CHAPTER 1

SEASONAL VARIATION IN THE METABOLITES OF THE LIVER OF THE MIGRATORY STARLING, STURNUS ROSEUS (LINNAEUS)

It is well known that migratory birds deposit large amounts of fat in their body prior to migration (Odum and Perkinson, 1951; Wolfson, 1954; Odum and Connell, 1956; Farner and Oksche, 1962). This migratory fat is mainly stored in fat depots, like the adipose tissue and the liver. Connell *et. al*.,(1960) have shown that the fat-free weight as well as the lean dry weight of birds of the same size is more or less constant and that in the case of migratory species the great fluctuationsare due to the large variation in the fat deposits.

The liver is generally believed to be the main centre for the production and distribution of intermediary metabolites (Popper and Schaffner, 1957). Cyclic changes in the weight of liver of migratory birds as opposed to that of nonmigrants, have been shown (Okeson, 1953, 1956). It was therefore thought useful to obtain data on the changes in the water, fat, protein and glycogen contents of the liver of Rosy pastor (*Sturnus roseus* Linnaeus), a migratory bird which arrives in Baroda about the month of September and leaves towards the end of April. The observations were made in the months of October to April. Glycogen was estimated only in the premigratory phase.

Material and Methods

All birds used were shot early in the morning about 5 a.m.

and immediately weighed. The whole liver was quickly excised, weighed and pieces were cut for histochemical observations and quantitative estimations. Histochemical localization of fat was studied according to the procedure laid down by Baker (1946) using Sudan Black B. Fat content was estimated by Soxhlet extraction with a 1:1 alcohol-ether mixture. Protein content was determined by the micro Kjeldahl steam distillation method (Hawk et al., 1954). Glycogen was estimated by the anthrone method (Seifter et al., 1950). The percentage of water of the tissue was also estimated.

Results and Discussion

The results of the quantitative estimations are presented in Table I. Histochemical localization of fat in the liver is shown in figures 1 & 2. From the results obtained it is seen that there is a decrease in the fat content in January extending to March (Fig. 1) and then a sharp increase of fat with increase in body weight upto the time of migration. It is also seen that during the week prior to the actual migration there is a sudden increase in fat and correspondingly a decrease in protein and water and increase in glycogen. The increase and mobilization of fat during this period can be seen in Fig. 2.

The reason for the decrease in the fat content in January extending upto March may be attributed to the shorter feeding hours of the winter months and to the higher energy requirement obtained from fat to maintain its body temperature. Thereafter the fat content

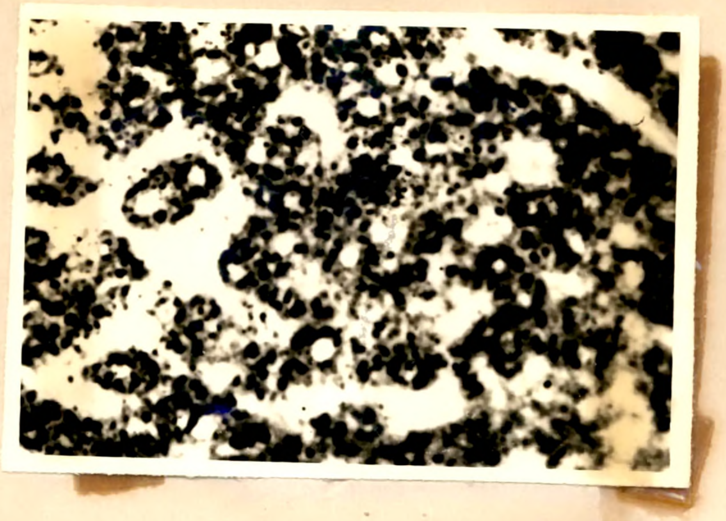
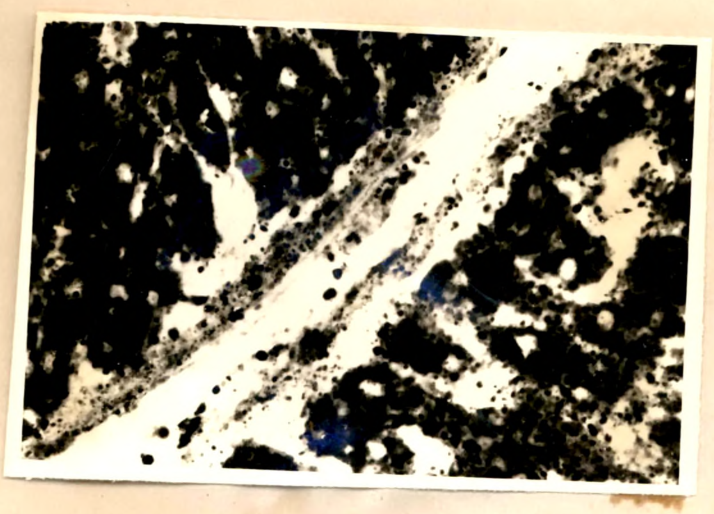


Fig. 1.

Fig. 1. Photomicrograph of the liver of Rosy Pastor showing the distribution of fat in the month of March.



30 μ Fig. 2.

Fig. 2. Photomicrograph of the liver showing higher concentration of fat in the month of April just prior to migration. Note in the centre of the figure a blood vessel containing large droplets of fat and also fine fat granules adhering to the wall of the blood vessel. The paranchymatous cells are loaded with fat droplets.

Table 1

Water, fat, protein and glycogen contents of the liver of Rosy Pastor

Month & date	Body weight in grams	Water %	Fat % Dry weight	Protein % wet weight	Glycogen % wet weight
October 1 - 31	55.50 (13)[1] (51.00 - 58.50)[2]	70.05 (5)[1] (68.80-71.20)[2]	17.69 (5)[1] (17.20-18.12)	23.58 (5)[1] (22.41-24.62)[2]	--------
November 1 - 30	65.00 (12) (62.00-69.00)	70.20 (5) (69.30-71.30)	18.17 (5) (17.50-19.12)	23.88 (5) (23.33-24.20)	--------
January 1 - 31	63.00 (10) (60.50-66.00)	70.60 (6) (69.60-71.50)	12.80 (6) (11.83-13.34)	23.82 (6) (23.15-24.45)	--------
February 1 - 28	63.50 (18) (61.00-67.50)	69.90 (6) (69.00-70.50)	13.10 (6) (12.38-13.88)	23.42 (6) (23.10-23.82)	---------
March 1 - 15	68.00 (20) (64.00-71.50)	69.80 (7) (68.40-71.30)	13.50 (7) (12.35-14.65)	23.53 (7) (22.75-23.96)	---------
March 16 - 31	74.50 (20) (70.50-78.00)	67.63 (10) (64.00-69.20)	23.10 (10) (22.10-24.50)	20.20 (10) (18.79-21.60)	---------
April 1 - 15	77.00 (27) (72.00-84.00)	66.90 (9) (65.00-68.50)	24.10 (9) (22.28-27.00)	19.93 (9) (18.21-21.64)	0.2569 (6) (0.2333-0.2905)
April 16 - 24	90.00 (36) (80.00-125.00)	65.66 (10) (63.00-67.21)	34.00 (10) (28.20-40.10)	17.67 (10) (16.60-18.86)	0.6201 (10) (0.4083-1.1200)

Figures in paranthesis (1) denote the number of birds used and that in 2 the range of readings obtained.

is increased with a fall in protein and water. This is of interest because it is generally stated that with the increasing of fat level the water level is decreased making no reference to the level of protein. The reduction in protein suggests two possibilities, (1) the conversion of some proteins finally to fat, (2) a decline in the process of protein synthesis due to an increase of fat synthesis.

The increase in glycogen is also of interest since it suggests the possibility of increased storage of glycogen for final conversion to fat. Kamemoto et al., (1958) however, studying the effect of long photoperiod on the energy storage in migratory finches have observed a decrease in the glycogen level and a very high increase in fat in the liver. This observation that glycogen is decreased, if true, suggests that the result of the experimental long photoperiodic treatment is not the same as natural premigratory state. It should also be mentioned that the increase in glycogen noted in the present work is not due to shorter nights since Baroda is in the tropical region where the difference in day length is not so considerable as in the temperate regions.

Summary

1. Changes in the body weight, and the content of water, fat, protein and glycogen in the liver have been studied in the migratory bird Sturnus roseus (Linnaeus).

2. A fall in the fat content of the liver during winter was noted. A sudden rise in fat and glycogen and a fall in protein and water were noted during the week prior to actual migration. The significance of the findings is discussed.