A web-based application to estimate wildlife fatality: from bias correction factors to corrected fatality estimates

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Outline

Impacts of wind energy facilities

- Wind generated energy is considered as one of the most lowest-priced renewable energy sources available in nature and is recognized to be a viable option for supplying energy needs;
- Unfortunately, wind farms development raise concerns related to the potential effects on flying vertebrates;
- Main areas of concern:
  1. **Mortality caused by collision**;
  2. Displacement of wildlife due to human disturbance;
  3. Effects on migration flyways and/or flight paths;
  4. Direct habitat loss and habitat changes resulting from the construction of wind energy facilities

Mortality caused by collision

- In wind farms, post-construction searches are used to monitor fatalities driven by collision, aiming to estimate real mortality;
- Observed Fatality (C) $\neq$ Real Fatality (F);
- Main reasons:
  1. Carcass removal by scavengers or decomposition (r);
  2. Imperfect detection by observers (p);
  3. Search interval length (i);
  4. Proportion of the searched area (π).

$$\hat{F} = \frac{C}{r \times p}$$

$$\hat{F} = \frac{C}{r \times p \times i}$$

$$\hat{F} = \frac{1}{\pi} \frac{C}{r \times p \times i}$$

Statistical estimation problem

- From a purely statistical point of view quantifying fatality is an *estimation* problem;

Definition

If $\hat{t}$ is an estimate of θ, a loss function — *Absolute Error Loss* — can be defined, reflecting the distance between $\hat{t}$ and θ such as

$$L(\theta, \hat{t}) = |\hat{t} - \theta|$$

- This function reflects the fact that the loss of information increase as the distance between θ and $\hat{f}$ increases;
- In fatality estimation, we aim to find an fatality estimator $\hat{F}$ that minimizes the loss defined by

$$L(F, \hat{f}) = |\hat{f} - F|$$

Minimizing error loss in fatality estimation
What has been done so far?

Carcass Removal:

- Carcass removal trials design (Anderson et al., 1999; Morrison, 2002)
- Modeling "time until removal" data (Bispo et al., 2010)
- Distributional assumptions impacts (Bispo et al., 2011)

Search Efficiency:

- Distance sampling analysis (Kerns, Erickson and Arnett, 2005)
- Trials design — visibility classes (Kerns, Erickson and Arnett, 2005, Bernardino, 2006)
- Dogs detection efficiency (Arnett, 2006; Paula et al., 2011)

Search Interval:

- Effective search interval (Huso, 2010)

Searched Area:

- Modified weight representing an unequal probability sample, Horvitz-Thompson estimator (Huso, 2010)

Computer application

- As the complexity associated with the procedures may hinder its use, we have developed a web-based application to estimate wildlife fatality, the *Wildlife Fatality Estimator*
- Application contents:
  1. Description, documentation and contacts
  2. Carcass Persistence Module
  3. Search Efficiency Module (under development)
  4. Fatality Estimation Module (under development). Available estimators:
     - Huso (2010)
     - Jain et al. (2007)
     - Kerns et al. (2005)
     - Erickson et al. (2004); Shoenfeld (2004)
- Live demonstration — http://internal.bio3.pt/demo:

Conclusion

- *Wildlife Fatality Estimator* highlights:
  1. User-friendly interface.
  2. Easy access: all you need is an internet connection.
  3. Tabular and graphical displays may be printed, saved or copied.
  4. Bias correction factors estimation and fatality estimation can be used independently.
  5. Integrates the several fatality estimators published until now. The user can use them all or simply choose which one(s) to use.
  6. It's free!
- We invite all the conference attendees to try it out during the "*Workshop on Estimating Fatality at Wind-Power Plants*"!

Thank you for your interest!