

CHAPTER VII

SEASONAL CHANGES IN BODY WEIGHT, GONADAL WEIGHT AND
GONADAL HISTOLOGY IN THE FERAL BLUE ROCK PIGEON
COLUMBA LIVIA (G.)

Well defined cyclic variations in body weight are commonly encountered in many avian species (Farner and Follett, 1966). In many birds, winter weight is usually the highest followed by spring weight and that of autumn. An inverse correlation between monthly variations in temperature and body weight is rather a general concept e.g. in case of the Indian house swift, Apus affinis (Naik and Naik, 1966). Accumulated winter fat reserves (Mewaldt and King, 1977) is one of the reasons for an increase in the body weight during cold season provided that the availability of food supply is profuse. Recently, March and Sadlier (1975) have reported on the seasonal variations in body weight of the band tailed pigeon (Columba fasciata) of British Columbia. Haftorn (1976) has correlated the seasonal changes in body weight of the great tit (Parus major) with photoperiodism; the night length acting as proximate factor whereas the air temperature acts both as an ultimate and a modifying proximate factor. Nice (1946) had remarked that some species may gain weight in winter while others may not show any change.

Some other studies concernⁿg seasonal variations in the body weights include those on the white crowned sparrows Zonotrichia leucophrys (King and Farner, 1959), some wading birds (Minton, 1973), wood pigeons (Murton et al., 1974), white crowned sparrows in coastal California ^{Mewaldt and} (King, 1977) and oyster catchers, Haematopus ostralegus (Dare, 1977). Dare (1977) has correlated the fluctuations in body weights with annual cycle of moult, breeding and migration. Correlation between body weight and gonadal cycles in the case of the rain quail (Cortunix cortunix coromandelica) has been reported (Saxena and Thapliyal, 1977). An attempt has been made here to investigate possible correlates of changes in the body weight among the different seasons of the year and stages of the reproductive cycles.

There is extensive literature on the cyclic testicular histophysiology (Chapter II) and, to a very lesser extent, on the cyclic ovarian histophysiology (Lofts and Murton, 1973). This study was taken up to find extra evidences to substantiate earlier observation on the reproductive cycles in both the sexes and to throw some light on the histological features of ovarian compartments. In recent years many investigators have been trying to find the possible attributes of the suspected endocrine role of the postovulatory follicles

with the aid of histological (Pal Dhanonjoy, 1976); histophysiology^{at} (Chalana and Guraya, 1978) and biochemical techniques (Dick et al., 1978). In the Columbidae ovary, certain histochemical and morphological features of atretic follicles in different states have also been considered in this context (Guraya, 1976). The probability of endocrine nature of the post-ovulatory follicles and atretic follicles has been discussed (Chapter III).

MATERIAL AND METHODS

Feral blue rock pigeons (Columba livia G.) were shot down with an air rifle of .22 calibre in the University Campus. Birds were promptly brought to the laboratory. They were immediately weighed. Both the sexes were studied. Gonads were taken out, blotted and immediately weighed. Right and left testes were weighed separately in order to note the differences, if any. Right testis and a part of ovary were fixed in Bouin's fixative for monthly histological examinations. Later, gonads were processed through conventional series of dehydration and infiltration steps and paraffin blocks were prepared. 8-10 μ m thick sections were cut on a rotary microtome. Sections were stained with standard HE technique and finally mounted in DPX.

OBSERVATIONS AND DISCUSSION

Monthwise variations in body weight and gonadal weight are represented in Figs. 1 and 2 and tables I and II respectively.

BODY WEIGHT: As is clear from Fig. 1 and table I males, in general were found to be heavier than the females at any time of the year. The body weight of male birds varied from 280 to 340 gms. and that of the females from 240 to 280 gms. That the males are generally larger and heavier is in confirmity with the observations of Wexelsen (1937) who had commented that the pigeon cocks are usually larger than the hens. During field works, it is thus possible to identify sexes on the basis of size. Males can also be distinguished from the females by their overall larger appearance, broader neck and behavioural observations with fairly good precision. Individual variations and exceptions with regard to body weight were met with occasionally. However, it is the female which is heavier in the case of the great tit Parus major (Haftorn, 1976). The male black breasted rain quail is smaller than the female (Saxena and Saxena, 1977) but no consistent sex difference with respect to body weight is found (Saxena and Thapliyal, 1977).

The annual fluctuations in the body weights of both the sexes followed more or less a similar pattern of variation. During one of the breeding phases (March-April:

Summer) body weight recorded was very low (minimum in the case of males). Low mid-summer body weights have also been reported by Mewaldt and King (1977) in case of the white crowned sparrows. The male birds then revealed an increase during May and June reaching to its peak in July. Female birds too exhibited a moderate increase in body weight till May but thereafter there was a sharp rise in the month of July and a comparatively slight rise in August. Body weight remained more or less at the same level upto September. Males on the other hand showed decline in body weight through August and September, October and November. In the month of December however, a rise in weight was discernible. It became evident therefore that both sexes exhibited highest body weights in the wet summer (May to August in case of males and June to September in case of females) i.e. during the post-breeding season when they were undergoing post nuptial moult (in June and July). It is noteworthy that a similar conspicuous increase in the body weight coincides well with the period of post-nuptial moult in both sexes of Zonotrichia leucophrys (Mewaldt and King, 1977). Another factor could be the change of diet : grains of common long grass (Cynodon dactylon) that were easily and abundantly available a little after commencement of monsoon (July onwards). There was also a significant rise of weights in the case of females in winter (December, January and

TABLE I

Cyclic variations in body weight (Mean \pm S.D.)

Month	MALE BIRDS	FEMALE BIRDS
January	287.10 \pm 12.56	270.35 \pm 10.06
February	295.75 \pm 9.75	278.75 \pm 12.95
March	293.63 \pm 12.03	276.00 \pm 11.16
April	281.87 \pm 09.62	260.00 \pm 08.12
May	306.25 \pm 08.16	258.57 \pm 13.34
June	307.00 \pm 07.02	276.25 \pm 11.26
July	310.00 \pm 11.32	280.00 \pm 10.00
August	304.54 \pm 09.68	278.59 \pm 11.78
September	295.00 \pm 07.63	277.14 \pm 09.80
October	291.00 \pm 13.52	251.66 \pm 14.71
November	295.71 \pm 07.86	275.00 \pm 09.58
December	300.00 \pm 10.00	266.60 \pm 11.96

TABLE II

Seasonal variations in gonadal weight (Mean \pm S.D.)

Months	G R A M W E T W E I G H T		
	Right Testis	Left Testis	Ovary
January	0.547 \pm 0.103	0.463 \pm 0.091	0.422 \pm 0.076
February	0.677 \pm 0.194	0.605 \pm 0.181	0.300 \pm 0.103
March	0.930 \pm 0.183	0.848 \pm 0.106	1.039 \pm 0.117
April	0.632 \pm 0.115	0.551 \pm 0.126	0.581 \pm 0.128
May	0.461 \pm 0.116	0.417 \pm 0.155	0.253 \pm 0.064
June	0.083 \pm 0.021	0.071 \pm 0.020	0.084 \pm 0.015
July	0.149 \pm 0.036	0.129 \pm 0.025	0.155 \pm 0.023
August	0.627 \pm 0.123	0.571 \pm 0.117	0.259 \pm 0.090
September	0.810 \pm 0.108	0.712 \pm 0.108	1.621 \pm 0.235
October	0.700 \pm 0.095	0.587 \pm 0.099	0.536 \pm 0.100
November	0.414 \pm 0.074	0.336 \pm 0.088	0.283 \pm 0.020
December	0.659 \pm 0.107	0.590 \pm 0.095	0.794 \pm 0.101

EXPLA. NATION TO FIGURES

Fig.1. Graphic representation of monthly variations in body weight in both sexes.

Fig.2. Graph showing monthly variations in gonadal weight in both sexes.

FIG. 1

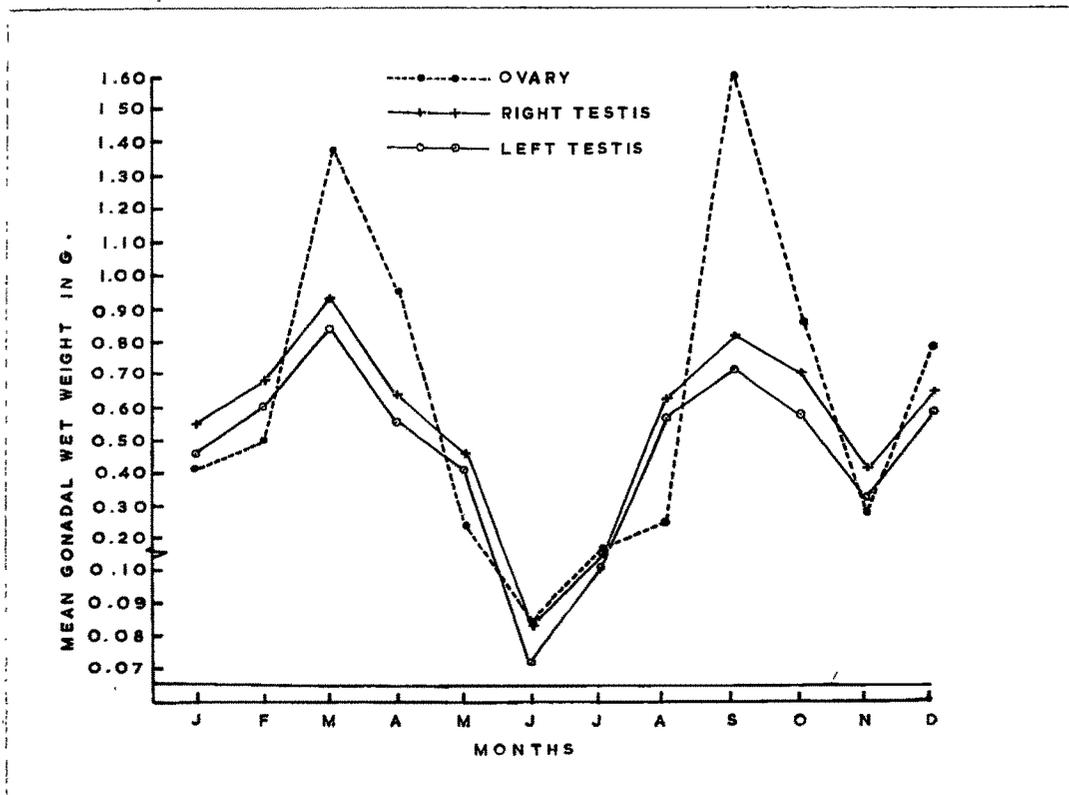
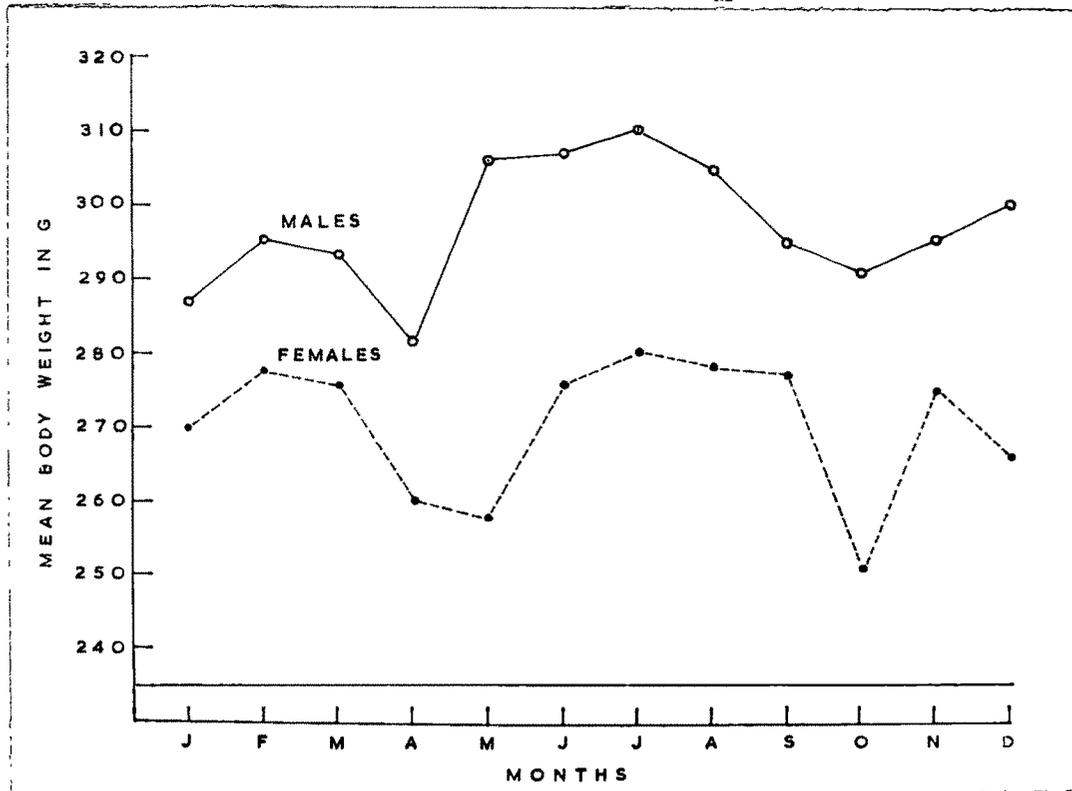


FIG. 2

February) which could probably be due to accumulation of winter fats. An overall picture that emerged indicated highest body weights in wet summer (June to September), moderately high in winter (except in October when the females registered the lowest mark) and minimum in Summer (March, April and May). Mewaldt and King (1977) encountered minimum body weights in mid summer and maximum in winter in case of the white crowned sparrows. The latter rise he attributes to an increase in the content of depot fat and enlargement of the reproductive organs in the females. That in the females, body weights did not decline in August and September was probably due to the hypertrophy of the reproductive and associated organs whereas in the case of males a decrease during this time was noticeable.

GONADAL WEIGHT AND HISTOLOGY :

Right testis was found to be always heavier than the left counterpart (Fig. 2) all through the year. This is in conformity with the observations of Riddle (1918) who had remarked that due to the asymmetry already established in the presumptive embryonic gonad, right gonad is larger and heavier in the adult pigeon males. This is

also the case with the dove (Rana, 1973) and Turkey (Law and Kosin, 1958). In most of the other avian species, the reverse is true. January and February revealed moderately high gonadal weights showing an increasing trend in March. Ovaries exhibited numerous atretic follicles in January and February which were easily identifiable even with naked eye. Cross sections of testes however showed that the birds were spermatogenically active. Pairing and nesting was however not seen till mid February. With the exception of testicular histology, all features observed above were indicative of a non-breeding stage. It was noted that this phase was not a typically regressive phase. Lofts and Murton (1973) have pointed out that, in the temperate climate, feral pigeons are capable of producing sperms in post-nuptial phase for a fairly long period of time. This may also perhaps be true in the present context i.e. the testes retaining spermatogenic activity yet the birds do not breed till March. With regard to tropical climates, birds having more than one breeding phase is not uncommon (Naik and Naik, 1965). In the month of March, the first peak of gonadal weight in both the sexes was clearly evident. Active spermatogenesis was observed during March-April (Fig. 3). Yellow yolk laden ova were seen in these months and histological preparation of ovary showed pre-ovulatory follicles of large diameters with distinct

thecal and granulosa layers (Figs. 7 and 10). These layers revealed intense 3β - and 17β -hydroxysteroid dehydrogenase activities. In late March and subsequent two months (April & May), post-ovulatory follicles were regularly encountered (Chapter III, Fig. 2), the endocrine role of which has been discussed (Chapter III). An entrapped egg, in some part of the hypertrophied oviduct, was frequently encountered in March & April. These observations, together with earlier ones (Chapters I, II and III) were distinctly indicative of the chief breeding phase occurring in Summer. Testicular weights remained moderately high till mid May. The month of June revealed a drastic difference. Both the testicular as well the ovarian total weights registered a record low values (Table II) and these were retained at more or less same levels in July. Sections of testes showed typical regressive phase during these months (June-July); the seminiferous tubules being small and collapsed and filled with post-nuptial accumulation of lipids and cellular debris (Fig. 6). During this phase, sections of ovaries depicted typical sexually quiescent stage with large number of small follicles (Figs. 11,12,13) and numerous corpora atretica at various stages of atresia (Fig. 14; Chapter III: Figs. 11,15 & 16). These observations corroborated the earlier findings viz. extremely low hydroxysteroid dehydrogenase activities and accumulation of

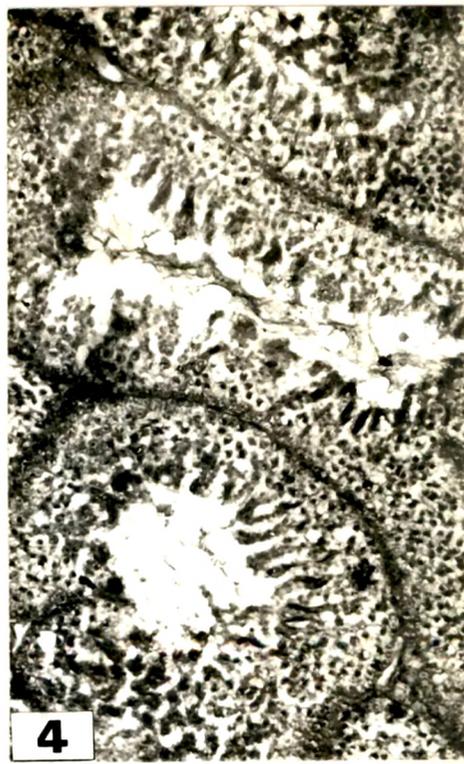
cholesterol positive lipids in the gonads during June and July (Chapters I, II and III). Some birds did show this type of phase in the month of November but it was not characterisable of the populations as was the case in June and July. Gradually through later part of August, September and October, another rise of gonadal weight reaching to its second annual peak was seen to build up. Gonads revealed similar characteristics as were seen during the first peak of breeding (March-April) (Figs. 4,8,10). The months of November and December showed moderately high gonadal weights. Few samples exhibited active spermatogenesis also in December (Fig. 5). It could be said that simulation to breeding condition is quite apparant but obviously supressed as a result of yet unrecognized ecological adaptations of feral pigeons of this region. More extensive investigations to that effect certainly are desirable.

EXPLANATION TO FIGURES

Photomicrographs of T.S. of pigeon testes.

(Histological preparations)

- Figs. 3 & 4. Spermatogenetically active testis during March and September (breeding). X 200
- Fig. 5. Testes of some individuals reveal spermatogenesis in December. X 200
- Fig. 6. A typically regressive testis showing collapsed seminiferous tubules loaded with lipid rich cellular debris. X 200.



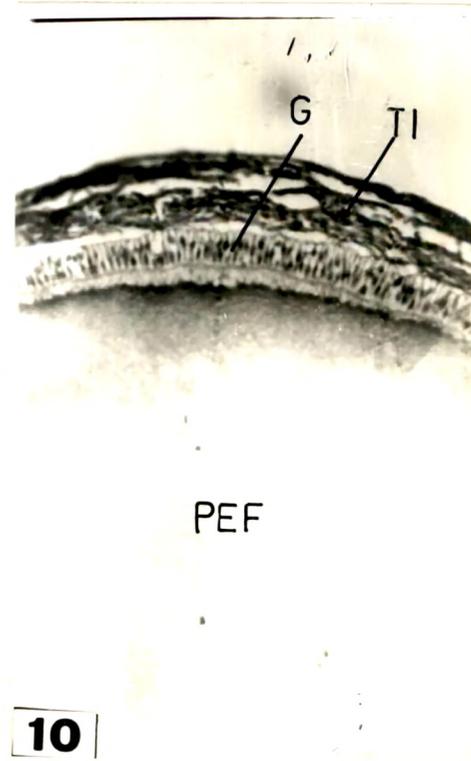
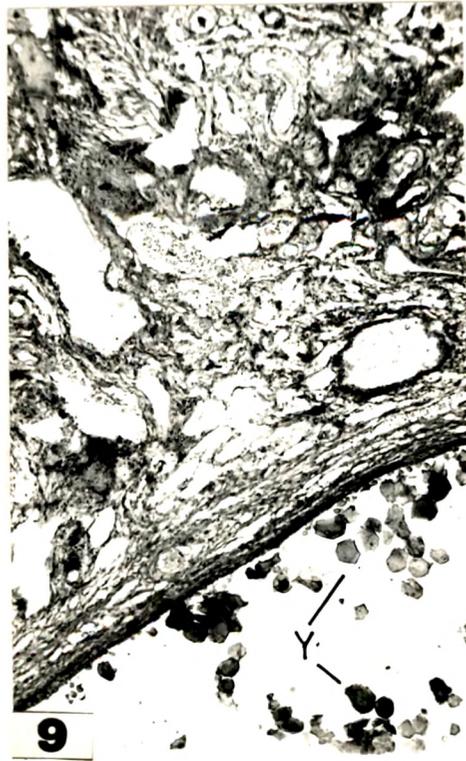
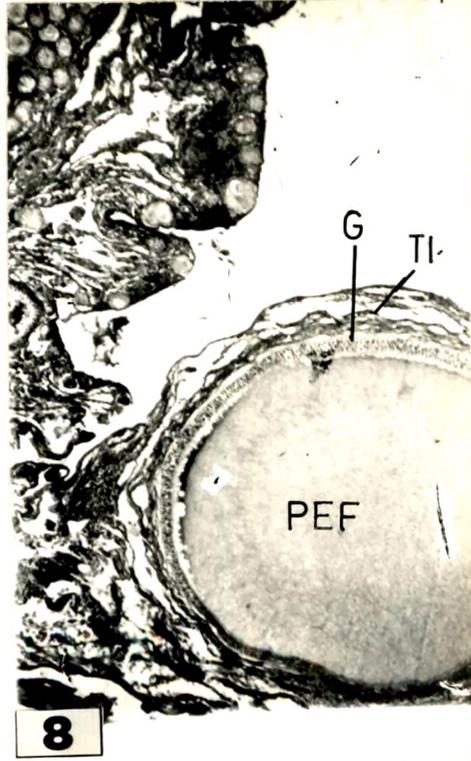
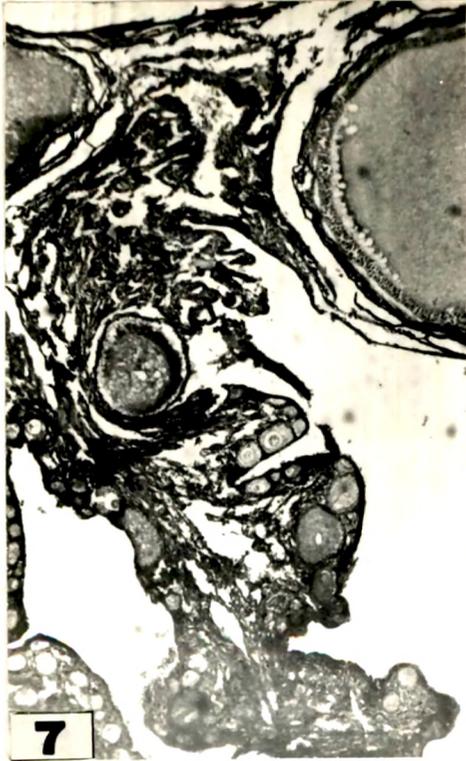
EXPLANATION TO FIGURES

Photomicrographs of T.S. of pigeon ovaries
(Histological preparations)

- Fig. 7. Section of ovary showing follicles at various stages of development in March. X 75.
- Fig. 8. A well developed follicle with distinct theca and granulosa layers (September). X 75.
- Fig. 9. An extremely well developed follicle loaded with yolk. (April). X 200.
- Fig. 10. The theca and granulosa layers of a pre-ovulatory follicle (October) are apparently distinguishable. X 200.

ABBREVIATIONS

PEF - Pre-ovulatory follicle	AF - Atretic follicle
TI - Theca interna	Y - Yolk
G - Granulosa	



EXPLANATION TO FIGURES

Photomicrographs of T.S. of pigeon ovaries
(Histological preparations)

Fig. 11. A sexually quiescent ovary with numerous,
minute primary follicles (June). X 75.

Fig. 12. Regressed ovary as seen in early June. X 75.

Fig. 13. Same as Fig. 11. X 200.

Fig. 14. An atretic follicle studded with yolk;
hypertrophied granulosa and thecal layers
are evident.

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