DISSERTATION ABSTRACTS

A STUDY OF THE BLACK-SHOULDERED KITE *Elanus caeruleus*

Colour-marked Black-shouldered Kites (*Elanus caeruleus*) were studied during 1977-1978 in a 6900 ha area near Settlers (24° 572S; 28° 33E) in the Springbok Flats, South Africa. Most of the annual rainfall of 601 mm fell during the summer months. About 75% of the area was cultivated. Results from ringing and moult studies during 1970-1976 in a wider area of the Transvaal Province were incorporated into the present work.

The study aimed to describe the basic biology of kites and to investigate the role of food supply in their behaviour and breeding. About 97% (n = 3408) of prey found in pellets were small mammals (Mendelsohn, J.M. 1982. *African J. Zool.* 17:197-210). Three rodents, *Otomys angoniensis, Rhadbomys pumilio* and *Praomys natalensis*, formed about 92% of the weight of the kites' prey. Regular trapping suggested that rodent densities changed substantially during the study. Measures of the food intake of kites showed changes that closely matched variation in rodent numbers (Mendelsohn, J.M. 1982. *Durban Mus. Novitates* 13:75-116).

The birds usually caught 1-3 prey items each day by hovering and perch-hunting. The proportions of hovering (about 30%), perch-hunting (70%) and the duration of hunting each day varied greatly. Non-breeders probably hunted for average periods of about 2 h each day while breeding males hunted for about 4 h. The 2 hunting methods differed in several ways; when hovering, prey was caught more rapidly than when perch-hunting, but hovering was energetically more expensive. Hovering was probably used to obtain prey as rapidly as possible, while perch-hunting helped minimize energy costs. It would be important to economize on daily energy expense since the unpredictability of prey capture means that excessive energy spent in hunting could not be replaced with certainty.

Individual kites showed a high degree of variability in their social behaviour and dispersion (Mendelsohn, J.M. 1983. *Ostrich* 54:1-18). Residents were unpaired, paired or breeding birds; unpaired kites experienced the poorest, and breeders the best, feeding conditions. Males usually established territories and remained resident as long as food supply allowed. Territories with good feeding conditions were at a premium and nomadic males probably spent long periods searching for suitable vacancies. Females seldom occupied territories alone but usually settled with territorial males. Most females settled to pair with males when most pairs were starting to breed. Females also deserted territories more readily than males and moved around probably in search of those males with territories holding the best breeding prospects. There were always more males than females in the study area and this could have allowed females to change territories often.

Many males and females were resident for short periods and, as a result, the average monthly turnover of residents was about 26%. These short-term residents and records of great concentrations of kites suggest that kites are often eruptive and nomadic, particularly when rodent densities vary erratically. Information concerning changes in food supply is probably exchanged at communal roosts; kites roosted communally when feeding conditions were poor. Such itinerant behaviour contrasts with the site-tenacity of some individuals that remained resident for most or all of the census period.

Residents bred repeatedly and opportunistically at any time of the year. Some males made up to 7 breeding attempts in 19 months but most failed, particularly at early stages of the cycle. The average duration of breeding was: pre-laying (24 d), incubation (31 d), nestling period (35 d) and post-nestling period (82 d). Most adult females deserted soon after the young left the nest and probably searched for unpaired males to attempt breeding again. The flying young were fed by adult males for the remaining part of the post-nestling period. For males, each successful breeding cycle lasted on average 172 d. Some males started breeding again immediately after the young became independent, and thereby breeding twice in one year. Females, with a shorter participation in each breeding cycle, could breed three times each year.

Breeding females seldom hunted. Males supplied them and the young with food. Many breeding attempts failed, probably because of frequent food shortages. Females accumulated energy reserves during the pre-laying period which helped them produce eggs and probably withstand food shortages later in the cycle. Other adaptations to future feeding conditions are indicated. Kites might stop breeding if poor feeding conditions early in the cycle indicate that greater food demands are unlikely to be met later during the nestling period. They may also time breeding on the basis of the amount of breeding activity in their rodent prey, again as an indication of expected food availability (Mendelsohn, J.M., In press. *Proc. 5th Pan-African Ornith. Congr.*).

It is suggested that breeding females do not hunt and remain largely inactive at the nest so that they can conserve energy reserves. Further, the fact that females are larger than males enables them to store proportionately greater reserves. Males probably do not store energy because the increased weight of reserves would hinder their flying ability in catching prey.

Residents in the study area defended territories (feeding and breeding) against all conspecific intruders. Tail wagging was probably an aggressive display to warn other kites away. The most violent conflicts, sometimes involving physical contact, were between neighbouring residents; intruding nomads were repulsed more readily.

Kites showed several responses to excessive heat and cold. They usually perched in the shade of trees during the hot, midday period, or soared sporadically if they were hunting. Most nests were built in the SW sectors of trees where incubating females and nestlings were protected from direct sun. In the early morning kites usually perched low above the ground where they were less exposed to cold wind. Similarly, they roosted within the foliage of trees during winter, where they were more protected from cold wind than on perches on the outermost branches of trees, their roost sites at other times.

Most kites moulted during summer and this seasonality contrasted with the variable timing of their breeding. Primary feathers moulted in a single sequence from the inner wing outwards, but sequences in the secondaries and rectrices were variable, as in many raptors.

Several size differences were found between males and females and between adults and 2 age groups of subadults. Changes in the weights of subadults during the year, and probably in those of adults, corresponded to changes in food supply. Males that remained resident for long periods were probably morphologically more 'typical' than short-term residents. The physical features of males may therefore in part determine their ability to catch prey and consequently to pair and breed successfully. The performance of females, however, may depend more on their ability to choose mates and territories which will provide the best feeding conditions.

In conclusion, I suggest that unpredicted fluctuations in feeding conditions play a central role in the biology of kites. Such fluctuations occur at 2 levels, one on an hourly or daily basis and the other on a weekly or monthly scale. The capture of large and irregularly spaced prey is an unpredictable event and several aspects of hunting behaviour and daily activity are geared to meeting the general requirement of obtaining prey as rapidly and at the least possible energy expense.

Many social, spatial and breeding strategies are probably adaptations to feeding conditions that fluctuate over longer periods. While kites often survive and occasionally breed in situations of moderate food supply, the 'slumps' and 'gluts' in prey numbers are the periods when selection is most severe. It is then that kites will either manage to survive or will so capitalize on a superabundant food supply that they leave great numbers of offspring. **Mendelsohn, J.M. 1981. Ph.D. Dissertation. University of Natal, Pietermaritzburg, South Africa. 285 pp.**

UNIFORMITY IN RELATIVE HABITAT SELECTION BY *Buteo lineatus* AND *B. platypterus* IN TWO TEMPERATE FOREST REGIONS

I have examined nest site habitat use and selection by 2 woodland hawk species, *Buteo platypterus* (Broad-winged Hawk, BWH), and *B. lineatus* (Red-shouldered Hawk, RSH). The hypothesis tested was that species select similar nesting habitat in dissimilar regions after accounting for differences in habitat availability.

Study sites were located in northeast Wisconsin (WI) and in western Maryland (MD). Twenty-seven characteristics were measured at active nest sites from 1978 through 1982. Also, random samples were collected to estimate habitat availability. Sample sizes were: 87 MD BWH, 34 WI BWH, 30 MD RSH, 22 WI RSH, 100 MD random, and 73 WI random. The two regions differed in structural features of the available habitat, and both species selected only portions of the available habitat within each region. Also, habitat use by BWH and RSH differed between regions.

To determine whether relative habitat selection differed between regions for each hawk species, I adjusted for regional differences using a series of 'Z' score rescalings of the availability data. Study area differences were eliminated by these transformations. The resultant data vectors were then applied to the specific hawk data sets for tests of habitat selection uniformity. Relative habitat selection was uniform between regions. For the BWH, only 2 of 18 rescaled variables were different between regions. Three of 18 rescaled variables were different between regions for RSH.

I contend that these two species have uniform patterns of habitat selection. Differences in habitat use between regions may merely reflect habitat availability related to differences in scale between regions. **Titus, Kimberly. 1984. Ph.D. Dissertation, Univ. of Maryland, Cantonsville. Dissertation directed by James A. Mosher, Appalachian Environmental Laboratory.**