The timing of breeding in Blackshouldered Kites in southern Africa

J. Mendelsohn

SUMMARY

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In southern Africa Blackshouldered Kites *Elanus caeruleus* may breed throughout the year, but most eggs are laid before and after the wet season. A study in the Transvaal showed that breeding depends on a good food supply, and breeding usually starts before prey abundance reaches a peak. This suggests that kites respond to predicted increases in food supply that may occur at any time; the population dynamics of their rodent prey in southern Africa are seldom predictable. Several factors which may be indicative of increasing rodent density are considered. It is suggested that kites respond to some measure of rodent breeding activity, and that this is the most efficient predictor of future prey abundance.

INTRODUCTION

The Blackshouldered Kite *Elanus caeruleus* is one of the commonest African raptors. Part of this success may be due to an ability to breed more than once and at any time of the year (Mendelsohn in prep.). In Africa this kite is largely dependent on rodents as prey (Siegfried 1965, Tarboton 1977, 1978, pers. obs.). This paper examines the relationship between the timing of breeding and food supply

METHODS

Breeding records were obtained from the Southern African Ornithological Society's Nest Record Card collection (192 records), Dean (1971) (14), W.R. Tarboton (pers. comm.) (24), A.C. Kemp (pers. comm.) (10) and a study at Settlers, Transvaal (24 57S, 28 32E) (32 records). Egg-laying dates of nests found at later stages of breeding were estimated by back-dating, using average incubation (31 days) and nestling (33 days) periods.

A small population (average of 26 kites) in a 69 km^2 area was studied for 19 months during 1977 and 1978. The area, on the Springbok Flats, was a mosaic of cultivated fields and strips of *Acacia* woodland and grassland. Most kites were marked with coloured patagial tags. Food supply was monitored

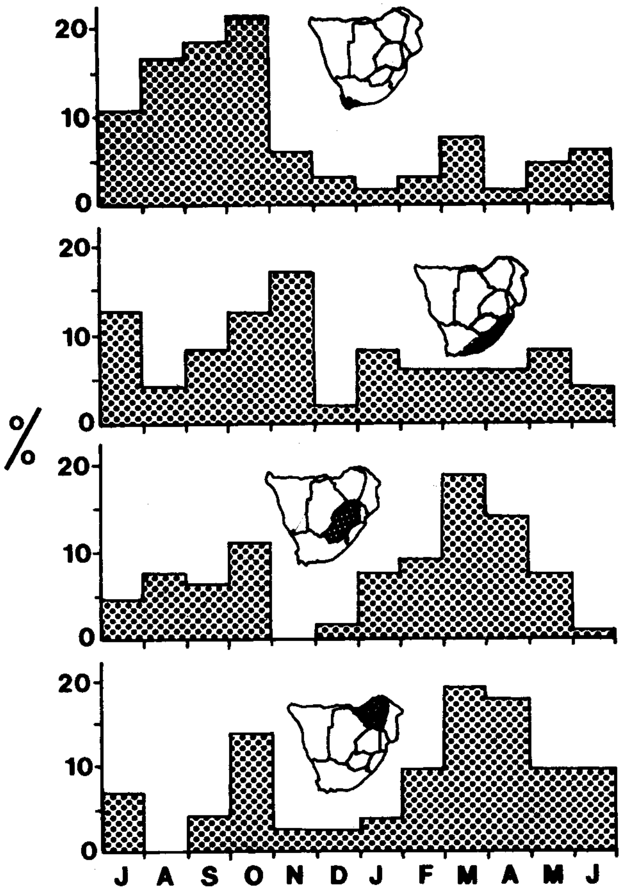

Fig. 1. Monthly frequencies (%) of egg-laying by Black-shouldered Kites in four regions of southern Africa. S.W. Cape - 66 records, Eastern Cape and Natal - 46 records, Transvaal and Orange Free State - 106 records, and Zimbabwe - 73 records.

by trapping rodents, observing hunting success and analysing pellets. A fuller description of the study is in preparation.

RESULTS

Egg-laying has been recorded throughout the year (Fig. 1). However, most kites started breeding after the rainy season in the S.W. Cape (winter rainfall area), and Transvaal-Orange Free State and Zimbabwe (summer rainfall areas). Smaller peaks of egg-laying activity also occurred before the wet season in these areas (Fig. 1). Similar pre- and post rains peaks of egg-laying activity probably occur in Zambia (Benson *et al.* 1971). Seasonality was less clear in the eastern Cape and Natal, perhaps because of fewer records, or the poorly defined wet and dry seasons in parts of this region. Few data were available for other areas of southern Africa.

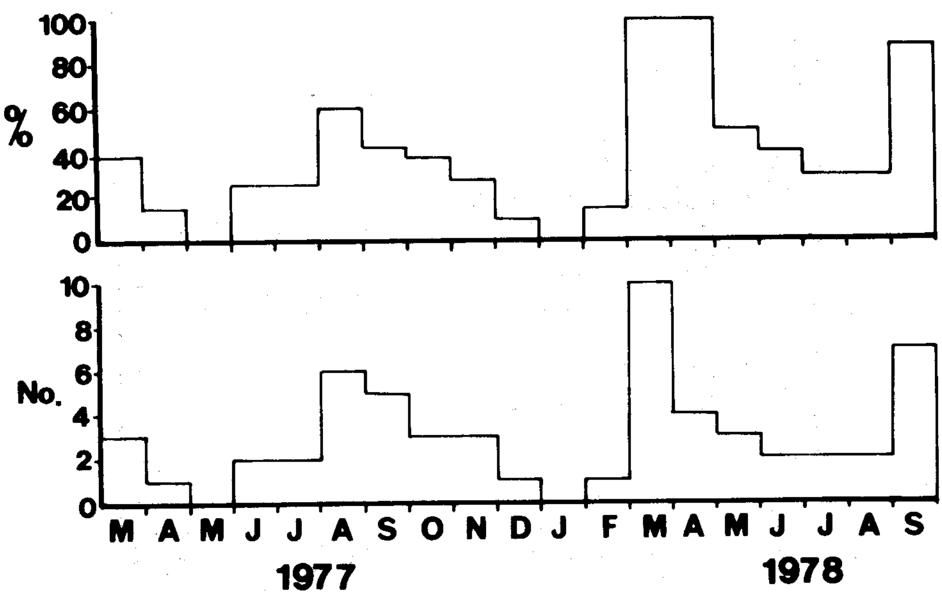

Fig. 2. Numbers of Blackshouldered Kite pairs seen copulating each month, and this number as a percentage of all pairs that could have started breeding.

Figure 2 shows the number of pairs observed copulating each month at Settlers, and this number as a percentage of all those pairs that could have started breeding. Copulating pairs inspected nest sites, built nests and females were fed by males. The mean interval between the onset of copulation and egg-laying was 24,1 days (S.D. = 11,0 days; range 10-46

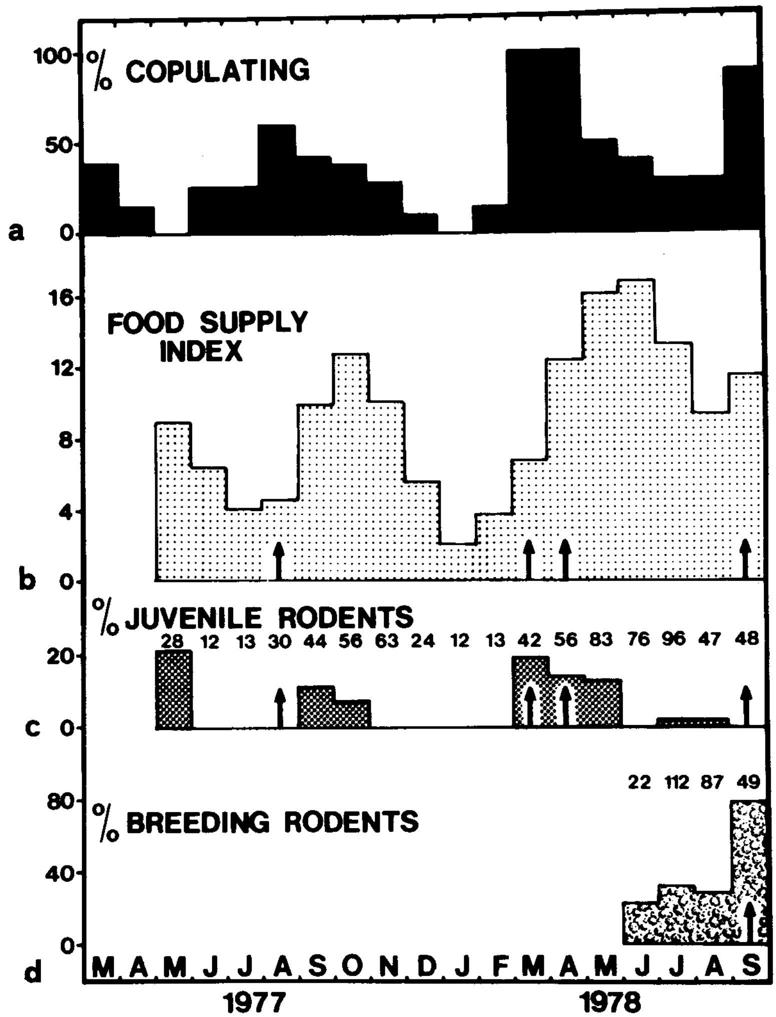

Fig. 3. a) Percentage of Blackshouldered Kite pairs copulating each month - taken from Fig. 2. b) Index of food supply (see text). c) Percentage juvenile *Rhabdomys pumilio* and *Praomys natalensis* trapped each month. Juvenile *Rhabdomys* weighed less than 20 g and juvenile *Praomys* less than 15 g. d) Percentage *Rhabdomys* and *Praomys* in breeding condition (males scrotal, females pregnant or lactating). Sample sizes are given for (c) and (d), and arrows in (b), (c) and (d) indicate months in which most breeding started.

days; n = 13). Pairs started breeding during most months at Settlers, but most copulating pairs were seen just before and after the summer rains (Fig. 2). Individuals were flexible in the timing of breeding attempts, e.g. one pair was observed copulating and attending nests in September and November 1977, and in February, July and September 1978. Another (a male with various females) made separate breeding attempts in June, August and September 1977, and in March, August and September 1978.

Breeding depended on a good food supply. Breeding kites regurgitated heavier pellets (reflecting greater food intake (Tarboton 1977)), and had better hunting success than non-breeders (Mendelsohn in prep.). Failed breeding attempts were often associated with food shortages. At certain stages, breeding males had to catch 200-300 g of prey/day to feed their chicks and mates; this was several times more than a mean of 36,5 g/day eaten by a kite hunting for itself. Finally, high densities of kites breeding continuously have been observed during rodent plagues (Malherbe 1965).

These observations suggest that for breeding to be successful, it had to coincide with periods of abundant food supply. Changes in food supply during the study are shown in Fig. 3b. This average curve was based on an index of rodent density at six trapping lines, numbers of kites seen with prey, and mean pellet weights each month (Mendelsohn in prep.). Comparing Figs 3a and 3b indicates that kites usually started breeding before food supply reached a peak. This is confirmed by highly significant positive correlations between the proportions of pairs copulating and food supply one month hence (Spearman's $r_{16} = +0{,}80$; $p < 0{,}001$) and two months hence ($r_{15} = +0{,}71$; $p < 0{,}005$). This relationship did not hold for food supply three months hence (Spearman's $r_{14} = +0{,}27$; NS). There was a moderately significant correlation between the proportion of pairs copulating and food supply in the same months (Spearman's $r_{17} = +0{,}44$; $p < 0{,}05$). It is noteworthy that few pairs attempted breeding during October and November 1977 and May to July 1978 (Fig. 3a) when prey densities were greatest (Fig. 3b).

Fig. 3c records the proportion of juvenile rodents in trapped samples each month, and Fig. 3d the proportion of rodents in breeding condition for four months (July-September 1978). Only *Rhabdomys pumilio* and *Praomys natalensis* are considered. *Otomys angoniensis*, an important prey item, was excluded from Figs 3c and 3d because few were trapped. Most juvenile *R. pumilio* and *P. natalensis* were produced before or after the summer rains. Comparing Figs 3a and 3c indicates that kites started breeding either one month before (August 1977 & September 1978), or in the same month as juvenile rodents appeared (March & April 1978). Although rodents were not sampled, great numbers of juvenile rodents were seen during field work in October 1978, agreeing with the high proportion of rodents breeding one month before in September 1978 (Fig. 3d).

TABLE 1

Data relating to prey size for Blackshouldered Kites in their first month of breeding and at all other times.

	Kites during their first month of breeding	All other kites
Mean weight of[a] prey items seen caught		
Hovering (n)	27,3 (11)	21,5 (78)
Perched-Hunting (n)	26,7 (9)	28,9 (105)
Mean pellet weight (n)	1,45 (133)	1,26 (1857)
Mean food [b] weight (grams)	44,61	38,53
No. prey items/pellet (no. pellets)	1,28 (144)	1,33 (2429)
Mean prey [c] weight (grams)	34,9	29,0

a - estimated weight of prey seen caught by kites
b - calculated by ((mean pellet weight - 0,056)/0,025)(0,8) from Tarboton (1977) and Mendelsohn (in prep.)
c - 'mean food weight/no. prey items/pellet'

DISCUSSION

Blackshouldered Kites appear to be opportunistic in probably being able to breed whenever suitable feeding conditions arise. Such flexibility and a strong dependence on rodent prey may be co-evolved aspects of their biology. Rodent population dynamics in southern Africa are seldom predictable; densities change at different times and rates each year (Coetzee 1967, Choate 1972, de Wit 1972, Davis 1973, Brooks 1974). This is partly because rodent breeding is linked with rainfall (Coetzee 1965, 1967, Taylor & Green 1976). While rainfall is broadly seasonal over much of southern Africa, its timing and extent may vary markedly (Schulze 1974).

Similar peaks in the onset of breeding (Figs 1 & 2) suggest that changes in food supply at Settlers were similar to those usually experienced by kites in summer rainfall areas. Rodents generally breed in summer in southern Africa and densities become greatest between late summer and early winter (Coetzee 1965, 1967, de Wit 1972, Davis 1973, Brooks 1974). Egg-laying during March and April is therefore probably related to prey usually being abundant after summer. The egg-laying peak before the summer rains may also be linked with increased food availability, as suggested by the Settlers data (Fig. 3b). Rodent populations are usually low at this time of the year, but the early production of young (Fig. 3c), poor grass cover and extensive foraging by rodents may result in an increased food supply (Mendelsohn in prep.). Rodents often start breeding before the onset of the main summer rains (Taylor & Green 1976, pers. obs.).

The situation in the S.W. Cape winter rainfall area is not clear. A study by J. David (pers. comm.) in alien *Acacia* showed that *Rhabdomys pumilio* densities are lowest in September and highest between February and April as a result of summer breeding. If these findings are representative of prey populations over the whole region, most kites seem to start breeding when prey populations are lowest, and about six months before they reach a peak.

The breeding seasons of most birds are probably timed so that periods of greatest food availability and demand coincide (Perrins 1970). This probably explains why kites started breeding before prey densities reached a peak. Breeding males had to catch the greatest quantity of food when chicks were present, two to four months after the onset of breeding (Mendelsohn in prep.). In the light of these periods, significant correlations were expected between proportions of pairs copulating and food supply three months hence. The absence of this relationship suggests that kites did not respond to predicted increases in prey abundance as efficiently as they might have done. Two factors may have prevented kites from timing their breeding more closely with changes in food supply. Firstly, food shortages may have prevented breeding from starting earlier, e.g. in January and February 1978. Secondly, rodent density often decreased unpredictably as a result of fire, grazing and other agricultural practices.

While an explanation is available for why kites start breeding before prey is most abundant, it is less clear what stimulates breeding proximately. Most birds breed at the same time each year, and the onset of breeding is triggered by changing environmental factors such as day length and rainfall. Variation in kite breeding seasons indicates that such proximate stimuli could not trigger breeding. The close link between breeding and food supply suggests that some feature of food itself may stimulate breeding. Four such aspects of food may be considered.

Firstly, kites may start breeding whenever prey abundance, and consequently body condition, are above a certain threshold. A good food supply is certainly required during the early stages of breeding for males to feed their mates and for females to form eggs (Perrins 1970). (A clutch of kite eggs may weigh 20-40% of the female weight). However, data from Settlers do not suggest that a good food supply stimulated breeding since the correlation between food supply and proportion of pairs copulating was weak and few pairs started breeding when prey densities were highest (Figs 3a and 3b).

Secondly, kites could respond to increasing food supply, gonad activity being stimulated by improving body condition. This idea assumes some mechanism in kites which measures changing body condition. Environmental conditions during a period of rodent population growth are evidently favourable for rodent survival. It is therefore least likely that prey densities would decrease, and more probable that either increases or similar population densities would be sustained for a while. The few data available do not support this second idea. Increases in food supply from one month to the next occurred during nine months at Settlers (Fig. 3b). In four of these months fewer than half of the pairs were starting to breed.

Thirdly, the proportion of juvenile rodents caught could be used as a predictor of greater food availability in the near future. While there is good agreement between the onset of breeding and the appearance of juvenile rodents (Figs 3a & 3c), other data do not suggest that more juveniles were caught in the first month of breeding than at other times (Table 1). There is also the problem of how kites would distinguish young of large rodent species from adults of small species.

Finally, breeding may be stimulated by gonadal activity in the rodent prey. The presence of reproductive steroids in rodents could trigger hormonal activity in kites. Similar suggestions are made for rodents and fleas - plant oestrogens probably stimulate the production of reproductive hormones in rodents, and mammalian reproductive hormones stimulate breeding activity in fleas (Bodenheimer & Sulman 1946, Reynolds 1960, Rothschild *et al.* 1970, Field 1975, Taylor & Green 1976). A threshold response, based on numbers of breeding rodents, might provide an efficient index of future prey abundance. Consumption of a great number of breeding rodents would result in a high concentration of ingested reproductive hormones and predict a high rodent density in the near future. Conversely, smaller densities would be forecast by lower numbers of breeding rodents.

This hypothesis would be easy to test in the field or the laboratory. Data in Figs 3c and 3d provide some support for it by suggesting that great numbers of rodents in breeding condition were present in August-September 1977, February-April and September 1978. Except for February 1978, most kite breeding started in these months. A poor food supply may have prevented kites from starting to breed in February 1978.

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Dr J. Mendelsohn, Durban Museum, P.O. Box 4085, DURBAN 4000, South Africa.