University of the Highlands and Islands
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A review of avian collision risk models

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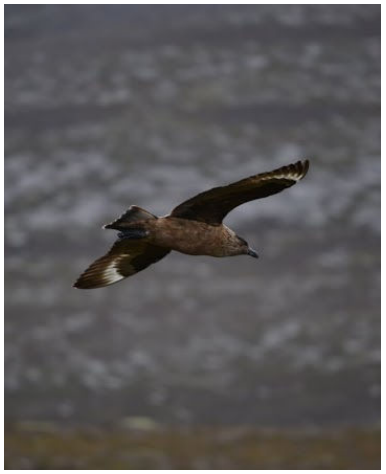
Presentation Outline

1. Background
2. Review of avian collision risk models
3. Opinions on CRM
4. Concluding remarks

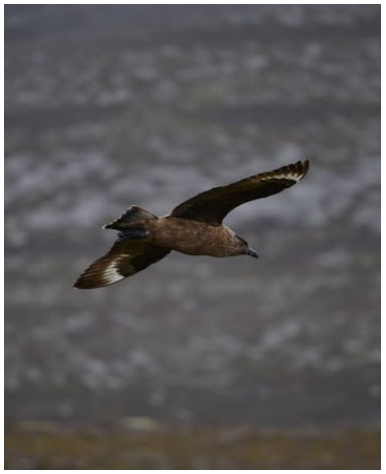
Wind farms and birds

- Increasing number of offshore wind energy projects
- Effects/impacts of individual projects on seabirds
  - Collision
  - Habitat loss (direct or indirect)
  - Barrier effects
- Methods to understand collision include
  - Direct observations
  - Remote observations
  - Corpse searches
  - **Collision Risk Modelling**



Avian Collision Risk Models

- CRM used to predict the likely number of bird collisions with a wind turbine/farm
- Bird and turbine inputs (no variation)
- Core usually probability of collision from a single transit
- Based on probability of a turbine blade occupying same space as bird during the time that bird takes to pass through rotor
- One transit to many, using survey data
- Add element of bird behaviour (assume single value of avoidance or several)
- Output is single estimated number of collisions
- In UK, goes back to 1995 when SNH/Bill Band developed first model for Islay wind farm onshore



Avian Collision Risk Models

- Reviewed literature on avian CRM
- 10 models
- No information available for 1 model
- Not enough detail on model function for quantitative comparison
- Descriptive comparison (9 models)

Avian Collision Risk Models

Model	P(collision) based on own or other	Tower	Turbines	Oblique angles of attack	Non-linear flight paths	Effect of wind included	Individual or Population	Off- or onshore example	Output	Stochastic or deterministic	Ref
Band	Band	N	Multiple	N	N	N	Population	Offshore	# birds colliding	D	[1]
Tucker	Tucker	N	Single	N	n/a	N	Individual	n/a	Probability of collision	D	[2]
Smales	Smales	Y	Multiple	Y	Y	N	Population	Onshore	# birds colliding	D	[3]
Podolsky	Podolsky	Y	Multiple	Y	N	N	Individual	Onshore	Probability of collision	D	[4]
McAdam	Band	N	Single	Y	N	Speed & direction	Individual	Offshore	Probability of collision	S	[5]
Desholm	A constant (from Tucker)	N	Multiple	N	N	Direction	Population	Offshore	# birds colliding	S	[6]
Eichhorn	Band	N	Single	N	Y	N	Individual	Onshore	Mortality rate	S	[7]
Holmstrom	Tucker	N	Single	Y	n/a	Speed & direction	Individual	n/a	Probability of collision	D	[8]
Bolker	A constant	N	Multiple	Y	N	N	Individual	Onshore	Probability of collision	D	[9]
Folkerts	Band	-	-	-	-		-	-	-	-	-

Avian Collision Risk Models

1. Band: bird is represented by a cross
2. Tucker: similar to Band but a rectangle and only calculated P(collision)
3. Smales: uses average number of turbines in a flight path
4. Podolsky: similar to Band and Tucker
5. McAdam: includes flight height, wind speed and direction
6. Desholm: it is stochastic
7. Eichhorn: an agent based model including foraging
8. Holmstrom: included oblique angles
9. Bolker: number of turbines encountered on flight paths
10. Folkerts: based on Band but little information available

Avian Collision Risk Models

- Single or multiple turbines
- Include wind speed and/or direction
- Angle of approach
- Non-linear flight paths through array
- Individual or population
- Stochasticity (variability and uncertainty)

Interviews

- 20 people from a range of stakeholders in UK
- Questions on CRM and variability and uncertainty
- Majority use most recent Band model

Stakeholder Interviewees

BTO
DONG Energy
EDPR
MacArthur Green
Natural England
NIRAS
PMSS
Scottish Natural Heritage
Sue King Consulting
CEH
ECON
Joint Nature Conservation Committee
Marine Scotland Science
Natural Power
Pelagica
Royal Society for the Protection of Birds
Statkraft/Forewind
The Crown Estate

…and Bill Band

Interview Questions

1. How much experience do you have, relating to collision risk models/modelling?
2. What collision risk models do you most regularly use or have experience of?
3. What uncertainties exist in the collision risk models that you have used?
4. What are the key uncertainties in input parameters?
5. What parameters do you think have the greatest influence on the outputs of collision risk modelling?
6. If you could, how would you improve collision risk models/modelling?
7. Would the explicit reporting of variability and uncertainty in outputs from collision risk models benefit the consenting process and discussions with regulators?

Interviews

- What are the key uncertainties in input parameters?
  - Flight height data
  - Avoidance
  - Density
  - Nocturnal activity
  - Flight speed
  - Rotor speed

Interviews

- If you could, how would you improve collision risk models/modelling?

Interviews

Related to input data…

- Present a covering/summary sheet with input data values to ensure parameters are clearly set out and defined.
- Have a standard approach to derive turbine parameters and bird parameters including consistently defining breeding season periods.
- More studies/data on bird behaviour around turbines and avoidance behaviour.
- Collect flight height data objectively, not just human observation/estimation but using rangefinders.

Interviews

Related to the model or output…

- Stop presenting single numbers as black and white and also provide context.
- Take data from existing sites to validate the model and also use post-construction monitoring.
- More and clearer guidance on the model and model use and intended use.
- Factor uncertainty into estimates.
- Use R code rather than excel to make modelling process more reproducible.
- Better interpretation of model outputs.
- Single location to have the most up to date version of model and email updates.

Interviews

- If you could, how would you improve collision risk models/modelling?

Very few people thought that the models themselves needed changing dramatically

Interviews

- Would including variability and uncertainty in collision risk models benefit the consenting process and discussions with regulators?

Interviews

- **Scientifically there is a benefit to making clear what the uncertainties are.**
- Accounting for uncertainty in data collection methods and survey data would be useful.
- I am uncomfortable with presenting a value that is apparently so precise.
- **There is an absolute fixation on single numbers.**
- Greater acceptance that we live and work in an uncertain world and things are grey, not black and white.
- Need a way of showing that some scenarios are more likely than others.
- **Decision makers have to be confident that they are making the right decisions so they need an understanding of uncertainty around the single numbers.**
- Must weigh up risk (or use a risk assessment process) and we can't do that currently with CRM, though it happens more regularly with PVA.
- The current approach is too precautionary and always uses the most precautionary values.
- If the system were to change, including variability and uncertainty is a more useful approach.
- Any outputs need to be suitable to be taken forward through the assessment process.
- The risk is that it complicates the process even more than already because the more the risks are explicit the more difficult it is to explain to the planning inspectorate.
- **There is probably too much uncertainty in the system to make it useful.**

Final thoughts

- Variety of collision risk models available
  - time a bird spends passing through a rotor relative to the time taken for a single rotation
- In the UK, the Band model is accepted industry standard
- At present inputs mainly single values and output is a single value/number of collisions
- Responses from interviews suggest that people keen to move away from single numbers and include variability and uncertainty
- Any changes must aid decision making

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