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Eagle deaths in Tasmania attributed to energy assets, with a precautionary appeal to future development

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Abstract. The Tasmanian subspecies of the Wedge-tailed Eagle *Aquila audax fleayi* is listed as Endangered under both federal and state threatened species legislation, with an estimated population of <1000 individuals, and ongoing threats. The species is vulnerable to injury and mortality from wind-power infrastructure. The same is true of the similarly sized White-bellied Sea-Eagle *Haliaeetus leucogaster*, which is listed as Vulnerable under Tasmanian threatened species legislation. This paper summarises research undertaken on the number of documented Tasmanian eagle deaths and injuries from energy assets in the period 2010–2022. Information about eagle deaths and injuries is not readily available nor readily made available. Hence, the information comes from searching primary sources such as annual reports. I provide evidence of 272 individual Wedge-tailed Eagles injured or killed plus 49 White-bellied Sea-Eagles. In addition to the 321 reported cases of eagle deaths and injuries, it is likely that unrecorded casualties are higher since most are recorded anecdotally and are not the result of systematic survey.

Introduction

Wind energy is a significant source of renewable energy globally, and the number of new wind-energy projects in Australia is increasing rapidly. For birds and bats, collisions with wind turbines and other power infrastructure such as overhead wires, and electrocution, can be a major source of mortality (e.g. Thaxter *et al.* 2017). For all fauna, the fragmentation of natural habitat to provide roads and tracks to enable access to infrastructure is an additional negative impact of wind-energy development.

For migratory species, the Australian Government has developed significant impact guidelines known as the *Draft Referral Guideline for 14 Birds Listed as Migratory Species under the EPBC Act* (Commonwealth of Australia 2015). This document states under its 'ecologically significant proportion of the population of a migratory species' guidelines, that the loss of 1% of the population of a species is of importance. Currently, no similar policy guideline is available for resident bird species despite mortality from windfarm development and operation being a threat to multiple species. Perhaps the best example of this is the Tasmanian subspecies of the Wedge-tailed Eagle *Aquila audax fleayi*, which is listed as Endangered under both the federal *Environment Protection and Biodiversity Conservation Act 1999* and the Tasmanian *Threatened Species Protection Act 1995*.

Commercial wind turbines, and their aggregation into windfarms, began in Tasmania with three 0.75-megawatt (MW) turbines installed on King Island in 1998 to reduce the Island's dependence on diesel generators. This was the second group of turbines constructed in Australia. Four years later, the first windfarm was built on Bluff Point, at Woolnorth, on Tasmania's far north-western coast, consisting of six 1.75-MW generators, with blade tip heights of 93 m. In 2004, another 36 units of similar size were commissioned at the site.

Over time, more windfarms have been established by private operators on the Tasmanian mainland, each with larger-capacity wind-turbine generators (WTGs) and therefore increasingly longer blades. These projects include Studland Bay (established in 2007; 25 WTGs with a tip height of 125 m), Musselroe (established in 2013; 56 WTGs, tip height 125 m), Cattle Hill (established in 2020; 48 WTGs, tip height 170 m), and Granville Harbour (established in 2020; 31 WTGs, tip height 199 m) (Table 1). Further windfarms are in the development stage in Tasmania, including up to 31 WTGs at Jim's Plain, with tip heights of >220 m. Nearby Robbins Island Renewable Energy Park is in the approval stage, with up to 122 towers with a tip height of 270 m. These would be among the tallest in the world.

Among the species most likely to be impacted by development of windfarms in Tasmania are Australia's two largest raptors, the Tasmanian Wedge-tailed Eagle and the White-bellied Sea-Eagle *Haliaeetus leucogaster*. The population size of the former in 2022 is not well understood but has been variously estimated at 130 breeding pairs (Mooney & Holdsworth 1991), <1000 individuals involving ~220 pairs (Bell & Mooney 1999; Threatened Species Section 2006), and ~1300 individuals including ~200 pairs breeding successfully in most years (Mooney 2005). The most recent assessment in *The Action Plan for Australian Birds 2020* estimated the number of breeding Tasmanian Wedge-tailed Eagles as between 466 and 766 birds (average 600 birds) derived from ~426 territories and a 54–90% territory occupancy (Mooney *et al.* 2021), based on data in Mooney (2005) and Threatened Species Section (2006).

Large eagles are amongst the most vulnerable birds to collide with wind turbines (e.g. Thaxter *et al.* 2017) and the Tasmanian Wedge-tailed Eagle is no exception. Specifically, mortality surveys of birds at Bluff Point and Studland Bay windfarms from 1999 to 2009 (Hull *et al.* 2013) recorded 13 deaths of the Tasmanian Wedge-tailed Eagle, the second most of any bird species at those sites.

The ongoing concern over the small population size of the Tasmanian Wedge-tailed Eagle and ongoing threats

Table 1. Summary of windfarm developments in Tasmania: year of establishment, number of turbines, capacity, rated maximum output (MW) to Tasmanian mainland or to Tasmanian islands, and tip height.

Location	*Year*	*Number of turbines*	*Capacity*	*MW/mainland*	*MW/islands*	*Tip height (m)*
King Island (Huxley)	1998	3	250 KW		0.75	
	2003	2	850 KW		1.7	
Bluff Point	2004	37	1.75 MW	65		93
Studland Bay	2007	25	3MW	75		125
Musselroe	2013	56	3 MW	168		125
Flinders Island	2017	1	900 KW		0.9	
Cattle Hill	2020	48	3 MW	148		170
Granville Harbour	2020	31	3.6 MW	112		199
Total		**203**		**568**	**3.35**	

(Threatened Species Section 2006), the increasing role of windfarm development as a threatening process for the subspecies, and the lack of easily accessible public information on eagle mortality at windfarms have emphasised the importance of outlining eagle mortality and injury from wind-energy assets. The current paper assesses all available data sources to summarise Tasmanian eagle deaths and injuries from wind energy in the period 2010–2022.

Methods

Each year windfarm operators and TasNetworks (a Tasmanian Government business enterprise, which is responsible for power distribution and linking new generators to the energy system) are required to produce an environmental report, which is to be made publicly available. Data on eagle mortality for the present study were obtained from environmental reports prepared for Bluff Point, Studland Bay, Musselroe and Cattle Hill Wind Farms from 2010 onwards, and from TasNetworks annual reports since its inception and first report in 2014 (TasNetworks 2023).

There are protocols that must be followed by windfarm operators upon discovery of an injured or dead eagle, and these are documented in the yearly assessments. Methods and timing of carcass detection differ across the sites and, although the requirements have improved with each development, reports rely solely on ground searches close to turbines. Essentially a bird or a substantial part of a bird (without which the bird would die) must be found. The maximum search area in Tasmania is at the Cattle Hill Wind Farm, where a circle of radius 120 m is searched around each tower. An impacted bird that falls outside this defined search boundary is rarely found and, if it is, may not be considered as a turbine casualty. Presentation of information is not standardised and requires careful scrutiny year on year to extract data. The regulator does not treat recorded deaths in a cumulative fashion nor freely give mortality data on request (Nick Mooney pers. comm., 12 February 2021).

Data collected by TasNetworks is compiled from advice by staff following maintenance or network outages or reports of raptors found dead by the public. TasNetworks also sponsors a position at the Tasmanian Museum and Art Gallery to conduct necropsies on raptors found dead or crippled and later euthanased. The results of this work have not been published.

Numbers also come from injured raptors found by the public, with organised rehabilitation of raptors introduced in 1973 (Nick Mooney pers. comm.). Rehabilitation continues mostly through various centres (including Raptor Refuge, Raptor Care North West, Bonorong Wildlife Centre and Roaring Beach Wildlife Rescue). Formerly, an 'umbrella permit' ensured close cooperation between participants but now separate permits are issued by authorities, which has diminished consistent record keeping and sharing of data. Nevertheless, if probable duplications are excluded, numbers of eagles recorded as definitely or highly likely injured or killed by power assets can be determined.

Results

From 2010 until 2022, 268 eagles were recorded killed and an additional 53 injured (Appendix 1). Deaths at the four operational windfarms number 38 with one injury, whereas the TasNetworks data report 139 deaths and 2 injuries. Raptor Rescue data consist of 91 deaths and 50 injuries. Of the 321 injured or dead eagles, 272 were Wedge-tailed Eagles and 49 were White-bellied Sea-Eagles.

Discussion

This study has documented a high number of eagle deaths and injuries caused by wind-energy assets. The real number can only be higher since surveying at windfarms is incomplete (see also Huso *et al*. 2023). Specifically, it is only close to turbines, is periodic and does not involve all turbines or all habitat around each turbine, scrub often being excluded. In addition, carcasses are found by TasNetworks crews by coincidence during maintenance, not planned searches.

Of great concern is that the majority of these deaths involve the Endangered Tasmanian Wedge-tailed Eagle. The impact of this new threat on the population viability of this taxon has not been independently assessed (Briscoe 2019). A recent study from The Netherlands found that a small increase in mortality of 1% of "postfledging cohorts" in slow-breeding, long-lived birds such as eagles can see a 2–24% decrease in the population over a decade (Schippers *et al.* 2020, p. 1). If the mortality rate rises to 5%, the depletion could be as high as 77%. This concern is exacerbated by the inevitable future growth in wind-energy infrastructure in order to meet Tasmanian Government targets for renewable energy. The existing 197 turbines on the Tasmanian mainland will be dramatically increased by the 996 that are either approved or being proposed for construction within the next 8 years. It would require another 500 turbines to reach the Tasmanian Government's target generation capacity of 9950 MW by 2040 (*Tasmanian Renewable Energy Action Plan*: Tasmanian Government 2020).

Despite great differences in eagle densities across Tasmania's landscape as represented by distribution of nests (Threatened Species Section 2006), there are currently no designated 'no turbine zones'. Local eagle densities do not contribute to decisions on windfarm placements, despite the Tasmanian Government's *Offset Guidelines for Impacts to Threatened Eagles from Wind Farm Developments* (Tasmanian Government 2022, p. 1) 'Principles to consider when assessing offset proposals' stating: "The mitigation hierarchy should always be applied. Offsets should only be considered as a last resort after all other options (avoidance, mitigation) have been exhausted".

Several additional sources of information on mortality and injury of eagles exist; however, none of these were used in the current study. These sources are discussed below. Incorporating them into future estimates of mortality will assist in increasing the accuracy of the estimates.

First, the Department of Natural Resources and Environment Tasmania holds the data on mortalities at windfarms and across the transmission network, but these data are not publicly available. The Environmental Protection Authority Tasmania issues permit conditions for hydro development, windfarm operators and TasNetworks projects. Annual reports detailing the granting of permits and exemptions are required under its statutory authority. However, it does not release figures on eagle injuries or mortalities. Carcasses discovered during searches of windfarms and transmission-line maintenance are deposited (where stipulated by permits) with the Tasmanian Museum and Art Gallery, where they are frozen for routine necropsy. Anecdotal information suggests that these may number in the hundreds, and the Museum speaks of a 'large backlog'. However, this information is not publicly available (David Hocking, Tasmanian Museum and Art Gallery, pers. comm., 12 August 2021).

At present, the threat faced by Wedge-tailed Eagles at windfarms has not been able to be mitigated by design features. IdentiFlight, a camera-based detection system, is currently being trialled at the Cattle Hill Wind Farm in the Central Highlands (Rogers 2022a). Although the first report into the effectiveness of IdentiFlight detailed three Wedge-tailed Eagle deaths during its set-up phase, published data suggest that it has been effective in preventing eagle collisions by predicting the raptor's flight trajectory, and 'curtailing' any turbines in its path, i.e. reducing the speed to a more visible idle. However, IdentiFlight does not detect collisions (Rogers 2022a) and, with searches limited to only 120 m from the turbines, birds and bats lying further out would not be found. The Cattle Hill Wind Farm annual environmental report (Rogers 2022b) published in October 2022 detailed the death of one Wedge-tailed Eagle.

Another mitigation approach is to develop collision risk models as Murgatroyd *et al.* (2021) have recently done for Verreaux's Eagles *Aquila verreauxii* in South Africa. This approach is focused on the placement of wind turbines in areas that minimise collision risk potential with raptors and other soaring birds. Information on space use is obtained by fitting birds with GPS trackers, then using the collected data to predict the optimal placement of turbines to reduce interaction of eagles with them (Murgatroyd *et al.* 2021). A similar approach could be used to develop a collision-risk model for Tasmanian Wedge-tailed Eagles (M. Murgatroyd pers. comm., 20 April 2021).

The Robin Radar MAX radar system has been implemented at the Musselroe Wind Farm. The objective of this radar system is to implement a successful and commercially viable solution to mitigate and reduce the risk of eagle mortalities on the windfarm. The results to date indicate that, overall, the correlation of radar plots to positions of GPS-equipped birds is ~60% (Woolnorth Renewables 2021). Musselroe's 2021 *Annual Environmental Review* deemed the IdentiFlight detection system to be the most effective technology currently in use.

It has long been suggested that eagles resident in or around windfarms should be fitted with radio/satellite telemetry (first suggested for Woolnorth in 2001: Nick Mooney pers. comm.) but this concept, now progressed to GPS trackers, has been slow to establish. Some Wedge-tailed Eagles have been equipped with GPS trackers in Tasmania for various studies (e.g. Pay *et al.* 2022) and several of these birds live on and around current windfarms but no data from this study appear to have been used in windfarm planning.

To ensure long-term persistence and ecological function of the Tasmanian Wedge-tailed Eagle, in addition to collision statistics, ongoing studies are needed of the resident population within windfarm boundaries – number of eagles, stability of breeding pairs, nesting success and surviving chicks, presence of juvenile birds, and whether disruption to natural habitat has caused dislocation. Population sinks in windfarm areas are an obvious risk (Hunt & Hunt 2006; Smales 2006) that can only increase across Tasmania if further windfarm establishment is allowed without science-based information on eagle densities.

Conclusion

As we embrace renewable energy production as a planet-saving alternative to carbon-emitting fossil fuels, we must strive for ecologically sustainable development at the local level. Accelerated deaths of the Tasmanian Wedge-tailed Eagle and White-bellied Sea-Eagle are a grim reality if thousands of new wind turbines and hundreds of kilometres of transmission lines are erected across Tasmania to meet a legislated doubling of renewable energy production by 2040 (Tasmanian Government 2020).

Application of the precautionary principle and mitigation hierarchy is becoming more widely called for as the fallout from adaptive management practices emerges in industries that exploit natural resources.

The total of 321 dead and injured eagles recorded in this study presents a stark reminder that science-based strategies are needed immediately if the long-neglected *Threatened Tasmanian Eagles Recovery Plan* (Threatened Species Section 2006, p. 3) is to achieve its objective:

> To increase the breeding success of both eagle species by protecting nesting habitat from destruction, modification and disturbance and by minimising both the modification of foraging habitat and the occurrence of human-related mortality with the ultimate goal of an increase in the population size and stability of both species.

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Appendix 1. Number of Wedge-tailed Eagles and White-bellied Sea-Eagles recorded injured or killed, by location and year from 2010 to 2022.

		No. of birds injured		*No. of birds killed*	
Site	*Year*	*Wedge-tailed Eagle*	*White-bellied Sea-Eagle*	*Wedge-tailed Eagle*	*White-bellied Sea-Eagle*
Bluff Point and Studland Bay	2010			1	
	2011				
	2012				
	2013				
	2014				
	2015				
	2016–2018				
	2019			2	1
	2020				
	2021				
	2022				
Subtotal		**0**	**0**	**3**	**1**
Musselroe	2013				
	2014			2	1
	2015			3	
	2016			1	
	2017		1	1	
	2018			4	
	2019			1	
	2020			8	
	2021			6	1
	2022			3	
Subtotal		**0**	**1**	**29**	**2**
Cattle Hill	2020				
	2021			2	
	2022			1	
Subtotal		**0**	**0**	**3**	**0**
Granville Harbour	2022	0	0	0	0
Total for windfarms		**0**	**1**	**35**	**3**
TasNetworks	2014				
	2015			8	1
	2016			10	
	2017			12	1
	2018	2		28	3
	2019			19	5
	2020			14	1
	2021			12	1
	2022			21	3
Total for TasNetworks		**2**	**0**	**124**	**15**
Raptor Rescues	2017	5	1	2	5
	2018	3		24	7
	2019	3	1	14	2
	2020	3	1	6	2
	2021	7	1	17	2
	2022	4	4	9	1
Subtotal		**25**	**8**	**72**	**19**

Appendix 1 continued

Site	*Year*	*No. of birds injured*		*No. of birds killed*	
		Wedge-tailed Eagle	*White-bellied Sea-Eagle*	*Wedge-tailed Eagle*	*White-bellied Sea-Eagle*
Raptor Refuge	2020	7	2		
	2021	6	1		
	2022	1			
Subtotal		**14**	**3**	**0**	**0**
Total for rescue organisations		**39**	**11**	**72**	**19**
Grand Total		**41**	**12**	**231**	**37**