

Qr5/Qr6
Vertical Axis Wind
Turbines – visibility to

BATE



Introduction

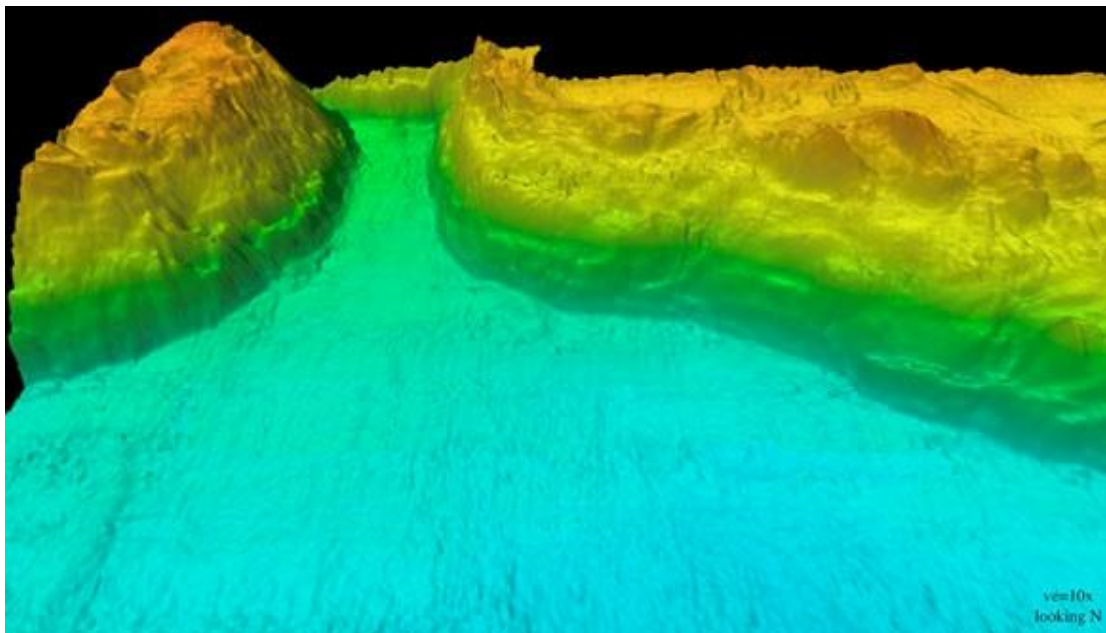
Bats use echolocation, also called biosonar, which enables them to 'see' with a high level of clarity and detail and to navigate and seek prey (typically insects). They are generally active from dusk to dawn, with peak levels of activity at dusk as they will roost once fed. Bat habitats, food sources, distances travelled etc. vary from one species to another.

Bats are most active from April to October and generally hibernate or have extended periods of 'torpor' during winter months, however they do become active in mild weather during the winter. This has become more common in recent years as the winters have become milder.

Bats are able to detect small flying objects and can fly through a cluttered woodland environment, even when tree branches and leaves are being moved by high winds. Bats have and use their vision but in dark environments they rely on echolocation for navigation.

Bats produce two types of echolocation call: Constant Frequency and Frequency Modulation (calls that descend in pitch - Bennu 2001). Each type reveals different information for the bat. Constant Frequency is used to detect an object, and Frequency Modulated is used to provide information regarding the nature of the object and its distance.

It is highly probable that bats create an audio picture of their environment. The image below is a sonar image of a sea-bed, perhaps indicating the level of detail a bat 'sees' using echolocation.



Reduction in Bat populations

There are several main issues that cause a reduction in bat numbers. They are listed below in order of importance with a commentary on whether the installation of a small wind turbine might have a negative impact.

1. **Loss of habitat**

Loss of habitat is associated with removal of ponds, intensive agriculture, forestry management, building on brown field sites, repairs of older buildings where access is sealed and chemical treatments kill bats and their young.

A small scale wind turbine installation is highly unlikely to cause loss of habitat.

2. **Loss of food source**

"A loss of insects has contributed to the decline in bat populations Loss of habitat, the use of pesticides and intensive farming practices have led to a reduction in the abundance of insects which the bats rely on as their only food source."

[Bat Conservation Trust]

We don't anticipate that a turbine installation would affect the total levels of food. A wind turbine will kill some insects, but only a fraction of a percent of the insect population in the area and probably far less than vehicles travelling on adjacent roads.

3. **Pollution**

Pollution may not affect the bats directly but may affect their food source.

"It is clear that populations have suffered declines, the causes are poorly understood but thought to include changes in agriculture, the use of insecticides, habitat loss and change, disturbance and loss of breeding and resting places."

[Bat Conservation Trust]

The installation of a wind turbine will not affect pollution levels.

4. **Global warming**

Global warming will cause loss of habitat and loss of food. It will cause a variety of different species of insects and bats to migrate to the UK affecting existing populations.

"Storms devastate bat population"

"Summer storms are being blamed for devastating Scotland's bat population prompting fears that global warming could jeopardise the future of the species"

[Independent Tuesday, 19 October 2004 Paul Kelbie, Scotland Correspondent]

Renewable Energy devices such as wind turbines are of course part of the solution to Global Warming, so effectively protecting bat habitats.

5. **Predators**

Bat predators include Owls [Tawney & Barn], Raptors such as Kestrels & Falcons. In addition bats living close to the ground may be taken by stoats, weasels, cats and perhaps snakes and foxes.

Wind turbines will have no effect on predator levels.

6. **Forest and building management disturbing roosts**

Wind turbines by their very nature are situated well away from trees and forests.

7. **Impacts from man-made activities such as aircraft, vehicles and other**

This last category is where the installation of a wind turbine could potentially be relevant, the key questions being how likely a bat is to fly into a wind turbine by mistake.

Are bats inquisitive?

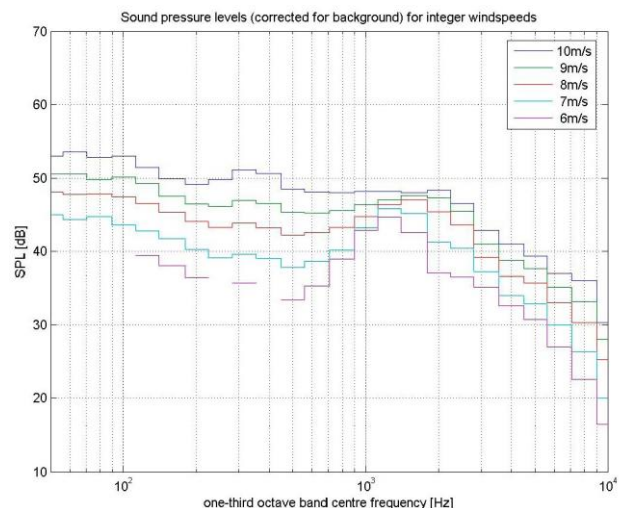
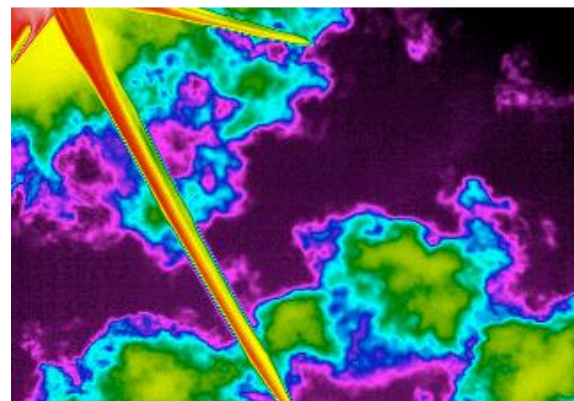
We do not know whether bats are attracted to man-made objects. It is possible that objects that emit sounds in the ultra-sonic range might be of interest, or that the bats are simply inquisitive about the environment in which they inhabit. See video clip.

Even if bats are inquisitive, it would appear that the qr turbine produces very low levels of high frequency noise, see one-third octave band centre frequency graph.

Note: sound pressure levels are declining rapidly beyond 1000 Hz and by 10,000 Hz are low for all wind speeds.

Bats typically use sound frequencies between 20kHz-200kHz. It would appear that the qr turbine is unlikely to produce noise interference to bats nor be a source of interest.

The qr turbine utilises an ultrasonic anemometer to monitor wind speed and direction. The operating frequency is 150kHz, however the manufacture has advised that the anemometers we use have previously been utilised for studies of bats in caves, without any effect on the population.



It is known that occasionally bats collide with car aerials on moving vehicles leading to a small number of reported fatalities.

Flight in high winds

Bats are able to fly in strong wind, however these conditions are likely to be less favourable to the insects on which they feed. In higher wind conditions, bats will probably choose to hunt in more sheltered areas.

Pulmonary Barotraumas

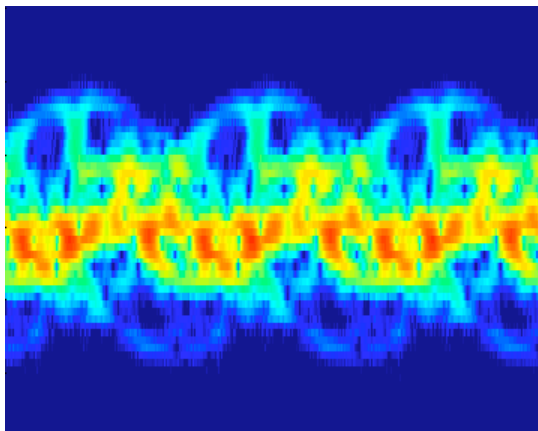
Recent reports claim that bats suffer barotraumas near large wind turbines, the hypothesis being that the pressure drop is causing the trauma.

For a 'wind turbine aerofoil' to provide lift it relies on pressure differentials. A major pressure drop is very localised to the aerofoil, typically a cord1 length or less, so a bat would need to be very close to the turbine to be affected. In the case of a qr turbine the bat would need to be within 20 cm of the rotating aerofoil.

The hypothesis for barotraumas within bat populations may well prove to be substantiated with further studies as it would appear to be a reasonable argument given the evidence. However these studies to date have focused on large scale wind turbines in the US where the speed of the aerofoil and cord lengths are many times larger than a qr VAWT. The 'zone' of pressure drop as well as the pressure differentials will be far greater in large scale turbines than in the qr turbine.

Collisions with rotors

We suspect that a bat will clearly see a qr VAWT while in operation. To the eye it looks like a semi-solid object [picture], to a bat's sonar it will probably look rather like a high resolution radar image.





Conclusion

We anticipate that bats will easily 'see' quiet**revolution** turbines, we also do not expect our turbines to have any detrimental impact on the local environment that would affect food source or habitat. The company is keen to set up a test to confirm this hypothesis and will be happy to work with the Bats Conservation Trust and other key stakeholders to this end.

A summary 'brief' for such a test is below.

Brief:

To examine the impact of the installation of a quietrevolution qr VAWT within the proximity of known bat colonies.

Introduction

quietrevolution wish to explore whether there are real risks to bat population numbers from the installation of qr VAWTs.

We use the word ‘see’ to describe the ability of a bat to form a ‘sound picture’ using ultrasound.

We hope that interested parties and stakeholders will support our endeavours to investigate whether bats are injured by our turbines or whether the turbines can be clearly ‘seen’ when in operation and that bats will avoid the spinning rotor.

Natural England’s guideline document, IN13.6, requires local authorities to consider mitigation measures if bat populations might be affected by development:

“Mitigation to reduce or compensate for any impact of development is likely to be a condition of the licence and must be proportionate to the impact. Mitigation may require particular timing of operations, protection of existing roosts or the creation of new roosts to replace ones being lost. In some cases, a considerable period of time may be required to carry out this work. Monitoring of the effect of the mitigation is usually required.”

Factors

Currently there is some evidence, collected from large wind farms using industrial scaled HAWTs, that bats are from time to time killed by wind turbines, whether from direct collision or other trauma.

There are [to our knowledge] no published papers following field trials that quantify the risk to bats from small scale wind turbines, VAWTs in particular.

Due to the lack of data, the current advice given to planning departments by conservation groups is broadly as follows:

- There are some risks associated with wind turbine placement close to bat populations or along bat flight paths. However the level of risk cannot be quantified due to lack of evidence.
- The current thinking is to remove the risk by placing the turbine away from the populations.
- There is a lack of evidence for many reasons:
 - It is time consuming to monitor bats
 - It is costly to set up instrumentation
 - The instrumentation will usually only indicate that bats are in the proximity rather than inform whether there have been any injuries or fatalities.
 - If there are fatalities [or injuries], scavengers will probably remove the corpses before they are found.

In every natural species population there is always greater reproduction than the local environment can support. The reasons for this phenomenon are numerous:

- There will always be some individuals that are weak or deformed at birth
- There will be losses from predators
- There will be freak occurrences that may devastate populations, over breeding allows population to increase more rapidly when favourable conditions return.
- If habitat or food sources increase there are sufficient species numbers available to exploit the new habitat [e.g. new opening into roof eaves, the addition of bat boxes to a locality]

Individual bat deaths are both undesirable and emotive, however one or two deaths are unlikely to cause population decline. If fatalities are observed, the deaths may be part of a natural selection process – the bats in question may already be injured, unwell or unable to properly echolocate.

As the original ‘health’ of an individual bat is too difficult to ascertain following a recorded / reported trauma, it is probably best to assume that if there are any fatalities in the proximity of the turbine that the bat was healthy.

Stakeholders

- The site owner
- quietrevolution
- The local authority
- Bat Conservation Trust / Environmental Impact Assessor
- The Local Community

The site owner may be keen to progress with an installation of wind turbines on their site, however they are concerned that they will be left with costs should the turbines fail the monitoring programme.

quietrevolution wish to demonstrate our belief that bats will not be adversely affected by the installation of our turbines.

The local authority does not wish to support projects that may have impacts on protected species.

The Bat Conservation Trust [BCT] are understandably very cautious over the siting of small scale wind turbines where there could be a threat to both individual bats and more importantly colonies.

The local community will have diverse opinions on the subject. It is important to demonstrate a reasonable approach and a robust methodology for monitoring.

The main issue is that there is currently a relatively low level of understanding on how and whether wind turbines have a major effect on bats or not. In addition, there has been very little research on the effects different small scale wind technologies have on individual bats and bat populations in general.

quietrevolution are keen to work with various stakeholders, especially the Bat Conservation Trust to establish a methodology for monitoring and assessing the effects of the qr VAWT. Below is an initial methodology for discussion.

Methodology / Agreement

The local authority agree to grant planning permission with a condition that the following survey will take place and the results be reported to the local authority.

The local authority planning condition should allow the turbine to remain in situ but at reduced operational hours should the monitoring prove that there is a risk to bat populations at certain times of the day.

That if no bat fatalities are observed during the testing program, the turbine will be allowed to operate 24/7/365 for the life of the turbine.

If bat fatalities are observed, the turbine will be allowed to operate during all times when bats are not normally active.

Testing program

Agree brief, 1st Draft:

- Install a qr wind turbine with operating hours that are limited to those hours that bats are inactive [daytime all year and winter months].
- Check the site for bat deaths / bat impacts on regularly. [The BCT have volunteers who might undertake this work].
- Gradually increase the operating hours of the turbine - initially the early hours of the morning [bats are less active in the morning than at dusk].
- Keep increasing total operating hours until 24/7 is achieved.
- Thermal night imaging cameras might be used during the observation period to look for bats interest in the turbines.

The testing program should take place between April and September to ensure that the testing is undertaken while the bat population is active.

Stage 1

- Install Rotor at location that is known to be within the 'zone of concern' as identified by the BCT.
- Rotor to be installed and commissioned.
- The rotor is to be left operational for the hours of dawn to dusk. The rotor is to be switched off at dusk.
- The rotor is to be installed with sound equipment with the ability to detect bats within the vicinity to the turbine.

Stage 1 is designed to last approx. 2 weeks. During this period visits / observations are to take place from time to time to view the rotor in operation and to witness the interaction of bats on the rotor.

Stage 2

- The rotor operational hours are to be extended by 1 hour into the initial dusk period. The rotor is to be observed for the entire hour.

Stage 2 is to last approx. 1 week.

Stage 3

- Repeat of Stage 2, extending the operating hours and observation hours by a further hour every 2 days until the turbine is operating from dawn to midnight.

Stage 4

- Repeat stages 2 and 3 for the hours from dawn back to midnight.

Following completion of stage 4, the testing program would be considered as complete.

The number of bat observations would be recorded as follows:

- bats seen by observers
- bats within 5m of turbines
- bats within 1m of turbine
- bat fatalities caused by the turbine

If fatalities are seen, the corpse should be recovered.

It is not necessary to undertake observations on consecutive nights.

Stage 5

- Add bat roost boxes to the turbine mast

Items for further discussion:

Any additional measures we propose to do to de-risk bat deaths? Any further investigation required following turbine installation?
Any additional reporting required?
Is all party consensus required?
What level of injury is acceptable?

1 : Cord length of Aerofoil : The dimension from leading edge to trailing edge, a qr5's cord length is approx. 200mm [perpendicular to airflow at widest point]

2. Information sources:

THREATS TO BATS – Source: <http://www.bats.org.uk>
<http://www.sciencedirect.com/science>

http://www.wired.com/science/planetearth/multimedia/2008/01/mf_continentalshelf_ss?slide=6&slideView=3