GENERAL CONCLUSION

Aves are the most varied and diverse group amongst the vertebrates which have always challenged the curiosity of the ornithologists. Lots of work have been carried out on the migratory as well as on the temperate zone birds (Hirschenhauser *et al.*, 1999; Jaquet, 1997; Sandberg and Petterson, 1996; Astheimer *et al.*, 1995) however reports on the sub-tropical birds are few (Ravikumar *et al.*, 1995; Hegner and Wingfield, 1986).

One such species is, Jungle Babbler (*Turdoides striatus,* Order: Passeriformes, Family: Silvidae), a typical semi arid sub-tropical bird. It has adapted itself very well to the urban conditions without losing much of its originality. Jungle Babbler has a wide distribution in India and it is mostly found near human settlements. It lives in plantations, gardens and other man-made habitats including agricultural fields in and around sub-urban areas (Ali, 1993).

Because of their omnivorous type of feeding habit, Jungle Babblers are known to have a contradictory role in an agro-ecosystem. They are known to devour on both animal as well as plant matter. Reports suggest that they are pest to crops like Sorghum, Pearl millet, Bajra *etc.* (Rana, 1972; Parasharya, 1988; Dhindsa *et al.*, 1994) while on other hand they have been reported to feed on insect pest especially *Helicoverpa armigera*, the gram pod borer which is known to

infest and cause heavy losses to crops like chick pea and pigeon pea (Gupta and Midha, 1994; Gokhale, 1992).

Feeding is the principal diurnal activity of the individuals of the flock and while on the ground; they spend almost all their time in foraging. They hop about on the ground mulching and turning over the leaves and digging the ground vigorously in search of food. This peculiar foraging style helps uncover the *Helicoverpa* larvae and other insect pests. Also they are able to expose the under ground pupae of *Helicoverpa* and white grubs (which infest the roots). In present study preference of feeding site by Jungle Babbler in various agricultural crops *viz.* Brinjal, cabbage, cowpea, maize and two unsown plots (one ploughed and another unploughed), and feeding on one crop in particular at various stages was studied *i.e.* pigeon pea (*Cajanus cajan*). Pigeon pea is known to be infested severely with *Helicoverpa* larvae. The sowing time of the crop is from September and is harvested in February and March which also coincides with the cropping of the Sorghum. Jungle Babblers were seen spending their maximum time in the pigeon pea fields and were rarely seen visiting the sorghum field. The number of Jungle Babblers was maximum in the pigeon pea fields during October and November in both the small pod stage and the large pod stage which had heavy infestation of *Helicoverpa armigera*. Least number of birds were seen during the flowering stage in September. Later the fields were sprayed with three applications of insecticides *viz.* Dunnate and Monocrotophos after

which the pest population decreased with consequently decreased the number of Jungle Babblers in the field. As the effect of the chemicals decreased, along with the rise of the *Helicoverpa* in January, Jungle Babbler number in pigeon pea fields increased. These observations indicate that Jungle Babblers prefer insect as food than grains and hence, is more of a beneficial bird than being harmful depending on the type of the food available and its food varies during different seasons. Secondly, *Helicoverpa* is the preferred food over Sorghum grains *i.e.* proteinaceous food is preferred over carbohydrate diet and because of its digging and mulching habit the pests are exposed and are easily available. Moreover, when Pigeon pea and Sorghum were planted in the adjacent fields, they were rarely seen feeding on Sorghum, thus it could be suggested that Pigeon pea can be used as divergent/ alternate or the decoy crop to protect sorghum from heavy losses from an omnivore bird.

Brinjal, Cabbage and cowpea are some of the important vegetables grown in and around Baroda, which are heavily infested with the pod borer, the Diamond back moth and the aphids. Number of Jungle Babblers in brinjal fields was minimum as in brinjal the larvae of pest insect are not exposed since present within the fruit. In Cabbage, the insect pests *viz.* aphids and Diamond back moth are not only depredated by birds but also by Lady bird beetles, hence probably the presence of Jungle Babblers is less because Lady bird beetles are known to a large extent responsible for keeping the pest population in

control. Cowpea at the time of the study was fully ripe and harvested and a mound was made in the center of the field. They were more predated by Blue Rock Pigeons.

Among the two unsown plots, Jungle Babblers were seen in adequate number in the ploughed field as ploughing exposed many under ground larvae and insects especially White grubs (*Holotrichia* Sp. Scarabidae) known to damage the root system of several crops. Jungle Babblers were seen in large number in this ploughed field supporting their involvement with other species of birds in controlling the pest population. In the unploughed field, least number of Jungle Babblers were found due to least availability of food.

Jungle Babblers are social birds or co-operative breeders which remain in flock of 7-8 birds during their non-breeding state (Ali, 1993; Andrews, 1968). It is a passerine that moves on the ground by hopping, allowing a close contact with its fellows and indulge in mutual preening (Andrews, 1968). The flock shows territory which is neither a feeding territory nor a breeding territory, but have a common foraging area occupied by the whole flock and is defended equally by all the members of the flock all throughout the year. The birds remain in a flock and the activities of the individuals are closely integrated and synchronized.

When a pair is in breeding state, the flock breaks up into a group of 3-4 members. Apart from the breeding pair, the group also consists of distinct members called "helpers" which forgo their

breeding in order to assist the breeding pair. This is an indication of successful co-operative breeding in Jungle Babblers. The "helpers" are usually the youngones from the previous brood or the youngones of the previous nesting attempt. Different reproductive periods have been reported for this species as irregularly through out the year (Ali, 1993), from April to September (Whistler, 1949), from April to August in Saurastra, India (Dharmakumarsinghji, 1954) and from April to August in and around Baroda district Long. 73^0 15' E Lat 22^0 17' N (Andrews, 1968). The male and the female Jungle Babblers obtained during the course of the study showed maximum gonadal weights from April to November which could be considered as their breeding period while from December to February, the minimum gonadal weights were observed suggesting their non-breeding state. Even during the breeding phase few non-breeding gonads were obtained, denoting somewhat irregular type of breeding. The peaks of gonadal activities were noted from May to August. Males showed highest testicular weights during May to August and females with highest ovarian weights were observed from April to July. A peculiar characteristic was observed amongst the females wherein, few females had ovarian weights equal to the breeding females but their oviducts did not show prominent development. The weight of the oviduct suggested that they were not fully developed and could not carry out the function of egg formation. Based on this the females with developed ovaries but under developed oviducal weights were separated out as "helper" females. In

present work, a comparative account of biochemical and histological study in the breeding males and females, non-breeding males and females and "helper females" of the Jungle Babbler with reference to the breeding state is considered. In case of males distinct breeding and non-breeding testes were obtained while no helper males could be separated out.

Jungle Babblers exhibit a close social organization (Andrews, 1968; Gaston, 1978) and the members of the flock show distinct pattern of time and energy budgeting especially during the breeding phase which is an energy demanding process. Several species of birds are known to accumulate fat in the body during their breeding season. As noted for the body weights of Jungle Babblers, no significant difference was noted for all the categories of Jungle Babblers. From this it could be suggested that since Jungle Babblers are social (co-operative) breeders, the energy demanding breeding activities are shared by all the individuals of the group and hence, no fat accumulation is observed in breeding individuals. Moreover it also suggests that, they depend on their daily food supply rather than on the stored energy which is reflected in their foraging behavior wherein they spend their maximum time in search of food. However, even though they are said to be irregular breeders, in a particular area/zone with the abundance of food during specific time of the year, they show peak in the reproductive activities thereby reflecting nearly seasonal breeding pattern (Andrews, 1968; Dharmakumarsinghji, 1954).

Reproductive hormones are the ultimate endogenous factors which influence or control the timing of breeding. The hormonal assay of testosterone and progesterone was carried out in all the five categories of Jungle Babblers. As discussed in chapter 2, no significant differences in the testosterone levels in the blood plasma were noted in the breeding males and females along with the helper females. Testosterone is known to maintain aggressiveness in male birds and causes decrease in care seeking behavior (Vleck and Brown, 1999; Trainor and Marler, 2001). From the levels of the testosterone in breeding males and females and helpers it could be suggested that the territorial defense, nest protection as well as protecting the youngones from predation is carried out by all the members of the flock. So the threshold levels are maintained at a comparable titer and no significant difference is seen in the hormone levels in the breeding male, female and helper birds.

Progesterone is known to influence the development of oviduct and initiate the brooding, nest building and incubation behavior (Hutchison, 1975; Balthazart, 1983; Seiler *et al.,* 1992). The progesterone levels were comparatively high in breeding females than the breeding males. Helper females also showed somewhat similar trend of both the hormone levels to that in breeding females however with comparatively lower titers. From the levels of the progesterone in breeding female birds, it could be said that as the breeding activities except egg formation and egg laying are carried out by all the

members of the group, high levels of progesterone as seen in females of other birds like Bank Myna and Brahminy Myna (Sapna, 2002) is not observed in breeding male, female and helper Jungle Babblers. The intermediate levels seen in the helper females suggest their equal participation in incubation but low oviducal development which prevents them from egg formation and egg laying (Chapter 2).

Ascorbic acid an important cofactor in various activities of general metabolism of the body and also known to play a significant role in the steroid metabolism was estimated in gonads as well as liver, intestine and kidney as the fluctuations in the concentration of the same are associated with variations in the metabolic activities of the tissue. Ascorbic acid for long has been related with fertility/reproduction via its three principal functions namely its promotion of collagen synthesis, its role in hormone production and its ability to protect cells from free radicals (Chinoy and Rao 1979; Luck *et al.,* 1995). It is known that Ascorbic acid has a synergistic action with testosterone for the potentiation of its anabolic action for increasing the testicular germ cell maturation and enhancing the activity of a number of androgen dependent enzymes (Chinoy *et al.,* 1978). Since, Ascorbic acid is essential for the formation of intercellular materials and structural elements as well as for metabolic activities, most of the animals have developed the ability to synthesize it. Most of the birds and mammals are known to synthesize Ascorbic acid in liver and/or kidney (Raychaudhari and Chaterjee, 1969).

Biosynthesis of Ascorbic acid in non-passerine birds occurs in the kidneys, whereas in higher passerines the kidney as well as the liver possesses this capacity (Raychaudhari and Chaterjee, 1969; Chinoy, 1972).

The present study reports the concentration of Ascorbic acid in liver, intestine, kidney and gonads of breeding and non-breeding males and females along with the helper females. Among the three tissues studied, kidney had lower levels than the liver but higher than the intestine. The Ascorbic acid content remained high in both the sexes during the breeding phase. Helper females showed ascorbic acid content equivalent to that in the breeding females suggesting they are equally involved in possible Ascorbic acid turnover (Chapter 2). Ascorbic acid is known to increase the testosterone synthesis by stimulating the 17â-HSDH activity in the testes of the rat (Biswas *et al.,* 1996) and influences the 3â-HSDH activity in toad testes (Biswas and Deb, 1970). The increased requirement of ascorbic acid in breeding male Jungle Babblers probably comes from the liver and the kidney. Comparatively low ascorbic acid and cholesterol levels in Jungle Babblers in relation to Bank Myna (colonial nester) and Brahminy Myna (solitary nester) may be due to its social nature. Almost equal ascorbic acid contents in the liver, intestine and kidney of breeding and helper females indicating its equal role in general metabolism in both the cases whereas accumulation of the same in the

ovary in helpers, equal to that of the non-breeding females, indicate the subdued involvement of gonads in steroidogenesis.

Both the gonads, the testis and the ovary exhibit the cycles of tissue remodeling and of peptide and steroid secretion that can be assumed to be ascorbate dependent. The reaction of steroid hormone biosynthesis is accompanied by the formation of oxygen radicals (Rapaport *et al.,* 1998) and ascorbic acid may prevent gametes from damage by the free radicals during gametogenesis and fertilization (Luck *et al.,* 1995). According to Pintauro and Bergan (1982), ascorbic acid increases the conversion of pregnenolone to $Ä^4$ steroids and decreases its conversion to $Ä^5$ steroids. They support a general inhibitory effect of high ascorbic acid on the steroid hydroxylation and a possible regulatory role of ascorbic acid in the conversion of pregnenolone to $Ä^4$ and $Ä^5$ steroids. The levels of ascorbic acid present in the testis of the breeding and the non-breeding males suggest the utilization of ascorbic acid as a cofactor in steroidogenesis in the breeding males and its accumulation in the non-breeding males in the absence of steroidogenesis. In Jungle Babbler, having a longer breeding season as well as sharing its parental responsibilities with other individuals of the flock, comparatively lower testosterone and progesterone levels have been found (Chapter 2) than those species which show distinct breeding and non-breeding seasons. This is probably reflected by the lower fluctuations in ascorbic acid and cholesterol levels of gonads too (Chapter 3).

A correlation between ascorbic acid and cholesterol wherein the status of ascorbic acid affects the cholesterol levels in pregnant guinea pigs (Jenkins 1980) and gonadal cholesterol and ascorbic acid content (Ambadkar and Kotak, 1976; Ambadkar and Padate, 1993, 1995; Byrd *et al.*, 1993) have been reported. All the steroid hormones, *viz.* estrogens, progesterone, androgens and adreno-cortical hormones are synthesized from cholesterol. Cholesterol, an important sterol, is widely distributed in the body and is a constituent of all the animal cells. It has various important roles including functions as a special transport agent for unsaturated fatty acids in the blood plasma, as a precursor of bile acids in liver and most important as a precursor for various steroid hormones. A correlation between ascorbic acid levels in different tissues and cholesterol metabolism especially in steroidogenesis is considered here in these birds. In Jungle Babblers, no significant difference in cholesterol content of liver, intestine and kidney of breeding and non-breeding birds as well as helpers are noted, except for a significantly lower level of cholesterol in the kidney of the non-breeding females. Non-significant differences in cholesterol levels in general in all the Jungle Babblers could be due to its flocking or social nature. In Bank myna and Brahminy myna which have a distinct breeding and non-breeding seasons as well as move around in pairs, distinct difference in ascorbic acid and cholesterol levels during breeding and non-breeding season have been reported from our laboratory (Padate, 1990). These birds also show higher testosterone

and progesterone levels (Sapna, 2002) when compared to Jungle Babblers (Chapter 2). Even the accumulation of cholesterol in non-breeding gonads of Jungle Babbler, though higher, is non-significant. This is probably the reflection of social nature of Jungle Babblers as 6-8 individuals of the flock show the similar foraging activities and mainly feed on carbohydrate and / or protein diet. The significantly lower renal cholesterol might be explained in relation to higher 17â-HSDH activity of the kidney in non-breeding birds (Sapna unpublished data).

The requirement of the energy by the birds depend on the type of the activity they perform during different seasons of the year and one of the cost effective, energy requiring activity is reproduction. In Jungle Babbler, a common irregular breeder of sub-tropical region of India, all the individuals in the group spend energy for rearing the brood. Many birds start their reproductive season with large energy reserves but this is not true for all the birds (Thomas, 1982). The Jungle Babbler falls in the later category. In Jungle Babbler the energy spent by the individual bird decreases and probably they rely on daily food supply rather than storing the food. Therefore the physiological status of a pair which is in the breeding state may not be significantly different from the other members of the group which are helpers. Animals obtain all their required energy from the food they eat which consists of various biological components (Hazelwood, 1986) *viz.* carbohydrates, lipids and protein, the proportion of which varies

depending on the type of the food. Jungle Babblers show changes in the total amount of the food consumed as well as the nature of the diet throughout the year (Gaston, 1978).

In most species of birds, the reproductive activities are crowded in a short favorable period (Lofts and Murton, 1973; Phillips *et al.*, 1985) and the energy required by different tissues, depending upon their role, show variations in metabolites (Ambadkar and Kotak, 1976). This results in quantitative fluctuations in the levels of metabolites and enzymes as the bird undergoes adaptive changes during its breeding activities. The present study also deals with the involvement of selected tissues likes liver, intestine and kidney in energy metabolism along with testes and ovaries in the breeding and the non-breeding male and female Jungle Babblers as well as helper females. The metabolites include carbohydrate, lipids and proteins (Chapter 4). One of the important biomolecules which makes the maximum part of the energy reserve is glycogen, a major storage form of carbohydrate in animals. Lipids are other energy yielding important dietary component accumulated in various parts of the body which serve as an efficient source of reserved energy. Depending on eating habits, fat intake among the non-domestic species varies widely (Griminger, 1986). The fats are the most variable metabolites among the major body constituents. While it varies with species, sex and age it is also strongly affected quantitatively as well as qualitatively by nutrition (Sturkie, 1986).

Proteins play both structural as well as metabolic roles in the body. They also provide energy in their due course of degradation thus having a functional role of energy supply after carbohydrates and lipids (Griminger and Scanes, 1986). Excess dietary amino acids are not excreted out but are converted to common metabolites that are precursors of glucose, fatty acids and ketone bodies and are therefore metabolic fuels (Voet *et al.,* 1998). There is an inter-relationship between carbohydrates, lipids and protein metabolism (Hazelwood, 1986). For Jungle Babblers of both the sexes, it can be said that there is higher uptake of carbohydrate in the diet of breeding birds leading to its storage in liver for instant energy needs. In the non-breeding birds where demand for the energy is low, both liver and intestine show lower glycogen levels. Further, Jungle Babbler, a social bird with a long favorable breeding period, probably shows typical avian adaptation of minimum accumulation of fat to decrease the body weight. This is reflected by minimum difference in the lipid contents of liver, intestine and kidney of all the categories of Jungle Babblers and also as evinced by no fluctuation in the body weight too. The energy required for breeding activities in case of Jungle Babbler mainly comes from the carbohydrate consumed as observed in the increased intestinal glycogen (carbohydrate) content resulting into increased hepatic glycogen in the breeding and the helper females compared to non-breeding birds.

The maximum number of birds found in non-breeding state was between November to February coinciding with the cultivation period of the crops like pigeon pea and chick pea grown in winter and known to be heavily infested with *Helicoverpa armigera* larvae. Jungle Babblers have been reported to feed on these (Gokhale, 1992, Parasharya, 1988) and personal observations (Chapter 1). This is reflected by highly significant increase in the intestinal proteins in the non-breeding birds. In male birds similar trend is maintained but in females opposite trend is observed. The high protein demand by the breeding females for egg production is reflected by increased protein levels in liver as well as kidney on one hand and decreased intestinal proteins indicating a faster uptake from the same. The helper female which do not lay eggs show lower intake of proteins compared to breeding and non-breeding females reflected in the lower hepatic and the renal protein levels.

Wild birds are known to undergo cyclic physiological changes through the breeding and the non-breeding states of their reproductive cycle (Nalbandov, 1970) which mainly includes fluctuations in the levels of storage of lipids and glycogen. Accumulation of lipids in avian testes and ovaries during the non-breeding state has been reported (Lofts and Murton, 1973; Ambadkar and Kotak, 1976; Ambadkar and Padate, 1993, 1995; Prasad and Guraya, 1983; Patel and Ramachandran, 1987). Almost all the seasonally breeding vertebrates

depict a seasonal lipid decrease during active spermatogenesis and steroidogenesis (Johnson, 1970).

Testicular and ovarian lipids reflect accumulation in the non-breeding male and female Jungle Babblers too. This suggests that there appears a sudden change in the metabolic pattern of testes and ovaries indicating non-utilization of lipids and its subsequent accumulation during the non-breeding state. The depletion which is noted during the breeding state is indicative of increased utilization of lipid as a precursor of steroidogenesis. The total lipid content present in liver, intestine and kidney in breeding as well as non-breeding birds along with the helper females is nearly same which accounts for the social behavior of Jungle Babblers where along with the breeding pair, helpers are also involved in care taking of eggs as well as the youngones and thus the burden of parenting is shared equally by all the members of the flock.

Along with the metabolites certain enzymes involved in carbohydrate metabolism and energy releasing processes are also studied. These include Glycogen Phosphorylase (GP), Glucose-6-phosphatase (G6Pase), Succinate dehydrogenase (SDH) and total Adenosine triphosphatase (ATPase). The regulation of glucose synthesis, storage, mobilization and catabolism is elaborate and sensitive to the immediate and long term energy needs of the organism. The glycogen metabolism must be controlled according to

the cellular needs which involve enzymic as well as hormonal control (Hazelwood, 1986). They also affect the rate of transport and synthesis as well as the overall metabolism of carbohydrates, fats and proteins (Spannhake, 1976). The opposite processes of glycogen synthesis and glycogen degradation and of glycolysis and gluconeogenesis are reciprocally regulated *i.e.* one is largely turned on while the other is largely turned off (Voet *et al.,* 1998).

GP is the initial catalytic enzyme in glycogenolysis which catalyses glycogen to yield glucose-1-phosphate which can be used for production of ATP (Biorn and Graves, 2001; Mayes, 2000). Increased activity of GP is associated with the increased glycogenolysis and it also indicates that the tissue depends upon carbohydrate as the chief fuel for activities (Cahill *et al.,* 1957). As seen in chapter 5, the hepatic as well as intestinal glycogen levels in breeding birds are high; correspondingly the GP activity is also high in these birds indicating that the enzyme activity is modulated parallel to that of metabolic load. In Jungle Babbler, it seems that the carbohydrate metabolism slows down in the liver and intestine of the non-breeding birds and the activity in the kidney increases during this period as is reflected by increase in the GP activity. In helper females which share the domestic duties except for egg formation and egg laying, the energy is not utilized probably equal to that of breeding birds as they have non-significantly higher glycogen in liver and lower GP in all the three tissues studied.

G6Pase is another crucial enzyme of glucose homeostasis, since it catalyses the ultimate biochemical reaction of both glycogenolysis and gluconeogenesis. G6Pase plays an important role in glucose release from the liver and kidney through mechanism involving either gene expression and/or biochemical inhibitions of its enzymatic activity (Haber *et al.,* 1995; Minassian *et al.,* 1996; Mithieux *et al.,* 1996). The extent of glycogen accumulation is inversely related to G-6-Pase which is a rate limiting glycogenolytic enzyme (Raheja *et al.,* 1980). In Jungle Babblers it is reflected by non-significantly lower G6Pase levels in the liver of breeding and helper females and accumulation of glycogen too. The progressive increase in the liver glycogen concentration is associated with a concomitant decrease in the hepatic G6Pase activity (Raheja *et al.,* 1980). The other two enzymes quantified are SDH and ATPase. SDH is a key enzyme of the Kreb's cycle. It usually functions as an index of oxidative metabolism. The quantitative measurement of SDH activity is one of the reliable indices of oxidative metabolism and the production of the ATP molecules of any metabolically active organ. An active synthesis of ATP and its enzyme hydrolysis is the characteristic feature of the metabolically active tissue where ATPase is actively involved in high energy phosphate metabolism. ATPase and SDH both are actively involved in cell metabolism wherein ATPase carries the catabolic reaction while SDH keeps up the supply of energy rich ATP molecules for ATPase.

According to the energy needs of the body, the increase or decrease rate of Kreb's cycle and the oxidative phosphorylation could be inferred from the activities of the enzyme such as SDH and ATPase respectively. The high levels of hepatic and intestinal SDH and ATPase activities observed in the breeding Jungle Babblers compared to the non-breeding birds are suggestive of an active synthesis as well as hydrolysis of ATP to provide energy in order to fulfill tremendous energy demand to carry out several physical processes during the breeding state. Both the enzymes are active in breeding male and female Jungle Babblers. The energy released during the process is for the synthesis of different metabolites as well as for all the physical activities carried out during reproduction. Thus, from the activities of these enzymes some information on the relative occurrence of gluconeogenesis, oxidative metabolism and ATP utilization in Jungle Babblers can be gained. That is, in Jungle Babbler, a social breeder with a long breeding readiness, all the energy demanding reproductive processes are not only shared by adults but are equally shared by helpers too.

Histological and histometric studies of various tissues of Jungle Babbler were also carried out in the present study. The testicular cycle of Jungle Babbler could be divided roughly into seven stages showing different types of germ cells and also variation in their numbers. As per the histometric studies, it was found that the seminiferous tubule diameter and germ layer thickness increases during the breeding state

of Jungle Babblers (Chapter 6, Plate I). Ovaries also showed varying degree of follicular maturation in breeding, non-breeding and helpers. The breeding ovaries had maximum number of large follicles which also achieved the largest diameter. Accumulation of fat droplets (for yolk synthesis) could be seen in mature follicles in the breeding ovaries. The non-breeding ovaries consists of maximum number of small follicles in the cortical region with less percentile of large follicles, whereas the helper females showed both mature as well as small follicles along with large number of atretic follicles (Chapter 6, Plate IIa, IIb). The extra-gonadal tissues studied were liver, intestine and kidney which do not show seasonal or sex related variations. Liver was having typical vertebrate pattern wherein two cords of hepatocytes were observed arising from the central vein. In intestine (duodenal region), at the base of the villi, Brunner's glands were observed along with a typical intestinal structure. Lacteals were seen dilated possibly reflecting that they spend maximum time in feeding, so maximum amount of food absorbed and thus lacteals remain dilated.

Thus from the histological studies it could be inferred that even though gonads show cyclicity of development and regression during breeding and non-breeding states, no variations in the extra-gonadal tissues was observed during different reproductive states as well as no sex related variations were observed suggesting that these organs responsible for the metabolic and physiological control of body do not

show morphological or histological differences in all the five categories of Jungle Babblers.