POST-CONSTRUCTION WIND ENERGY PROTOCOL FOR BATS

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Introduction

This post-construction protocol provides instructions for companies monitoring bat activity and fatalities at wind energy facilities. Following this protocol allows data to be gathered consistently across sites. Because every situation is different, this protocol should be discussed with Alberta Environment and Parks (AEP), Fish and Wildlife, Operations Division, prior to implementation in case minor amendments are required; however, modifications should be kept to a minimum and only with sufficient justification. Adjustments may be required pending data collection (e.g., high carcass counts in a portion of the facility may require more intensive monitoring in that area).

Post-construction data can be used to determine whether the number of bat fatalities at a particular site warrants operational mitigation at that site. If it is determined that mitigation is necessary, mitigation options, and an implementation and monitoring plan for these activities, should be developed in consultation with AEP.

This protocol is based on data collected from a subset of southern Alberta wind farms and from post-construction guidelines from other North American jurisdictions. Thus, it is not known whether survey periods and survey methods will be applicable to all of Alberta until research has been conducted in various regions of the province. See Table 1 for definitions for each monitoring season. When conducting research from May to October, it should be treated as three seasons when determining the number of trials required for searcher efficiency and carcass persistence.

1. Carcass searches

- Timing: 1 May to 1 October, per the frequency intervals below. Dates can be adjusted for locations at different latitudes within the province.
- Frequency: Table 1 indicates the recommended search frequency for each season.

Table 1. Recommended Carcass Search Frequency by Monitoring Season

Season	Dates	Search Frequency
Spring bat migration	May 1st to May 31st	Once every 7 days
Summer	June 1st to July 14th	Once every 7 days
Fall bat migration	July 15th to October 1st	Once every 3 to 7 days

Note: Search Frequency may change if results from carcass persistence suggest that a different frequency is more appropriate (e.g., if carcass removal rate is high, sampling interval may need to decrease), provided it is still possible to calculate fatality estimates.

- Duration: Discussions regarding the duration of the program should be conducted with AEP prior to construction, and potentially during pre-determined milestones

during the program. Monitoring duration may be longer depending on whether mitigation is implemented, and the type of mitigation.

- Number of turbines to survey:

Table 2. Recommended Turbine Sample Size based on Project Size

Project Size	Turbine Sample Size
≤ 20 turbines	100% of turbines
21 to 40 turbines	The greater of 20 turbines or 75% of project turbines
41 to 60 turbines	The greater of 30 turbines or 65% of project turbines
≥ 61 turbines	The greater of 31 turbines or 50% of project turbines

The number of turbines recommended to be surveyed may be amended pending annual results. It is important to ensure that selected turbines represent different habitat types (e.g., native pasture, cultivated cropland) and topographical features (e.g., ridge lines, proximity to coulees, open/low-lying areas), and cover the geographic distribution of the wind farm. Turbines on the edges of arrays should constitute a disproportionally large percent of selected turbines, especially in non-cultivated areas.

- Visibility classes: These help to account for differential detectability between plots; between 2 and 4 classes are recommended. The following classes are recommended in Strickland et al. 2011:
    - Class 1 (easy): Bare ground 90% or greater; all ground cover sparse and 6 inches or less in height (i.e. gravel pad or dirt road).
    - Class 2 (moderate): Bare ground 25% or greater; all ground cover 6 inches or less in height and mostly sparse.
    - Class 3 (difficult): Bare ground 25% or less; 25% or less of ground cover over 12 inches in height.
    - Class 4 (very difficult): Little or no bare ground; more than 25% of ground cover over 12 inches in height.
- Search area per turbine: Search area radius from the base of the turbine must cover a minimum of 50 m or half of the height of the blade, whichever is greater (Strickland et al. 2011). If the whole search area cannot be searched (e.g. due to vegetation or restricted access), the percentage of area searched should be calculated for each turbine.
- Search methods: Searches should be initiated as soon after sunrise as possible. Searchers should follow line transects (see Environment Canada 2007) or spirals (see Baerwald and Barclay 2009) depending on habitat type and terrain features. Spirals are generally more efficient but line transects may be preferable in complex terrain or habitat (e.g., canola cropland). Transect spacing should be determined through discussions with AEP, and consider the number of turbines to be searched (e.g., a greater number of turbines can be searched for the same effort if transect spacing is increased). Spacing between transects is recommended to be between 5 and 10 m depending on habitat type, terrain, and visibility class (i.e., 10 m spacing for visibility Class 1 and 5 m spacing in visibility Class 4). Searchers should walk transects at a slow and consistent pace (e.g., 2.5 to 3.0 kilometers per hour).

- Carcass data collection: Each carcass should be labelled with a unique identification number. At a minimum, the following data should be collected, recorded, and submitted to AEP annually:
    - species found,
    - sex (when possible),
    - age class (Juvenile or Adult; when possible),
    - position of carcass from turbine,
    - the visibility class of where each carcass was found, and
    - the state of the carcass, i.e., intact (not badly decomposed and no sign of being fed on by scavengers), or scavenged (entire carcass shows signs of being fed on or portions of the carcass are missing).
    - if possible, the approximate time of death and suspected cause of death

  If tissue is collected, the protocol from Lausen (2006) should be followed.
- Reporting: If estimated annual fatality rates at the wind farm are between 4 and 8 bats per turbine per year, operators are required to inform AEP immediately and discuss mitigation strategies as per the AEP Bat Mitigation Framework for Wind Power Development (ESRD 2013). Annual reports are to be submitted to AEP as prescribed in the individual wind farms Post-Construction Monitoring Plan signed-off on by AEP.
- Carcass storage: All carcasses collected during searches should be reused in searcher efficiency trials. Carcasses that are not being used in trials can be taken to the AEP Laboratory (O.S. Longman Building, Edmonton) for future use in other searcher efficiency trials.

2. Searcher efficiency trial

- Frequency: Trials should be conducted throughout each season in order to determine how changes in habitat may affect searcher efficiency. This can be achieved by a minimum of three trials (more may be recommended pending habitat changes) spread out over each season, or ongoing blind testing (i.e., one person periodically puts out a carcass without informing the other searcher[s]). As searcher efficiency increases, trials can involve fewer carcasses (if habitat remains the same), but must continue throughout each season.
- Number and type of carcasses: A total of 20 bat carcasses or surrogates per searcher over each season, or 100 carcasses in total (slight variation is acceptable according to different situations). If new searchers join mid-season, trial schedule may need to be adjusted to ensure proper training. Bat carcasses should be used if they are available, and ideally each bat species should be used in trials because detectability can vary with species; however, a shortage of carcasses may make this unfeasible. Trials need to be conducted to identify suitable surrogates given the shortage of bat carcasses, and in the interim, biologists are encouraged to experiment with different types of surrogates. Suitable surrogates may include: dark mice, dark gerbils, or darkly feathered one-day old chicks.
- Technique: Must be blind trials with marked carcasses to distinguish from other carcasses. Remove unfound carcasses.
- Incorporation into fatality estimates: There are a few fatality estimators available, including Huso (2011) and Shoenfeld (2004), with the former being the most

commonly used, and the one recommended by AEP. Refer to Strickland et al. (2011) for a discussion about these estimators and the assumptions used (e.g., whether the average carcass removal time is longer or shorter than the average search interval). Because there is no perfect estimator, more than one estimator is recommended. See Huso (et al. 2012) for a guide to using the Huso fatality estimator.

3. Scavenger trials

- Frequency: Three times (early, middle, late) during each season to capture potential changes in the scavenger community. Leave carcasses out for two weeks or until they disappear, whichever happens first.
- Number and type of carcasses: 12 carcasses per trial (different species, if possible). Fresh or frozen bats are preferred. Frozen bats should be allowed to thaw before being used in trials. Surrogates should only be used for scavenger trials if bat carcasses are not available. Suitable surrogates are darkly-furred small mammals such as mice or gerbils. Strickland et al. (2011) recommend against using bird carcasses because scavenger rates may differ.
- Technique: In order to avoid attracting scavengers to the site, conduct trials away from the search plot if possible, and use a maximum of two carcasses per turbine per trial. It is recommended that carcasses are checked each day crews are on site or are monitored by remote cameras.
- Incorporation into fatality estimates: As per searcher efficiency trials, above.

4. Echolocation monitoring

Acoustic monitoring is recommended to evaluate the efficacy of mitigation activities. In the absence of acoustic monitoring it is not possible to evaluate the level of bat activity around a wind farm, or to compare the level of bat activity to pre-construction levels. It is also necessary to correlate pre-construction acoustic monitoring results with post-construction fatality rates.

- Timing: Per peak in activity observed during pre-construction surveys.
- Duration: Annually with fatality monitoring.
- Locations: Same as pre-construction detector sites, if possible.
- Height: Paired detectors at ground level and at 30 m (or whatever height was used for elevated pre-construction detectors).

5. Presentation and disposition of data

a. Units for recording data: For consistency and clarity, the number of fatalities must be reported as number of fatalities per turbine per year. In addition, the number of fatalities per megawatt may be presented. Also, correction factors and confidence intervals and/or ranges should be provided to understand if searcher efficiency, or other factors, may be contributing to an under- or over-estimate of fatality.

b. Database: Data must be submitted to the AEP Fish and Wildlife Management Information System (FWMIS) database for comparative analyses of pre-post data and geographic comparisons. Review FWMIS load form for required fields and units (https://www.alberta.ca/fisheries-and-wildlife-management-information-system.aspx).

6. Treatment of live bats

Injured bats should be counted as a fatality, regardless of outcome. See Appendix 1.

References

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Appendix 1. Guidelines for management of live bats found at wind energy facilities during mortality surveys

Bat mortality at wind turbines is an issue of growing concern in Alberta, as outlined in *Bats and Wind Turbines. Pre-siting and pre-construction survey protocols (*May 2008). However, because not all grounded bats are fatally injured, these guidelines address how to deal with live bats.
The Wildlife directive for Alberta wind energy projects summarizes potential wildlife issues associated with wind energy projects and provides a directive for minimizing effects to wildlife and wildlife habitat during the siting, construction, and operation of wind energy projects. https://open.alberta.ca/publications/wildlife-2016-no-6

It is illegal in Alberta to handle any live wildlife, including bats, without a specific permit from the Fish and Wildlife Division. In the context of work with live bats, an approved Research Permit and/or Collection Licence is required. Appropriate approvals from the Division must be in place BEFORE any action is taken with injured bats. Therefore, anyone conducting carcass searches should secure appropriate permits in anticipation of finding and handling live bats.

Prolonged holding and treatment of injured bats is not permitted in Alberta, except by qualified wildlife rehabilitation facilities (several conditions apply). Bats with obvious physical trauma such as hemorrhage, broken or severed wings, open lacerations, compound fractures, cranial or otic damage, abdominal evisceration, and/or spinal fractures must be euthanized as per *Alberta Wildlife Animal Care Committee Class Protocol #004: Bat capture, handling, and release,* see ABAT Programs and Publications https://www.alberta.ca/abat-programs-and-publications.aspx. Any non-approved method for euthanasia is unacceptable. Therefore, personnel should be familiar with approved euthanasia methods before entering the field.

Live bats that exhibit no external signs of trauma yet are lethargic, weak, or cannot fly may revive if rehydrated and held in an aerated container kept in a cool dark quiet location for up to 2 hours (Klug and Baerwald, pers. comm.). Revived bats can then be released. In the field, oral rehydration can be a simple and effective treatment; however, it should only be undertaken by persons wearing gloves and who have rabies pre-exposure immunization. If the person is bitten during this procedure, they should seek immediate medical attention. Any bat that does not become fully active and regain coordination within 2 hours should be euthanized (as per Protocol #004 identified above) and submitted for rabies testing.

Anyone who handles a live bat should be familiar with the potential human health risks associated with rabies virus and should take appropriate precautions. While the extent of rabies infection in Alberta bat populations is low, the consequences of potential human exposure are extreme. Rabies infections are fatal and once established cannot be treated or reversed. As such, bats are inappropriate for rehabilitation and caution should be taken when handling all live bats to avoid being bitten.

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Further Reading: Klug, B. J. and E. F. Baerwald. 2010. Incidence and management of live and injured bats at wind energy

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