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Observations of transoceanic movements by Nankeen Kestrels *Falco cenchroides* and a catalogue of terrestrial birds interacting with offshore vessels in Bass Strait, Australia

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Abstract. How terrestrial avifauna interact with offshore infrastructure is relatively understudied. The migratory pathway and movements over Bass Strait (an expanse of ocean between Victoria and Tasmania, Australia) for many terrestrial species remains poorly known. Whilst working in Bass Strait, I observed multiple terrestrial species flying over deep offshore waters, up to distances of 35 nautical miles from the nearest coastline. Some of these species utilised offshore vessels as temporary refugia. Of particular note are several observations of Nankeen Kestrels *Falco cenchroides*. These observations are discussed, alongside an empirical list of species observed during my engagement with the offshore industry.

Introduction

Interactions between birds and offshore vessels are relatively understudied (Lyons & De Oliveira Menezes 2020). A recent literature review (Ronconi *et al.* 2015), which focused on avian interactions with offshore oil and gas platforms in the Northern Hemisphere, identified a mere 24 studies that reported these interactions. Most studies were qualitative in nature, and only half underwent peer review (Ronconi *et al.* 2015). Specifically, the review noted that, although the potential environmental effects of offshore oil and gas operations are well understood, few studies have examined avian interactions with daily operations, or the cumulative impacts of these occurrences. It also remarked on the absence of empirical data, because of either constraints associated with company regulatory processes or absence of relevant data collection. Such data are crucial to quantifying elements associated with avian attraction to offshore operations, and would inform mitigation strategies to reduce future avian interactions (Ronconi *et al.* 2015).

Recently, whilst working as an offshore marine fauna observer around oil and gas infrastructure in Bass Strait, Australia, I observed a suite of terrestrial birds roosting on the ships and oil rigs. Operators for the project (an offshore operation for Beach Energy) have observed many terrestrial birds on their vessels but, at the time of writing (5 April 2022), had not recorded any as injured or deceased. Herein, I provide empirical data in an information-poor field, and use these data to discuss future research and knowledge gaps. In particular, I focus my discussion on the movements of one species observed numerous times whilst offshore: the Nankeen Kestrel *Falco cenchroides*.

The Nankeen Kestrel is a small raptor belonging to the Falconidae family (Menkhorst *et al.* 2017). It is known to be partially migratory and dispersive, but there have been reports of temporary range expansions and seasonal or conditional movements (Olsen & Olsen 1987; Schulz & Lumsden 2009). Explicitly, there are reported northward expansions of this species throughout the Austral winter from the Australian mainland towards areas such as Papua New Guinea, and other countries within the Malay Archipelago (Bell 1970; Olsen & Olsen 1987). There are also regular eastward expansions into New Zealand and its island territories during this time (Miskelly *et al.* 2011, 2013, 2019, 2021).

Methods

From 1 March until 5 April 2022 and from 29 April until 31 May 2022, I was employed as a Marine Fauna Observer (MFO, or environmental consultant) onboard the *Siem Aquamarine* (a mobile, anchor-handling vessel) for Beach Energy's Otway offshore operations (Figure 1). MFO shifts were roughly 12 hours long (10 minutes before sunrise, to 10 minutes after sunset – as per the Bureau of Meteorology definition of daylight) with at least one of two MFOs on the bridge at all times maintaining constant watch. If only one MFO was present on the bridge (e.g. when the other was collecting lunch), bridge crew assisted with the watch where safe and possible to do so. The primary role of MFOs was to monitor mobile offshore drilling unit (oil rig) interactions with marine mammals and/or large aggregations of other vertebrate fauna. There were up to three anchor-handling vessels stationed around the oil rig at any one time, and a maximum of six MFOs on watch. Binoculars, reticle binoculars (for trigonometric calculations regarding distance), shipboard compasses, and cameras (usually with 100–400-mm lens) were used to identify species and pinpoint a location. Weather conditions, including cloud cover, wind direction and strength, and swell were recorded. All times are given as Australian Eastern Standard Time. Opportunistic records of individual birds (such as those of terrestrial species) were documented out of interest, but were not central to project operations.

Observations

In total, 18 terrestrial bird species were observed offshore during, and prior to, my engagement with the operation (Table 1). During my time onboard, the observations of Nankeen Kestrel were of particular interest.

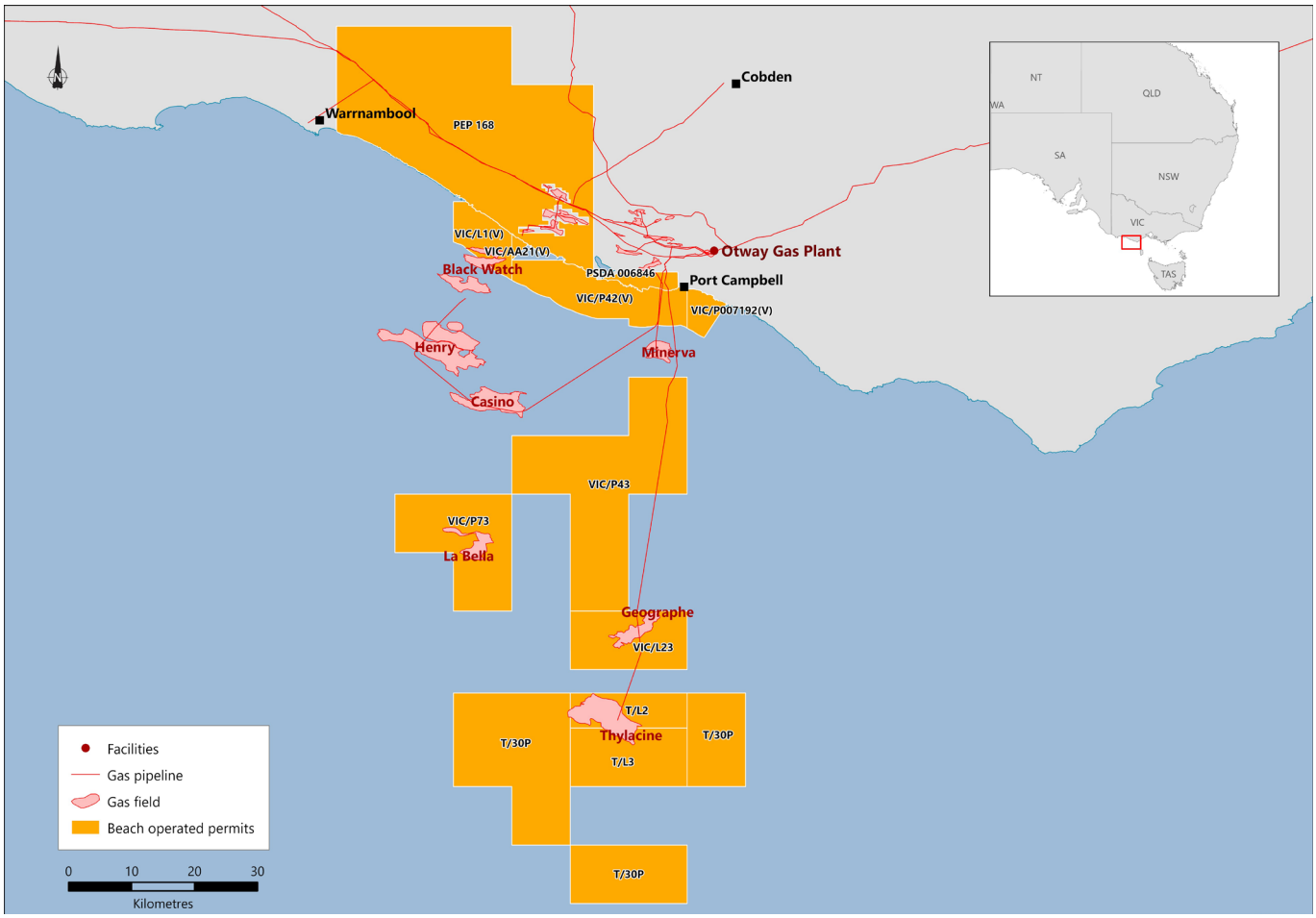

Figure 1. Location of Beach Energy offshore Otway operations (as per Beach Energy website) and the relevant project location names listed throughout the manuscript. Project location names are also seen in Table 1.

On 14 March 2022, whilst working around the Thylacine location (Figure 1), I observed a Nankeen Kestrel utilise a support vessel (*Siem Aquamarine*) as a refugium from a storm (Figure 2). The bird was observed 62 km from the nearest land over an ocean depth of 105 m. It landed on the vessel's crane at 1820 h, and remained in place until 0840 h the next day, occasionally moving to reposition itself against the wind and rain. It looked alert, strong, and healthy, with no obvious injuries.

Before the Kestrel's arrival on 14 March, weather conditions had been changing throughout the day. My watch began at 0615 h, 10 minutes before sunrise. Visibility was reasonably good, with observations viable at 3–5 km from the vessel. Wind direction was north-westerly, at 10–20 kt. The first swell was south-westerly, at a height of 1–2 m. Cloud cover was heavy, and remained at 8 okta (measure of eighths, where 8 refers to complete cloud coverage) until 0830 h. At 0830 h, the cloud cleared a little (7 okta) until 1030 h, when a light haze set in around the ship. By 1530 h, cloud cover was heavy again (8 okta), it was raining, and the wind direction had changed from north-westerly to north-easterly, and then easterly. Sea state was clearly becoming more intense, and lightning was observed on the horizon. Rain continued until 1620 h, and for *c.* 2 hours there was a change in wind direction from easterly to westerly. It was during this respite that the Kestrel landed on the vessel's crane, where it remained for the night (according to the officer on watch). Squalls continued periodically throughout the night, and it was raining when I resumed watch at 0615 h the next day. The rain stopped at 0830 h and at 0840 the bird departed, heading south towards the Tasmanian coast (~200 km away).

During the next bout of intense weather (described here as winds >10 kt and swell ≥2 m), on 19 March 2022, I observed another four individual Kestrels on headings of ~145° towards the Tasmanian coastline throughout the day. The first two birds (Figure 3) arrived at 1000 h, with a new individual landing on the vessel and departing at 1025 h; both of these individuals (Figure 3) displayed visibly different plumage from the first Kestrel (Figure 2). The next two Kestrels flew past the bridge of the ship at high speed, unfortunately preventing photography; the third Kestrel for the day flew past at 1300 h, and the fourth at 1500 h. Weather was fairly consistent throughout the day. Wind direction was southerly in the morning (from 0630 until 0830 h), before swinging south-easterly for the rest of the day. Wind persisted at speeds between 30 and 50 kt, occasionally falling to 20–30 kt. Swell was consistently between 2 and 4 m and predominantly south-westerly. Cloud cover ranged between 5 and 8 okta throughout the day, but there was good visibility, with sightings of larger fauna possible at distances of 3–5 km from the bridge of the ship. All four Kestrels observed on 19 March appeared to be alert, vigorous, and in good health, with no obvious sign of injury.

Table 1. List of terrestrial bird species seen from, or landing on, vessels associated with Beach Energy offshore operations in western Bass Strait, from February 2021 until March 2022. An asterisk (*) denotes species where an individual landed on a vessel; when there were observations of >1 individual, these are numbered. E = east, S = south, SE = south-east, SW = south-west, NW = north-west.

Common name	*Scientific name*	*Weather detail where recorded*
Species seen between February 2021 and March 2021 (Artisan Project – not shown in Figure 1, but was near Casino)		
Cattle Egret	*Bubulcus ibis*	Not recorded
Swamp Harrier	*Circus approximans*	Not recorded
Australasian Pipit*	*Anthus novaeseelandiae*	23 March – haze/fog/drizzle. Wind direction: E/SE (10–20 kt). Swell: SE (1–2 m)
Species seen between April 2021 and November 2021 (Geographe Project – see Figure 1)		
White-faced Heron	*Egretta novaehollandiae*	Not recorded
Straw-necked Ibis	*Threskiornis spinicollis*	Not recorded
Swamp Harrier	*Circus approximans*	Not recorded
Brown Falcon	*Falco berigora*	Not recorded
Peregrine Falcon	*Falco peregrinus*	Not recorded
Galah*	*Eolophus roseicapilla*	26 May – drizzle. Wind direction: SW (30–50 kt). Swell: SW (7 m)
Rock Dove*	*Columbia livia*	4 & 5 April – clear. Wind direction: SE (0–10 kt). Swell: S (2–4 m)
Brush Bronzewing*	*Phaps elegans*	22 October – clear. Wind direction: NW (0–10 kt). Swell: SW (0–1 m)
Welcome Swallow*	*Hirundo neoxena*	Not recorded
Grey Fantail*	*Rhipidura albiscapa*	Not recorded
Silvereye*	*Zosterops lateralis*	22 October – clear. Wind direction: NW (0–10 kt). Swell: SW (0–1 m)
Australasian Pipit*	*Anthus novaeseelandiae*	Not recorded
Common Starling	*Sturnus vulgaris*	Not recorded
Species seen between November 2021 and March 2022 (Thylacine Project – see Figure 1)		
Black Swan	*Cygnus atratus*	Not recorded
Australian Shelduck	*Tadorna tadornoides*	Not recorded
White-faced Heron*	*Egretta novaehollandiae*	1: no data. 2: 28 & 29 March – clear. Wind direction: SE (10–20 kt). Swell: SW (0–1 m)
Nankeen Kestrel*	*Falco cenchroides*	1*: 14 & 15 March – haze/drizzle/squalls/rain. Wind direction: SE (10–20 kt). Swell: SW (1–2 m) 2*, 3, 4 & 5: 19 March – clear. Wind direction: S/SE (30–50 kt). Swell: S/SW (2–4 m)
Rock Dove*	*Columbia livia*	13 February – clear. Wind direction: NE/SW (20–30 kt). Swell: E (1–2 m)
Satin Flycatcher*	*Myiagra cyanoleuca*	23 November – stormy. Wind direction: E/NE (10–30 kt). Swell: SW (2–4 m)
Silvereye*	*Zosterops lateralis*	1: no data. 2: 27 March – smoke haze from fuel-reduction burns on mainland Victoria. Wind direction: E/SE (0–20 kt). Swell: SW (1–2 m)

Figure 2. The first of five Nankeen Kestrels observed on the offshore vessel (individual from 14 and 15 March 2022).

Discussion

Anecdotal reports from offshore crew members suggest that interactions with other terrestrial birds (listed in Table 1) have been similar, with individuals often leaving the vessel soon (<24 h) after arrival. Unfortunately, detailed data regarding terrestrial fauna does not exist as these sightings are not the primary focus of observers or crew.

Terrestrial birds are believed to be drawn to offshore vessels as roosting or feeding sites, with some species consuming food scraps in waste bins (Tasker *et al.* 1986). Lighting dynamics and activity at sea have also recently been found to play a role in attracting nocturnally migrating species to vessels (Rebke *et al.* 2019). Although some species were seen during periods when migratory behaviour is expected – such as the migration of Satin Flycatchers *Myiagra cyanoleuca* across Bass Strait in the Austral summer (Green & McGarvie 1971) – other observations, such as those of Nankeen Kestrels, recorded young birds flying south at a time when migration typically occurs in the opposite direction (i.e. heading north). Explicitly, Nankeen Kestrels are generally considered to be summer–autumn migrants, moving northward and coastally for the winter (Olsen & Olsen 1987).

Although Nankeen Kestrels are not generally considered to migrate over Bass Strait (between mainland Victoria and mainland Tasmania), banding information suggests that they actively move between islands in the north-eastern area (Garnett *et al.* 1991; Marchant & Higgins 1993; Debus *et al.* 2019). Also, despite some earlier contention surrounding similar species (Olsen & Debus 2013), many now accept and observe other raptor species, such as the Tasmanian Boobook *Ninox leucopsis*, Brown Goshawk *Accipiter fasciatus*, Australian Hobby *Falco longipennis* and Brown Falcon *F. berigora*, migrating across, and moving between, islands in Bass Strait seasonally (Garnett *et al.* 1991; Menkhorst *et al.* 2017; S. Debus pers. comm.).

Nankeen Kestrels are abundant on King and Flinders Islands and, although generally uncommon in mainland Tasmania, there are sites in the north of that state where they are routinely reported (BMV pers. obs.; Sullivan *et al.* 2009; eBird: https://ebird.org/species/auskes1/AU-TAS). A few nests have been observed in professional surveys throughout the northern and southern midlands in central Tasmania (N. Mooney pers. comm). It is unknown whether these populations interact, or are terrestrially constrained with the occasional vagrant. However, the observations presented here may serve as preliminary evidence for potentially regular Bass Strait crossings by this species. Notably, at the time of sighting for each of the individuals seen offshore, the wind was never northerly. All five Kestrels were actively flying into the wind in the direction of Tasmania. They were also clearly using offshore vessels to rest. This raises questions that could be answered with tracking studies concerning possible local migratory/dispersal pathways for birds between Tasmania and Victoria. It also raises questions regarding the roost sites that may be utilised by birds along the way.

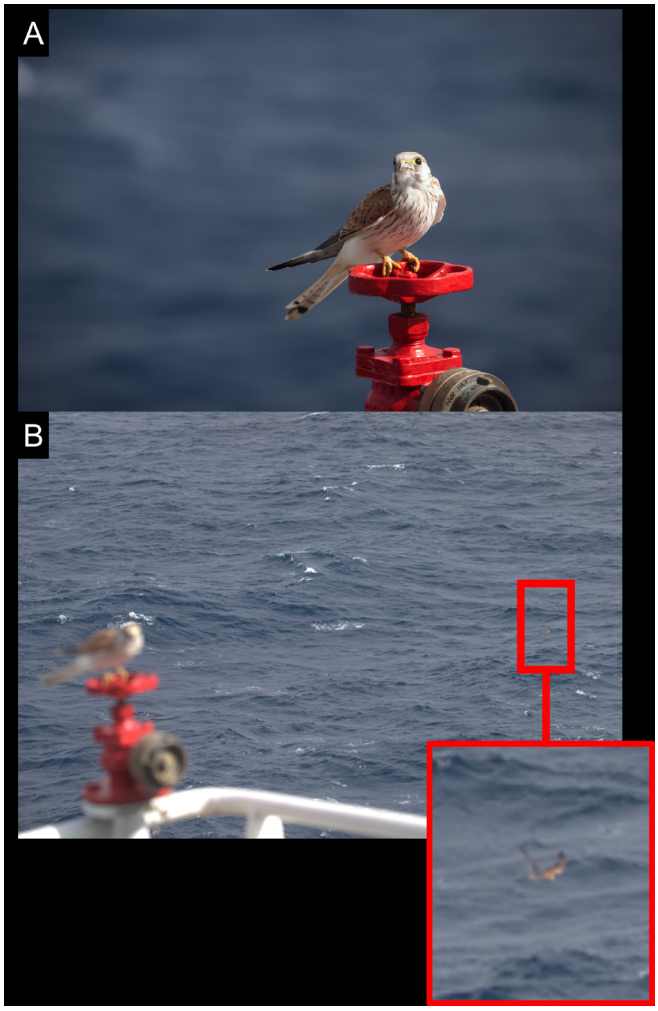

Figure 3. (A) The second Nankeen Kestrel observed on the offshore vessel. (B) The second and third Nankeen Kestrels observed from the offshore vessel. The third individual is highlighted and magnified within the red boxes (all observed 19 March 2022).

The plumage of the Kestrel in Figure 2 appears to be juvenile (Menkhorst *et al*. 2017), suggesting that autumn southward movements may be related to juvenile dispersal from the mainland, rather than typical migration. Given the somewhat cyclical irruptions of young Eastern Barn Owls *Tyto alba delicatula* along the northern coast of Tasmania in response to plagues of House Mouse *Mus musculus* on the Australian mainland (approximately every 10 years in autumn, with most of the Owls dead or dying from starvation: N. Mooney pers. comm), it is possible that the southward movement of young Nankeen Kestrels during the winter reflects a similar pattern – particularly in response to the

2021 Australian mouse plague that affected Queensland, New South Wales, Victoria and South Australia (Brown & Henry 2022). Olsen & Olsen (1987) also noted that Kestrels disperse following mouse plagues.

When considering these observations, there are important questions that arise from an operations perspective. Cross-water migration and dispersal in a terrestrial bird highlights potential risks posed by proposed windfarm operations in Bass Strait. Studies that assess avian mortality associated with windfarm interactions have occurred elsewhere in the world, with one particularly thorough study assessing the vulnerability of 81 marine bird species to offshore windfarm infrastructure (Kelsey *et al.* 2018). Studies like this are crucial to due diligence, and extremely important from an ecological perspective. During my preparation of this paper, Reid *et al*. (2022) released a government report, *Impacts on Birds from Offshore Wind Farms in Australia*, which allocates risk categories on the impacts of offshore windfarms to each species. It highlights that there are many terrestrial species traversing Bass Strait, including the Critically Endangered Swift Parrot *Lathamus discolor* and Orange-bellied Parrot *Neophema chrysogaster*. Given that there are still questions to be answered about local migratory and dispersal pathways between Victoria and Tasmania, windfarm development plans should be considering a wide range of terrestrial species (i.e. not just marine species) in due diligence assessments.

Understanding interactions between avifauna and offshore infrastructure is a crucial component to mitigating anthropogenic impacts on wildlife (Bailey *et al.* 2014). By collaborating with industry, scientists can obtain data from areas that are logistically difficult to access under normal circumstances (Kark *et al.* 2015). It is important to acknowledge that anthropogenic offshore activity affects wildlife and the environment, and that mitigating impacts is a priority (Popper & Hastings 2009; Teilmann & Carstensen 2012; Obusan *et al.* 2016; Finlayson *et al.* 2018; Zhang *et al.* 2019; Komyakova *et al.* 2022). However, attentive, and deliberately planned offshore activity can also provide a range of benefits to society (Pauli 2010; Komyakova *et al.* 2022; Novaglio *et al.* 2022). Ceasing offshore operations altogether is unrealistic, and extreme. Conversely, working with industry to minimise the impact of offshore infrastructure generates information pertinent to environmental policy and mitigation, and has a real impact on improving operations from an environmental perspective (Rondinelli & London 2003). One example where collaboration has led to notable progress is the mitigation of aggregate vessel noise in oceanic environments. In response to anthropogenic ocean noise, and rising concerns made by an international community of stakeholders, the United Nation's International Maritime Organization specifically developed guidelines for the reduction of underwater noise from commercial shipping (Southall *et al.* 2017).

Provided that the relationship between industry and science remains amicable, we can also ask questions that have, in the past, not been possible subject to confidentiality clauses (BMV pers. obs.). This is relevant to traditional (oil and gas) and emerging (wind power) offshore infrastructure. One such question is which terrestrial species interact with offshore infrastructure, and whether there are any that have been overlooked? Another is what differences (if any) exist between traditional and novel infrastructure in relation to avian attraction and mortality? Only through collaborations between industry and research can we realise better environmental planning and mitigation strategies. Future studies should seek to investigate how terrestrial bird species such as Nankeen Kestrels are migrating/dispersing over Bass Strait, and actively engage with industry where possible to provide better informed management strategies.

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