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Studies on nest construction and nest microclimate of the Baya weaver, *Ploceus philippinus* (Linn.)

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Abstract: *The nest construction pattern at different stages of nest and variations in the nest microclimate i.e., temperature and light intensity were assessed in different nests of Baya weaver (Ploceus philippinus) between November 2002 and March 2003 in Nagapattinam and Tiruvarur District of Tamil Nadu, India. The Baya weaver constructed nests in palm (Borassus flabellifer), coconut (Cocos nucifera) and date palm trees (Phoneix psuilla) and majority of the nests were found in the solitary palm. The male bird only involved in the construction and took 18 days to construct a single nest. The birds spent different amount of working hours (in terms of days) for completing various stages of nests viz., wad, ring and helmet stage and in which the 'helmet stage took a maximum of eight days. Furthermore, totally eight active nests were selected and once in a week the variations in the nest microclimate was investigated with reference to atmospheric temperature and light intensity (two active nests) across day throughout the study period. The mean temperature of the nests ranged from 25°C to 29°C and light intensity varied between 25 Lux and 625 Lux. The analysis of variance (ANOVA and ANCOVA) indicated that the nest microclimate varied among the nests in different hr of a day.*

Key words: *Nest construction, Wad stage, Ring stage, Helmet stage, Temperature, Light intensity*
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Introduction

An important behavioral reproductive decision of a bird is, where to place the nest (Cody, 1985; Johnson, 1994). Birds use their nests chiefly to protect themselves, their eggs and developing youngs by constructing the nests that are inaccessible, armored, camouflaged or built in colonies that provide the safety from the predators (Welty, 1982; Burger and Gochfeld, 1988). Besides, the nest also helps to maintain the warmth that promotes incubation of the eggs and rapid development of the young ones. Topographic and climatic requirements *viz.*, availability of nesting materials, surrounding biological environment, temperature, light intensity, humidity *etc.*, restrict the nest selection of birds. Psychic factors also influence the nest site selection (Welty, 1982; Bhardwaj *et al.,* 2006).

The selection of an appropriate nest site is vital for reproduction of birds because it determines the environment to which adults, eggs and altricial nestlings will be exposed during critical periods (Travaini and Donazar, 1994). The abiotic and vegetative qualities of nest sites can influence nesting success by concealing the nest from predators (Hines and Mitchell, 1983; Hill, 1984; Jackson *et al.,* 1988; Peterson, 1990) or reducing exposure of eggs to harsh environments (Cooch, 1965; Schamel, 1977). According to Reynolds *et al.* (1982), placement of nests amidst dense vegetation provides shaded mild environments and physical protection from predators. In this paper the causes for the variations in the microclimate of the nests were assessed. Earlier Asokan *et al.* (2003), studied the population characters of *Merops orientalis* in Mayiladuthurai.

Materials and Methods

Study habitats: The present work was carried out in Nagapattinam and Tiruvarur District (Latitude 10°46' N and Longitude 79°5'E) of Tamil Nadu, Southern India. The study area is dominated by wet agricultural lands irrigated by river Cauvery and its tributaries *viz.*, Kollidam, Uppanar, Vellar, Manjalar and Arasalar *etc.*, as the major perennial water sources.

Nest construction: A palm tree was selected in the study area and a hide was constructed by using casuarina and bamboo poles under the tree. Daily the birds were observed from the hide with the help of 7' x 50" field binocular. The duration of each nest construction activity (throughout day) of bird was recorded with an electronic stop watch.

Nest microclimate: The temperature was measured by using a digital thermometer (CIE 302 k Thermometer, Thermocouple type-K Nicr-Ni Ai) of 1° accuracy. The light intensity in Lux units was measured with the help of digital probe Lux meter (LTT Lutron LX-101 digital Lux meter) of one Lux unit accuracy.

Results and Discussion

The Baya weaver (*Ploceus philippinus*) bird constructed its nests mainly in the palm (*Borassus flabellifer*), coconut *(Cocos nucifera*) and date palm trees (*Phoneix psuilla*). Initially the bird selected the tip of one or more leaflets and made a base for construction of nest with thin strips of leaf of palm and other fibrous materials and this stage was called wad stage. This base was converted by knotting various kinds of plant fibrous materials. This complicated knot stage was called as advanced wad stage. From this advanced wad stage the weaver bird constructed central ring by weaving the fibrous materials and this stage was called ring stage. The base of the ring split the nest chamber into two equal halves. This stage looked like a helmet and this stage was called helmet stage. At this time the female baya starts visiting the tree in search of a nest and a mate. When a female is sighted from far off distance, the males of the colony are beside themselves with excitement and there is a big commotion with hectic flights around the trees. Each male was perching on his nest and fluttering his wings and lifting the nest towards the female. The female baya inspects all nests by poking her beak into wall and pulling out some fibre as if performing a ritualized test of building standards. Finally, she selects the best nest indicating her willingness to accept the architect of that nest as her mate. The female selected a nest and the male designed and structured the egg chamber. Then the chamber was expanded and connected with other half of the helmet. Thereafter the bird developed a tube from the bottom of the dome called as entrance tube.

The chronology of the nest construction *i.e.* the time spent by the weaver bird to construct different stages of nests is given in Table 1. The bird took 18 days to complete a single nest. The initial wad stage took six hours and an hour was spent to make the advanced wad stage. Different stages of ring took five days for construction. A maximum of six days was spent to complete the helmet stage of the nest and then the advanced helmet stage took another two days of work. The bird took one day and worked continuously to complete the egg chamber. Besides two more days were taken to complete the entrance tube as well as the whole nest.

The atmospheric and nest temperature across different hours of a day was measured in eight different nests. The mean atmospheric and nest temperature between 8.30 and 18.00 hr are plotted in Fig. 1, which indicated that the trends of mean temperature fluctuation in the nest was following the fluctuation of mean atmospheric temperature. The mean nest temperature increased from $25^{o}C$ to just $29^{o}C$ at 13.00 hr and then it gradually declined to $26^{o}C$ towards end of the day (18.00 hr). The individual effect of nest pattern on the regulation of the nest temperature was analyzed by using analysis of covariance (ANCOVA). This analysis confirmed

Table - 1: Chronology of the nest constructed by Baya weaver

Stages	Working hr	Time spent	No. of days taken
Initial wad stage	8 am to 6 pm	6 hr	2
Advanced wad stage	8 am to 9 am	1 hr	
Initial ring stage I	8 am to 9 am	1 hr	5
	9.30 am to 10 am	30 min	
	4 pm to 5.25 pm	1 hr 15 min	
Ring stage II	8 am to 9 am	1 hr	
	11 am to 11.45 am	45 min	
	4 pm to 5.30 pm	1 hr 30 min	
Ring stage III	8 am to 9 am	1 hr	
	4 pm to 5.30 pm	1 hr 30 min	
Ring stage IV	8 am to 9 am	1 hr	
	4 pm to 5.30 pm	1 hr 30 min	
Ring stage V	8 am to 9 am	1 hr	
	4 pm to 5.30 pm	1 hr 30 min	
Initial helmet stage I	4 pm to 5.30 pm	1 hr 30 min	6
Helmet stage II	4 pm to 5.00 pm	1 hr	
Helmet stage III	11 am to 12 pm	1 hr	
	4 pm to 5 pm	1 hr	
Helmet stage IV	11 am to 12 pm	1 hr	
	4 pm to 5 pm	1 hr	
Helmet stage V	11.30 am to 12 pm	30 min	
	4 pm to 5 pm	1 hr	
Helmet stage VI	4 pm to 5 pm	30 min	
Advanced helmet stage I	8 am to 9 am	1 hr	2
	1 pm to 1.30 pm	30 min	
	4 pm to 6 pm	2 hr	
	8 am to 9.30 am	1 hr 30 min	
Advanced helmet stage II	1 pm to 1.30 pm	2 hr	
	3.30pm to 5.30 pm		
Nest with completed egg chamber	8 am to 9 am	1 hr 1 hr 30 min	1
	3.30 pm to 5 pm		
Nest with short tube	3.30 pm to 5 pm	1 hr 30 min	1
Complete nest	3.30 pm to 5 pm	1 hr 30 min	1

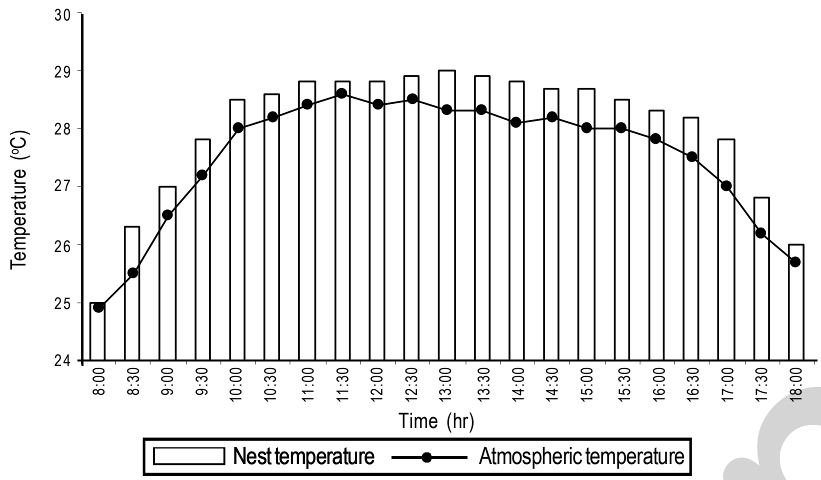

Fig. 1: Comparison between atmospheric temperature and nest temperature of Baya weavers' nest across different hours of day

Table-2: Analysis of Co-variance (ANCOVA) to investigate the effect of atmospheric temperature and nest temperature of Baya weaver

	ANOVA for nest temperature					
Source	**DF**	**Seq. SS**	**Adj. SS**	**Adj MS**	**F**	**p**
Temperature	1	689.85	213.20	213.20	1036.21	0.000
Time	19	18.78	1.52	1.66	8.06	0.000
Nest No.	7	14.61	4.61	2.09	10.14	0.000
Error	732	150.61	50.61	0.21		
Total	759	2873.84				

Term	**Coefficient**	**SD**	**T**	**p**
Constant	6.4645	0.6942	9.31	0.000
Temperature (Atmospheric)	0.80088	0.02488	32.19	0.000

Table - 3: Analysis of Variance (ANOVA) to investigate the variations in the light intensity of atmosphere, nest and egg chamber during different time blocks of a day.

	ANOVA for atmospheric light intensity					
Source	**DF**	**Seq. SS**	**Adj. SS**	**Adj. MS**	**F**	**p**
Time	19	39067597	39067597	2056189	30.98	0.000
Nest	1	1296	1296	1269	0.02	0.889
Error	379	25151714	25151714	66363		
Total	399	64220607				

	ANOVA for light intensity in the nest					
Source	**DF**	**Seq. SS**	**Adj. SS**	**Adj. MS**	**F**	**p**
Time	19	53302.9	53302.9	2805.4	2036	0.000
Nest	1	379	52213.5	52213.5	137.8	
Error	379	52213.5	52213.5	137.8		
Total	399	106559.7				

	ANOVA for light intensity in the egg chamber					
Source	**DF**	**Seq. SS**	**Adj. SS**	**Adj. MS**	**F**	**p**
Time	19	10670.89	10670.89	561.63	12.13	0.000
Nest	1	5.52	5.52	5.52	0.12	0.730
Error	379	17545.03	17545.03	46.29		
Total	399	28221.44				

that the nest pattern had an influence in the regulation of nest temperature (Table 2).

The light intensity in the atmosphere, nest and egg chamber of nests across different hours of a day was measured in two different nests. The atmospheric light intensity and nest light intensity showed uniform fluctuation across the day. The atmospheric and nest light intensity were almost at the maximum until mid day (12.00 hr) and after 13.00 hr it gradually declined to the lowest value of 625 Lux and 45 Lux respectively. The light intensity in the egg chamber did not exceed 45 Lux and the maximum light intensity was observed during 8.30 hr (45 Lux) and then it gradually declined to the value of less than 25 Lux during 18.00 hr.

The effect of time blocks of a day and the light intensity of the nest and egg chamber was analyzed using analysis of variance (ANOVA) and the results were given in Table 3. The atmospheric light intensity ($F_{19,379}$= 30.98, p<0.01), the light intensity in the nest ($F_{19, 379}$= 20.36, p<0.01) and in egg chamber ($F_{19, 379}$ = 12.13, p<0.01) varied across the day. Although the nest light intensity between the two nests showed significant ($F_{19, 379}$ = 7.57, p<0.01) variations, the intensity of light in the egg chamber did not differ significantly among the two nests ($F_{1,379}$ = 0.12, $p \leq 730$).

The Baya weavers constructed their nests in four different major stages *viz.*, wad stage, ring stage, helmet stage and complete nest stage. On the other hand, Ambedkar (1978) has reported five stages in nest building *viz.*, wad, ring, helmet, completed egg chamber and complete nest. Since there was no critical distinction between the last two stages, they were treated as a single stage in the present study. In contrast to the above classification Crook (1964), mentioned seven distinct stages in nest formation *viz.*, initial wad, wad with horns, initial ring, helmet stage, padded helmet stage, complete nest and construction after completion.

It was observed that the bird took 18 days to complete the nest construction. The duration of nest building by Baya weaver was in concurrence with the previous observations of Davis (1974) and Mathew (1972), but markedly different from that of Finn's Baya, *Ploceus meghryhchus* reported by Ambedkar (1978). Long duration was necessitated at ring and helmet stage because of the male waiting for the female to inspect and accept the nest. If the nest was not visited and accepted by a female, then the male abandoned the nest or began to construct a new nest leaving the previous one at its helmet stage. This kind of waiting for the female to accept the nest was observed in the Wrens (*Troglodytes troglodytes*) of north America (Frisch, 1975). The effect of skeleton photoperiods in Baya weaver was studied by Bhardwaj *et al.* (2006).

In the present study it was found that the temperature and light intensity of the nest was influenced by the atmospheric temperature and light intensity. The Baya weaver used a wide variety of thin delicate plant materials as nesting materials to construct the nests. Although the nest was constructed by using different knots and weaving of the fibres still there is a possibility for having minute pores. These pores would have allowed the light in the nest and also air circulation from external environment. This property of the nest would have established for this relationship. There were wide variations in the nest architecture due to construction pattern. These variations could be associated with the age and experience of the owner of the nest. However, the light intensity of egg chamber did not exceed more than 45 Lux. This was because of the nesting materials in the egg chamber. Collias and Collias (1964) observed changes in actual nest building skill with age of village weaver bird (*Textor cucullatus*). The expertise in the nest construction associated with age could have influenced the nest architecture. The variations in the nest architecture might be responsible for variation in the nest microclimate.

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