Breeding strategies of birds in a moist deciduous forest at Siruvani

SACON

Sálim Ali Centre for Ornithology & Natural History

BREEDING STRATEGIES OF BIRDS IN A MOIST DECIDUOUS FOREST AT SIRUVANI IN THE NILGIRI BIOSPHERE RESERVE

(Project funded by the Biosphere Reserve Programme of the Ministry of Environment & Forests, Govt. of India)

FINAL REPORT

Investigators

Lalitha Vijayan
V S Vijayan

Project staff

P R Arun
C Venkatraman

Sálim Ali Centre for Ornithology & Natural History

2000

Lalitha Vijayan is the Principal Scientist in the Division of Avian Ecology. She received her Ph.D. degree from Bombay University for a study on the comparative biology of drongos in South India under the guidance of late Dr. Salim Ali. She worked in a multidisciplinary project on the 'Ecosystem of Keoladeo National Park' for a decade. At SACON, she has been working on the avian communities and endangered species in the Western Ghats and Andaman Islands.

V.S. Vijayan is the Director of SACON. A student of Dr. Sálim Ali in Field Ornithology, he was awarded Ph.D. from Bombay University for his work on the biology of bulbuls. Headed the Wildlife Biology Division of the Kerala Forest Research Institute for five years and subsequently the Keoladeo National Park Ecosystem Study of the Bombay Natural History Society for more than a decade. His research interests are ecology and conservation of birds of wetlands and tropical forests, conservation and sustainable use of wetland resources and fundamental ornithological studies.

Moongilpallam, Anaikatty P.O.
Coimbatore 641 108, INDIA
Ph: 0422-857103 to 105
Fax: 0422-857088
Email: salimali@vsnl.com & sacon@vsnl.com

Typesetting: **K.K. Ramakrishnan**

CONTENTS

1. EXECUTIVE SUMMARY AND CONCLUSIONS

Introduction

Although breeding biology of birds is extensively studied in different parts of the world, looking at them in line with Darwinian fitness started with Lack (1968) when he placed post-natal growth and other life history attributes in an evolutionary context. Breeding strategies of birds are complex as it has several components such as breeding season, breeding requirements (food availability, breeding habitat, nesting location), mating pattern and reproductive rates. The survival strategies depend on the proximate factors increasing fecundity and ultimate factors determining life-time reproductive success. The reproductive effort is related to resource variability and, reproductive output to environmental stability.

Information on the breeding of most species in India is qualitative and detailed studies are conducted only on a few species where the biology and breeding seasonality of particular species or groups are dealt with. Attempts have been made in a few cases to establish the relationship between the breeding season and insect seasonality. However, the relationship among environmental factors, insect abundance and breeding seasonality of birds have not yet been worked out. Only a few studies in India have reported the abundance of different insect groups, but that too have not made any attempt to find their relationship with the environmental factors. Hence, a detailed study was done on the abundance of different insect groups, especially as this form the major food of birds (even for non-insectivorus birds as food for the nestlings), ecological determinants of them and the important role they play in the breeding seasonality of the birds. Gaston and Vijayan (1986) compared the data on the breeding seasonality of birds in different regions of the sub-continent, but could not define the factors determining it. Such studies are required on a long-term basis in order to examine the strategies of birds with respect to seasonality under varying ecoclimatic conditions. Besides providing interesting insight into various academic questions, such a study would bring out habitat requirements for successful breeding and better productivity. With this background, a project was taken up with the objective:

- to evaluate the breeding strategy of selected species of birds in a moist deciduous forest.

Aspects studied

a. Breeding seasonality of various species of birds present in the area with the possible factors affecting it.

b. Breeding requirements of the species with regard to the habitat.

c. Nesting details of a few selected species.

Study area and methods

The study was conducted during 1994-97 at the foothills of Siruvani, 31 km west of Coimbatore city which is a part of the Boluvampatty reserve forest in the Coimbatore forest division in the Western Ghats. This area is contiguous with the Muthikulam reserve forest of the Attapady range, Palghat. Water from this area is drained to the Anaiar stream which flows along the whole length of the southwest boundary of the intensive study area of about 250 ha and joins Noyal river. The climate is cool and pleasant for the major part of the year except during March to May when it is hot and dry. The area is subjected to both South-West and North-East monsoon with a mean annual rainfall of about 180 cm.

The vegetation type present in the study area is of "Southern Tropical Moist Deciduous" dominated by *Lagerstroemia lanceolata, Terminalia spp., Trewia nudiflora, Bridelia retusa, Albizzia spp., Stereospermum tetragonum* and *Syzygium cumini* in the top storey. The middle storey consists mainly of *Antidesma diandrum, Piliostigma malabaricus, Bauhinia racemosa, Cassia fistula, Emblica officinalis, Careya arborea, Trema orientalis, Mallotus spp., Tectona grandis* and *Meliosma simplicifolia. Bambusa arundinacea* forms tall bushes among trees. The undergrowth of shrubs is poor, the common ones being *Cipadessa baccifera, Hibiscus furcatus, Lantana camara, Clerodendrum baccifera, Glycosmis mauritiana* and *Securinega virosa.*

Climatic factors

Maximum and minimum temperature and relative humidity were recorded. Rainfall data was obtained from TWAD (Tamil Nadu Water Supply and Drainage) Board at Siruvani.

Plant community and phenology

Vegetation sampling was carried out where the bird census was done following plot method covering trees, shrubs and herbs. The phenology of trees was recorded for two consecutive years and shrubs for the second year. Ten individuals of dominant species were marked and recorded by grading the abundance of leaf, flower and fruit.

Insects and other macroinvertebrates

Quantitative assessment of insects and other major invertebrates was done once in ten days using the standard methods, namely Sweeping, Knockdown, Transect counting and Light trap.

Birds

Variable width line transect method covering 2 Km was followed for counting birds in the morning preferably between 6.30 and 8.00. Breeding studies were made by systematic nest search and direct behavioural observation. Nest and nest-site details were recorded.

Statistical analyses

Statistical analyses wherever required were conducted using basic statistics and the SPSS software package.

Results and discussion

Physical and Biological Environment

A. Climatic factors

Temperature: The temperature ranged from 27°C to 37°C during 1994-95 and 31.5°C to 36°C during 1995-96. It was cooler during July and August and hotter during March and May.

Relative humidity: The relative humidity fluctuated from 40 to 87 during 1994-95 and 40 to 85 during 1995-96. It was higher during July and August and lower during March correlating with the monsoon.

Rainfall: The area receives both south-west and north-east monsoons; more of it by the former which normally commences in the latter part of May or in early June and extends up to September. The north-east monsoon also provides good amount of showers to the area during the latter part of the year. The area had received an average annual rainfall of 1925 mm during the 13 year period of 1984 to 1996, with a maximum of 2640 mm during 1992, and a minimum of 1467 mm during 1993. High rainfall was recorded during July 1996 (595 mm) and July 1995 (487 mm) and the lowest during December and March (1 mm). During 1994 the north-east was highest in October (369 mm) while it was in September in 1995 (408 mm).

For the purpose of the study the following four seasons were identified in the climate of this region: i) south-west monsoon (June - August), ii) north-east monsoon (September - November), iii) Winter (December – February) and iv) Summer (March – May).

B. Biotic factors

Vegetation: The vegetation of the area is of the Southern moist mixed deciduous forest type (Champion & Seth 1968) interspersed with scrub jungle having a gradation towards drier type and hence, has many moist and dry habitat species, a variety of grasses, legumes and asters (Subramanyan 1959, Subramanian 1966). The forest in some areas at the foothills of Siruvani was converted into teak plantation and the weedy species such as *Lantana camera, Chromolaena odorata* have invaded the under storey.

Twenty eight shrub species were observed in the study area during the vegetation sampling. The dominant among them were *Glycosmis pentaphylla, Lantana camara,* and *Justicia betonica.* The diversity of shrub species (H') was 2.01 and evenness 0.60. Tree species richness was high (51) in the area; the dominant species being *Tectona grandis, Dalbergia latifolia, Trewia polycarpa, Cassia fistula* and *Grewia tiliifolia.* The diversity of tree species was 2.71 and evenness 0.69. However, shrub species were fewer at Siruvani than at Mudumalai mainly because of higher intensity of human disturbance in the study area.

Phenology: Although flowers and fruits were present during all the months on shrubs and herbs, flowers were more during October to January. Most of the trees were in flower during January to May. In the case of herbs and shrubs many species showed flushing of leaves during and after the monsoon which was followed by flowering. Fruits were abundant during August to January which corresponded with the breeding season of a few frugivores and omnivores and fledgling period of some others. A few species such as *Olea dioica* were in fruit in summer providing food for the summer breeding birds such as bulbuls and mynas.

Insect abundance: Of the 29 orders of insects under the Class Insecta (Richards and Davies 1977),17 major orders were encountered in the study area, of which Coleoptera (beetles), Lepidoptera (butterflies and moths), Hemiptera (bugs), Diptera (flies, mosquitoes), Orthoptera (grasshoppers) and Hymenoptera (ants, bees, wasps) were relatively more abundant than the others, and hence were selected for detailed study.

The general insect abundance from the pooled data of three sampling methods, namely sweep, light trap and knock down shows that the maximum abundant insect order in the study area was Hymenoptera which was responsible for 23% of the total insect abundance. The other dominant groups were: Lepidoptera 16% and Coleoptera 15%. The hierarchy of abundance (Hymenoptera < Lepidoptera <

Coleoptera < Diptera < Orthoptera < Hemiptera) among the insect groups was statistically significant

The seasonality patterns of total abundance and different insect orders were analysed in relation with various environmental factors such as rainfall, number of rainy days, humidity, temperature, plant phenology and bird abundance to decide the role of these factors in the seasonal patterns of insect orders.
The major results are given below:

1. Insect abundance significantly differed among the seasons. The highest abundance was in south-west monsoon and the lowest in north-east monsoon. The climatic conditions determine the seasonal fluctuations in the abundance; fewer number of rainy days favour the insect abundance during the south-west and north-east monsoons.

2. Seasonal abundance of insects fluctuated more significantly in smaller sections of the population identified based on habitat or taxa, while the overall abundance of insects tend to fluctuate in a much less dimension, because of the probable buffering of an unfavourable season of one group of insect with another group that prefers that season.

3. The seasonal fluctuation in the abundance of different insect groups varied highly between years. Diptera was the strongly seasonal insect order which showed regular annual cycles of abundance fluctuations with consistently high abundance levels during August in both the years. Significant difference in the abundance was observed in all the insect groups between seasons with significant F ratios in ANOVA ($P < 0.005$). Maximum seasonal variation was recorded in the abundance of Diptera followed by Coleoptera and Lepidoptera. Hemiptera, Hymenoptera and Orthoptera showed relatively less seasonal fluctuations.

4. The temporal abundance pattern of the Lepidoptera and Orthoptera showed similar pattern of fluctuations in their abundance. Both these orders were more abundant during winter, while others were so during south-west monsoon. It is interesting to note that there was a corresponding fluctuation in the bird population also, which was statistically significant in the case of Orthoptera. As these two insect orders are the major components in the diet of insectivorous birds, it appears that, the abundance levels of orthopteran and lepidopteran insects in the region might be a major regulating factor of the local abundance of birds in the region.

5. Among the environmental factors, temperature was a major factor affecting the abundance of Diptera, while rainfall was important in the seasonal

fluctuations of Coleoptera. However, certain other orders such as Hemiptera and Hymenoptera did not show any direct relationship with any of the environmental factors.

Community and breeding of birds

Avifauna

One hundred and twenty nine species of birds were observed during the study, 1994-97. Seasonal variation in the abundance was regular. Resident birds were 87.5% while migratory only 9%. The proportion of resident species in the moist deciduous forest of Siruvani was more than that in the Mudumalai Wildlife Sanctuary. Foraging guilds of these birds also showed similarity with more abundance of insectivores as observed in many disturbed forests.

Rare birds such as the Shaheen Falcon, Blackcrested Baza, Great Eared Nightjar, Forest Eagle-Owl, and Great Pied Hornbill and species endemic to the Western Ghats, namely the Nilgiri Wood Pigeon, Malabar Grey Hornbill, Whitebellied Treepie, and Bluewinged Parakeet (Ali & Ripley 1987, Stattersfield *et al.* 1998), were seen during the study period. The Bluewinged Parakeet was common and abundant while the endangered Nilgiri Wood Pigeon was observed only once as a vagrant. The Great Eared Nightjar was reported nesting in Siruvani, a new record for Tamil Nadu. The Golden Oriole which is a local migrant also nested once in the study area.

Bird community

Species richness and abundance: A total of 80 species was counted during the censuses which was only about 62% of the total observed in the area as in many other studies. As in the case of species richness, the number of individuals was also high during the second year (1445) than in the first year (1102).

The number of species and individuals increased steadily from July reaching a maximum in January 1995 and 96 (305 & 277 birds of 39 spp.) with the increase in the local and winter migrants. In general, species richness as well as number of individuals was more during winter followed by summer and minimum during the south-west monsoon.

Species richness and abundance based on feeding guild: The bird species were classified into seven categories (guilds) such as carnivore, frugivore, granivore, insectivore, nectarivore, omnivore and piscivore. Birds in all the feeding guilds were present during January and February correlating with the higher species diversity. Carnivore species were present during most of the months, except May to August and October. Frugivores occurred all through the year with a maximum in

January, so also the insectivorous birds. Piscivores were very poorly represented, since there were no water bodies in the study area, except a small stream. Insectivores formed the dominant guild in both the years, although it was slightly less in the second year (40.6%) than in the first year (42.4%). Omnivores increased from 34.6 in the first year to 37.5% in the second year, which was because of the reduction of winter migrants, mainly insectivores.

Species diversity and evenness: Species diversity was more during March (H'= 3.05) followed by January (H'= 2.85), while it was less during July (H'= 2.12), followed by August (H'= 2.31). But the evenness was less during January (0.78) followed by February (0.79). There was slight variation during the second year. It was more (H'= 3.09) during February and December, while it was less during July (H'= 2.19), followed by August (H'= 2.21). Evenness was more (0.92) during February and less (0.45) during August. Diversity was the highest in February 1996 (3.09) as against March in 1995 (3.05). The winter migrants start arriving in September and reach a peak in December–January when the area gets the maximum number of species. But towards the end of the migratory season some migrants are still present and the resident birds get established in their territories for breeding. The higher diversity in February 1996 was because of the early commencement of breeding by many species thereby forming a stable community.

Breeding bird community

Four hundred and ninety eight nests of 43 species were observed during the study, September 1994 to May 1997. Breeding bird community comprised species with various types of nest, namely dome or ball, pendant, ground, platform, hole and cup. Dominant species were hole-nesters (40%), but cup nests (54%) were comparatively much more than hole nests (35%). Minimum nests were of ground nesters. Species with pendant nest and dome nest were two each only but pendent nests were more than dome nests. Ground nests were very few, probably because of the disturbance by people and cattle from the nearby settlements.

The breeding birds were classified into five types based on feeding guild, namely insectivore, omnivore, frugivore, nectarivore and granivore. Although 43 species bred in the area, most of them were insectivores (46.5%) and omnivores (30%) as observed in the general bird community. There was larger proportion of nests belonging to omnivores in comparison with the number of species of omnivores and insectivores. Frugivores also behaved in a similar way, having more nests per species while nectarivores and granivores were fewer, probably confirming the abundance of respective species.

Plants harbouring nests

Fifty seven plant species were used by various bird species for nesting. *Tectona grandis* was used more followed by *Grewia tiliifolia*. Species such as *Lantana camara*, most dominant shrub in the area, supported 18% of species and 7% of nests mainly because of its closed branching system with the protective thorns, whereas *Glycosmis arborea*, the second most dominant shrub, was not preferred for nesting. *Melia dubia* supported only 5% of nests, but 27% of species used this tree for nesting. *Albizzia odoratissima* and *Bridelia retusa* had more or less the same diversity of nests, but the latter supporting fewer nests. These species were preferred because of the thick foliage and branching system. The next group of 8 species of plants had 13-18% of species nesting on them with a few nests (2-4%). *Croton*, although a garden plant had 6% of nests, but of only one species, the Red-whiskered Bulbul, 37% of nests of this species was on this garden plant and 90% of these nests were successful unlike in the other cup nests. Foliage of this plant is very thick giving cover to the nest. Also, nearness to people helped them to reduce predation when compared to other cup-nesters, especially other bulbuls and the Jungle Babbler in the area. *Polyalthia latifolia* another garden plant supported the dome nests of the Rufous-bellied Munia, because of the dense branches and foliage.

Birds with more than 10 nests were taken for further analyses such as plant species preference, preferred nest height, tree height and GBH and breeding success. Some species of birds showed special affinity for one or two species of plants while others used many species. Hole nesting birds such as the Bluewinged and the Blossom-headed Parakeets and the Small Green Barbet preferred larger trees of *Grewia tiliifolia*. While the Blossomheaded Parakeet used teak also in a good proportion, the endemic Bluewinged Parakeet used *Melia dubia* and *Terminalia arjuna*. The Bronzed Drongo nested mainly on teak while the Jungle Babbler used it slightly less along with some smaller trees and shrubs. The Redwhiskered Bulbul preferred *Croton* in the garden and *Lantana* bushes on the edges of the forest, whereas the Yellowbrowed Bulbul and the Racket-tailed Drongo preferred an evergreen tree *Trewia polycarpa*.

Nest-site selection of some selected bird species

Selection of a proper nest-site (characteristics of the environment within the immediate vicinity of the nest) is vital in the reproduction of birds, since it determines the environment to which adults, eggs, and altricial chicks will be exposed during critical periods. The plant species of particular size, height and structure forms a major criterion for building the nest.

Nesting of 20 species of birds was observed in some detail, of which four species preferred undergrowth or lower canopy below 5m with a GBH of less than 40cm.These were largely shrub species which were densely grown with other shrub

species as well as short tree species. This is the case with the Red-whiskered Bulbul mainly nesting on the garden plant with thick cover over the nest and closer to areas of human activity for avoiding predation. About 11 species nested in the upper or top canopy (>8m) while some others nested in between. Constructing the nest close to the foraging height may be their strategy to save energy and increase vigilance over the nest and prey. Species such as the Racket-tailed Drongo, an aggressive defender capable of chasing predators from open sites are successful even when they nest on the canopy which is partly open. They perch on a branch and feed by fly-catching and hence selects an open area. Thus, the feeding strategy may also explain the nest-site selection.

Breeding season

Four hundred and ninety eight nests of 43 species were spotted during September 1994 to May 1997. The peak breeding season was January - April. Variation was observed in different years in terms of peak breeding season, number of nests and number of species bred. The maximum number of nests (38) was during March 1995 and maximum number of species bred (16) was during April 1995. Peak breeding in 1996 was in January with the maximum number of nests being 40 while maximum number of species bred during 1996 was only 12 in March. The peak breeding in 1997 had a similar pattern with a maximum of 39 nests in January while species bred was only 10 in March.

The cup-nesters bred continuously while hole-nesters were more seasonal. The latter's breeding season was June to August and November to May with the peak during December to March. They avoided peak monsoon as observed elsewhere in south India. Pendant- nesters bred during July to April with the peak during August to October. Platform- nesters bred from October to May. Ball- nesters like Munia started breeding from July and ended in November covering both the monsoons as found in the Mudumalai Wildlife Sanctuary (Gokula 1998).

Granivorous birds such as Munias and Doves commenced breeding during June and ended in November. After granivores, omnivores started breeding, the season being July-May with the peak in April and May. Except nectarivore, the remaining species bred continuously. Nectarivores such as Flowerpecker and Sunbird had two distinct breeding seasons, from August to October and December to May. This was because of the lag in flowering after the monsoons. Insectivores started breeding from September and extended up to May. The peak breeding season was March and April which was reflected in the overall breeding season because of the abundance of the insectivorous birds in the area. Frugivores started breeding after the northeast monsoon and extended up to April.

The number of species bred in each month is positively correlated with maximum temperature ($r=0.5190$, $P<0.05$), humidity ($r=-0.6380$, $P<0.01$), total rainfall ($r=-0.4507$, $P<0.05$), number of rainy days ($r=-0.4088$, $P<0.05$) and fruit availability ($r=-0.5723$, $P<0.05$); but the stepwise regression showed only humidity and temperature as the significant variables. Similar stepwise regression procedures delineated the humidity and availability of fruit to be the most important factors that could be related to number of nests found during each month.

Based on the above observations, three parameters, namely humidity, availability of food and temperature were employed and multiple regression was tried in order to bring out the relative importance of these variables for the number of nests and species. All the three parameters that entered in the regression equation accounted for 63%, and 70% of the total variability in number of nests and species respectively. In all regression equations the proportion of variables explained were significant at 5% level (F-test).

Breeding biology and seasonality of three species of birds, namely the Bronzed Drongo, Redwhiskered Bulbul and Bluewinged Parakeet were studied in detail. Clutch sizes were 2, and 3, incubation periods 10 and 19 days, and nestling periods 12 and 17 respectively for the Redwhiskered Bulbul and Bronzed Drongo. Main factors determining the breeding season of the Redwhiskered Bulbul were temperature, humidity, and rainfall (Factor I, PCA) and abundance of fruit and caterpillar (Factor II). In the case of the Bronzed Drongo, besides temperature and humidity, abundance of insects and leaves also were important (PCA).

Nesting success

Breeding success of the 38 species were recorded. 10 species had no success. Hole nesters had the maximum success while among the cup nesters only the Racket-tailed Drongo and the Redwhiskered Bulbul had fairly good success in breeding, the first because of its aggressiveness and the last because of protection by people.

Breeding biology of the Bluewinged (Malabar) Parakeet

The Bluewinged (Malabar) Parakeet *Psittacula columboides* is one of the 16 bird species endemic to the Western Ghats. Breeding season of the Bluewinged Parakeet was between December and March. A total of 22 nests were spotted during the study period. Major factors determining the breeding season were temperature and humidity as the Factor I (PCA) and fruit and insect abundance (Factors II &III). Six tree species were used for nesting; the majority of the nests (44%) were on tall *Grewia tiliifolia*. A linear regression was obtained between tree height and nest height, but there was no correlation among other nesting variables. There was no preference for the direction of the nest hole. Nests were cut open and the clutch size, incubation and nestling periods were noted. Breeding biology studies showed that

the average clutch size was 4.63 and incubation and nestling periods were 23 and 32 days respectively. The female parent spent more time in incubating the eggs. During the first 13 days of the nestling period the female alone did nest guarding and providing food which was brought by the male while later, the role was exchanged, the male feeding the young till they fledged. This species had a high breeding success (100%). Larger trees, especially those with natural holes are important in the conservation of this endemic bird.

Practical utility of the study

Breeding requirements of the species with respect to the season, habitat specificity, microhabitats including nesting trees and sites would help in the management and conservation of the birds in this area and other similar forests.

Data generated on the seasonal trends in the population abundance, diversity and breeding of various bird species of the area would be helpful for the forest managers to anticipate the effect of any disturbance in a given month/ season of the year on the bird community at large and on major resident species in particular.

Substantiated the importance of large and dead trees in the conservation of avifauna of the region which include many hole nesters. Breeding biology of the endemic Bluewinged (Malabar) Parakeet was documented.

Research gaps

- Basic studies on the biology of various bird species, especially the rare, endemic and habitat specialists, essential to understand their ecological requirements for their conservation and management.

- Long-term studies on the biology of species to bring out the breeding strategies in varying eco-climatic conditions.