for how long they have been present. All 15 kittens of the tame (black) cat had tabby markings. The colour of the male parents was not known. On Marion Island 69 per cent of sightings (n = 192) of feral cats were of black or mainly black animals; four black and one tabby cat comprised the original introduction (Anderson & Condy 1974).

No information is available on the number of cats on Dassen Island. It is thought that their impact on the bird population is small, due to the presence of feral rabbits.

ACKNOWLEDGEMENTS

I acknowledge financial and other support received from the Sea Fisheries Branch, the South African Nature Foundation and the South African National Foundation for the Conservation of Coastal Birds.

REFERENCES

ANDERSON, G. D. & CONDY, P. R. 1974. A note on the feral house cat and house mouse on Marion Island. *S. Afr. J. Antarctic Res.* 4: 58–61.

COOPER, J. 1974. The predators of the jackass penguin *Spheniscus demersus*. *Bull. Br. Orn. Club*, 94: 21–24.

FOOD CONSUMPTION AND PELLET PRODUCTION IN THE BLACK-SHOULDERED KITE, ELANUS CAERULEUS

W. R. TARBOTON
Nature Conservation Divison,
Transvaal Provincial Administration

Accepted: June, 1976.

METHODS

A male and a female captive, hand-reared, black-shouldered kite, 15 months old and from the same brood were provided with known weights of live food during two periods in 1975. The birds were jessed and tethered outside during the day and put indoors at night. The amount of food given daily was regulated to maintain the birds at constant (morning) weight. Their pellets were collected and weighed wet, then air-dried to constant weight.

For purposes of comparison a pair of wild nesting kites was watched continuously from sunrise to sunset on 1 October 1975.

RESULTS

The data are summarized in Table 1.

During 1–31 July 1975 the female was fed domestic mice, *Mus musculus*, exclusively and she consumed up to three a day. The bird's evening weight was, on average, 9,4 per cent greater than its morning weight. The evening weight was more variable than the morning weight and was on one occasion 19,2 per cent higher than the latter after a large, late meal. The bird had a mean daily food intake of 41,4 g which was 19,0 per cent of its mean (morning) weight. (The intestines of some mice were discarded by the kite, but this weight loss has been ignored.)

In August both male and female were fed day-old poultry chicks. There was a significant ($p < 0{,}001$ by students t test) difference in weight between the birds, the female being 12,6 per cent heavier than the male. Both had similar daily food intake/body weight ratios which were,

TABLE 1

Morning and evening weights, percentage weight difference and percentage daily food consumption of captive black-shouldered kites.

All weights in grams, $\bar{x}$ = mean, SE = standard error.

	female (July 1975)	*female* (August 1975)	*male* (August 1975)
Food	mice	chicks	chicks
Number of days	31	28	15
Morning weight $\bar{x}$	218	223	198
SE	0,8	1,4	1,8
Evening weight $\bar{x}$	238	240	214
SE	1,4	2,1	2,3
% weight difference $\bar{x}$	9,4	8,8	10,6
SE	0,65	1,33	1,07
Gross daily food weight $\bar{x}$	41,4	43,2	37,9
SE	2,34	3,14	3,10
Daily consumption, percentage of morning weight	19,0	19,4	19,1

respectively, 19,4 and 19,1 per cent. There was no significant difference in the daily weight variation between the two birds.

Both birds consistently produced one pellet/day (n = 74), irrespective of the size or time of the previous day's meal and the number of food objects taken. Pellets were cast in the early morning, usually between 06h00 and 08h00. A nylon tracer was attached to the skull of a mouse fed to the female one day at 17h30 and it reappeared in the following morning's pellet. Pellets produced when the birds were fed chicks were small (< 0,2 g, air-dried constant weight), but those produced on a diet of mice were larger and heavier ($\bar{x}$ = 0,95 g; SE = 0,07; n = 21). In the latter case dry pellet weight correlated (r = 0,70) with the gross (wet) weight of the previous day's meal and this provides an index to the amount consumed by a bird. The regression is shown in Figure 1.

A sample of pellets cast by wild black-shouldered kites was collected in central Transvaal and had a mean dry weight of 1,56 g (SE = 0,05; n = 260). Skeletal fragments in them were analysed, and small mammals, principally the striped field-mouse, *Rhabdomys pumilio* (42,5 per cent) and the vlei rat, *Otomys angoniensis* (29,1 per cent), were found to make up 99,6 per cent of the 261 recorded prey objects present. By applying the dry pellet weight/daily food intake regression derived for captive kites, a daily food intake of 61 g is indicated for wild kites. Mendelsohn *et al* (in press) found that wild black-shouldered kites in central Transvaal had a mean weight of 243 g (n = 232) and a 61 g daily food intake is thus 25 per cent of their body weight. This is equivalent to about two *Rhabdomys*-sized rodents/day (using weights in Dean 1973).

This was tested by watching a pair of nesting black-shouldered kites continuously for one day. The female made no effort to secure food for herself and was fed six times by the male. All six food items were small rodents (which could have been *Rhabdomys*) and at least three, and possibly all, had been partly eaten by the male first. He was lost to view for periods during the watch so it could not be ascertained whether he consumed additional food which was not shared with his mate. The observations show, however, that the pair of kites consumed between them at least six small rodents in a day.

DISCUSSION

Siegfried (1965) recorded 82 out of 97 food objects in the diet of the kites he studied to be *Rhabdomys pumilio*, and the present findings confirm that black-shouldered kites prey primarily on small diurnal rodents. The observed consumption by a nesting female during one day was probably greater than the estimated daily food requirement, but other factors such as her weight and the availability of prey could have affected her consumption.

Several assumptions have been made in extrapolating the data from the captive to wild kites, namely: wild kites cast one pellet/day and this represents their previous day's meal; the pellet weight/daily food intake of wild birds

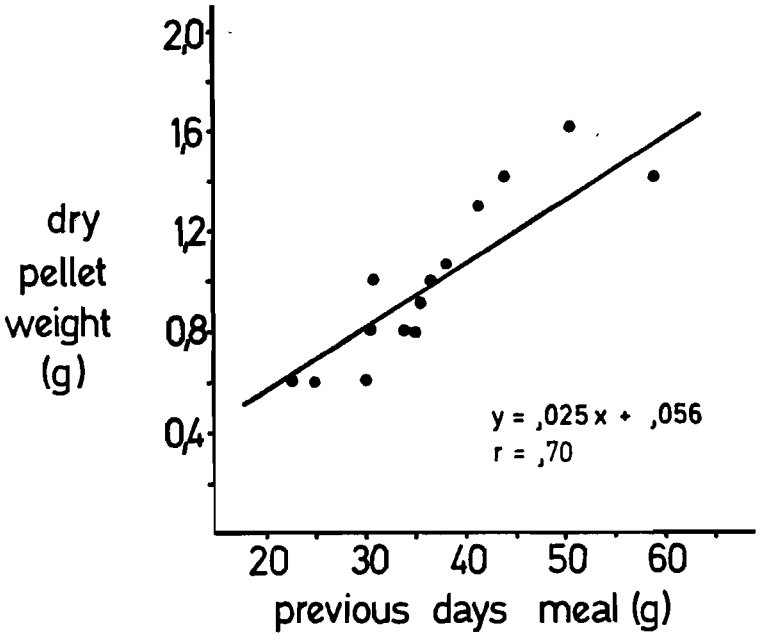

FIGURE 1

Relationship between the previous day's meal size and the dry pellet weight in a captive black-shouldered kite fed on mice.

does not differ from captive birds; the sample of pellets collected from wild kites was representative.

Some of the present findings on captive black-shouldered kites are comparable with the findings of Duke *et al.* (1976) in a feeding study which they made on seven North American species of Falconiformes. In both cases pellet dry weight correlated with the weight of the previous day's meal; pellets were cast at dawn and one pellet/day was cast.

The difference in the daily food intake in captive versus wild kites is most likely attributable to differences in their respective thermal environments and (more important) their daily activity budgets. In the latter respect wild kites search for and secure some of their prey by hovering (Brown & Amadon 1968; pers. obs.). However, the proportion of time that is spent flying and hovering and the energy cost in so doing is unknown.

ACKNOWLEDGEMENTS

The Transvaal Nature Conservation Division gave permission to publish this note and Professor W. R. Siegfried critically read an earlier draft.

REFERENCES

BROWN, L. H. & AMADON, D. 1968. *Eagles, hawks and falcons of the world*, vol. 1. Feltham: Country Life Books.

DEAN, W. R. J. 1973. Analysis of a collection of barn owl *Tyto alba* pellets from Warmbaths, Transvaal. *Zool. afr.* 8: 75–81.

DUKE, G. E., EVANSON, O. A. & JEGERS, A. 1976. Meal to pellet interval in 14 species of captive raptors. *Comp. Biochem. Physiol.* 53A: 1–6.

MENDELSOHN, J. M., BIGGS, H. C. & LEDGER, J. A. In press. The biology of the black-shouldered kite. Part 1. Weight, moult and age classes, breeding season, movements and parasites. *Ostrich.*

SIEGFRIED, W. R. 1965. On the food of the black-shouldered kite. *Ostrich*, 36: 224.

NOTE ON VARIABLE INCUBATION PERIOD WITHIN A CLUTCH OF EGGS OF THE LEOPARD TORTOISE (GEOCHELONE PARDALIS) (CHELONIA: CRYPTODIRA: TESTUDINIDAE)

B. L. CAIRNCROSS* AND J. C. GREIG†

Accepted: November 1976

Jayakar & Spurway (1964) reported on a case of apparent bimodality in laying-hatching time in *Geochelone* (*Geochelone*) *elegans*, the Indian starred tortoise. Two peaks of hatching within a clutch of seven eggs were noted, one after *c.* 50 days and one after *c.* 130 days. The suggestion was made that, as all eggs were kept under identical conditions, and as a distinct tendency towards bimodality was observed in the incubation period, the mechanism of delay is not simply determined by environmental factors, but is also influenced genetically.

A similar case was reported for *Geochelone* (*Geochelone*) *sulcata* in the Sudan by Cloudsley-Thompson (1970) where one egg out of a clutch of 17 hatched on 16 June 1966 after incubating for 212 days. As no more hatched, two of the remaining eggs were opened on 6 August for inspection; one of these was dead but the other contained a living embryo of length 37 mm (cf. hatchling length of 45 mm). No further eggs hatched, but on the evidence afforded by this observation, Cloudsley-Thompson suggested that the hatching period within a single batch of eggs may extend over several months in *G. sulcata*.

One of us (B.L.C.) has kept many tortoises of several South African species in captivity since 1930, one of these being *Geochelone* (*Geochelone*) *pardalis*, which is widely distributed from the Cape to the Sudan. It is a close relative of *G. sulcata* and *G. elegans*, and shares with these other members of the same subgenus, both large size and the capacity to lay large clutches of eggs. Various attempts were made to hatch eggs of this species in an incubator (Cairncross 1946) but the great majority were infertile. However, a clutch of 12 eggs laid in Pretoria, South Africa, by a specimen of *G. pardalis* originating from the farm "Waterkloof" near Aberdeen (map reference: 3224AC Aberdeen: 32° 18′S/24° 06′E) included two fertile eggs. The clutch was laid on 19 December 1945 and the nest was marked and watched. On 30 March 1947 a small hole was observed above the nest after rain, and a newly hatched, active, mud-covered tortoise was found about 3 m away. The site was watched for further activity until 27 April, but as no further hatchings occurred, the nest was opened and the eggs were removed. A broken empty shell was found, as expected, together with the remaining 11 whole eggs. The eggs were opened, and although ten had putrefied, the 11th contained a living embryo *c.* 6 mm long (cf. hatchling length of 50 mm.)

In sea turtles nesting in south-east Africa the hatching of individuals within a single clutch of eggs is normally synchronized within a

*"Glenderg", Box 188, George 6530.
†Department of Nature and Environmental Conservation, Private Bag 5014, Stellenbosch 7600.