

BREEDING BIOLOGY OF THE INDIAN RING DOVE IN THE RAJASTHAN DESERT

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THE Indian Ring Dove, *Streptopelia decaocto*, is one of the common columbid birds of the Rajasthan Desert. Its preferred habitat is tracts where such trees as *Prosopis cineraria*, *Acacia tortilis*, *A. senegal*, and *Albizzia lebbek* grow in appreciable numbers. Its other preferred nesting site is in the hedges of *Ingadelsis*. It also dwells near human habitations. Although species of *Streptopelia* are widely distributed in the Indian subcontinent, little work has been done on this genus. Except for Misra's (1960-61) observations on the reproductive cycles in the Red Turtle Dove, *S. tranquebarica*, and in the Little Brown Dove, *S. senegalensis*, at Banaras, East India, almost no information is available in India on any aspect of breeding in *S. decaocto*. This paper deals with the breeding behavior, male fecundity, female fertility, seasonal reproductivity, sex ratio, and body weights of the ring dove.

This study was carried out at Central Research Farm, Central Arid Zone Research Institute, Jodhpur. Grasses abundant on the sandy plain at the farm are: *Eleusine compressa*, *Cenchrus biflorus*, *C. ciliaris*, *C. setigerus*, *Panicum antidotale*, *P. turgidum*, *Brachiaria ramosa*, and *Dichanthium annulatum*. The herbs are represented by *Tephrosia purpurea*, *Heliotropium strigosum*, *Boerhavia diffusa*, *Indigofera cordifolia*, and *Crotalaria burhia*. The dominant shrubs are *Zizyphus nummularia* and *Capparis decidua* and among the trees are *Prosopis cineraria*, *Acacia tortilis*, *A. senegal*, *Azadirachta indica*, and *Albizzia lebbek*. Crops of millet and pulses are also grown at the Central Research Farm.

MATERIAL AND METHODS

At Jodhpur 200 ring doves were shot from August 1969 to July 1970. Soon after collection the doves were weighed, dissected, and sexed. The gonads were extracted and preserved in 10% formaldehyde. The measurement of testes and three largest developing oocytes from the left ovary were recorded in situ. The preserved testes and ovary were weighed to 0.001 g in a semimicro Mettler balance and smears from epididymis or from vas deferens were examined for the occurrence of sperms. Field observations on the nests, number of eggs and period of egg-laying, hatching period, breeding success, and growth of nestling were also recorded.

RESULTS

Male fecundity.—In the present study, observations on reproduction aspects of male ring doves were limited to the examination of smears of vas deferens and epididymis and measurements of testes. The adult

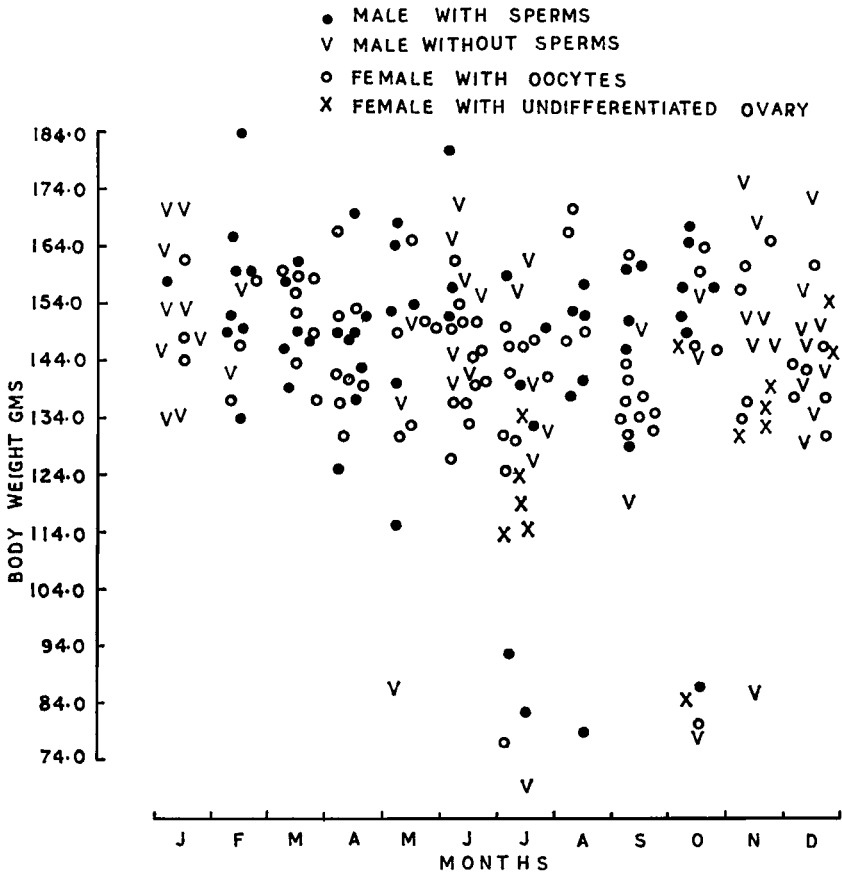


Fig. 1. Gross body weight of doves, *Streptopelia decaocto*, through 1969-70.

male doves were found to be fecund from February to October as evidenced by the presence of sperms in the smears of epididymis and vas deferens (Fig. 1). Two peaks are evident in the frequency of fecund adult male doves, March-April and August-September. It also appears that production of sperms ceases from November to January (winter season).

Male ring doves attain sexual maturity when they are about 130 g in body weight, but during the monsoon a few young doves weighing 80 to 95 g also had sperms in the smears (Fig. 1).

The right testes of ring doves were found to be significantly heavier than the left during breeding season (at 1% level of probability) and during nonbreeding season at 5% level of probability. But it is worth

TABLE 1
MEAN MONTHLY WEIGHT AND LENGTH OF RIGHT AND LEFT TESTES OF RING DOVE

	Weight (g)		Length (mm)	
	Right \pm SE	Left \pm SE	Right \pm SE	Left \pm SE
January	0.0218 \pm 0.003	0.0162 \pm 0.003	6.41 \pm 0.53	6.39 \pm 0.73
February	0.1943 \pm 0.05	0.1553 \pm 0.02	11.10 \pm 0.96	12.45 \pm 0.83
March	0.3499 \pm 0.04	0.3053 \pm 0.03	14.50 \pm 0.45	15.75 \pm 0.50
April	0.6345 \pm 0.03	0.4716 \pm 0.07	15.66 \pm 0.44	18.41 \pm 1.83
May	0.6281 \pm 0.06	0.5282 \pm 0.05	17.61 \pm 0.50	19.60 \pm 0.90
June	0.0653 \pm 0.02	0.0572 \pm 0.02	8.50 \pm 0.66	8.75 \pm 0.96
July	0.5679 \pm 0.10	0.4868 \pm 0.06	16.41 \pm 0.83	18.08 \pm 1.20
August	0.4713 \pm 0.09	0.4244 \pm 0.09	14.30 \pm 1.18	17.20 \pm 1.40
September	0.5997 \pm 0.06	0.5593 \pm 0.05	17.00 \pm 0.41	19.20 \pm 1.37
October	0.1704 \pm 0.06	0.1600 \pm 0.06	10.91 \pm 1.04	12.91 \pm 1.50
November	0.0880 \pm 0.07	0.0817 \pm 0.06	8.33 \pm 1.00	9.50 \pm 1.66
December	0.0226 \pm 0.04	0.0209 \pm 0.04	6.75 \pm 0.58	7.25 \pm 0.70

noting that left testes were found to be significantly ($P < 0.05$) larger than the right testes throughout the year (Table 1), as has been observed in House Swift, *Apus affinis* (Naik and Naik 1965). The mean paired weight of testes differed significantly ($P < 0.01$) from month to month.

The mean monthly testis weight also shows two peaks corresponding to frequency of ovulation (Fig. 2).

Female fertility.—The follicular size varied significantly ($P < 0.05$) from month to month. The mean monthly maximum diameter of the follicles varies considerably during the year. The main peak occurs in May and the second peak in July and September. Similar trends are also revealed when the follicular size of all the female doves collected during a year are grouped in seven classes at 1.5-mm intervals (Table 2).

The ovary weight and length of oviduct also run parallel to the follicular size and the testes weights (Fig. 3).

BREEDING BEHAVIOR

Nest site.—Ring doves prefer to build their nests on trees like *Prosopis cineraria*, *Acacia tortilis*, and *A. senegal*, and in the hedges of *Inga delsis* species. The simple flat nest is usually situated at a height of 1.5 to 2.7 m on the branches, similar to the nest height of the Turtle Dove, *Streptopelia turtur*, in England. The nest of *S. decaocto* is usually in the middle of the tree where the tree's top branches conceal it. The selection of almost similar nest heights by *S. turtur* in England and by *S. decaocto* in India probably indicates parallel evolutionary trends in these two species.

Nest composition.—Most doves lay eggs in freshly built nests but some birds renovate the old ones. The male ring dove plays an im-

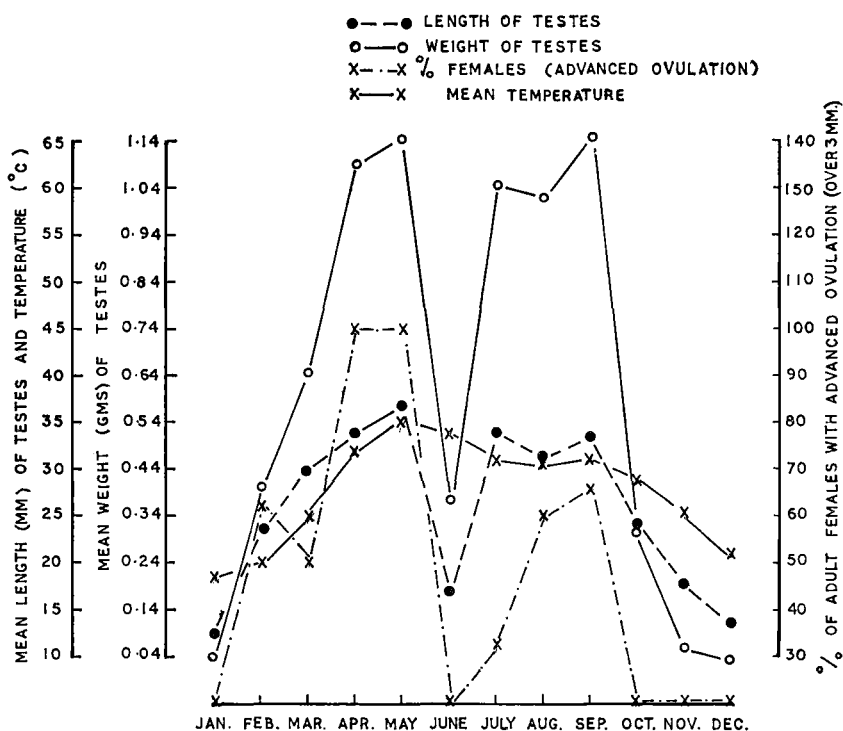


Fig. 2. Mean monthly testes weight, length, temperature, and percent adult female ovulated doves.

portant role in collecting the nest building materials, like twigs mainly of *Zizyphus nummularia*, *Leptadenia pyrotechnica*, *Tephrosia purpurea*, and *Calotropis procera*. Thin grasses like *Eleusine compressa*, and *Aristida* sp., wool of sheep, and sometimes its own feathers are used

TABLE 2
 MONTHLY DISTRIBUTION OF FOLLICULAR SIZE OF RING DOVE AS PERCENT MONTHLY COLLECTION

Size class (mm)	Months of Year											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Undifferentiated	—	—	—	—	—	—	26.6	—	—	28.6	55.5	25.0
0 to 1.5	100	33.3	—	—	—	23.0	6.7	—	12.5	14.2	22.2	62.5
1.6 to 3.0	—	—	57.1	12.5	—	77.0	33.3	40.0	25.0	57.1	22.2	12.5
3.1 to 4.5	—	66.6	42.8	75.0	60.0	—	20.0	60.0	50.0	—	—	—
4.6 to 6.0	—	—	—	12.5	—	—	6.7	—	—	—	—	—
6.1 to 7.5	—	—	—	—	20.0	—	—	—	12.5	—	—	—
7.6 to 9.0	—	—	—	—	20.0	—	—	—	—	—	—	—
9.1 to 10.5	—	—	—	—	—	—	6.7	—	—	—	—	—

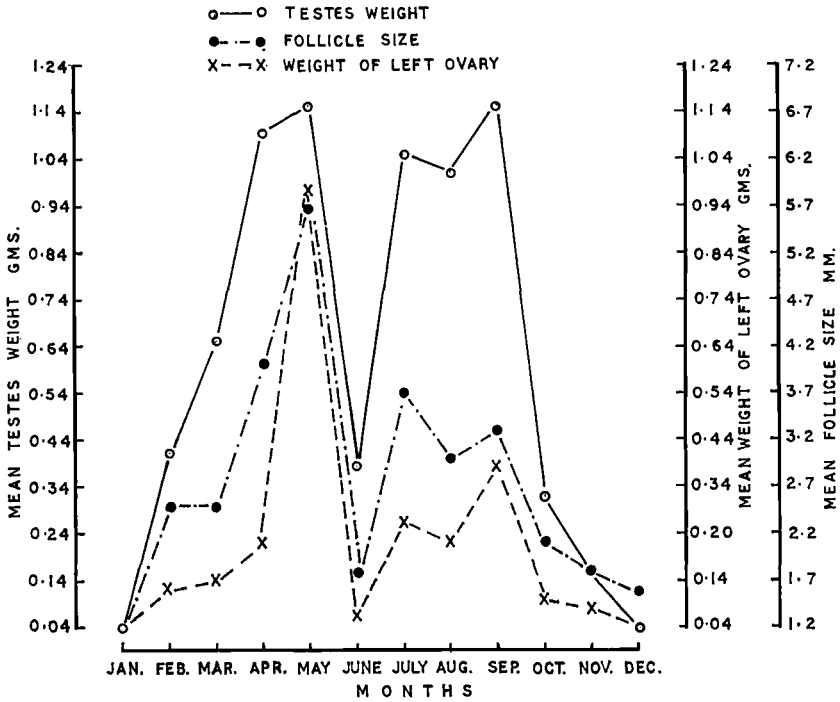


Fig. 3. Seasonal variations in the mean testes weight, follicle size, and weight of ovary of ring dove.

for lining the nests. Sheep wool was found only in one out of about 54 nests examined. This particular nest was very near an experimental sheep pen. Although doves were not actually seen taking the wool, the neat arrangement of the wool fibers in a cluster under the eggs clearly indicated that the birds used the wool as nesting material.

TABLE 3
SEASONAL DISTRIBUTION OF CLUTCH SIZE IN RING DOVE

Months	Clutch size			Total number of clutch	Percentage of eggs	Average number of eggs per clutch
	1	2	3			
April	2	11	—	13	22.0	1.84
May	2	3	—	5	7.3	1.60
July	1	2	—	3	4.5	1.66
August	3	12	—	15	24.7	1.80
September	2	17	2	21	38.5	2.00
October	1	1	—	2	2.7	1.50
Total	11	46	2	59	99.7	—
% of clutch size	18.7	78.0	3.3	—	—	—

Clutch period.—The first ring dove egg was found on 4 April 1970. The monthly clutch distribution shows the ring dove has two distinct breeding peaks, i.e. one in April (22.0%) and the second in August (24.7%) and September (38.5%) (Table 3).

The egg.—Egg weights varied from 5.9 to 8.6 g (average 7.5 ± 0.25 g). The mean length and breadth were 26.82 ± 0.40 mm and 20.75 ± 0.38 mm. The eggs laid in spring were significantly ($P < 0.01$) smaller than those laid in the monsoon period.

Clutch size.—The clutch size varied from 1 to 3 (average 1.84). The frequency of two eggs per clutch is 78.0% (Table 3), whereas only two clutches of three eggs were recorded in September.

Incubation and nestling period.—The incubation periods during spring and monsoon seasons differed significantly ($P < 0.01$) from each other. The spring period ranged from 18–19 days (mean, 18.5 ± 0.15); the monsoon period ranged from 10–17 days (13.3 ± 0.57).

Female doves feed their nestlings until they leave the nest. The spring nestling period varies from 14–18 days (16.0 ± 0.90); the monsoon nestling period ranged from 12–17 days (14.0 ± 0.43). These differences were not significant.

Breeding success.—Of 32 eggs laid during spring only 31.2% hatched and a low percentage of nestlings fledged, 15.6% of total eggs laid (Table 4). The nesting success during the monsoon period was higher. Of 77 eggs laid, 44% hatched and a comparatively large number (39.0%) fledged. The nestling success between the two breeding periods was not significantly different ($\chi^2 (1) = 3.15, \chi^2 (1) < 0.05 = 3.84$).

Care and feeding of nestlings.—In the early morning hours during the first few days the females brood the young. Parents feed the young with crop milk. Thereafter they feed young mainly upon Bajra, *Tephrosia purpurea*, *Brachiaria ramosa*, *Citrullus vulgaris*, Til, seeds of *Heliotropium strigosum*, and termites, as revealed by the examination of crops of five nestlings.

Egg predation.—The House Crow, *Corvus splendens*, and the Indian Roller, *Coracias benghalensis*, usually feed on ring dove eggs. Predatory birds destroyed about 68.7% of the eggs during spring and 55.8% during the monsoon (Table 4). Only three eggs out of 109 were infertile. These losses amount to 61.4% of the total eggs laid. After hatching 8.2% of the nestlings were lost to predatory birds.

SEX RATIO

The sex ratio in monthly collections and on an overall yearly basis did not deviate significantly from the normal 50:50 hypothetical figures.

TABLE 4
BREEDING SUCCESS OF RING DOVE DURING BREEDING SEASONS

Seasons	No. of eggs laid	% of eggs hatched	% of eggs destroyed	% of nestlings destroyed	% fledged
Summer	32	31.2 (n = 10) ¹	68.7 (n = 22)	15.6 (n = 5)	15.6 (n = 5)
Monsoon	77	44.1 (n = 34)	55.8 (n = 43)	5.5 (n = 4)	39.0 (n = 30)

¹ Figures in parentheses indicate the actual numbers.

Still females predominated in March, June, and September, and males in January, February, May, and October to December (Table 5). The yearly sample ratio of males to females was 1:0.86.

BODY WEIGHTS

The body weights of 107 male and 93 female doves varied from 146 to 156 g in male doves and from 138 to 154 g in females (Fig. 1). Apparently female doves acquire sexual maturity when they reach 130 g body weight. This is further borne out by the fact that the lightest female carrying eggs in the uterus weighed 150 g.

Most male doves also attain sexual maturity when their body weight reaches 130 g, but smears of a few doves weighing 80–95 g showed sperms. Laboratory-reared young reach 130 g body weight when they are about 2 months old. This suggests that young fledged in the spring breeding season may breed in the following monsoon period. Statistical

TABLE 5
MONTHLY VARIATIONS IN THE SEX RATIO OF RING DOVE

Month	Male	Female	% of male
January	11	3	78.5
February	10	3	76.9
March	6	8	42.8
April	8	8	50.0
May	10	5	66.6
June	10	13	43.4
July	10	10	50.0
August	5	5	50.0
September	7	9	43.7
October	10	5	66.6
November	6	5	54.5
December	8	6	57.4
Total	107	93	53.5

TABLE 6
MEAN MONTHLY BODY WEIGHTS (G) OF ADULT MALE AND FEMALE DOVES
DURING EACH MONTH

	Male \pm SE	Female \pm SE
January	150.98 \pm 4.48	150.66 \pm 4.00
February	155.15 \pm 4.51	147.36 \pm 6.29
March	150.40 \pm 3.08	151.80 \pm 2.85
April	149.68 \pm 4.19	145.20 \pm 4.07
May	154.64 \pm 3.36	142.70 \pm 4.45
June	156.42 \pm 3.90	145.43 \pm 2.64
July	146.36 \pm 4.42	142.15 \pm 2.94
August	149.50 \pm 3.09	153.20 \pm 6.62
September	151.08 \pm 3.54	138.61 \pm 3.33
October	155.50 \pm 3.03	154.00 \pm 3.75
November	156.46 \pm 5.37	143.63 \pm 4.41
December	148.78 \pm 5.19	145.00 \pm 3.50

analysis revealed that male doves average significantly heavier than female doves (Table 6).

Seasonal variations.—Neither the mean monthly body weight of male nor of female doves was found to vary significantly from month to month. Body weights were lowest during July and September because of an influx of lighter adult doves in the collection for these months (Table 6). Thereafter they gained weight and reached the peak during postmonsoon and winter seasons, which may be due to accumulation of body fat as has been observed in the Wood Pigeon, *Columba palumbus* (Murton 1958).

Distribution of body weights in the sample.—The body weights of all doves are grouped in four classes arranged at 30 g intervals.

The subadult classes, 70 to 100 g and 101 to 130 g are distributed from April to December among male doves, whereas the female subadults were collected only during June, July, and October (Table 7). It is difficult to explain why female subadults should be fewer than males. The proportion of subadult doves collected during the earlier half of the year is lower than that in the latter half, probably because of the low egg-laying rate during the former period (Table 3). It may also indicate that nestling mortality during the first 6 months of the year is high because of poor vegetation condition, adverse climatic factors, and poor nourishing condition of mothers.

DISCUSSION

The ring doves' breeding season lasts from March to October, as evidenced by the presence of sperms in male birds, seasonal fluctuations in testis weight, rate of ovulation, and actual egg-laying. Two distinct peaks are evident in the birds' egg-laying activities, the first peak in

TABLE 7
MONTHLY DISTRIBUTION OF WEIGHT CLASSES OF MALE AND FEMALE DOVES EXPRESSED
AS PERCENT OF MONTHLY COLLECTION

Weight of classes (g)	Months of year											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Males												
70 to 100	—	—	—	—	9.1	—	25.0	20.0	—	27.3	14.3	—
101 to 130	—	—	—	12.5	9.1	—	8.3	—	25.0	—	—	12.5
131 to 160	72.7	70.0	83.3	75.0	54.6	70.0	58.3	80.0	75.0	54.5	66.4	75.0
161 to 190	27.3	30.0	16.7	12.5	27.2	30.0	8.3	—	—	18.2	18.2	12.5
Females												
70 to 100	—	—	—	—	—	—	6.6	—	—	28.5	—	—
101 to 130	—	—	—	—	—	7.6	33.3	—	—	—	—	—
131 to 160	66.6	100.0	100.0	87.5	100.0	84.6	60.0	60.0	88.8	57.1	66.6	87.4
161 to 190	33.3	—	—	12.5	—	7.6	—	40.0	11.1	14.3	33.3	12.5

the spring and the other during the monsoon. During both seasons, green food is comparatively abundant in the desert, much more during the monsoon, when a significantly ($\chi^2 (1) = 22.9, P < 0.001$) higher rate of egg-laying is manifested. The hatching success and survival of young birds is also of a higher order, after the monsoon breeding peak. Such a dependence for the maintenance of maximum breeding response to green pastures has also been reported for the Wood Pigeon in London (Baker 1938, Lack 1950, Moreau 1950, Murton and Isaacson 1962, Murton et al. 1963, Lofts et al. 1966).

It is also interesting to find that the breeding season of some of the columbids lasts from March to October in many countries (Table 8), irrespective of the wide variation with respect to mean temperatures, latitude, and precipitation. The northwest Australian birds also start breeding in February (August of southern hemisphere) and the breeding activity exhibits two peaks during March–April (September–October of

TABLE 8
BREEDING SEASONS OF COLUMBIDAE FAMILY

Spp. of the bird	Locality	Breeding season	Authority
Ring dove	Jodhpur, Rajasthan	March to October	Present study
Stock dove	Oxford, London	March to October	Campbell 1951
"	British Trust for Ornithology, nest records	March to October	Robbins in litt.
"	Celles, Belgium	February to September	Delmee 1954
"	Sevendonk, Belgium	March to September	Paulussen 1953
Wood Pigeon	East Anglia, London	March to October	Murton 1958
"	Carlton and Cambs	May to October	Murton and Isaacson 1964

the southern hemisphere) and during August–September (February–March of southern hemisphere).

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SUMMARY

Ring doves were collected by shooting in every month during 1969–70 at the farm of Central Arid Zone Research Institute, Jodhpur in the Rajasthan Desert.

Male doves were found to be fecund from February to October. The fecundity in males was attained at 130 g body weight, but a few young doves weighing 80 to 95 g exhibit sperms in smears. The testes weights and percent fecundity of adult male doves were broadly parallel to those of the adult advanced ovulated female and frequency distribution of egg laying. The right testes of adult doves collected over the year were found to be heavier than the left in both breeding and nonbreeding seasons, the differences being significant at 1% and 5% level respectively. The average testes weights were also found to vary significantly ($P < 0.01$) from month to month.

Ring doves prefer to build their nests at a height of 1.5 to 2.7 m on trees like *Prosopis cineraria*, *Acacia tortilis*, *A. senegal*, and hedges of *Inga delsis* spp. The simple flat nest is usually made up of thin grasses and small tree twigs.

The egg weight ranged from 5.9 to 8.6 g (average 7.5 g). The clutch size varied from one to three (average 1.84). Of the total eggs laid 69.6% were destroyed by predatory birds. The eggs laid in monsoon season were significantly ($P < 0.01$) larger than those laid during spring period. The average incubation and nestling period were 15.9 and 15.0 days respectively.

The proportion of male and female doves collected over the year do not deviate significantly from the hypothetical 50:50 ratio.

The ring dove breeds from March to October as evidenced by seasonal fluctuations in testes weights, percent adult fecund males, rate of ovulation, and egg-laying. The two peaks in egg-laying correspond to the spring season and to the monsoon period when green forage is available.

The male doves were found to be significantly heavier than the females. Body weights of doves were lowest during July and September,

thereafter they gain body weights and reach a peak during postmonsoon and winter seasons.

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