

**ROOSTING AND NESTING ECOLOGY OF HOUSE SPARROW  
(*Passer domesticus*) IN GUWAHATI CITY, ASSAM**

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**ABSTRACT**

Aves are unique in having a coat of feathers and in balancing on the hind limbs alone. They are known as the feathered bipeds. Roosting, nest building in birds has been considered a remarkable behaviour in aves. The nesting ecology of birds is likely the most important component of its life history and it is affected by several ecological and environmental factors. Guwahati city, a rapidly growing city in northeast India inhabits a lot of species of birds. It is located between the Brahmaputra River's southern bank and the Shillong plateau's foothills. Total of the 57 nests, 28% were discovered in the rolling shop shutters, followed by 27% in the tin sheet roofs of homes, followed by 19% in building crevices, 9% in building holes, 7% in advertisement hoarding and 5% in AC outdoor units and 5% in unused building pipes. It is also observed that 49% of the nests are located at a height between 2–4 metres from the ground level, 70% of the nests are located between 1–5 metres from the nearest food source, and 58% of the nests are located between 1–5 metres from the nearest water source. Out of the 57 nests observed, 50 were found to be solitary, 5 were found to be Pair, and 2 were found to be cluster type. The study found that choosing a nest is influenced directly by the location of the nearest food source and nearest water source in Guwahati city. The study presents the merit and needs for studying the nesting ecology of birds in India, also suggests best practices to conserve bird's nest specific to the Indian context which might provide important information for the nesting ecology of House Sparrows (*Passer domesticus*).

**Keywords:** Roosting, Guwahati city, Brahmaputra River, Nests, Solitary.

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## INTRODUCTION

Birds have long been used as bio-monitor to assess environmental conditions and are among the finest indicators of changes in environmental circumstances. The most widespread and numerous bird in the entire world is the House Sparrow (*Passer domesticus*), which is a member of the Passeridae family. This bird species breeds in small colonies or loose groups. It is omnivorous and eats grains, fruit buds, flower nectar, weed seeds, insects and kitchen garbage. The chicks are fed aphids, weevils, grasshoppers, and caterpillars. Birds can serve as an indicator of the ecological balance of a given area since they are sensitive to environmental changes. The House Sparrow (*P. domesticus*) is a small bird locally known as 'Ghor Sirika' in Assam. It is closely associated with human habitation and is highly adaptable to urban, suburban and agricultural habitats.

The House Sparrow is the most widely distributed land bird in the world (Anderson, 2007). House Sparrow inhabits every continent, with the exception of Antarctica, China and Japan. It is native to Eurasia and North Africa and was introduced to South Africa, North and South America, Australia, New Zealand, the Middle East, India and Central Asia, where its population flourished under a variety of environmental and climatic conditions.

Within India, House Sparrows are found throughout the country, up to the Assam valley and lower parts of the Assam hills. It is a widely prevalent bird species, reported from all habitats, including deserts and cold regions of the Himalayas (Sundaramoorthy, 2007). The House Sparrow inhabits a wide variety of habitats. Of all the wild birds, House Sparrows have the closest association with man (Laet & Summers-Smith, 2007). Although found in widely varied habitats and climates, house sparrows normally avoid extensive woodlands, grasslands and deserts away from human development.

House sparrows mostly feed on grain and weed seeds, but they are opportunistic feeders

who also consume insects and a variety of other things. In cities, they devour insects, berries, seeds, flower buds, and pieces of other human waste. They raise their young completely on insects (Sundaramoorthy, 2007). House sparrows are largely seed eaters in rural areas, focusing on the seeds of cultivated grain crops such as oats, wheat, barley, corn, and maize. House Sparrows, like many other birds, modify their food as they grow. Whereas adult House sparrows are predominantly granivorous, nestlings are primarily nourished on insects for the first three days of their lives, with plant food becoming increasingly significant after that (Anderson, 2006).

Mating occurs around the nest location throughout the breeding reproductive cycle (March to early August). They establish monogamous partnerships for each mating season, with active nests being observed from February to April (peak breeding season). House Sparrows lay 3 to 6 eggs and incubate them for 10 to 12 days, the shortest incubation time of any bird. Every year, a pair of House Sparrows raises two to three broods (Sundaramoorthy, 2007).

House sparrows typically prefer holes or small crevices near the roof, as a nesting site (Ali & Ripley, 1983). They also prefer other structures such as street lights, gas-station roofs, and the overhanging fixtures that hold traffic lights. They usually collect materials for nest building from nearby areas. These materials vary widely and can be classified as natural and artificial materials. Natural material means parts of plants or animals. The artificial material too, is usually vegetable or animal, but is processed by man (Heij, 1986), such as plastics, textiles, string or rope etc. The inside of the nest is always lined with soft light-coloured materials such as wool, feathers, bits of paper (Heij, 1986).

Pollination is the transport of pollen during the sexual reproduction process in flowers. Sparrows assist in the pollination process that leads to fertilization in flowers. Despite the wide distribution of House Sparrows, in recent times there have been many reports from

around the world on the dramatic decline of the House Sparrow (*P. domesticus*) population. Both rural and urban and sub-urban populations of House Sparrow have declined by 47% and 60% respectively in the UK since the mid 1970s (Robinson et al., 2005). The sharp decline of the sparrow population has also been observed by ornithologists across Mumbai, Bangalore, Hyderabad and other cities (Kurahde et al., 2013).

As a result, development is happening too fast, and in a way which does not take issues like biodiversity conservation into consideration, when (the construction of) buildings, townships and development is undertaken. The new buildings and landscaped gardens which are being constructed are not at all sparrow friendly. The modern glass-clad match box shape buildings lack cavities and holes which are important for sparrows to make nests. Humans today, for instance, would not appreciate sparrows building nests inside their homes and leaving behind nesting materials. Nowadays no one sits outside their homes to feed upon sparrows with grain or chapatti, which were a daily ritual and a source of food for sparrows and other birds earlier. Hence, it has been tried in this study to observe the roosting behaviour, nesting substrates and the availability of the nearest food resources of the House Sparrows in Guwahati city.

## MATERIALS AND METHODS

### Study area

Guwahati is located at North 26.14 latitude and East 91.73 longitude, with GPS coordinates of 26°8'40.2612"N and 91°44'10.4532"E. Guwahati has an elevation of 49.717 metres above sea level. According to Census India data, the population of Guwahati in 2011 was 957,352. Although the city of Guwahati has a population of 957,352, the urban/metropolitan population is 962,334. The study was conducted in the most commercial and busy areas of Guwahati city viz. Pan Bazaar, Paltan Bazaar, Ulubari, Lachit Nagar, Christian Basti, Walford, Ganeshguri, Six miles, VIP road, Jayanagar,

Khanapara (Fig. 1). These areas were chosen for the study because they are important commercial corridors in Guwahati, including the Guwahati train station, the Assam State Transportation Corporation bus station, and the stops of various private regional bus service providers. These are the busiest and most congested areas in Guwahati, which is home to numerous manufacturers, showrooms, brand outlets, malls, supermarkets, hospitals, hotels, restaurants, fruits/vegetables market, and office hub for wholesale products ranging from food and beverages, garments, to hardware and building materials, among other things.

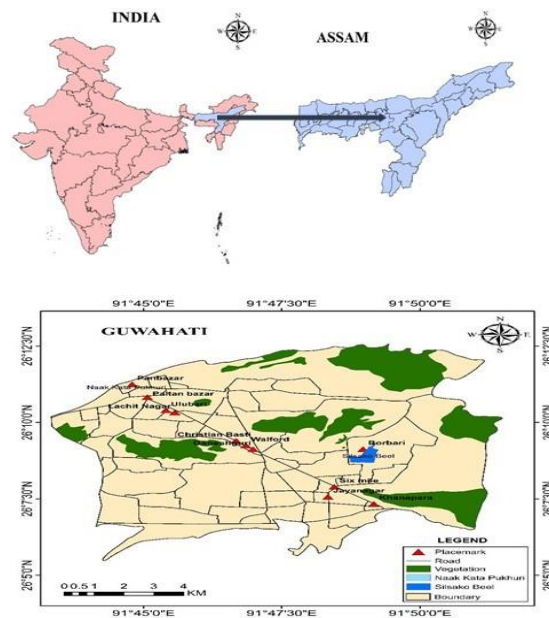


Figure 1. Locations of selected study areas in Guwahati city

The study was conducted over a period of 1 year (2021 to 2022). Nests of House sparrows and Roosting trees were located through the personal survey. The instruments and software used in locating the House Sparrows during the study were Binoculars, GPS Tracker, QGIS, Google Earth Pro. Ecological characters of Roosting trees were recorded using a Clinometer. The diameter at Breast Height (DBH) of each Roosting tree was measured by using a meter tape. Foraging micro-habitats

such as restaurants, houses, and buildings, as well as vegetative patches, were noted. The spatial distance of each roosting tree from the nearest food source was recorded. The spatial distance of each roosting tree from the nearest water source was recorded. Water sources, both Artificial and Natural were considered. The distance between the Roosting trees was measured using Google Map. The different types of nest i.e., solitary, pair and cluster were observed and recorded. The height of each nest was recorded. The foraging micro-habitats like

restaurants, hotels, houses and buildings, vegetation patches were observed. The spatial distance of each nest from the nearest food source was measured using Google Map. The spatial distance of each nest from the nearest water source was recorded. Both Artificial and Natural water sources were considered. Nesting substrates for each nest was observed and noted.

## RESULTS

### Roosting

*Table 1.* The roosting trees of House Sparrows located in the study locations are put in tabular form along with the ecological characteristics

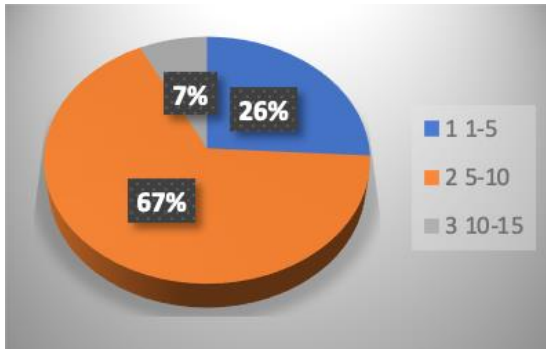
No.	Location	Height (m)	DBH (cm)	Distance from nearest food source (m)	Distance from nearest water source (m)	Distance from nearest roosting tree (m)
1	Ganeshguri flyover	4.5	50	7	10	24
2	Walford	7.6	110	11	9	19
3	Walford	6.08	78	5	5	14
4	Walford	5.4	27	6	8	25
5	Walford	5	89	5	7	24
6	Opposite Walford	6.3	75	13	14	22
7	Opposite Walford	6.6	98	10	11	10
8	Opposite Walford	7.6	45	9	10	5
9	Walford	8	20	7	7	11
10	Christian Basti	7	30	15	8	28
11	Christian Basti	6.5	26	9	9	10
12	Christian Basti	8.5	56	8	8	18
13	Christian Basti	5.5	36	11	8	22
14	Christian Basti	6.3	38	10	9	16
15	Christian Basti	4.8	20	13	10	7
16	Christian Basti	4.5	21	17	9	8
17	Christian Basti	6.3	42	12	7	8
18	Christian Basti	7	18	19	15	20
19	Christian Basti	7.6	98	11	11	9
20	Christian Basti	4.2	39	9	7	5
21	Christian Basti	4	26	8	8	9
22	Christian Basti	5	31	9	6	13
23	Lachit Nagar	8.8	19	8	8	34
24	Borthakur Mill Road	9	25	7	9	9
25	Borthakur Mill Road	14.5	102	6	7	5
26	Borthakur Mill Road	12	49	5	7	18
27	Borthakur Mill Road	9	36	9	9	5

**Height of roosting trees**

The height of roosting trees from ground level is ranged between 4.5–15 m. According to the records, the roosting trees were found to have an average height of 6.57 m.

*Table 2.* The height of roosting trees is divided into class intervals, the number of trees in each interval, as well as the mean height and standard deviation of the roosting trees

No.	Height (m)	Number	Mean ± SD
1	1–5	7	6.57 ± 2.78
2	5–10	18	
3	10–15	2	



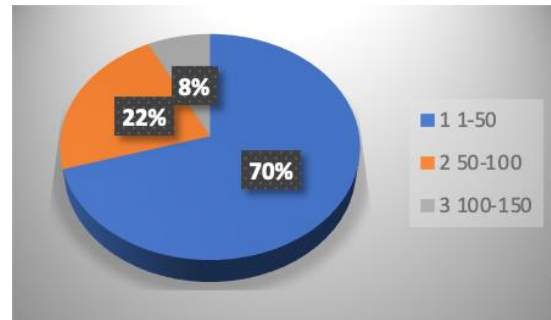
*Figure 2.* The percentage of height of roosting trees in each class interval

**Diameter at breast height (DBH) of roosting trees**

The diameter at breast height of roosting trees from ground level is ranged between 18–110 cm. According to the records, the roosting trees were found to have an average DBH of 43.51 cm.

*Table 3.* The DBH of roosting trees is divided into class intervals, the number of trees in each interval, as well as the mean DBH and standard deviation of the roosting trees

No.	DBH (cm)	Number	Mean ± SD
1	1–50	19	43.51 ± 31.46
2	50–100	6	
3	100–150	2	



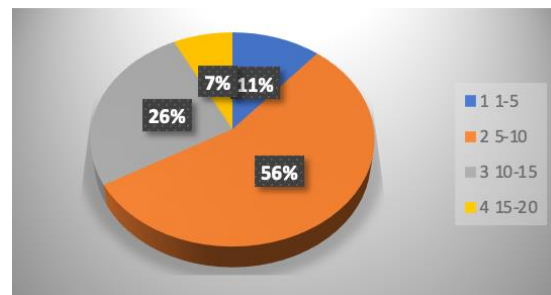
*Figure 3.* The percentage of DBH of roosting trees in each class interval

**Distance from nearest food source**

The distance of roosting trees from the nearest food source ranges between 5–19 m. According to recordings, the mean distance of roosting trees from the nearest food source is 8.98 m.

*Table 4.* The distance of roosting trees from the nearest food source is divided into class intervals, the number of trees in each interval, along with the mean distance and standard deviation

No.	Distance from nearest food source (m)	Number	Mean ± SD
1	1–5	3	8.98 ± 3.87
2	5–10	15	
3	10–15	7	
4	15–20	2	



*Figure 4.* Percentage of roosting trees in each class interval

**Distance from the nearest water source**

The distance of roosting trees from the nearest water source ranges between 5–15 m.

According to recordings, the mean distance of roosting trees from the nearest water source is 8.05 m.

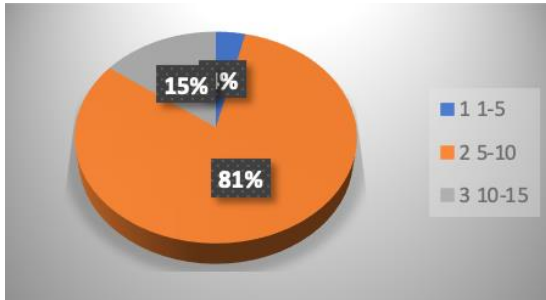


Figure 5. Percentage of roosting trees in each class interval

Table 5. The distance of roosting trees from the nearest water source is divided into class intervals, the number of trees in each interval, along with the mean distance and standard deviation

No.	Distance from nearest water source (m)	Numbers	Mean $\pm$ SD
1	1-5	1	8.05 $\pm$ 2.11
2	5-10	22	
3	10-15	4	

**Distance from nearest roosting tree**

The distance between each roosting tree ranges from 5-34 m. The mean distance from the nearest roosting tree is 13.05 m.

Table 6. The distance of roosting trees from the nearest roosting tree is divided into class intervals, the number of trees in each interval, along with the mean distance and standard deviation

No.	Distance from nearest roosting tree (m)	Numbers	Mean $\pm$ SD
1	1-5	4	13.05 $\pm$ 7.38
2	5-10	8	
3	10-15	3	
4	15-20	5	
5	20 and above	7	

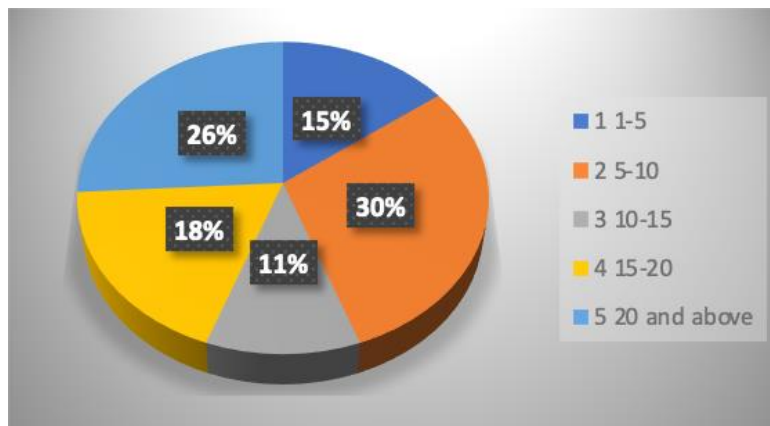


Figure 6. Percentage of roosting trees in each class interval

**Identification of roosting trees**

During the study, a total of 27 roosting trees of House Sparrows were recorded in different localities of Guwahati city. Most of these trees were in the Christian Basti area and others were in the Walford/Ganeshguri

area followed by the Lachit Nagar area. Although many of the Roosting trees were relatively common and could be easily identified, few Roosting trees were identified with the help of Google lens software, Plant Net software and others were identified with the help of locals living near the areas.

Table 7. Abundance of nesting trees in the city

No.	Common name	Scientific name	Abundance in study area
1	Java Plum/Jamun	<i>Syzygium cumini</i>	+++
2	Koroch/Pongam tree	<i>Pongamia pinnata</i>	+++
3	Bokul tree/Spanish tree	<i>Mimusops elengi</i>	+++
4	Mango tree	<i>Mangifera indica</i>	++
5	Krishna chura	<i>Delonix regia</i>	+++
6	Sindur/lipstick tree	<i>Bixa orellana</i>	++
7	Guava	<i>Psidium guajava</i>	++
8	Peepal tree	<i>Ficus religiosa</i>	+++
9	Neem	<i>Azadirachta indica</i>	++
10	Rubber plant	<i>Ficus elastica</i>	+
11	Chinese honeysuckle	<i>Quisqualis indica</i>	++
12	Kadam	<i>Anthocephalus chinensi</i>	+++
13	Kola Jamun	<i>Syzygium species</i>	+++
14	Kanchan	<i>Bauhinia purple</i>	+++
15	Weeping Fig	<i>Ficus benjamina</i>	+++
16	NA	<i>Ficus species</i>	++
17	NA	<i>Ficus species</i>	+++
18	NA	Unknown 1	+

Legend: +: Low abundance; ++: Medium abundance; +++: High abundance; NA: Not available.

## Nesting

Table 8. The nests of House Sparrows located in the study locations are put in a tabular form along with the ecological characteristics

No.	Locality	Nest type	Height (m)	Nesting substrates
NEST 1	Walford	Solitary	3.96	Shop shutter
NEST 2	Walford	Solitary	5.5	Building holes
NEST 3	Walford	Solitary	4.5	Building holes
NEST 4	Walford	Solitary	7	Shop shutter
NEST 5	Christian Basti	Solitary	5	Building holes
NEST 6	Christian Basti	Solitary	4	Shop shutter
NEST 7	Christian Basti	Solitary	6	Shop shutter
NEST 8	Christian Basti	Solitary	5	Shop shutter
NEST 9	Christian Basti	Solitary	8	Building crevices
NEST 10	Christian Basti	Solitary	9	Building crevices
NEST 11	Christian Basti	Solitary	8	Building crevices
NEST 12	Christian Basti	Solitary	5	Shop shutter
NEST 13	Christian Basti	Solitary	6	Building crevices
NEST 14	Lachit Nagar	Solitary	4.5	Shop shutter
NEST 15	Lachit Nagar	Solitary	5	Building crevices
NEST 16	Lachit Nagar	Pair	4.3	Building crevices
NEST 17	Lachit Nagar	Solitary	3.5	Tin sheet roof
NEST 18	Lachit Nagar	Solitary	7	Building crevices
NEST 19	Lachit Nagar	Solitary	6	Unused building pipe
NEST 20	Lachit Nagar	Solitary	6.5	Unused building pipes

No.	Locality	Nest type	Height (m)	Nesting substrates
NEST 21	Lachit Nagar	Pair	5	Building crevices
NEST 22	Lachit Nagar	Solitary	4	Building crevices
NEST 23	Lachit Nagar	Solitary	3	Tin sheet roof
NEST 24	Lachit Nagar	Cluster	6.5	Unused building pipes
NEST 25	Lachit Nagar	Solitary	6	Building crevices
NEST 26	Lachit Nagar	Solitary	7	Building holes
NEST 27	Lachit Nagar	Cluster	6	Building holes
NEST 28	Lachit Nagar	Solitary	2.9	Shop shutter
NEST 29	Lachit Nagar	Solitary	3	Shop shutter
NEST 30	Lachit Nagar	Pair	4	Building crevices
NEST 31	Ulubari	Solitary	3	Advertisement hoarding
NEST 32	Ulubari	Solitary	3.5	Advertisement hoarding
NEST 33	Ulubari	Solitary	4	Tin sheet roof
NEST 34	Six Mile	Solitary	3.3	Tin sheet roof
NEST 35	Six Mile	Solitary	4	Tin sheet roof
NEST 36	Six Mile	Pair	4	Shop shutter
NEST 37	Six Mile	Solitary	3.5	Tin sheet roof
NEST 38	Six Mile	Solitary	3	Shop shutter
NEST 39	VIP Road	Solitary	5.5	Shop shutter
NEST 40	VIP Road	Solitary	3	Shop shutter
NEST 41	VIP Road	Solitary	5	Tin sheet roof
NEST 42	Jayanagar	Solitary	6	Tin sheet roof
NEST 43	Jayanagar	Solitary	6	AC outdoor unit
NEST 44	Jayanagar	Solitary	3	Tin sheet roof
NEST 45	Jayanagar	Pair	3	AC outdoor unit
NEST 46	Jayanagar	Solitary	5	AC outdoor unit
NEST 47	Jayanagar	Solitary	4	Tin sheet roof
NEST 48	Khanapara	Solitary	4	Tin sheet roof
NEST 49	Khanapara	Solitary	4	Tin sheet roof
NEST 50	Khanapara	Solitary	5	Tin sheet roof
NEST 51	Khanapara	Solitary	5	Tin sheet roof
NEST 52	Paltan Bazaar	Solitary	3	Advertisement hoarding
NEST 53	Paltan Bazaar	Solitary	3	Advertisement hoarding
NEST 54	Paltan Bazaar	Solitary	2.5	Tin sheet roof
NEST 55	Pan Bazaar	Solitary	3	Shop shutter
NEST 56	Pan Bazaar	Solitary	3.9	Shop shutter
NEST 57	Pan Bazaar	Solitary	3.5	Shop shutter

Table 9. The nests of House Sparrows found in different study locations are put in a tabular form along with the distance from the nearest food and water source

No.	Locality	Distance from nearest food source (m)	Distance from nearest water source (m)
NEST 1	Walford	6 ± 0.5	4 (Artificial)
NEST 2	Walford	5 ± 1	4.5 (Artificial)
NEST 3	Walford	5 ± 2	5 ± 1 (Artificial)



No.	Locality	Distance from nearest food source (m)	Distance from nearest water source (m)
NEST 4	Walford	3 ± 0.5	6 (Artificial)
NEST 5	Christian Basti	5	3 ± 1 (Artificial)
NEST 6	Christian Basti	4	9 (Artificial)
NEST 7	Christian Basti	3 ± 0.5	8 (Artificial)
NEST 8	Christian Basti	3 ± 1.5	10 (Artificial)
NEST 9	Christian Basti	5 ± 0.5	4.5 (Artificial)
NEST 10	Christian Basti	5 ± 1.5	6 (Artificial)
NEST 11	Christian Basti	2 ± 0.5	7 (Artificial)
NEST 12	Christian Basti	4 ± 1	4 (Artificial)
NEST 13	Christian Basti	6 ± 1	3.5 (Artificial)
NEST 14	Lachit Nagar	3 ± 2	3.5 (Artificial)
NEST 15	Lachit Nagar	3.5 ± 1	3 (Artificial)
NEST 16	Lachit Nagar	4 ± 0.5	4 (Artificial)
NEST 17	Lachit Nagar	3.5 ± 1	5.5 (Artificial)
NEST 18	Lachit Nagar	2 ± 1.5	4 (Artificial)
NEST 19	Lachit Nagar	4 ± 0.5	3 (Artificial)
NEST 20	Lachit Nagar	3 ± 1	2 ± 2 (Artificial)
NEST 21	Lachit Nagar	3.5 ± 0.5	2.5 (Artificial)
NEST 22	Lachit Nagar	5	4 (Artificial)
NEST 23	Lachit Nagar	3 ± 0.5	5 (Artificial)
NEST 24	Lachit Nagar	5.5 ± 2	4 (Artificial)
NEST 25	Lachit Nagar	2.5 ± 1	5 (Artificial)
NEST 26	Lachit Nagar	3 ± 0.5	3.5 (Artificial)
NEST 27	Lachit Nagar	4 ± 1	6 (Artificial)
NEST 28	Lachit Nagar	5 ± 2	4 (Artificial)
NEST 29	Lachit Nagar	4.5 ± 0.5	4 (Artificial)
NEST 30	Lachit Nagar	5 ± 0.5	3 (Artificial)
NEST 31	Ulubari	6 ± 1	4 (Artificial)
NEST 32	Ulubari	5.5 ± 1	4 (Artificial)
NEST 33	Ulubari	7 ± 0.5	3 (Artificial)
NEST 34	Six Mile	8 ± 1	12 (Artificial)
NEST 35	Six Mile	7 ± 1	9 (Artificial)
NEST 36	Six Mile	10	7 (Artificial)
NEST 37	Six Mile	5 ± 0.5	7 (Artificial)
NEST 38	Six Mile	4 ± 1	6 (Artificial)
NEST 39	VIP Road	13	40 ± 2 (Natural)
NEST 40	VIP Road	7	50 (Natural)
NEST 41	VIP Road	6.5	30 ± 3 (Natural)
NEST 42	Jayanagar	4 ± 1	8 (Artificial)
NEST 43	Jayanagar	5 ± 0.5	4.5 (Artificial)
NEST 44	Jayanagar	4.5	7 (Artificial)
NEST 45	Jayanagar	3.5 ± 0.5	5 (Artificial)
NEST 46	Jayanagar	3 ± 0.5	4 (Artificial)
NEST 47	Jayanagar	4 ± 1	5 (Artificial)

No.	Locality	Distance from nearest food source (m)	Distance from nearest water source (m)
NEST 48	Khanapara	3 ± 1	3 ± 1 (Artificial)
NEST 49	Khanapara	4 ± 0.5	5 (Artificial)
NEST 50	Khanapara	4 ± 1	5.5 (Artificial)
NEST 51	Khanapara	4.5 ± 2	6 (Artificial)
NEST 52	Paltan Bazaar	11	4 (Artificial)
NEST 53	Paltan Bazaar	6 ± 2.5	7 (Artificial)
NEST 54	Paltan Bazaar	7.5 ± 0.5	4 (Artificial)
NEST 55	Pan Bazaar	6 ± 1	20 ± 2 (Natural)
NEST 56	Pan Bazaar	8 ± 2	13 ± 1 (Natural)
NEST 57	Pan Bazaar	10	33 ± 2 (Natural)

**Total number of nests**

In the study areas of Guwahati City, a total of 57 nests were discovered during the survey.

Table 10. Distribution of nests in the study areas of Guwahati City, categorised by location

No.	Locality	Nest number
1	Walford	4
2	Christian Basti	9
3	Lachit Nagar	17
4	Ulubari	3
5	Six Mile	5
6	VIP Road	3
7	Jayanagar	6
8	Khanapara	4
9	Paltan Bazaar	3
10	Pan Bazaar	3

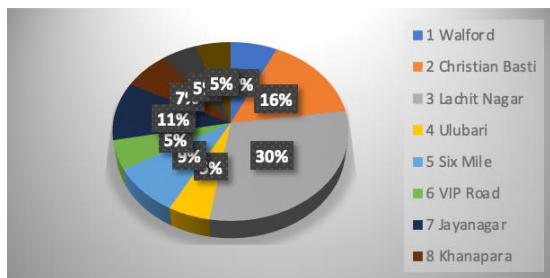


Figure 7. Percentage of nests present in each location of Guwahati

**Different types of nests**

Of the 57 nests, 50 nests were discovered to be solitary type, 5 nests were found to be

in pairs and 2 nests were discovered to be in clusters.

Table 11. Different types of nests and the number of nests in each type

No.	Nest type	Numbers
1	Solitary	50
2	Pair	5
3	Cluster	2

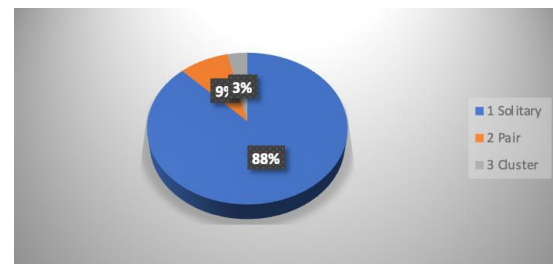


Figure 8. Percentage of nests representing each nest type (Nest number)

**Height of nest**

Table 12. The height of nests are divided into class intervals, the number of nest in each class interval, along with the mean and standard deviation

No.	Height (m)	Numbers	Mean ± SD
1	2(+0.5) - 4	28	4.29 ± 1.43
2	4(+0.5) - 6	21	
3	6(+0.5) and above	8	

The height of each nest from ground level ranges between 2.5 m to 9 m. The mean height and standard deviation of each nest is calculated and recorded.

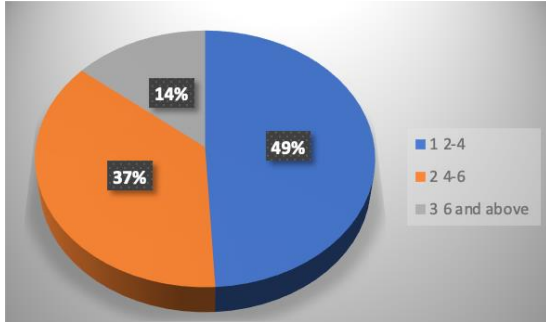


Figure 9. Percentage of height of roosting tree

#### Distance from nearest food source

The distance of each nest from the nearest food source ranges between 1 to 15m. The mean distance from the nearest food source is 4.16 m.

Table 13. The distance of each nest from the nearest food source is divided into class intervals, the number of nests in each class interval along with the mean and standard deviation

No.	Distance from nearest food source (m)	Numbers	Mean $\pm$ SD
1	1–5	40	4.16
2	5–10	15	$\pm$
3	10 and above	2	2.72

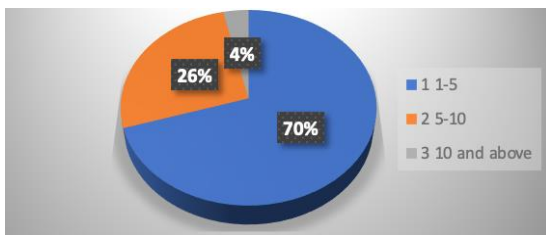


Figure 10. Percentage of distances from nearest food source

#### Distance from the nearest water source

The distance of each nest from the nearest water source ranges between 2–50 m. The

mean distance from nearest water source is 5.21 m.

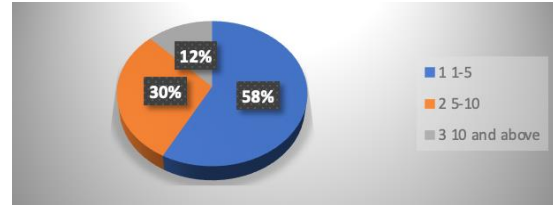


Figure 11. Percentage of distances from the nearest water source

Table 14. The distance of each nest from the nearest water source is divided into class intervals, the number of nests present in each class interval along with the mean and standard deviation

No.	Distance from nearest water source (m)	Numbers	Mean $\pm$ SD
1	1–5	33	5.21
2	5–10	17	$\pm$
3	10 and above	7	3.56

#### Nesting substrates

The nesting substrates are the materials and structures that are used by House Sparrows (*P. domesticus*) to build their nests. House sparrows are opportunistic nest builders, they use a variety of nesting substrates depending upon their availability.

In Guwahati city, 27 House Sparrow roosting trees have been observed throughout the study period. There are only a few roosting trees found in the Lachit Nagar area, followed by the Walford area. The majority of the roosting trees are found to be clustered in the Christian Basti area. The availability of food and good conditions in the Christian Basti area may be the cause of its dispersion. According to the statistics, majority (67%) of the roosting trees are between the heights of 5–10 metres, and the majority (70%) of the roosting trees has a DBH between 1–50 cm (Table 2, Fig. 2). This leads that heights of roosting tree (Table 12, Fig. 9) ranging between 5–10 metres and the DBH ranging between 1–50 cm has considered being the optimal ranges for House Sparrow roosting

trees (Table 3, Fig. 3). Additionally, 56% of the roosting trees are located 5–10 metres from the nearest food source and 81% of the roosting trees are located 5–10 metres from the nearest water source (Tables 1, 4; Fig. 4). These distances are mostly preferred by the House Sparrows because they can move easily between the foraging areas and the nesting site. The distance of each roosting tree from

the nearest roosting tree was also measured. It was found that each of the roosting trees has some varied distance between them (Table 5, Fig. 5). According to data, the majority (30%) of roosting trees have a distance ranging between 5–10 metres from the nearest roosting tree. Therefore, this could be regarded as the optimal distance between roosting trees (Tables 1, 6; Fig. 6).

Table 15. Types of nesting substrates along with the number of nest made in each nesting substrate

No.	Nesting Substrates	Numbers
1	Shop Shutter	16
2	Building holes	5
3	Building crevices	11
4	Tin sheet roof	15
5	Inside unused building pipes	3
6	AC outdoor unit	3
7	Advertisement hoardings	4

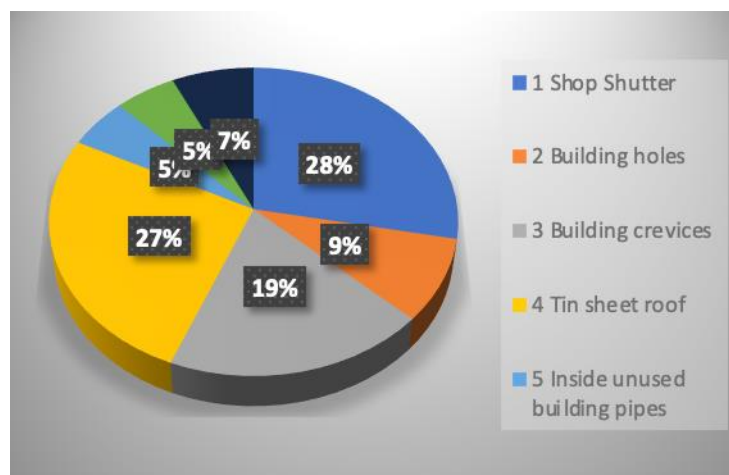


Figure 12. Percentage of nests made in each nesting substrate

Additionally, during the study period it was noted that in the months of December to February, house sparrows were abundant in the Christian Basti area and over 100 House Sparrows were present in each of the area's roosting trees (Table 7). But from mid-March to April, there was a change in flocking density, with fewer House Sparrows congregating in the Christian Basti area and fewer birds appearing in the area's roosting trees as a result. Also, during mid-march, it was observed that some of the already noted

roosting trees of House Sparrows in the Christian Basti region had been completely abandoned by the sparrows (Table 10).

A total of 10 locations in Guwahati city were chosen for the study. From the selected locations the highest number of nests were found in Lachit Nagar (17), followed by Christian Basti (9), followed by Jayanagar (6), followed by Six miles (5), followed by Walford (4) and Khanapara (4), and followed by Ulubari (3), VIP road (3), Paltan Bazaar (3), Pan Bazaar (3) (Table 8, Fig. 7). The

highest number of nests were found in Lachit Nagar and Christian Basti area because of the availability of food, water and other advantageous conditions (Tables 8, 9). Different types of nests were also found during the study, i.e. solitary, pair and cluster. Out of the 57 nests, 50 were found to be solitary, 5 were found to be Pair, and 2 were found to be cluster type (Table 11, Fig. 8).

## **DISCUSSION**

The recent decline of the House Sparrow in India has been recognised at the appropriate moment. The availability of nesting sites is a key aspect in sustaining the House Sparrow population in urban (Modak, 2015). During the study, a total of 57 nests in Guwahati city were discovered throughout the different study locations. From the study, it was discovered that House Sparrows use different nesting substrates to build their nests. The nesting substrates protect House Sparrows from the elements and predators. Out of the 57 nests, 28% were discovered in the rolling shop shutters, followed by 27% in the tin sheet roofs of homes, followed by 19% in building crevices, 9% in building holes, 7% in advertisement hoarding and 5% in AC outdoor units and 5% in unused building pipes (Tables 8, 9, 15 and Fig. 12). House sparrows often prefer small cracks and holes near roofs to make their nests, according to Ali and Ripley, 1983.

From the data collected, it is discovered that 49% of the nests are located at a height between 2–4 metres from the ground level, 70% of the nests are located between 1–5 metres from the nearest food source, and 58% of the nests are located between 1–5 metres from the nearest water source (Table 8, 9, 12 & Fig. 10). Since it reduces the amount of energy required for the frequent journeys to the foraging grounds and back to the nest, it is assumed that House Sparrows choose low nest height and minimum distance from nearest food supply and water source (Tables 13, 14 & Fig. 11). According to Sundaramoorthy (2007), Daniels (2008), House Sparrows only feeds their young chicks with insects while

they raise them. For House Sparrow nestlings, invertebrates constitute a significant source of protein. House Sparrows, therefore, regularly go to the food sources. It is also clear from the study report that choosing a nest is influenced directly by the location of the nearest food source and nearest water source (Tables 13, 14).

Rajashekhar and Venkatesha (2008) also discovered that a range of food supplies, including those for adults and nestlings, as well as crucial nesting locations close to the food sources, are critical factors in the abundance of the House Sparrow population. According to several studies (Miller et al., 1998; Yasue & Daerden, 2006), human disturbance can affect birds' decisions on where to build their nests. The House Sparrow is a species that has historically been found around people (Summers-Smith, 2003). House Sparrows may also link the presence of people to accessible food sources (McKinney, 2002). Also, for House Sparrows habitat patch selection for nesting could be the response for food availability in a crowded zone in cities (Nath et al., 2015). Concerned about the decreasing number of nests, numerous organizations have set up artificial nest boxes in various places in Guwahati city in order to save the decreasing House Sparrow population. The nest boxes are set up to offer House Sparrows nesting possibilities. However, none of the nest boxes were inhabited during the study period, which included the peak breeding season for House Sparrows. Generally, House Sparrows build their nests out of straws and other materials that blend in with their environment and thus protect them from predators. On the other hand, these artificial nest boxes appear to be bright and so quickly discovered by predators. This could be one of the reasons why the nest boxes aren't being used by the House Sparrows.

The majority of the 57 nests that were found were in the Lachit Nagar neighbourhood, followed by Christian Basti region. The Christian Basti neighbourhood of Guwahati city had the highest flocking

concentrations as well as the highest number of roosting trees, out of 27 roosting trees observed. These Guwahati neighbourhoods are commercial neighbourhoods with a lot of noise and traffic. Despite the noise and activity, these places had the highest concentration of House Sparrows due to the simple accessibility of food. The city's Christian Basti and Lachit Nagar neighbourhoods are populated with residences, houses, hotels, wholesale market places restaurants, malls, offices etc.

Most nests were discovered in tin sheet roofs and rolling shop shutters among the nesting substrates. The buildings provide the cavity preferred by House Sparrows for nesting. House sparrows are facultative cavity nesters Cink (1976) noted that pairs who nest in cavities or nest boxes had higher rates of successful reproduction than those that do not. This can be one of the reasons why shutters are preferred as a nest substrate since they offer good protection from strong rain and storms. However, the glass facades of new modern buildings and commercial centres do not allow for much nesting room for House Sparrows. As a result, such improvements may pose a threat to House Sparrow nesting and breeding in the near future. Solitary nests were the most common form of nest found in the research areas. House sparrows are known to nest in loose colonies (Summer-Smith, 1963). Nests observed in the study are solitary, possibly to prevent competition among the individuals for food resource and nesting space. It presents the adaptability of House Sparrows to dwell anywhere, where roosting areas, nesting areas, and food sources are available.

## CONCLUSION

As a result of the current study, it is concluded that constructing an artificial nest box is not the only solution for increasing the diminishing population, as the various nest boxes constructed in Guwahati city are not inhabited by any sparrow. The different components of avian nesting ecology have proved to be important traits for testing fundamental ecological and evolutionary

hypotheses, and for monitoring the efficacy of biological conservation programs. It has been observed that House Sparrows build nest mostly under tin sheet roof and rolling shop shutters, to get protection against predators and also to avoid competition. The majority of nests are solitary, possibly to adapt with competition among the individuals for food resource and nesting space. House Sparrow's adaptability characters observed in the study might provide them to dwell anywhere where adequate roosting areas, nesting areas, and food resources are available. As per requirement, artificial nest boxes should be made in such a way that it resembles the natural environment which must be suitable for the House Sparrows to prosper and have proper protection. After creating a suitable artificial nest, the public and the concerned state department authority should take the necessary steps to monitor sparrow populations on a regular basis to prevent the species from vanishing from the city.

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