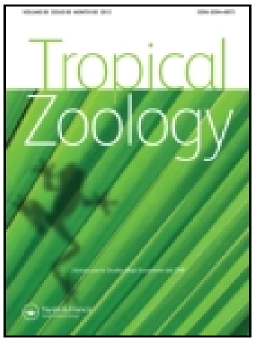

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Selection of nest platforms and the differential use of nest building fibres by the Baya weaver, *Ploceus philippinus* Linnaeus 1766

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The choice by the Baya weaver between different plant species as nesting platforms and sources of nesting fibre was analysed on an agricultural study plot at Chorao (15°30'N, 73°50'E), an island in the Mandovi estuary in Goa, India. The bird chose eucalyptus over coconut palms, as shown by a higher ratio of utilised trees to available trees and by the maintenance of significantly higher numbers of total nests ($t = 2.92$, $P < 0.05$) and viable nests ($t = 3.10$, $P < 0.05$). The wider anchoring area, providing a better display front for the male birds competing for mates, and the protection against monsoon vagaries (such as rains and winds) provided by the extensive drooping canopy of profuse branches seem to have favoured of eucalyptus trees over coconut palms. The choice went against short and medium sized coconut palms and tall eucalyptus trees, as probably the former were more prone to the menace of intruders and the latter were more exposed to strong monsoon winds. The birds exhibited a differential use of nesting fibres to fabricate the different zones of the nest. Sugarcane fibres, which probably provided better anchorage and stability due to their interlocking silicious spicules, were used for the base, stalk and roof of the brood chamber. Fibres from coconut leaves went into the construction of the entrance tube and floor of the brood chamber, probably to provide added comfort to the altricial young and incubating parent and to afford the required resistance against wear and tear owing to frequent movements of the mother bird while ferrying food to the young.

KEY WORDS: Baya weaver, *Ploceus philippinus,* bird, breeding, nest platforms.

INTRODUCTION

The Baya weaver, *Ploceus philippinus* Linnaeus 1766, has from time immemorial been considered an architectural genius for the delicate craftsmanship of building intricate pendant nests. Though in India there is a wide variety of plants available to serve the purpose of nesting platforms for the breeding birds of the species (Ali & Ambedkar 1957, Ambedkar 1958) there has been extensive use of coconut palms on the west coast, palmyra palms in the eastern parts of the peninsula and spiny acacia in the arid north-west (Sharma 1989). Therefore, a regional bias seems to exist in the choice of certain plant species for nesting by the breeding weaver populations of the subcontinent. One of the reasons proposed for such a choice is the protection against intruders provided by these plant species, due to either their unbranched tall trunks or spiny armature. This has even been considered the overriding factor, taking precedence over availability of food and nesting fibres (Davis 1974). Yet amongst the plants recorded as serving as nesting platforms for the weavers, trees as defenceless as eucalyptus with well branched trunks and profuse canopy are also included. Therefore, it was interesting to understand whether the apparent bias in selection of plant species noticed in different regions of the subcontinent is a reflection of a real choice or the result of their common occurrence in the region. Further if the birds did make a choice, it was interesting to learn whether it was guided by a mere protection/safety factor or whether any other factors were involved.

During early summer of 1999, in the course of routine reconnaissance surveys, we landed by chance on a unique agricultural plot on Chorao Island tailor made for such a study. The plot was at the edge of extensive paddy fields by the side of an orchard. It was fringed and interspersed by coconut palms and eucalyptus trees of different heights. The plot was used to grow both paddy and sugarcane simultaneously. The orchard by its edge had other trees, like mango Careya, as well as bamboo bushes. Deserted viable nests of weavers and those abandoned at various stages of construction from the previous breeding season on some of these trees showed that the site was a breeding ground of the bird. Discussions with the local farmers revealed it to be a traditional breeding site, at least in the preceding 3 years. Thus, the site was an ideal study plot to investigate the choice, if any, made by the birds for nesting platforms or nest building fibres and the possible criteria of the choice.

STUDY AREA

The study site/plot was located towards the northeastern border of Chorao (15°30’N, 73°50’E), an island in the Mandovi estuary of Goa. The island has a total agricultural area of 1016.85 ha with paddy as its chief crop. The study plot, with an agricultural area of 100 m^2, was entirely fringed by coconut palms with a parallel row of eucalyptus trees on the western side. The coconut trees ranged from 1.22 to 4.09 m in height, while the eucalyptus trees were

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taller, ranging from 7.01 to 23.16 m. The central and peripheral areas of the plot were used for paddy and sugarcane cultivation. Paddy fields were situated towards the northeast and southwest while sugarcane was cultivated to the northwest and southeast of the plot. Rows of coconut palms were intermittent between the paddy and sugarcane crops. Paddy plantations were also present adjacent to the study area on the eastern and southern side. On the western side of the study plot, there were a few bamboo bushes and coconut palms, *Careya arborea* and other fruit bearing trees. A row of Australian acacia (*Acacia auriculiformes*) trees bordering the margin of a metal road ran parallel to the study plot along its northern boundary. Electric power lines and telegraph wires were also present to the north of the plot.

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MATERIALS AND METHODS

The nesting behaviour of the Baya weaver was studied during one complete breeding season from May-October 1999. All field observations were made using 7 × 50 field binoculars. Field observations were made at weekly intervals to determine the choice of host trees/plants and nest building material used by the bird. Meticulous weekly observations were also undertaken to ascertain the number of nests in various stages of fabrication, their progress and their fate, especially during and after the torrential rains that lashed the state in mid-July. Individual nests which were torn down by the mid-July gales and at the end of the breeding season were collected and analysed to study the plant source of the fibres used, their relative, utilisation and any regional differences.

Nest orientation was studied using a simple apparatus especially devised for the purpose coupled with a directional compass. The device consisted of 4 rods placed perpendicular to one another and joined to the two halves of an adjustable ring. By placing the directional compass on one of the rods and moving the entire assembly just below the crown of the tree under study, the exact number of nests oriented in different directions was ascertained.

For the purpose of statistical analysis the total numbers of coconut palms and eucalyptus trees available for nesting were divided into 3 height-dependent clusters. Among coconut palms, cluster 1 included trees shorter than 2 m, cluster 2 trees from 2-3.5 m high and cluster 3 trees taller than 3.5 m. Amongst the eucalyptus trees, cluster 1 included trees with a height of less than 15 m, cluster 2 trees from 15-20 m high and cluster 3 trees taller than 20 m.

All the data were log (base 10) transformed for parametric statistical analysis.

The relationship between clusters and total number of nests per tree was analysed by Pearson correlation coefficient analysis. The monthly variations in the number of helmets, viable, bistoreyed and total nests at the site, as well as those in the number of helmets, viable, destroyed and total nests between clusters of coconut trees, were analysed by One-Way ANOVA followed by the Tukey-Honestly Significant Difference (Tukey-HSD) multiple range test. The nests at various stages of development on coconut and eucalyptus trees were compared using the unpaired Student t-test. The variations amongst clusters of eucalyptus trees were analysed by Kruskal-Wallis One-Way ANOVA as the sample size was insufficient for parametric statistical analyses. All statistical analyses were performed in SPSS (version 6.1.3 for Windows) with the probability (alpha) level set at 0.05.

OBSERVATIONS

Time scale

Male Bayas were first observed at the study site in mid-June with the onset of monsoons. By the end of June, 15 out of 53 coconut palms and 4 out of 11 eucalyptus trees available on the plot contained a total number of 54 helmet stage nests.

The weekly changes in the number of different types of nests and the analysis of variance in their quantity at monthly intervals is provided in Tables 1 and 2 respectively. Nest building activity intensified with the arrival of females in early July. However, mid-July experienced heavy downpours and squally weather, as a result of which 58% of the nests were either destroyed or abandoned. Nest building activity was resumed with gusto in the 1st week of August. The number of viable nests was minimal during July, with a weekly average of 8.5, but reached a statistically significant peak in September with a weekly average of 88.75 (ANOVA, df 3,12, $F = 8.31$, $P < 0.01$). A parallel change was noticed in the total number of nests irrespective of the stage of construction, with a significant difference during different months (ANOVA, df 3,12, $F = 7.06$, $P < 0.01$). Bistoreyed nests appeared during August, increased during September and showed a small decline in October (ANOVA, df 3,12, $F = 35.27$, $P < 0.001$). However there was no significant difference in the number of helmet stage nests during the different months of the breeding season.

Considering the entire breeding season, the colony had a total number of 382 nests in varying stages of development, with each male having contributed 2-4 of them. Of these, 66 nests were destroyed by gales, 145 nests remained incomplete, i.e. in the helmet stage, and the rest became viable nests.

Although most nests were normal, a few abnormal nests were also observed. These included 6 bistoreyed nests, 2 fused nests, 13 faulty nests, 4 nests with a hole above the entrance tube, 2 nests with a hole in the egg chamber and a nest with one hole just below the stalk and another below the egg chamber.

Table 1.

Comparative picture of the nests (weekly mean) in varying stages of fabrication during the 4 months of the active breeding phase.

Months	Helmet Mean ± SE	Faulty Mean ± SE	Complete Mean ± SE	Bistoreyed Mean ± SE	Total Mean ± SE
July	13.50 ± 10.55	2.70 ± 1.29	8.50 ± 4.25	0.00	54.75 ± 7.57
August	56.20 ± 9.34	1.40 ± 1.04	50.00 ± 1.73	0.80 ± 0.18	110.60 ± 21.43
September	67.50 ± 0.90	0.25 ± 0.25	88.75 ± 6.03	4.50 ± 0.56	163.50 ± 6.23
October	34.66 ± 2.99	0.00	62.00 ± 4.78	3.00 ± 0.00	99.66 ± 7.66

Table 2.

Results of ANOVA used to analyse variations in the different types of nests during the different months of the breeding period.

Nest type	df	F	*P*
Helmet	3,12	2.2073	0.1400
Faulty	3,12	1.2971	0.3204
Complete	3,12	8.3114	0.0029 *
Bistoreyed	3,12	35.2672	0.0000 *
Total	3,12	7.0570	0.0055 *

* Indicates significant difference from other groups at the 0.05 level.

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Host plants

The Baya weavers tried to nest on five plant species on the study plot. These included a monocot tree *Cocos nucifera*, two dicot trees *Eucalyptus* sp. and *Careya arborea*, and two grasses *Bambusa* sp. and *Saccharum* sp. Of these only *C. nucifera* and *Eucalyptus* sp. supported viable nests, while the attempts on other plants either ended in faulty nests or did not progress beyond the helmet stage (Table 3).

Of the 53 coconut trees available on the study plot, only 35 were utilised as nesting platforms and 23 of them had viable nests. Among the eucalyptus trees, 11 of the 14 available were used as nesting platforms and 8 of them supported viable nests. Considering the number of trees utilised for nesting, the total number of nests per coconut palm was only 6.97, while that per eucalyptus tree was 15.11. The comparison of different types of nests supported by the two types of host trees is provided in Tables 4 and 5. The number of viable nests and the total number of nests irrespective of category were significantly higher on eucalyptus trees than on coconut palms ($t = 3.10$, $P < 0.05$ and $t = 2.92$, $P < 0.05$ respectively). There was no

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Table 3.

Comparative utilisation of the available plants as nest building platforms.

Host plant	No. of plants used	No. of nests	Nest/Plant (Mean ± SE)
Cocos nucifera	35	244	6.97 ± 1.4
Eucalyptus sp.	11	136	15.11 ± 3.27
Careya arborea	1	2	2.00 ± 0.00
Saccharum sp.	2	3	1.50 ± 0.35
Bambusa sp.	3	3	1.00 ± 0.00

Table 4.

Number of different stages of nests per tree in relation to height-based clusters.

Cluster no.	Height (m)	Trees available	Trees used	Trees with viable nests n	Trees with viable nests %	Helmet (Mean ± SE)	Viable (Mean ± SE)	Destroyed (Mean ± SE)	Total (Mean ± SE)
Coconut palms									
1	< 2	04	03	01	33.33	1.33 ± 0.27	3.33 ± 2.72	1.33 ± 1.09	6.00 ± 3.68
2	2-3.5	44	28	19	67.85	2.57 ± 0.28	2.21 ± 0.56	0.82 ± 0.27	5.61 ± 0.80
3	> 3.5	05	04	03	75.00	8.50 ± 3.90*	5.50 ± 2.41	3.25 ± 2.81	17.25 ± 8.99*
Eucalyptus trees									
1	< 15	03	02	01	50.00	2.00 ± 0.71	8.00 ± 5.66	3.50 ± 2.47	13.50 ± 8.84
2	15-20	08	07	06	85.71	3.71 ± 1.08	7.86 ± 2.18	2.71 ± 1.15	14.28 ± 3.83
3	> 20	03	02	01	50.00	2.50 ± 1.06	3.00 ± 2.12	0.00	5.50 ± 3.18

* Indicates significant difference from other groups at the 0.05 level.

Table 5.

Comparison between coconut palms and eucalyptus trees in relation to the different types of nests supported by them (independent sample Student t-test).

Types of nests	t	*P*
Helmets	1.16	0.251
Viable	3.10 *	0.004
Destroyed	2.04 *	0.048
Total	2.92 *	0.006

* Indicates significant difference at the 0.05 level.

Table 6.

Results of parametric ANOVA and Kruskal-Wallis One-Way ANOVA for the variation in the number of different types of nests borne by coconut palms and eucalyptus trees respectively, with reference to height-based clusters.

Nest type	Coconut palms			Eucalyptus trees		
	df	F	*P*	df	F	*P*
Helmet	2,32	6.9369	0.0031*	2	0.8074	0.6679
Viable	2,32	1.5269	0.2326	2	0.9186	0.6317
Destroyed	2,32	1.6990	0.1990	2	1.6622	0.4356
Total	2,32	3.9890	0.0284*	2	1.1177	0.5719

* Indicates significant difference from other groups at the 0.05 level.

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significant difference in the number of helmet nests on these two types of trees whereas the number of destroyed nests was significantly higher on eucalyptus trees than on coconut palms (t = 2.04, $P < 0.05$).

The Bayas also seemed to show a marked preference for the coconut palms interspersed among paddy and sugarcane crops rather than for those on the periphery. Although the height of coconut palms on the study plot ranged from 1.22 to 4.09 m, the maximum numbers of both viable and total nests were supported by palms taller than 3.5 m. Among clusters of coconut trees the total number of nests and the number of helmet nests increased with an increase in height (r = 0.34, $P < 0.05$, n = 34 and r = 0.48, $P < 0.01$, n = 34 respectively). There was a significant difference in the number of helmets among clusters (ANOVA, df 2,32, F = 6.93, $P < 0.01$). Cluster 3 had more helmets than clusters 1 and 2. The total number of nests also varied significantly between clusters (ANOVA, df 2,32, F = 3.98, $P < 0.05$). Cluster 3 supported a greater number of nests than the other two clusters, as shown in Table 6. However there was no significant difference among clusters in viable or destroyed nests.

For the eucalyptus trees, there was no significant correlation between either the total number of nests and height of the tree or between the clusters and total number of nests (r = 0.17, $P > 0.05$, n = 11 and r = – 0.23, $P > 0.05$, n = 11). There was also no significant variation among clusters in the number of helmet nests

(Kruskal-Wallis χ^2 = 0.81, $P > 0.05$), viable nests (Kruskal-Wallis χ^2 = 0.91, $P > 0.05$) or destroyed nests (Kruskal-Wallis χ^2 = 1.66, $P > 0.05$), as shown in Table 6.

Nest orientation

Of the total nests in the study plot 87% were oriented towards the east while only 8.1% and 3.6% were oriented towards the south and north respectively. A lone nest exhibited westerly orientation. Subsequent attempts by the builder to reorient this nest were futile and it was ultimately abandoned.

Differential use of nest fabrication material

Nests in the study plot were fabricated with fibres from the leaves of coconut, sugarcane, paddy and other grasses, in order of preference. Some viable nests were fabricated with coconut fibres uniformly throughout the nest, with only a few sugarcane fibres used to weave the stalk. However most complete nests had coconut fibres only in the egg chamber and entrance tube, while the stalk and roof of the egg chamber were built with sugarcane fibres. Even in the few nests with a 1:1 proportion of coconut and sugarcane fibres, the egg chamber was lined with coconut fibres. The entrance tube of all the nests examined was made up exclusively of coconut fibres. Nests woven entirely with sugarcane fibres turned out to be faulty. The fibres used for the construction of these faulty nests were thicker than those used for the construction of normal nests, which were 0.05-0.1 cm thick.

DISCUSSION

Earlier studies on the breeding biology of the Baya weaver have only recorded coconut palms as nesting platforms on the west coast of India, except for rare instances of nesting on exposed overhanging power lines or telecommunication wires (Betts 1952, Kirkpatrick 1952, Ambedkar 1970). To the best of our knowledge the current study records for the first time the use of eucalyptus trees as the nesting platform by the bird in this region. Indeed on the study plot, the weaver bird used a larger proportion of available eucalyptus trees than coconut palms. Moreover, the former bore a significantly larger number of both viable and total nests than the latter. Both these factors are fairly good indicators of the preferential choice of eucalyptus trees over coconut palms.

Protection against intruders and climatic vagaries provided by the tall sturdy unbranched trunks and the crown of swaying fronds of coconut/palmyra palms have been considered the criteria for their selection by the bird on the western and eastern coasts of India (Davis 1974). A similar argument has been proposed for the choice of *Acacia nilotica* and *Prosopis julliflora*, with their prickly armature, in the arid north-west zone of the country (Sharma 1995). However, nests constructed on totally exposed open wires on the west coast are not uncommon. Although these might be protected from intruders, their tolerance of heavy rains and violent winds is a matter to be surmised. Secondly, the proportionately higher utilisation and greater end result on eucalyptus trees, despite the greater destruction of nests, as

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well as the choice of coconut palms as short as 1.22 m observed in the course of the present study are not tenable with the concept that protection is the overriding factor in the choice of nesting platforms. Ever since the promotion of eucalyptus plantations in the country by pulp-based industries, stands of eucalyptus trees have been common on the west coast, but thus far there has not been any report of their use as nesting sites by the Baya in the region. It may be noted that most of the eucalyptus plantations are in the foothills of the Western Ghats, away from the crop plantations which serve as the source of food and nest fibres for the bird, while coconut trees, the common cash crop of the west coast plains, are generally interspersed with paddy and sugarcane plantations. Against this backdrop, the apparent regional bias for specific trees as the choice of nesting platforms seems to be due to the greater chances of their being in the proximity of sources of food and nesting fibres, merely owing to their regional abundance rather than to the protection rendered by them per se.

Amongst the coconut palms, a significantly higher number of helmet nests and total nests in the cluster of taller trees suggests the bird's preference for them over those of medium and shorter heights. In contrast, shorter and medium sized eucalyptus trees contained a higher number of nests than the taller ones. However, the difference was not statistically significant, probably due to the smaller sample size of the tree species available on the study plot. The widespread anchoring surface provided by profuse delicate branches and the drooping canopy of eucalyptus trees probably not only shields the nests from lashing rains and violent winds, but also provides a wider display surface for males to draw the attention of prospective female mates. Therefore, there being no difference in availability of food and nesting fibres in the vicinity, the choice must have gone in favour of eucalyptus trees over coconut palms. Higher probabilities of intruder menace on short and medium coconut trees and the susceptibility of taller eucalyptus trees to the vagaries of monsoon winds must have gone against their selection.

Material used for nest fabrication was almost always obtained from either coconut or sugarcane. Fibre from rice plants, although abundantly available was not used even in a single nest. This may be because the rice blades attained their full length only towards the mid-breeding season. Furthermore, although fibres from both coconut and sugarcane were extensively used, a distinct partitioning was observed in their fabricational utilisation. Sugarcane fibres were chiefly used to construct the stalk and upper part of the egg chamber. The leaves of sugarcane have silicious deposits in the form of fine spicules giving a definite interlocking between the two interwoven fibres, thereby giving the necessary stability to the stalk. The lower part of the egg chamber and the entrance tube are woven exclusively of coconut fibres. This may be because the coconut fibre is more resilient and tensile than the sugarcane fibre and thus provides the much needed strength against wear and tear of the extensively used components of the nest. Since the entrance tube is fabricated entirely of coconut fibres, it can easily withstand the pressures incurred by the continuous movement of the mother weaver bird during her food collection trips. Coconut fibres are devoid of silicious deposits and are preferred for construction of the egg chamber so as to avoid any discomfort to the attrical hatchlings.

Thus it can be concluded that if a sufficiently diverse choice of nesting platforms is available to the bird, coupled with abundant food and nest building fibre, the bird will select a wider range of trees as nesting platforms, even if the trees

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available are not well equipped with protective devices. Therefore a single attribute such as nest protection cannot take precedence over the availability of food and nest fibre. Further, given a choice of nest building fibres, their relative use in the fabrication of the different parts of the nest also varies considerably.

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