GENERAL CONSIDERATIONS

The regular and cyclic fluctuations of annual seasons are known to influence the life activities of various organisms. Among the various biochemical and behavioural adaptations, the periodicities related to the procreation of the species have acquired prime importance at all stages of evolution and are so adjusted that the survival of progeny is insured in accordance with the concerned species. Such seasonal adaptations of reproductive activities in most of the species of birds are easily discernible. Further, these recurrent events are so timed that there is minimum stress on the adults and there are maximum chances for the survival of young ones. Varied rhythms of reproduction and survival usually define the characteristic breeding season of any particular species. A fairly good amount of literature is available on the reproductive cycles of various species of birds. Most of the reports were, however, published in respect of individual species of birds, and, then a few attempts have been made by various authors to present a comparative account of the same. On this background the present author thought of making a modest beginning in conducting a comparative study of some proximate factors related to reproductive cycles of two closely

related species of birds viz.- the Bank myna Acridotheres ginginianus and the Brahminy myna Sturnus pagodarum both residents of one locality i.e. the vicinities of Baroda city (Longitude 72.3° 13'E, Latitude 22° 18'N). As was stated, this being the first step in this direction, only the gross biochemical parameters could be taken up for investigation, looking to the scope of a work of this magnitude. However, an attempt has been made to consider simultaneously with gonads some other tissues related with the reproductive cycles like the liver and blood plasma. Another feature of the present work was the inclusion of kidneys and intestine, which were till recent times not considered to be influenced by reproductive phenomena. The parameters investigated quantitatively were total lipid content, total and esterified cholesterol contents, tissue protein content, levels of glycogen and ascorbic acid. Simultaneously, the gross body weight, gonadal weight and the gonosomatic index were recorded. All these were recorded for both the sexes of the two species of mynas. For the sake of practical convenience the annual reproductive cycles of these two species were grossly divided into four phases viz.- pre-breeding, breeding, post-breeding and non-breeding phases.

The selection of these two species of birds was

prompted from the general field observations regarding their nesting habits (hole-nesting) and almost over-lapping breeding periods — May to September (Bank myna) and late April to August (Brahminy myna). Though there is such a closeness of habits between the two species, the challenge to investigate possible species-specific differences was accepted in the light of the facts that there are some differences with regard to the following details :-

i) Bank mynas are colonial breeders as opposed to the individualistic habit of Brahminy mynas.

ii) Brahminy mynas are known to feed exclusively on fruits and insects, whereas Bank mynas usually add all sorts of human leftovers to their menu.

In general, male birds were observed to weigh more than the female ones, almost round the year. However, female birds of both species registered rather a steep increase in body weight just prior to oviposition due to sudden spurt in the accumulation of yolk material. The overall fluctuations of body weight revealed that in Bank mynas minimum differences between male and female birds were recorded during breeding season and that in case of Brahminy mynas during post-breeding period. Female Brahminy mynas did not show any noticeable variation in body weights throughout the reproductive

cycle. The right and left testes of male birds of both species showed that the left testis always was lighter. Maximal testicular weights (individually and together) were naturally recorded during the breeding season. Thereafter the fall in gonadal weights were comparatively steeper in case of Bank myna than the Brahminy myna. Similar comments were applicable to the ovary in both species. However, as noted in succeeding pages, while interpreting the quantitative fluctuations of various parameters under study, it was brought forth that they bore better and more meaningful relationship with the gonosomatic indices rather than with either only body weight or only gonadal weights.

It is well known that the fluctuations in different components of blood/blood plasma truly reflect to a great extent the metabolic states of various organs and tissues of the body. Within the scope of this work, only the following few parameters were assessed :- Total lipids, TC and EC in blood plasma and AA levels in the whole blood. Plasma total lipid, TC and EC concentrations were investigated with a view to know the contribution of the liver and their uptake by the gonadal tissue. Blood AA levels were studied to adjudge the possible contributions from the liver as well as the kidney — the known alternate site

of vitamin synthesis. Probably, the rate of absorption of this vitamin by the intestine is influenced not only by the dietary content but also by the circulating hormones concerned with reproduction. The data on blood AA levels would also help in understanding its well known involvement in overall energy metabolism as well as in steroidogenesis.

In general, the fluctuations in almost all of the parameters were less in magnitude in Brahminy myna as compared to those of Bank myna. High EC : TC ratios during PR to BR were found to be more condusive to gonadal steroidogenesis than otherwise, particularly in case of Bank myna. This was also applicable, but from a different angle during NB, wherein regressional accumulation of gonadal lipids was obvious. It was not possible to provide, on the basis of data at hand, plausible explanation of the said two different aspects of EC : TC ratios.

Fluctuations in blood AA levels were found to be less intense in case of male Brahminy myna and female Bank myna, however, these did reveal close association with gonadal steroidogenesis in both sexes of the two species. On the other hand, non-utilization and its accumulation in the male gonads of both species was very obvious immediately after BR, that continued

through PS to NB. In the case of the female gonads of both species a graded rise from BR to PS and then further on from PS to NB indicated possible continuation, though at reduced rate, of ovarian steroidogenesis during BR to PS. The possible implications of these aspects will be referred to subsequently at appropriate places.

Male birds : A quick glance at the data concerning phase-wise variations in the three major metabolite contents of liver, gonads, kidneys and intestine, revealed certain comparable trends that underlay the cyclic events in both the species. Nevertheless a few species-specific differences could also be noted.

In case of male Bank mynas the liver, gonads and kidneys exhibited enhanced protein synthesis, rising levels of glycogen in gonads, intestine and kidney, noticeable rise in total lipids of liver, plasma and gonads and significant lowering of hepatic glycogen during the transition from PR to BR — all these changes clearly indicated an overall rise in biosynthetic activities demanding corresponding supply of metabolic energy which could be said to have been met with by significantly enhanced rate of hepatic glycolytic activity. During the subsequent transition from BR to PS, except the gonadal protein and lipid levels, the other

parameters registered a decreasing trend. Hepatic glycogen breakdown was noted to be continued further. While interpreting these variations, it was found appropriate to take into consideration the variations of EC : TC ratios in the liver, gonads and plasma, and the AA levels during these two transition phases. Considered on this background, it could be said that the former changes were in favour of greater conadal steroidogenesis whereas those during latter period were indicative of more or less an abrupt cessation of spermatogenesis as well as gonadal hormone synthesis. During the next transition from PS to NB most of the parameters showed rising levels to varying extents. However, changes related to total lipids, EC : TC ratios as well as AA levels in case of gonads, liver and plasma were of biochemical significance indicating post-nuptual regressive changes.

In male Brahminy myna, barring some numerical variations in the metabolites in the tissues studied, the overall pattern was comparable to that of Bank myna. However, it cannot be missed that there were a few species-specific differences. Notable among these were : lowering of gonadal proteins from BR to PS and a phenomenal rise during PS to NB, considerable rise in hepatic glycogen during BR to PS in contrast to that in

Bank myna, followed by a remarkable lowering during PS to NB and also accompanied by a significant rise in renal glycogen content, and, phenomenal rise in intestinal level of the same. In the light of these facts, the present author is tempted to suggest that, during the post-breeding part of the cycle partial reduction in hepatic contribution of energy-yielding glucose for a generalized rise in biosynthetic activities (alike those in Bank myna) was made good partly by enhanced renal gluconeogenesis and liberation of glucose into blood coupled with intestinal uptake of carbohydrates. In this manner the underlying metabolic patterns during post-nuptial part differed significantly from those of male Bank myna. Further, it was evident that in the male Brahminy mynas the variations of EC : TC ratios in various tissues during PR to BR did not evince as clear cut influence on gonadal steroidogenic response as was observable in case of male Bank myna.

Bank myna female : The general synthetic trend observed from PR to BR in male birds was also applicable to female Bank mynas, except lowering of intestinal glycogen content and significant decrease in ovarian proteins. In case of female birds, it seemed that the energy required for synthetic activities during transition from PR to BR was supported by higher uptake

of lipids in chylomicrons from dietary source, as the liver was found to be building up glycogen. The present author regrets the lack of data concerning blood glucose levels, which would have been very useful in coming to some definite conclusion. Comparatively lower proportion of EC component and falling AA levels seem to be more favourable for enhanced gonadal steroidogenesis in female Bank myna.

Thereafter, during transition from BR to PS all the parameters exhibited decreasing trend, except gonadal proteins and AA levels of plasma, liver and gonads. During this period the rising total lipid levels of plasma indicated that instead of a normal mode of transport via 'chylomicrons' there was a shift to 'portomicrons'. The author would like to suggest that lipid utilization was the method of choice to meet general energy demands for post-breeding activities like nurturing the youngones.

During PS to NB almost all the parameters in all tissues studied exhibited rising trends, except total lipids of gonads and plasma as well as hepatic AA levels. From the changes noted in various metabolites assessed, it could be suggested that from the greater emphasis on lipid utilization during BR to PS a shift towards mixed metabolic pattern became evident utilizing carbohydrates

as well as lipids. However, the greater glucose supply seems to come from enhanced dietary absorption as well as gluconeogenic function of the kidney, and not from the usual source — liver.

The sex-specific differences noticeable with respect to EC and TC were as follows :- the EC component during PR to BR exhibited rise in plasma and lowering in hepatic level as compared to changes in the male birds. During BR to PS the gonadal EC as well as TC components registered noticeable decrease as against the significant rise in males, hepatic AA increase was more prominent in females. As far as transition from PS to NB was concerned, the ovarian EC rise was significant. Another interesting difference with regard to hepatic AA levels was that in case of female birds, the hepatic NB level was higher than that of PR, as against the highest AA level obtained during PR in case of male birds and lowest at NB level.

Brahminy myna female : The overall fluctuations in different parameters were found to be of low magnitude when compared to Bank myna, except for gonadal, hepatic and intestinal glycogen contents. The species-specific differences noted during PR to BR were the non-responsiveness of hepatic glycogen and marginal increase in intestinal glycogen and marginal decrease in ovarian, intestine and kidney lipids. The following phase was remarkable with highly significant

increase in hepatic glycogen content and further decrease in ovarian proteins. On the basis of available data it could be suggested that a phenomenal rise in hepatic glycogen is, in all probability, supported by enhanced lipid absorption from the diet as evinced by further rise in plasma lipids. On the other hand, the gonadal protein depletion seems to be species-specific character as corroborated by similar gonadal depletion in case of male birds also. On approach of NB, that is from PS to NB, equally remarkable drop was noted in hepatic glycogen content and rise in ovarian proteins and intestinal glycogen. From these characteristic changes, it is obvious that hepatic glycogenolysis seems to be the main source of energy supply for overall synthetic activities seen in most of the other parameters. Simultaneously, there was a significant drop in total plasma lipids. All this leads to a shift from lipid utilization during the previous phases to exclusively carbohydrate centred energy economy during PS to NB.

The sex-specific differences during PR to BR were no response of hepatic glycogen, decrease in gonadal proteins, increase in intestinal glycogen and decrease in intestinal proteins, and an increase in plasma total lipids in case of Brahminy mynas. From no response of liver during PR to BR, as far as hepatic synthesis of

glycogen as well as lipids is concerned, and from the observed increase in plasma lipids it could be suggested that intestinal absorption and transport of lipids via 'portomicrons' rather than 'chylomicrons' was taking place to provide necessary energy for general metabolic activities.

Among the female birds of the two species with regard to the TC, EC and AA levels the following points were noted :-

i) PR to BR — the hepatic TC showed a decrease in Brahminy myna as against rise in Bank myna, and the plasma EC level showed a decrease as compared to the increase in Bank myna.

ii) BR to PS — the plasma EC level of Brahminy myna exhibited noticeable increase as against a precipetous fall in Bank myna.

iii) PS to NB — the hepatic AA levels revealed that in Bank myna it was higher than PR levels whereas in Brahminy myna it was at an all time low level.

By way of summarizing the different points stated above it could be suggested that there are phase-dependent shifts in the energy economies of both the species with subtle species-specific variations with respect to preferences for carbohydrates/lipids. The male birds of

both species seem to undergo an abrupt end of the spermatogenic and steroidogenic activities as compared to the females. The subdued continuation of ovarian steroidogenesis in female birds from BR to PS seems to be appropriate for post-breeding care given mostly by the female birds. However, if one considers transition from NB to PR, it becomes apparent that male birds undergo recrudescence comparatively earlier than females, a fact consistent with early pre-breeding activities exhibited by the males such as territory occupation, seeking of mates, etc..

The present author wants to put on record that there are many lacunae in the data collected, but it was beyond the time and magnitude of this work. Here, the author would like to indicate following points, which would have certainly added much to the meaning of whatever has been inferred in this work :-

1) Assessment (RIA) of various concerned hormones in circulation during various phases of reproductive cycle.

2) Histoenzymological studies of some of the important enzymes relevant to the work presented.

3) Variations in blood glucose levels.

4) Supportive histological observations.

The author is aware of the fact that the discussion presented here on metabolic patterns merely on the basis of one time levels of various metabolites alone is rather presumptuous and that, at least in future, it should be substantiated to be of significance. Nevertheless, an attempt has been made to put forth certain deductions, with limited data collected, which nevertheless open up venues for further work.