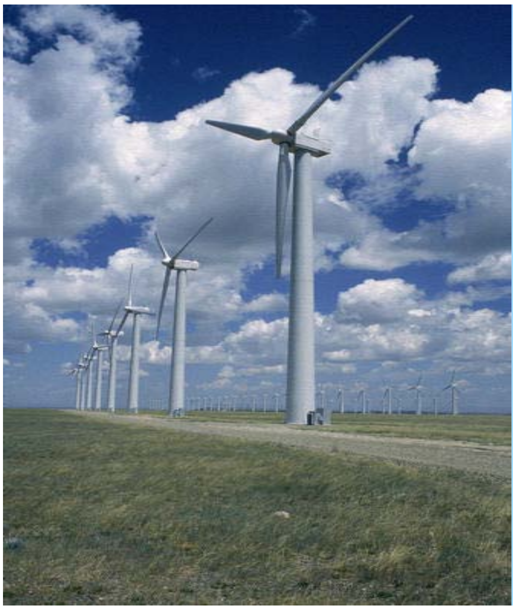
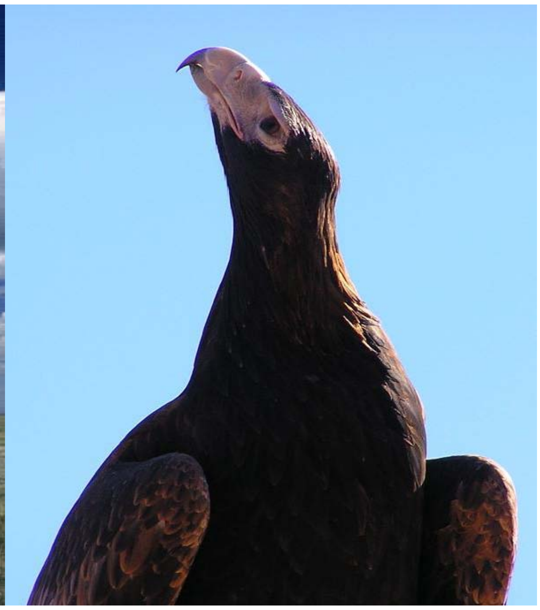
Briefing note on the effects of wind farms on bird and bat populations

Lower North Natural Resource Management Group



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Introduction

Wind is Australia's most rapidly growing renewable energy source, and is an important component of strategies to reduce dependence on fossil fuels and limit contributions the global climate change. The predicted outcomes of climate change, driven by the greenhouse effect, will significantly impact upon agricultural and natural environmental systems around the world. In South Australia, the Mid North is fast becoming a hub for wind farm developments due to the:

1. open exposed nature of the landscape,
2. north-south orientation of mountain ranges and the prevailing westerly winds,
3. proximity to current energy infrastructure, and
4. consistent wind resources.

As with all infrastructure developments, wind farms have both positive and negative environmental effects. In the case of wind farms, the positive outcomes occur at a national and global scale, while the negative effects occur on a local, regional scale. There are currently 16 wind farms either in operation or in the planning phases in the N&Y NRM Region, with a total of 833 wind turbines expected to produce 1,608 MW of electricity (see below).

Location	Turbines	Mega-Watts	Status
1. Wattle Point	55	91	operational
2. Snowtown	150	170	operational
3. Clements Gap	45	57	operational
4. Hallett (Brown Hill)	45	95	operational
5. Hallett (Hallett Hill)	34	30	operational
6. She-Oak Flat	36	70	operational
7. Troubridge Point	15	25	operational
8. Hallett (North Brown Hill)	63	132	under construction
9. Waterloo	37	111	under construction
10. Hallett (Mt Bryan)	30	80	approved
11. Gulnare (Carmody's Hill)	70	175	approved
12. Bluff Range	25	50	approved
13. Willogoleche Hill	26	52	approved
14. World's End	80	160	approved
15. Red Hill (Barn Hill)	62	130	planning
16. Collaby Hill	60	180	planning
	833	1,608	

The concentration of wind farms in the Mid North is likely to place pressures on the region's biodiversity but, at present, the level and extent of these pressures is largely unknown. This briefing note examines the evidence in the scientific literature on the effects of wind farms on avifauna, i.e. birds and bats. The vast majority of studies have been conducted overseas, with no published studies with an Australian context. Pressures on other components of the natural environment can also be significant (e.g. construction of turbines in areas of significant habitat and/or with threatened species), but are not addressed here.

Impacts on avifauna

The negative impact of wind farm operations arise primarily from two sources, i.e.:

1. direct effects arising from collisions with rotating turbine blades, and
2. indirect effects arising from the avoidance of wind farm operations.

The direct loss of habitat, due to construction activities, is not considered to have a significant effect on avifauna in Australia, due to the various legislative restrictions on development activities (e.g. SA native Vegetation Act, Commonwealth Environment Protection and Biodiversity Conservation Act).

Collision mortality

Early wind farm operations were synonymous with high mortalities of birds (e.g. Altamount Pass in the USA). However, recent advances in the design of wind farms have greatly reduced mortality levels. The most important factors to be considered in reducing collision mortality are:

1. avoiding concentrations of birds (e.g. flocking waders),
2. avoiding stopover points for migratory species,
3. the spacing and layout of wind turbines,
4. lighting on infrastructure, and
5. feeding and flight behaviours (e.g. raptors soaring in the area swept by rotors).

A wide variety of birds have been reported to be impacted upon by wind farm operations, including; flocking waders, migratory species, song birds and raptors.

Many species have been recorded to react to the presence of turbines at distances of between 100m and 500m, however this is not universal. Collision risk increases substantially if the species' flying height matches the height of the rotor blades. Collision with rotor blades generally occurs when birds are approaching the rotor with a tail-wind, which reduces their ability to take evasive action. Mortality or injury can also result from birds being driven down to the ground by the force of the wake behind the rotor. Flocking waders, seabirds and ducks have been observed to make several attempts to approach their roosting sites, before flying directly through wind farms. Most migratory species fly at high altitudes when moving between stopover locations, well above turbine height. However, the risk for these species occurs when wind farms are placed adjacent to stopover locations, where the birds may need to fly through the wind farm while taking-off or landing. Lighting on wind farm infrastructure may attract both birds and bats, resulting in increased collision risk, and should be minimised.

While the majority of studies report low collision rates for birds, this does not necessarily mean that the flow-on effects are ecologically insignificant. Further, most studies determine collision rates via. counts of found carcasses, which are likely to produce substantial under-estimates of true mortality, because of the removal of carcasses by scavengers (e.g. red fox).

Bird mortalities from collision with turbine blades are well documented, but the behavioural and population level consequences remain largely unknown. While annual mortality may be generally low, the cumulative effects during the life span of a wind farm operation and/or from a concentration of wind farms could have severe implications for many species' populations. Even low rates of mortality can have a substantial effect on populations existing at low densities. For example, populations of long-lived species with low reproductive rates will be significantly affected by the loss of mature (breeding) individuals. Following on, the removal of mature individuals from a population would create vacant territories into which juvenile birds would be attracted. Given the general naivety of juveniles, many of these could also be lost to rotor strike, creating a self-perpetuating zone of attraction for juveniles and the loss of juveniles from wider regional populations, resulting in broader population declines.

Vulnerability to collision with wind turbines varies between species and is linked to each species flight characteristics. Birds of prey are the most likely species to be affected by the concentration of wind farms in the Mid North. Large raptors, with low manoeuvrability and/or low capability for powered flight are most at risk, due to their reliance on updrafts and thermals. The topography of the Mid North is characterised by gently rolling hills, dominated by native, or introduced, pastures and crops. The resultant weak updrafts from these slopes will increase the risk of large soaring raptors colliding with turbines, due to their reduced ability to take evasive action. Particular behaviour patterns can also place specific guilds at risk of elevated mortality rates, due to rotor strike. Emerging evidence suggests that birds lose track of the location of turbines while foraging and that species which hover and dive for prey are particularly at risk (e.g. raptors).

Although limited data exists, evidence suggests that wind farms can result in considerable bat mortality. Studies indicate that bat mortalities are linked to turbine height and wind speed, with more bats killed on low wind evenings. Weather conditions and aviation warning lights do not appear to greatly influence mortality. Until recently, it was unclear why bat mortality was so high around wind farms, given that bats navigate using echo-location and can therefore detect moving objects better than stationary ones. Evidence is now emerging that shows that 90% of bat mortalities can be linked to *baro-trauma,* i.e. damage to the lungs, due to rapid pressure changes resulting from the significant differences in air pressure near moving turbine blades. Death occurs due to resultant internal injuries or through the inability of the injured bat to avoid the turbines. Because bats are relatively long-lived and have low reproductive rates, high levels of adult mortality will have significant effects on the long-term sustainability of local populations.

The potential effects of wind farm operations extend beyond the direct consequences for bird and bat populations and may cause disruptions to important ecological processes. Many of the species impacted upon are high level predators and play an important role in sustaining ecological processes (e.g. raptors and insectivorous bats). This is particularly true in highly modified and/or agricultural landscapes where pest species can be over-abundant.

Raptors are major predators of feral pests, particularly rabbits and mice, and a local reduction in raptor populations would allow populations of these pests to increase, and would also remove one of the factors that helps prevent populations of these pest species from increasing to plague proportions. Raptors also consume considerable numbers of other large native bird species and help to prevent their populations from becoming over-abundant. Over-abundant, species such as corellas and galahs can impact upon agricultural production, cause damage to infrastructure and become a nuisance to local communities. Similarly, increased populations of ravens, crows and butcher-birds would have an increased impact on native prey species, resulting in declines in their populations (e.g. reptiles and small mammals). This would be of particular concern, if the prey was a threatened species. Similarly, an increase in the abundance of some species (e.g. noisy miners) may result in other species being pushed out of their habitat.

All of the bats found in the Mid North are small, insect feeding species. Insectivorous bats consume vast quantities of prey on a daily basis, including many species that are considered agricultural pests. A decline, or local extinction, of populations of these bat species would result in a dramatic increase in the number of pest insects feeding on crops and a subsequent increase in the amount of insecticides required to offset economic losses.

Displacement

The most commonly reported indirect effect of wind farms is the displacement of birds from the vicinity of operations, due to noise and visual disturbance from the turbines. The underlying reasons for this disturbance are unclear. However, one study reports that there was no difference in the degree of displacement between active and inactive turbines, suggesting that (in this case) it was the presence of the wind towers, rather than the noise from rotating turbines, that led to the displacement of birds. Disturbance to birds can also occur during the construction phase of wind farms and/or due to the regular traffic that occurs during post-construction maintenance and monitoring operations.

The degree of disturbance to bird communities can vary significantly, dependent on a range of factors, including;

1. the number of turbines,
2. the particular bird species present at the site,
3. seasonal patterns of habitat use, and
4. the availability of alternative habitat.

Likewise, the distance over which disturbance effects can extend from a wind farm varies considerably. A distance of 600m is often reported as the zone of disturbance around turbines, however this ranges from as little as 80m (for a grassland songbird) to as much as 800m (for waterfowl) and 4km (for seabirds).

The majority of studies have reported lower bird population densities in the vicinity of wind farms, rather than the complete absence of species. This indicates that the extent to which individual birds modify their behaviour in the presence of turbines can vary within species. Although the zone of disturbance around individual turbines can be relatively small, the cumulative area of this zone around large wind farms can be extensive. A localised reduction in the density of bird populations could result in the disruption of a range of ecological and population processes, including;

1. reductions in the pollination of plant species, resulting in changes in the structure, composition and condition of habitat,
2. alterations in the dispersal ability of plant species,
3. reductions in the consumption of insect prey, with potential consequences for agricultural productivity,
4. changes in the competitive balance between bird species, resulting in changes to the structure and composition of bird communities and subsequent flow-on effects, and
5. the decline and extinction of affected species, through time, due to a reduced ability to find mates and lowered reproductive output.

Under a worse case scenario, if a species is totally excluded from an area adjacent to a wind farm then this displacement equates to a loss of available habitat. Where wind farms are located adjacent to small blocks of remnant habitat in fragmented landscapes, displacement could result in localised species extinctions.

Although the majority of evidence suggests that the displacement of raptor species is negligible, some studies have reported shifts in the home ranges of larger species (e.g. Golden Eagles). With a concentration of wind farm operations in the Mid North, it is possible that raptor species will be displaced from their preferred habitats (i.e. along the edges of ranges) into less suitable habitat, and that this may influence the sustainability of their populations

In a few cases, some species have been observed to increase in abundance at wind farm sites. The mechanism for this change is not understood, but is generally attributed to changes in land use (often farming practices) that occur at the same time as the construction of wind farms. Unfortunately, a full spectrum of data is rarely collected, to enable analyses of these trends.

Most studies have examined the effect of wind farms for only a few years post-construction, making it difficult to determine whether birds become habituated to the presence of wind farms through time. However, the few studies that do exist suggest that the impacts are likely to persist, or worsen, through time, suggesting that habituation is unlikely.

To date, there have been no published studies of the effects of wind farms on the behaviour of Australian birds, so it is impossible to evaluate the extent to which bird communities will be adversely affected. Given the wide range of responses observed for international bird species, an understanding of the possible impacts of wind farms on our native avifauna will require considerable research effort.

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