AUSTRALIAN FIELD ORNITHOLOGY 2005, **22**, 58–66

Foraging, Habitat Use and Nesting of the Black-shouldered Kite *Elanus axillaris* in the Australian Capital Territory

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Summary

Aspects of the behaviour, foraging, habitat use and nesting of the Black-shouldered Kite *Elanus axillaris*, during the birds' prelaying period, were studied by observation of one pair in October 1991. The pair occupied a home-range of 200 ha and defended a territory of 100 ha about the nest. The male foraged over tall grassland with numerous perches, mostly by quartering and hovering, and caught only mice (presumably House Mice *Mus domesticus*), captured by drop-attacks; he delivered 4–5 mice per day to the nest-building female. The male spent most of his time perching, on exposed perches, but foraged in bouts of about 2 hours morning and afternoon (for 4 h/day), whereas the female spent most of her time on the nest. Vocalisations, nest-defence and nest-site characteristics are described.

Introduction

The habits, behaviour, habitat and breeding biology of the Black-shouldered Kite *Elanus axillaris* have been described in general terms, but with little or no quantification of home-range size, habitat use, or activity budgets of the sexes during the breeding cycle (Marchant & Higgins 1993). A regrettably unpublished study of one pair of Kites (Pastorelli 1984), minimally cited by Marchant & Higgins (1993), quantified some aspects of the birds' habitat use and foraging behaviour, in terms of flight types, flight heights, perching substrates, daily activity, diet, and niche partitioning with respect to the ecologically similar Nankeen Kestrel *Falco cenchroides*. Recent work by Engel & Rose (1997) and Mathieson *et al.* (1997) has added substantially to the small number of quantified dietary studies, and Aumann (2001) quantified aspects of habitat use, foraging behaviour and daily activity for several individual Kites in the arid zone. The Kite's congeners, particularly its allospecies on other continents (the White-tailed Kite *E. leucurus* in the Americas and Black-winged Kite *E. caeruleus* in the Old World) are better known (del Hoyo *et al.* 1994; Ferguson-Lees *et al.* 2001), although a comparison of the hunting behaviour of these species was scarcely able to quantify the foraging ecology of the Australian species (Mendelsohn & Jaksić 1989).

The Black-shouldered Kite is well distributed in open areas of the Australian Capital Territory, being present all year round though with seasonal and annual fluctuations in abundance (Taylor & COG 1992; Fennell 2000; Veerman 2002). In view of the paucity of information on the ecology and behaviour of this common species, a study was conducted of the home-range, habitat use and activity budgets of one pair of Kites during the prelaying phase. Observations were also obtained on the vocalisations, nesting habitat, nest-building behaviour, mating, and territory defence of the pair, with data on nest-site obtained for a second pair. The aim of the study was to quantify aspects of home-range and habitat use by the Kites, in particular (i) time spent hunting or in other activities, (ii) gender differences in activity budgets and home-range use, (iii) perching sites, and (iv) nest-site characteristics.

Study area and methods

The environment of Canberra and surrounds has been described elsewhere (Taylor & COG 1992; Fennell 2000; Veerman 2003). One pair of Kites was located in outer suburban Canberra between June and October 1991, and studied in detail in October. The territory of this pair included Fisher Paddocks (35°22′S, 149°03′E), Mt Arawang and the base of Mt Taylor.

A 1:10 000 topographic map of the study area of 228 hectares (enclosing the home-range of the pair of Kites) was overlaid with a 100 × 100 m grid, and landscape features used by the Kites, such as dead trees, marked on it. A vegetation map (following Specht's 1970 classification) was drawn on the map, using 1:10 000 aerial photographs. All perching locations were marked, numbered and categorised as: (a) dead tree or other exposed perch, (b) live tree with some dead branches (crown dieback) or (c) live tree.

The pair of Kites was observed daily from dawn to dusk (0520–1830 h; c. 13 h/day, total 39.5 h) on 2, 6 and 9 October 1991, during the prelaying period, by means of 7 × 35 binoculars and a 20× telescope. Each Kite's location and activity, i.e. perching (resting, perch-hunting or prominent perching), hunting, feeding, territory defence, nesting activity, vocalisations and copulation, were noted against time of day. A perching Kite was regarded as resting when it was inactive (e.g. loafing, preening); perch-hunting when it was alert and actively scanning the ground for prey during a foraging bout; and prominent perching when it sat conspicuously on the topmost, bare branch of a tall tree in the nest area. Roosts were defined as the position the bird was in at dawn or dusk; observations did not continue after dark. Hunting methods follow the terminology of Marchant & Higgins (1993), transect-hunting being direct flap-and-glide on a straight course while scanning the ground.

Observations were made from the cover of small trees 30 m from the nest-tree, and the activities of both sexes were monitored continuously. Time-budgets were calculated as the proportion of total observation time spent by each sex of the pair in each activity and location. Habitat use was calculated as the amount of total foraging time spent by the male hunting in each of the habitat classes in his home-range. Prey items in the perched female's grasp were identified visually by binoculars or telescope. The pair was also monitored for several days after the intensive observations, until laying was confirmed by inspection of the nest.

A second pair of Kites, found nesting late in the study, was located at The Pinnacle (35°16′S, 149°02′E). For the two Kite nests, the following were measured or calculated: slope at the base of the nest-tree (from contour maps, and confirmed in the field with a level and protractor); distance to nearest permanent water; diameter of nest-tree at breast height (dbh); foliage cover (depth and diameter) above the nest; height of nest-tree; height of nest (by trigonometry and measuring distances on the ground). The focal nest was examined *in situ*, by climbing to it. Weather data, for temperature during the study period and for local rainfall during 1991, were obtained from the Bureau of Meteorology in Canberra. In 1991, rainfall was below average with a dry autumn and spring and winter peak, unlike the normal pattern of a slight winter trough (cf. Taylor & COG 1992; Fennell 2000).

Results

Nesting chronology and behaviour

The Kites started nesting in early October, following a wet winter and declining rainfall in spring. It appeared that the female Kite governed the male's behaviour during the prelaying period, by begging for food and controlling the amount of time that he spent at the nest. The female was moulting her primaries in the days before egg-laying.

Nest-building was conducted throughout the day, with no apparent pattern. Both sexes gathered material: the male made an average of 4±2.2 twig-gathering forays per day, and the female 11.3±2.0 (n = 12 and 34 forays respectively over the three days). The female performed all of the nest construction, including appropriation of twigs delivered by the male.

Copulation was observed eight, three and zero times per day over the three days (2, 6 and 9 October), respectively, as laying approached. Laying and incubation

Table 1

Nest-site characteristics of two pairs of Black-shouldered Kites, Canberra, October 1991. *E = Eucalyptus.*

Variable	*Pair 1*	*Pair 2*
Tree sp.	Blakely's Red Gum *E. blakelyi*	Yellow Box *E. melliodora*
Dbh (m)	1.1	1.0
Foliage cover above nest (m):		
diameter	9	21.5
depth	1.5	12.5
Height of nest in tree (m)	16.5	10.5
Slope at base of tree (°)	5	10
Distance to nearest permanent water (m)	171	210
Vegetation type within 100 m of nest	Open forest with closed grassland, low closed forest	Open forest with closed grassland

were inferred from the behaviour of the female, and confirmed by inspection of the nest after incubation had started. The clutch consisted of three eggs.

Vocalisations

In flight and near their mate, the Kites uttered a long *peep...peep...peep* whistle. Immediately before or after flight they uttered rapid *peep* calls, apparently to announce their departure or arrival. During the prelaying period the female solicited the male with a whistle and 'scrape' call *peep-crair-peep-crair* or a repeated scrape call *crair-crair-crair*, during food passes and copulation. When both Kites were on the nest, the male delivering twigs to the female or mating, they uttered a rapid chatter *plick-plick-plick...*, in unison. The female appeared to see or hear the approaching, food-bearing male from some distance, as she often seemed to know that he was returning when he was still barely visible to the human eye.

Nest-site characteristics

The nest-sites of the two pairs were in tall eucalypts in open areas on gentle slopes (Table 1), giving a wide view of the surroundings, and about 200 m from permanent water (farm dams). Both nests were of sticks, lined with green leaves, and were 35 and 40 cm in diameter.

Nest-defence

Both sexes defended the nest-site. They performed low-intensity defence (warning calls and fly-overs rather than attack) against the Nankeen Kestrel, Galah *Cacatua roseicapilla*, Laughing Kookaburra *Dacelo novaeguineae*, Australian Magpie *Gymnorhina tibicen* and Australia Raven *Corvus coronoides*. The Kites vigorously attacked and chased the Brown Goshawk *Accipiter fasciatus*, Brown Falcon *Falco berigora* and Pied Currawong *Strepera graculina*, all potential predators of nestling Kites or eggs. They did not defend the nest-site against various other birds, from small or medium-sized passerines to parrots and cockatoos, nor against the Wedge-tailed Eagle *Aquila audax*.

Adult Black-shouldered Kite, ACT

Plate 6 Photo: J. Olsen & S. Trost

Diet, foraging behaviour and feeding rates

Observed prey items of the Kites over three days in the prelaying phase were exclusively mice (n = 14 identified items delivered to the female), presumably House Mice *Mus domesticus* which are the only mouse-sized mammal in disturbed habitats locally. Observed searching techniques in 10 hours of foraging time were 80% high quarter and hover, 15% perch-hunting and 5% transect-hunting. All prey items were taken on the ground, entirely by the drop-attack.

During the prelaying period the male supplied all the female's food; she did not hunt. Her rate of food consumption at this stage was 4–5 mice per day over the three days.

Activity budgets

Over three days of the prelaying period the male spent 25% of observation time foraging, and the remainder mostly perching (70%), on the nest (3%) or defending the nest (2%). The female spent most of her time on the nest (79%) or perching near the nest (16%), with increasing time on the nest as laying approached, and the remainder feeding (2%) or defending the nest (3%).

The male hunted in bouts in the morning and afternoon from around 0700 to

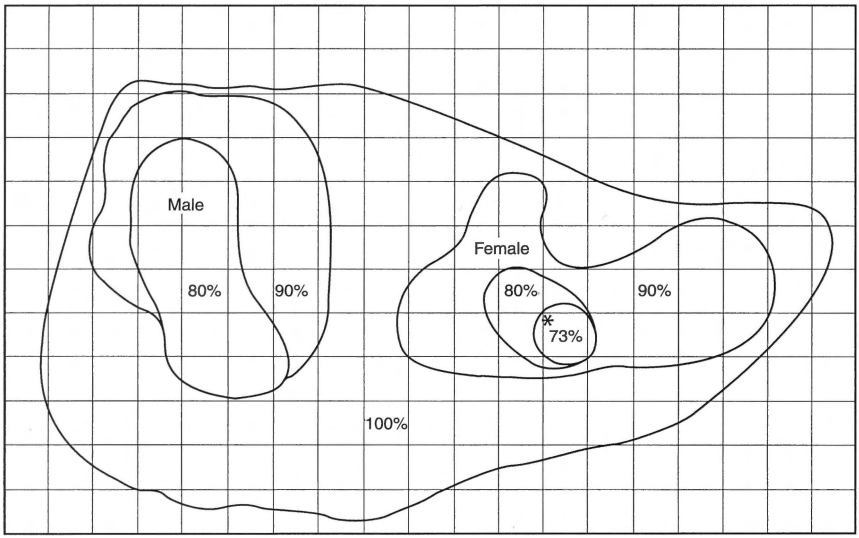

Figure 1. **Proportions (%) of time spent by a male and a female Black-shouldered Kite in parts of the breeding territory, prelaying period, Canberra, 2, 6 and 9 October 1991 (from 13 h/day observation, dawn–dusk). * = position of nest-tree. Scale: grid = 100 m × 100 m.**

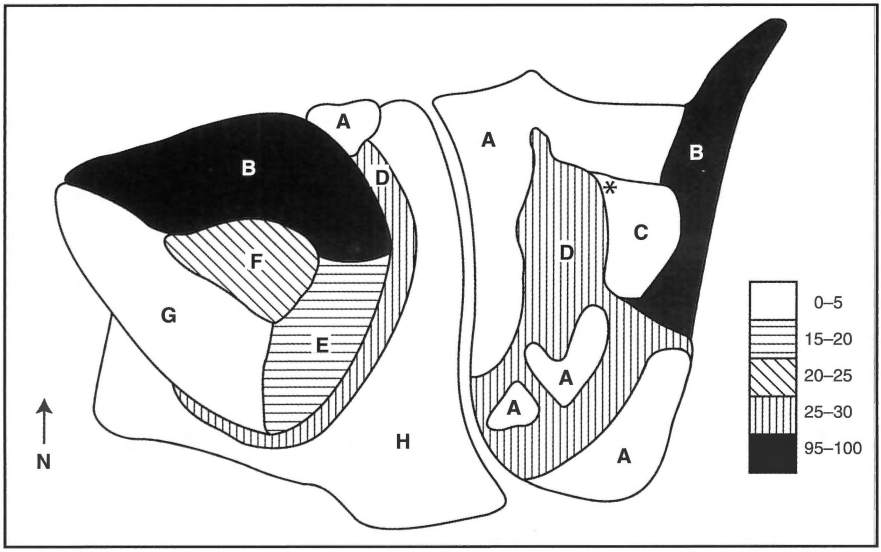

Figure 2. **Amounts of time spent by a male Black-shouldered Kite hunting in parts of his home-range, prelaying period, Canberra, 2, 6 and 9 October 1991 (minutes per day, from 13 h/day observation, dawn–dusk). * = position of nest-tree. See Table 2 for habitat codes and descriptions.**

Table 2

Vegetation types and perch densities in the home-range of one pair of Black-shouldered Kites, Canberra, October 1991.

Vegetation type	*Description*	*Perch density (perches/ha)*
A	Low closed forest with grassland	1.6
B	Woodland with closed grassland	2.9
C	Open forest with closed grassland	6.7
D	Open woodland with closed grassland	4.5
E	Closed grassland (steep, SE aspect)	5
F	Closed grassland (flat)	10
G	Closed grassland (steep, SW aspect)	0.8
H	Low grassland (grazed)	0.8

1000 h and 1400 to 1730 h, for a total of about 2 hours in each hunting period (4 h/day), although each session was punctuated by periods of perching for typically 15–30 minutes (sometimes longer, 40–80 minutes). He perched (resting) during the middle of the day. On the first and third days most afternoon hunting occurred after 1430 h, but on the second day in dull conditions he hunted from 1330 h as rain approached, then perched from 1400 h during rain showers and a thunderstorm, and resumed hunting from 1630 h after the storm as the rain eased.

On the first day the female alternated between nest and perch, though mostly on the nest between 0900 and 1200 h; on the second and third days she was on the nest, perching only for a few minutes in the morning (0730–0900 h) and afternoon (1430–1630 h).

Habitat use

From June to October the pair of Kites used a home-range of 200 ha; during the prelaying period they defended a territory, against potential nest predators, of about 100 ha around the nest. At this stage the female spent all day on or in the immediate vicinity of the nest, whereas the male moved about the home-range but spent most of his time in an area 0.5–1 km from the nest (Figure 1). The male spent most of his hunting time in areas of woodland with rank grassland, and least time in areas of short (grazed) grassland (Table 2, Figure 2). The only area of closed grassland avoided was that with a south-westerly aspect, exposed to the prevailing winds, but it also had few perches.

Perching substrates

The Kites used trees, a trig point and a telegraph pole as perches: in the prelaying phase 37% of perches were exposed sites including dead trees, 43% were dead crowns in live trees (the Kites used the protruding dead branches), and 20% were live trees. In the prelaying phase the Kites performed four activities on perches: male resting (76% of perching time), prominent perching near the nest apparently as a display (14%), perch-hunting (8%), and feeding on captured prey (2%); female resting (68%), prominent perching (23%), and feeding (9%). Live trees, or live trees with some dead branches, were used for resting. There was an

average of four perches per hectare distributed unevenly among habitats (Table 2), with the habitats most used for foraging tending to have among the highest densities of perches (Figure 2).

The only night-roost used by the male Kite during the three-day study was a live tree 80 m from the nest-tree, where he sheltered on the side of the tree, just under the canopy. The female used this site on two nights (including that before day 1 of the intensive watch), then roosted on the nest for nights 2 and 3 as laying approached.

Discussion

This study found, for a pair of Black-shouldered Kites in the prelaying period: differences in time spent hunting versus other activities, with most time spent perching; a preference for areas of rank grassland with many potential perches when hunting; gender differences in activity budgets and home-range use; and an uneven distribution of perching sites in the home-range, with a preference for exposed perches. The male supplied all prey for the pair: entirely mice, located mostly by high quartering and hovering, and taken in a drop-attack, during foraging bouts in mid morning and mid to late afternoon. By contrast, the female spent 80% of her time on or within 100 m of the nest. The male's foraging times, and time spent hunting (up to 4 hours per day), were similar to those found by Mendelsohn & Jaksić (1989) for breeding male *Elanus* kites elsewhere.

Aspects of the Kites' breeding biology and nest-sites were within parameters previously recorded (Marchant & Higgins 1993). The predominance of mice, most likely the introduced House Mouse, in the diet accords with previous studies (Marchant & Higgins 1993; Engel & Rose 1997; Mathieson *et al.* 1997). For instance, Pastorelli (1984) recorded 95% mice and one insect in 19 prey items (discounting Galah remains under the nest-tree as unlikely Kite prey, probably left by another predator or scavenger). Specialisation on rodents is a feature of the genus *Elanus* (del Hoyo *et al.* 1994). Vocalisations, and their contexts, were much as described previously for this species, and for its congeners (Marchant & Higgins 1993; Jurisevic 1998; Ferguson-Lees *et al.* 2001). Prelaying lethargy, a declining frequency of copulation as laying approaches, and the female moulting her flight-feathers while inactive and tied to the nest are features of raptor breeding biology (e.g. Olsen 1995).

Results for foraging behaviour were similar to those of previous studies, in terms of the preponderance of high quartering and hovering, and drop-attacks (Marchant & Higgins 1993; Aumann 2001). Pastorelli (1984) recorded the following proportions for sightings of Kites in flight (perched not counted as hunting): 53% quartering and hovering, 47% direct flight (transect-hunting and possibly commuting, non-hunting flight); hovering was 58% at medium height (15–30 m) and 42% low (<15 m). Results for daily activity differ somewhat between studies, possibly because of the way data were collected or expressed: Aumann (2001) recorded most Kite sightings (perched and in flight) in the early morning, followed by mid morning to mid afternoon, and none in late afternoon, whereas Pastorelli (1984) obtained, for Kites in flight only, 42% of sightings in the afternoon, 36% around midday and 22% in the morning. This study, and other Australian data, support the view that the Australian species spends less time quartering and hovering than the longer-winged, longer-tailed White-tailed Kite, but less time perch-hunting than the shorter-winged, shorter-tailed Black-winged Kite (Mendelsohn & Jaksić 1989).

Results for habitat use confirm the Kite's preference for tall grass over short grass for hunting (Marchant & Higgins 1993). For instance, 96% of Pastorelli's (1984) Kite sightings were in tall grassland and 4% in short grassland. Pastorelli obtained similar results to the present study for perching substrates: 56% of sightings in live trees, 44% on dead trees or telegraph poles. The Kite's avoidance, in this study, of wind-swept grassland may have been related to hunting or capture efficiency (fewer perches; shorter, moving grass; fewer or less detectable prey).

The Kites' behaviour in this study was similar to that of the Nankeen Kestrel in a similar environment, in terms of home-range size (160 ha), foraging habitat (grassland), and hunting methods (hovering and perching), but the Kestrel differed somewhat in hunting times and strongly in diet (invertebrates and lizards), with a higher food-delivery rate to the prelaying female (Paull 1991). Pastorelli (1984) found significant niche partitioning from the Kestrel by flight type, hover height and temporal activity, with 56% overlap in perch substrate. In that study, the Kestrel overlapped completely in habitat use but quartered and hovered more (75%), at similar frequency at medium height but less (20%) in the low and more (21%) in the high height classes, and was seen in flight more in the morning (39%) and middle of the day (40%) and less in the afternoon (21%). The Kestrel used dead trees and poles more (79%) and live trees less (5%), and some perch types (telegraph wires 12%, fence posts 4%) not used by the Kite.

This study confirms and enlarges on previous information on the Black-shouldered Kite, with additional detail on the prelaying period, nest-building behaviour, home-range size, habitat use, and activity budgets. It remains to conduct further detailed studies on these aspects, and on diet and breeding biology, before the Australian species is as well known as its congeners on other continents.

Acknowledgements

This study was part of an undergraduate course at the University of Canberra, supervised by Dr Jim Hone who commented helpfully on the project report on which this paper is based. I thank Jerry Olsen, Frank Barnes and Philip Veerman for relevant literature, suggestions and help in the field; the ACT Parks & Conservation Service for a permit and helpful information; and Gavin Melville, Ross Bennett and the Canberra Ornithologists Group for assistance. Thanks also to David Read for commenting helpfully on a draft, and Andrew Ley for editing.

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Received 26 May 2004 ■

CHANGES TO RARITIES EDITOR AND EDITORIAL BOARD

After five years of service, Ken Simpson has retired as Rarities Editor. During this time, ten new bird species for Australian territory were documented in *AFO*, as well as records of several other rare vagrants. Ken has also retired from the *AFO* Editorial Board, after two years' service as one of the inaugural Board members. We thank Ken and wish him well. The departure of Ken, and also of Les Christidis, leave vacancies on the Editorial Board which remain to be filled.

We welcome Margaret Cameron as the new Rarities Editor. Margaret is well known as a past president of the RAOU (now Birds Australia), and past editor of the *Geelong Naturalist* and *Australian Birding*. Henceforth, contributions on rare vagrants should be directed to Margaret (contact details inside front cover).