Ecology and Nesting Behaviour of *Ploceus philippinus* (Linnaeus, 1766) in Selected Study Site of Chorao, Goa

A Dissertation for
ZOO-651 Submitted in partial
fulfilment of Master's Degree in
Zoology
By
MISS. SANGINI GAJANAN DHURI

Under the Supervision of
DR. NITIN SAWANT
School of Biological Sciences and Biotechnology
Discipline Zoology
Goa University

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April 2024

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DECLARATION BY STUDENT

I hereby declare that the data presented in this Dissertation report entitled, **"Ecology and Nesting Behaviour of *Ploceus philippinus* (Linnaeus, 1766) in Selected Study Site of Chorao, Goa"** is based on the results of investigations carried out by me in the Zoology at the School of Biological Sciences and Biotechnology, Goa University, under the Supervision of Dr. Nitin Sawant and the same has not been submitted elsewhere for the award of a degree or diploma by me. Further, I understand that Goa University or its authorities will be not be responsible for the correctness of observations / experimental or other findings given in the dissertation.

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COMPLETION CERTIFICATE

This is to certify that dissertation report **"Ecology and Nesting Behaviour of *Ploceus philippinus* (Linnaeus, 1766) in Selected Study Site of Chorao, Goa"** is a bonafide work carried out by Ms. Sangini Gajanan Dhuri under my supervision in partial fulfilment of the requirements for the award of the degree of Master's Degree in Zoology in the Discpline Zoology at the School of Biological Sciences and Biotechnology, Goa University.

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PREFACE

Having being raised amidst the rich diversity of flora and fauna on the captivating island of Chorao, my early years were filled with an intimate connection to the natural world. And one of the sights that never failed to captivate me as a child were Baya weavers crafting their intricate nests in our fields. Now, as I begin my first research study as a student of wildlife zoology, I embark this journey as a desire to understand and protect them. The decision to study Baya weavers for my research project is deeply rooted in my personal connection to them. With the knowledge gained from this study, I hope to shed light on the importance of preserving their habitats and safeguarding these remarkable birds. My ultimate goal is to contribute to their conservation, ensuring that future generations can continue to marvel at their creativity and beauty.

ACKNOWLEDGEMENT

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ABBREVIATIONS USED

Entity	Abbreviation
August-precipitation	A-P
August-temperature	A-T
August-humidity	A-H
Egg-chamber closed	ECC
June-precipitation	J-P
June-temperature	J-T
June-humidity	J-H
July-precipitation	JY-P
July-temperature	JY-T
July-humidity	JY-H
September-precipitation	S-P
September-temperature	S-T
September-humidity	S-H

ABSTRACT

This study investigates the Ecology and Nesting behaviour of *Ploceus philippinus* within agricultural fields in Chorao Village of Goa, spanning from June to October. Observations are centered on key attributes, including abiotic factors and habitat characteristics such as height of nesting trees, nesting fiber sites, perching sites, and water sources. *P. philippinus* showed adaptive nesting behaviour by utilising nesting materials based on their availability in their habitat, during early June, coconut fronds were utilized for nest construction due to the scarcity of grass. As grass reached full maturity by late July, *P. philippinus* transitioned to stripping grass fibers for nesting material. At the end of nesting season Paddy fibres were also utilised once they had reached full length size. A total of 85 wad stage nests, 68 helmet nests, 51 ECC nests, and 48 complete stage nests were documented. Furthermore, the research analyzes the duration required to complete various developmental stages of nest construction. Findings reveal that the duration varies across stages: for the wad stage, it ranged from 6 days to 16 days; for the helmet stage, from 6 days to 20 days; for the ECC stage, from 13 days to 41 days; and for the complete stage, from 6 days to 27 days. Notably, while no significant human threats were observed, but there were instances of brood chamber holes attributed to crow activity.

KEYWORDS

Goa

Chorao

Ecology

Baya weaver

Ploceus philippinus

Nesting behaviour

CHAPTER 1

INTRODUCTION

1.1 Background

Baya weaver *Ploceus philippinus* (Linnaeus, 1766) are known for their elaborately woven nests which are complex, retort shaped, dangling nest, woven with strips of palm, coconut leaves and grass. They are found in Indian subcontinent (Ali et al. 1956) Java, China, Vietnam, Singapore, Laos, Myanmar, Thailand and Malacca (Birdlife international 2016). *P. philippinus* is listed as 'least concern' on the IUCN Red list of threatened species (Birdlife international 2016). The adult male Baya is similar to a sparrow, but with brown streaks, a thick bill, and a short, rounded tail. Males have brighter and more vibrant colours during mating season, whereas females appear comparable in non-breeding season (Inskipp et al., 2011). During the breeding season, the male becomes sexually dimorphic and develops golden yellow plumage on his breast and head and the female is more drab colour.

Their breeding season in India is from May to November (Ali & Ripley 1987; Rasmussen & Anderton 2005). *P. philippinus* are colonial nesters and prefers to nest in open habitats like agriculture fields where food and nesting resources are available. Their movement is mostly influenced by rainfall and rice cultivation. They are social, polygamous birds, living in flocks and breeding in colonies. They feed on cereal, weed seed, grass, grains and insects.

Nesting birds choose *Cocos nucifera* (Arecaceae) along Indian Peninsula west coast, *Vachellia nitotica* (Fabaceae) in arid northwestern region and *B. flabellifer* (Arecaceae) along east coast (Sharma 1989). *P. philippinus* nests in variety of trees but prefers palms with tall and unbranched trunks and long swaying foliage trees to keep predators away and provide leaf strips to build nests (Davis 1974).

Males typically construct partial helmet stage nest and complete them only after females choose them and mate (Ali et al. 1956). The male alone weaves the nest using grass fibers, whereas the female just lines the egg chamber after accepting the nest. In the early phases of nesting, the female is completely absent. Several males may construct their nests on the same trees, resulting in colonies of varying size. Males displays and communicate with visiting females by twitching their wings and singing high-pitched songs near the helmet nest (Crook 1960). Extreme forms of this display include males hanging upside down from their helmets and flapping wings. Female which visits the nests perches on the helmet's chinstrap, pushing nest fibers against the walls with her wings and pulling with her bill. Rarely the pair may mate while sitting on the chinstrap (Ambedkar, 1964; Quader 2003). Female mate selection is based heavily on colour, material, and quality of available nests (Collias & Collias 1964, 1984; Crook 1960; Narasimhacharya et al. 1987).

Females inspects the nest and accepts them if found suitable. Before eggs are laid, the male must build the vertical entrance tube of nest with variable length. Females incubate eggs and feed nestlings, sometimes, the male may carry food to the nestling (Ali, 1931; Ambedkar,1964). The male may construct another helmet stage nest to attract other female. If a helmet stage nest are not accepted by any female than the males tears it down and Constructs a new one in its place. *P. philippinus* takes about 18 days to build complete nest (Ashokan et al. 2008).

The nest-building material utilized by this bird may vary depending on locality in India. They mostly utilise herbs from the Poaceae family as a nesting material. Nest selection is restricted by factors such as availability of materials, surrounding biological habitat, temperature, light intensity, and humidity (Asokan et al. 2008). Preference for specific plant species for nesting has been linked to a geographical bias, one of the reason for this is that choice of protection against invaders provided by different plant species (Borges et al., 2002). Priority over feeding and nesting resources has been identified as a primitive component in nest site selection. Food supply is dependent on environmental factors like temperature and rainfall, which ultimately affect seasonal breeding. (Immelmann 1971; Baker 1938).They also prefers to make nests near the power cable, roadways and human dwellings (Pandian, 2022). Baya weavers rely heavily on nest construction and microclimate to ensure successful reproduction. Different environmental conditions within and outside nests may influence the ideal interior environment required for the reproductive success.

Farmers are mostly responsible for the declining population of *P. philippinus* in India. They burn herbs, shrubs beneath nest-supporting trees and clears the grass surrounding irrigation wells which may cause scarcity of nesting substrata for *P. philippinus* (Pandian 2021). Rapid urbanization and industrialization have led to a 20% decline in cultivation areas, including cereal crops, resulting in a lack of food and insect fauna for *P. philippinus* (Pandian 2018). Other threats such as birds like *Dendrocitta vagabunda, Corvus splendens, Corvus macrorhynchos, Dicrurus macrocercus,* and *Eudynamys scolopaceus* cause damage to weaver bird nests by creating circular holes and preying on eggs and chicks (Ali 1931; Pandian 2021–2022).

1.2 Objectives

1.To correlate abiotic factors influencing nesting behaviour of *P. philippinus*.

2.To evaluate the duration required for different developmental stages of nest building.

3.To quantify various developmental stages of nest building.

1.3 Hypothesis

Ecological factors are responsible for nest building behaviour of *P. philippinus*.

1.4 Scope

The scope of this study involves exploring the ecological dynamics and nesting behaviour of *Ploceus philippinus*, with a particular emphasis on their reliance on agricultural landscapes for essential resources such as nesting fibers, nesting trees and feeding grounds crucial for successful reproduction. By investigating their behavior, this research aims to provide valuable insights towards conservation efforts aimed at preserving the species and their habitat. Furthermore, it seeks to establish a baseline dataset essential for future studies within this domain.

CHAPTER 2

LITERATURE REVIEW

Borges et al. (2003) recorded first time use of eucalyptus trees as the nesting platforms on west coast of India and also highlights differential use of nesting fibres: sugarcane fibres were chiefly used for constructing stalk and upper part of the egg chamber and coconut fibres were used for lower part of the egg chamber and entrance tube.

Asokan (2006) studied, the nest construction pattern and variations in the nest microclimate, i.e., temperature and light intensity, between November 2002 and March 2003 in different Baya weaver (*Ploceus philippinus*) nests in the Nagapattinam and Tiruvarur Districts of Tamil Nadu, India. They made nests in palm (*Borassus flabellifer)*, coconut *(Cocos nucifera)*, and date palm trees *(Phoneix psuilla*), with the bulk of the nests located on solitary palms. They found that the male bird was solely responsible for nest construction, which took 18 days, they spent a variable amount of working hours (in terms of days) for constructing various phases of nests, viz., wad, ring, and helmet stage, with the helmet stage taking the most time that is eight days. They also monitored microclimate of eight active nests once a week, taking into account air temperature and light intensity (two active nests) throughout the day and found that nest temperatures ranged from 25 to 29 degrees Celsius, with light intensity ranging from 25 to 625 Lux and the analysis of variance (Anova and Anova) revealed that the microclimate of the nests varied by hour of the day.

Ali (2009) studied nest site selection and prey delivery pattern to nestlings in Nagapattinam and Tiruvarur District, Tamil Nadu. They studied various characteristics between nesting and non-nesting trees and concluded that nesting trees indicate higher values in supporting nests than that of non nesting trees. They also found that habitats such as water source, agricultural lands and electric lines were closer to nest site selection. Prey delivery pattern studies reveals that grasshoppers, caterpillars, unidentified items were delivered throughout the day to the nestlings by two brood parents and prey items were delivered more frequently by smaller brood parents than that of bigger brood parents.

Abdar (2013) study deals with nest tree characteristic and measurement of nest structure in Western Ghats especially Walwa and Shirala Taluka of Maharashtra. It reported *Acacia nilotica* as nesting trees and morphometric measurement of the nest revealed that complete nests varied in length, height from the ground or water, diameter of branches, area of entrance, and great circle of nest.

Thiruvenggadam et al. (2022) study shows that optimal microclimate within nest structures is crucial for successful reproduction. They documented nest tree and nest structure features of 66 fully completed nests for 22 colonies placed in two climatically distinct sites in Peninsular Malaysia. They studied how these factors affected the microclimate within six nests that were randomly picked at each location. The climate factors inside and outside the nests showed a substantial correlation in both sites. Study showed that nest structure influences the microclimate of the nest.

Pandian (2022) study pertains to nesting habits of *P. philippinus* in agricultural landscape of Tindivanam taluka, villupuram district Tamil nadu : total 11,382 nest (wad stage-840, ring stage-478, helmet stage-3,980, egg-chamber closed stage-2,865, completed nests-2,028, abnormal nests-938, and damaged nests-257) and 12,600 *P. philippinus* were observed on 833 nest supporting plants. Nest supporting plants were from 27 species, 26 genera and 17 families. Principal nest supporting palm species were *Borrassus flabellifer, Cocos nucifera* and *Phoenix sylvestnis*. It also highlights nest predation and other threats. Nests per colony ranged from 1 to 109 including all stages. Large-billed Crows, House Crows, Black Drongos, Asian Koels and Rufous Treepies preying on nests and killing by Shikras were reported.

Pandian (2023) studied physio-chemical analysis of clay which is deposited in helmet stage nest, reconstruction, repairing of damage nests, and time taken to built various stages in Chendur village Tamil nadu. They studied two nest colonies having 98 nests in various developmental stages (wad stage-4, helmet stage-31, egg-chamber closed stage-5, and complete nests-58). Nesting materials used were from leaf fibres of Indian date palm (*Phoenix sylvestris*) and sugarcane (*Saccharum offcinarum*) leaves, which took 6-48 days to build a complete nest. From the nests analysed they found that 95% of helmet stage nests (n = 126) had clay deposits which were found to be alkaline with a pH of 9, and its dry weight ranged between 5.1 and 5.8 g. They also found that males repaired destroyed nests and reconstructed new nests from residual stalks attached to palm frond tips.

2.1 Lacuna

Study lacks sufficient data on ecological factors affecting the rate of nest building activity of *P. Philippinus* in the region of Goa.

CHAPTER 3

METHODOLOGY

3.1 Study area

The study site is situated in Chorao Village, Tiswadi Taluka, an island within the Mandovi estuary in Goa. The study area features agricultural fields primarily with paddy cultivation during the monsoon season, extending on both sides of the nesting tree. There were total 16 Coconut trees in straight row out of which only 7 coconut trees were selected for nest building. The study area is characterized by a diverse array of flora, with prominent dominance by coconut trees (*Cocos nucifera*). Additionally, the landscape features grass species such as *Cyrtococcum sp.* and *Eragrostis sp.*, along with herb *Sphagneticola sp*.

These nesting trees serve as multifunctional sites, attracting various bird species, including the Jungle myna, Tricolored munia, Rose-ringed parakeet, Plum-headed parakeet, and Crested serpent eagle, for activities such as perching and resting. The ecosystem is enriched by a diverse population of insects, such as grasshoppers, butterflies, and moths, providing abundant and essential food sources for the nestlings.

Figure 3.1.1 Map showing study site
(source: Google earth pro App)

3.2 Methodology

The methodology employed for this study involved identifying potential nesting sites and studying nesting behaviour of *P. philippinus*. To identify potential nesting sites, random field surveys were conducted initially, and the species were identified by referring to Field guide birds of India by Majumdar et al. (2022).

With respect to the methodology outlined by Pandian (2023) regular visits were made weekly to the nesting sites on both Saturday and Sunday mornings and evenings hour, spanning from 9 am to 1 pm and 3 pm to 6.30 pm, equipped with binoculars for clear observation. These visits aimed to monitor and document activities related to nest building, including the location of fibers, feeding grounds, and other behavioral patterns. Binoculars were employed to closely observe each nesting tree, and relevant data were meticulously recorded. Nesting trees were categorized into colonies, each coconut trees with constructed nests were specifically designated as Colony 1, 2, 3 and so forth. In total, seven nesting colonies were identified and analyzed.

Following Pandian's (2023) methodology, the height of trees, distance from nesting trees to fiber sources, and perching sites were measured using a 100-meter measuring tape. Fallen nests were examined for clay deposits. To capture the developmental progress of nests, weekly monitoring was implemented and observations were recorded, time taken to complete each developmental stage of nests was recorded. Additionally, the total number of nests constructed at different stages were also recorded.

By referring to methodology of Thiruvenggadam et al. (2022), abiotic ecological factors such as temperature, precipitation, and humidity were sourced from https://power.larc.nasa.gov/data-access-viewer/ for accuracy. To document the observations, photographs were captured using a Nikon D 3500 Camera, ensuring a visual record of overall study carried out.

Descriptive statistics including the mean and standard deviation (SD) were calculated to provide an overview of the data. Unpaired t-test was conducted using GraphPad Prism software to determine whether there existed a significant difference in the number of complete nests constructed on coconut trees based on factors such as tree height, distance from nesting fibers, and distance from perching sites. Kruskal-Wallis test was also conducted using GraphPad Prism software to assess differences in mean variables across four stages of nests built weekly. Spearman correlation analysis was employed to examine the relationship between monthly abiotic factors such as precipitation, temperature, and humidity and nest construction behaviour using SPSS version 29 (IBM®). Wilcoxon signed-rank test was also conducted using SPSS version 29 (IBM®) to evaluate whether there was a significant difference in the number of days required to build nests in June-July and August-September.

CHAPTER 4

ANALYSIS AND CONCLUSIONS

4.1 Observations

Breeding of *P. Philippinus* was commenced in June. Males were first reported in fields. Other birds which were reported in fields with *P. philinninus* were Rosed ringed parakeet, Plum-headed parakeet, Jungle myna, Crested serpent eagle, and Tricoloured munias. No old nests were reused for breeding purpose. *P. philippinus* had constructed their nests on coconut trees which were in middle of agriculture field with paddy as chief crop. There were total 16 Coconut trees in straight row out of which only 7 coconut trees was selected for nest building. Primarily used nesting fibres were Coconut fronds, Paddy and fibres from two grass species (*Eragrostis sp.* and *Cyrtococcum sp.*).

Initally *P. philippinus* males were observed striping coconut fronds to construct nests. On 15 july large flocks of male and female *P. philippinus* were reported feeding in paddy fields. From 29 July onwards when the grass had attained full maturity males were observed striping grass and carrying in their beak for nest construction. Also constants fights between males and stealing of fibres were observed from other nests. From 15 august onwards pace of building of nests was increased due to abundantly available grass. At the end Paddy fibres were also used once they had reached full length size. Males were observed in paddy fields collecting clay to deposit in helmet stage nest.

Out of the various stages of nests built only few nests had attained complete stage, colony 1 had 8 complete nests, colony 2 had 13, colony 3 had 6, colony 4 had 1, colony 5 had 4, colony 6 had 10 and colony 7 had 6 complete nests. *P. philippinus* had constructed total of 85 nests of wad stage, 68 helmet stage nest, 51 ECC stage nest and 48 complete stage nest during the breeding season. Out of the nests constructed 28 nests were fallen down due to heavy rains and some were torn by other males during fight. Mostly it was observed that wad stage nest were fallen due to heavy rains and helmet stage nest were torn from the binding site by other males including the nests which got rejected by females and could not proceed to ECC stage. Two abnormal nests with extra opening to helmet stage were reported which did not progress to complete stage nests. Anthropogenic activities from humans were not reported but there were holes seen in some nests by crows.

a

b

Figure 4.1.1 *P. philippinus*: a-Male , b- Female.

Figure 4.1.2 *P. philippinus* feeding in paddy fields

Figure 4.1.3 *P. philippinus* on perching sites

a

b

c

Figure 4.1.4 a-c: Nesting colonies

Figure 4.1.5 *P. philippinus* weaving initial knot .

Figure 4.1.6 *P. philippinus* striping coconut fronds for weaving nest.

a

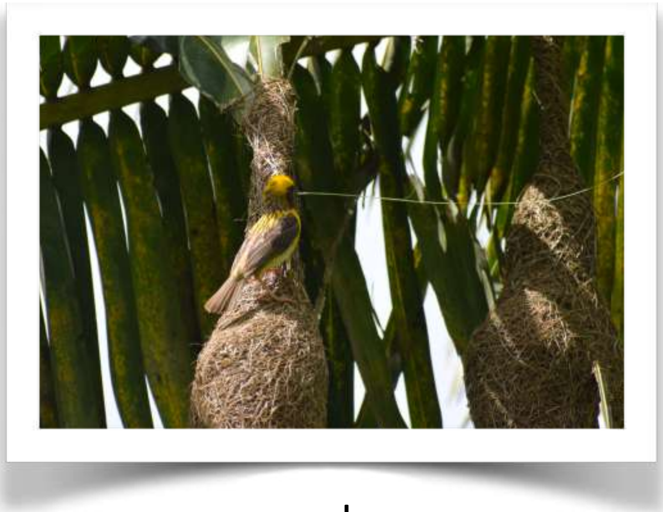
b

c

d

Figure 4.1.7 a-d: *P. philippinus* displaying courtship behaviour from helmet stage nests.

a



b

c

d

e

Figure 4.1.8 Nesting behaviour of *P. philippinus*: a-b carrying fibre in beak ,c-e weaving of nest.

a

b

c

d

Figure 4.1.9 Nesting fibres utilised: a- coconut fronds, b- Paddy , c- *Eragrostis sp.* , *d - Cyrtococcum sp.*

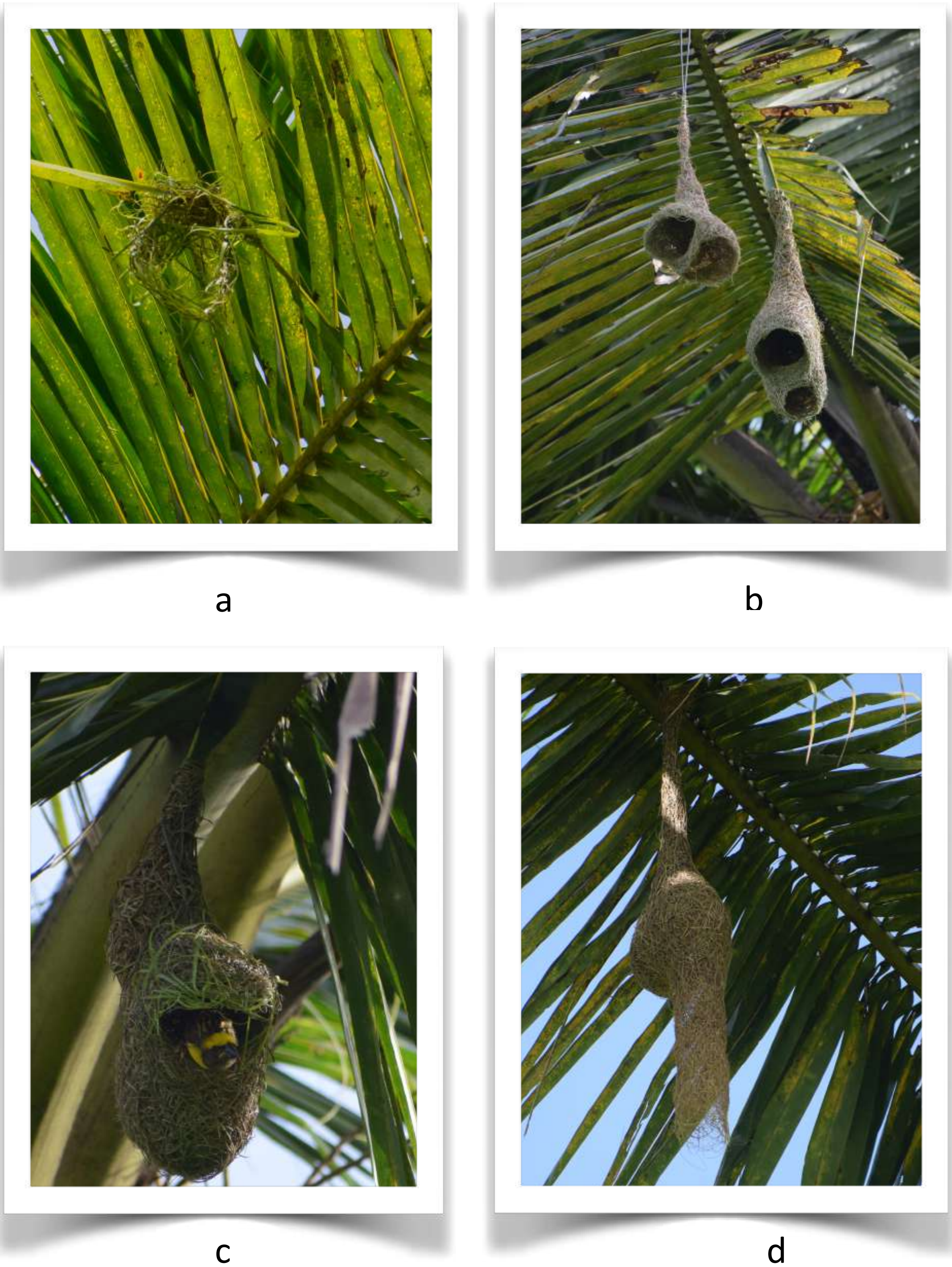


Figure 4.1.10 Stages of nests: a- wad stage, b- helmet stage , c- ECC stage , d- complete stage .

a

b

Figure 4.1.11 a-b: Abnormal nests

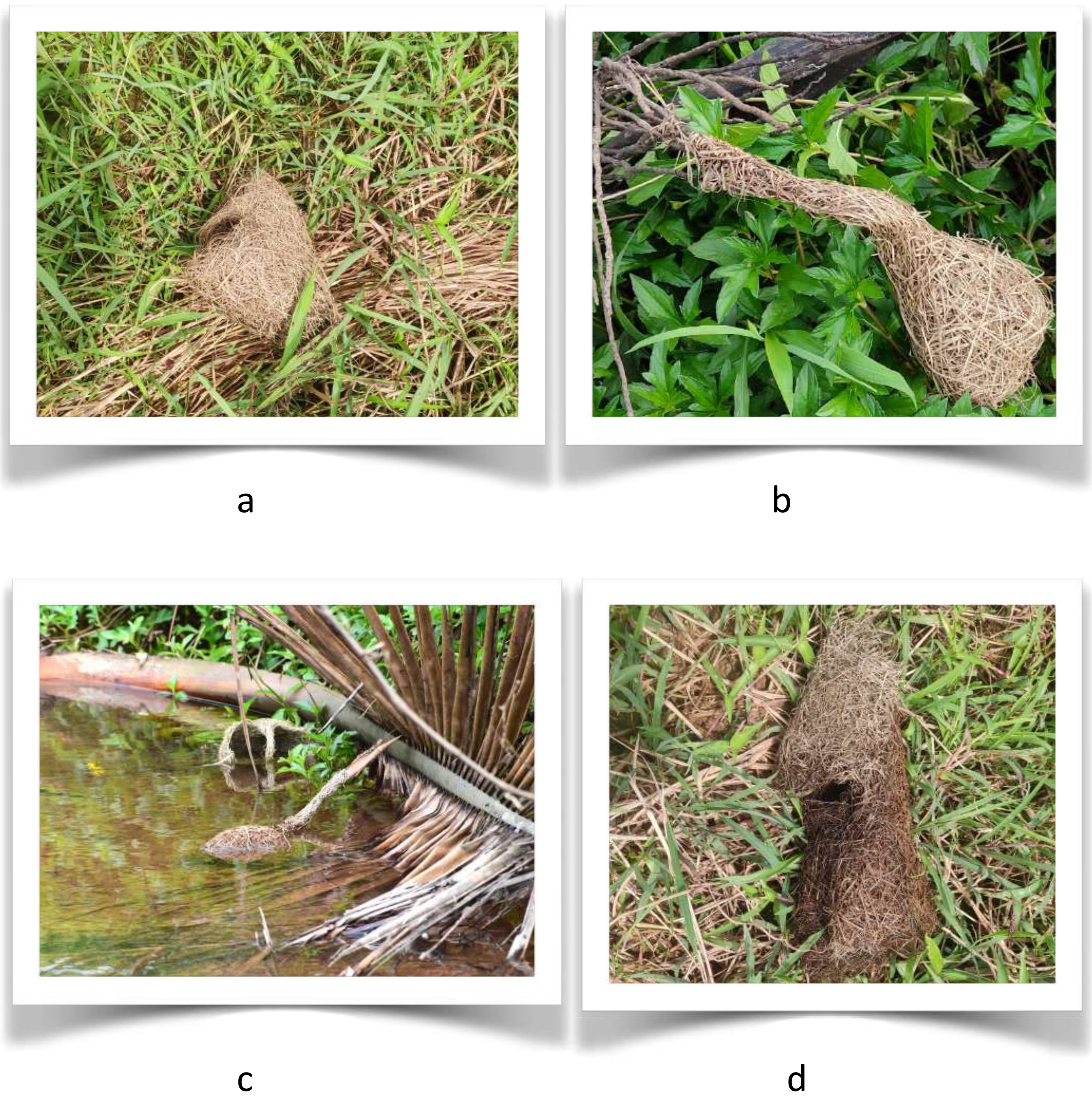
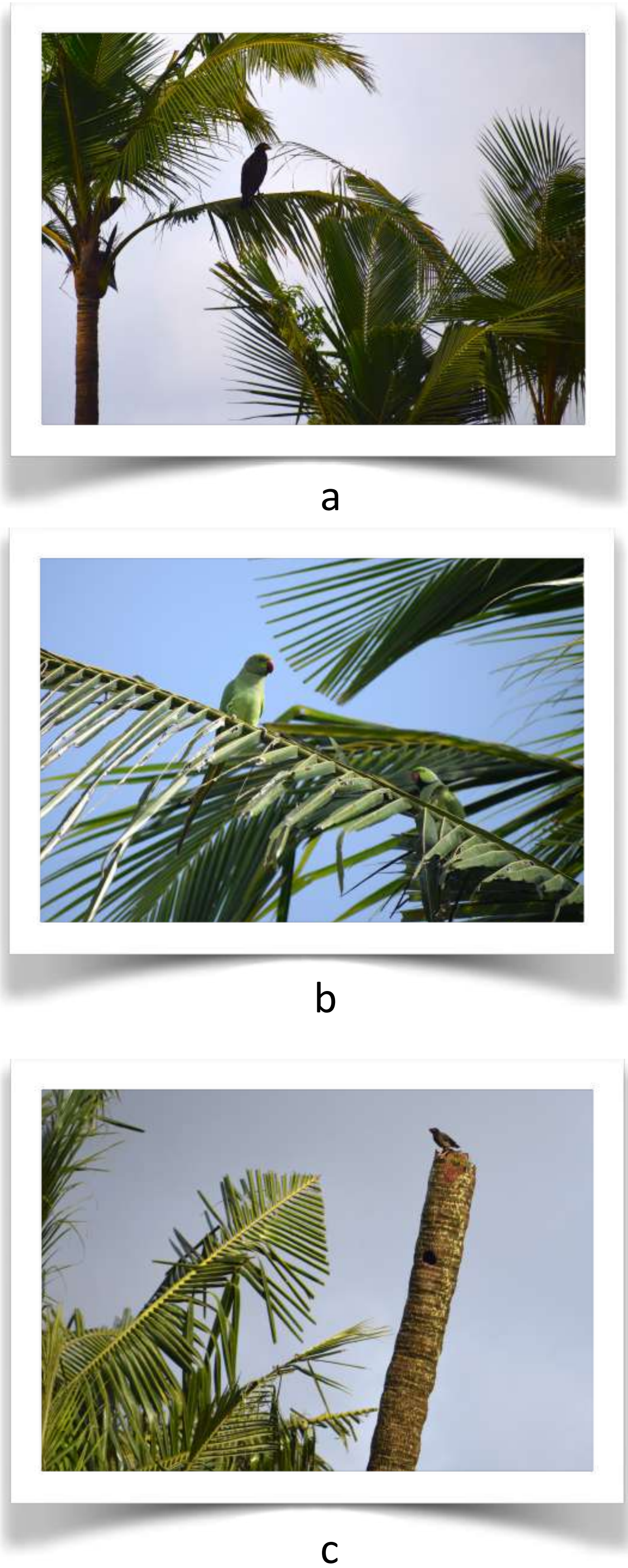


Figure 4.1.12 a-d: Fallen nests.



a

b

c

Figure 4.1.13 Birds observed in vicinity of nesting colonies: a-Crested serpent eagle, b-Rose-ringed parakeet, c- Jungle myna.

4.2 Results

Table 4.2.1 Nesting colonies with complete nests and its habitat characteristics.

Nesting Colonies	Height of trees (m)	Distance from perching sites (m)	Distance from nesting fibres (m)	Number of Complete stage nests
1	9.5	24	25	8
2	9	7	25	13
3	7.5	7.5	25	6
4	9	8	30	1
5	8.5	30	27	4
6	10	32	28	10
7	8.5	35	30	6

Table 4.2.2 Descriptive statistics and unpaired t-test results for table 4.2.1.

Parameters	Mean ± SD	P-value
Complete nests	6.857 ± 3.934	-
Height of nesting trees	8.8570 ± 0.8018	0.212
Distance from perching sites	20.50 ± 12.60	0.018*
Distance from nesting fibres	27.14 ± 2.268	< 0.0001****

* Indicates statistically significant difference at level P < 0.05 and
**** indicates statistically significant difference at level P < 0.0001

Table 4.2.3 Monthly Spearman correlation results between abiotic factors.

	J-P	J-T	J-H	JY-P	JY-T	JY-H	A-P	A-T	A-H	S-P	S-T	S-H
J-P	1.000	-0.760***	0.794***	_	_	_	_	_	_	_	_	_
J-T	-0.760***	1.000	-0.887***	_	_	_	_	_	_	_	_	_
J-H	0.794***	-0.887***	1.000	_	_	_	_	_	_	_	_	_
JY-P	_	_	_	1.000	-0.183	0.306	_	_	_	_	_	_
JY-T	_	_	_	-0.183	1.000	-0.594***	_	_	_	_	_	_
JY-H	_	_	_	0.306	-0.594***	1.000				_	_	_
A-P	_	_	_	_	_	_	1.000	-0.267	0.852***	_	_	_
A-T	_	_	_	_	_	_	-0.267	1.000	-0.435***	_	_	_
A-H	_	_	_	_	_	_	0.852***	-0.435***	1.000	_	_	_
S-P	_	_	_	_	_	_	_	_	_	1.000	0.121	0.728***
S-T	_	_	_	_	_	_	_	_	_	0.121	1.000	0.085
S-H	_	_	_	_	_	_	_	_	_	0.728***	0.085	1.000

*** Indicates statistically significant correlation at level $P < 0.001$

Table 4.2.4 Weekly construction of nest stages with Descriptive statistics and kruskal- Wallis test results.

	No. of nests			
Weekly data	Wad stage	Helmet stage	ECC stage	Complete stage
10 June	14	-	-	-
17 June	31	-	-	-
24 June	47	-	-	-
1 July	8	32	-	-
8 July	2	34	-	-
15 July	6	33	-	-
22 July	3	23	8	-
29 July	6	23	5	-
5 Aug	12	35	10	-
12 Aug	-	36	23	-
19 Aug	2	12	28	-
26 Aug	3	32	18	30
2 sept	7	31	2	48
9 sept	6	39	3	47
16 sept	-	38	1	45
23 sept	2	39	2	40
30 sept	-	22	5	36
7 Oct	-	22	2	34
15 0ct	-	22	2	34
Mean ± std D	10.64 ±18.04	29.56 ± 7.882	8.835 ± 8.959	39.25 ± 6.777
P value	< 0.0001****			

**** Indicates statistically significant difference at level P < 0.0001

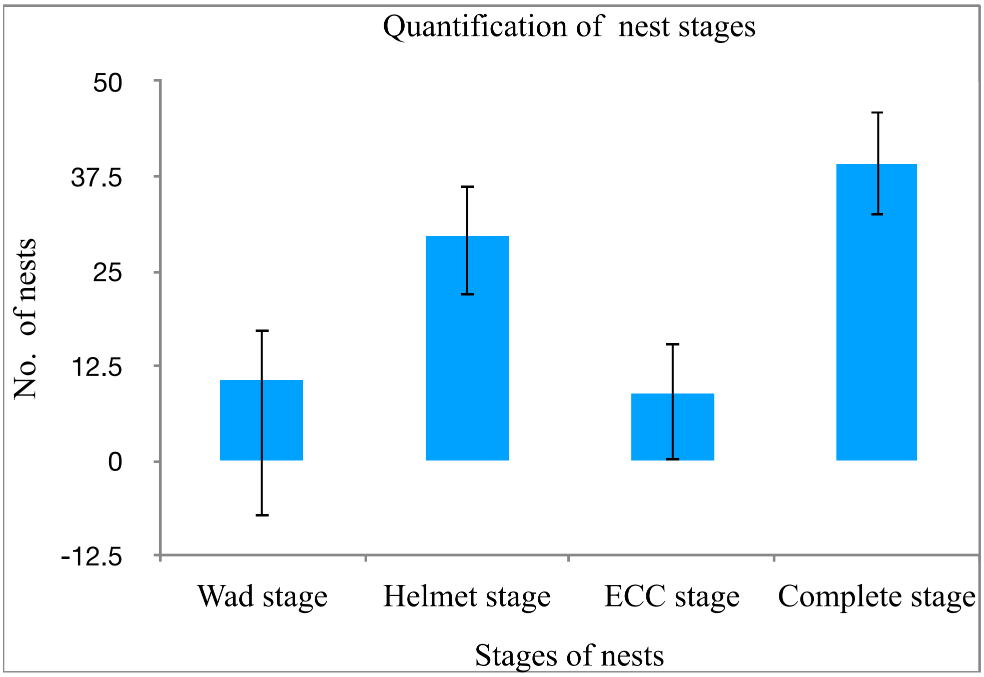


Figure 4.2.1 Graph depicting quantification of nest stages.

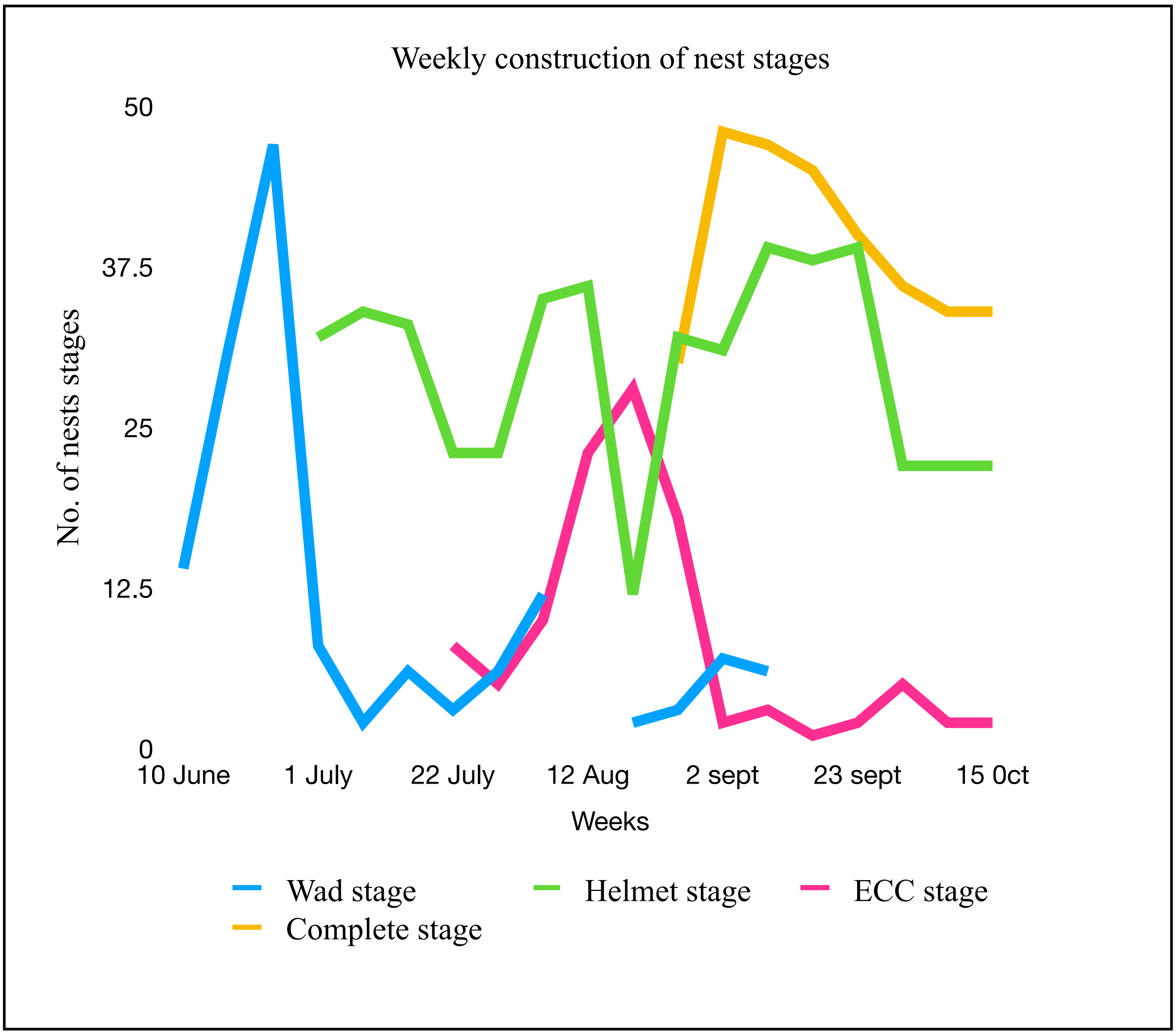


Figure 4.2.2 Line graph depicting weekly construction of nest stages.

Table 4.2.5 No. of days required to build different stages in June-July and August -September.

	No. Of days required to build stages of nests							
	June -July				August -September			
Nesting colonies	Before wad stage	Before Helmet stage	Before ECC stage	Before Complete stage	After Wad stage	After Helmet stage	After ECC stage	After Complete stage
1	16	20	41	20	2	6	6	6
2	6	20	20	20	3	6	13	6
3	6	20	41	6	-	-	-	-
4	6	12	13	6	-	-	-	-
5	6	6	20	13	-	-	6	6
6	6	6	13	27	2	6	-	6
7	6	6	41	13	-	-	-	6

Table 4.2.6 Descriptive statistics and wilcoxon sign ranked test results for table 4.2.5

Stage	Mean ± std.D (before)	Mean ± std.D (after)	Wilcoxon z	P-value
Wad	7.429 ± 3.780	2.333 ± 0.5774	-1.604	0.109
Helmet	12.86 ± 7.010	6 ± 0	-1.414	0.157
Egg closed chamber	27 ± 13.40	8.333 ± 4.041	-1.604	0.109
Complete	15 ± 7.789	6 ± 0	-2.041	0.041*

* Indicates statistically significant difference at level $P < 0.05$

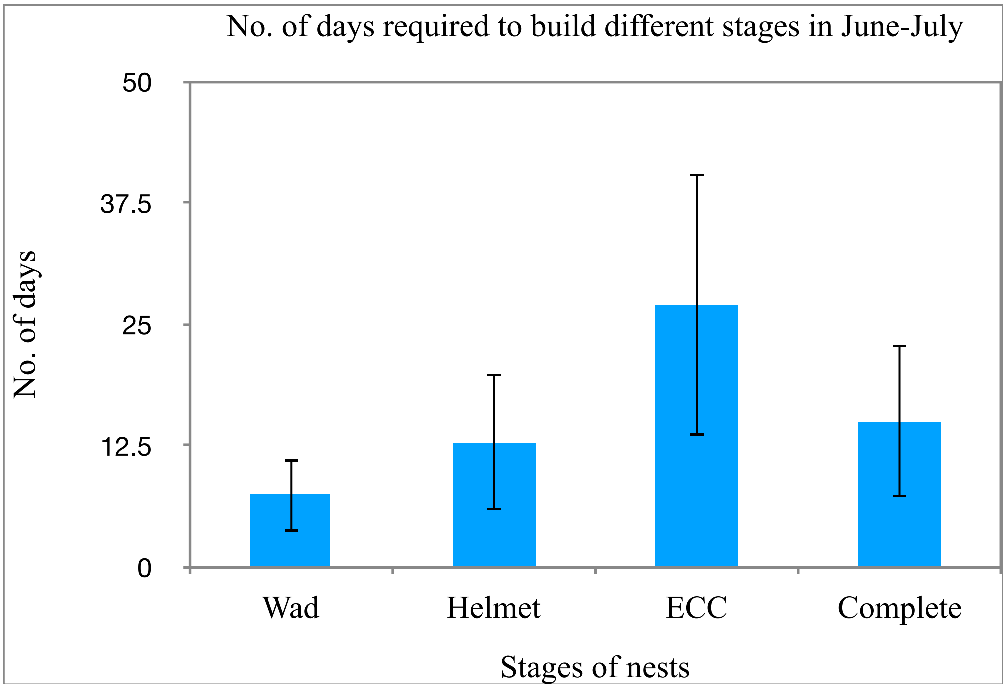


Figure 4.2.3 Graph depicting no. of days required to build different stages in June-July.

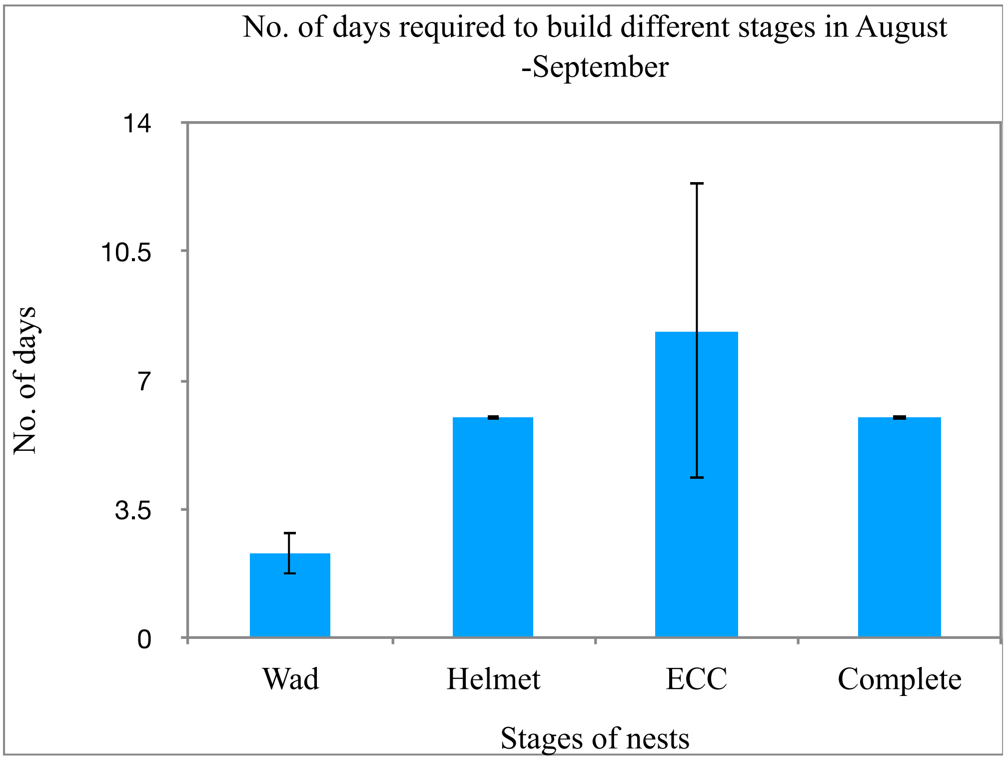


Figure 4.2.4 Graph depicting no. of days required to build different stages in August -September.

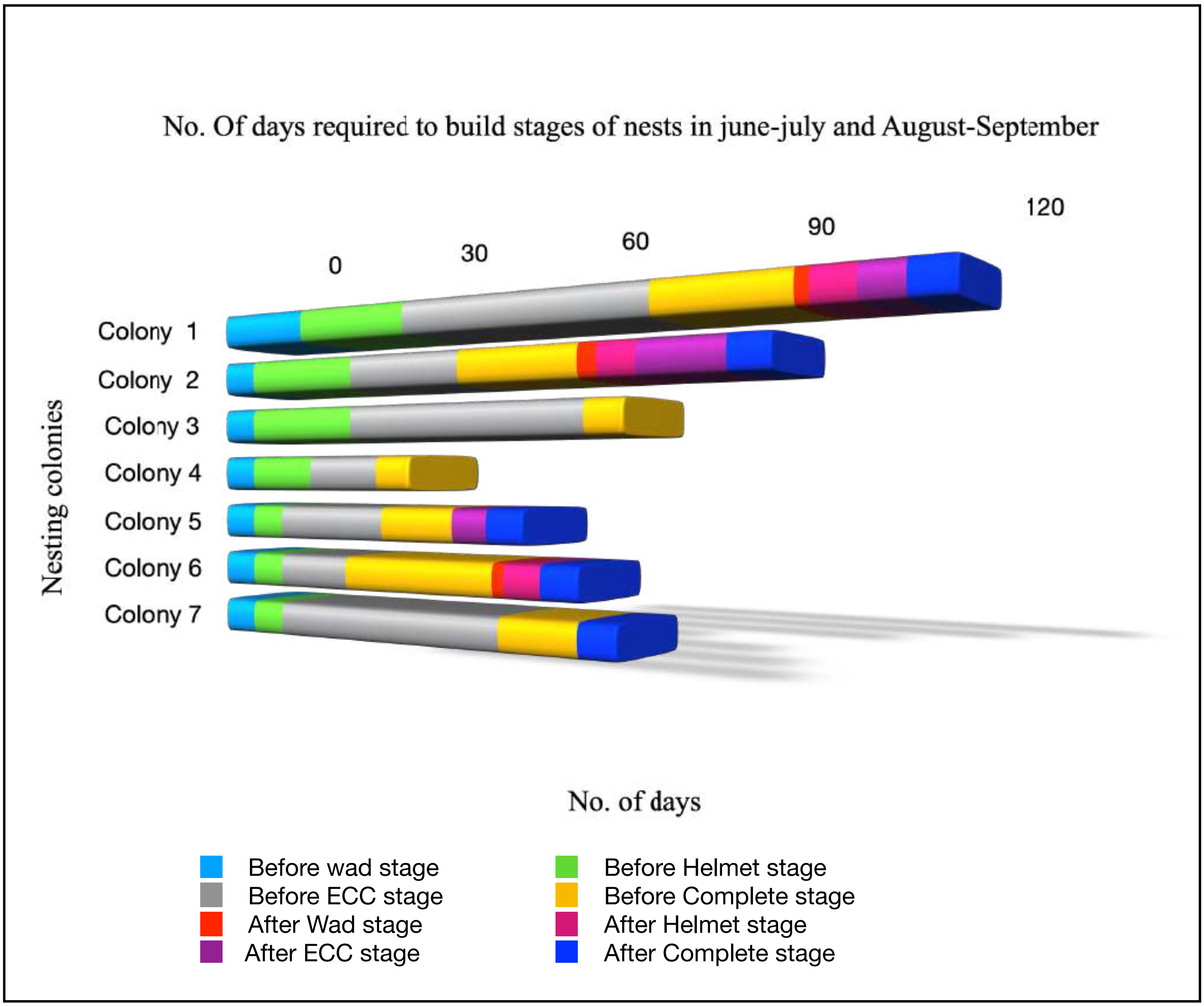


Figure 4.2.5 Stacked bar graph depicting no. of days required to build different stages in June-July and August-September.

Table 4.2.7 Quantification of nests.

No. of nests	
Wad stage	85
Helmet stage	68
ECC stage	51
Complete stage	48
Fallen nests	28
Clay deposits in fallen nests	19

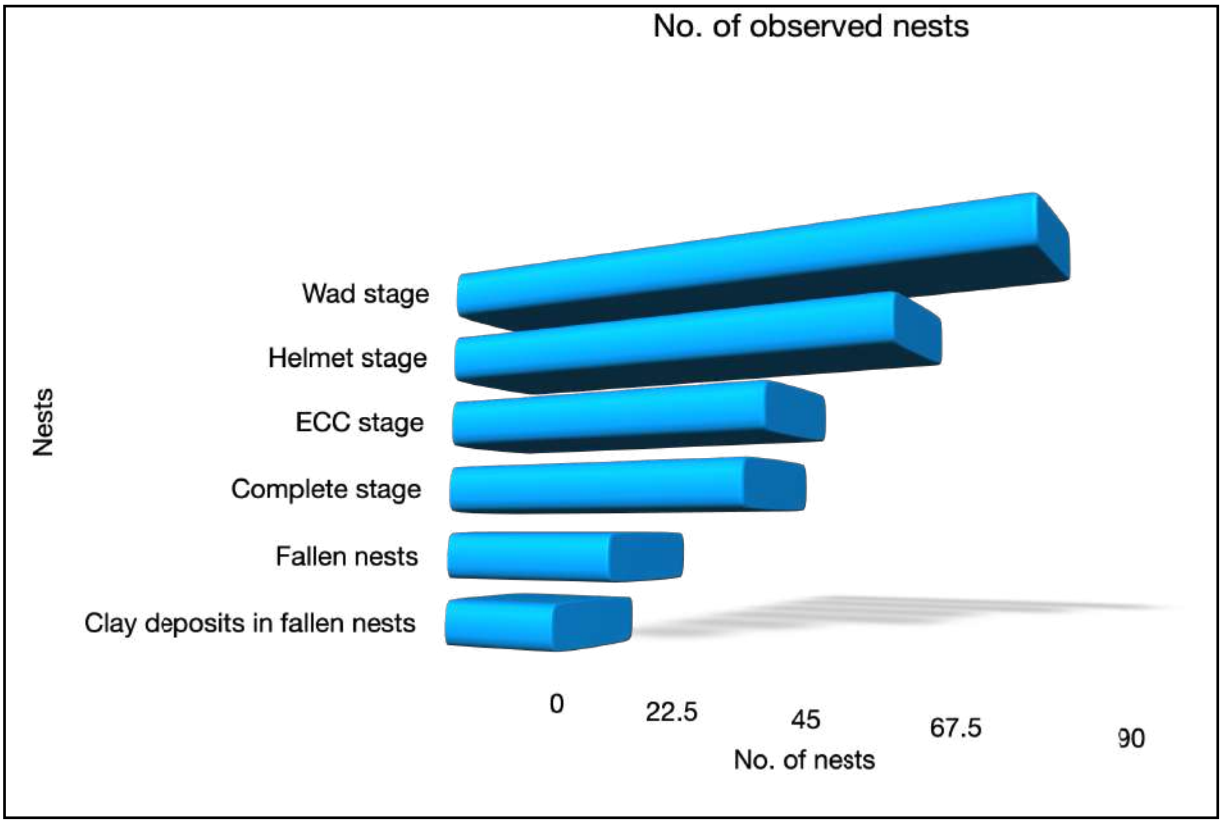


Figure 4.2.6 Graph depicting no. of observed nests.

The Unpaired t-test analysis comparing the height of nesting trees with the number of complete nests built on them revealed non-significant differences ($p = 0.212$). Conversely, when assessing habitat characteristics, significant differences were observed in the distance from nesting fibers to trees hosting complete nests ($p < 0.0001$), as well as the distance from perching sites to these trees ($p = 0.018$).

Furthermore, the Kruskal-Wallis test conducted on the weekly counts of nests at various developmental stages (wad, helmet, ECC, and complete) exhibited a high level of statistical significance ($x^2 = 30.37$, $p < 0.0001$), indicating notable differences between these stages.

In terms of monthly correlations with abiotic factors, June revealed a significant negative correlation between precipitation and temperature ($r = -0.760$, $p < 0.001$), a positive correlation between precipitation and humidity ($r = 0.794$, $p < 0.001$), and a negative correlation between temperature and humidity ($r = -0.887$, $p < 0.001$). In July, a significant negative correlation was found only between temperature and humidity ($r = -0.594$, $p < 0.001$). August showed a significant positive correlation between precipitation and humidity ($r = 0.852$, $p < 0.001$), while September exhibited a significant positive correlation between precipitation and humidity ($r = 0.728$, $p < 0.001$).

The Wilcoxon signed-rank test was conducted to compare the number of days required to build nests in June-July when nesting fibers were scarce, versus August-September when ample nesting fibers were available. The results indicate that there is no significant difference between the days required to build nests before and after in the wad stage ($p = 0.109$), helmet stage ($p = 0.157$), and ECC stage ($p = 0.109$). However, there is a significant difference in the days required to build complete stage nests between June-July and August-September ($p = 0.041$).

4.3 Discussion

The study provides insights into the ecology and nesting behaviour of *P. philippinus* in Selected Study Site of Chorao, Goa from June to October. Ambedkar (1969) observed that *P. philippinus* from various regions showed a preference for different plant species when constructing nests. In Tamil Nadu, he documented six species used for nest construction: *B. fabellifer, P. sylvestris, C. nucifra, P. dulce, T. indica, and Acacia sp.* Mathew (1972) reported that *P. philippinus* in Uttar Pradesh utilized 25 plant species for nesting, while Pandian (2021a) found 17 plant species used in Arakkonam taluka of Tamil nadu. In present study *P. philippinus* exhibited a preference for nesting in coconut trees within paddy fields, as one of the species recorded by Ambedkar where nesting materials, water sources, and feeding grounds were in close proximity.

The choice of nest materials varied depending on the locality. Dewar (1909) observed that in India, *P. philippinus* predominantly used leaf fibers of *C. nucifera and P. sylvestris*, except in the northern regions. Similar observations were made in the Northern Province of Sri Lanka, India, Africa, and Seychelles (Wood 1926; Crook 1962). In Maharashtra's Kolaba district, Ali (1931) reported the use of *Phoenix sp*., coarse grass, and paddy for nest construction, while in the Cuddapah district of Andhra Pradesh, Mathew (1972) recorded the use of *Phoenix sp*., paddy, millets, coconut, and lemon grass. The present finding of *P. philippinus* using fibres from coconut fronds, paddy and two grass species (*Eragrostis sp.* and *Cyrtococcum sp.*) are similar to observations of Mathew (1972).

Davis (1974) stated that the tall, unbranched, smooth trunks, and long swaying leaves of palm and coconut trees have a dual function of deterring predators and providing suitable leaf strips for nest weaving. However, in the present study, tree height was not a significant factor in nest site selection. This may be attributed to the dense clustering of coconut trees with minimal height variation, and minimized predation threats in study site.

Asokan et al. 2008 had stated that availability of nesting materials and surrounding biological environment are crucial which decides nest selection in birds similar preferences were observed in study site where habitat features such as the availability of nesting fibers, perching sites, and proximity to water sources were conveniently located, saving energy and time for the birds.

During the breeding season, nests at various stages were observed, with fluctuations influenced by monthly abiotic factors. Immelmann 1971; Baker 1938 had reported that food supply is dependent on environmental factors like temperature and rainfall, which ultimately controls seasonal breeding. In present study Positive correlations between precipitation and humidity, coupled with negative correlations with temperature, were observed in June, likely signaling optimal conditions for nesting initiation. Conversely, July exhibited a negative correlation between temperature and humidity, corresponding to reduced nest-building activity but increased courtship behaviors. Nest construction accelerated in August and September, coinciding with positive correlations between precipitation and humidity, and increased availability of nesting fibers.

Throughout the breeding season, nest construction varied weekly across all stages, with some nests lost due to environmental factors or male-male competition. New nests were exclusively constructed by males until the ECC stage, after which females were observed contributing to nest completion, primarily through tunnel-building.

Males were observed depositing clay from paddy fields in helmet stage nest and all fallen nests examined had Clay deposits in them. This behavior of applying mud to the inner walls of nests is also seen in other *Ploceus* species like the Black-breasted Weaver *P. benghalensis* and Streaked Weaver *P. manyar* (Crook 1962). Wood (1926) suggested that this practice strengthens the nest against strong winds and might have been inherited from ancestors of the *P. philippinus*. Crook (1963) and Davis (1973) proposed that mud plastering reinforces the fibers, especially during the female's vigorous nest examination. Ali et al. (1956) observed a common behavior among male *P. philippinus*, where they frequently destroyed the nests of rivals while the rightful owners were away collecting materials, similar observations were recorded during this study primarily occurring during the helmet stage of nest building.

Pandian (2022a) documented the duration required to build nests across various stages: for the wad stage, it ranged from 2 hours to 9 days; for the helmet stage, from 1 to 15 days; for the ECC stage, from 1 to 29 days; and for the complete stage, from 1 to 28 days. However, the present study found slight variation with Pandian's observations. The duration varied across stages: for the wad stage, it ranged from 6 days to 16 days; for the helmet stage, from 6 days to 20 days; for the ECC stage, from 13 days to 41 days; and for the complete stage, from 6 days to 27 days.

The duration required for nest construction varied across the months of June- July and August-September. In all three stages (wad, helmet, and ECC), Despite the limited availability of nesting fibers, there was no statistically significant difference in the mean duration days required to build nests between June-July and August-September. This suggests that *P. philippinus* maintains a relatively consistent pace of nest building, demonstrating adaptability to environmental fluctuations, such as the utilization of coconut fronds when grass fibers were scarce. However, during the complete stage in August-September, when grass fibers were abundant, there was a notable decrease in the duration required to construct nests. This indicates that the availability of nesting fibers facilitates faster nest construction during this period.

In August, hatching occurred, and females commenced feeding nestlings, primarily with insects such as grasshoppers. Minimal threats were posed by humans or other animals, although some brood chambers exhibited damage, likely caused by crows.

In the study site, population of baya weavers persist due to the presence of essential resources such as agricultural land, nesting fibres, feeding grounds, and suitable nesting trees. However, extensive urbanization poses a significant threat to these resources in many areas. Agricultural lands, crucial for the birds' survival, are either abandoned or repurposed for construction projects. Additionally, nesting materials like grasses are indiscriminately harvested for fodder, further depleting the available resources.

The coconut trees preferred by *P. philippinus* are historically tall and mature, providing ideal nesting sites. However, modern agricultural practices aimed at enhancing coconut yield often result in the cultivation of dwarf varieties that do not reach the heights required by the birds for nesting. Consequently, these modified coconut trees are unable to support Baya weaver populations effectively. Moreover, destruction of traditional bunds during road expansion, further leads to loss of coconut trees.

The combination of these factors poses a severe threat to the population dynamics of *P. philippinus*. To ensure the species' survival, conservation efforts focusing on habitat preservation are crucial. Such measures should prioritize the protection of agricultural lands, the sustainable management of nesting materials, and the preservation of suitable nesting trees. Only through concerted conservation initiatives we can mitigate the adverse impacts of urbanization and safeguard the habitat essential for the survival of Baya weavers.

All the above findings states that present study supports the hypothesis that ecological factors play significant role in nest building behaviour of *P. philippinus.*

4.4 Conclusion

The nesting behaviour of *Ploceus philippinus* is intricately influenced by various ecological attributes within its habitat, encompassing both abiotic factors and habitat characteristics such as nesting fibers, feeding grounds, and water sources. Despite encountering numerous challenges, the species demonstrates remarkable resilience by adapting its nesting strategies to environmental fluctuations, thereby ensuring the timely construction of nests and maintaining a balance within its ecosystem. However, the increasing threat of habitat degradation, primarily driven by urbanization invading upon agricultural lands, poses a significant risk to the species' survival. While *P. philippinus* exhibits some capacity to adapt to gradual environmental changes, the potential loss of critical components of its habitat, including nesting trees and agricultural lands, could lead to its decline. Consequently, concerted conservation efforts are essential to mitigate the adverse impacts of habitat loss, thereby safeguarding the long-term survival of *P. philippinus* populations.

References

1. Abdar, M. R. (2013). Nesting Ecology of Baya Weaver *Ploceus philippinus* (Linnaeus: Passeriformes). *Current Trends in Life Sciences,* 10, 74-80.
2. Ali, M. (2009). Studies on nest-site selection and prey delivery patterns to nestlings by the Baya Weaver *Ploceus philippinus* (Aves: Passeriformes) in Tamil Nadu, South India. *World Journal of Zoology*, 4, 308-312.
3. Ali, S. (1931). The nesting habits of the baya (*Ploceus philippinus*): A new interpretation of their domestic relation. *Journal of the Bombay Natural History Society*, 34, 947-954.
4. Ali, S. (2002). *The book of Indian birds* (Thirteenth edition). Bombay Natural History Society, Mumbai.
5. Ali, S., & Ripley, S. D. (1987). *Compact handbook of the birds of India and Pakistan together with those of Bangladesh*, Nepal, Bhutan and Sri Lanka (2nd ed.). Delhi: Oxford University Press.
6. Ali, S., Vijayakumar, & Ambedkar, C. V. (1956). Notes on the Baya weaver Bird. *Journal of the Bombay Natural History Society*, 53, 381–389.
7. Ambedkar, V. C. (1964). *Some Indian Weaver birds*: *a contribution to their Breeding biology*. University of Bombay Press, Bombay.
8. Arigela, R. K., Singh, R. K., Siddabathula, N., Prasad, K., & Yadav, B. S. (2021). Botanical view of the Baya Weaver's choices in India. *Species*, 22, 420-430.
9. Asokan, S., Ali, M. S., & Nagarajan, R. (2008). Studies on nest construction and nest microclimate of the Baya Weaver, *Ploceus philippinus* (Linn.). *Journal of Environmental Biology*, 29, 393–396.

10. Baker, J. R. (1938). The relation between latitude and breeding seasons in birds. *Proceedings of the Zoological Society of London*, 108, 557–582.

11. Bird Life International. (2016). *Ploceus philippinus*: The IUCN Red List of Threatened species 2016:eT22719005A94606190. Accessed on 22 September 2023.

12. Borges, S. D., Desai, M., & Shanbhag. (2002). Selection of nest platforms and the differential use of nest building fibres by the Baya weaver, *Ploceus philippinus* Linnaeus 1766. *Tropical Zoology*, 15(1), 17-25.

13. Collias, N. E., & Collias, E. C. (1964). The development of nest building behavior in a weaver bird. *The Auk*, 81, 42–52.

14. Collias, N. E., & Collias, E. C. (1984). *Nest building and bird behavior*. Princeton, NJ: Princeton University Press.

15. Crook, J. H. (1960). Studies on the reproductive behavior of the Baya Weaver bird *Ploceus philippinus* (Linn.). *Journal of the Bombay Natural History Society*, 57(1), 1– 44.

16. Crook, J.H. (1962). A comparative analysis of nest structure in the Weaver Birds *(Ploceine*). *Ibis*, 105, 238–262.

17. Crook, J.H. (1963). A Comparative Analysis of Nest Structure in the Weaver Birds (*Ploceinae*). *Ibis*, 105, 238–262.

18. Davis, T.A. (1973). Mud and dung plastering in Baya nests. *Journal of the Bombay Natural History Society*, 70(1), 57–71.

19.Dewar, D. (1909). The nesting habits of Baya. *Journal of the Bombay Natural History Society*, 19(3), 627–634.

20.Davis, T. A. (1974). Selection of nesting trees and the frequency of nest visits by Baya Weaver birds. *Journal of the Bombay Natural History Society*, 71(3), 356–366.

21. https://power.larc.nasa.gov/data-access-viewer/. Accessed on 9 December 2023

22.Immelmann, K. (1971). Ecological aspects of periodic reproduction. *Avian biology*, 1, 341–389.

23.Inskipp, C., Allen, R., Inskipp, T., & Grimmet, R. (2011). *Birds of the Indian Subcontinent*. United Kingdom: Christopher Helm.

24.Majumdar, A., Maheswaran, G., Alam, I., Chandra, K., Alfred, J. R. B., & Roy Chawdhury, B. (2022). *Field guide Birds of India*, 1-600. Published by Zoological Survey of India.

25.Mathew, D.N. (1972). The ecology of the Baya in Rajampet, Cuddapah district, Andhra Pradesh. *Journal of the Bombay Natural History Society*, 69(1), 188–191.

26.Narasimhacharya, A. V. R. L. (1987). Investigations on hormonal factors integument and certain aspects of breeding biology of the male Indian baya weaver bird *Ploceus philippinus* l. Ph.D. thesis, Department of Bioscience, Sardar Patel University.

27.Pandian, M. (2022a). Nests construction and repairing habits of Baya Weaver *Ploceus philippinus* (Aves: Passeriformes: Ploceidae) in the agricultural landscape of Villupuram District, Tamil Nadu, India. *Journal of Threatened Taxa*, 15(9), 23843–23856.

28.Pandian, M. (2022b). Nesting habits of the Baya Weaver *Ploceus philippinus* (Linnaeus, 1766) in the agricultural landscape of Tindivanam, Tamil Nadu, India. *Journal of Threatened Taxa*, 14(4), 20970-20987.

29.Quader, S. (2003). What makes a good nest? Benefits of nest choice to female Baya Weaver (*Ploceus philippinus*). *Auk*, 123(2), 475-486.

30.Quader, S. (2006). Sequential settlement by nesting male and female Baya weaverbirds, *Ploceus philippinus*: The role of monsoon winds. *Journal of Avian Biology*.

31.Sharma, S. K. (1989). Host plants used by Baya Weaver Bird *Ploceus philippinus* (L.) for nesting in Udaipur district, Rajasthan. *Journal of the Bombay Natural History Society*, 86, 453–454.

32.Thiruvenggadam, T., Mohd. Top, M., Nulit, R., & Puan, C. L. (2022). Influence of Climatic Factors and Nest Tree Characteristics on the Nest Structures of the Baya Weaver (*Ploceus philippinus*) in Peninsular Malaysia. *Animals*, 12, 815.

33.Wood, C.A. (1926). The nest of the Baya Weaver bird. *The Auk*, 43(3), 295–302.

Appendix I:

Table 4.2.8. Five-months weather data.

			Rainfall	Temperature	Relative humidity
	MONTH	DAY	PRECTOTCORR	T2M	RH2M
	June				
2023	6	1	1.19	29.15	76.81
2023	6	2	0.14	29.57	71.69
2023	6	3	0.13	30.15	72.06
2023	6	4	0.94	30.16	73.75
2023	6	5	1.34	29.83	74.75
2023	6	6	0.37	30.06	73.12
2023	6	7	0.19	30.18	72.44
2023	6	8	0.82	30.19	73.56
2023	6	9	2.82	29.94	77.44
2023	6	10	30.51	29.44	79.31
2023	6	11	12.67	29.62	75.31
2023	6	12	9.11	30.08	73.31
2023	6	13	4.8	29.97	75.88
2023	6	14	5.3	29.87	76.44
2023	6	15	1.99	30.0	75.19
2023	6	16	4.88	29.58	77.19
2023	6	17	13.13	29.18	80.31
2023	6	18	6.41	28.81	82.69
2023	6	19	1.68	28.69	83.19
2023	6	20	0.98	29.02	80.81
2023	6	21	2.61	29.32	80.12
2023	6	22	19.13	28.32	84.56
2023	6	23	16.02	28.4	79.25
2023	6	24	38.35	28.1	84.0
2023	6	25	17.35	28.15	84.69
2023	6	26	30.31	28.42	84.25
2023	6	27	104.53	27.49	85.06
2023	6	28	23.35	27.55	83.81

2023	6	29	60.06	27.54	82.06
2023	6	30	82.13	27.65	86.25
	July				
2023	7	1	37.12	28.01	84.81
2023	7	2	38.64	27.95	86.69
2023	7	3	60.84	27.89	89.0
2023	7	4	82.12	27.51	89.75
2023	7	5	84.46	26.98	87.31
2023	7	6	71.2	26.98	84.81
2023	7	7	42.38	27.32	85.5
2023	7	8	21.99	27.5	85.69
2023	7	9	11.21	27.52	86.56
2023	7	10	10.23	27.42	86.06
2023	7	11	4.71	27.19	88.0
2023	7	12	10.25	27.38	88.38
2023	7	13	75.06	27.33	88.56
2023	7	14	50.64	27.25	86.38
2023	7	15	19.91	27.27	86.94
2023	7	16	5.62	27.29	88.5
2023	7	17	19.25	27.4	88.06
2023	7	18	46.3	27.12	89.06
2023	7	19	60.34	26.78	89.69
2023	7	20	47.0	26.82	90.19
2023	7	21	61.86	26.86	89.81
2023	7	22	68.03	26.55	89.12
2023	7	23	80.12	26.85	88.44
2023	7	24	64.8	26.6	89.38
2023	7	25	41.12	26.56	88.81
2023	7	26	82.51	26.45	90.06
2023	7	27	30.05	26.37	90.56
2023	7	28	10.02	26.77	89.69
2023	7	29	6.44	26.88	86.75
2023	7	30	8.53	26.85	87.38
2023	7	31	9.76	26.87	88.06

	August				
2023	8	1	8.83	26.93	87.0
2023	8	2	5.27	27.14	85.94
2023	8	3	4.79	27.09	85.69
2023	8	4	7.77	27.38	87.31
2023	8	5	4.25	27.19	85.06
2023	8	6	6.5	26.7	88.44
2023	8	7	3.55	26.8	86.5
2023	8	8	2.38	27.02	84.62
2023	8	9	4.66	27.18	85.75
2023	8	10	2.71	27.08	85.5
2023	8	11	1.27	27.33	82.56
2023	8	12	2.16	27.12	83.19
2023	8	13	1.02	27.07	80.94
2023	8	14	1.19	27.08	78.75
2023	8	15	2.72	26.8	83.06
2023	8	16	3.37	26.78	85.44
2023	8	17	3.59	27.03	84.75
2023	8	18	4.97	26.83	85.62
2023	8	19	11.95	26.98	88.31
2023	8	20	6.74	27.19	86.94
2023	8	21	3.18	26.95	86.25
2023	8	22	1.73	26.83	85.12
2023	8	23	1.79	27.26	83.31
2023	8	24	5.86	27.04	86.0
2023	8	25	10.57	27.01	88.12
2023	8	26	4.58	27.12	86.06
2023	8	27	0.46	27.75	79.0
2023	8	28	1.08	27.73	80.38
2023	8	29	6.06	27.58	84.06
2023	8	30	3.29	27.43	84.25
2023	8	31	1.17	27.55	83.56
	Sept				
2023	9	1	6.55	27.81	82.62

2023	9	2	10.66	27.05	85.12
2023	9	3	4.45	27.11	84.31
2023	9	4	5.77	27.02	86.75
2023	9	5	9.87	27.04	86.44
2023	9	6	1.69	27.56	82.88
2023	9	7	3.08	27.37	83.88
2023	9	8	5.26	27.51	86.12
2023	9	9	18.93	28.01	87.38
2023	9	10	5.57	27.88	84.88
2023	9	11	7.27	27.8	84.81
2023	9	12	4.39	27.6	84.19
2023	9	13	3.8	27.65	83.56
2023	9	14	6.13	27.66	84.06
2023	9	15	14.47	27.69	85.06
2023	9	16	11.28	27.73	87.19
2023	9	17	7.35	27.83	86.69
2023	9	18	5.27	27.96	84.94
2023	9	19	8.04	27.94	85.31
2023	9	20	10.76	27.8	86.25
2023	9	21	9.77	27.81	85.62
2023	9	22	6.95	27.4	86.88
2023	9	23	13.46	27.58	86.38
2023	9	24	12.12	27.26	87.06
2023	9	25	5.56	27.16	86.44
2023	9	26	3.51	27.19	82.25
2023	9	27	8.24	26.99	86.38
2023	9	28	56.4	27.12	86.94
2023	9	29	73.17	27.41	90.56
2023	9	30	14.45	27.83	86.5
	October				
2023	10	1	23.16	27.4	84.88
2023	10	2	2.13	27.61	82.88
2023	10	3	1.57	26.89	84.88
2023	10	4	15.29	26.51	85.12

2023	10	5	18.27	25.25	81.44
2023	10	6	16.29	27.14	86.75
2023	10	7	4.1	27.62	86.94
2023	10	8	2.78	27.75	86.38
2023	10	9	7.68	28.01	87.44
2023	10	10	3.9	28.37	85.88
2023	10	11	4.33	28.84	81.75
2023	10	12	2.8	28.67	82.19
2023	10	13	0.35	28.28	82.5
2023	10	14	1.66	28.34	77.5
2023	10	15	6.34	28.1	82.25
2023	10	16	9.41	28.33	81.25
2023	10	17	5.46	27.92	82.06
2023	10	18	2.76	28.55	78.56
2023	10	19	0.61	28.8	75.44
2023	10	20	0.33	28.91	73.31
2023	10	21	0.63	28.87	73.94
2023	10	22	0.79	28.8	77.94
2023	10	23	0.15	29.07	69.38
2023	10	24	0.15	28.35	70.56
2023	10	25	0.24	28.64	65.44
2023	10	26	0.0	27.84	65.69
2023	10	27	0.0	26.94	71.88
2023	10	28	0.0	27.44	70.31
2023	10	29	0.02	28.48	69.5
2023	10	30	2.75	27.66	81.19
2023	10	31	40.9	27.4	83.62