Australian Field Ornithology 2021, **38**, 201–205
http://dx.doi.org/10.20938/afo38201205

Autumn–winter breeding by the Spotted Harrier *Circus assimilis* in southern Victoria

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Abstract. The breeding cycle of a pair of Spotted Harriers *Circus assimilis* was observed in southern Victoria, at 38°S, in autumn–winter 2017 for 42 hours over 22 days from incubation to the post-fledging period. From hatching on 10 June and fledging on 19 July, laying was inferred to have commenced on *c*. 8 May. Three chicks fledged from an initial brood of four; the nestling period was 38 days for the first-hatched chick. Rodents dominated a small sample of identified prey during a plague of House Mice *Mus musculus*. The male prey-delivery rate to the incubating female was 0.32 item/h, whereas during the nestling period the male brought 0.71 item/h and the female 0.11 item/h for a combined effective delivery rate of 0.64 item/h to nestlings. The combined parental feeding rate to new fledglings was 0.65 item/h. Parental behaviour is described. Juveniles were dependent for 6 weeks after fledging.

Introduction

The Spotted Harrier *Circus assimilis* is a sexually size-dimorphic (females larger than males), long-legged, aerially foraging hawk of tall crops and grasslands Australia-wide, including southern Victoria. It preys mainly on various small terrestrial vertebrates (mammals, birds, reptiles), including rodents and especially the House Mouse *Mus musculus* (Marchant & Higgins 1993). It breeds mainly in late winter and spring in south-eastern Australia and elsewhere on the continent, and its breeding biology, vocalisations and behaviour, including sex-roles, have been described (Marchant & Higgins 1993), although there are no details on parental time-budgets.

There has been only one detailed study on this species since the review by Marchant & Higgins (1993). That study examined breeding biology and diet (Aumann 2001a,b). In addition, there have been several notes on prey and foraging (Christie 2004; Hassell 2004; Buij 2014).

The Spotted Harrier is normally a spring–summer breeding partial migrant to Victoria. There is only one report of winter breeding in north-western Victoria (eggs in mid June, fledging in late August), at ~35°S, and only two reports of laying in April and early March in central New South Wales, at ~33°S, and a few suggestions of autumn breeding in the tropics (Marchant & Higgins 1993). Autumn breeding in New South Wales appears to be related to plagues of House Mice (Baker-Gabb 1985).

There are no records of autumn–winter breeding in southern Victoria. There is one case of "nesting 6 m up on end of horizontal branch of pine tree" at Sutherlands Creek near Geelong on 12 August 2005 (Hewish 2006, p.15; no further details provided). Concurrent breeding events (adults visiting nests) occurred at Buckley and Winchelsea near Geelong in October–November 2013 (Morley 2019; outcomes unknown). There is also circumstantial evidence of Spotted Harriers having bred at or near the Western Treatment Plant, Werribee (southern Victoria). K. Bartram & K. Bragge (pers. comm. to M. Hulzebosch) observed an apparent new fledgling in January 2015, and J. Preece (pers. comm. to M. Hulzebosch) inferred a breeding event nearby in that year. Further, a pair was observed carrying sticks in 2015, with multiple sightings of adults and juveniles during 2015–2018 (M. Hulzebosch unpubl. data). The latter observations occurred after Spotted Harriers invaded the area following the Millennium Drought that ended in 2009 (M. Hulzebosch pers. comm.). Further details of breeding and dates remain to be documented for all those aforementioned events.

There are also no records of parental feeding rates during the Spotted Harrier's breeding cycle. Here I record successful breeding in autumn–winter by a pair at ~3 degrees of latitude (~400 km) south of the closest earlier autumn–winter breeding record. In addition, I report the rate of the male feeding the incubating female and parental feeding rates to the nestlings and fledglings.

Study area and methods

The study site was in agricultural land (pasture and cropland) with little original vegetation and with shelterbelts of, for example, Sugar Gums *Eucalyptus cladocalyx* and Monterey Pines *Pinus radiata* at Wingeel, southern Victoria (38°04′S, 143°51′E; ~50 km west of Geelong). Observations, as logistically feasible, were conducted from 3 May to 29 July 2017 (42 hours over 22 days from incubation to post-fledging Week 2, mostly after 1130 h: Table 1), and thereafter were opportunistic or casual (28 and 30 August; final check 2 September). Observations were made, using a telescope and binoculars (8.5 x 42), from an unconcealed position on the ground at least 80 m from the nest, retreating a further 20 to 100–120 m away during the nestling period when the female appeared to be possibly agitated by human presence. The heights of the nest tree and of the nest above ground were estimated.

Backdating from the fledging date of the first juvenile (19 July), and using median incubation and nestling periods from Marchant & Higgins (1993) of *c*.33 days and *c*. 39 days, respectively, the inferred incubation period was observed for 6.2 hours over 5 days (16 May–9 June) and

Table 1. Observation schedule at a Spotted Harrier nest, Wingeel, Vic., June–July 2017. There were two observation sessions on 2 days of the nestling period. For logistical reasons most observation sessions were biased towards the midday period and afternoons, with only three starting before 1100 h (one at 0900 h, two at 1000 h); *n* = number of observation days, time = length of observation session(s), and total time = total observation time.

Stage	*Date(s)*	*n*	*Time (min.)*	*Total time*
Pre-laying	3 May	1	10	10 min
Incubation	16 May–9 June	5	50–115	6.2 h
Nestling	10 June–14 July	12	32–275	28 h
Post-fledging[a]	19–29 July	5	45–120	7.7 h

[a]From date first young fledged

the nestling period for 28 hours over 12 days (10 June–14 July; 1–3 days in each week: 3 days in Weeks 1, 3 and 4; 2 days in Week 5). The fledging date was taken as 19 July, although the other two young did not fledge until after 21 July (inferred to have fledged by 25 July, though they might have fledged and returned to the nest on or before that date). Parental feeding rates were calculated as the number of deliveries per hour of observation time in each phase of the breeding cycle. Prey items in the bill and/or talons of the adults were identified visually, with optical aids, to the extent possible.

The adult Harriers were sexed on the basis that the female was the larger, with a noticeably flat-topped head and wings broader than the narrow wings of the male. The vocalisations described here are based on the descriptions of Marchant & Higgins (1993), with examples of the adult loud chatter call and nestling begging call (immature *seep* call) available on the CD by Plowright (2001).

Results

Breeding chronology

The pair of adults was first observed in the nest area on 3 May, in the pre-laying period. The backdating calculations (see Methods) are supported by observations that the female consumed prey (provided by the male) off the nest on 9 June, and took prey to the nest on 10 June, behaviour indicating that there was a chick on 10 June but not before (S. Debus pers. comm.). Laying therefore is considered to have commenced on *c.* 8 May and, allowing for a clutch of four eggs (four hatched) and assuming a 2-day laying interval, the clutch to have been completed by mid May.

Nest site

The nest tree was a Monterey Pine <10 m tall, in a farm shelterbelt within pasture and cropland, amidst slightly shorter trees. The nest was located 7–8 m above ground and was a flat structure within the upper foliage of the senescent pine (Figure 1).

Vocalisations

At Wingeel, the adults used the shrill *seep* call near the nest: the female as a food-begging call, e.g. during aerial transfers (sometimes noted as with a 'fluty', sharp or piping quality), the male sometimes as a food-call (with a 'yelp' quality) when arriving with prey. They used the soft chitter (*kitter-kitter* call) when communicating with each other near the nest, and a louder chatter version when responding to the presence of other raptor species and, perhaps, to the proximity of the observer(s). Advanced nestlings and fledglings food-begged with the *seep* call and, in one case, a new fledgling flew in with a 'buzzy' type of call (a version of the chitter) as well as reedy *seep* calls to meet the incoming adult.

Figure 1. Nest site of a pair of Spotted Harriers, Wingeel, southern Victoria, August 2017. Above: nest tree and position of nest; below: situation of nest in tree. Photos: Craig Morley

Incubation period

On 16 May, before discovery of the nest, when the clutch was probably being completed, during a short watch (50 minutes) the male and female were observed flying about and perching in the area. On 20 May, during an hour around midday, neither Harrier was observed but it seems likely that the female was incubating out of sight for the entire watch. On 27 May, during a 75-minute observation period, both adults made several flights over the nest area and perched in trees near the nest. On 3 June, the male arrived with prey in his talons and there was an apparent exchange (not clearly observed) as the female met him, before the male perched empty-footed in the nest tree, as the female flew off then subsequently returned to the nest tree with prey. On 9 June, the male flew in with a small prey item and passed it by aerial drop to the female, which took it out of sight while the male then perched. Two minutes later, the female flew to a eucalypt ~50 m away, pulling at foliage, then flew over the nest (Figure 2), but was not seen to carry foliage to the nest. As she moved closer to the nest, with four Whistling Kites *Haliastur sphenurus* overhead, there was 'nervous' chittering from the Harriers.

Figure 2. Adult female Spotted Harrier arriving in nest tree, Wingeel, Vic., 27 May 2017. Photo: Craig Morley

Nestling period

Throughout the nestling period, the male made aerial food-passes to the female, and the female fed the chicks. His behaviour varied from perching nearby, and departing to hunt, to flying over the nest area. During one attempted aerial prey delivery by the male (Day 17), when the female remained on the nest, he took the prey to her then lingered on the nest for 7–8 minutes.

In Week 1, the female brooded the chicks (to at least Day 7; no data for week 2). On Day 7, the returning female settled quickly on the nest after apparently rolling the remaining egg(s) beneath her. In Week 3, she continued to attend the nest constantly (until at least Day 17), whereas her behaviour changed from Day 21 and through Week 4 to Day 31 (Week 5), when she perched in nearby trees or sometimes circled over the nest. From late in Week 3 (Day 21), she brought to the nest some prey items that she had apparently caught. From Week 4 (Day 22), she sometimes dropped food onto the nest for the chicks to feed themselves. From late in Week 5 (Day 35), the nest was often unattended by the adults.

Four chicks hatched, though only three fledged. On the first day that chicks were visible (Week 3, Day 21), a noticeably smaller chick with ochre down was fed and took food first. Another chick, older/larger and with dark-grey down and a hint of chestnut feathering on the nape, then fed voraciously from morsels offered by the female. This chick pecked at its smaller sibling. At the next feed, *c.* 30 minutes later, the female fed a nestling that had an ochre face and dark-grey hind-crown and nape, apparently intermediate in age/size between the previous two chicks. On Day 21, the food-begging *seep* call of a nestling could be heard. The fourth chick was still downy white on Day 27, when it would have been *c.* 18 days old (or possibly less), assuming an asynchronous hatching interval of *c.* 2 days between chicks. It did not survive the pecking and apparent starvation, and perhaps exposure, in the female's absence.

The chicks were acquiring dorsal feathers, flapped their wings, and they fed themselves on prey in the nest at 3 weeks old, were well feathered at 5 weeks, and the oldest fledged at 38 days old (Table 2).

Table 2. Growth and development of Spotted Harrier nestlings, Wingeel, Vic., June–July 2017. Week and day refer to age of the oldest of the initially four chicks; difference in age between successive younger chicks was assumed to be *c.* 2 days (see text).

Week	*Day*	*Comments*
3	21	Three nestlings confirmed: oldest was feathered dark fawn/brown; second had a pale mask and darkest 'hood' (ochre face, dark-grey hind-crown and nape); third was noticeably smaller, and its head was pale ochre and covered in down.
4	22	At least two chicks with grey/brown down and feathers. Chicks flapped wings and apparently fed themselves on prey dropped by the female.
	27	Fourth chick confirmed when more developed; feathering chick pecked at a downy white head bobbing about in the nest.
5	31	Two chicks had a dark-brown head, the third chick's head was paler.
	35	Two chicks were well feathered.
6	39	Oldest nestling fledged.

Fledging and post-fledging period

The first nestling was found to have fledged on 19 July, when it flew in to meet an incoming adult near the nest. Later that day, it was perched and begging for food near the female, which was feeding on the ground away from the nest. On 22 July, two young were flapping on the nest, and on 25 July they were still on the nest. On the latter date, the adult female twice (over a period of *c*. 30 minutes) flew over the nest with prey in her talons without landing. On the second occasion, she made circuitous passes over the nest with a prey item (larger than the previous item) that she had apparently caught, and made a chittering call briefly. This behavioural sequence might have been enticement behaviour. On 29 July, one juvenile flushed off the nest as the observer approached; it flew strongly and purposefully, suggesting that it had experience flying from the nest rather than this event being its first flight. Taking the mid point between the first nestling fledging and this observation on 29 July gives an approximate fledging date of 24 July for the two younger fledglings. However, they might have fledged unobserved by 25 July (or even 22 July) and subsequently returned to the nest, given the short watches on those dates (1.5–2 h). This possibility is supported by observations that fledglings can return to and spend much time on the nest, resting, jumping and flapping thereon, until Day 4 post-fledging (S. Debus pers. comm.).

On 28 August, a female juvenile with a full crop was observed (Figure 3). Two days later, on 30 August, an adult delivered food to a juvenile, and on 3 September a male juvenile flushed from the ground near the nest and flew off giving the *seep* call. No Spotted Harriers were observed thereafter. These events give a post-fledging dependence period of 6 weeks.

Spotted Harriers were next observed in the immediate area when an adult male and female were present on 21 April and an adult male on 25 April 2018, but no further observations of breeding were obtained.

Figure 3. Dependent juvenile Spotted Harrier, Wingeel, Vic., 28 August 2017. Above: in flight; below: perched. Photos: Richard Weatherly

Prey

Some prey items carried by the Spotted Harriers could not be reliably identified from the views obtained. The prey items that were identified included two House Mice and a rat *Rattus* sp.; other prey items were two unidentified rodents, two probable rodents, and a fawn-and-white bird that was larger than a mouse (probably a quail, Phasianidae, or a grassland passerine). There was a mouse plague in the area at the time (L. MacEachern pers. comm.).

Feeding rates

The male delivered two prey items to the incubating female during 6.2 h of observation (delivery rate of 0.32 item/h).

Of prey items delivered during the nestling period, the male brought 20 to the vicinity of the nest during 28 h of observation (delivery rate 0.71 item/h). The majority of these food deliveries involved an aerial food-pass to the female (this was inferred in a few cases), and one to the nest when the attending female did not leave for an aerial exchange. Of those 20 items, the male apparently consumed one when the female did not collect it, and the female consumed three without feeding the chicks. The female brought three apparently self-caught items to the nest during the nestling period (delivery rate 0.11 item/h), of which she consumed one. The combined effective delivery rate to the chicks was 18 items at a rate of 0.64 item/h.

In Week 1 of the post-fledging period, the combined delivery rate to the fledgling(s) was four items during 6.2 h of observation (delivery rate 0.65 item/h): one by the female, two by the male via a pass to the female, and one (inferred) by an adult directly to a fledgling. There were no observed deliveries during 1.5 h of observation in Week 2 (Day 9), and just one to a juvenile at 6 weeks post-fledging (Day 43).

Interactions with other species

During the Harriers' nestling period (on 1 and 6 July), a pair of Whistling Kites had two well-developed nestlings ~50 m from the Harriers' nest, and another pair of Whistling Kites had at least one nestling 120 m from the Harriers. During this phase, there were several interactions between the Harriers and other raptor species. On Day 1, an adult Harrier (presumably the male) briefly chased a Brown Falcon *Falco berigora*. In Week 3 (Day 17), a Black Kite

Milvus migrans was 'seen off' by both Harriers from their nest area; a Whistling Kite was 'seen off' by one Harrier; and two Peregrine Falcons *Falco peregrinus* were high overhead while both Harriers uttered chittering calls but did not rise to the Falcons. In Week 3 (Day 21), when a Brown Falcon called noisily in the area, the female Harrier left her perch and circled the nest area. Later, she returned to the nest area, chittering, and perched, continuing to utter a quiet chittering call, perhaps in response to a Wedge-tailed Eagle *Aquila audax* that flew through. Fifty minutes later, a Wedge-tailed Eagle briefly drifted towards the Harriers' nest area; in response, both Harriers were in flight, chittering, and the Eagle drifted away. Thirty minutes later, the female Harrier flew to see off Wedge-tailed Eagles. A pair of Black-shouldered Kites *Elanus axillaris* performed a 'butterfly' courtship flight (see Marchant & Higgins 1993) high overhead, without any reaction from the Harriers. Two Black-faced Cuckoo-shrikes *Coracina novaehollandiae*, one of which perched within 10 m of the female Harrier ~25 m from the nest, were seemingly ignored by the Harriers.

Discussion

The breeding event detailed herein is the most southerly autumn–winter breeding record for the Spotted Harrier to date, and could have been related to the mouse plague in the area providing an abundance of prey. The parental feeding rates are the first documented for the species. There has been no previous mention for this species of possible enticement behaviour with food to encourage young to fledge, a subject that could bear further investigation.

The brood size at fledging of three chicks is at the upper end of the range for the Spotted Harrier (Marchant & Higgins 1993). Parental and defensive behaviour, vocalisations and vocal behaviour, chick growth and development, and sibling relations were similar to previous accounts, to the extent that these aspects have been documented (Marchant & Higgins 1993). The present study has added some behavioural detail. However, the picture at Wingeel might have been modified by a more balanced observation schedule covering more early-morning sessions. Identified prey items were also consistent with previous knowledge, i.e. terrestrial grassland mammals and birds in south-eastern Australian agricultural environments (Marchant & Higgins 1993).

The nestling period was as previously recorded for male chicks (mean 38 days, range 36–39 days), and the later fledging of the other two young was consistent with the age difference, a male and at least one female in the brood, and with a longer nestling period for female chicks (mean 42 days, range 40–43 days: Marchant & Higgins 1993). Fledging on or after 25 July at Wingeel is conceivable, given that fledging of a brood can be staggered over up to a week, depending on chick gender and hatch order (Marchant & Higgins 1993). The presence of two younger females in the brood may also facilitate the successful fledging of three young, as they would soon overtake an older male sibling in body size and competitive ability at feeding times. The post-fledging dependence period was similar to that in a previous account (6 weeks: Marchant & Higgins 1993).

There has been no comprehensive study of Spotted Harrier parental time budgets throughout a complete breeding cycle from nest-building to independence of young, as has been done for other Australian raptors. Such knowledge would contribute to understanding the breeding biology of this species, which remains relatively little studied.

Acknowledgements

I thank David Tytherleigh and David Hollands for sharing some observation sessions. I thank Rod Lowther who was with me when the adult Spotted Harriers were located at the site. Thanks go to Richard Weatherly and David Hollands for passing on additional observations late in the nestling and early in the fledgling periods, and to Richard for images of one of the juveniles. Thanks also go to Maarten Hulzebosch for sharing his unpublished compilation on the Spotted Harrier breeding in southern Victoria. Sincere thanks go to Stephen Debus for assistance with transforming field notes into a manuscript worthy of publication, and to an anonymous referee and editor Chris Pavey for helpful comments on the draft.

References

Aumann, T. (2001a). Breeding biology of raptors in riparian environments in the south-west of the Northern Territory, Australia. *Emu* **101**, 305–315.

Aumann, T. (2001b). An intraspecific and interspecific comparison of raptor diets in the south-west of the Northern Territory, Australia. *Wildlife Research* **28**, 379–393.

Baker-Gabb, D.J. (1985). Autumn breeding by the Spotted Harrier *Circus assimilis*. *Australian Bird Watcher* **11**, 48.

Buij, R. (2014). Spotted Harrier hunting lizards on foot. *Australian Field Ornithology* **31**, 107–112.

Christie, M. (2004) Spotted Harrier taking Southern Boobook. *South Australian Ornithologist* **34**, 176–177.

Hassell, C. (2004). Prey of Spotted Harrier. *Boobook* **22**, 30.

Hewish, M. (2006). *Geelong Bird Report 2005.* Geelong Field Naturalists Club, Geelong, Vic.

Marchant, S. & Higgins, P.J. (Eds) (1993). *Handbook of Australian, New Zealand & Antarctic Birds, Volume 2: Raptors to Lapwings.* Oxford University Press, Melbourne.

Morley, C. (2019). *Geelong Bird Report 2013-2016.* Geelong Field Naturalists Club, Geelong, Vic.

Plowright, H. (Ed.) (2001). *A Field Guide to Australian Birdsong, CD2: Darter to Red Kno*t. Bird Observation and Conservation Australia, Melbourne.

Received 10 April 2021, accepted 24 August 2021, published online 28 October 2021