Can regulatory requirements always be met? A case study examining indirect (disturbance) impacts of wind farms on birds

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Topics to be covered

- Why study disturbance effects?
- Previous studies - issues and resolutions
- Definition of terms
- Our sites and methods
- Our findings
- Conclusions

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Why study disturbance effects?

- Required by regulators,
  presumably based on their reading of the literature
- Approaches are currently set by regulators
- What to do if an effect is found?

Previous studies

- Evaluated studies of onshore wind farms and birds
- Majority of information still in reports (not scientific literature)
- All studies from outside Australasia
- To date, very little empirical evidence provided to demonstrate an impact
  - inconsistent results
  - barrier - misnomer
- Limited number of well designed studies
- Presumed impacts rather than objective analysis

Identified issues

- Differentiation between effects and impacts

  effect does not necessarily mean negative impact

- Terms are not defined
  - What is meant by *disturbance*?

    Ecological disturbance, behavioural response????
  - Issues often rolled together (e.g. mortalities due to collisions)
- *Disturbance* vs *Avoidance* or *diversion*
- Inadequate or no controls – manage confounding effects

  landscape or other anthropogenic effects
- Level of disturbance – what is biologically or ecologically important?

  short-term, low-level effect to impacts on fecundity or survival
- Scale of the impact:
  - Spatial scale
  - Few individuals to important populations or species

Resolution

- **Determine:** What we are measuring:
  - clearly define disturbance and measure that
  - consider the role and importance of avoidance

- **Manage:** or at least acknowledge, confounding effects

- **Separate effects from impacts:**
  - what level of impact matters (impacts to fecundity or survival)
  - what scale is important:
    - spatial - extent
    - biological – individuals, populations, species?

Our definitions of terms

- ***Direct impacts –*** collisions with infrastructure
- ***Indirect impacts –*** disturbance (perceived threat)

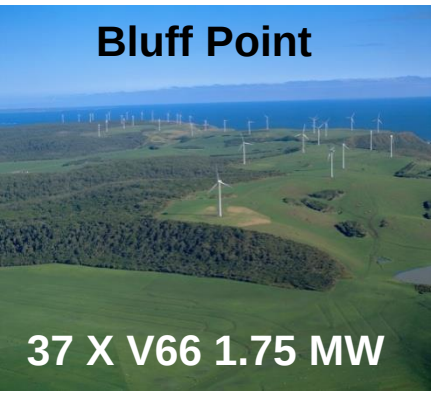
Avoidance - actively avoiding the area immediately around a turbine, not the entire wind farm, local, fine-scale effect

Alienation or displacement - actively avoiding a group of turbines or wind farm, larger-scale effect

Deviation - a change in flight path in response to a turbine or group of turbines. Small scale (turbine level) or larger scale (wind farm-wide)

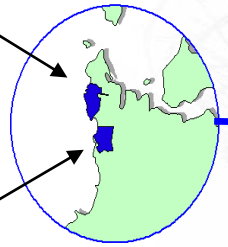
Barrier - birds are prevented from moving beyond a wind farm, particularly applies to migrants

Our sites

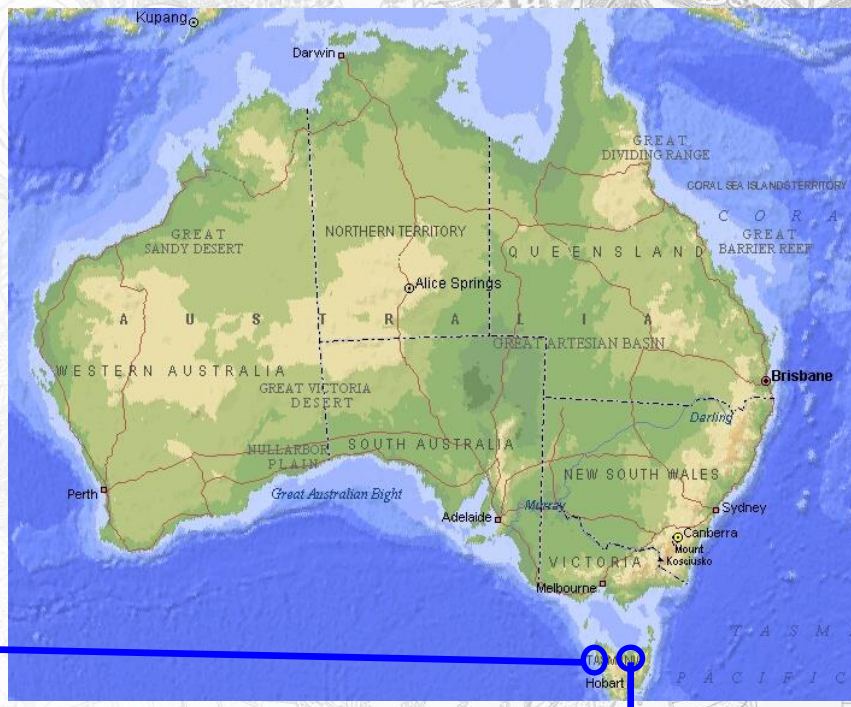


Developed in two stages:

- 6 turbines, commissioned 2002
- Full (37 turbines), commissioned 2004



"Woolnorth WF"
140 MW



Developed in one stage, commissioned 2007

Developed in one stage, commissioned 2013

Our studies - methods

Bluff Point and Studland Bay:

- Bird utilisation studies 3 years before construction (1999-2001)
- 3 years post-commissioning (between 2004-2009)
- Spring and autumn (deemed priority by Regulators)
- 9 fixed points on transects on each site
- 9 reference (control) sites minimum of 400m from turbines
- 5 minute observations after settling period
- 10 replicates of each survey point each season
- Data collected on species, number of movements and metadata

Musselroe:

- 19 fixed points (8 are reference)
- 2 years of pre-construction (2002/3 and 2005/6), first year of post-commissioning studies
- 3 seasons (spring, summer, autumn)
- 20 minute observations

Analyses

Species Richness

- Length of list of detected species
- Discrete (giving less power)

Diversity

- Total detections and the proportion of the given species
- Shannon-Weaver diversity, with first order bias correction of Schuermann (2004)
- Sensitive metric to change
- Cannot readily determine if change is due to change in the mix proportions, or a change in the length of the species list

Evenness

- Rescaled to be between zero and one
- Allows comparisons

Avian community effects

- Study not designed as a species-specific study, so ad hoc analysis inappropriate
- Data too variable for meaningful trend analysis
- Used guilds (based on food resource use: Granivore, Omnivore, Insectivore, Waterbird, Seabird, Raptor/Scavenger)
    - Resident/migratory

Results

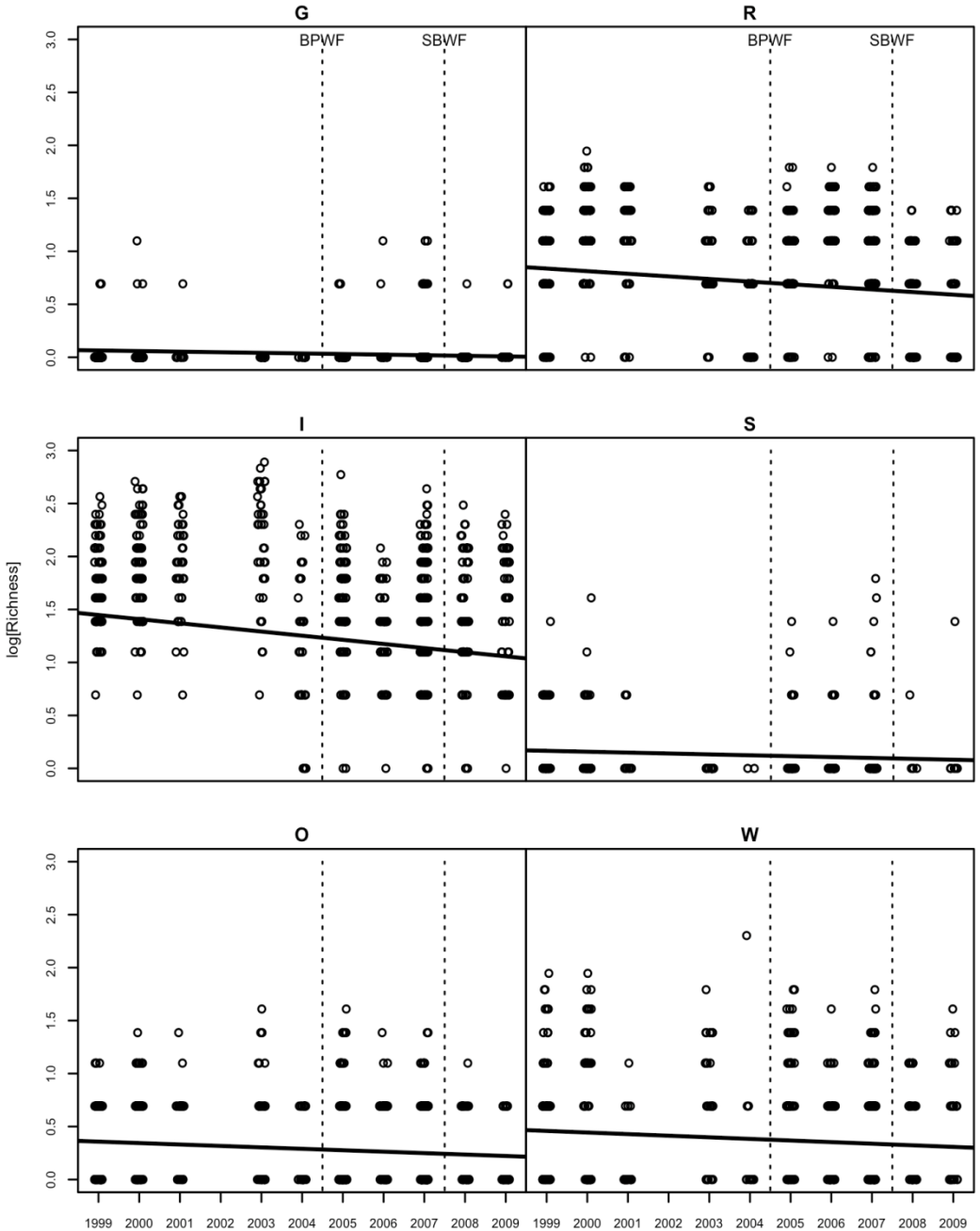
Bluff Point and Studland Bay:

- BP: 545 monitoring sessions; Studland Bay: 854
- BP: 86 species; SB: 78 species
- BP: 73,817 movements; SB: 128,446 movements
- Decrease in species richness and biodiversity
- Consistent between treatment and reference sites
- Decline amongst all guilds of birds, largest for insectivores

Musselroe:

- 2002/3: 270 and 2005/6: 575 monitoring sessions
- 2002/3: 20,035 and 2005/6: 19,839 movements
- 105 species
- currently undertaking first year post-commissioning

Bluff Point and Studland Bay



- Species richness:
  - average decline 2.2% per annum (SE 0.6%)
- Significant for all guilds except granivores (too few data)
- Largest decline insectivores
- Diversity:
  - annual decline 0.018 (SE 0.006)
- Gradient model best fit

- G – granivores
- R – raptors/scavengers
- I – insectivores
- S – seabirds
- O – omnivores
- W - waterbirds

Our findings

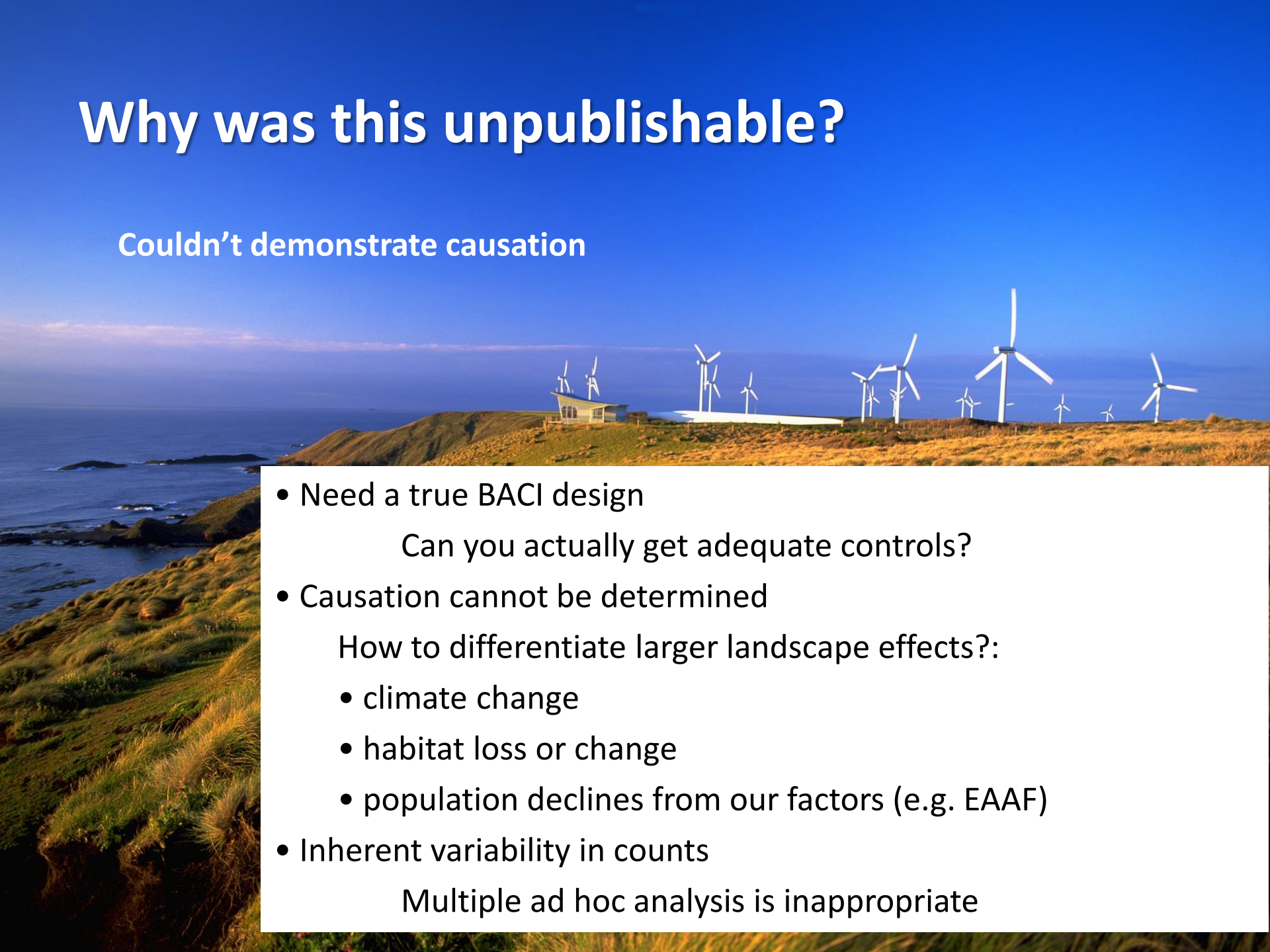
- Consistently negative trend in species richness and diversity, not evenness
    - declines at treatment and reference sites
    - decline in residents and migratory species
- Decline gradual, not stepped
    - therefore these wind farms (two different sized turbines) most likely not causal effect
- No evidence for alienation or barrier effects
    - alienation effect may be species- and site-specific

Declines consistent with other parts of southern Australia

Speculated causes: Habitat loss, climate change, drought

Why was this unpublishable?

Couldn't demonstrate causation



- Need a true BACI design

  Can you actually get adequate controls?

- Causation cannot be determined

  How to differentiate larger landscape effects?:

  - climate change
  - habitat loss or change
  - population declines from our factors (e.g. EAAF)

- Inherent variability in counts

  Multiple ad hoc analysis is inappropriate

Conclusion

Need to consider how wind farm impacts might manifest themselves and how a survey can be designed to capture such impacts

- Define terms
- Determine what you want to measure
- Determine the level of impacts that are biologically important
- Control confounding effects
- More robust science, less perpetuation of presumptions
- Communicate/work with regulators

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Thank you!

Questions?