

INTRODUCTION

Propagation is the most important activity in the life cycle of any organism, wherein there is greatest dependence on the different environmental factors which directly or indirectly affect the successful breeding with the survival of the hatched young ones and minimize the stress on the breeding parents (Lofts and Murton, 1973; Phillips *et al.*, 1985). In order to reproduce, a large amount of additional energy is required, therefore birds lay their eggs at such a time that when the youngones are in the nest the availability of the food is maximum. The natural selection favors those individuals whose breeding time coincides with the peak abundance of food. Hence, a bird will not breed if the number of surviving offsprings on an average is less than the mortality of the adult. Therefore these factors have played an important role in limiting the breeding season of many species of the birds.

In the areas around the equator or sub-tropical regions with long summer season along with moderate to heavy rainfall, the availability of the food is maintained, when the insect population including larvae, increases after rains. Many species of birds depending on insects breed during this long period, when the chances of survival of the young ones increase by a great number of folds. However there are many species in which different ecological groups of birds in an area may breed at quite different

times of the year (Phillips *et al.*, 1985). As a consequence, some breeding activity may be seen through out the year or atleast spread widely over the year. Therefore it appears to be difficult to draw any general conclusion about the breeding seasons of such birds. Availability of food is influenced by many factors *e.g.* geographical position, temperature and habitat. In terms of energy requirement (from the food eaten), reproduction is a process which is very expensive. The surplus amount of energy which is required during the breeding season for different purposes like nest building, laying of eggs, incubation and finally feeding the youngones is procured by birds in either of the two ways : - i. By having reserve food material or ii. Relying on finding sufficient food each day. Therefore, for those birds which rely on their daily food supply, the surplus food should be available within a continuous period of their breeding to support both the increased energy demands of the parents as well as for the faster growth of the chicks.

Jungle Babbler (*Turdoides striatus*, Order: Passeriformes, Family: Silvidae), is one such species which probably depends on daily food supply. Jungle Babbler, a resident bird of semi arid sub-tropical area with wide distribution are reported to be irregular breeders (Ali, 1993), however when the abundance of food is during a specific time of the year *i.e.* from April/May to October/November, they show peak in the reproductive activities, thereby reflecting nearly seasonal breeding activity (Dharmakumarsinghji, 1954; Andrews, 1968). Jungle Babblers are

co-operative or social breeders. During their non-breeding state, they remain in a flock of 7-8 birds which breaks up into a group of 3-4 birds during the breeding state in which apart from the breeding pair, helpers are also present. Helpers share/assist the breeding pair in different reproductive activities which is a sign of successful co-operative breeding. Feeding is the principal diurnal activity of the individuals of a flock. While on ground the birds spend almost all their time in foraging, they hop about on the ground, turning over the leaves and digging and mulching the ground vigorously in search of food. Phillips *et al.*, (1985), have suggested the advantages of the association between the diet and the reproduction in species which show co-operative breeding.

Agricultural practices in India have changed in about last two decades and the farmers have adopted to the large scale monocultural practices. Many animals have adapted themselves to these altered conditions which applies to birds too as they constitute an important component of an agro-ecosystem. Large numbers of birds have started depending directly or indirectly on these altered agricultural practices. On one hand, they damage the crop at various stages beginning from sowing to the storage stage; while on the other hand, they benefit the crop by feeding voraciously on the pest species and in turn controlling the pest population. Thus they have become an integral part of integrated pest management (IPM) and hence, the study of birds in relation to agriculture and their application in management of agricultural

crops has become an essential field of study of "Agricultural Ornithology" (Dhindsa and Saini, 1994). Birds are the most effective group that could gobble up a sizeable number of pest species. The beneficial aspects to agriculture accrued by bird fauna out play the damage. The degree of benefit or damages could vary considerably depending on the crop, environment and the climate.

The omnivore bird species play a dual role in agriculture (Gokhale, 1992; Gupta and Midha, 1994), and Jungle Babbler falls in this category having a binal role. Jungle Babblers along with several other species of birds have been considered beneficial to the crops like Chick pea and Pigeon pea which are heavily infested with the notorious pest, the gram pod borer, *Helicoverpa armigera*. Ninety percent decrease in *Helicoverpa armigera* and sixty percent decrease in grubs of *Holotrichia* species is by the birds (Parasharya, 1988). Jungle Babblers have been reported to feed on the larvae and the pupae of this pest and thus help in biologically controlling this insect species to a large extent. While on the other hand, they have been reported to feed on the cereal crops like Sorghum, Pearl millet, Bajra etc. with other birds and damaging them and causing economic losses. Hence, in the present study feeding activity of the Jungle Babblers in various agricultural fields' viz. crops of Pigeon pea, Sorghum, Maize, Brinjal, Cabbage etc. along with two empty plots one being the ploughed ones and the other unploughed ones were observed for a comparative study.

In order to assess the impact of birds on agricultural fields it

is very much necessary to understand the bird's life; its physiological adaptations in feeding as well as during its breeding and non – breeding phases of the reproductive cycle. In the present study an attempt is made to understand the feeding activities of Jungle Babbler with reference to agro-ecosystem and physiological adaptations of males and females in breeding and non-breeding states and that of the helpers. Jungle Babblers are social birds and exhibit co-operative breeding activities hence a question emerged what is the physiological status of the helpers ? Depending on the testes weight, ovary weight and/or oviducal weights the Jungle Babblers were categorized as breeding males and females, non-breeding males and females and helper females. No bird could be categorized as helper males. Energy budgeting in these five categories of birds has been considered with the help of variations in certain biochemical parameters in relation to sex hormonal profile and body weight.

During the breeding cycle, the reproductive hormones are secreted in a cyclic manner in increasing or decreasing amounts which synchronize and regulate all the reproductive activities including reproductive physiology as well as behavior. The changes in hormone levels are expected to have varied effects which are of great reproductive significance (Lofts and Murton, 1973; Hau, 2001). Hence, in the present study, reproductive hormones *viz.* testosterone and progesterone were also taken into consideration with variations in the gonadal weights.

Testosterone is known to control aggression, territorial defense and also stimulates courtship display (Vleck and Brown, 1999). It is also responsible for the growth, development and maintenance of male reproductive system and secondary sexual characters through out the breeding season. It also mediates a negative co-relation between parental behavior and aggression in several seasonally breeding avian species (Trainor and Marler, 2001). In females, their sexual receptivity is controlled by the endogenous secretions by the ovary (estrogen and progesterone). Progesterone along with testosterone stimulates nest-building in both males and females and also stimulates incubation behavior of broodiness in both (Balthazart, 1983). Progesterone also stimulates the oviducal development by inducing the development of tubular glands of the magnum region of the oviduct (Hutchison, 1975). Hence, on the basis a comparative study of progesterone titers in breeding females, males and helper females an attempt is made to understand the role of helpers in reproductive activities.

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). Ascorbic acid is known to act as a cofactor enhancing the enzymic activities of 17 β -HSDH and 3 α -HSDH (Biswas *et al.*, 1996; Biswas, 1969; Biswas and Deb, 1970), thereby increasing the hormonal output. The Ascorbic acid levels in various extra gonadal

and gonadal tissues fluctuate in accordance to the reproductive status of the animal. Jungle Babblers are social breeders where helpers also assist in breeding activities hence, the levels of the Ascorbic acid in these breeding, non-breeding and helper birds would give us an idea about the status of steroidogenesis in helpers and in turn an idea about their reproductive state and their involvement in accessory reproductive activities under the influence of hormonal titers. The present investigation reports the concentration of Ascorbic acid in liver, intestine, kidney and gonads of breeding and the non – breeding males and females and helper females of Jungle Babbler.

It is a well established fact that all steroid hormones *viz.* androgen, estrogens, progesterone and adreno – cortical hormones are synthesized from cholesterol. Cholesterol is an important sterol, which is widely distributed and is a constituent of all animal cells. It has various important roles which include functions as a special transport agent for unsaturated fatty acids in the blood plasma, as a precursor of bile acids in liver, and as a precursor of various steroid hormones. The production of sex- steroids consequently should affect the level and distribution of this important metabolite in various tissues. Hence, in the present study variations in the ascorbic acid and cholesterol contents of liver, intestine and kidney along with gonads in breeding and non-breeding as well as helper birds was carried out.

In accordance with the functional and the non – functional

states of gonads well defined histological and biochemical changes have been observed (Free, 1970; Ambadkar and Kotak, 1976; Patel and Ramachandran, 1987; Ambadkar and Padate, 1993, 1995). The energy requirement by different tissues in seasonally breeding birds would vary according to the different phases of their reproductive activity (Patel, 1982). Seasonal reproduction involving development and regression of reproductive structure controlled by endocrine factors usually bring about altered metabolic patterns and modified energy equilibrium (Nalbandov, 1970). This result in the fluctuations in the levels of metabolites, enzymes etc. as the bird undergo adaptive changes during seasonal breeding activities. In the present study variations in certain biochemical parameters of breeding and non-breeding Jungle Babblers were also carried out.

Regulation of metabolic pathways that provide fuel molecules is essential if the supply is to be maintained under altered metabolic conditions. The biological components which fulfill the tremendous energy demand during the breeding phase include glycogen, total lipids and proteins. Glycogen is the major storage form of carbohydrates in animals. It is easily synthesized from all available nutrients and is easily broken down when energy demand of the body increases. Therefore, glycogen is preferable storing material in the body. Lipids are another important constituent because of their high energy value and in the body, they serve as an efficient source of energy. Proteins have all the structural, biochemical and physiological roles to play in the body. Their biochemical role is

exemplified by enzymes and plasma proteins while their physiological role represents their degradation in severe cases (of starvation or tremendous energy demand) thus provide energy after carbohydrates and lipids. Excess of dietary amino acids are not secreted out but are converted to common metabolites that are precursors of glucose, fatty acids and ketone bodies and are metabolic fuels (Voet *et al.*, 1998). Therefore there exists an inter-relationship between carbohydrates, lipids and proteins. The variations in glycogen, total lipid and proteins were carried out in liver, kidney and intestine.

For the regular supply of energy depends on functioning of carbohydrate metabolism. Hence, the study of carbohydrate metabolism becomes important for the better understanding of bird's physiology. Carbohydrate metabolism is influenced by the enzymes involved in glycogenolysis, Kreb's cycle and gluconeogenesis viz. glycogen phosphorylase (GP), glucose-6-phosphatase (G-6-Pase), Succinate dehydrogenase (SDH) along with the Adenosine triphosphatase (ATPase). GP is initial catalytical enzyme in glycogenolysis which plays a strategic role in glycolytic pathway. It leads to phosphorylative degradation and utilization of glycogen and the phosphorylase levels in the tissue would apparently indicate the rate of glycolysis of the tissue. Glucose-6-phosphatase is a crucial enzyme of glucose homeostasis since it catalyses the ultimate biochemical reaction of the both glycogenolysis and gluconeogenesis (Plewka *et al.*, 2000).

According to the energy needs of the body, the increased or decreased intensity of aerobic glycolysis, Krebs's cycle and ATP usage could be inferred from the activities of the enzymes such as SDH and ATPase. ATPase and SDH both are actively involved in cell metabolism wherein ATPase generally carries the catabolic reactions while SDH keeps up the supply of energy rich substrate ATP molecules for ATPase. As the birds face tremendous stress during breeding the energy requirement of these birds should vary and should be indicated by the variations in the enzymic activities of different tissues during breeding and non-breeding phases. Therefore these enzymes were also assayed in the above said tissues during different phases of the reproductive cycle.

Finally depending on the breeding status and physiological changes if there exists any histological variations in the tissues studied has been carried out. The study is aimed to find out feeding preferences with reference to agricultural practices and physiological variations with reference to breeding and non-breeding status of a social semi arid sub tropical bird- Jungle Babbler.

Jungle Babbler (*Turdoides striatus*)

