

# Fledgling productivity and breeding parameters of the Black Falcon *Falco subniger* in southern Victoria, 2014–2024

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**Abstract.** Fledgling productivity of two pairs of Black Falcons *Falco subniger* was studied in the Bacchus Marsh district of Victoria over 11 breeding seasons (2014–2024), with a third nesting pair known but no fledging outcomes determined. Nests were appropriated stick nests of corvids and medium-to-large raptors, in the canopies of common local eucalypts in the agricultural landscape, and situated >6 m (mostly >10 m) above ground. Fledging occurred in September–October, following egg-laying in July–August. From 81% nest success over 11 years, at least 1.7 fledglings were raised per pair per year ( $n = 15$  nest-years) and 1.6 raised per attempt, including a failed repeat attempt within a year. Mean and modal brood sizes at fledging were 2.0 and 2, respectively (brood size range 1–4), and the sex ratio of 26 fledglings was close to parity (11 male, 13 female, two unsexed). Causes of failure were storms destroying nests with chicks, and one ground-roosting fledgling was killed by a predator. Successive nests of each pair were clustered in a core territory of radius 1–2 km (Pair 1) or 0.8–1 km (Pair 2), with long-term site fidelity. The nesting areas of the three pairs were at the points of an equilateral triangle separated by 18 km, although there may have been additional breeding pairs in the district. We present historical notes by the late Len Harvey (oologist) for comparison with the present situation in the study area. On the basis of our data on productivity, inferred nesting density and extrapolated likely population size, the Black Falcon's current official listing as Critically Endangered in Victoria may warrant reassessment as Endangered.

## Introduction

The Black Falcon *Falco subniger* remains one of Australia's lesser known and relatively little-studied falcons with respect to demographics. Otherwise, behavioural aspects of the breeding cycle are now well known, including chronology and duration of the various phases from nest selection to juvenile independence (Debus 2022, 2023).

The Black Falcon was categorised as Vulnerable under the Victorian Department of Sustainability and Environment's 2013 *Advisory List of Threatened Vertebrate Fauna in Victoria* (DSE 2013) and was recommended for listing as 'threatened' under Victoria's *Flora and Fauna Guarantee Act 1988* (FFG Act) by the Scientific Advisory Committee in 2017 (SAC 2017). Following amendments to the FFG Act in 2019, categories and criteria were updated for species to align with those set out in the Common Assessment Method Intergovernmental Memorandum of Understanding (2015) which in turn match the International Union for Conservation of Nature (IUCN) Red List categories. The Black Falcon was proposed for listing as Critically Endangered in 2021 (DELWP 2021) and is currently listed as this category under the *Flora and Fauna Guarantee Act 1988 Threatened List* (DEECA 2024). Table 1 gives the rationale for its current status.

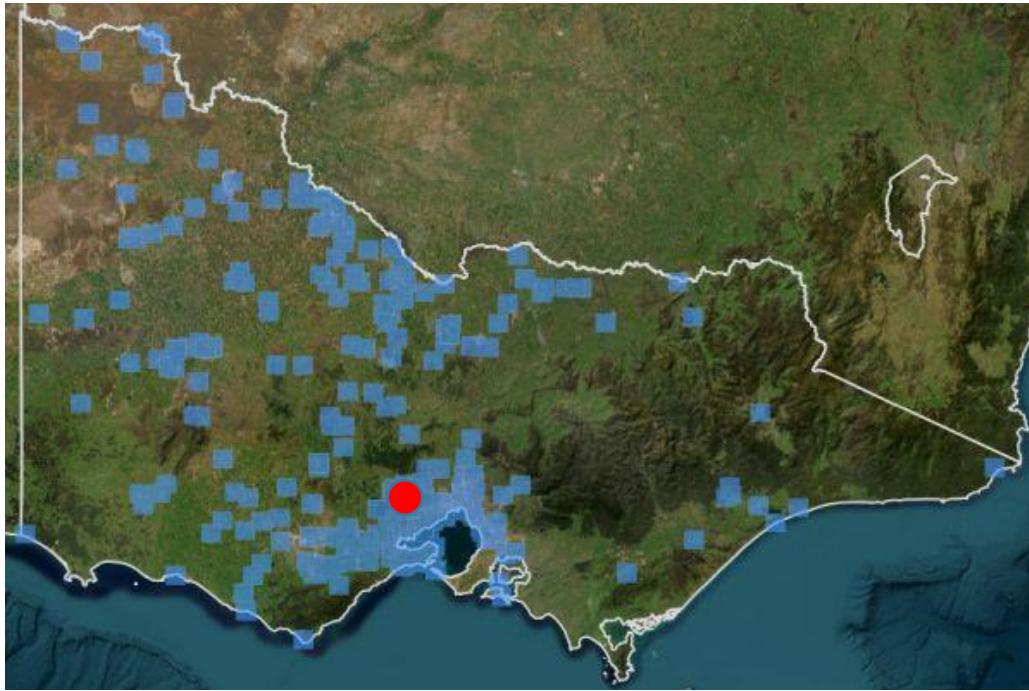
The estimate of 200 mature individuals in Victoria by DELWP (2021), quoting 'D. Whelan', was a conservative estimate by DJW based on the few pairs then known during the study by Whelan *et al.* (2016). Accurate information on these criteria for the Black Falcon in Victoria is mostly lacking, except for extent of occurrence (most of Victoria other than upland forests: Figure 1). The Black Falcon is also listed as Vulnerable in New South Wales (NSW) under the *Biodiversity Conservation Act 2016* and Rare in South Australia under the *National Parks and Wildlife Act 1972*.

**Table 1.** Reasons given for listing the Black Falcon as Threatened or Critically Endangered, as applicable, in Victoria by Scientific Advisory Committee (SAC 2017) and Department of Environment, Land, Water and Planning (DELWP 2021), under IUCN criteria as applicable. X denotes the criteria listed by the respective agency.

Reason/criterion	SAC	DELWP
Population decline	X	X
Existing/continuing threats	X	
Reduced reproduction/recruitment	X	
Past and projected population reduction		X
Population <250 mature individuals [in Vic.]		X
>90% of individuals in one [Vic.] subpopulation		X

Whelan *et al.* (2016) described the breeding of a pair of Black Falcons in the Rowsley Valley, near Bacchus Marsh, Victoria, ~45 km north-west of Melbourne, in 2014–2015, and raised the possibility of other pairs breeding in the general area. Debus (2022) cited the fledgling productivity of two pairs, as recorded by DJW, in that area during 2014–2019. Here we provide data on the annual fledgling productivity of the two known pairs in this area over 11 breeding seasons 2014–2024, including the fledging results previously recorded (Whelan *et al.* 2016; Debus 2022). We here consider the DELWP (2021) population assessment in the light of our decade-long findings.

We also take the opportunity to place on record the historical notes of oologist Len Harvey (deceased), who observed Black Falcons hunting and breeding between Bacchus Marsh and Ballarat ~50 km westwards in the middle of the 20th century, and compare them with our findings.



**Figure 1.** Black Falcon records in Victoria 2020–2023. Source: SWIFFT (2024) collation of Victorian Biodiversity Atlas records in 5-minute grids. The study area (red dot) is embedded in contiguous grids with Black Falcon records. The adjoining Melbourne–Geelong cluster of records reflects the density of observers.

## Study area and methods

Centred on the Rowsley Valley near Bacchus Marsh (Figure 1), the study area and Black Falcon habitat consisted of flat to undulating agricultural land (cropping and livestock grazing) and remnant woodland on basaltic soil (Whelan *et al.* 2016). The district is increasingly affected by urban expansion, existing and proposed renewable-energy developments, and lack of tree recruitment in remnant woodland.

Continuing the study by Whelan *et al.* (2016) and DJW (in Debus 2022), annual fledgling productivity and other data (including nest-site parameters, fledgling sex ratio) were recorded by DJW and BWM for the 2020–2024 breeding seasons in diary notes and date-stamped digital photographs of nests and fledglings. To avoid disturbance, observation methods were as previously described (Whelan *et al.* 2016), i.e. by binoculars, telescope and/or telephoto lens from distances at which the adult Falcons appeared comfortable.

Clutch size was undetermined, as nest trees were not climbed. Fledglings were sexed by relative size against the adults and siblings in this size-dimorphic species (Debus 2022, 2023), and heights of nests above ground were estimated. Nest and fledging success were determined by finding active nests early in the breeding cycle and monitoring them to the fledging stage or, in three cases, by inferring a nesting event from the presence of newly fledged dependent juveniles where the nest was undiscovered but had obviously existed, within the nesting territory of a long-term known pair. Nest success is the proportion of such known or inferred active nests (i.e. where eggs must have been laid) that produced fledglings, and fledging success is the number of young that fledged (i.e. made their first flight from the nest tree) per pair per year. The latter is

a minimum, given the three cases where newly fledged young were found after the respective nesting event in a territory that was successful in every year of the study (i.e. no failed nests with eggs were missed for that pair).

Three pairs were followed during the study. Pair 1 is the focal pair of Whelan *et al.* (2016) near Rowsley; Pair 2 is the Mt Rothwell (You Yangs) pair (Whelan *et al.* 2016) whose nest was subsequently found; and Pair 3 was found in 2016, on the Werribee River near Eynesbury (south-east of Rowsley). The nest of Pair 3, though confirmed visually (see below), was not visited repeatedly, because of access and possible disturbance issues for this ‘untested’ pair. The nest of Pair 2 was monitored in 2024, but for logistical reasons the nests of the other two pairs were not.

## Results

For a total of 12 known nest structures used by the Black Falcons, nine were appropriated (vacant) stick nests presumably of Little Ravens *Corvus mellori* (75%), and the remainder were the vacant nests of Whistling Kite *Haliastur sphenurus*, Wedge-tailed Eagle *Aquila audax* or Little Eagle *Hieraetus morphnoides* (one each: Table 2). Nest trees were the common local eucalypts, i.e. Grey Box *Eucalyptus microcarpa* and Yellow Gum *E. leucoxylon*, and nests were sometimes on a mistletoe *Amyema* sp. Nest heights ranged from ~6 to 15–20 m, commonly (64% of 11 nest structures) >10 m above ground. Mostly the Falcons did not use the same nest in successive years or later years. However, two sheltered or robust nests were used in two consecutive years (one in a mistletoe, one a Wedge-tailed Eagle nest) and another (Whistling Kite nest) was reused in non-consecutive years, and one nest tree (though a different nest in that tree) was reused after 4 years (Table 2).

**Table 2.** Nesting events of pairs of Black Falcons near Bacchus Marsh, Victoria, 2014–2024 (see text for details, including for nuptial behaviour). M = male young, F = female young. No productivity data for Pair 3 (see text).

Year	Notes
<b>Pair 1</b>	
2014	Nest ~6 m up in a Grey Box, 200 m from railway line and 250 m from isolated farm house; 2 fledged (1 M, 1 F) 29 Oct.
2015	Nest 12–15 m up in a Yellow Gum: vacant Whistling Kite nest (used by the Kites in 2014), 80 m from isolated road and 300 m from edge of clay quarry; 2 fledged (1 M, 1 F) 12 Oct.
2016	Nest not located, adults observed in nuptial behaviour; 1 juvenile M post-fledging.
2017	Nest ~12–15 m up in a Yellow Gum near edge of working clay quarry; 3 fledged (1 M, 2 F) 22 Sept. One fledgling killed by feral Cat <i>Felis catus</i> , Red Fox <i>Vulpes vulpes</i> or raptor after roosting on ground overnight (on the basis of its carcass).
2018	Nest a vacant Little Eagle nest ~10–15 m up in a Yellow Gum; 2 fledged (1 M, 1 F) 25 Sept.
2019	Falcons' initially selected nest was 40 m from a roadside in a public, disturbed setting and not used. Subsequently active nest not located, both adults observed in nuptial behaviour; 1 juvenile F post-fledging in December.
2020	Nest not located, both adults observed in nuptial behaviour; 2 juveniles (1 M, 1 F) post-fledging.
2021	The most southerly nest, ~6–9 m up in top of a Yellow Gum; 4 fledged (2 M, 2 F) before 3 Oct.
2022	The most westerly nest, ~15 m up in a mistletoe in a Yellow Gum; 1 fledged (M?) before 28 Oct.
2023	Same nest as 2022; 3 chicks hatched (c. 10 Aug.), 2 fledged (1 M, 1 F) 20 Sept. Adult male not seen after advanced nestling stage (chicks large and downy, feathers emerging) on 27 Aug. Male absent by 3 Sept., female alone tended young thereafter. Third nestling (smallest, lagging in development) not confirmed to fledge or survive fledgling period, still at nest on 28 Sept. when older (flying) sibling intercepted female's food delivery.
<b>Pair 2</b>	
2016	Two pairs in nuptial behaviour; one pair inspecting a nest on 23 Apr., subsequent active nest not located, outcome unknown.
2017	Two pairs in nuptial behaviour, nest (vacant Whistling Kite nest) 10–15 m up in a Grey Box; no. of chicks uncertain, fledging not observed, outcome unknown.
2018	First nest 10–20 m up in upper canopy of a Yellow Gum; at least 2 (possibly 3) chicks fed by female. Nest blown down in spring storm, no young survived; pair attempted to breed again (nuptial and nesting behaviour) in Nov. Second nest 10–15 m above ground in adjacent Grey Box 25 m west of first nest tree, again unsuccessful (no fledglings produced).
2019	Nest a vacant Wedge-tailed Eagle nest 6–10 m above ground; 2 fledged (1 M, 1 F).
2020	Same nest as in 2019; at least 1 fledged (sex undetermined) (per D. Hollands).
2021	Used 2017 nest tree (Grey Box), different nest ~6 m above ground; 1 advanced chick (M) 21 Oct. Severe spring storm blew nest and pre-fledged chick out of tree 28 Oct., no sign of chick surviving on 29 Oct. (was due to fledge later that week).
2022	Adults seen sporadically in area during breeding season, nest not found, outcome unknown.
2023	Adult observed in nest area, no evidence of breeding found.
2024	Same nest as used in 2017 (vacant Whistling Kite nest 10–15 m above ground); 3 fledged (1 M, 2 F) second week of Oct.

All the Rowsley Valley nests were within a radius of 1.5–2 km of one another, indicating high fidelity to available nest sites within a nesting territory. All Mt Rothwell nest trees were located within a mixed stand of Yellow Gum, Yellow Box *Eucalyptus melliodora*, Grey Box, Buloke *Allocasuarina luehmanii* and planted roadside she-oaks *Allocasuarina* sp. within a radius of 0.8–1 km across flat grazing and cropping farmland, again indicating fidelity to available nest sites and trees within that agricultural landscape. The Eynesbury nest was in a patch of three Grey Box trees. The respective nest areas of the three pairs of Falcons were at points of a triangle equidistant ~18 km apart.

Nest-site inspection and selection by the Falcons took place as early as late April (Table 2). Of eight recorded fledging dates over the 11 years for Pair 1 and one for Pair 2, three broods fledged in late September, one by early October, two in early-to-mid October, and two in late October (Table 2). The near-fledged young of Pair 2 would also have fledged in late October, had it survived. Allowing 5 weeks for incubation and 6 weeks for the nestling period

(Debus 2022, 2023), laying dates ranged from the second or third week of July to the third week of August, and hatching dates from early August to mid September. One of the late clutches, in 2014, followed an initial nest-site shift in the pre-laying period (Whelan *et al.* 2016). A late fledging of Pair 2 young also followed a nest-site shift early in the breeding cycle (Table 2).

Pair 1 produced at least 20 fledglings over 10 nest-years, and Pair 2 produced six fledglings over 5 nest-years for which the outcomes were known (81% nest success): 1.6 fledglings per observed attempt (16 nest-years including a failed second attempt in a year), 1.7 fledglings per pair per year, and 2.0 fledglings per successful nest. If only the observed nests are included, nest success was 77% from 13 nest-years. Brood sizes at fledging ranged from one to four (B/1 × 4, B/2 × 6, B/3 × 2, B/4 × 1; mean 2.0, mode 2), with additional broods of one and two or three that failed to fledge (see Figures 2, 3 and 4).

On plumage, behaviour and annual photographic record, the female of Pair 1 appeared to be the same individual



**Figure 2.** Brood of three Black Falcon fledglings, Mt Rothwell, Vic., 6 October 2024. Photo: D.J. Whelan



**Figure 3.** Brood of four Black Falcon fledglings, Rowsley, Vic., 29 September 2021. Photo: D.J. Whelan



**Figure 4.** Black Falcon fledgling, Rowsley, Vic., 9 October 2021. Photo: D.J. Whelan



**Figure 5.** Black Falcon fledglings typically perching near the ground, Mt Rothwell, Vic., 13 October 2024. Photo: D.J. Whelan

across the 10 years, although the original male was apparently replaced by a different male at the end of the 10 years. If the female was the same throughout, her lifetime reproductive success during those 10 years is at least 20 fledglings.

Causes of nest failure were storms that blew down two nests with chick(s). One of three nestlings in another brood might not have survived to fledge after the adult male disappeared (see below and Table 2). Pair 1 raised nine male, one probable male and 10 female fledglings, and Pair 2 two male, three female and one unsexed fledgling, giving an overall sex ratio at fledging of parity. One fledgling was killed by a predator when it roosted on the ground overnight (Table 2). Other fledglings sometimes rested in vulnerable positions on or near the ground (Figure 5).

The nests that blew down were at Mt Rothwell (Pair 2), in a possibly more exposed (windswept) location, whereas Pair 1 (Rowsley Valley) has been successful annually over 10 years. The successful nests of Pair 2 were vacant Wedge-tailed Eagle and Whistling Kite nests – perhaps reflecting those structures' robustness in that landscape. However, the data are heavily skewed towards Pair 1, and the sample of known outcomes for Pair 2 is small (5 vs 10 nest-years), thus obscuring any differences between the pairs in long-term fledgling productivity.

In 2023, the male of Pair 1 was last seen on 27 August, and was absent by 3 September, when the three chicks were between 2 and 3 weeks old (i.e. old enough not to need day-brooding); the female successfully raised two fledglings after the male disappeared and was not replaced during that breeding cycle (Table 2). A Black Falcon near the nest site in late June 2024 appeared to be a confiding different bird (not the wary adult female), i.e. possibly a replacement male.

In 2019, a second local adult female with prominent twin brood patches was hunting 2 km north of the Pair 1 nesting territory at the same time as the adults of Pair 1 were seen, indicating the presence of a second local breeding pair. However, it is not known how far away the second female's nest was, and if her foraging range could have approached or overlapped with that of Pair 1.

In 2016 and 2017, two pairs of Black Falcons were observed in nuptial behaviour (mutual soaring and hunting, nest selection and defence, courtship feeding) at Mt Rothwell (Table 2), indicating potential competition for breeding space and nest sites and/or a higher breeding density than the 18 km between the known nests.

At Eynesbury (Pair 3), the adults changed places on the nest, defended it against a Whistling Kite, and flew 350 m to defend strongly against a Wedge-tailed Eagle

(behaviour indicating an active nest: Debus *et al.* 2017), and the female had pronounced brood patches. Chicks or fledglings could not be seen from the accessible viewing point, and no productivity data were obtained. Black Falcons have been observed at the Eynesbury site almost annually since 2016, indicating at least one resident breeding pair having at least one nesting attempt, in that area.

Len Harvey's notes (Appendix 1) show that the Black Falcon was a permanent breeding resident in and around the present study area in past decades (1930s–1960s). Many of his named locations fall between Eynesbury, Mt Rothwell and Ballan. His informant John Jenz, of Parwan (near Rowsley), also informed DJW (pers. comm.) during the course of our study that Black Falcons still occur on Jenz's farm, thus revealing their continuous occupation of the area for the past 60 years. Harvey's October–November egg dates were at least 1–2 months later than hatching dates in the present study, although his dates were for eggs observed, not necessarily laying dates. A dependent juvenile seen in late November suggests a somewhat earlier clutch (hatched or fledged in October), though still a month later than in our study.

## Discussion

### *Breeding parameters*

Nest-site parameters of the pairs of Black Falcons in the study area are consistent with earlier information for the Rowsley Valley and elsewhere in the south-eastern Australian agricultural belt (Whelan *et al.* 2016; Debus 2022). A few nests were found to be near the lower end of the accepted height range for Black Falcons (>4 m: Marchant & Higgins 1993). These nests might have been where low Little Raven nests were the only suitable nest sites available. The distribution of nests within each pair's home range, and the consistent occupation over 9–10 years of a discrete area holding a cluster of alternative or sequential nests, indicates long-term residence and fidelity to a core breeding territory. Harvey's notes, and Jenz's observations along with those by DJW and BWM, indicate regular occurrence of Black Falcons in the area over decades. The low rate of reuse of nests, as also found by Harvey, may relate to a possibly low annual survival or condition of vacant corvid nests in that open landscape.

In recent years, Black Falcons in temperate south-eastern Australia have been recorded laying in winter and fledging in spring, with later spring clutches being often unsuccessful repeat attempts following an initial failure (this study; Debus 2022, 2023). In contrast, Len Harvey reported clutches of eggs in October–November (Appendix 1), suggesting a later breeding season, although it is unclear if his observations were typical of the time or if early clutches were missed. It is uncertain if there has been a shift to an earlier nesting season in Victoria, because of an absence of comparative data. However, there is a strong August peak in observed clutches Australia-wide and a recent June–August peak in laying dates elsewhere in eastern Australia (Debus 2022, 2023).

Fledgling productivity in the study area was in the mid range of earlier recorded values, from other similarly small

sample sizes of pairs and much shorter sampling periods (Debus 2022, 2023), and may better reflect the long-term average than do snapshots from two or three years. Long-term data are desirable from other agricultural areas, to determine for instance whether the low nest success and fledgling productivity in the NSW sheep–wheat belt (Debus *et al.* 2017) is real, or partly a function of cold wet weather in the 2016 season. Storms are a significant cause of nest failure for Black Falcons (Debus 2022, 2023) and other falcons (McDonald *et al.* 2004), and probably increasingly so under climate change (Debus *et al.* 2017). Exposure to storm winds may affect the Falcon's territory selection, nest-site selection and possibly breeding distribution. Fledglings are also clearly vulnerable to predation or vehicle strike when resting or feeding on the ground (Debus 2022, 2023).

Lifetime reproductive success is undocumented in the Black Falcon (Debus 2023). A breeding lifespan of up to 10 years is plausible, as one Black Falcon banded as a nestling was 12 years old when recovered as a road casualty (Debus 2022, 2023), and another lived for 12 years in captivity (Slater & Elmer 2024). Another, of unknown age, was retrapped alive after 6 years (Debus 2022, 2023). Turnover of breeding males may be higher than for females (this study; Debus *et al.* 2017) as, being the food providers, the males may be susceptible to collision accidents during frequent hunting forays (Debus 2014, 2022). Disappearance of the male is one factor in breeding failure (Debus *et al.* 2017), although in our study it is noteworthy that the mateless female reared her brood of two large nestlings on her own (the third nestling not confirmed to have fledged successfully).

Distances between the three neighbouring nesting pairs suggest a density of perhaps ~250–300 km<sup>2</sup> per pair in our study area, apparently a lower density than in the NSW sheep–wheat belt (~100 km<sup>2</sup> per pair: Debus *et al.* 2017). However, sightings of additional breeding individuals and courting pairs suggest a higher density around Rowsley than we found, and some intruder or neighbour pressure, territorial conflict being a factor in nest failure (Debus *et al.* 2017). Surveys for additional nesting territories in the Rowsley Valley and wider region would clarify nesting density.

Len Harvey's subjective assessment of the Black Falcon being 'very rare' in the study region in the previous century (Appendix 1) appears to contrast with the occurrence of several breeding pairs in our study within 10–20 km of Bacchus Marsh, including DJW's observations at some of the same localities. This difference may reflect an increase in the Falcon's population following deforestation, but also improvements in knowledge, detection and identification of the Black Falcon. Otherwise, Harvey's notes on breeding parameters, hunting behaviour and prey accord with and supplement current knowledge (as reviewed by Debus 2022, 2023).

### *Population and conservation status*

There are at least three breeding pairs of Black Falcons within ~20 km of Bacchus Marsh, with 81% nest success and fledging success of 1.7 young per pair per year; one pair averaged 2.0 fledglings per year over 10 years and the other 2.0 fledglings over six attempts in 5 years.

Recent long-term breeding occurrence and nest success in the Bacchus Marsh district are higher than suggested for southern Victoria (SAC 2017). Our data suggest that the Black Falcon is faring better in Victoria than implied in Table 1.

Up to six Black Falcons can gather at a single farm activity in the Rowsley Valley (Whelan *et al.* 2016), and up to 18 at single farm activities in the sheep–wheat belts of adjoining states (Debus 2022, 2023), although the ‘catchment’ area of such attraction is unknown and could include itinerant birds. Extrapolation suggests that there are likely >250 mature individuals in Victoria. On a proportional area basis, if there are ~3000+ individuals in NSW (NSW Scientific Committee 2013) there could be ~700 birds or >125 pairs in non-forested parts of Victoria (one-third the area of NSW). The Victorian population is also unlikely to be a discrete subpopulation, being contiguous with a single continental population, and given the likelihood of episodic irruptions of Black Falcons from interstate (Debus 2022, 2023).

An alleged reduction in the Black Falcon’s range (= extent of occurrence) in Victoria (SWIFFT 2024) was based on a comparison of all historical mapped records in the Victorian Biodiversity Atlas (VBA) to 2023 with those just for 2020–2023 (see Figure 1), at the same resolution (presence/absence in 5-minute grids). The 4 years of recent data actually show a similar statewide distribution, albeit at a lower density of recorded grids than for a century or more of cumulative records. The density of atlas records in the central Murray Valley (Figure 1) suggests a possibly greater regional population density than around Bacchus Marsh. Historical records might also be inflated by misidentified Brown Falcons *Falco berigora* (e.g. Marchant & Higgins 1993; Debus 2022). A decadal comparison of VBA data since 1970 might be more meaningful, taking into account recent improvements in field identification, digital photography, the increase in observers etc.

Our recent data challenge the species’ Critically Endangered status in Victoria, on the basis of (i) reduced reproduction/recruitment unlikely, (ii) population not likely to be <250 mature individuals in Victoria, and (iii) no separate Victorian subpopulation (cf. Table 1). However, the Black Falcon might qualify for Endangered in Victoria under criterion C1: <2500 mature individuals and likely current or future population decline of 20% in two falcon generations (~10 years: DELWP 2021). Using a conservative territory figure of 300 km<sup>2</sup> per pair, if the Rowsley Valley is typical, and half of the area of Victoria (total 227,444 km<sup>2</sup>) is potential habitat (from Figure 1), extrapolation suggests that there could be ~400 pairs in Victoria.

The above caveats notwithstanding, Black Falcons in Victoria and elsewhere are at increasing risk from change in land use (habitat loss, urbanisation) and collisions with vehicles and various infrastructure (barbed-wire fences, powerlines, windfarm turbines) (Debus 2022, 2023), and from second-generation anticoagulant rodenticides in areas where the Falcon preys on rodents (Lohr & Davis 2018). The situation will require monitoring and publication of data on impacts, and there is a need for diligent survey and also the planning for renewable energy and other developments to avoid conflict with biodiversity.

## Acknowledgements

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**Appendix 1.** Notes on the Black Falcon in the Ballarat, Victoria, district by the late Len Harvey (local ornithologist and egg collector in the 1930s–1960s), from his diary notes held by Museums Victoria (here *verbatim*, slightly edited for brevity and clarity).

Black Falcons range far over the Bacchus Marsh area but are very rare. When the Sugar Gums [*Eucalyptus cladocalyx*] flower at Melton Railway Station in February–March, Swift Parrots [*Lathamus discolor*] and lorikeets [*Trichoglossus/Glossopsitta* sp(p).] arrived to feed in them. A single Black Falcon then periodically worked the area. When large influxes of Swift Parrots arrived to feed on flowering gums at the Ironbark Forest at Ingliston in 1943, a Black Falcon hunted in the area. There was another influx of Swift Parrots and lorikeets at Beremboke and Mount Wallace in August–September 1956. On 6 September 1956, a Black Falcon was seen chasing Swift Parrots at Beremboke but was not seen to catch one. In 1962, Black Falcons were severe on Stubble Quail [*Coturnix pectoralis*] during crop stripping operations at Parwan. In 1964, a pair at Parwan skimmed low into a strong wind and kept coming in behind a harvester to snap up flushed Stubble Quail. In December 1964, a local Parwan farmer, John Jenz, was picking up hay stooks with a mechanical lifter. A Black Falcon was in attendance, catching mice that had been disturbed... the bird showed unerring skill. Near Parwan, I witnessed a Black Falcon repeatedly attack and knock down a kestrel [Nankeen Kestrel *Falco cenchroides*] that fluttered to ground... Black Falcons work these plains periodically throughout the year. There are usually many rosellas [*Platycercus* spp.], Red-rumped Parrots [*Psephotus haematonotus*], Galahs [*Eolophus roseicapilla*] and quail in this area, and in wet seasons waterbirds abound in the various swamp depressions. I have had sightings at Durdidwarrah [Bushland] Reserve on 6 September 1956; at Mount Wallace on 2 September 1956; at Ingliston on 4 June 1957 and 4 March 1958; and at Bacchus Marsh on 27 July 1963 and 8 August 1963. I see Black Falcons occasionally at Eynesbury, where many parrots breed. A Black Falcon flying in a leisurely way seems to use only the outer wingtips in short beats. In driving flight with full wingbeats, they hurtle at terrific speed. On a straight stretch of the Exford Road, a Black Falcon flew so close to ground level that it had to lift over two fences. It [overtook] my car [whose] speedometer was showing 50 miles per hour [80 km/h]. The falcon

flew approximately three quarters of a mile [~1 km] and [seemingly] covered well over double the distance my car travelled in the time... Of two nests I found and one shown to me in the Rowsley Valley, all were in... ravens' nests. They were in broken country. The nest trees grew on steep banks that, with other timber, afforded the falcons cover for a cautious approach and departure. The pair did not use the same nest each season. When I approached the nest on 1 November 1961, the sitting bird dropped off to near ground level and flew swiftly away. Unlike the Peregrine Falcon [*Falco peregrinus*], she did not return to swoop and dive past me when I climbed to the nest. It contained 2 eggs. Nesting season is October–November. Adults and immatures were noticed occasionally in December–January. On 28 November 1961 at Ingliston, an adult Black Falcon stood on a large boulder with an immature starling [Common Starling *Sturnus vulgaris*] in its talons. An immature Black Falcon perched on a roadside fence nearby appealing for food. Finally the adult flew with the youngster following it... [In the] Ballarat district In February 1930, one Black Falcon continually harassed waterbirds at the Cockpits approximately 10 miles [16 km] west of Dowling. Coots [Eurasian Coots *Fulica atra*] and waterhens [Dusky Moorhens *Gallinula tenebrosa*] screamed from abundant reed cover of this swamp when the Black Falcon swept or dived overhead. In December 1932, a pair of Black Falcons, I think an adult and a [dependent juvenile], perched on a dead tree in a crop paddock while oats were being stoked and the crop cut at Dowling near Ballarat. The crop was the home of many Stubble Quail. As the binder cutting the crop flushed a quail, the falcons were after it. Many of the pursued quail dropped back into the standing crop, or if away from the crop, into the stubble in the cover of a stook. These were safe. However, it was surprising how many attempted to out-pace the falcons and reach the cover of a gorse [*Ulex europaeus*] hedge on a fence line. The falcons rarely missed these victims... There was a nest with 3 eggs at Cockpits in October 1932; 2 young hatched. In October 1933, a nest with 3 eggs at Cockpits.

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