BAT HABITAT ASSESSMENT
WEST WIGHT

for
YOUR ENERGY LIMITED

April 2006

Terence O'Rourke

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Executive summary

1. Field surveys were undertaken at the proposed site of West Wight Wind Farm on 13th March 2006. The work comprised a survey of the habitats on site along with an assessment of their suitability for use by foraging bats. The woodland on site was also evaluated for its suitability to support roosting bats.

2. No signs of roosting bats were recorded in any of the woodlands on site. A number of mature trees with features that could be used by roosting bats were identified within these woodlands. No evidence of any roosting bats was recorded.

3. The Isle of Wight Bat Group was contacted and all bat records within 5km of the site were obtained. The feeding ecology of the species known to occur in the area was assessed along with the risk of collision with turbines.

4. A review was undertaken of studies into bat mortality recorded at wind farm sites in the US. The findings of most of these studies show that migratory species are most vulnerable to collision with turbines. The period of highest risk appears to be concentrated in the autumn migration period. It is thought that bats do not echolocate whilst flying at high levels, hence the vulnerability of bats to collision with turbines whilst migrating.

5. It was concluded that for most species recorded on the Isle of Wight the risk of collision with turbines was low, primarily due to the absence of high quality foraging areas within the wind farm. Species with known migratory tendencies, such as Nathusius' pipistrelle and noctules were considered to be at higher risk of collision based on evidence from the US. The period of highest risk is likely to be confined to the autumn migration period.

Background

Terence O'Rourke was commissioned to undertake a review of the suitability of land south of Thorley and Wellow on the Isle of Wight to support feeding and roosting bats. A field survey was undertaken to evaluate the suitability of the site for bats and record any bat activity on site. Existing information on bat populations around the site was obtained on behalf of Your Energy Limited.

In a meeting with English Nature and the Isle of Wight Council (18th November 2005) it was concluded that the site was likely to be poor quality foraging habitat, but that a full assessment of the potential for the site to support bats should be undertaken.

Bats are protected under UK and European law. For planning applications it is necessary to demonstrate that the proposed development will not have adverse impacts on local bat populations. Little data exists on the impacts of wind farms on bat populations in the UK, however, a number of studies have been undertaken in the US and these have been reviewed as part of this work.

Desktop survey

Contact was made with the Isle of Wight Bat Group to request records within a 5km radius of Wellow. Dr Colin Pope provided this information in March 2006 and these records form the basis for the assessment. Full details of the records supplied can be found in Appendix A. For ease of reference, all records have been mapped by species on Map 1(a&b). This map shows the distribution of bat records in relation to the proposed wind farm. It should be noted that the Isle of Wight Bat Group does not hold records of common pipistrelle (*Pipistrellus pipistrellus*), soprano pipistrelle (*Pipistrellus pygmaeus*) and brown long-eared bat (*Plecotus auritus*).

Field survey

The site was visited on the 13th March 2006. The site was walked during the afternoon and its suitability to support feeding and roosting bats was assessed. There are no buildings within the survey area, but mature trees were evaluated for their suitability to support roosting bats.

The survey was undertaken during the winter to ensure that any suitable cracks and crevices in trees would be located. Due to the time of year, as most species of British bats hibernate between October and February, no fieldwork was undertaken to record use of the site by feeding bats

Limitations of field survey

It can prove very difficult to locate tree roosts; "except in the simplest cases it is extremely difficult to survey trees and be certain that any bat roosts have been detected" (Mitchell-Jones, 2004). Whilst maternity roost of species such as noctules (*Nyctalus noctula*) can be relatively easy to find in the summer, roosts of other species and hibernating bats can be very difficult to find. Therefore, the winter survey will only be able to identify trees with the potential to support roosting bats, it is highly unlikely to find evidence of actual bat roosts.

Desktop survey

Records provided by the Isle of Wight Bat Group showed that the following species of bat had been recorded in the vicinity (within 5km) of the proposed wind farm site:

- Noctule (*Nyctalus noctula*)
- Nathusius' pipistrelle (*Pipistrellus nathusii*)
- Serotine (*Eptesicus serotinus*)
- Whiskered bat (*Myotis mystacinus*)
- Brandt's bat (*Myotis brandtii*)
- Grey long-eared bat (*Plecotus austriacus*)
- Barbastelle (*Barbastella barbastellus*)
- Bechstein's bat (*Myotis brandtii*)
- Natterer's bat (*Myotis nattereri*)

It is also assumed that the following three species will be present within the search area:

- Common pipistrelle (*Pipistrellus pipistrellus*)
- Soprano pipistrelle (*Pipistrellus pygmaeus*)
- Brown long-eared bat (*Plecotus auritus*)

The locations of the records in relation to the proposed wind farm are shown on Map 1(a&b) in Appendix A.

Habitats on site

The site is a series of large arable fields, quite open and exposed. The undulating topography of the site means there are a number of more sheltered areas in the bottom of small, shallow valleys across the site (see photo 1). The more interesting habitat features on site are situated along the shallow valleys; ditches and streams bordered by rough grassland (see photo 2), hedgerows or small copses (see photo 3). A habitat map (Map 2) has been prepared showing the key habitats on site.

The proposed wind farm generally offers poor foraging habitat for bats. The large areas of arable crops are regarding as being sub-optimal foraging habitats for most bat species.

Some of the linear features on site could provide suitable foraging habitats, particularly the ditches, streams, hedgerows and copses (see photos 3 & 4). Although there is limited woodland, these areas offer potential foraging and roosting areas for some bat species. Some of the linear features on site, wet ditches, the chain of copses and hedgerows, could provide links to the wider countryside for bats moving between roost sites and foraging areas (see photo 5). Each of the main habitats on site is considered in more detail below.

Arable land

The vast majority of the proposed wind farm area is currently under intensive arable farming, with wheat and oil seed rape being grown on site. Studies of the use of habitats by bats have shown that at a landscape level foraging bats will actively avoid arable land when foraging (Walsh and Harris, 1996). This avoidance of arable habitats is also shown at a local level and is thought to relate to a low abundance of insects found in these habitats.

It is likely that there will be some use of the arable areas by feeding or commuting bats. High flying and wide ranging species such as noctules are likely to cross the site when travelling between roosting and foraging sites. It is also possible that generalist feeders such as common and soprano pipistrelles will cross arable areas to reach more favourable foraging areas.

It is unlikely that those species with more exacting habitat requirements, such as Bechstein's and barbastelle bats, would be found regularly feeding over arable areas. The evidence available from detailed studies on the diets of these species, along with other species which obtain a significant proportion of their food through gleaning, such as whiskered and brown long-eared bats, indicate that they species do not regularly feed in these habitats. It is also unlikely that these species would commute across open, exposed areas such as arable fields.

It is concluded that the arable fields across the site are a sub-optimal foraging habitat for bats, with evidence suggesting that foraging bats actively avoid arable areas. It is possible that these areas are crossed by some species such as pipistrelles and noctules, but would not typically be used for foraging.

Copses

The series of copses on site offer good feeding opportunities for bats, along with limited roosting opportunities. Studies into foraging behaviour of bats have shown that areas of woodland edge are strongly selected at a landscape level. It is thought this is due to the higher insect densities found along woodland edges and the more sheltered environment this habitat provides. Small streams, bordered by conservation headlands, link the woodlands on site. This will increase the attractiveness of these small copses to foraging bats and allows them to commute between roosting and foraging sites along linear landscape features.

The woodlands on site are relatively simple in structure (see photo 6), with predominantly young trees and poorly developed shrub and field layers. However, some of the copses do have small numbers of more mature trees, some of which offer suitable roosting opportunities for bats (see photos 7 & 8). These areas of woodland do support large numbers of ivy-covered trees. Although these trees are unlikely to support large numbers of roosting bats, they could be used as summer roost sites, particularly by single male bats.

Wet ditches/streams

There are a number of wet ditches and small streams on the site, all flowing towards the Solent. Only one of these streams provides an unbroken link across the site, the others issue from the underlying chalk in the middle of the most westerly arable field. The streams are all bordered by rough grassland, mostly MG1 grassland, and all have low scrub along their length (mainly bramble).

Although these ditches are not open enough to be used by true riparian specialists such as Daubenton's bats (which forage almost exclusively in the 1m airspace above the water), they are likely to be used to some degree by bats. Studies of habitat use by bats have highlighted the importance of riparian habitats to many species (Walsh and Harris, 1996 and Wickramasinghe, 2003). These studies have shown that, where available, bats show a strong preference for all water bodies including small ponds and streams as well as large rivers and reservoirs.

It is generally assumed that the preference for riparian habitats is linked to high insect densities, since many insects have an aquatic larval stage. However, the relationship between foraging habitats and water bodies is complex. For example, in more intensively farmed areas the preference for foraging in riparian zones is significantly reduced. This could be due to the reduced insect biomass in these watercourses due to run-off of agricultural insecticides.

It is likely that these ditches will be used be some bat species, either as foraging areas (possibly only seasonally), or as flight lines between roosting and foraging areas.

Conservation headlands

The areas of rough grassland bordering many of the fields within the proposed wind farm site could offer foraging opportunities for a number of bat species. The attractiveness of these areas is enhanced by the fact that many border watercourses, hedgerows or woodland, thus leading to the possibility that insect biomass will be higher in these areas.

Pasture is known to attract some species of bats, particularly serotines and noctules, which generally take advantage of seasonal flushes of insects such as tipulids. The rough grassland of the conservation headlands, dominated by cock's-foot and false oat grass,

are not likely to generate the large insect flushes associated with large expanses of open grassland.

It is considered that the conservation headlands will offer feeding opportunities for some species of bats. These areas also provide a useful link between areas more favoured for feeding e.g. streams and woodland on the site.

Hedgerows

Hedgerows perform two key functions for bats in the wider countryside. They are used by many species for foraging, although their attractiveness varies depending on many associated factors. Hedgerows also provide key flight lines that allow bats to move between feeding and roosting sites.

At a landscape level it has been shown that bats show an active preference for feeding along hedgerows in many situations (Walsh and Harris, 1996). However, the use of hedgerows by feeding and commuting bats is subtle and can be influenced by a number of factors including surrounding land use, the connectivity of hedgerows to other habitats and the height and structure of the hedgerow. The hedgerows on this site are generally too small, many having only just recently been planted or fragmented to be of any significant value to foraging bats.

The ecology of bat species recorded at West Wight

To allow for an assessment of the potential impacts of the proposed development on each of these species, details of their known ecology is outlined below. It should be noted that some of the species recorded close to West Wight, such as grey long-eared bat, are poorly studied in the UK and their breeding and foraging requirements are not yet fully understood.

Serotine

This species occurs roughly to the south of a line between the Wash and south Wales. The English population was estimated to be in the region of 15,000 individuals in 1995. Serotine roosts occur almost exclusively in buildings, those buildings with high gables and cavity walls are particularly favoured. The males are solitary throughout the year. A study of a nursery roost of less than 20 females found that the animals had home ranges between 24 and 77km^2, with areas of high activity covering 13-33km^2.

These bats typically emerge about 20 minutes after sunset and move an average of 6.5km to and from feeding areas each night. Up to five different feeding areas can be used per night, with foraging peaks at the beginning and end of the night. Serotines can forage up to 30 metres above the ground, though feeding typically occurs 0-5 metres above ground level. Coleoptera, Lepidoptera and Diptera are the main food items.

Serotines forage over pasture, parklands, in open woodland and along hedgerows and woodland edges. This species has also been recorded feeding in gardens and other suburban areas. They are frequently found feeding along landscape features such as tree lines or hedgerows. These bats are also attracted to seasonal flushes of insects such as cockchafers (*Melolontha*) and dung beetles (*Aphodius*) that occur in grassland habitats. This species does not regularly forage over arable fields.

Grey long-eared bat

This species is very difficult to distinguish from its more common congener, the brown long-eared bat. It is extremely uncommon in Britain, with a population estimated to be in the region of 1000 animals in 1995. It is only known to occur in the south-west England, along the south coast and on the Isle of Wight and the Channel Islands. It favours warm, lowland areas, cultivated land and valleys below 400m.

The species is thought to form small roosts in Britain, typically around 20 animals in a large, open roof void. These bats emerge from roosts after dark and feed sporadically throughout the night. Feeding flight is low, between 2 and 5 metres above the ground. The feeding ecology of this species is poorly understood, although it is thought to favour open areas around woodland, close to the roost site. Lepidoptera and woodland Diptera form a significant part of the diet. Most of the prey items are believed to be taken by bats gleaning insects from vegetation, although many individuals will also use feeding perches.

Brown long-eared bat

This species is one of Britain's most common bat species, with an estimated population of 200,000, with around 150,000 in England. Maternity roosts tend to be found in buildings or trees. There is some evidence that older buildings are favoured, with woodland or water within 0.5km of the roost site. This is probably related to the fact most bats forage close to their roost sites, with individuals rarely traveling further than 1.5km to forage. Brown long-eared bats will disperse from roost sites using well-establish flight lines, often along hedgerows and tree lines.

Brown long-eared bats typically emerge about 1 hour after sunset and forage in a wide variety of habitats including deciduous and coniferous woodland, parks, gardens and hedgerows. Foraging flight is slow and fluttering, typically close to vegetation and between 5-6m above ground level. A large proportion of prey is obtained through gleaning. The diet of brown long-eared bats is almost exclusively Lepidoptera, including many tympanate species.

Noctule

Although a widespread species in England and Wales, this species is not considered common, with an estimated 45,000 individuals in England in 1995. This species is

strongly associated with mature trees. Females show a preference for establishing maternity roosts in woodpecker holes and males roost mainly in holes or crevices in trees. Noctules are large, fast-flying bats and forage in open habitats such as large gardens, parks and over pastures or wetlands.

Noctules leave the roost early in the evening, on average only 5 minutes after sunset, though lactating females can leave even earlier in the summer. Foraging activity is concentrated in the period 2 hours after dusk and again half an hour before dawn. Their diet comprises mainly Diptera, Coleoptera and Lepidoptera, foraging often takes place well above tree height. It is thought that noctules in northern England move to the south and south-west during the winter months.

Brandt's bat

This species is widespread in England and Wales. It is thought that it is more numerous in northern Britain, although due to the difficulties in separating Brandt's and whiskered bats, the current status of both species is unclear. The population in England was estimated to be in the region of 22,500 animals in 1995.

Brandt's bat is thought to feed primarily in woodland or over fresh water. Summer roost sites are often in the roof timbers of buildings. The bats typically leave the roost within half an hour of sunset. The feeding ecology of this species is not fully understood. However, as Diptera are an important component of their diet, particularly the sub-order *Brachycera*, (these are diurnal insects), this would suggest a significant amount of food is obtained by gleaning insects from vegetation.

Whiskered bat

Whiskered bats have a similar distribution to Brandt's bat, with a population in England estimated to be in the region of 30,500 individuals in 1995. Summer roost sites are often in houses, bat boxes or loft spaces. This species is less of a crevice roosting species than Brandt's. Males are solitary throughout the year.

This species forages in open country, woodland, parks and gardens, often near flowing fresh water. Typically the bats emerge around 30 minutes after sunset and are thought to be active throughout the night. Foraging flights are typically up to 20 metres above ground levels and this species is thought to obtain at least some food through gleaning.

Natterer's bat

Natterer's bats are found throughout the British Isles, north to the Great Glen in Scotland. This species is scarce over much of its range, with an estimated population of 70,000 in England. Summer roost sites are typically in buildings or crevices in trees and nursery roost may number 200 individuals. Studies in Dorset have found that most individuals are

extremely faithful to a small number of roosts, with few moving to another site 2.8km away. Natterer's bats hibernate almost exclusively in caves and mines.

This species forages in a range of habitats including large gardens, open woodland, conifer plantations, parkland, watercourses and along hedgerows. Natterer's bats are unusual as they forage very close to vegetation and it is thought that they derive a large proportion of their prey through gleaning. The bulk of their diet comprises diurnal Diptera, although medium-sized arthropods such as harvestmen, beetles, dung-flies and spiders are also a significant dietary component. This species is highly maneuverable at low speeds and tends to fly at heights below 5m.

Common pipistrelle

Common pipistrelles are widespread in Britain, with a population thought to be in the region of 1 million individuals. Common pipistrelles feed over fresh water, farmland, pasture, along hedgerows and within woodland. Maternity roosts have been found to be more common in built up areas or areas of improved grassland. Pipistrelles will leave roost sites approximately 20 minutes after sunset and will often follow the same flight path to feeding areas. This species tends to follow linear features and roost sites are likely to be situated near features such as hedgerows. Whilst commuting, common pipistrelles fly at around 2 metres above ground level. Foraging takes place in the air space between 5 and 10 metres above the ground.

Soprano pipistrelle

This species shares many characteristics of the common pipistrelle and has a similar-sized population on the UK. This species may be more common in northern Britain than the common pipistrelle and it is thought to favour riparian areas for foraging. Soprano pipistrelles often avoid open habitats such as farmland and grassland. Both species will forage up to 5km from roost sites. The males of both species are solitary and occupy roosts all year round. Maternity roosts are normally situated in buildings or trees. Common and soprano pipistrelles are the dominant bat species on both conventional and organic farms in England.

Nathusius' pipistrelle

The range and ecology of this species is still poorly understood in the UK. It was not known to breed in the UK until 1997 when maternity colonies were found in Lincolnshire and Northern Ireland. This species is migratory over much of its European range and it considered that the UK supports a resident population that is supplemented by bats from north-eastern Europe during the winter months. Nathusius' pipistrelles frequently travel up to 1000km between breeding and hibernation sites (normally in a south-westerly direction).

Nursery roosts in Europe are almost exclusively in tree cavities, although the only known maternity roosts in the UK are in buildings. They hibernate in tree holes, caves and crevices in cliffs and walls. This species forages primarily in lowland woodland and parks, emerging early in the evening, and foraging at heights between 4-15m above ground level. The diet of Natusius' pipistrelles consists almost entirely of aquatic diptera, particularly Chironomidae. This would suggest that, as with soprano pipistrelles, woodland and riparian habitats are likely to be a key habitat for this species.

Barbastelle

Barbastelle bats are restricted to southern England and Wales in the UK. This is an extremely rare species in the UK with an estimated population of around 5,000 individuals. Only six maternity roost sites are known at present, with around 30 hibernation roosts identified. Summer roosts occur in old buildings and trees, under loose bark and cracks or crevices. Hibernation sites include hollow trees, tunnels or other underground sites. Barbastelles are known to use streams, small rivers, ditches and hedgerows as flightlines.

Barbastelles often emerge from roost sites whilst it is still light and will frequently forage under the tree canopy, or commute to foraging areas under the canopy, until it becomes darker. The early emerge of this species may be linked to the fact this species has a large territorial range and feeding areas are often remote from roost sites. Studies of the West Sussex colony showed females ranged over an area totaling 240km^2, with the most distant foraging area being 18km from the roost.

Their diet consists almost entirely of Lepidoptera caught by aerial hawking, although foraging by gleaning also takes place. Preferred foraging areas include wet woodland, riverine habitats and water meadows, although they have been recorded foraging around scrubby trees and gorse in Somerset. Foraging heights vary from low over water bodies to aerial hawking around treetops.

Bechstein's bat

This species is restricted to southern England, with important roosts in Devon, Dorset, Gloucestershire and the Isle of Wight. At the present time only two maternity and 20 hibernation roosts are known. The UK population is estimated to be in the region of 1,500 individuals. Summer roosts are generally located in tree holes, with hibernation roosts in cellars, rock crevices or caves.

Bechstein's bats generally leave their roosts about 30 minutes after sunset. Foraging flight is slow and fluttering, but these bats are very agile. Foraging flights can be up to 15m above ground level but are generally lower. Feeding takes place mainly in enclosed vegetation in woodland habitats, both deciduous and coniferous, and parkland. Lepidoptera (including tympanate Noctuidae) and crepuscular and diurnal Diptera are the main components of this species diet. Bechstein's bats typically forage close to roost

sites, with studies of a colony in Dorset finding that foraging ranges of 300-1000m from roost sites.

Evaluation

Roost sites

The site at West Wight offers limited roosting opportunities for most bat species. The only opportunities for maternity or hibernation roosts within the proposed wind farm site are limited to hollow trees or woodpecker holes in the copses on site. It is possible some of the ivy-clad trees within the small copses may provide summer roost sites for solitary bats, such as male pipistrelles.

The small number of mature trees with loose bark, woodpecker holes or other cracks and crevices would provide roosting opportunities for some species of bat. The species considered most likely to occur within the woodland on site are noctules, common and soprano pipistrelles. Brown long-eared and Natterer's bats have been recorded using tree roosts and it is not infeasible that these species could also occur. The woodlands on site are not considered to be extensive enough, or sufficiently varied structurally, to support rarer tree-roosting species such as barbastelles and Bechstein's bats. It should also be noted that although the only UK records of maternity roosts of Nathusius' pipistrelle are from buildings, this species is almost exclusively found in trees in Europe. As its ecology on the UK is poorly understood at present it should also be considered a possibility.

The other bat species known to occur close to the proposed wind farm are largely found in buildings or roost in crevices. Suitable roost sites are likely to exist for species such as serotine and brown long-eared bat in the houses and buildings of Thorley Street and Wellow. It is possible that these are roosting opportunities for crevice roosting species such as Brandt's and grey long-eared bat within Prospect Quarry

Foraging habitat

The area covered by the proposed wind farm is considered to offer limited feeding opportunities for bats. It is not considered that the range of habitats on site is sufficiently extensive or diverse to provide feeding opportunities for more specialist feeders such as Bechstein's and barbastelle bats. The areas of woodland, streams and wet ditches are the most valuable foraging habitats on site. These are habitats that bats have been shown to actively select as foraging areas at a landscape level. However, the extent of these habitats on site is limited and they are unlikely to support large numbers of feeding bats.

Wet ditches, hedgerows and conservation headlands link the areas of woodland. These links between foraging areas help to create a high degree of connectivity between foraging areas within the site and within the wider countryside. However, most of the site is arable fields and these are considered to offer poor foraging opportunities for bats.

Some bat species will forage over open habitats, particularly unimproved grassland and pasture. Noctules and serotines will forage over these habitats and at certain times of the year, insects associated with these habitats form a significant proportion of the diet of these bats. Radio tracking of serotines in England found these bats foraging over cattle pastures and around street lamps in villages. However, although studies have shown that bats forage on farms, even generalist feeders such as common pipistrelles do not commonly forage over arable land. Bats recorded from farmland tend to be associated with other landscape features such as hedgerows, woodland, ponds, ditches and grassland. Arable fields are considered to be a sub-optimal foraging habitat for bats.

Pipistrelle bats, both common and soprano, are the commonest bats recorded foraging over farmland. Soprano pipistrelles are believed to favour riparian zones for feeding, whilst common pipistrelles feed over a wide range of habitats, such as plantations, unimproved and improved grassland. Feeding activity over arable fields, although higher than many species of bat, is still low compared to foraging activity in other habitats. Most feeding activity takes place between 5 and 10 metres above the ground.

Impacts of wind farms on bats

A number of species of bat have been recorded close to the site of the proposed wind farm. However, it is thought that the potential impacts of any development on bats are likely to be low. Most of the species recorded from the area are not known to forage over arable habitats. As the turbines are located within arable fields, they are positioned where they will have the least potential to impact on feeding bats.

However, there is a long history of bat collisions and mortality with man-made structures. The first recorded bat mortalities were from Ontario in 1930, when five bats (eastern red bat, hoary bat and silver-haired bat) were recorded killed at a lighthouse. Five eastern red bats were killed after colliding with a television tower in Kansas in 1956 and 12 dead hoary bats were collected from under a television tower in Florida over an 18-year period. A similar study in Florida recorded 54 bat fatalities, of seven species, at a television tower over a 25-year period.

There have also been records of bats colliding with buildings; four eastern red bats were killed after collisions with the Empire State Building in 1954. Over an 8-year period, 50 eastern red bats, 27 silver-haired bats, 1 hoary bat and 1 little brown bat were found under large windows of a convention centre in Chicago, Illinois.

The first documented fatalities caused by wind turbines was recorded in Australia in 1972, where 22 white-striped mastiff bats were found over a 4-year period. Studies in Europe have recorded bat fatalities with 17 dead bats (six different species) recorded at 160 turbines in Sweden. Eleven species have been recorded as fatalities inn Germany.

Studies from America have demonstrated that wind farms have the potential to kill large numbers of bats. For example, 458 bats of seven species were found dead during a 7-

month study at a wind farm in West Virginia with 44 turbines. It was estimated that the actual mortality rates at this site could have been as high as 2,100 bats during the study period. High numbers of fatalities have also been recorded at Buffalo Ridge, Minnesota (420 bats), Wyoming (135 bats) and in Wisconsin (72 bats). The table below summarises the studies of bat mortality in the US.

Table 1: Results of bat mortality studies at wind farms in the US

Location	Turbine size	Year	Number of bat fatalities found	Bat mortalities per turbine per year
Buffalo Ridge, MN Phase 1. 73 turbines	330kw 53m high	1994-1998	20	0.1
Buffalo Ridge, MN Phase 2&3. 281 turbines	750kw 74m high	1998-2002	400	2.0
Northeastern Wisconsin 31 turbines	660 kw 89m high	1999-2001	72	4.3
Foote Creek Rim, WY 105 turbines	660 kw 61m high	1999-2002	135	1.3
Buffalo Mountain, TN 3 turbines	660 kw 89m high	2001	72	28.5
OR/WA border 399 turbines	660 kw 74m high	1999-2002	54	0.9
Klondike, OR 16 turbines	1.5MW 100m high	2002	6	1.2
Vansycle, OR 38 turbines	660 kw 74m high	1999	28	0.7
Nine Canyon, WA 37 turbines	1.3MW 91m high	2003	27	3.2
Backbone Mountain, WV 44 turbines	1.5MW 102m high	2003	476	10.8

Table taken from Johnson and Strickland, 2003.

The studies in the US have shown a range of expected annual mortality per turbine. Even for a small wind farm, a minimum mortality rate of one bat per turbine per year could be expected using the findings of these studies. The work undertaken in the US would also suggest that this minimum estimate could be wrong by a factor of twenty. A mortality

rate of 2 or 3 bats per turbine per year could have a devastating impact on bat populations in the UK which have a low reproductive capacity, a long life expectancy and high adult survival rates. The extrapolation of data from the US studies and its application to wind farms in the UK is fraught with difficulties, and it is not safe to conclude that mortality rates in the UK will be directly comparable to potential mortality rates in the US. The findings of the US studies, and their relevance to the situation in the UK are discussed below. A comprehensive review of US studies can be found in Johnson and Strickland, 2003 on which this section is based.

Of the 45 species of bat found in America, only nine species have been recorded as fatalities at wind farms despite the variations in geography and habitats of the wind farms studied. Of the 1,044 identified corpses in the studies listed in Table 2, 87.5% were migratory tree bats. Hoary bats were the most common collision fatalities (53.9%), with eastern red bat totaling 24.5% of recorded fatalities. Silver-haired bats (9.1%), little brown bat (4.7%) and big brown bat (2.1%) comprise most of the other fatalities.

Table 2: Species recorded as fatalities at US wind farms

Location	Total number	Hoary	Eastern red	Silver-haired	Big brown	Little brown	Eastern pipistrelle	Mexican free-tailed bat	Long eared bat	Northern myotis	Unidentified
Buffalo Ridge	420	273	73	20	15	8	7	0	0	0	24
Buffalo Mountains	72	10	48	1	2	0	11	0	0	0	0
North-east Winconsin	72	25	27	13	1	0	0	0	0	0	6
Nine Canyon	27	12	0	15	0	0	0	0	0	0	0
Vansycle	10	5	0	3	0	1	0	0	0	0	1
Klondike	6	3	0	1	0	0	0	0	0	0	2
Ponnequin	39	36	0	2	0	0	0	0	0	0	1
Foote Creek Rim	135	119	0	5	2	6	0	0	0	0	3
OR/WA border	54	25	0	25	2	1	0	0	0	0	1
Backbone Mountain	242	52	107	10	0	32	38	0	0	1	2
Green Mountain	1	0	0	0	0	1	0	0	0	0	0
California	9	3	1	0	0	0	0	1	1	0	3
Total (%)	1087	563 51.8%	256 23.6%	95 8.7%	22 2.0%	49 4.5%	56 5.2%	1 0.1%	1 0.1%	1 0.1%	45 4.0%

Table taken from Johnson and Strickland, 2003.

The majority of fatalities at wind farms in the US occur during late summer and early autumn. Data available for 1,021 collision fatalities show that 90% of the recorded fatalities occurred between mid-July and mid-September, with 50% of all fatalities occurring in August. The number of collisions with turbines should be considered in relation to the respective population sizes. The populations of many of the species recorded in the US are in excess of a million individuals. Table 3 below shows the timings of bat fatalities recorded at American wind farms.

The species involved and the timings of the fatalities at wind farms in the US strongly suggest that migratory species are the most vulnerable to collisions with wind turbines. The small numbers of studies in Europe also found that the majority of fatalities were migratory species.

It is not known why migratory bats are killed at wind farms, or why there are few recorded casualties of migrants in spring. It is possible that bats use different migratory routes in spring and autumn, or that there is a greater concentration of migrants along certain routes in autumn, with spring migration having a more scattered spatial distribution. Given that studies have shown that bats can avoid colliding with moving objects more successfully than stationary objects, and the ability of bats to navigate through constructed clutter zones made of staggered vertical strands of twine 3mm in diameter, spaced 1m apart, it is perhaps surprising that bats are recorded as regular fatalities at some wind farms.

The reasons behind the peaks in autumn mortality at wind farms in the US are not clearly understood. There is some evidence that recently fledged juvenile bats have reduced abilities to echolocate and fly compared to adult bats. There is also evidence from studies of colonial bats in the US that in some species adults change foraging patterns and locations once juveniles are capable of flying, presumably to reduce intra-specific competition for food resources close to breeding sites. One theory is that juvenile bats are at high risk of colliding with turbines immediately after fledging due to their relative inexperience.

However, studies in Minnesota found 68% of all bats killed in collisions were adults, and at Foote Creek Rim, Wyoming, all of the 21 bat collisions aged in 2000 were adults. Most resident bat species in the US produce young between June 1st and July 15th, yet only 42 of the 1,021 bat collision mortalities recorded (4%) fall within this period. There is also evidence from several studies that few bats traversing wind farms actually collide with turbines.

A 2-year survey at Buffalo Ridge, Minnesota estimated 96,102 bat passes occurred around turbines during the survey period. No relationship was found between bat activity at turbines and the number of bat fatalities. This study also found that although large breeding populations of bats occurred within 3.6km of the site in June and early July, collision mortality during this period was virtually non-existent. Similar findings were obtained at Foote Creek Rim, where 260 bats were captured in mist nets. Bats from the genus Myotis comprised 81% of the captures yet these species comprised only 6 of the 123 casualties recorded (5%).

Hoary bats (a migratory species) comprised 88.1% of fatalities, even though 95% of all identified calls recorded at turbines were from other species. At Buffalo Mountain in Tennessee, two species of bat, little brown and northern long-eared bat, were detected near wind farm plant yet neither species was recorded as fatalities.

The situation in the US would appear to show that certain species of migratory tree bat are at high risk in some areas of collisions with wind turbines. The collision risk is significantly higher in the autumn and there is no evidence to date to show that juvenile bats are any more susceptible to colliding with turbines than adults. The reasons for the increased collision risk in autumn are not fully understood, and a number of theories have been suggested. It is thought that bats may not echolocate whilst flying at higher altitudes during migration and this could potentially make them more susceptible to hitting turbines. Other hypotheses include the possibility that bats are attracted to turbines as potential roost sites, or when turbines are lit through feeding opportunities due to insects being drawn to the lighting around the turbines.

Some of the studies in the US have shown that resident species do not show any significant increased risk of collision with turbines compared to migratory species. These findings should be treated with caution, as many factors will affect the use of wind farm sites by resident bat species. For example, altitude, proximity of woodland and water, the presence of maternity or hibernation roosts near to the wind farm and the ecology of the bat species involved, will all have a significant impact on use of the wind farm area. As with British bats, the ecology of many American species is poorly studied.

Table 3: Timings of bat collision mortality at US wind farms

Dates	Buffalo Ridge	Vansycle	Klondike	Buffalo Mountain	OR/WA border	Foote Creek Rim	North-east WI	Backbone Mountain	Total
April	0	0	0	0	0	0	0	16	16 (1.6%)
1-15 May	0	0	0	2	0	0	3	0	6 (0.6%)
16-31 May	1	0	1	0	0	1	0	0	5 (0.5%)
1-15 June	0	0	0	3	0	1	0	0	6 (0.6%)
16-30 June	4	0	2	0	0	2	0	0	8 (0.8%)
1-15 July	16	0	0	8	0	3	0	0	28 (2.7%)
16-31 July	101	0	0	6	1	26	4	0	138 (13.5%)
1-15 August	144	0	0	15	1	23	1	0	185 (18.1%)
16-31 August	92	4	0	17	15	35	54	146	365 (35.7%)
1-15 September	55	4	1	14	7	25	5	80	196 (19.2%)
16-30 September	4	2	2	3	15	0	5	-	39 (3.8%)
1-15 October	1	0	0	2	11	3	0	-	19 (1.9%)
16-31 October	2	0	0	0	3	0	0	-	7 (0.7%)
1-15 November	0	0	0	2	1	0	0	-	3 (0.3%)

Table taken from Johnson and Strickland, 2003.

Conclusion

In the absence of large-scale migratory movements of bats in the UK, the risk is likely to be limited to the possibility that bats would collide with turbines whilst feeding or moving between feeding and roosting sites. It is possible that Nathusius' pipistrelles could migrate to or across the Isle of Wight and would therefore be at risk (based on evidence from the US) of collision with turbines. It is also possible that noctules undertaking migratory movements would be at risk from the proposed wind farm.

As discussed above, the feeding ecology of the species recorded close to the site makes it unlikely that bats will be feeding in the areas where the turbines are located. Even those species that are most frequently recorded foraging over arable land, such as pipistrelles, predominantly feed between 5-10m above the ground, well below the area swept by the blades. Figures 1.1-1.6 show typical feeding heights for those species recorded close to the proposed wind farm location. Information on typical feeding heights is limited and will vary considerably depending on the habitats being used by the various species. These diagrams are only intended to give an approximate indication of known feeding habits for some species of bat in the UK.

High-flying aerial feeders such as serotines and noctules potentially have the highest risk of entering the area swept by the blades. However it is unlikely that bats will be foraging over the arable fields around the turbines. The pasture and improved grassland close to the site will be more favoured foraging areas of these species, although feeding intensity is likely to vary seasonally. Given the large areas of pasture and improved grassland to the south and west of the application site, around Tapnell Farm, it is not thought that the area proposed for the wind farm will be a used by large numbers of these bats.

The value of the area covered by the wind farm for bats is thought to relate primarily to the hedgerows, streams and woodland areas within the development area. These areas provide foraging opportunities for bats, as well as providing links with the wider countryside. Through the careful siting of access routes the connectivity of the existing hedgerows can be maintained to ensure that established foraging routes are retained.

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Appendix A

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Records from Isle of Wight Bat Group

Bat records within 5km of West Wight