CHAPTER 4

SEASONAL CHANGES AT THE STUDY SITES
4.1 OVERVIEW

Seasonality in climate is reflected, more often than not, in the biota. Rainfall, or more specifically the water balance, is known to affect the phenologies of tropical plants. Most climates in the tropics are seasonal in regard to rainfall distribution (Medina, 1983). Even in tropical or equitorial areas with little seasonal rainfall variation, there could be other factors which trigger seasonal cycles in plants (e.g., leaf flush, flowering), like hours of bright sunshine which enable the build up of assimilates (Whitmore, 1985).

Rainfall, after or followed by a dry spell, stimulates leaf flush in many tropical species (Whitmore, 1985; Prasad and Hegde, 1986). Price (1979) found that the number of arthropods on branches correlated significantly with the number of leaves. Other studies in the tropics have demonstrated a decrease in insect abundance in areas with extended dry season, concurrent with leaf loss and in particular, with lack of new leaf growth (Fogden, 1972; Janzen, 1973; Karr, 1976). Deciduousness has ecological significance in that it strongly reduces water loss. Many of the trees and plants, especially of the dry regions, flower and fruit when they are leafless (Somasundaram, 1963). These include many bird-pollinated flowers like Butea, Erythrina, Bombax, etc. (personal observations). Phenological changes perhaps have a more direct influence on frugivores, and nectarivores than any other avian guild. Except in equable tropical regions without severe dry seasons, flowering in
any plant community is generally concentrated to a limited part of the year (Snow, 1981).

As was already mentioned (Section 2.1) Peninsular India has a monsoonal climate with essentially two rainy periods - that during the south-west monsoon and that during the north-east monsoon. Bangalore receives rain from both the monsoons, but Sampaje does so only from the south-west monsoon. Moreover the rainfall is also markedly heavier in the Sampaje site as compared to that in Bangalore.

Mani (1985) classifies the seasons of Bangalore as follows:

1. the cold weather season, from December to February,
2. the hot weather season from March to May,
3. the south-west monsoon season, from June to September, and
4. the north-east monsoon season, October and November.

These seasons could also be called cool-dry, hot-dry, hot-wet and cool-wet seasons. Flowering of most of the native species occurs in Bangalore during the hot-dry season while many of the exotics start blooming in December (Table 4.1). Leaf flush of many native tree species takes place in the hot dry season. Accompanying changes in insect and other resources for birds could be expected during these seasonal changes and have been presumed to be so.

As indicated earlier, data on the seasonal fluctuations of birds were collected at three sites in Bangalore and at one from the Western Ghats. The three
Bangalore sites will be considered first and then, the Sampaje Range Forest Study site from the Western Ghats. The graphs depicting the seasonal fluctuations are appended to this chapter.

4.2 LALBAGH

Of the sixty species come across during the transects at Lalbagh, about twenty-five species can be classed as regularly occurring, about ten as occurring occasionally, and the rest as vagrants or stray occurrences. Of the regularly occurring species, five species are migratory, and the rest are residents. The total number of species and densities are highest around December-January, when the local numbers are augmented by winter migrants.

Strongly seasonal climatic patterns would impose a cyclicity on the biota too. While many migrants show a relatively smooth up and down cyclical fluctuation, some residents have erratic patterns. The period for which the monthly mean is higher than the annual mean could coincide with their (local) breeding seasons provided, the population is not a locally nonbreeding one (though resident population). It should be noted that the patterns of the guild are to a great extent influenced by the numerically dominant species in the guild.

The fluctuations of the various guilds are illustrated in Figures 4.1a to 4.1i. Different guilds responded to changing climatic conditions differently. A test for seasonality, as described by Lack (1985), indicated significant seasonal changes at the 1% level for frugivores,
hole nesters, foliage gleaning insectivores, migrants, nectarivores, omnivores and seed eaters; and at the 5% level for sallying and aerial insectivores. The fluctuations of the regularly occurring species are shown in Figures 4.5a to 4.5z.

The carnivores showed a peak in January-February, the ground insectivores in February-March, the frugivores in March-May, the nectarivores in July-September (though in only three out of five years), the omnivores in August-December, and the seed eaters in November-February. If a sharp fall in the abundance fluctuation curve is considered, the migrants are absent from around May to August/September and the seed eaters show a decline in March-May.

Rainfall in Bangalore continues to the end of the calander year. Conditions start becoming drier after the monsoon rains and it is mainly a rainless period till the premonsoon showers of May. The drying conditions trigger-off blooming and fruiting of trees and shrubs. Grass, if it is not cut, bears seed by the beginning of the dry weather. Trees start blooming and fruiting subsequently. Exotic tree species at Lalbagh do not always strictly stick to this pattern. For example, Spathodea campanulata, the Tulip tree attracts a lot of mynas, (especially Jungle Mynas), when it is in bloom. This tree is in flower for a long period from September to February. Tabebuia avellanidae, again an exotic species which attracts sunbirds, blooms in December, which is not the usual case with native large-flowered species. These could bring about a change in the fluctuation of species which can tap the resources.
This changing pattern in the conditions, reflects in the abundance of the guilds, which is treated in greater detail below:

**Omnivores:** Figure 4.1h shows the fluctuation patterns of the crows for five years. It can be seen that the greater numbers are reached around August-February. Scavenging opportunities would perhaps be better at this time. Both are resident species and there is a large movement of crows from communal roosts outside Lalbagh every day. Of the two species, it can be seen from the graphs (Figures 4.5l and 4.5m) that the Jungle Crow has a less distinct fluctuation pattern than the House Crow. The amplitude of the fluctuation is also less with the coefficient of variation being 37%, while it is 59% for the House Crow.

**Frugivores:** Of the thirteen frugivores recorded at Lalbagh, only eight species were regularly occurring species. Figure 4.1b gives the fluctuation of the guild. The fluctuations coincide with the hot dry season when many of the tree species are in fruit and/or flower. The Golden Oriole is the only migratory frugivore occurring regularly at Lalbagh.

**Seed eaters:** (Figure 4.1i). The Roseringed Parakeet has been included here; this is a 'seed predator' and since it also takes fruit, it could be perhaps be considered along with the frugivores for a seasonal analysis. This species and the Spotted Dove dominate the guild. There is a characteristic decline in March-May. It is peak summer when the grass and other seed availability would be low at
Lalbagh.

**Nectarivores:** Figure 4.1g gives the fluctuation of the guild. The densities are quite even. In three out of five years, there was a peak in August.

**Migrants:** Figure 4.1f. Most of these species are Palearctic migrants; the Brown Flycatcher breeds in one or two restricted patches in the peninsula. The migrants arrive by October and depart by May.

**Sallving and aerial Insectivores:** The two common regularly occurring species of this guild, the Brown Flycatcher and the Grey Drongo are both migrants.

**Foliage gleaning insectivores:** (Figure 4.1d). This guild has two common migrants and three common resident warblers. When they occur, the migrants are more abundant than the residents. The resident warblers breed during the monsoon months when the migrants are absent.

**Ground feeding insectivores:** (Figure 4.1g). Peaks are in February- March. All are almost vagrants into this habitat.

### 4.3 BANGALORE MILITARY SCHOOL

The fluctuations of the guilds are shown in Figures 4.2a to Figure 4.2j. As has already been mentioned in Chapter 2, this area is poor in shrubbery. It is a residential school area which attracts scavenging species.

In the case of the nectarivores, the bark gleaning insectivores, the ground feeding insectivores and the carnivores (Figures 4.2i, 4.2e, 4.2g and 4.2a respectively) the fluctuations are erratic. The migrants are shown in Fig.
4.2h. The representation in July is because of the Brown Flycatcher overstaying. If the peaks of the various guilds are considered, there is a sequence of peaks in the year. The omnivores (Figure 4.2j) show a peak around January, the seed eaters (Figure 4.2k) in February-March, the frugivores (Figure 4.2b) in April and the hole nesters (Figure 4.2c) during the premonsoon. If the troughs are considered, the foliage gleaning insectivores had a low in May-October, the sallying and aerial insectivores in December-January, the seed eaters again in January, the migrants after April, and the frugivores in July. A test for seasonality, as described by Lack (1985), indicated significant seasonal changes at the 1% level for omnivores, seed eaters, nectarivores, foliage gleaning insectivores, frugivores, carnivores, migrants and hole nesters; and at the 5% level for sallying insectivores.

The timing of the rise and fall of the populations of the seed eaters and the frugivores coincides with what can be expected due to the gradual change from a wet postmonsoon condition to a drier premonsoon season. The smaller plants (e.g. grass) would be affected by the lack of availability of water earlier than the trees, and hence flower and seed earlier.

4.4 KALKERE STATE FOREST

Kalkere has more shrub layer vegetation than the sites dealt with earlier. Tree vegetation is dominated by Eucalyptus species and Shorea talura. The shrub layer also has abundant suckers of Shorea. The seasonal fluctuation
noticed at Kalkere is illustrated in Figures 4.3a to 4.3j.

Two of the guilds at Kalkere State Forest showed dual peaks. The nectarivores were abundant in December-January and again in August. The migrants showed a peak after arrival and again towards the end of their stay here. The seed eaters showed a peak in January-February while the ground feeding insectivores exhibited a peak in April-May. Both the frugivores and migrants showed a dip in January. The fluctuation patterns of the carnivores, the omnivores and the hole nesters were quite erratic. This could be because, only one count was taken per month. The carnivores tended to increase during the premonsoon months, the foliage gleaning insectivores showed a dip during the month of January and the hole nesters showed a decreasing trend.

The migratory species which come here are mainly foliage gleaning insectivores. A test for seasonal fluctuation, as described by Lack (1985), indicated significant seasonal fluctuation at the 1% level for seed eaters, omnivores, nectarivores, ground feeding insectivores, foliage gleaning insectivores, sallying and aerial insectivores, frugivores, hole nesters and migrants; and none just at the 5% level.

4.5 **SAMPAJE RANGE STUDY SITE**

Betts (1929, 1951), working in Coorg, observed that there is considerable local movements of resident species generally in an East and West direction. He observed that such insectivorous birds as swifts and bee-eaters move into the dry zone (after breeding), to avoid the heavy rains of the monsoons. Other species which breed in the dry zone
wander up into the wet zone in the dry season. Zacharias and Gaston (1983) studying an area of tropical dry secondary scrub, suggested that the timing of breeding for birds in this area of Southwest India is determined mainly by the physical effects of the distribution of rainfall and is relatively little affected by the ecology of the species concerned. The breeding of insectivorous species was concentrated during the pre-monsoon period to a greater extent than that of other species, although both exhibited peaks during February to May. An analysis on the basis of nest sites showed that ground- and hole nesting birds tend to concentrate their breeding in the pre-monsoon period compared with species building open nests above ground. Gaston et al. (1979), studying babblers of the genus Turdoides, in the same area, found a lack of correlation in the timing of breeding, and seasonal changes in insect abundance. They suggested that heavy monsoon rainfall depresses breeding through curtailing feeding activity rather than affecting the actual abundance of food.

From what the above mentioned workers have recorded, it is clear that even species of open secondary habitats are affected by the heavy rainfall. Though bird abundances were not estimated during the actual monsoon months during the present study, many species showed a decline in their densities with the approach of the rainy season.

The fluctuation in the guilds at this study site are shown in Figures 4.4a to 4.41. A test for seasonality, as described by Lack (1985), indicated significant seasonal fluctuations at the 1% level for the frugivores, foliage
gleaning insectivores, nectarivores, seed eaters, hole nesters and migrants. The monthly mean densities of the individual species are given in Table 4.1. The different guilds exhibited peaks at different times; but the relative differences in their timing did not vary as much as in the dry zones. The foliage gleaning insectivores showed a peak in October, while the sallying insectivores showed two peaks, one in October and the other in April. But, again, the bark gleaning insectivores showed two peaks, separated by two months, one in January and the other in April. The nectarivores exhibited a peak in January while the hole nesters and the seed eaters showed a peak in February. The omnivores, birds of essentially drier conditions which were come across in this study, had a peak in the dry months of March and April. The carnivores and the frugivores showed a decline in December.

4.5a. DISTRIBUTION OF BIRDS IN RELATION TO THE VEGETATION STRATA AT THE SAMPAJE STUDY SITE

The Blackheaded Babbler and Whitebellied Blue Flycatcher were species which were predominantly found near the ground or in the shrub zone. The latter species was found especially near thick growth of tall lanky seedlings of the evergreen forest ('treelets'). Ali &
Ripley (1968-78) mention that the Largebilled Leaf-Warbler is a species which keeps to the crowns of medium sized trees and the lower canopy of larger trees. Price (1979) mentions that during the migratory passage the species is restricted to the undergrowth. During the present studies also, the species was found to keep to the understorey and shrub layer. The distribution pattern of birds by vegetation strata, for species for which data could be collected is given in the inset. In the case of mixed feeding flocks (or 'mixed hunting parties') there seemed to be a shift from the species' preferred zone to a 'compromise' level of the flock.
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4.6 THE MIGRANTS

The definition used here for delimiting migrants is that of McClure (1974) (specifically his trans-zonal and the serial types): For species not recorded in adequate numbers or in sufficient frequency, the status as recorded by Ali & Ripley (1968-78) has been used as a criterion. Thirteen migratory species were recorded at Lalbagh, ten at Sampaje, eight at BMSC and ten at Kalkere State Forest. Going by the annual average percentages, Lalbagh had 11.414 percent, Sampaje had 9.682 percent, BMSC had 8.058 percent and Kalkere had 7.234 percent. The percentage accounted for by migrants in the annual total at Sampaje would go down, had counts from the monsoon months too been included. Though totally sixteen migrants were come across only eight species belonging to four families were in adequate numbers. Amongst these, the Golden Oriole was the only frugivore species, while all the rest were insectivorous. The Blyth's Reed Warbler, and to some extent the Largebilled Leaf-Warbler, were shrub zone species and the Grey Wagtail was the only ground feeder. The Brown Flycatcher usually keeps to shaded situations and tends to be crepuscular. Beals (1970) observed a similar pattern in an Ethiopian woodland, where he found that the migrant insectivores were essentially species that fed on tall shrub and tree foliage.

The timing of arrival of the migrants from the Palearctic seems to be regulated by changing conditions there (Karr, 1976a), while departures from the winter quarters could be delayed until food levels rise in the
winter quarters (Price, 1979). Most of the winter migrants that visit Peninsular India start arriving chiefly between September and November, and leave for their northern breeding grounds, from and beyond the Himalayas, in March/April (Ali & Ripley, 1978). The present study also revealed that the migrants are here from September-October to March-May. Golden Orioles arrived late and left early (October to March usually) while the Greenish Leaf-Warblers arrived early and left late (September end, to beginning of May sometimes). Examining the data, the following patterns in the seasonal changes are suggested:

1. The populations may go up after arrival and then decrease (like in autumn migration);
2. An increase before the end of the wintering season (like in spring migration);
3. Increase in the beginning and end of the winter stay (or a relative decrease in the middle of the stay, as during passage both to and fro);
4. A gradual increase and a gradual decrease with the peak somewhere in the middle of the winter stay;
5. An erratic fluctuation without a strong repeating pattern within the period of stay.

It should however be noted that the geographical locations of the study sites is in the southern half of the wintering ranges of many species. Hence, a strong seasonal passage pattern cannot be expected. The patterns observed may also be due to habitat and site shifts: the most favorable sites
being preferred, and individuals dispersing if excluded out of territories being formed in the cases, like pattern #1. At Lalbagh, the types of patterns noted above are shown by the Greenish Leaf-Warbler (#1), the Golden Oriole, (#2, in most years), the Brown Flycatcher to some extent and the Grey Wagtail (#5). At BMS the Blyth's Reed-Warbler showed the third pattern:

If the observed fluctuation patterns of migrant warblers are considered [with information from Gaston (1978, from Delhi) and Price (1979, in the Eastern Ghats)], the following is indicated:

1. The Blyth's Reed-Warbler starts arriving in Delhi in July-August and the numbers increase by beginning of September. In Bangalore the peak densities are reached in December-February. In the Eastern Ghats, Price observed an influx in mid March.

2. In the case of the Greenish Leaf-Warbler, passage in Delhi was in August-September, in Bangalore in October, and Price makes no special mention about its passage. At Sampaje, there was no appreciable peak noticed though numbers in October were slightly higher.

3. The Large-billed Leaf-Warbler exhibited a peak in Sampaje in October, and in the Eastern Ghats it was recorded in passage in September-October and April.

4. The Large Crowned Leaf-Warbler was in higher numbers in Delhi again in August-September, in Sampaje in January, and was uncommon in the Eastern Ghats. In Bangalore it occurred as a vagrant (personal observations).

As compared, the latter two species are birds of moist...
habitats to the former two. For species like the Largebilled Leaf-Warbler, the winter distributional range itself is not satisfactorily known (Ali & Ripley, 1973).

There could be differences in the seasonal patterns in the same zone, with differences in habitat. At Lalbagh, the Blyth's Reed Warbler showed a mid season peak while at BMS (perhaps a less suitable habitat) it dips in January.

4.7 SEASONAL FLUCTUATION PATTERNS IN CONGENERIC SPECIES

In the case of congeneric species, it was found that the commoner species was invariably larger in size than the less common species, and also fluctuated less. The following sets are given as examples to illustrate the point.

Lalbagh: The Jungle Crow is larger than the House Crow, is more abundant, and fluctuates less as indicated by the coefficient of variation which is 37% for the Jungle Crow and 58% for the House Crow. In the case of the Barbets it is 63% in the Small Green Barbet and 67% percent in the Crimsonbreasted Barbet. The Indian Myna has a CV of 38% and the Jungle Myna has a CV of 88%. This seems to hold good even in the case of closely related species not congeneric, as in the case of the Tailor Bird (40%) and the Ashy Wren-Warbler (93%).

The same pattern is shown at other sites also.
Fluctuations in Carnivores

Fig. 4.1a

LaBargh, Bangalore
Fluctuations in Frugivores
Lalbagh, Bangalore

Fig. 4.1b

Fluctuations in Sallying Insectivores
Lalbagh, Bangalore

Fig. 4.1c
Fluctuations in Foliage Insectivores
Lalbagh, Bangalore

Fig. 4.1d

Fluctuations in Ground Insectivores
Lalbagh, Bangalore

Fig. 4.1e
Fluctuations in Migrants
Lalbagh, Bangalore

Fig. 4.1f

Fluctuations in Nectarivores
Lalbagh, Bangalore

Fig. 4.1g
Fluctuations in Omnivores

Fig. 4.11

Fluctuations in Seed eaters

Fig. 4.11
Fluctuations in Carnivores
Bangalore Military School Campus

Fig. 4.2a

Fluctuations in Frugivores
Bangalore Military School Campus

Fig. 4.2b
Fluctuations in Carnivores
Bangalore Military School Campus

Fluctuations in Frugivores
Bangalore Military School Campus

Fig. 4.2a

Fig. 4.2b
**Fluctuations in Hole nesters**
Bangalore Military School Campus

![Graph of Fluctuations in Hole nesters](image)

**Fig. 4.2c**

---

**Fluctuations in Sallying Insectivores**
Bangalore Military School Campus

![Graph of Fluctuations in Sallying Insectivores](image)

**Fig. 4.2d**
Fluctuations in Ground Insectivores
Bangalore Military School Campus

Fig. 4.2g

Fluctuations in Migrants
Bangalore Military School Campus

Fig. 4.2h
Fluctuations in Nectarivores
Bangalore Military School Campus

Fig. 4.2i

Fluctuations in Omnivores
Bangalore Military School Campus

Fig. 4.2j
Fluctuations in Seed eaters
Bangalore Military School Campus

Fig. 4.2k

Fluctuations in Carnivores
Kalkere Range Forest

Fig. 4.2a
Fluctuations in Frugivores
Kalkere Range Forest

Fig. 4.3b

Fluctuations in Hole nesters
Kalkere Range Forest

Fig. 4.3c
Fluctuations in Sallying Insectivores
Kalkere Range Forest

Fig. 4.3d

Fluctuations in Foliage Insectivores
Kalkere Range Forest
Fluctuations in Ground Insectivores

Kalkere Range Forest

Fig. 4.3f

Fluctuations in Migrants

Kalkere Range Forest

Fig. 4.3g
Fluctuations in Nectarivores
Kalkere Range Forest

Fluctuations in Omnivores
Kalkere Range Forest

Fig. 4.3h

Fig. 4.3i
Fluctuations in Seed eaters

Kakere Range Forest

Fig. 4.31
Fluctuations in Carnivores
Sampaje Study Site

Fig. 4.4a

Fluctuations in Frugivores
Sampaje Study Site

Fig. 4.4b
Fluctuations in Carnivores
Sapajus Study Site

Fluctuations in Frugivores
Sapajus Study Site
Fluctuations in Sallying Insectivores
Sampaje Study Site

Fig. 4.4c

Fluctuations in Bark Insectivores
Sampaje Study Site

Fig. 4.4d
Fluctuations in Foliage Insectivores
Sampaje Study Site

Fig. 4.4c

Fluctuations in Ground Insectivores
Sampaje Study Site

Fig. 4.4d
Fluctuations in Migrants
Sampaje Study Site

Fluctuations in Nectarivores
Sampaje Study Site

Fig 4.4
Fluctuations in Omnivores
Sampaje Study Site

Fluctuations in Seed eaters
Sampaje Study Site
Fluctuations in Ground nesters

Sampaje Study Site

Fluctuations in Hole nesters

Sampaje Study Site

Fig. 4.4k

Fig. 4.4l
Zalicastrum indicus


Fig. 4.3 a
Acceptable densities

Fig 4.5 b
Eudynamys scolopacea


Fig. 4.5 e
Dicrurus leucophaeus

Acridotheres fuscus
Cortes macrophyllus

mean density

JAN JUL JAN JUL JAN JUL JAN JUL JAN JUL
APR OCT APR OCT APR OCT APR OCT APR OCT
months
Aegithinia tiphia


Fig. 4.5 n
Pycnonotus jocosus

Fig 4.5 o
Muscicapa latirostris

Fig. 4.5 p
Fulica atra
Acrocephalus dumetorum


Fig. 4.5 a

mean density

JAN APR JUL OCT JAN APR JUL OCT APR JUL OCT JAN APR JUL OCT
months
**Phylloscopus trochiloides**


![Graph showing the mean density of Phylloscopus trochiloides over different months from January 1978 to October 1988.](image)
Copsychus saularis