An overview of the Biosis Collision Risk Model

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Why use a collision risk model?

> Mathematical quantification. Alternative is guesstimation

> Inputs & assumptions are explicit so can be readily scrutinised

> Designed to permit refinements as data accumulates or new information becomes available

Collision models

> Models of bird interaction with a turbine

> Models of collision *risk*

- probability of a turbine encounter
- mechanics of bird interaction with turbine
- capacity of bird to avoid collision

Modelling fundamentals

> Logic & consistency of metrics

> Representative quality of data (seasonal & long-term environmental variability)

> Site-specific – each site is unique

biosis

Basic functions of collision risk model

- Dimensions, geometry & rotor speed of turbine
- Frequency of flights within defined time & space. Site-specific field data
- Collision = probability of hitting an obstacle
- Capacity to avoid potential collision
- Number of turbine encounters per flight

Features of Biosis collision risk model

1. Flights at risk vs individuals at risk

2. Multidirectional or unidirectional approach

3. Static & dynamic turbine components – different avoidance capacity

4. Number of turbine encounters per flight – scattered vs linear arrays

1. Model logic – flights & individuals

- Input measured in number of flights
- Number of individuals is something different
- Requires further calculation based on size of population at-risk
- Model results must be expressed clearly:
  - number of flights at risk
  - number of birds at risk

2. Directions of flight approach

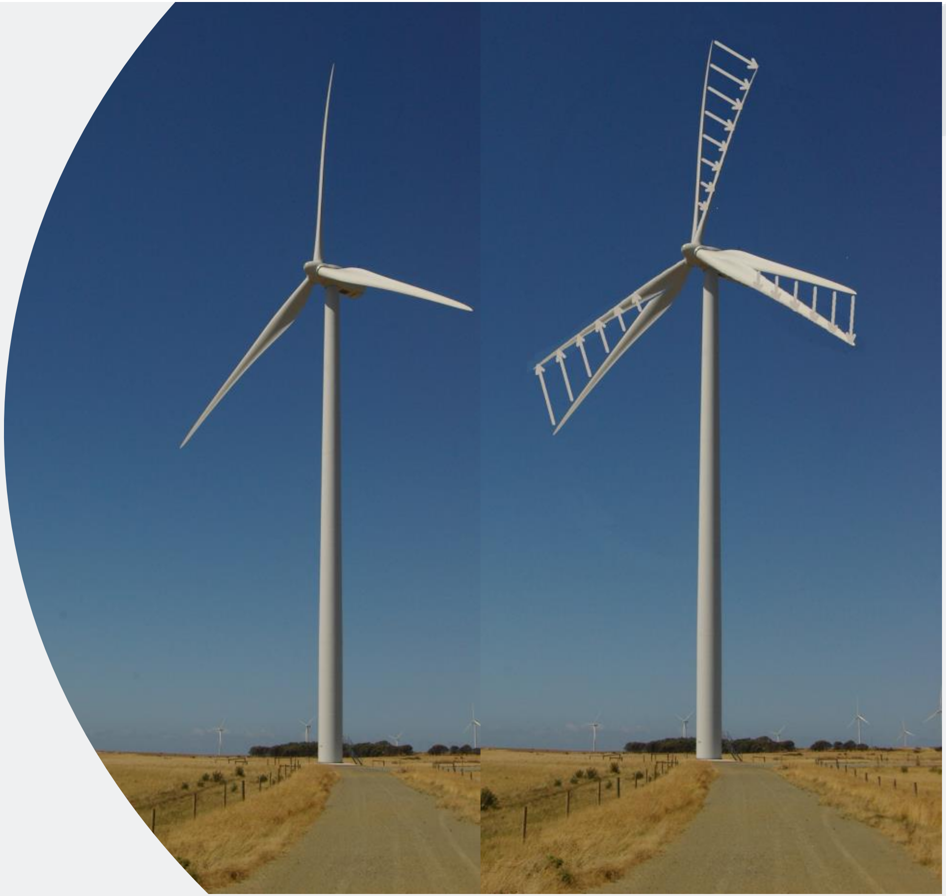
- Despite complex shape, obstacle can be quantified as surface of a given area
- Multidirectional flights (resident birds): mean presented area (m^2) of turbine calculated from 360° 'walk'
- Unidirectional flights (single passage): presented area (m^2) of turbine for specific approach angle

3. Risks for turbine components

> Static turbine

> Dynamic component of rotor sweep:
  - ❖ Rotor speed
  - ❖ Bird speed
  - ❖ Bird size

> Different avoidance rates

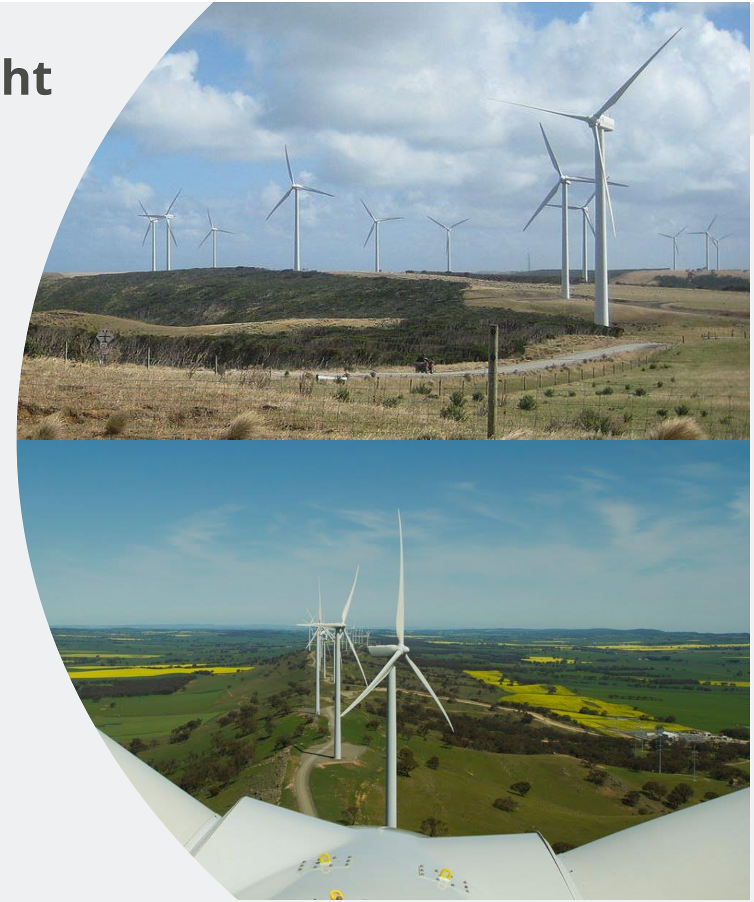


4. Number of turbine encounters per flight

- Scattered array – flight through wind farm may encounter any number. ‘Average’ = $\sqrt{N}$

- Linear turbine array – flight likely to encounter ≤ one

- Model has capacity to scale between fully scattered to single row



Avoidance rates

- Birds generally avoid large pale obstacles
- ‘Micro-avoidance’ relevant to collision risk
- ‘Macro-avoidance’ not relevant
- Since definitive avoidance rates generally unavailable, model provides results for a range of avoidance rates

Model validation?

Annual average of detected mortalities & model projections for eagles at two Tasmanian wind farms (Bluff Point: 2002 – 2011 & Studland Bay: 2007 – 2011)

	White-bellied Sea-eagle		Wedge-tailed Eagle	
	Bluff Point	Studland Bay	Bluff Point	Studland Bay
Mortalities detected	0.4	0.0	1.6	1.1
CRM 90% avoidance	0.9	0.8	2.7	1.9
CRM 95% avoidance	0.5	0.4	1.5	1.1
CRM 99% avoidance	0.1	0.1	0.4	0.3

Limitations

> Model can’t predict when collisions might occur

> Due to statistically small numbers of collisions, they are likely to be unevenly distributed in time

Applications

> Comparison of sites / portions of large site during feasibility

> Comparison of turbine configurations during design phase

> Impact assessment - if quantified in individuals at-risk & where effect on population is assessable