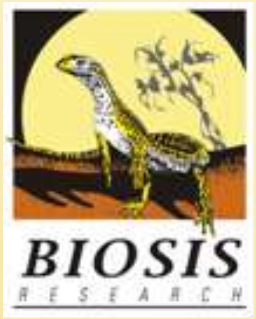
Linking turbine collision risks with population models to assess cumulative impacts of multiple wind farms on threatened birds

Ian Smales[1], Stuart Muir[2], Charles Meredith[1] & Robert Baird[1]

[1] Biosis Research
[2] Symbolix
Australia



Assessments to determine potential effects of wind energy on threatened birds are usually undertaken singularly as part of approvals processes for individual wind farms

Typically, collision risk modelling (CRM) is used to estimate risk for threatened birds in terms of an average number of fatalities per annum at a wind farm

Of itself, such a number has no demographic meaning for conservation management of a threatened species, which must be aimed at long-term maintenance of entire population

Standard impact assessment may be lacking because …

1 A simple prediction of annual number of fatalities at a wind farm does not permit evaluation of effects on the species overall population

2 The population of a threatened species may interact with multiple wind energy facilities within it's geographic range

Recently some regulatory authorities have required assessment of effects of multiple wind farms within the range of threatened species; or of the contribution of a single wind farm to such a cumulative effect

Other anthopogenic impacts on populations are usually not quantified in the same manner as is required of wind energy industry – thus are not available or comparable for inclusion in cumulative risk evaluation

Hence *cumulative* here refers to:

potential or real impacts of multiple wind energy facilities on a threatened avian population

The modelling tools

1 Turbine collision risk modelling (CRM) provides predicted risk for threatened birds measured as number of fatalities per annum at a wind farm

Various collision risk models are in use internationally

2 Population viability analyses (PVA) are well established tools used to assist conservation decision-making based on modelled demographic responses to impacts (positive or negative), measured as altered extinction risk

Prerequisites for cumulative risk assessment

- Sufficient demographic information about entire population to allow PVA to be used

- Collision model estimate for each relevant wind farm, measured in numbers of birds at risk - not numbers of flights at risk (Chamberlain *et al.* 2006)

- Known or estimated number of birds at risk per annum (i.e. number of individuals that might interact with turbines) at each relevant wind farm site

Process to determine cumulative risk

1. Model collision risk using standard metrics & parameters for each wind farm within species' geographic range

2. Combine the estimated number of collisions predicted for all relevant individual wind farms (note: sedentary vs migratory species)

3. Calculate portion of the species population that is predicted to collide with wind turbines per annum

4. Determine increase in annual mortality rate due to turbine collisions as a demographic parameter for use in PVA

Key differences exist between ways in which different birds use their distributional ranges must be recognised in the cumulative process

Sedentary species

Migratory species

Examples from south-eastern Australia

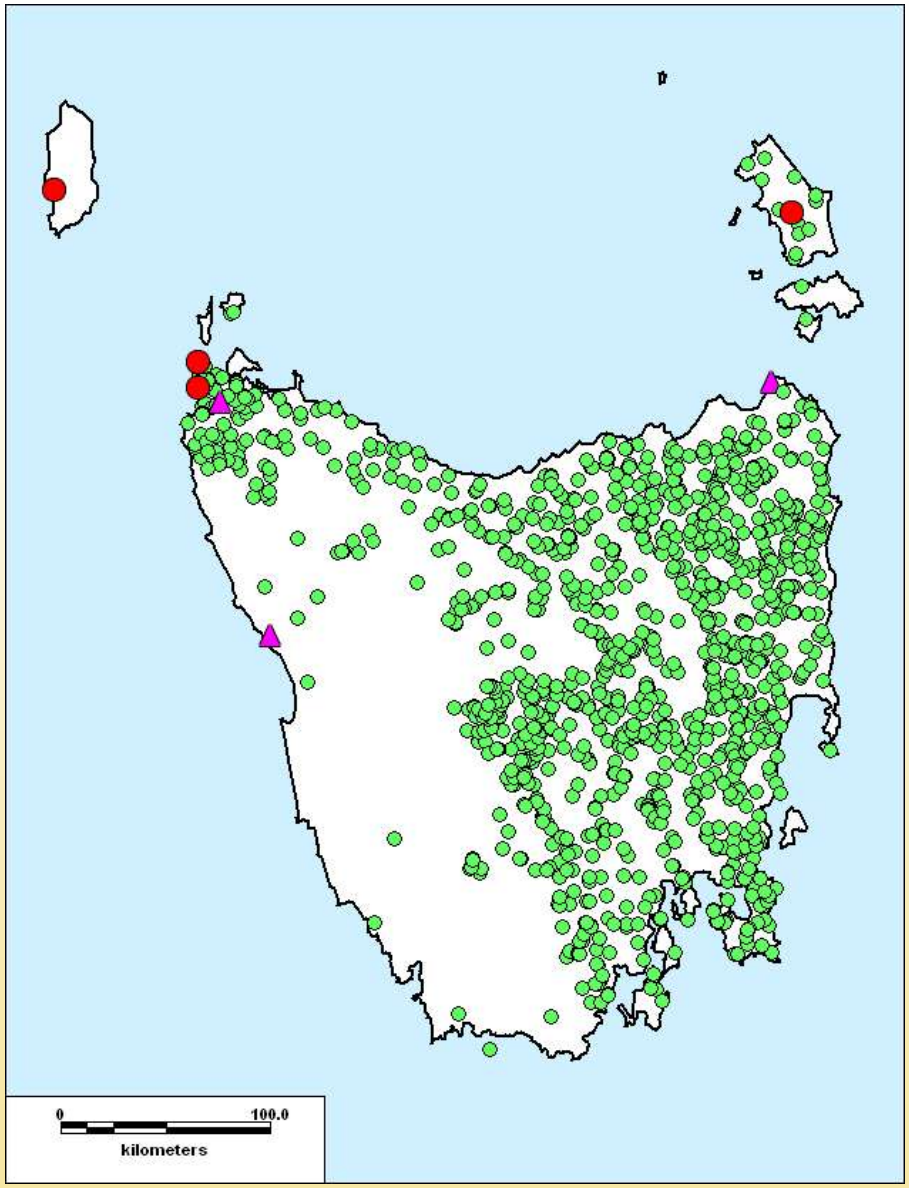
Example sedentary species

Tasmanian Wedge-tailed Eagle *Aquila audax fleayi*

Example sedentary species

Tasmanian Wedge-tailed Eagle

Aquila audax fleayi



For sedentary species the risk of colliding with turbines exists only for the portion of the overall population whose home ranges coincide with wind farms

Numbers of birds at risk may be determined from census surveys of each relevant wind farm site

For sedentary resident species the effect of multiple wind farms is the ***sum*** of the estimated impacts on various parts of the population that are at risk of collisions

Example migratory species

Orange-bellied Parrot *Neophema chrysogaster*

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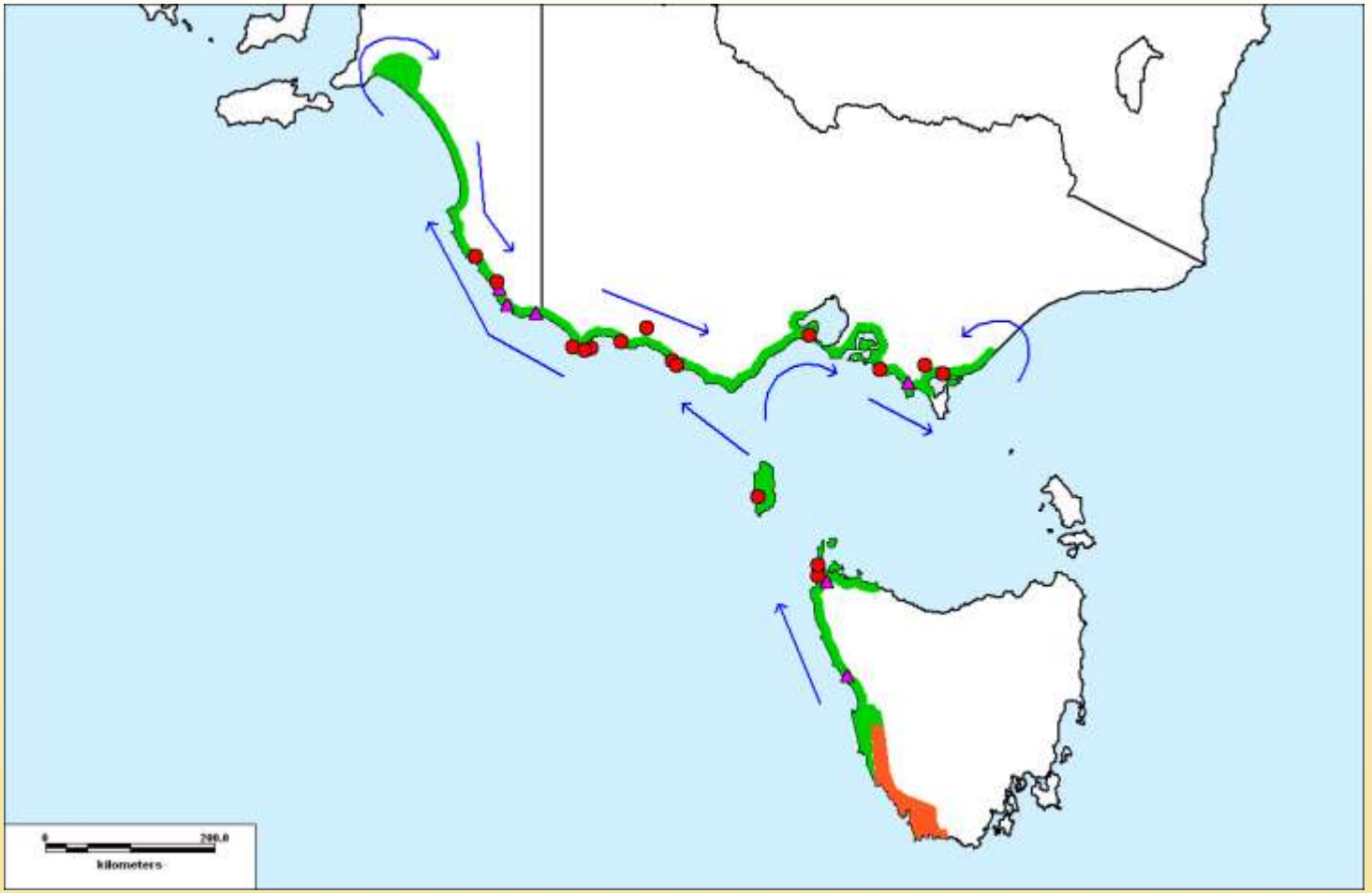


For migratory species, entire population or a portion of population may be at risk of collisions during passage through wind farms on one or two occasions per annum

Numbers of birds at risk may be determined from census surveys at relevant wind farm sites, usually combined with informed assumptions

For migratory species, the effect of multiple wind farms is the ***product*** of the probabilities of birds surviving impacts at one wind farm after another (incremental survivorship rate) for as many wind farms as they pass through on their migratory route

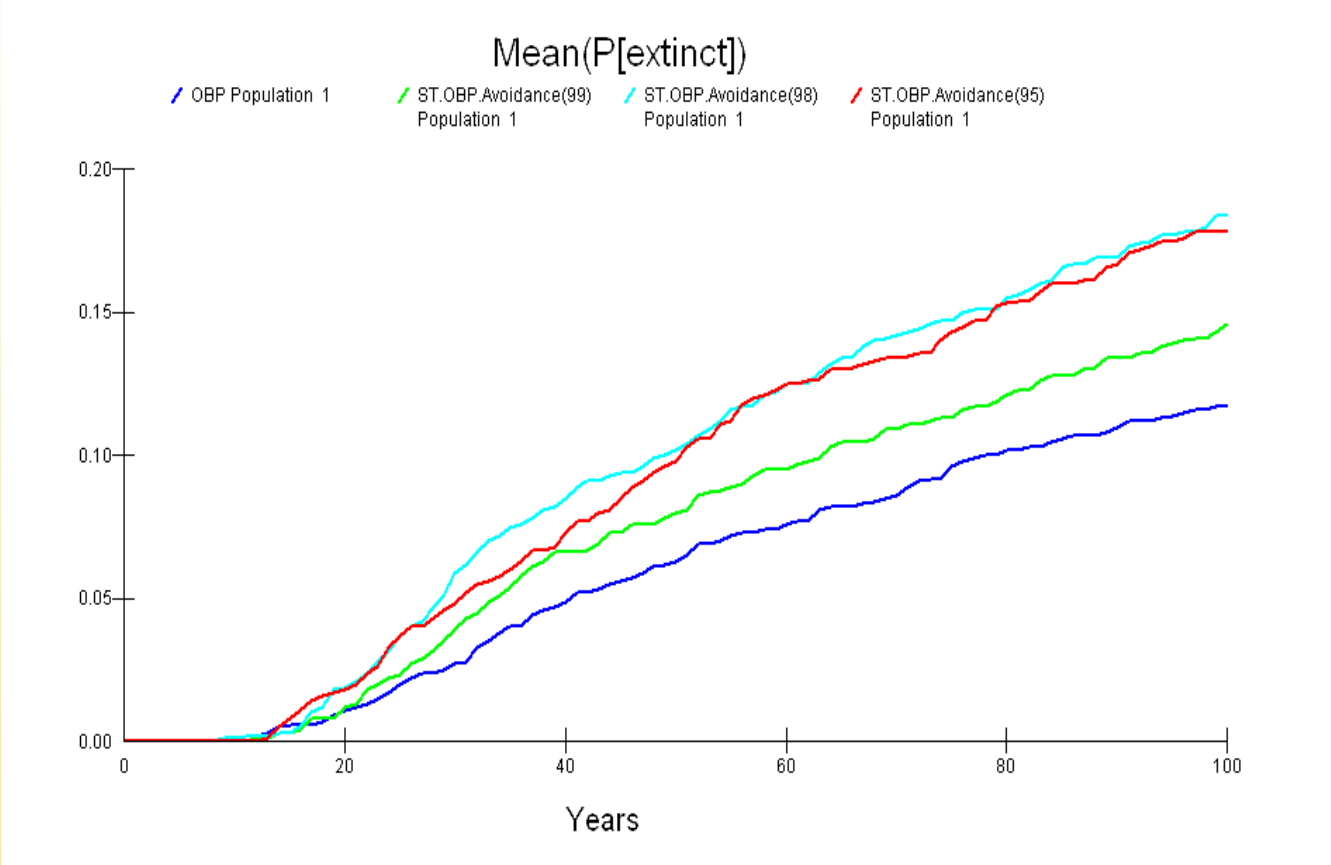
PVA modelling is used to compare population extinction probability for:

mortality rate altered due to cumulative impact of multiple wind farms

relative to

background mortality rate

Example of PVA results for Orange-bellied Parrot using scenario collision modelling & three avoidance rates for cumulative impact of 16 operational & 7 potential wind farms



Summary

- Results of collision risk modelling when linked with population modelling can be used to estimate effects of multiple wind farms on threatened birds at the population level

- This process permits decisions about turbine collision effects to be made on a basis that is relevant to conservation of the entire population

- This broader population conservation context offers objectivity that may not be possible when focus is centred on simple number of fatalities for single or multiple wind energy facilities