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**New Zealand Bat Recovery Group Information sheet**

This information sheet summarises current understanding of the potential impacts of windfarms on New Zealand bats and the potential management responses. The research on windfarms and bats is rapidly changing so the reader should always be scanning for the latest information.

# Bats and windfarms in New Zealand

**Overview:**

1. Bats are Absolutely Protected Wildlife under the Wildlife Act 1953. Under Section 63 of the Act, it is an offence to kill, hunt, possess, molest or disturb bats. DOC is not able to authorise disturbing bats under the Wildlife Act and is unlikely to authorise killing bats because that would be inconsistent with the Act's purpose (i.e., the protection and control of wildlife).
2. The Department of Conservation Bat Recovery Group supports the development and the use of sustainable energy in New Zealand.
3. However, windfarms are known to kill significant numbers of bats globally. The critically endangered New Zealand long-tailed bat and the lesser short-tailed bat are known to feed and travel through open areas around proposed windfarms in New Zealand where they will be vulnerable to collisions with the towers, the blades, and barotrauma. Therefore, our position is:

    ***Windfarms should not be developed in areas occupied by bats because of the risks to these threatened bat species from operating turbines.***

4. If an applicant proceeds with windfarm proposals in occupied bat habitats, then the Recovery Group recommends avoiding habitat loss (both roosting, commuting, and foraging habitats) and supports the introduction of effective techniques to minimise

impacts based on global best practice, and adapted for the New Zealand bat species, to reduce the potential to disturb, kill or injure bats.

5. Before decisions are made about windfarm placement, sufficient information on the bats is needed to inform decisions. Bat surveys will normally need to be undertaken to determine if and when bats are present and how they are distributed at, and around, the site through the year. Habitat use by bats varies by season therefore surveys need to consider use across the entire year (preferably several years) to determine how bats are using the landscape. Single surveys may miss significant bat activity.

6. To date, overseas strategies that curtail turbine activity when bats are present, or predicted to be present, only reduce mortality of bats rather than stopping it. Some curtailment strategies have been successful at reducing bat mortality by c.50 – c.85%. However, successful strategies are often species, site, or even turbine, specific.

7. No-one has tested curtailment strategies for New Zealand bats, but the rich overseas literature shows us there are options for curtailment to reduce risk to bats.

8. Acoustic deterrents have been used overseas to encourage bats to avoid windfarms. Their success appears to be variable, and sometimes temporary only, and it is ineffective for many species. However, their effectiveness has not been tested with New Zealand species. Testing them would require Animal Ethics approval.

9. The effectiveness of any mitigation techniques applied to avoid harm to New Zealand bats needs to be validated by monitoring responses of bat populations and, if ineffective, protocols should be reviewed and improved.

**Summary of research:**

1. Conservation status of New Zealand bats

- Two threatened bat species occur in New Zealand that may interact with proposed windfarms – the long-tailed bat (*Chalinolobus tuberculatus*) and lesser short-tailed bat (*Mystacina tuberculata*).
- Both bats are Absolutely Protected Wildlife under the Wildlife Act 1953. Under Section 63 of the Act, it is an offence to kill, hunt, possess, molest or disturb bats. DOC cannot authorise anything that would be inconsistent with the Act's purpose (i.e., the purpose of the Act is the protection and control of wildlife).
- The long-tailed bat is the most threatened of the two species. It is assigned to the category most at risk of extinction; "Nationally Critical" (O'Donnell *et al*. 2023). This is based on an assessment of studies where the rate of decline in unmanaged populations was 5-9% per annum suggesting a high probability of a 70% decline within the next three generations (Pryde *et al*. 2005, 2006; O'Donnell *et al*. 2017).
- In the context of windfarms, this is a higher risk situation than that recorded in Europe and the USA where many of the species at risk from turbines are not critically endangered.
- <u>This rarity makes the New Zealand situation even more challenging to assess the risk a windfarm poses and monitor responses to mitigation methods or measure their effectiveness.</u>

2. <u>Species vulnerable around proposed windfarms</u>
    - There is no plausibly supported reason to expect that windfarms in New Zealand, if placed in bat commuting or foraging areas, would not cause deaths and injury to New Zealand bat species.
    - Long-tailed bats are vulnerable to death or injury from wind turbines due to collisions with the towers and blades and barotrauma from moving blades because they feed and commute in open and forest edge habitats similar to those habitats proposed for windfarms (O'Donnell 2000, O'Donnell *et al*. 2006, Davidson-Watts 2019, Borkin & Parsons 2011, Bennett 2019, Boffa Miskell 2019). They are also potentially attracted to wind turbines out of

curiosity as they may provide potential feeding and roosting opportunities (Cryan & Barclay 2009).

- Lesser short-tailed bats may also be vulnerable to turbines because, although they prefer old growth forest, they have been recorded flying along forest edges and in open areas (Bennett 2019, O'Donnell *et al*. 2006).

3. Habitat use patterns of New Zealand bats that make them vulnerable to wind turbines
    - There are several studies now that show that bats that have similar requirements and behaviours to New Zealand bats may be attracted to turbines as blades warm the air and attract insects (Cryan & Barclay 2009, Horn *et al*. 2008). As the long-tailed bat is entirely insectivorous it is likely that it would react in a similar way.
    - There are numerous studies that show long-tailed bats frequently feed or commute in open habitats (O'Donnell 2000, O'Donnell *et al*. 2006, Davidson-Watts 2019, Borkin & Parsons 2011, Bennett 2019, Boffa Miskell 2019). Lesser short-tailed bats also commute and forage across open areas (O'Donnell *et al*. 1999, Christie & O'Donnell 2014, Bennett 2019).
    - In New Zealand, windy conditions do not rule out the presence of foraging and commuting bats.
4. Impacts of windfarms on bats globally
    - Widespread international research has found significant negative effects of windfarms on numerous bat species in all continents (e.g., Barclay *et al*. 2007, Kunz *et al*. 2007, Cryan & Barclay 2009, Rydell *et al*. 2010, Grodsky *et al*. 2011, Georgiakakis *et al*. 2012, Roscioni *et al*. 2013, Arnett & Baerwald 2013, Aronson *et al*. 2014). Bats are killed by collisions with the towers, the blades, and by barotrauma (Cryan & Barclay 2009). Barotrauma is caused by rapid decompression areas behind the moving blades resulting in internal haemorrhaging of the lungs (Baerwald *et al*. 2008). Hypotheses have been presented that bats may just randomly collide with turbines, or it may be that they forage in the area with turbines, and collisions are due to

attraction to the turbines themselves. Bats may also be attracted to wind turbines to investigate if they are a potential roost because the tower produces an echo signature similar to that of a tree (Cryan & Barclay 2009, Cryan *et al*. 2014).

- The tips of turbine blades are the main hazard area for bats (this is where they are most often killed). Therefore, outer most turbine blade tips (rather than the base of the turbine) should be placed farther than 200 metres from the forest edges (i.e., the zone most frequently used by foraging bats) to reduce risks.

5. <u>Determining if a proposed windfarm site is likely to support bats in New Zealand</u>

- A simple flow chart to show the decisions that should be made when considering siting a windfarm that may overlap with long-tailed bat habitats is provided in Appendix 1 and Table 1.
- The most up to date maps of long-tailed and lesser short-tailed bat distribution should be used to help determine if bats are present or likely to be present (Appendix 2 or contact DOC for the latest version)[1]. https://www.doc.govt.nz/our-work/monitoring-reporting/request-monitoring-data/. However, there have been no bat surveys in many parts of New Zealand, so a precautionary approach should be used to interpreting existing distribution maps.
- If bats are present, consider moving to new site where there are no bats.
- To determine presence of bats, developers should undertake a minimum of three surveys to cover spring, summer and autumn, which may need to be over several years, because habitat use patterns and flight ranges vary over time. Absence of bats in one season does not mean that they will not be present in others.
- If no bats are detected, and it is agreed by bat specialists that the surveys have been adequate, then, from a bat perspective, planning could go ahead

[1] New Zealand bats can fly >25 km from roost sites to foraging areas in a night. Therefore, consideration should be given to bat records >25 km from a proposed wind farm site in the assessment.

without further consideration of bats (although there may be other biodiversity issues to be considered).

6. Strategies to reduce bat fatalities.

- Where bats are present, further monitoring should be done to determine bat activity and habitat use at and near all potential wind turbine sites and the surrounding area to determine how the bats are using the landscape, areas of hotspots and potential flight paths so that these areas can be avoided. Methods to help determine this information could include using automatic bat detectors, radiotracking bats and thermal imaging. An example of a suitable monitoring exercise of long-tailed bats at a wind farm of approx. 50 wind turbines is deployment of 80 Automatic Bat Detector Units with four monitoring sessions between November and April to describe habitat use patterns adequately (Ian Davidson-Watts pers. comm.).
- There is literature on curtailing turbine activity when bats are present. It is necessary to review all the most up to date literature available and be aware that new insights are being published all the time.
- Overseas research has found that stopping blades spinning at low wind speeds can reduce bat fatalities in the order of c.50 – c.85% ( e.g., Arnett et al. 2010; Măntoiu et al. 2020; Adams et al. 2021; Bennett et al. 2022). This includes feathering, where the turbine blades are turned to point into the wind in order to reduce surface area and to slow or stop blade rotation at or below the cut-in speed. In addition to feathering, increasing cut-in speeds (the wind speed at which the turbines begin producing electricity) has been found to be effective at reducing the number of bats killed for some species.
- Blanket curtailment strategies can mean that the turbines may be inactive when bats are not present. Research has therefore been done on site specific curtailment strategies based on activity when bats are predicted to be present (e.g., Adams *et al*. 2021, Friedenberg & Frick 2021, Voigt *et al*. 2022).
- Curtailment periods can be determined by predicting times when bats will be active using on-site data (temperature, wind speed), or from observations.

Environmental variables or bat activity should be measured from, or very near, every turbine site. Curtailment procedures can then be automated to reduce the time when harm could be caused. Research to date has formulated curtailment times for specific sites and types of turbine and cannot be generalised for use in other places (Voigt *et al* 2015).

- Curtailment periods can also be instigated when bats are known to be present (live-curtailment). This has the advantage of reducing the amount of time that the turbines are **not** active when bats are **not** present. This technique is highly reliant on monitoring using bat detectors. Problems associated with this method include the efficacy of bat detectors at detecting bats, attenuation of bat calls over relatively short distances, suitable placement of recorders and the ability to switch the turbine off quickly. Peterson (2020) noted high variation between the rates at which detectors recorded bats, which would need to be accounted for in any research. There has been no widespread uptake of this technique and further research would be required (Frick et al 2020).

- Bat Deterrents: Research has been done on the effectiveness of ultrasonic deterrents to reduce bat mortality. Effectiveness varies between species (Romano *et al*. 2019, Good *et al*. 2020, Weaver *et al*. 2020). Where it has been used, it has only reduced fatality rates, not halted them, and for many species deterrence did not help at all. The effect of acoustic deterrents on New Zealand bats is unknown and may change with continued use of the deterrent (i.e., they may become habituated, making the deterrent ineffective). Any research into the effectiveness of this method would need to consider the immediate and long-term effects and would need an Animal Ethics approval.

Table 1: Options to reduce bat fatalities at windfarms

| Reduce bat fatality | Options | Method | Pros/cons |
|---|---|---|---|
| 1. **Avoid** bat areas | Only site wind farms in areas where there are no bats | Implement at least three seasonal presence/absence surveys to ensure that bats are not on the site. This may have to be done over several years if there is some doubt about activity or if weather is poor during surveys. | Removes the risk of killing bats |
| 2. Placement of turbines | Turbines should not be placed within 200m of the forest edge (Rodrigues et al 2015) Turbines should not be placed across flyways. Avoid areas of high activity | Position turbines as far away as possible from the forest edges | May avoid areas of highest activity but bats can still be killed in open areas. Bats can still be killed in open areas and may be attracted to wind turbines. |
| 3. Implement feathering at low wind speeds along with increasing the wind speed where turbines become operational (cut-in speed). | Preventing the blades turning at low wind speeds (feathering) **and** implementing a cut-in speed for turbine operation. | Feather the blades at low wind speed and the implement a cut in speed. Based on current research this is between 5-7.5 ms-1. However, these speeds have not been tested on New Zealand bats. | Straight forward to implement and proven to reduce bat fatalities overseas. Bats may be flying at higher wind speed so may still be at risk. Turbines may be curtailed even when there are no bats present. |
| 4. Halt turbine activity when bats predicted to be present | Single turbine implementation Multiple turbine implementation. Near real-time acoustic bat detections and wind speed thresholds to trigger curtailment | Use overseas parameters (Korner-Nievergelt *et al*. 2013, Correia *et al*. 2013, Behr *et al*. 2017; Hayes *et al* 2019, Hayes *et al* 2023, Whitby et al 2021). Undertake NZ specific study to develop models. SMART vs simple (Farnsworth *et al*. 2021). | Studies to date have been site and turbine specific therefore the algorithms are not transferable. NZ study will take time and be extra cost but would yield more accurate predictions. |

| | | | |
|---|---|---|---|
| 5. Halt turbine activity when bats are present | Bat detectors at single turbines<br>Bat detectors close to multiple turbines | Simple yes/no, on/off. The timing of the shut off would need to be immediate. | Less time switched off than if using modelled time.<br>Bats will only be available for detection when they pass within the range of an acoustic detector which will only be a small proportion of the area around the turbine. Detectors may or may not detect bats even when they are present due to varying sensitivities in detectors (Peterson 2020).<br>A suitable detector system and call classification system will need to be developed for New Zealand bats. |
| 6. Bat deterrents | Use acoustic lures to deter bats from the turbines | Set up acoustic lures at all turbines | Efficacy varies with species. Has not been tested in New Zealand. Bats may become habituated to the lure. However, illegal to disturb bats, and needs ethical assessment. |

- Building high turbines will not resolve the risk of bat-deaths and injury because bats can fly high (>60 m) and may be attracted to higher blades or the tower and nacelle, e.g., to inspect it as a potential roost. The turbines heat the air, and invertebrates can be attracted to higher levels (Cryan & Barclay, Horn *et al*. 2008) and this may in turn attract bats.

7. <u>Monitoring success of mitigation strategies</u>

- The efficacy of mitigation strategies to reduce harm to bats on windfarms in New Zealand is unknown. Therefore, long term monitoring (following international standards) must be undertaken at all windfarms in bat areas (i.e., monitoring all turbines for 5-10 years with robust statistical standards, with independent checks and adjustments made for scavenging rates and observer biases; Korner-Nievergelt *et al*. 2013, 2015, Dominguez del Valle *et al*. 2020). For example, during a study at the Te Uku windfarm in New Zealand, observers were not able to detect the small carcasses placed on site to test their effectiveness at finding them. No adjustments were made to account for this (Boffa Miskell 2014). This means that the results of the three years monitoring were unreliable. Recent studies show that dogs outperform humans searching for small carcasses such as bats so this needs to be considered in monitoring programmes (Dominguez del Valle *et al*. 2020).

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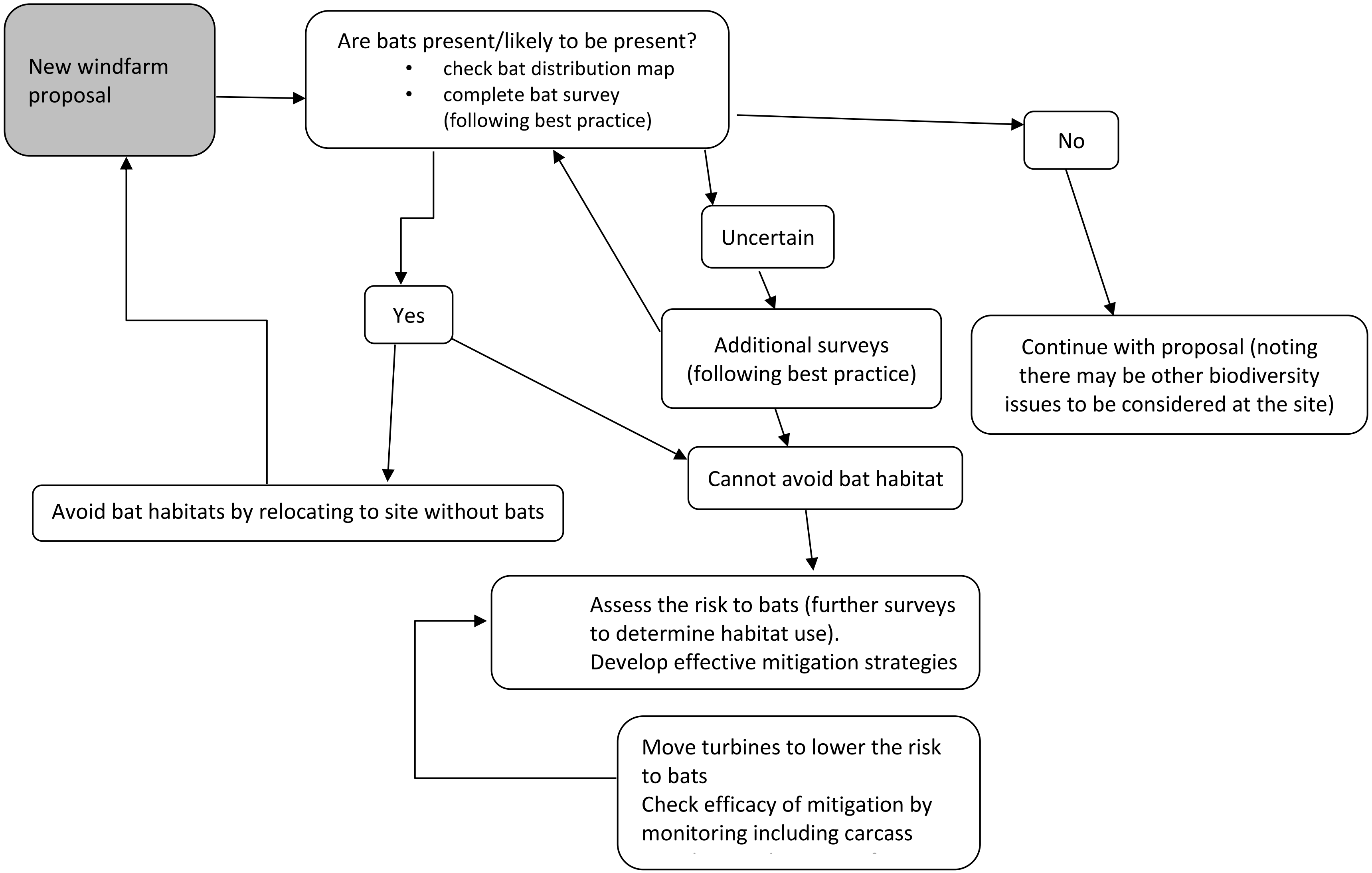
Appendix 1 – Flow diagram for assessing suitability of proposed windfarm sites in the context of bats in New Zealand.



**Appendix 2a**: Distribution of long-tailed bat records in New Zealand from 1990 onwards. Sites where long-tailed bats have been detected are shown with a pink dot. Each sighting has a with 11 km buffer added to closely reflect median home range size based on home range studies (Dekrout 2009, Davidson-Watts 2019, Borkin and Parsons 2011, O'Donnell 2001).

**Appendix 2b**: Distribution of lesser short-tailed bat records in New Zealand from 1990 onwards. Sites where lesser short-tailed bats have been detected are shown with a purple dot. Each sighting has a with a 11 km buffer added to closely reflect median home range size (Christie & O'Donnell 2014, O'Donnell *et al* 1999).