A review of Wedge-tailed Eagle population stability in the Fleurieu Peninsula region of South Australia in 2017

EMMA ROWE, ROBERT BRINSLEY AND TERRY DENNIS

Abstract

The Fleurieu Peninsula was comprehensively re-surveyed for Wedge-tailed Eagle, Aquila audax, *population status and breeding activity across an area of 1,540 km² in 2017. All 29 territories originally found by Dennis (2005) were re-surveyed. Of the original territories 25 (86%) were still occupied, 2 were unconfirmed and 2 were abandoned more than a decade later. An additional 23 territories were identified and in total 48 occupied territories were confirmed, with 44 of these rated as active (incubation, young or other signs of breeding activity). Of the active territories, 38 (86%) were successful in fledging young.*

A simple estimation of the territory density was calculated as 32.1 km²/pair which was a smaller area than the 53.1 km²/pair found in 2005, due to the higher number of occupied territories found in 2017, some of which had active nest sites as close as ~1.5 km apart.

The majority of active nests were on private property, and landowners in general valued the presence of the eagles. Due to the proximity and frequency of various human activities, 13 territories (25%) were considered to be in a high disturbance location in 2017, compared with 9 (31%) in 2005.

Based on these findings, the current population status of the Wedge-tailed Eagle on the Fleurieu Peninsula is stable and appears to have continued to adapt to environmental and landscape change in the region.

INTRODUCTION

The Wedge-tailed Eagle, *Aquila audax*, is one of Australia's most iconic birds and plays an important ecological role as a top predator and scavenger (Hatton, Olsen and Gruber 2015). It remains widespread and common on the mainland despite former intense persecution, but has declined locally in the south through habitat disturbance in heavily settled and farmed areas (Debus 2012).

Like other agricultural areas of South Australia, the Fleurieu Peninsula has undergone extensive clearance of native vegetation to facilitate agricultural development since European settlement (Nance and Speight 1986). The dramatic modification of the landscape has resulted in widespread habitat disturbance affecting many bird and mammal species, including the Wedge-tailed Eagle, which was thought to have suffered population decline in this region (Paton, Carpenter and Sinclair 1994).

Monitoring raptors is important in order to detect population changes and threatening activities so that appropriate management and conservation strategies may be implemented (Wiersma and Koch 2012). A baseline population survey in 2005 (Dennis 2005, 2006a) followed by a population stability survey in 2006 (Dennis 2006b) confirmed that the Wedge-tailed Eagle population in the Fleurieu Peninsula was adapting to environmental changes at that time.

It was recommended that population monitoring surveys be repeated in the future using the 2005 baseline data as a foundation.

More than ten years later this study describes the systematic re-survey and assessment of the current status and distribution of the Wedge-tailed Eagle on the Fleurieu Peninsula, including vital information on population stability, trend over the last decade and productivity for the 2017 breeding season.

METHOD

Survey

In addition to extensive surveys of prospective breeding habitat, former Wedge-tailed Eagle territories on the Fleurieu Peninsula identified in an earlier study (Dennis 2005, 2006a) were all re-surveyed in the 2017 breeding season to determine occupancy and breeding activity. This information was directly compared with the previous survey completed more than 10 years prior (Dennis 2005).

Background information for the 2017 survey was directly available using precise (GPS) nest-site location data gathered during the extensive surveys of 2005 and 2006 (Dennis 2005, 2006b).

A scientific research permit was issued by the Department of Environment, Water and Natural Resources (number Q26620-1).

Survey area

The Fleurieu Peninsula is defined as the area to the south and west of a line between Port Willunga (35°16'S, 138°28'E) and Goolwa (35°30'S, 138°47'E). However, as was done in the previous survey, to cover likely overlapping Wedge-tailed Eagle territories a small area of the northern Sellicks Hill Range and Southern Mount Lofty Ranges was included by arcing the survey boundary inland to the northeast by approximately 5 km, resulting in a survey area of approximately 1540 km^2 (Figure 1).

Survey timing and strategies to minimise disturbance

During July–December 2016 and January 2017–January 2018 suitable habitat was searched to locate as many eagle territories as possible. All territories located in the 2005 study were surveyed first and additional prospective habitat then searched based on the following: suitability of terrain for nest sites; eagles having been sighted in the area; or from observations reported by others. Monitoring involved two to ten visits to each territory during the study period. Observations began in 2016 to locate territories, due to the large study area and therefore the logistics involved.

During the early breeding season (May- October) extended observations of one to two hours were made throughout the survey area from vantage points overlooking likely habitat. Binoculars were used to minimise disruption to normal behaviours. Expected territorial behaviours included display (territorial) flights and the carrying of nest material.

Actual nest location search effort and approach was deliberately postponed until mid-October (through to December) when active nests contained developed young, hunting and prey-carrying flights were frequent and obvious, and sensitivity to approach lessened. When nest sites were located, observation of nest contents was conducted from a distant elevated position.

When nest sites were approached, data-gathering time was kept to a minimum (<5 minutes) and the area vacated as soon as possible to allow the adults to resume normal behaviour (Olsen 2005). The nest height above ground (by visual estimate) and aspect were recorded, where possible, in addition to the location. The precise location of nest sites was determined by a hand-held GPS (Global Positioning System) unit, or in difficult terrain, by compass bearing and estimate of distance from a fixed point (determined by GPS).

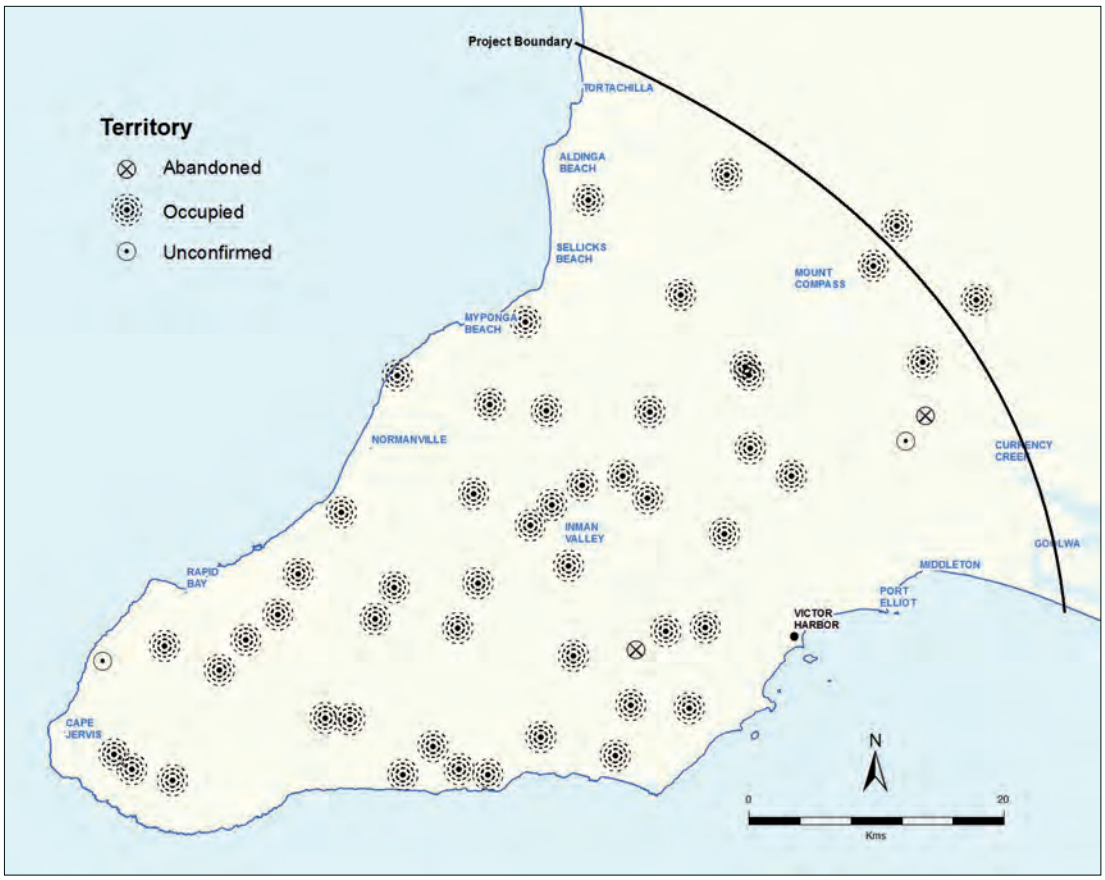

Figure 1. Map of the Fleurieu Peninsula showing the distribution and status of 52 Wedge-tailed Eagle territories identified within the survey area boundary in 2017, with an additional two territories confirmed nearby in the southern Mt Lofty Ranges.

Terminology

Key terms used throughout this study are defined as follows.

Occupied territory: where an adult pair is observed together during the breeding season in the vicinity of the nest(s) with nest repair, territory defence behaviours or copulation observed.

Active nest or territory: where incubation behaviour is observed; where young are recorded; where a pair was observed on at least two occasions with a prey- or stick-carrying flight and repeated fast and direct low-level flight toward a freshly lined nest with accumulated faecal spray present.

Successful nest or territory: where fledged young are recorded.

Unconfirmed territory: a locality where a pair, or a single adult was observed on at least two occasions soaring late in the breeding season (mid-October to mid-December), performing territorial display flights in the same area and distant from known active territories, but where nest searches were unsuccessful and fledged young were not seen.

Habitat disturbance

Each territory was assessed for likely disturbance factors and proximity to human activities as was done in the previous survey (Dennis 2006a). A standardised habitat quality assessment method was used, adapted from a similar study assessing

landscape characteristics and human disturbance factors in a Bald Eagle, *Haliaeetus leucocephalus*, population (Mathison 1968). This included assessment of:

1. proximity and visibility of roads, tracks, walking trails and dwellings;
2. proximity and visibility of recreational activity or industry;
3. status of surrounding landscape;
4. nest site location, visibility and access.

The specific criteria used to allocate a nest site to a disturbance category are summarised in Table 1.

RESULTS

Resident population, territory status and population stability

A total of 52 territories was located within the survey boundary (Figure 1). All 29 occupied territories (28 of these were rated as active) from the 2005 survey (Dennis 2005, 2006a) were studied and 25 (86%) confirmed to be occupied more than 10 years later in the current study. An additional 23 occupied territories were located within the survey area that are either new since the original survey of Dennis (2005) or which may have been missed. Five unconfirmed territories identified in 2005 were confirmed as active in 2017.

In total 48 territories were occupied (Table 2) and 44 of these were rated as active (Table 3) in 2017, where:

- incubation, nestlings or recently fledged young were observed (n = 39);
- recently fledged young were seen on the wing with adults in an occupied territory but no active nest was found (n = 4); and,
- a pair was observed exhibiting territorial displays, prey flights and direct diving into

Table 1. Criteria used to classify Wedge-tailed Eagle nest sites for levels of human disturbance during the breeding season (May-January). Adapted from Mathison (1968).

Low	Moderate	High
• No road, track, walking trail or dwelling within 1000 m of the nest.	• Road, track, walking trail or dwelling 500 - 1000 m from nest.	• Road, track, walking trail or dwelling <500 m from nest.
• Little or no human recreational activity (bushwalking, hunting, mountain bike or 4WD motorbike riding) or industry (commercial tourism, timber or brush cutting, agriculture.	• Human recreational activity or industry may periodically occur within sight of nest during breeding season, 500 - 1000 m distant.	• Human recreational activity or industry frequently occurs within sight of nest during breeding season and often within 500 m.
• Surrounding landscape has natural vegetation cover not modified by land treatments.	• Surrounding landscape may be partially modified by grazing.	• Surrounding landscape appreciably modified, e.g. natural vegetation largely cleared, tree felling.
• Nest difficult to locate without specific knowledge; location may be known to only a few individuals.	• Nest may be seen from road, bush track or dwelling, but considerable effort required to reach it; location generally not known.	• Nest is readily visible from road, track, walking trail or dwelling, access requires little effort; location is generally known.

the location of a freshly lined nest with accumulated faecal spray present, but where incubation was not witnessed (n = 1).

Four territories were found to be occupied but could not be confirmed as active. Three of these occupied territories had previously been confirmed as active in 2005. Comparing territory data from the previous study, of the 28 active territories in 2005, 21 were again active, 2 were unconfirmed, 3 were occupied and 2 were found abandoned in this survey.

The precise locations of active nest sites were lodged with Birds SA in a confidential report (Rowe, Brinsley and Dennis 2018). To protect the interests of private landowners and ensure nest site security is retained, these precise locations are not reported here.

Territory density and productivity

Using the same formula as was used in the previous survey (Dennis 2005), a simple division of the survey area (1540 km^2) by the number of territorial pairs identified (48 occupied territories) equates to 32.1 km^2/pair. This is a smaller area per pair than the 53.1 km^2/pair found in 2005, due to the higher number of occupied territories found in 2017, some of which had nests in close proximity (e.g. ~1.5 km apart). However, this is over-simplified and unlikely to represent the area of home range by each pair (Figure 1).

Thirty-eight pairs successfully fledged young, with 28 pairs (74%) fledging a single young and 10 pairs (26%) fledging two young (Table 3) (for more detail see Rowe and Brinsley 2018).

Nest site selection

Active nest sites were found in 41 territories and site description notes taken, with the majority being on private property. Four of the active nests found in 2005 were in use in 2017. The nest trees were located in a gully or sloping hillside (n = 20), a creek gully (n = 16) or a copse of open woodland (n = 5). The slope of the gullies or hillsides ranged from ~15°–60° (visual estimate where possible).

Table 2. Location and status of Wedge-tailed Eagle territories on the greater Fleurieu Peninsula in 2005 (Dennis 2005) and 2017 breeding seasons.

	No. of occupied territories		No. of unconfirmed territories		No. of abandoned territories
Locality	**2005***	**2017**	**2005***	**2017**	**2017**
Southern coastal area (Goolwa to Cape Jervis)	5	13	1	0	0
Western coastal area (Cape Jervis to Normanville)	5	6	0	1	0
Western coastal area (Carrickalinga to Port Willunga, including Sellicks Hill Range)	3	6	2	0	0
Yankalilla River catchment	4	6	1	0	0
Myponga River catchment	1	2	1	0	0
Hindmarsh River catchment	2	4	1	0	0
Inman River catchment	6	9	0	0	1
Currency Creek catchment	2	1	0	1	1
Finnis River catchment	1	1	1	0	0
Total No.	**29**	**48**	**7**	**2**	**2**

* data taken from Dennis T.E. (2005)

Table 3. Location, active status and productivity outcome among Wedge-tailed Eagle territories on the greater Fleurieu Peninsula in 2005 (Dennis 2005) and 2017 breeding seasons.

	No. active territories		No. successful territories	
Locality	**2005***	**2017**	**2005***	**2017**
Southern coastal area (Goolwa to Cape Jervis)	5	13	3	11
Western coastal area (Cape Jervis to Normanville)	5	5	4	5
Western coastal area (Carrickalinga to Port Willunga, including Sellicks Hill Range)	3	4	1	3
Yankalilla River catchment	4	6	2	5
Myponga River catchment	1	2	1	1
Hindmarsh River catchment	1	4	1	4
Inman River catchment	6	8	5	7
Currency Creek catchment	2	1	1	1
Finnis River catchment	1	1	-	1
Total No.	**28**	**44**	**18****	**38^**

* data taken from Dennis T.E. (2005); ** productivity outcome determined for 22 active territories in 2005; ^ productivity outcome determined for 44 active territories in 2017.

Table 4. General location and number of Wedge-tailed Eagle territories categorised for disturbance on the Fleurieu Peninsula in 2017 compared with 2005 (Dennis 2006a).

	Disturbance Category					
	Low		Moderate		High	
Locality	**2005***	**2017**	**2005***	**2017**	**2005***	**2017**
Southern coastal area (Goolwa to Cape Jervis)	3	9	-	2	2	2
Western coastal area (Cape Jervis to Normanville)	2	4	1	-	2	3
Western coastal area (Carrickalinga to Port Willunga, including Sellicks Hill Range)	-	2	2	2	1	2
Yankalilla River catchment	4	4	-	-	-	2
Myponga River catchment	-	1	1	1	-	-
Hindmarsh River catchment	1	3	-	1	1	-
Inman River catchment	3	4	2	5	1	1
Currency Creek catchment	-	1	-	-	2	2
Finnis River catchment	-	-	-	-	1	1
Total No.	**13**	**28**	**6**	**11**	**10**	**13**

* data taken from Dennis T.E. (2006a)

The majority of nests were in a large, dominant older tree (*Eucalyptus* sp.), with the nest platform having partial canopy cover and placed at or slightly above the level of surrounding foliage. One notable exception was a nest built on top of a low She-oak, *Allocasuarina verticillata,* located within a creek gully, which had no canopy cover.

Estimated height (above ground level) for the nest sites averaged ~10 m (n = 35, range ~3–18 m). As was found in 2005 (Dennis 2005), the nest aspect in this survey (recorded at 36 sites) was found to vary even among those in the same territory. However there appeared to be a preference for a cooler, shaded aspect over a hot, windy aspect: northeast–south (n = 27) and southwest–north (n = 9).

Habitat disturbance

Examples of Wedge-tailed Eagle habituation to human activity and infrastructure were found, with several nests in close proximity to regular human activity. Using the standardised criteria, 28 territories were classified as Low disturbance; 11 were classed as Moderate; and 13 were classed as in the High disturbance category in 2017 (Table 4). The two abandoned territories were in a high disturbance and moderate disturbance area respectively.

DISCUSSION

Resident population, territory status and population stability

The population status of the Wedge-tailed Eagle on the Fleurieu Peninsula in 2017 is encouraging, with more occupied and active territories identified in 2017 compared with 2005.

Of the territories located in 2005, many (25) were still occupied more than ten years later. Wedge-tailed Eagles show strong site fidelity with individuals often occupying the same territories for 40 years or more (Hatton *et al.* 2014).

Two occupied territories in 2005 were unconfirmed in this survey. These locations were observed several times and eagles were seen in both territories at each visit, but their behaviour was inconclusive. The two abandoned territories found in 2017 had been previously active, but the nests found by Dennis (2005) were no longer present and there was no suitable habitat for alternative nest structures. A bushfire had destroyed the nest and surrounding habitat in one, and in the other the active nest had disappeared without suitable habitat for alternative sites (despite an old inactive nest still present), therefore it is not surprising that those two territories were abandoned.

Nest-site quality contributes to breeding success (Collins and Croft 2007). There are specific nesting requirements including height and girth of the tree (Hatton *et al*. 2014; Silva and Croft 2007), shelter from weather, shade, security from predators and aspects that provide maximum protection from prevailing winds and bushfires (Foster and Wallis 2010). Active nest trees were found on a significantly different aspect compared with inactive trees in one study (Hatton *et al.* 2014) and thus a territory may be abandoned if a suitable nest tree cannot be found.

In addition to the original territories, more occupied territories were identified in this study. Five of these additional territories were recorded as possible territories in the previous study (Dennis 2005). With an extensive survey covering large distances, such as this, it is not possible or feasible to check every potential site and extensively search for new sites (Hatton *et al.* 2014) given the available resources. With 86% of the 2005 territories still occupied, a further 23 occupied territories identified and a total of 44 territories confirmed as active in 2017, the population can be confirmed as at least stable. Future surveys will be required to monitor the population for stability and/or trend over time.

There was one territory in this study classed as active without evidence of incubation or young. The pair in this territory was observed exhibiting territorial displays and on at least two

occasions seen with a prey- or stick-carrying flight and repeated fast and direct low-level flight toward a freshly lined nest (green leaves) with accumulated faecal spray present. It was difficult to see inside the nest bowl and thus signs of incubation may have been missed, or alternatively, the nest may have been lined without breeding activity.

Wedge-tailed Eagles line their nests with green leaves early in the breeding season and continue to line nests during the nestling period (Wiersma and Koch 2012), thus the green lining may be an indicator of incubation or young. However, they have also been reported to line nests in a territory for consecutive years but not use them for breeding (Cherriman, Foster and Debus 2009).

The presence of faecal whitewash is also a strong indicator of an active nest; however, it can be present below a nest used for roosting, a display or feeding platform or a breeding site (Wiersma and Koch 2012).

It was concluded based on both the nest characteristics and the eagles' behaviour that this was an active territory.

A small number of territories (n = 4) were occupied but could not be confirmed as active. Three of these occupied territories had been confirmed as active in 2005; however, the 2005 active nests were no longer present in the previously identified GPS location, alternative nests sites could not be found during search efforts, and incubation or fledged young were not seen in 2017.

Territory density and productivity

Using the same formula as was used in the previous survey (Dennis 2005), the area per pair was smaller (i.e. higher density of eagles) than that found in 2005. However, the calculation was over-simplified and unlikely to represent the area of home range. Due to the variable nature of the landscape and with much of the survey area developed for silviculture or other intensive land-use and therefore unsuitable as WTE habitat, it was elected not to perform nearest neighbour density calculations. It is also possible that there may have been territories that were missed. Territories and home ranges are not necessarily regular in shape, as it depends on topography and habitat, and where both nest sites and prey are located (Olsen 2005). For example, ridgelines can be a territory boundary with a pair on either side (Olsen 2005).

In this study along one of the escarpments there was only ~1.5–2 km between each of three active nests (Figure 1). Debus (2017) reported other similar examples in the literature: near Broken Hill in semi-arid western NSW in 1996-99, neighbouring nests were 2–3 km apart along a range system at Mutawintji National Park (n = 80) (Sharp, Norton and Marks 2001) and at Armidale, NSW in 2005 neighbouring nests were 4–7 km apart (Debus *et al*. 2007).

Thirty-eight pairs in this study successfully raised young and favourable seasonal conditions may have contributed to the breeding activity and success in 2017. (see Rowe and Brinsley: in press).

Nest site selection

Active nest-site characteristics of the Wedge-tailed Eagle on the Fleurieu Peninsula were similar to those previously described by Dennis (2005) and in the literature.

Four of the active nest sites found in 2017 were also active in 2005. In the other territories active in both 2005 and 2017 the active nest site was either a refurbished old inactive nest or a newly built nest. A Wedge-tailed Eagle pair has between two and three nests on average, and occasionally up to ten in a breeding territory (Olsen 2005).

Traditional nest sites may be occupied for up to 40 years by generations of eagles (Debus 2017). In a Tasmanian study, most nests were used repeatedly if undisturbed, even if they failed to produce young (Olsen 2005), thus it is interesting that not more active nests were in use over a

decade later and may reflect adaption to changes in their environment. All except one of the active nests were located in large *Eucalyptus* sp., which is consistent with other studies (Foster and Wallis 2010; Silva and Croft 2007).

In contrast to other nests found in creek gullies (n = 16), the one nest on top of an *Allocasuarina* sp. tree was only ~3 m above ground level. This was exceptional, and studies elsewhere have also found nests in creek-lines to be substantially higher than nests on elevated slopes or ridge habitat (Sharp, Norton and Marks 2001).

Overall, the estimated height (above ground level) for nest sites was consistent with the published estimates (Debus 2017). The nest aspect varied, even among nests within the same territory, but most sites were exposed to morning sun and were sheltered from prevailing weather.

The availability of suitable nest sites plays an important role in determining territory size and spacing (Ridpath and Brooker 1987) and the remaining remnant natural vegetation across the Fleurieu landscape has no doubt shaped the distribution and abundance of the contemporary Wedge-tailed Eagle population. Territory size and spacing has also been linked to the abundance and long-term availability of prey species (Ridpath and Brooker 1987), which have likely increased in abundance with land modification in the study area over time.

Habitat disturbance

There is evidence that Wedge-tailed Eagles can become habituated to routine agricultural activity and road traffic (Debus *et al*. 2007), as was seen in this study with some successful territories having regular activity or road traffic in close proximity to the nests throughout the entire breeding cycle.

The most notable examples include:

- the successful territory in which a visually exposed nest was found only ~300 m from the road, in a paddock cut for hay, with farm machinery passing directly under and around the nest;
- the failed territory in which a visually exposed nest (in a large tree within a group of three trees) was located in a very open area only 300–400 m from a busy main road;
- the successful territory in which the nest was clearly visible from a farmhouse only 400 m away and in close proximity to large-scale pine tree felling during the nestling period;
- the failed territory in which a visually exposed nest, only 3 m above ground was in close proximity to a hut and 4WD motorbike track which were both in regular use;
- the successful territory with a visually exposed nest in a tree ~400 m from a busy road and ~300 m from a newly constructed shed with regular farm activity.

Nesting eagles vary in their response to human proximity. In one study 80% of nests were located within view, or within 200 m of roadways or houses (Foster and Wallis 2010); and in another study four nests were less than 500 m from houses (Fuentes, Olsen and Rose 2007). However, if irregular or new human activity occurs at sensitive phases of the breeding cycle such as during incubation, the nest may be deserted (Olsen 2005; Cherriman, Foster and Debus 2009).

During these surveys great care was always taken to avoid the prospect of researcher-induced desertions and also at the later stage of the cycle when human intrusion could potentially result in a branching fledgling taking flight before they have adequate strength and skill.

CONCLUSION

Currently, based on our 2017 data, the Wedge-tailed Eagle population on the Fleurieu Peninsula appears to be stable and continuing to adapt to a changing landscape and to the variety of commercial land uses across this region.

Communications with landowners highlighted the level of rural community acceptance and intrinsic value placed on the species, across the Fleurieu landscape. There will be emerging challenges for eagles, such as recreational and industrial use of drones, wind-farms and spread of urban development. It is important to continue to monitor and protect breeding habitat from disturbance and emerging threats.

ACKNOWLEDGMENTS

Special thanks to: Sharie Detmar (Department for Environment and Water), for producing the survey map; Stephen Debus (University of New England) for providing journal articles, advice and edits; and Birds SA for supporting the study.

We thank the many people from the rural community of the Fleurieu Peninsula and others who have contributed in some way to the project by providing local knowledge, valued observations, property access or support. These include, in no particular order, David Lush, Brenton and Jo Lush, Kevin and Mary Pearce, Barry Jagger, the late David Hunt, Kobey Morris, Brian Croser, Byron Morley, Jon Weise, Warwick and Julie Tetlow, Phil Irvine, Bill and Janet Paige, Tony Harding, Ben Willis, Mick McGrath, Gary and Allan Dalitz, James and Jackie Fisher, Andrew Bailey, Phil Reid, Jim Stacey, Ben Bellen (SA Water), Alistair Just, Jeff and Cathy Brittain, Nick and Kerrin Cowling, Gerald White, Dean and Julie Whitford, Mark Chapman, Keith and Cathy Shannahan, Corey and Karen Dugmore, Dr Rick Pierce, Ben Noble, Richard and Mary Ray, Jonathon Ray, Kym Wienert, Paul and Helen Neighbour, Sarah Barker, John Crompton, Steve and Loretta Tomlin, Dianne and Kimberly Thomas, Charlie and Sandy Nott, Steve and Helen Cossey, Ike Ashby, Alice Morley, Elizabeth Steele-Collins and Doug Collins, Paul and Beryl Price, Geoff and Betty Davis, Bill and Travis Keen, Kym Bishop, Liz James, Michael and Jodi Connor, Peter Dalton, Ben Dennis, Harry Harrison, Bob Hunt, Peter Rumbold, Andrew Klapas, Lee McKenzie, Sarah Wheeler, Brenton and Gail Thompson, Richard and Fiona Cooper, Bob McQueen, Phil Goode, Bernie Carmichael, Craig Littley, Bob Jones, Andrew Hinchcliff, John Hutchinson, Seiji Iawo (Department for Environment and Water), Rex Wilson, Dean Cutten, Harley Hooper, Bruce Creek, Helen Dennis, Sarah Brinsley, Chris and Anne Rowe.

REFERENCES

Cherriman, S. C., Foster, A. and Debus, S. J. 2009. Supplementary notes on the breeding behaviour of Wedge-tailed Eagles *Aquila audax*. *Australian Field Ornithology* 26: 142-147.

Collins, L. and Croft, D. 2007. Factors influencing chick survival in the Wedge-tailed Eagle *Aquila audax*. *Corella* 31: 32-40.

Debus, S. 2012. *Birds of Prey of Australia.* 2nd ed. CSIRO Publishing, Melbourne.

Debus, S. 2017. *Australasian Eagles and Eagle-like Birds.* CSIRO Publishing, Melbourne.

Debus, S. J., Hatfield , T. S., Ley, A. J. and Rose, A. B. 2007. Breeding biology and diet of the Wedge-tailed Eagle Aquila audax in the New England Region of New South Wales. *Australian Field Ornithology* 24: 93-120.

Dennis, T. E. 2005. *Population survey of the Wedge-tailed Eagle and White-bellied Sea-Eagle on Fleurieu Peninsula in South Australia, 2005.* Unpublished report to Birds SA.

Dennis, T. E. 2006a. Status and distribution of the Wedge-tailed Eagle on the Fleurieu Peninsula, South Australia in 2005. *South Australian Ornithologist* 35: 38-46.

Dennis, T. E. 2006b. *Wedge-tailed Eagle and White-bellied Sea-Eagle population stability survey on the Fleurieu Peninsula, 2006*. Unpublished report to Birds SA.

Dennis, T. E., McIntosh, R. R. and Shaughnessy, P. D. 2011. Effects of human disturbance on productivity of White-bellied Sea-Eagles *Haliaeetus leucogaster*. *Emu-Austral Ornithology* 111: 179-185.

Foster, A. and Wallis, R. 2010. Nest-site characteristics of the Wedge-tailed Eagle in Southern Victoria. *Corella* 34: 36-44.

Fuentes, E., Olsen, J. and Rose, A. B. 2007. Diet, occupancy and breeding performance of Wedge-tailed Eagles *Aquila audax* near Canberra, Australia 2002–2003: Four decades after Leopold and Wolfe. *Corella* 31: 65-72.

Hatton, F., Olsen, J. and Gruber, B. 2015. Post-fledging spatial use by a juvenile Wedge-tailed Eagle *Aquila audax* using satellite telemetry. *Corella* 39: 53-60.

Hatton, F., Patrick, H. M., Gruber, B., and Olsen, J. 2014. Modelling the nesting habitat requirements of the Wedge-tailed Eagle *Aquila audax* in the Australian Capital Territory using nest site characteristics. *Corella* 38: 63-70.

Mathison, J.E. 1968. Effects of human disturbance on nesting Bald Eagles. *Journal of Wildlife Management* 32: 1-6.

Nance , C. and Speight, D. L. (Eds.). 1986. *A Land Transformed - Environmental Change in South Australia.* Longman Cheshire, Melbourne.

Olsen, P. D. 2005. *Wedge-tailed Eagle*. CSIRO Publishing, Melbourne.

Paton, D., Carpenter, G. and Sinclair, R. 1994. A second bird atlas of the Adelaide Region. Part 1: Changes in the distribution of birds: 1974-75 *vs* 1984-85. *South Australian Ornithologist* 31: 151-193.

Ridpath , M. G. and Brooker, M. G. 1987. Sites and spacing of nests as determinants of Wedge-tailed Eagle breeding in arid Western Australia. *Emu* 87: 143-149.

Rowe E. L. and Brinsley R. F. 2018. Breeding productivity of the Wedge-tailed Eagle *Aquila audax* on the Fleurieu Peninsula, South Australia in 2017. *Corella* 42: 86-90.

Rowe E. L., Brinsley R. F. and Dennis T. E. 2018. *A repeat Wedge-tailed Eagle Population Survey in the Fleurieu Peninsula region of South Australia, in 2017*. Unpublished report to Birds SA.

Sharp, A., Norton, M. and Marks, A. 2001. Breeding activity, nest-site selection and nest spacing of Wedge-tailed Eagles (*Aquila audax*) in western New South Wales. *Emu* 101: 323-328.

Silva, L. M. and Croft, D. B. 2007. Nest-site selection, diet and parenteral care of the Wedge-tailed Eagle *Aquila audax* in Western New South Wales. *Corella* 31: 23-31.

Wiersma, J. and Koch, A. J. 2012. Using surveys of nest characteristics to assess the breeding activity of the Tasmanian Wedge-tailed Eagle. *Corella* 36: 38-44.

Emma Rowe
PO Box 253
Woodside SA 5244
emma@eaglefeather.com.au

Robert Brinsley
74 Alfred Street
Parkside SA 5063
rfbrin@hotmail.com

Terry Dennis
osprey842@gmail.com