



Lessons Learned



Lessons Learned from Post - Construction Bird & Bat Monitoring

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Overview

- Overview of Natural Resource Solutions Inc.
- Overview of Post-Construction Mortality Monitoring
- Mortality Search Radius
- Asymmetry of Carcasses
- Searcher Efficiency
- Scavenger Removal
- Other Issues
- Recommendations





Introduction

- NRSI has participated in operational monitoring at wind farms since 2006
- Involved in over 4000MW of wind power projects in Ontario, Manitoba, Saskatchewan, Alberta, and New Brunswick
- Projects range from individual turbines to some of the largest wind projects in Canada



NATURAL RESOURCE SOLUTIONS INC.

Aquatic, Terrestrial and Wetland Biologists



Search Radius

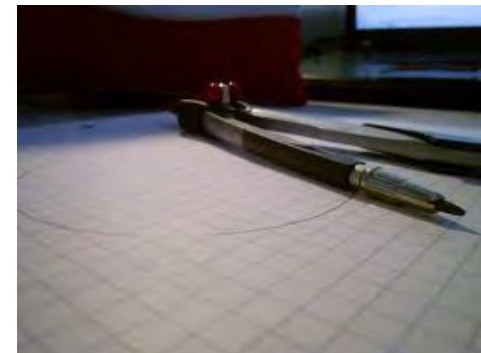
- Literature and methodology documents present a range of metrics for search radius from the base of turbines
- Typical numbers 50m to over 60m radius
- The area searched is related to the square of the radius, a small change in radius can have a substantial impact on search area

45m radius = 6361sq m

50m radius = 7854sq m

55m radius = 9503sq m

60m radius = 11309sq m

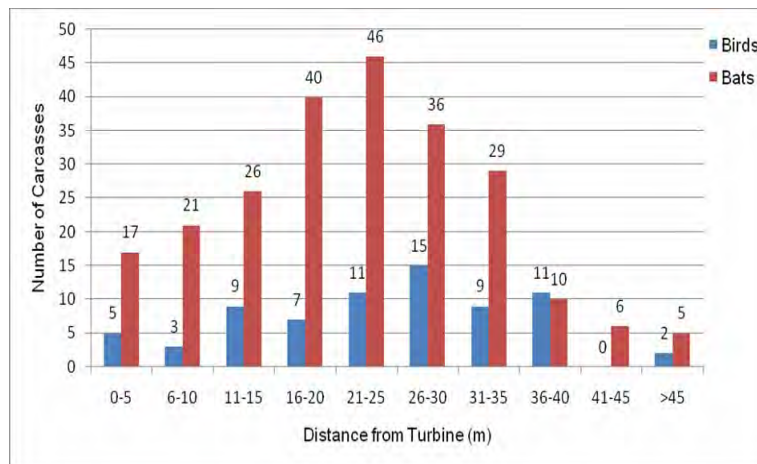


e.g. Going from 45m search radius to 60m is roughly doubling the area



Search Radius

- In some studies researchers have tested the radius
- Measure the distance from carcass to turbine and by plotting this, can determine the confidence in finding carcasses
- In some cases there is an assumption that a known search radius is required (e.g. 50m), and the searcher is required to adjust the results based on the % of the area

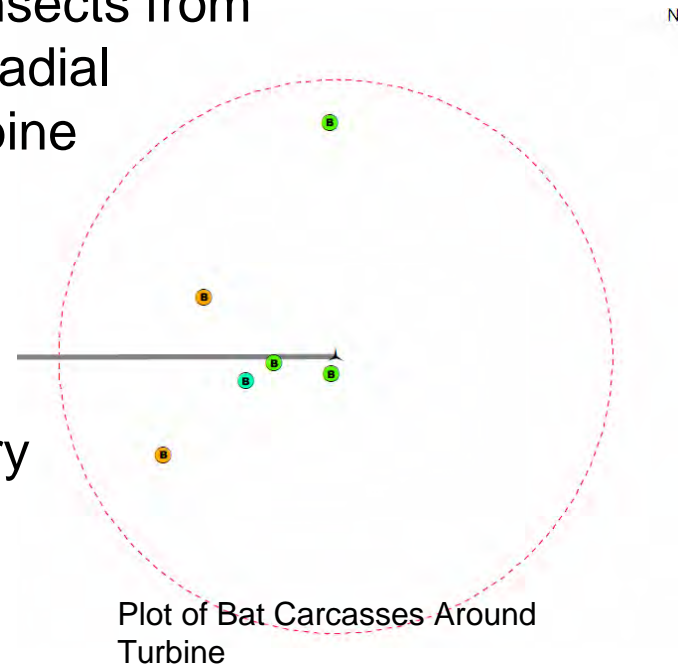


- In this specific case, we see that 45m search radius gave us 95% confidence and therefore an adjust factor is unlikely to be required, but if this other approach is required, adjustment of 123% would be required



Asymmetry of Carcasses

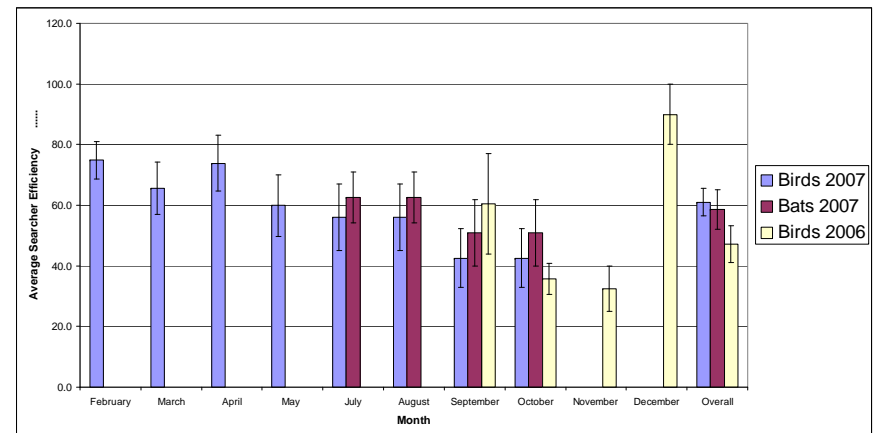
- In most cases full coverage of the area under the turbine, circular, square, variations in the layout of transects, linear vs spiral
- In some studies sectors or radial transects from the turbines are sampled, sample a radial subsample of the area under the turbine
- As part of mortality monitoring, the bearing & distance is recorded
- Provides a measure of the asymmetry of carcass (could result from number of factors - prevailing winds, etc.)





Searcher Efficiency

- What is the success of the individual searcher in finding the carcasses
- Determined in a number of ways, blind test where searcher is tested against a number of known search targets (birds, bats, surrogates)
- Number of factors come to play:
 - Individual to individual success
 - Training
 - Experience
 - Use of dogs
 - Ground cover
 - Related to seasonality in several ways





Searcher Efficiency

Searcher Efficiency by Time of Day

- Requiring crews to search many turbines per day in order to get monitoring requirements completed
- Have not seen any specific data related to searcher fatigue, but personally can attest to this likelihood





Searcher Efficiency

Seasonal Issues

- In cropped lands, change in groundcover through the monitoring period can be extreme, ranging from bare ground where SE is very high to densely grown crops such as corn or soybeans where SE can be very low
- in spring or with some tighter soil types, ponding of water on ground can obscure the carcasses
- in areas close to trees, leaf fall can impede ability of seeing carcasses

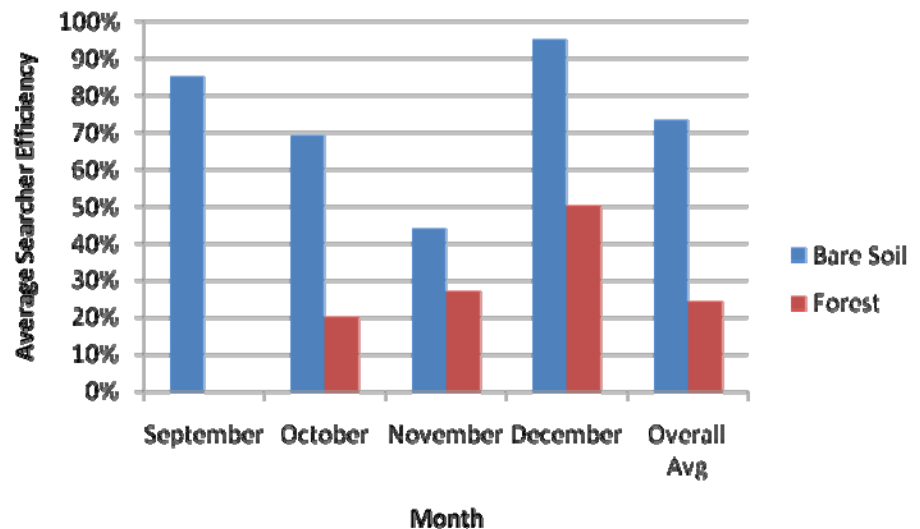




Searcher Efficiency

Woodland Searches

- Searcher efficiency and scavenger removal trials show that carcasses cannot be found
- Too much to obscure search – not worth the effort even with dogs.





Search Data Confounding

Data Confounding

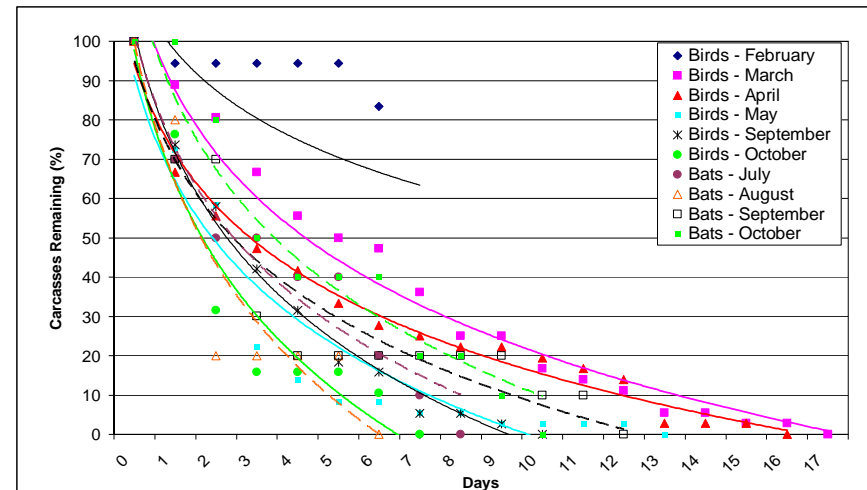
When search frequency is so frequent that results of one search cannot be deemed independent from previous search





Scavenger Removal

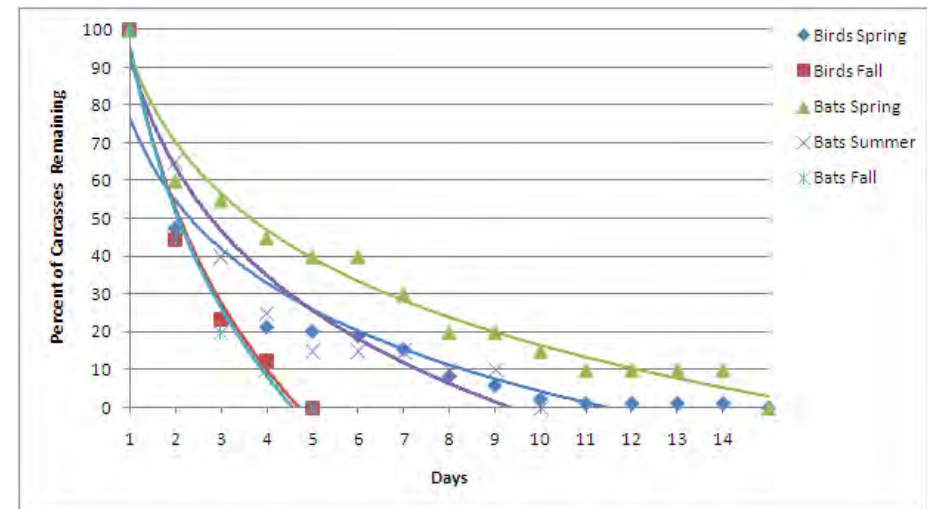
- What is the likelihood that a scavenger removed the carcass before the searcher had a chance to look
- Based on a test where test carcasses are placed and monitored over time (birds, bats, surrogates)
- Can have a substantial impact on results, but also very variable
- Results from studies vary, but in many cases see a semilogarithmic relation





Scavenger Removal

- Scavenger checks occur at varying frequencies, and with semilog relationship as the frequency of checks increases the accuracy of analysis decreases
- in case of semilog, as long as searches occur and are corrected less than or equal to the scavenger check frequency probably ok
- But in some examples there have been linear assumptions that can drastically underestimate the rate of carcass removal

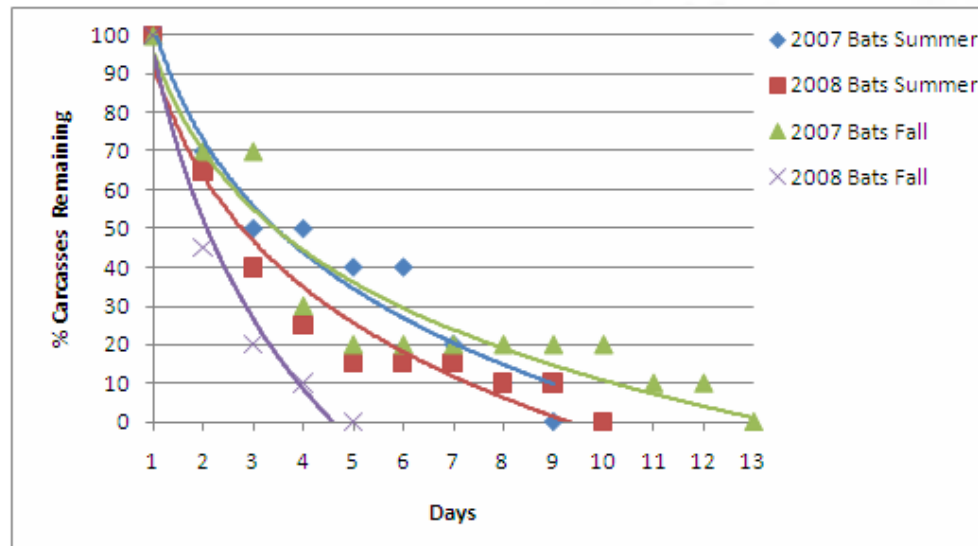




Scavenger Learning

Scavenger Learning

Do scavengers learn that areas around turbines can be a source of prey?





Challenge of Zeros

- Approach to assessing mortality generally based on averaging data across the project
- But if interested in specific turbines, zeros can be difficult to interpret
- Does a zero mean that there are no mortalities or that they were missed or scavenged?



High Adjustment Factors

- It is not uncommon to find that the combination of searcher and scavenger factors require a doubling, quadrupling or more of the number of found carcasses found
- Is the aggregate of conservative adjustment assumptions overwhelming the data?
- How much confidence do we have in the end results?
- In an example, that is not too extreme, a single carcass may after applying adjustments represent 5 dead animals (and you're basically at the threshold for applying mitigation in Ontario)
- The implications of high adjustment factors and the need for replicates to tighten confidence limits.



Recommendations

- Test the search radius as part of your experimental design
- Include full coverage of area under turbine not radial subsample
- Train crews, consider dogs
- Frequent scavenger tests
- Replicates
- The value in tightening up the confidence limits on the adjustment factors cannot be overemphasized

