

**Risk level to select species listed
under the EPBC Act, of collision at
wind farms in Gippsland, Victoria**

December 2005

Ian Smales and Mark Venosta

**Report for
Department of Environment and Heritage**

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ABBREVIATIONS

AVW	Atlas of Victorian Wildlife
DEH	Department of the Environment & Heritage
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999

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1.0 INTRODUCTION

1.1 Project Background

Biosis Research Pty. Ltd. was commissioned by the Department of the Environment & Heritage to provide an assessment of the potential for a variety of birds and a bat to be at risk of collisions with wind turbines at wind farms in Gippsland, Victoria.

Specific and detailed investigations of the bird and bat fauna of a number of individual wind farm sites in Gippsland have been made (e.g. Organ and Meredith 2004a, b, Brett Lane and Assoc. 2003a,b, 2005). However, those assessments are limited to the species that have been recorded during fieldwork at the particular site and/or to records of birds and bats included in public databases from areas local to the particular site.

The objective of the present study was to provide information about a suite of birds and a bat species listed under provisions of the EPBC Act, regardless of whether records of their occurrence in the immediate vicinity of wind farm sites presently exists or not. It thus has the intent of using information available from a variety of sources about the distribution, occurrence and behaviours of the species in question in order to provide an informed assessment of the potential for a risk to be posed to them by collision with wind turbines. It does not purport to provide a *detailed quantification* of collision risk of the kind that can be determined by collision risk modelling (Smales, Meredith and McCarthy 2004). Rather, it is designed to make a preliminary determination of *whether a risk exists for a species* and, if so, the likely *level of impact on the Australian population of the species* that might exist.

The list of species to be assessed was provided by DEH (table 1). Following an initial assessment of this list, we advised that some of the species have distributional ranges that do not extend to eastern Victoria, or records of them from the area represent very rare vagrant occurrences only. Those species are indicated by asterisk in table 1 and, as agreed following our advice to DEH, were not included in further assessment. With one exception the species assessed are all listed under provisions of the EPBC Act for “Migratory Species”. The exception is the Grey-headed Flying –fox, which is listed as ‘Vulnerable’ under provisions of the Act for “Threatened Species”.

Table 1 EPBC Act listed species assessed

Common Name	Scientific Name
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>
Common Sandpiper	<i>Actitis hypoleucos</i>
Fork-tailed Swift	<i>Apus pacificus</i>
Great Egret	<i>Ardea alba</i>
Cattle Egret	<i>Ardea ibis</i>
Ruddy Turnstone	<i>Arenaria interpres</i>
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>
Sanderling	<i>Calidris alba</i>
Red Knot, Knot	<i>Calidris canutus</i>
Curlew Sandpiper	<i>Calidris ferruginea</i>
Pectoral Sandpiper	<i>Calidris melanotos</i>
Red-necked Stint	<i>Calidris ruficollis</i>

Common Name	Scientific Name
Long-toed Stint	<i>Calidris subminuta</i>
Great Knot	<i>Calidris tenuirostris</i>
Double-banded Plover	<i>Charadrius bicinctus</i>
Greater Sand Plover, Large Sand Plover	<i>Charadrius leschenaultii</i>
Lesser Sand Plover, Mongolian Plover	<i>Charadrius mongolus</i>
Oriental Plover, Oriental Dotterel	<i>Charadrius veredus</i>
Latham's Snipe, Japanese Snipe	<i>Gallinago hardwickii</i>
Swinhoe's Snipe *	<i>Gallinago megala</i>
Pin-tailed Snipe *	<i>Gallinago stenura</i>
Grey-tailed Tattler	<i>Heteroscelus brevipes</i>
Wandering Tattler *	<i>Heteroscelus incanus</i>
White-throated Needle-tail	<i>Hirundapus caudacutus</i>
Broad-billed Sandpiper	<i>Limicola falcinellus</i>
Asian Dowitcher *	<i>Limnodromus semipalmatus</i>
Bar-tailed Godwit	<i>Limosa lapponica</i>
Black-tailed Godwit	<i>Limosa limosa</i>
Eurasian Curlew *	<i>Numenius arquata</i>
Eastern Curlew	<i>Numenius madagascariensis</i>
Little Curlew, Little Whimbrel *	<i>Numenius minutus</i>
Whimbrel	<i>Numenius phaeopus</i>
Red-necked Phalarope *	<i>Phalaropus lobatus</i>
Ruff (Reeve)	<i>Philomachus pugnax</i>
American Golden Plover *	<i>Pluvialis dominica</i>
Pacific Golden Plover	<i>Pluvialis fulva</i>
Grey Plover	<i>Pluvialis squatarola</i>
Short-tailed Shearwater	<i>Puffinus tenuirostris</i>
Wood Sandpiper	<i>Tringa glareola</i>
Common Greenshank, Greenshank	<i>Tringa nebularia</i>
Marsh Sandpiper, Little Greenshank	<i>Tringa stagnatilis</i>
Common Redshank, Redshank *	<i>Tringa totanus</i>
Terek Sandpiper	<i>Xenus cinereus</i>

The assessment here is based on available information about five wind farms in Gippsland. One of them, the Toora Wind Farm, is operational. The Wonthaggi Wind Farm is currently under construction and the remaining three, Bald Hills, Dollar and Rosedale Ridge Wind Farms, are proposed and either do not require assessment under the EPBC Act (Rosedale Ridge Wind Farm) or are at various stages of the project assessment or approval process.

2.0 METHODS

The project entailed a desktop study to evaluate available information from published sources and the collective knowledge and experience of Biosis Research zoologists, about the listed bird and bat species.

Our assessment was made against a matrix of the following criteria for each species:

- Based on geographic range and habitat requirements of each species, the *likelihood* that a portion of the Australian population of that species might encounter wind farms in Gippsland, assessed as Minimal / Low / Medium / High.
- Based on information available about population size and geographic distribution, an estimation of the portion of the Australian population likely to encounter wind farms in Gippsland, estimated as <2% / 2 - 10% / 11 - 50% / 51 - 100%. For some of the species assessed there are no records from Gippsland. In such instances we considered that the portion of the population that might encounter wind farms there is ‘minimal’.
- Based on migratory and other movement behaviours, where applicable, an indication of season(s) and annual duration for potential encounters to occur.
- Based on life-history characters and behaviours, in combination with habitats at and in the vicinity of Gippsland wind farm sites, potential for collision risk to exist, assessed as Negligible / Low / Medium / High.

Where applicable, the conservation status of the particular species in Australia was taken into account in combination with the above, to determine an indication of whether collisions with turbines might affect the species. Note that we use the term ‘impact’ in the sense that it refers to a negative effect on the conservation status of a species.

From the matrix of information provided by this assessment, we provide an evaluation of the potential value of undertaking more detailed modelling for each species of the cumulative impacts of collisions with turbines at the five wind farms combined.

For species with potential for cumulative modelling, the review provides a determination of priority for modelling amongst the suite of species listed.

1.2 Information sources

The project undertook a literature review, searches of relevant databases and collation of information from other reliable sources to ascertain relevant current data about bird and bat species on the list provided by DEH. Published sources are detailed in *References* to this report. Where applicable, information collected during field assessments of Gippsland wind farm sites by Biosis Research and other workers was used (see Table 2 *Notes*).

Information about current and proposed wind farms in Gippsland, such as location and size of the facility and type of turbines to be used, were drawn from information recently supplied to Biosis Research by DEH for wind farms in Australia. Key information related to habitats within, and in the vicinity of, wind farm sites was taken into account. In particular, given the fact that the great majority of species are waders and shorebirds, the proximity of coastal and freshwater wetlands to wind farm sites was evaluated. Information relative to habitats at and in the vicinity of Gippsland wind farm sites was drawn from pre-existing reports and specific Biosis Research knowledge of the sites.

3.0 RESULTS

An assessment matrix for evaluation of potential and likely impacts of collision risk at Gippsland wind farms for listed EPBC Act species is provided in Table 2. From evaluation of the matrix, a resultant overall likely level of impact on the Australian population of each species is provided on a scale of Negligible / Low / Medium / High (see *Resultant Overall Likely Level of Impact On Aust. Population of Species* Table 2).

The assessment indicates that potential impacts on the majority of species evaluated is considered to be Negligible and we consider that additional detailed collision risk modelling is unlikely to be warranted for those species.

Impacts at the species level is considered to be Low for the following species: Grey-headed Flying-fox, Great Egret, Cattle Egret, White-throated Needle-tail, Short-tailed Shearwater, Fork-tailed Swift, Red Knot, Latham's Snipe, Sharp-tailed Sandpiper, Double-banded Plover, Pacific Golden Plover, Common Sandpiper. For species assessed as having a Low impact potential we consider that detailed collision risk modelling may be of value as a tool in quantifying the level of impact that each species might experience as a result of collisions with wind turbines. On the basis of risk posed by species' flight behaviour and conservation status, we consider that the White-throated Needletail, Latham's Snipe and Grey-headed Flying-fox would constitute the highest priority species, in terms of being the most likely species to be at risk from collision with wind turbines at wind farms in Gippsland. All other species would constitute a lower priority. It should be stressed, however, that this priority ranking is only relevant in terms of the current group of species assessed in this study. Further, this finding should not be interpreted as a recommendation that these species should undergo a more detailed level of evaluation at this time, as the potential risk of collision posed by the Gippsland wind farms to these species is considered to be Low.

It should be noted that collision risk modelling can be undertaken on the basis of scenarios in the absence of actual bird or bat utilisation data obtained from field studies. However, modelling can be expected to be most accurate, and results more robust, when it utilises substantial field data collected from wind farm sites under various conditions and across a number of seasons.

Table 2 Assessment matrix for evaluation of potential impacts of collision risk at Gippsland wind farms for listed EPBC Act species

Common Name	Scientific Name	EPBC Act listing	Gippsland AWW records	Season and duration of risk	Likelihood of portion of population encountering current or proposed wind farms (Minimal / Low / Medium / High)	Estimated portion of Australian population with potential to encounter current or proposed wind farms (Minimal / <2% / 2 - 10% / 11 - 50% / 51 - 100%)	Likelihood of species' behaviour posing collision risk if/when encounters with wind farms occur (Low / Medium / High)	RESULTANT OVERALL LIKELY LEVEL OF IMPACT ON AUSTRALIAN POPULATION OF SPECIES (Negligible / Low / Medium / High)	Notes
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	Vu	Few single records from coastal areas, scattered inland records.	Summer, may be restricted to brief duration of semi-annual migrations or vagrants. No residence in western Gippsland	Medium	2 - 10%	High	Low	Movement between the Melbourne population and those in E. Gippsland and Southern NSW is known to occur (Menkhorst 1995), however records are scarce and precise movement routes are unknown. Menkhorst (1995) highlights the importance of the Gippsland coast as a significant source of food for the southernmost breeding populations during some winters. Known to use terrestrial wetlands, estuarine and littoral habitats, moist grasslands farm dams, areas of mangroves, floodwaters and artificial wetlands created by irrigation (Marchant and Higgins 1990, Emison et al. 1987). The species uses estuarine mudflats mainly as summer-autumn or drought refuges in southern Vic. (Marchant and Higgins 1990). Movement inland between coastal habitats and wetland habitats could pose collision risk.
Great Egret	<i>Ardea alba</i>	Mi/Ma	Numerous records along coast.	Year round	High	<2%	Medium	Low	

Common Name	Scientific Name	EPBC Act listing	Gippsland AVW records	Season and duration of risk	Likelihood of portion of population encountering current or proposed wind farms (Minimal / Low / Medium / High)	Estimated portion of Australian population with potential to encounter current or proposed wind farms (Minimal / <2% / 2 - 10% / 11 - 50% / 51 - 100%)	Likelihood of species' behaviour posing collision risk if/when encounters with wind farms occur (Low / Medium / High)	RESULTANT OVERALL LIKELY LEVEL OF IMPACT ON AUSTRALIAN POPULATION OF SPECIES (Negligible / Low / Medium / High)	Notes
Cattle Egret	<i>Ardea ibis</i>	Mi/Ma	Scattered records from Anderson's Inlet, Corner Inlet and inland.	Winter	High	<2%	Medium	Low	Regularly forage away from water on low-lying grasslands, improved pastures and croplands and associate with grazing animals. In Gippsland they prefer shallow wetlands between April-May, low-lying grasslands in June-Sept and improved pasture, lucerne plantings and cropland on higher ground in Oct (Marchant and Higgins 1990). Movement between wetland habitats could pose collision risk. Recorded at Dollar wind farm site (Biosis 2003).
White-throated Needle-tail	<i>Hirundapus caudacutus</i>	Mi/Ma	Numerous records from Gippsland.	Summer (peak in Feb-March)	High	<2%	High	Low	Usually recorded on the wing and rarely reported roosting. Often appears in feeding congregations where insects are abundant (Emison et al. 1987). Flight recorded across wide range of heights from <1m - >1000m (Higgins 1999). Regularly recorded during Dollar wind farm monitoring (Biosis Research Pty Ltd) and recorded at Bald Hills wind farm (Brett Lane & Assoc. 2003) flying at, above and below rotor swept height.
Short-tailed Shearwater	<i>Puffinus tenuirostris</i>	Mi/Ma	Numerous records concentrated around Corner Inlet/Wilsons Promontory, Anderson's Inlet and at sea.	Summer	Low	<2%	High	Low	Recorded close inshore or in pelagic waters far from land. Breed along coast or on offshore islands (Emison et al. 1987). Largest colonies on islands off Wilsons Promontory (Marchant and Higgins 1990). Potential for rotor strike at wind farms within close proximity to the coast.

Common Name	Scientific Name	EPBC Act listing	Gippsland AVW records	Season and duration of risk	Likelihood of portion of population encountering current or proposed wind farms (Minimal / Low / Medium / High)	Estimated portion of Australian population with potential to encounter current or proposed wind farms (Minimal / <2% / 2 - 10% / 11 - 50% / 51 - 100%)	Likelihood of species' behaviour posing collision risk if/when encounters with wind farms occur (Low / Medium / High)	RESULTANT OVERALL LIKELY LEVEL OF IMPACT ON AUSTRALIAN POPULATION OF SPECIES (Negligible / Low / Medium / High)	Notes
Fork-tailed Swift	<i>Apus pacificus</i>	Mi/Ma	Scattered records across Gippsland.	Summer	High	<2%	High	Low	Almost exclusively aerial from <1m - >300m and often occur over beaches and cliffs as well as farmland and developed areas (Higgins 1999). Potential for rotor strike due to flight behaviour.
Wood Sandpiper	<i>Tringa glareola</i>	Mi/Ma	-	Summer, Vagrant visitor	Low	<2%	Low	Negligible	Scattered records around Corner Inlet (Higgins and Davies 1996).
Common Greenshank, Greenshank	<i>Tringa nebularia</i>	Mi/Ma	Scattered records along the coast.	Summer	Low	<2%	Low	Negligible	Widespread in coastal habitats between Gippsland Lakes and Port Phillip (Higgins and Davies 1996). Numbers up to approx. 300 at Anderson's Inlet and Corner/ Shallow Inlet (Watkins 1993).
Marsh Sandpiper, Little Greenshank	<i>Tringa stagnatilis</i>	Mi/Ma	Three records along coast near Pt. Albert and Jack Smith's Lake.	Summer	Low	<2%	Low	Negligible	A few Gippsland records between Rotamah Island and Jack Smith's Lake, next closest records in Westernport Bay (Higgins and Davies 1996). Occasional vagrant visitor to Gippsland.
Broad-billed Sandpiper	<i>Limicola falcinellus</i>	Mi/Ma	One record from Anderson's Inlet	Summer	Low	<2%	Low	Negligible	Fewer than five birds a year appear in Victoria, in some years none (Emison et al. 1987, Higgins and Davies 1996).

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Bar-tailed Godwit	<i>Limosa lapponica</i>	Mi/Ma	Numerous records from Corner and Shallow Inlet.	Year round, mostly summer but non-breeding individuals frequently spend winter in Corner Inlet.	Low	<2%	Low	Negligible	<p>¹ 3,139 birds were recorded in Corner and Shallow Inlet in 1987 (Watkins 1993). These birds are regularly recorded using coastal mudflats and rarely recorded using wetlands or in areas of short grass such as farmland, paddocks or airstrips (Higgins and Davies 1996). Unlikely to be at risk of rotor strike due to specific habitat requirements that restrict the species distribution to intertidal areas.</p>
Black-tailed Godwit	<i>Limosa limosa</i>	Mi/Ma	Three records from Shallow Inlet.	Summer	Low	<2%	Low	Negligible	Rarely recorded in Gippsland (Higgins and Davies 1996). Occur on intertidal mudflats or sandflats, often with beds of seagrass, and occasionally on ocean beaches (Higgins and Davies 1996). Approximately 2000 birds occur regularly in Corner and Shallow Inlet (Emison et al. 1987, Higgins and Davies 1996, Watkins 1993, AVW). Emison et al. (1987) comment that most of the world population winters in eastern Australia, where the habitats in Victoria are vital for their conservation. Unlikely to be at risk of rotor strike due to specific habitat requirements that restrict the species distribution to intertidal areas.
Eastern Curlew	<i>Numenius madagascariensis</i>	Mi/Ma	Numerous records from Anderson's Corner and Shallow Inlet, and Jack Smith's Lake.	Year round, principally summer but small numbers over winter.	Low	2 - 10%	Low	Negligible	

Common Name	Scientific Name	EPBC Act listing	Gippsland AVW records	Season and duration of risk	Likelihood of portion of population encountering current or proposed wind farms (Minimal / Low / Medium / High)	Estimated portion of Australian population with potential to encounter current or proposed wind farms (Minimal / <2% / 2 - 10% / 11 - 50% / 51 - 100%)	Likelihood of species' behaviour posing collision risk if/when encounters with wind farms occur (Low / Medium / High)	RESULTANT OVERALL LIKELY LEVEL OF IMPACT ON AUSTRALIAN POPULATION OF SPECIES (Negligible / Low / Medium / High)	Notes
Whimbrel	<i>Numenius phaeopus</i>	Mi/Ma	Scattered records from Anderson's and Shallow Inlet.	Year round, principally summer but small numbers over winter.	Low	<2%	Low	Negligible	Flocks of up to 30 birds occur in Corner Inlet during summer on intertidal mudflats (Emison et al. 1987). Unlikely to be at risk of rotor strike due to specific habitat requirements that restrict the species distribution to intertidal areas.
Ruff (Reeve)	<i>Philomachus pugnax</i>	Mi/Ma	Nil	No records from area	Minimal	Minimal	Low	Negligible	No records from Gippsland (AVW, Barrett et al. 2003, Higgins and Davies 1996).
Red Knot, Knot	<i>Calidris canutus</i>	Mi/Ma	Numerous records from Anderson's, Corner and Shallow Inlet, and Jack Smith's Lake.	Year round, principally summer but non-breeders may remain over winter.	Low	2 - 10%	Medium	Low	Thousands of birds (7,110 Watkins (1993)) regularly occur on intertidal mudflats on Corner and Shallow Inlet. Small flocks irregularly occur elsewhere (Emison et al. 1987). During high tide they may move to nearby lakes, lagoons or floodwaters to continue feeding, although they usually roost with other waders on spits and islets (Emison et al. 1987). Unlikely to be at risk of rotor strike due to specific habitat requirements that restrict the species distribution to intertidal areas.
Curlew Sandpiper	<i>Calidris ferruginea</i>	Mi/Ma	Numerous records from Anderson's, Corner and Shallow Inlet, and Jack Smith's Lake.	Year round, principally summer but non-breeders may remain over winter.	Low	2 - 10%	Low	Negligible	Thousands of birds (9,068 Watkins (1993)) occur at Corner and Shallow Inlet, with congregations also recorded at Jack Smith's Lake and Anderson's Inlet (Emison et al. 1987, Higgins and Davies 1996) where they forage on intertidal mudflats. Occasionally forage among low emergent vegetation or from wet pastures (Emison et al. 1987). Unlikely to be at risk of rotor strike due to specific habitat requirements that restrict the species distribution mainly to intertidal areas.

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Pectoral Sandpiper	<i>Calidris melanotos</i>	Mi/Ma	Nil	No records from area	Minimal	Minimal	Low	Negligible	No records from Gippsland (AVW, Barrett et al. 2003, Higgins and Davies 1996).
Red-necked Stint	<i>Calidris ruficollis</i>	Mi/Ma	Numerous records from Anderson's Corner and Shallow Inlet, and Jack Smith's Lake.	Year round, principally summer but non-breeders may remain over winter.	Low	11 - 50%	Low	Negligible	Thousands are recorded regularly along coastal Sth Gippsland. 5000 have been recorded at Anderson's Inlet and 20338 at Corner and Shallow Inlet (Watkins 1993) where they forage on intertidal mudflats. During high tide they may move to nearby lakes, lagoons or floodwaters to continue feeding, although they usually roost with other waders on spits and islets (Emison et al. 1987). Unlikely to be at risk of rotor strike due to specific habitat requirements that restrict the species distribution mainly to intertidal areas.
Long-toed Stint	<i>Calidris subminuta</i>	Mi/Ma	Nil	No records from area	Minimal	Minimal	Low	Negligible	No records from Sth Gippsland (AVW, Barrett et al. 2003, Higgins and Davies 1996).
Great Knot	<i>Calidris tenuirostris</i>	Mi/Ma	Scattered records from Corner and Shallow Inlet, and Jack Smith's Lake.	Summer, some non-breeders may remain over winter.	Low	2 - 10%	Low	Negligible	Flocks occur regularly at intertidal mudflats on Corner Inlet (Emison et al. 1987, Higgins and Davies 1996). Smaller flocks are regularly recorded elsewhere along the Sth Gippsland coast. Unlikely to be at risk of rotor strike due to specific habitat requirements that restrict the species distribution mainly to intertidal areas.

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Latham's Snipe Japanese Snipe	<i>Gallinago hardwickii</i>	Mi/Ma	Scattered records from across Gippsland.	Summer	Medium	<2%	Low	Low	Occur in a wide variety of permanent and ephemeral wetlands with nearby cover (Higgins and Davies 1996). Widespread throughout most of Victoria, with only scattered records from Sth Gippsland (AVW). Potential for rotor strike at wind farms within close proximity to suitable wetland habitats. Has been recorded at Bald Hills wind farm (Brett Lane & Assoc. 2003).
Grey Plover	<i>Pluvialis squatarola</i>	Mi/Ma	Numerous records from Corner Inlet to Jack Smith's Lake and some from Anderson's Inlet.	Summer, some non-breeders may remain over winter.	Low	2 - 10%	Low	Negligible	Almost entirely associated with coastal habitats, but occasionally recorded on inland wetlands (Marchant and Higgins 1993). Most numerous on intertidal mudflats, particularly in Corner Inlet (over 400 birds) (Emison <i>et al.</i> 1987). Watkins (1993) report 900 birds from Corner and Shallow Inlet in summer 1987. Unlikely to be at risk of rotor strike due to specific habitat requirements that restrict the species distribution mostly to intertidal areas.
Ruddy Turnstone	<i>Arenaria interpres</i>	Mi/Ma	Numerous records from Corner Inlet to Jack Smith's Lake and some from Anderson's Inlet.	Summer, some non-breeders may remain over winter.	Low	<2%	Low	Negligible	During summer, small flocks (up to 100 birds) (161 reported on Corner and Shallow Inlet in summer 1987 by Watkins (1993)) occur regularly on rocky coasts with adjacent intertidal mudflats and on beaches with rock platforms exposed at low tide (Emison <i>et al.</i> 1987). Unlikely to be at risk of rotor strike due to specific habitat requirements that restrict the species distribution mostly to intertidal areas.

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Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	Mi/Ma	Numerous records from Anderson's Inlet, scattered records from Corner Inlet to Jack Smith's Lake.	Summer	Medium	2 - 10%	Medium	Low	Flocks of hundreds or thousands (Watkins (1993) reports 2530 birds in Anderson's Inlet) occur in shallow freshwater or saline swamps with scattered, low, emergent vegetation, especially those with wet muddy margins. They also exploit temporary floodwaters, including flooded saltmarshes, saltworks and sewage lagoons (Emison <i>et al.</i> 1987, Higgins and Davies 1996). On intertidal mudflats they only occur where there are nearby habitats that are suitable for feeding at high tide (Emison <i>et al.</i> 1987). Potential for rotor strike at wind farms within close proximity to suitable non-coastal wetland habitats primarily at high tide.
Sanderling	<i>Calidris alba</i>	Mi	Some records from Anderson's Inlet, Sandy Point and numerous scattered records from Corner and Shallow Inlet.	Summer, some non-breeders may remain over winter.	Low	<2%	Low	Negligible	Flocks occur on sandy ocean beaches, with regular populations of a few hundred birds (321 between 1981-85 (Watkins 1993)) at Corner and Shallow Inlets and Wilson's Promontory (Emison <i>et al.</i> 1987, Higgins and Davies 1996). Rarely recorded in near-coastal wetlands (Higgins and Davies 1996). Unlikely to be at risk of rotor strike due to specific habitat requirements that restrict the species distribution mostly to coastal areas.
Greater Sand Plover, Large Sand Plover	<i>Charadrius leschenaultii</i>	Mi/Ma	Scattered records from Shallow Inlet.	Summer, some non-breeders may remain over winter.	Low	<2%	Low	Negligible	Small numbers of birds regularly occur on intertidal mudflats in Corner Inlet (Emison <i>et al.</i> 1987). Almost entirely coastal, in littoral and estuarine habitats (Marchant and Higgins 1993). Unlikely to be at risk of rotor strike due to specific habitat requirements that restrict the species distribution mostly to coastal areas.

Common Name	Scientific Name	EPBC Act listing	Gippsland AVW records	Season and duration of risk	Likelihood of portion of population encountering current or proposed wind farms (Minimal / Low / Medium / High)	Estimated portion of Australian population with potential to encounter current or proposed wind farms (Minimal / <2% / 2 - 10% / 11 - 50% / 51 - 100%)	Likelihood of species' behaviour posing collision risk if/when encounters with wind farms occur (Low / Medium / High)	RESULTANT OVERALL LIKELY LEVEL OF IMPACT ON AUSTRALIAN POPULATION OF SPECIES (Negligible / Low / Medium / High)	Notes
Lesser Sand Plover, Mongolian Plover	<i>Charadrius mongolus</i>	Mi/Ma	Records from Anderson's Corner and Shallow Inlet.	Summer, some non-breeders may remain over winter in Pt Phillip Bay.	Low	<2%	Low	Negligible	Almost entirely coastal, in littoral and estuarine habitats (Marchant and Higgins 1993). Flocks of up to 50 birds regularly occur on intertidal mudflats on Corner inlet (Emison <i>et al.</i> 1987). Unlikely to be at risk of rotor strike due to specific habitat requirements that restrict the species distribution to intertidal areas.
Oriental Plover, Oriental Dotterel	<i>Charadrius veredus</i>	Mi/Ma	Nil	Summer	Low	<2%	Low	Negligible	Only one record of 53 birds from Jack Smith's Lake in 1983 during drought (Emison <i>et al.</i> 1987). Appears to be absent or vagrant to Sth Gippsland.
Double-banded Plover	<i>Charadrius bicinctus</i>	Mi/Ma	Numerous records from much of coastal Sth Gippsland.	Winter, very few non-breeders may remain over summer.	Medium	2 - 10%	Medium	Low	Inhabit littoral, estuarine and fresh or saline terrestrial wetlands; also saltmarsh, grasslands and pasture (Marchant and Higgins 1993). Flocks of up to 550 and 800 have been recorded at Anderson's Corner/ Shallow Inlets respectively (Watkins 1993). Potential for rotor strike at wind farms within close proximity to suitable non-coastal habitats ie: rank pasture.
Pacific Golden Plover	<i>Pluvialis fulva</i>	Mi/Ma	Records from Anderson's Inlet, Sandy Point and numerous scattered records from Corner and Shallow Inlet.	Summer	Low	2 - 10%	Medium	Low	Inhabits sandy, rocky or muddy shores, estuaries and lagoons, reefs, saltmarsh and short grass in paddocks and crops. Usually coastal, including offshore islands; rarely far inland (Marchant and Higgins 1993). Watkins (1993) reports 251 birds at Anderson Inlet and 303 birds at Corner and Shallow Inlet. Potential for rotor strike at wind farms within close proximity to suitable non-coastal habitats ie: wet pasture.

Common Name	Scientific Name	EPBC Act listing	Gippsland AVW records	Season and duration of risk	Likelihood of portion of population encountering current or proposed wind farms (Minimal / Low / Medium / High)	Estimated portion of Australian population with potential to encounter current or proposed wind farms (Minimal / <2% / 2 - 10% / 11 - 50% / 51 - 100%)	Likelihood of species' behaviour posing collision risk if/when encounters with wind farms occur (Low / Medium / High)	RESULTANT OVERALL LIKELY LEVEL OF IMPACT ON AUSTRALIAN POPULATION OF SPECIES (Negligible / Low / Medium / High)	Notes
Terek Sandpiper	<i>Xenus cinereus</i>	Mi/Ma	Records from Anderson's Inlet and Corner and Shallow Inlet.	Summer	Low	<2%	Low	Negligible	Small numbers (up to ten birds) occur on intertidal mudflats in Corner Inlet. They forage on mangrove-lined mudflats and roost on spits, islets or mangroves (Emison <i>et al.</i> 1987). Unlikely to be at risk of rotor strike due to specific habitat requirements that restrict the species distribution to intertidal areas.
Common Sandpiper	<i>Actitis hypoleucos</i>	Mi/Ma	A few records from coastal Sth Gippsland.	Summer	Low	2 - 10%	Medium	Low	Habitat includes a wide range of coastal or inland wetlands, with varying levels of salinity. Mainly muddy margins or rocky shores of wetlands, estuaries, stream deltas as well as banks further upstream from mudflats (Higgins and Davies 1996, Emison <i>et al.</i> 1987). Potential for rotor strike at wind farms within close proximity to suitable habitats ie: upstream from mudflats.
Grey-tailed Tattler	<i>Heteroscelus brevipes</i>	Mi/Ma	A few records from Corner and Shallow Inlets.	Summer	Low	<2%	Low	Negligible	Inhabits sheltered coasts with reefs and rock platforms or with intertidal mudflats. Rarely recorded in Gippsland (Higgins and Davies 1996). Small flocks (up to 40 birds) gather regularly in summer in Corner Inlet (Emison <i>et al.</i> 1987). Unlikely to be at risk of rotor strike due to specific habitat requirements that restrict the species distribution to intertidal areas.

4.0 CONCLUSION

We have assessed likely impacts on thirty-four species that might result from collisions with turbines at current and proposed wind farms in Gippsland. Using a matrix of criteria to determine likely levels of impacts, we conclude that impacts are likely to be low for twelve species and negligible for twenty-two of them.

Results are due to a variety of species-specific factors. For many of the species, the likelihood of any part of their populations interacting with wind turbines is low as a result of the location of the wind farms relative to their required habitats. For the majority of them, even those that might move through the wind farms, we also consider it most probable that only a very small portion of their total Australian populations would ever do so. The known behaviours of most suggest that they would also actively avoid collisions or do not frequently fly in the zone swept by turbine rotors.

IN COMBINATION, THESE FACTORS DRAW US TO THE CONCLUSION THAT COLLISIONS WITH WIND TURBINES POSE LITTLE RISK TO THE MAJORITY OF THE THIRTY-FOUR SPECIES EVALUATED HERE.

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