bat populations

Bat species	Relative population size and status**	Risk of collision^	Population Threat
Common pipistrelle	Common	Medium	Low
Soprano pipistrelle	Common	Medium	Low
Brown long eared bat	Common	Low	Low
Daubenton's bat	Common	Low	Low
Natterer's bat	Fairly common	Low	Low
Whiskered bat	Locally distributed	Low	Low
Brandt's bat	Common N.W, rare or absent E,S	Low	Low
Serotine	Widespread, restricted S	Medium	Medium*
Noctule	Uncommon	High	High
Leisler's bat	Scarce	High	High
Nathusius' pipistrelle	Rare	High	High
Lesser Horseshoe	Rare, endangered	Low	Low
Greater Horseshoe	V Rare, endangered	Low	Low
Barbastelle	Widespread, rare	Medium	Medium
Bechstein's bat	V rare	Low	Low
Grey long eared	V rare	Low	Low

^ Risk of collision is based on what we currently know about bat behaviour. *Within their distribution.

** Based on Battersby, J (Ed) & Tracking Mammals Partnership (2005).

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