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. It 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.

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

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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.

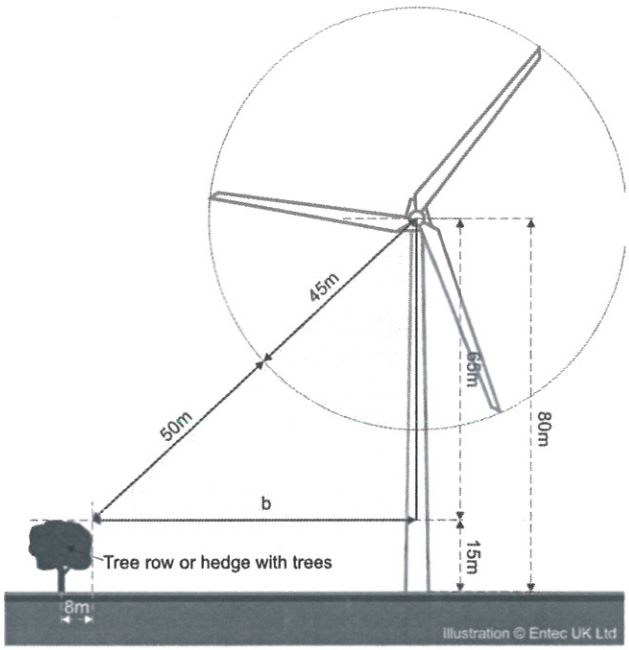
The use of linear features varies among species. Research found that serotines in Finland and Holland utilised linear features and open habitat. In Holland pipistrelle and serotine were known to cross gaps of 110-150 m in open and patchy landscapes, although pipistrelles did so infrequently. Traditional 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/publications/publication%20series/pubseries_no3_english.pdf**
- *Bat Surveys - Good Practice Guidelines* **www.bats.org.uk/pages/professional_guidance.html**
- *Bat Mitigation Guidelines* **www.naturalengland.etraderstores.com/NaturalEnglandShop/product.aspx?ProductID=77002188-97f9-45a5-86a6-326a7ea3cd69**

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 0845 600 3078 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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This note was written by Tony Mitchell-Jones and Caitriona Carlin. The illustration copyright Entec UK Ltd.

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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Natural England Technical Information Note TIN059

Bats and single large wind turbines: Joint Agencies interim guidance

The aim of this note is to provide a consistent approach to dealing with applications for single large wind turbines, ie greater than 250 kW, that takes into account the current lack of knowledge of the scale of any impacts of wind turbines on bat populations, whilst providing a proportionate and precautionary response. It has been written to help wind turbine developers, planners, statutory nature conservation agency staff and wind turbine operators consider the potential adverse impacts on bats when drawing up or assessing proposals for single wind turbine developments. It will be updated as more evidence becomes available.

This note applies to bats and their activity in the wider countryside and does not specifically address turbines proposed near protected sites, designated due to important bat populations. Such situations will require more extensive work in order to assess impacts on those populations for which the site is designated.

It is not intended to cover micro-turbines nor multi-turbine wind-farm developments. Small scale wind turbines and large wind turbines differ greatly in terms of scale, operational characteristic and locational consideration.

Wind farm developments are covered by Natural England Technical Information Note TIN051, *Bats and onshore wind turbines: Interim guidance*, which is currently also used by the Countryside Council for Wales and Scottish Natural Heritage.

Background

There is anecdotal evidence of bat casualties associated with single wind turbines as well as with wind farms. Research on the impacts of both wind farms and single wind turbines on bats in the UK is in progress and will not be available to inform guidance for some time.

Initial European studies of bat casualties at wind farms indicated that peak casualties occurred during migration, although some recent studies have found that resident bat populations may be vulnerable, particularly where turbines are located close to woodlands.

The extent of bat migration in the UK is not known. It seems logical that the larger the concentration of bats close to a turbine, the more chance there is of bat casualties. Locating a wind farm along a bat migration route would increase the risk of casualties, as would siting a single turbine along a flight path next to a nursery roost, or at a woodland edge.

In all cases, the severity of the risk will vary at different times of the day and at different times of the year. Higher casualties tend to occur in low wind speed conditions.

As with many other anthropogenic causes of bat mortality, such as road casualties or cat predation, it is not expected that all bat mortality can be prevented, but the aim is to avoid impacts on bat populations, including at a local level.

This note provides information on factors that can be used to assess the level of risk that may be associated with the siting and operation of single wind turbines and possible solutions.

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Bats and single large wind turbines: Joint Agencies interim guidance

Scoping

It is expected that the highest risk situations will be where activity of the more vulnerable bat species is highest, whether this is because of particularly large numbers of bats in the vicinity, or where the activity of a smaller number of bats is concentrated.

A bat survey should normally be recommended for applications for turbines that will be located within 50 m of the following features:

- buildings or other features or structures that provide potential as bat roosts, including bridges, mines etc;
- woodland;
- hedgerows;
- rivers or lakes; and
- within or adjacent to a site designated for bats (SSSI or SAC) (but please note more extensive work will be required at such sites than is recommended in this document).

The survey should aim to pick up high-risk situations, eg bat roosts close to the proposed turbine location, key feeding areas and commuting routes. Aerial photos and GIS or OS maps may be useful in assessing potential risk. Records of known bat roosts or important habitat should be gathered as part of the scoping exercise.

It may be possible to identify alternative lower risk locations for turbines at the scoping stage, in which case it may not be necessary to undertake surveys if the new locations fall outside the 50 m avoidance zone (see also Mitigation).

Even for locations that have the higher risk features within 50 m of the proposed turbine, it may also be possible to rule out the need for survey at some sites at the scoping stage if the person making the assessment has some knowledge of the habitat and/or buildings at the proposed site and of the bat species that could reasonably be expected to be resident in the area. An example might be a building with low or no potential as a bat roost in a very exposed situation.

The Bat Survey Guidelines provide further information on the features of structures and habitats that increase the likelihood of use by bats.

Bat surveys

It is not expected that a survey would locate all bat use of an area. It should provide an assessment of the risk of there being concentrations of bats at the site and an indication of the likely use of the site.

The information can then be used to decide if the site is appropriate for such a development or to inform possible mitigation. There is some limited evidence from studies of wind farms to indicate that the level of bat activity at a site is a good predictor of the level of bat casualties. It is important to note that any survey effort should be in proportion to the likely risk posed by the siting and operation of the turbine.

Proposed turbine locations very close to buildings with a high potential for roosting bats should be surveyed at a time of year when bats are active (between May - Sept, with the optimum period between May - August inclusive.

Proposed turbine locations close to underground sites ideally should be surveyed in late summer or autumn (mid-August to late September) to pick up possible swarming activity and potential for hibernation.

At sites offering good opportunities for bat roosts, the survey should include a daytime inspection of any structures that can be examined for evidence of roosting bats and any other features that should be observed at dusk should be mapped.

At least one survey should be carried out, with the aim of observing emergence at features assessed as providing high potential for roost sites and/or activity at features that provide high potential for commuting routes (hedgerows, tree lines, water courses) and/or habitat providing high potential for foraging (including lakes or larger water courses).

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Surveys should be undertaken in reasonable weather conditions during the highest risk period, ie when bats are expected to be most likely to be using the area, taking into account factors such as the proximity of the site to likely maternity or hibernation sites.

More than one survey may be required where habitats or other information indicate a high probability of use by bats; where it is considered that use may vary significantly between seasons, or where the first survey was not done at the optimal time (see also *Bat Surveys - Good Practice Guidelines*).

Again it should be emphasised that the aim of the survey is not to provide information on all bats at the site, but to provide an assessment of the risk of placing a wind turbine at one or a choice of locations.

The number and timing of surveys, the number position of observers and bat detectors and recorders should all be appropriate to that assessment. This interim guidance will be subject to revision in the light of further research.

Risk assessment

The Natural England guidance note *Bats and onshore wind turbines: Interim guidance* provides two types of risk assessment. One indicates the degree of risk of mortality facing individual bats of different species, based on flight characteristics etc. The second is the risk faced by bat populations, based on the relative size of the populations of each of the species, as shown in Tables 1 and 2.

Table 1. *Species 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	

Table 2. *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		

Evidence from continental Europe indicates that some species of bats are more likely to be killed by wind turbines than others. These include species found in the UK, particularly the pipistrelle species (primarily Nathusius' and common pipistrelle) and noctule.

Nathusius' pipistrelle is not widely recorded in the UK and few roosts have been identified. However, the soprano pipistrelle is probably more widespread and locally more numerous in the UK than in the rest of Europe and can be found in very high densities at some locations. Roosts of several hundred are not uncommon in Britain and others regularly reach well over 1000 bats.

Locally, populations of soprano or common pipistrelle bats in the UK could be at risk from wind farms, though the risk from an individual turbine would be expected to be low unless sited very close to a roost.

Mitigation

Where the potential risk of a high level of bat activity has been identified, eg at a foraging site, commuting route, or in close proximity to roost, the options for mitigating possible adverse effects currently under consideration are (in order of preference):

- Changing the location of the turbine. A low risk site should be used in preference to a higher

risk site if at all possible. Where a high risk has been identified, but there is no other location available, post construction monitoring should be conducted and another mitigation option should be considered.

- Limiting the use of the turbine to particular times of the day or the year, or weather conditions, depending on the bat species and the predicted use of the site. Bat casualties are reduced if the turbine blades are stopped (feathered) at low wind speeds. In high risk cases, use of the turbine could be limited to daylight hours, or could be restricted seasonally, or a combination of both.

A recent study (Arnett and others, 2009) found a significant reduction in casualties under turbines that had been feathered when bats are flying (½ hour before sunset to ½ hour after sunrise) at wind speeds of 6.5 m/s or at 5 m/s compared to turbines that were fully operational. Limiting the curtailment to the hours when bats are flying resulted in an estimated annual loss of generating output of 1% and 0.3% respectively. (No difference between the two speeds was confirmed). Further research is required as the sample size was small and the research was undertaken at wind farms, not on single wind turbines.

Where surveys indicate that the level of risk may be towards the higher end of the spectrum, planning authorities may wish to consider the following options:

- Asking for the turbine to be re-sited.
- Imposing conditions limiting the times when the turbine may be operated at particular times of day or seasonally.
- Imposing post development monitoring conditions with possible subsequent conditions limiting operating times if casualties are detected.

Any proposed restrictions should be based on a site-specific assessment of the risk, considering:

- the bat species involved;
- the habitat;
- the location of the turbine; and
- the feasibility of changing the operating times of the turbine.

Monitoring

There are currently no agreed recommendations for post-construction monitoring although methods have been developed in North America and Europe.

Monitoring of bat casualties under wind turbines in the UK is currently under way as part of a properly conducted research trial, but we do not expect turbine operators to undertake monitoring to the level that is required for such a trial.

There needs to be a balance between maintaining bat populations, whilst not discouraging green energy generation. As a principle, there should be monitoring of the highest risk cases, including activity monitoring and casualty surveys where feasible during high risk periods.

The level of monitoring should be proportionate to the level of risk, but there may be opportunities in some cases for an increased level of monitoring at lower risk sites eg sites such as educational or conservation establishments, or by larger organisations that may have staff available and where could be undertaken as part of a programme of other works. As so little information is currently available, this would be helpful, provided the monitoring is carried out in a consistent manner.

Casualty monitoring should, where practicable, involve detailed dawn searches under the turbine following the search method developed by the Bat & Wind Energy Co-operative in USA. However, number and frequency of surveys will be dependent on the level of risk.

Further details of post-construction monitoring methods may be available from the authors.

Further information

Natural England Technical Information Notes are available to download from the Natural England website: **www.naturalengland.org.uk**. In particular see:

Bats and single large wind turbines: Joint Agencies interim guidance

- *TIN051 Bats and onshore wind turbines: Interim guidance*

For further information contact the Natural England Enquiry Service on 0845 600 3078 or e-mail **enquiries@naturalengland.org.uk**.

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- Countryside Council for Wales **www.ccw.gov.uk**
- Natural England **www.naturalengland.org.uk**
- Scottish Natural Heritage **www.snh.org.uk**

Additional contacts

- Bat Conservation Trust **www.bats.org.uk**
- British Wind Energy Association **www.bwea.com**

References

ARNETT, E. B., SCHIRMACHER, M., HUSO, M. M. P., 2009 *Effectiveness of Changing Wind Turbine Cut-in Speed to Reduce Bat Fatalities at Wind Facilities* Annual Report Prepared for the Bats and Wind Energy Cooperative and the Pennsylvania Game Commission **www.batsandwind.org/**

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Natural England Technical Information Note TIN051 *Bats and onshore wind turbines: Interim guidance*

Bat Conservation Trust (2007) *Bat Surveys - Good Practice Guidelines*. BCT, London **www.bats.org.uk/pages/professionalguidance.html**

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.

This information note was produced by Countryside Council for Wales, Scottish Natural Heritage and Natural England's Evidence Team.

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