FACTORS AFFECTING THE COMMUNAL ROOSTING BEHAVIOUR OF BIRDS AT PANAMARAM HERONRY, WAYANAD DISTRICT

ROSE FRANCIS

(19-MSVP-07)

DISSERTATION

Submitted in partial fulfilment of the requirement for the degree of

MASTER OF SCIENCE

(Wildlife Studies)

2022

Faculty of Veterinary and Animal Sciences

Kerala Veterinary and Animal Sciences University

KVASU CENTRE FOR WILDLIFE STUDIES

KERALA VETERINARY AND ANIMAL SCIENCES UNIVERSITY

POOKODE, WAYANAD 673576

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DECLARATION

I hereby declare that this dissertation entitled **"Factors affecting the communal roosting behaviour of birds at Panamaram Heronry, Wayanad District"** is a bonafide record of research done by me during the course of research and that the dissertation has not previously formed the basis for the award of any degree, diploma, fellowship or other similar title, of any other University or Society.

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CERTIFICATE

Certified that this dissertation, entitled **"Factors affecting the communal roosting behaviour of birds at Panamaram Heronry, Wayanad District"** is a record of research work done independently by **Rose Francis (19-MSVP-07)** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to him/her.

Place:
Date:

Dr. Biju S
Chairman
Advisory Committee

CERTIFICATE

We, the undersigned committee of the advisory committee of **Rose Francis (19-MSVP-07),** a candidate for the degree of Master of Science in Wildlife Studies, agree that this dissertation entitled **"Factors affecting the communal roosting behaviour of birds at Panamaram Heronry, Wayanad District"** may be submitted by **Rose Francis (19-MSVP-07)** in partial fulfilment of the requirement for the degree.

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EXTERNAL EXAMINER

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Rose Francis

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INTRODUCTION

1. INTRODUCTION

A " roost " is just a spot where an animal rests during a long period of inactivity, while a "communal roost " is gathering where numerous animals who had been eating alone or in group/flocks of varying composition occupy the same space. Aggregation of organisms has been reported in birds, bats, and monkeys, among other creatures (Ward, 1965; Soini, 1987; Lewis, 1995; Merkel and Mosbech, 2008). Bees, wasps, beetles, dragonflies, butterflies, and moths are especially susceptible to roosting for rest safely from predators (Pearson and Anderson, 1985; DeVries *et al.*,1987; Salcedo, 2010). Animals were found cave roosting from the beginning of time. Juveniles of Barbary macaques are found roosting with adult females or males forming same-sex sleeping clusters (Ansorge *et al*., 1992).

Many diurnally active bird species congregate in communal roosts at night, and a few nocturnal feeders do so throughout the day (Ward and Zahavi, 2008). Roost which functions as the shelter during the day for nocturnal animals is a significant determinant of their fitness (Kerth *et al*., 2001). Roosting vertebrates like bats and birds have an extraordinary ability to memorize and find their way to and from the roost (Howarth, 2013). Thus, roosting for birds is the act of settling or resting in a given location at specific times of the day and night. Some birds like to roost alone, while others prefer to rest in groups (Mishra *et al.*,2020).

The information centre hypothesis explains avian roosting behaviour as an adaptation for exploiting patchily and unpredictably distributed food (Richner and Marclay, 1991). Thus the main advantage of communal roosting behavior is the enhanced individual foraging success (Ward and Zahavi, 1973), higher exploitative and interfering competition (Grover 1997, Keddy 2001), increased the likelihood of detection by predators (Page and Whitacre, 1975; Eiserer, 1984), and transmission of diseases and parasites are all costs associated with communal roosting (Moore *et al*., 1988; Kulkarni and Heeb, 2007; Buehler and Piersma, 2008).

1.1. ROOST FUNCTION

The two most essential functions of communal roosting are the sharing of knowledge about food sources and the mitigation of the risk of predation (Gadgil and Salim, 1974). Birds tend to breed or roost together to assist individuals in locating food resources (Groot, 1980). Communal roosts as well as certain other bird assemblages were evolved primarily to serve as "information-centers" for the effective utilization of irregularly distributed food sources (Ward and Zahavi, 2008). The information centre hypothesis suggests that the information exchange is happening between birds in the roosts. The number of birds present at a food source at a given time represents the total number of birds thus far informed from a roost (Richner and Marclay, 1991).

Intraspecific interactions formed as a result of roosting behaviour benefit individuals in many ways including forming up an anti-predatory mechanism as well as finding the suitable mating partners (Ientile, 2014).

1.2. BENEFITS OF ROOST

1.2.1. Information Gain

Roosts aid in acquiring food-related information as well as providing effective reproduction partners. It also offers information on the possibility of predation, which is easier to detect due to the large number of individuals.

1.2.2. Thermoregulation

Temperature regulation is essentially served by communal roosting of birds when the temperature drops down from the optimum. It was found that roosting behaviour lowered the rate of heat energy loss for all or portions of the colony of Rooks (Swingland, 1977). Babblers roosting in groups of seven or more at 5°C and groups of five or more at 15°C don’t have to increase their metabolic rates over baseline as the temperature regulation was served by the groups (Chappell *et al.*, 2016). Eagles move to night roosts during the colder months in order to find a more suitable microclimate, as they are susceptible to cold (Adams *et al.,* 2000).

But some birds maintain an individual distance (Conder, I949; Hediger, I950) between each other. For eg Cattle Egrets, was always maintained a distance between perched birds (Seigfried, 2010).

1.2.3. Lower Predation

The essential needs of birds are protection from predators and protection from adverse weather which is benefitted by communal roosting (Siegfried, 1971). Communal roosting helps in reduced predation at or around the roost because of the dilution effect (Lack,1968; Gadgil,1972) The dilution effect suggests that as group size (N) increases, the probability of any one individual being preyed upon (1/N) decreases (Treisman,1975; Foster and Treherne, 1981).

1.3. ROOST STRUCTURE

Birds move to the inner locations during roost formation, regardless of whether they started in the outside or inner position. As the roost formation aided in a greater number of birds, the chances of relocation towards an inner position are found rare. Differences in the dominance was recorded between by the birds occupying the inner and outer roost positions were observed (Summers *et al*., 1987). Breeding and nonbreeding birds are separated in the roosts based on their age and breeding prospects (Blanco and Tella, 1999).

The benefit of roosting in close proximity with related individuals is likely to vary depending on one's position inside the roost. In colder conditions, birds relocate more towards inner positions which serve the purpose of developing or sustaining both foraging relationships and social-dominance hierarchies when food is scarce (Mcgowan *et al*., 2006, Adams *et al.,* 2000). In starling roosts, external positions are more demanding in terms of responsibility, thermoregulation and/or predation risk and as subordinates compete with dominant birds for internal positions with additional advantages (Summers *et al*., 1987).

Predation pressure is considered to be another most essential element in "shaping" assemblages which includes the selection of safe locations, optimized diffusion, mutual awareness of attack, and joint defensive tactics, and it serves to reduce the vulnerability to predation that would otherwise occur when birds congregate in noticeable, and often predictable centers (Ward and Zahavi, 2008).

1.4. IMPORTANCE OF ROOST STUDY

Avian communal roosts can reveal information about evolution and act as conservation focal points. It contributes significantly to thermoregulation, increased foraging, predation alertness and for achieving the improved survival (James *et al.*, 2018, Manzoor *et al.*, 2021).

Many environmental factors are known to affect avian time–activity budgets. (Janicke and Chakarov, 2007). The cloud cover and temperature and the location of suitable pre-roost gathering sites significantly have effects on roosting behaviour of birds (Everding and Jones, 2004). Studying about the roosting activities and the abundance of the species, gives an idea about the current status of different birds of a particular area.

Very few studies have been done on the communal roosting behavior of birds in India (Jayson, 2018). Thus, the present is focused to understand the factors that are affecting roosting behavior of birds in Panamaram heronry.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

2.1. COMMUNAL ROOSTING AND ITS EVOLUTION.

Gadgil and Salim (1974) identified fifty-nine species of common Indian birds to form communal roosts in groups bigger than feeding or migrating flocks even without being forced by a scarcity of a roosting location. Thirty-five species of common Indian birds roost communally all year, while some bird roosts only during the non-breeding season and migrants during the winter season. Thirty-six species of birds form mixed communal roosts of more than one species irrespective of its feeding preferences.

Groot (1980) studied the information transfer in socially residing weaver birds *Quelea quelea*. In the presence of experienced birds, birds that are uninformed about the location of food or water can learn the location of a resource they require. In a further study, it was shown that a flock can make use of the more beneficial two food sources, of which quite a few individuals are aware. These findings explained that inexperienced birds tend to follow experienced birds in most cases, and other behavioural cues may also be involved. The significance of synchronous flock behaviour is also discussed.

Post (1982) studied the roosting behaviour of the Grey Kingbird (*Tyrannus dominicensis*) and reported that Grey Kingbird roosts do not function as food information exchange centres, but they do provide some predator avoidance benefits.

Eiserer and Leonard (1984) summarizes the communal roosting of birds. The species' preferences for specific environments, accessibility to food and water, and separation from anthropogenic activities all play a role in roosting site selection.

Beauchamp (1999) identified phylogenetic trees that included 30 families and 437 species to test the significance of theories associated with the evolutionary transformation to community resting/ roosting and later a minor setback to accompanied resting practices. He found that these transformations to behaviour of roosting together happened frequently on branches of flocking species and also on bigger species in the phylogenetic tree with no association of foraging preferences, sociality, geographical location or hour of the day.

Ward and Zahavi (2008) offered information to support the notion that communal roosts, breeding colonies, and certain other bird assemblages evolved primarily to serve as "information centres" for the effective utilization of unevenly dispersed food sources. Predation pressure is thought to be the most important component in "shaping" aggregates of birds. The shaping necessitates the selection of inaccessible or otherwise safe locations, optimum dispersal, mutual awareness of attack, and joint defensive tactics, and it serves to reduce the vulnerability to predation that would otherwise occur when birds flock in noticeable and predictable locations.

2.2. COMMUNAL ROOSTING SUBSTRATE

Gaston (1977) reported jungle babblers to roost in trees or shrubs with dense foliage or twigs and groups generally clumped together during roosting.

Charlotte *et al.*, (2002) experimented the impact of varying canopy cover and food quantity on roosting populations and also discovered characteristics that influence roost site selection of invasive White-vented mynas (*Acridotheres javanicus*) and common mynas (*Acridotheres tristis*) in urban Singapore. In their findings, Mynas chose roost trees with dense canopies that were 603.5 meters closer to food centers and surrounded by 2.6 percent more vegetation than random non-roost trees. Experiments with canopy density and food quantity indicated that, while both reduced the number of roosting Mynas, canopy density reduction had a greater effect.

Fischer *et al*. (2004) investigated the roosting site and roosting behaviour of Male Common Nighthawks (*Chordeiles minor*) and suggested that the roosts chosen by Nighthawks may provide selective benefits with respect to microclimate, energetics and predator avoidance.

Ientile (2014) studied urban roosts of Eurasian Magpie (*Pica pica*) on a regular basis and observed that they avoid north-facing sites and deciduous trees during the winter season, because the purpose of aggregating into the roosting groups was to tolerate the coldness of the season. And they also chose safe areas such as uncommon places and those without human habitation

Choudhary and Mahesh (2018) reported a communal roost consisting of around 50 Black Kites *Milvus migrans*, on high-tension cables (not the pylons) running over a large wetland in Chennai along with 250+ Spot-billed Pelicans *Pelecanus philippensis*, and 40 Little Cormorants *Microcarbo niger*. In addition to this, a total of 150 kites roosted on the pylons was also observed.

Mishra *et al.,* (2020) studied the communal roosting behavior of Egyptian vultures was examined in five districts of Uttar Pradesh, number of roosting birds rely on the availability of food from the area. The ground, tree, building, and electric pylon were recognized as four different roost substrates. The majority (63 per cent) of Egyptian vultures were seen roosting on the ground followed by an electric pylon (19 per cent), trees (10 per cent), and buildings (8 per cent)

2.3. FACTORS INFLUENCING ROOSTING BEHAVIOUR

Møller (1985) studied roosting behaviour of the Magpie Robin in winter and documented findings that roosting does not appear to be caused by information centre effects, predator avoidance, favourable microclimate, lack of roost places, or for breeding activity synchronization. According to him, the distribution and amount of food, with an unpredictable food supply contributes to roosting communally. He also looked into the late arrival and breeding of birds in the roost where the initiation of breeding is not synchronized within the roost.

Summers *et al*., (1987) studied the impact of age, gender, and physical condition on the structure of Starling roosts. They found age to be a factor influencing roosting behaviour as they found adult males occupying regions more towards the centre compared to the periphery and first-year females were located more over the periphery when compared to the centre. They concluded that the centre of the roost was most preferred and it was also a symbol of dominance while occupying such spaces.

Bishop and Groves (1991) studied the reason behind older male birds choosing to roost on the outside of roosts and discovered that as the external positions are more demanding due to thermoregulation costs and/or predation risk, oldest male Arabian babblers prefer to roost on the outside of night roosts and its also a sign of dominance.

Richner and Marclay (1991) observed different feeding groups of carrion crows (*Corvus corone*) and reported that more birds were arriving at a food source which was provided after a brief visit to the communal roost, implying that information was passed between birds. The study used marked birds and demonstrated its ineffectiveness by quantifying the daily turnover of birds at the food patch.

Morné Du Plessis *et al*., (1994) investigated thermal costs, energy benefits, and patterns of night time communal roosting in Acorn Woodpeckers (*Melanerpes formicivorus*) and found that the communal groups had more energy savings which lead greater winter survival for male Acorn Woodpeckers who dwell in larger groups

Buckley (1996) looked into the hunting behaviour and food competition of Turkey Vultures (*Cathartes aura*) and Black Vultures (*Coragyps atratus*) and concluded that as both vulture species roost communally, and their roosts have been proposed to function as information centres. The information-centre concept is unlikely to be a sufficient explanation so communal roosting is beneficial as it aids in the establishment of foraging groups in vultures.

A winter communal roost of Rooks (*Corvus frugilegus L.*) was studied in terms of its spatial and social organization. The rooks' roost behaviour was discovered to lower the rate of heat energy loss for all or portions of the colony. Because of the limited energy reserves available, it is essential for young bird's roosting in covered areas was essential so that they can save energy. It was observed that powerful individuals in search of refuge pushed less dominant birds from more sheltered to significantly less sheltered positions, increasing their energy loss when the weather was bad. The impacts of this social hierarchy during the night, are amplified on the feeding grounds during the day, when some rooks, particularly those at the bottom of the hierarchy, starve. So, it is a reason for young rook mortality being higher in the winter than adult rook mortality (Swingland, 1977).

All communal roosts, breeding territories, and vacant nest sites of non-breeding red-billed choughs, *Pyrrhocorax pyrrhocorax*, were assessed and evaluated the value of communal roosting for mating and territory gain. In which it was observed that there were two types of roosts, traditional main roosts which were utilized all year and sub roosts of nonbreeding season. By this study it was concluded that reason behind Red-billed choughs' mating and territory acquisition were its temporal, geographical, and social segregation between two types of communal roosts. Chough which primarily populated the sub roosts had morphology (males) and body condition (females) similar to established breeders so they attracted more choughs than main roosts, and Choughs usually mate with roost mates, but widowed territorial breeders are also common. And found that, choughs from sub roosts mated in main roosts obtained territories closer to the roost, indicating that sub roosts lower the costs of mating and territory acquisition (Blanco and Tella, 1999).

Adams *et al.,* (2000) investigated the effects of perch relocations in a communal night roost of wintering bald eagles (*Haliaeetus leucocephalus*) during two winters and tested two nonexclusive hypotheses that bald eagles shift inside roosts to assess conspecific foraging success, and bald eagles relocate to gain thermoregulatory advantages from a better microclimate. They observed that immature eagles did not relocate to be closer to adults, and relocations were less common when food was scarce. But to find a more suitable microclimate during the colder months, eagles relocate to night roosts as they are susceptible to cold and food stress.

Reale and Blair, (2005) examined American robin and northern cardinal nesting success and analysed changes in bird community along an urbanization gradient for the study. Nesting failure was not shown to be significantly connected with the gradient, but it was found to be highly correlated with nest height, which declined significantly from the most natural to the most urban areas and also discovered that the density of adult birds had no impact on nesting failure. The number of species that adopt a multiple-brood breeding method has increased with urbanization at the community level.

During the nonbreeding season, Mcgowan *et al.* (2006) observed the Long-tailed tits's (*Aegithalos caudatus)* behaviour of roosting in groups as they were kept in temporary captive groups to find out either within the bounds of roost, birds fight for particular locations or they just obtain such compatible locations or location of a bird in the roost is an outcome of its supremacy where it was concluded that the Long-tailed tits compete for inner locations within communal roosts, and the outcome of this competition determines dominance status of an individual within a flock.

Eurasian Magpie (*Pica pica*) roosts were watched and studied on a regular basis and found all of these communal roosts were used throughout the year, with the largest concentrations seen during the non-breeding season. Day length, temperature, and wind speed all have significant connections with the number of birds in the roosts (Ientile ,2014).

Chappell *et al.* (2016) investigated the impact of nest utilization and group size on roosting energy costs in Chestnut-crowned babblers (*Pomatostomus ruficeps*) from late winter to early summer and found that roosting in smaller groups is stressful. At thermoneutral temperature for solitary babblers (28°C), roosting in a group of four or more individuals had a 15 per cent lower baseline metabolic rate than single birds whereas groups of seven or more at 5°C and as well as group of five or more at 15°C didn't had to increase their metabolic rate over baseline.

The communal roosting of four widely distributed passerine species in Faisalabad is described in the research by Manzoor *et al*., (2021). For four hours in the morning, observations were done in four closely situated roosts in the selected agro-ecosystem of Faisalabad for 20-minute time intervals. Four passerines used trees such as *Salmalia malabarica*, *Dalbergia sissoo*, *Ficus bengalensis*, *Terminalia arjuna*, *Eugenea cumini*, *Cedrella toona*, and Eucalyptus species as roosts. Numerical counts were taken from three more roosts. The roosting habits of all four birds including brief flights, calls, mobbing, roost exits and returns, and breeding scuffles which depicted in all of the birds were also studied. The importance of roosting behaviours for all birds in their diurnal activities, as well as for obtaining enhanced sustainability and endurance in agro-ecosystems, was discovered.

2.4. COMMUNAL ROOSTING BEHAVIOUR ASSOCIATED WITH CHANGES IN VARIOUS ECOLOGICAL PARAMETERS.

Councilman (1974) conducted a study on the waking and roosting behaviour of Indian Myna (*Acridotheres tristis*) and recommended that communal sleeping provided more protection from predators than solitary sleeping and also additional benefits of forage efficiency and maintaining the unity of juvenile flocks were also observed.

Mahabal and Vaidya (1989) concluded that communal roosting of Indian Myna (*Acridotheres tristis*) showed systematic diurnal and seasonal changes for roosting activities with respect to the light and dark periods throughout all years of their study.

Beauchamp. G (1999) looked at interspecific variations in communal roosting behaviours across categories of many ecological parameters in order to test the significance of theories associated with the transformation to community resting/ roosting and later a minor setback to accompanied resting practices.

Roosting and Nesting Habits of Free ranging Indian Peafowl (*Pavo cristatus)* were studied for a period of one year and reported that peacocks observed to be both solitary and communal roosters, whereas peahens have only been observed to be communal roosters. When the light intensity of the habitat dropped below 8 lux, peafowls were seen to roost. They roosted in small groups of 3-4 along with subadults and utilized a variety of tree species like Neem, Tamarind etc. to roost whereas with young ones, the peafowls preferred dense thorny bushes. In the months of December to March, they found nesting, preferring Prosopis shrubs (Subramanian and John, 2001).

Peh (2002) studied roosting behaviour of House Crow (*Corvus splendens*) in relation to the environmental variables and found that it is influencing their roosting behaviour.

Roosting behaviour and Population size of Barn Swallows, *Hirundo rustica*, which is a non-breeding winter visitor, were examined in Jamshedpur, Jharkhand (India). The swallows first appeared in September, and their numbers gradually increased until December. The highest recorded numbers were 15,300 in 2006 and 16,700 in 2007. Their departure began in early March, and by mid-April, the majority of them had fled. During their stay, a significant number of swallows congregate in the town's overhead wires. The routes in these locations were illuminated all night, making it easier for them to spot predators. After sunset, the observed roosting time ranged from 13 to 28 minutes. One meter of electricity wire was filled by 10 to 12 roosting swallows. This event was rather consistent throughout the roost colony, allowing to extrapolate the overall population from random samples (Verma, S., 2010).

The findings of Ientile (2014) imply that environmental factors influence night roosting aggregations; long, cold, and windy nights cause birds to flock together, potentially to lower individual predation risk.

In research from Mazumdar *et al*. (2017) where the seasonal abundance and roosting habits of black kites in a suburb was examined it was observed that black kites roosted in groups and that their numbers fluctuate with the seasons and years. Evening roost counts and ad-libitum sampling were used to acquire data on the abundance and behaviour of roosting black kites in this habitat. Separate generalized linear models were used to analyses the data, with roosting kite abundance, number of black kites arriving to roost, and number of black kites performing pre-roosting display as response variables. Aspects of black kite behaviour within the roosts were also documented.

In research from Ranjana R. and C. A (2019) the Common Myna is a communal and heterogeneous rooster. Many factors influence roosting site selection, including physical qualities of those sites, limited anthropogenic disturbance, and anti-predation methods. However, the most important consideration when choosing a roost is the distance from the foraging area. By counting departing and incoming birds, the flock size and its relationship to the microhabitat were calculated. And also, the height of the trees, their distance from the nearest suitable tree, and the percent canopy closure were all calculated where distance between roost trees was very less.

2.4.1. Does Light Intensity Affect Communal Roosting?

Davis and Lussenhop (1970) from their research documented that the time it took for Starlings (*Sturnus vulgaris*) to leave for the roost was directly connected to the light intensity available. The time of departure from the feeding areas would most likely correlate better with light intensity than the time of departure from the first and final assemblies. And they found a reduced link between light intensity and time of departure from gathering places as the roost approaches. They observed that arrival of starlings at the roost was not solely a function of the light-time stimulus, but was also influenced by the light intensity at the moment the birds first started flying.

The possible impacts of intensity of light on the roosting hours during the winter of a huge roost belonging to rooks (*Corvus frugilegus*) are addressed in research and also it was observed that the departure of birds from the foraging sites, their arrival back to the roost, way into roost, and departure of birds in the next morning were sufficiently influenced by the intensity of light. Departure from the foraging sites shown relatedness to intensity of light as that it was observed to have early arrival to the roost in lower intensity of light and late arrival after foraging in higher intensity of light. The effect of the circadian rhythm on rooks' reactivity to light intensity was also discussed for rooks from various feeding grounds (Swingland, 1976).

Eiserer and Leonard (1984) published literature based on Communal Roosting in Birds and reported that the amount of light is a most essential element influencing roosting flights.

Janicke and Chakarov, (2007) studied the impact of the weather parameters on the behaviour of communal roosting shown by the Common Raven *Corvus corax* with unlimited food resources and recorded that, on cloudless evenings and days with shorter daylight, ravens arrived to the pre-roost and roost later relative to sunset even though parameters such as normal room temperature, daily accumulated rainfall, and speed of the wind have no influence upon Raven's arrival to the roost.

The availability of light and the ambient temperature were discovered to be the most critical elements in determining roosting time and duration of Barn swallows. Cloud cover and roosting time had a correlation. When the weather was cloudy, birds roosted early in the evening (about 13 to 17 minutes after sunset). Birds roosted much later almost every evening while the sky was clear (24 to 28 minutes after sunset). The time between the early bird's roosting and the last bird's roosting was usually 10 to 17 minutes (Verma, 2010).

According to Ientile (2014)'s research on communal roosts of Black-billed Magpie *Pica pica* in urban environments, day duration, temperature all have significant relationships with the number of birds in the roosts.

Black kites (*Milvus migrans govinda*) and their communal roosting behavior in an urban metropolis was studied and found that the black kites typically arrived at roosting locations after sunset in urban settings, and their arrival was influenced by sunset timing, temperature, relative humidity (Mazumdar *et al*., 2017).

Communal roosting of black kites along with Spot-billed Pelicans and Cormorants were observed in Chennai by Choudhary and Mahesh (2018). They found that the light intensity was influencing the arrival of the kites to the roost. It was observed that the first group of kites arrived at the roost on the metal frames of pylons, one hour before sundown. Kites roosted on cables and pylons until ten to twelve minutes before sunrise, with the majority departing at this time. The birds moved in three large groups: the first batch fled the roost 20 minutes before sunrise; the second batch left 20 minutes later.

2.4.2. Does Wind Speed and Direction Affect Communal Roosting?

Eiserer and A. Leonard (1984) identified that the wind has a major role in influencing roosting flights in their research on communal roosting in birds.

Janicke and Chakarov (2007) found that the pre-roost and roost arrival times were unaffected by weather factors like wind speed, and cumulative daily precipitation through their study on the effect of severe weather upon the roosting times at the community roost of common ravens *Corvus corax* in response to higher energy demands.

Day length, temperature, and wind speed all have significant connections with the number of birds in the roosts as suggested by Ientile (2014) in his research on communal roosts of Black-billed Magpie *Pica pica* in urban habitats.

2.4.3. Does Temperature Affect Communal Roosting?

It was reported that the temperature has an effect on the roosting flights of individuals showing communal roosting while addressing the communal roosting behaviour of birds (Eiserer and Leonard, 1984).

Morné du Plessis (1994) investigated Acorn Woodpeckers (*Melanerpes formicivorus*) during the non-breeding season, when they are most reliant on nutrient-poor acorn stocks and recorded that the oak branches (*Quercus*) in which Acorn Woodpeckers carve roost cavities cool more slowly than the surrounding air, i.e. The temperature within unoccupied woodpecker roost cavities will be more than outside temperature. Also, the temperature of occupied roosts was raised further in proportion to the amount of birds present. So, it was predicted that a single cavity-roosting woodpecker would reduce heat loss by at least 9 per cent at a temperature of 0°C, whereas four birds would reduce heat loss by at least 17 per cent, and even more in the presence of wind; which thereby increases their winter survival rate.

Eagles relocate to night roosts in order to find a more suitable microclimate during the colder months, when they are susceptible to cold and food stress. In both winter's Adams *et al*., (2000) found that most nightly relocations were to the roost's centre rather than its periphery and the frequency of relocation to the centre was observed higher when the temperature was low.

Communal roosting behaviour of the suburban population (*Corvus orru*) was monitored by Everding and Jones (2004). They studied the activity of Torresian crows as they departed and arrived at focal roosting trees. They found that roosting behaviour was significantly affected by cloud cover and temperature.

The arrival times at the pre roost and the roost were undisturbed by weather conditions such as temperature variation for the common raven's (*Corvus corax*) roosting behaviour evaluated by Janicke and Chakarov (2007). Similarly, roosting times were unaffected by moonlight.

Ientile (2014) observed significant relationships between mean daily temperatures and roost arrival time. The mean daily temperatures and roost arrival time have been discovered to have significant connections. During the coldest days, roost arrival times are delayed, most likely because of extended feeding activities.

Chestnut-crowned Babbler metabolism was measured at three ecologically relevant temperatures: 5°C (roughly similar to minimum night time temperatures during early breeding), 15°C (roughly similar to night time temperatures during late breeding), and 28°C (thermal neutrality). And it was found that bigger group sizes of Babblers had a significant impact, with energy expenditures saved up to 60% at low temperatures. Also, Babblers roosting in groups of seven or more at 5°C and groups of five or more at 15°C did not need to increase their metabolic rates over baseline. Whereas individuals roosting in groups of four or more had a 15% lower baseline metabolic rate than single birds at 28°C, implying that roosting in small groups is stressful (Chappell *et al.,* 2016).

Mazumdar *et al.* (2017) studied Communal roosting behaviour of Black kites (*Milvus migrans govinda*) in an urban metropolis and examined that temperature influenced the arrival of black kites to the roost along with other environmental factors of sunset timing, temperature, relative humidity etc.

2.5. DO SEASONAL CHANGES AFFECT COMMUNAL ROOSTING?

The roost populations vary extensionally in their total population size, age and also sex composition during different seasons as well as on a daily basis on indifferent time periods. (Eiserer and Leonard, 1984).

In the winter, why do Magpies *Pica pica* roost communally rather than alone was addressed by Møller (1985). When compared to the fall and spring conditions, less time was spent at the roost before and after roosting in the winter. During the winter, all Magpies roosted together. The majority of roosts were found in deciduous trees near water and held only a few birds. The height of roost perches was reduced by strong winds. Magpies from high-quality territory arrived late at night and flew out early the next day. As the day length reduced, so did foraging activity at the roost, but flight remained steady. In the spring, there was a lot of sexual and aggressive behaviour.

Mahabal and Vaidya (1989) concluded that communal roosting of Indian Myna (*Acridotheres tristis*) showed systematic diurnal and seasonal changes for roosting activities with respect to the light and dark periods throughout all years of their study.

Everding and Jones (2004) monitored communal roosting in the suburban population of six radio-tagged Torresian crows (*Corvus orru*) and studied their activity as they departed and arrived at focal roosting trees. It was detected that several hundred birds were using the roosts on most of the nights, and there was also an evident seasonal variation with the highest numbers being observed in autumn and the lowest in spring. Adult radio-tagged birds tended to return to the same roost on a regular basis while juveniles didn't.

The objective of the study by Janicke and Chakarov, (2007) was to see if severe weather affects the roosting times at the community roost of common ravens Corvus corax in response to higher energy demands. And they observed that the number of roosting ravens varies greatly throughout the year, ranging from 0 in the summer to 574 in the winter.

In the research by Verma (2010) on the communal roosting and Population size of Barn Swallows it was observed that from September through December, there was a seasonal increase in numbers. The departure of birds begins in late March and lasts until the middle of April. In February and March, roosting time was much later than dusk.

Mazumdar *et al*., (2017) discovered that there were seasonal variations in the abundance of black kites, with the abundance being highest in the summer and lowest in the winter. Seasonally, pre-roosting displays were at their peak during the monsoon and at their lowest during the winter. And their arrival to the roost also was influenced by season.

James *et al*., (2018) studied non breeding Caracas and reported that the number of non-breeding Caracas residing a communal roost was more in nonbreeding season than breeding season. The Caracas were also showing seasonal survival variations when compared with previous works on them. This provided a standardized explanation for previously unexplained paradoxes in their non-breeding ecology, which could be valuable in guiding conservation and broadening knowledge upon the ecology of other socially roosting birds.

2.6. COMMUNAL ROOSTING BEHAVIOUR OF HERONRY BIRDS.

Siegfried W. R. (1971) in his research finding significance of communal roosting in *Ardeola ibis* found that the entire benefit of social roosting cannot be described just in terms of predator protection as well as shelter from bad weather, and/or energy conservation at night. But also, it aids individuals in maintaining communication with one another. This behaviour allows for more efficient discovery and use of localized food resources. It is claimed that A. ibis communal roosting evolved predominantly in response to food availability, and that communal roosting may be considered as extension of the principle of feeding by enhancement.

Communal roosting and foraging behaviour of Sandhill Cranes (*Grus canadensis)* was documented as thousands of individuals were found to roost at night and disperse at dawn to forage in agricultural fields. Cranes with central roosts had activity ranges twice as large as those with peripheral roosts, and 42% of the birds shifted their activity ranges before migration began. Cranes utilized native grassland and farmed hayland more frequently than expected, and fed the longest there, whereas cornfields were under-utilized. These variations were likely due to either a limited distribution of grasslands and haylands which resulted in higher energy expenditure to acquire protein in the form of macroinvertebrates or due to a larger distribution of grasslands and haylands (Sparling and Krapu, 1994)

Choudhary and Mahesh (2018) recorded 40 Spot-billed Pelicans *Pelecanus philippensis roosting* on high-tension wires in Sholinganallur Lake (12.89oN, 80.23oE) of Chennai, India. Similar communal roosts of Black kites of 50 individuals, more than 250 Spot-billed Pelicans, and 40 Little Cormorants *Microcarbo niger* were seen roosting on these high-tension cables running over a large wetland, Pallikaranai of Chennai. But the former one was in spite of the absence of Black Kites.

The Black-headed Ibis (*Threskiornis melanocephalus*) roosting ecology was investigated in both urban and rural environments in southern Rajasthan, India. Black-headed Ibis roosting ecology, with an emphasis on site and tree characteristics, co-occurring roosting species, and factors impacting flock numbers at roosts were the major objectives. Any differences in site features between nest sites, urban and rural roost sites and paired sites (i.e. waterbird roost sites near Black-headed Ibis roosts but without Black-headed Ibis) were examined. The hypothesis suggested factors which affect Black-headed Ibis densities at roosts are the same in urban and rural areas was also examined. Between nest and roost sites, tree features (canopy cover, girth at breast height) were variable. Urban roost sites were disturbed 2.3 times more than rural roost sites (Koli *et al*., 2019)

MATERIALS AND METHODS

3. MATERIALS AND METHODS

3.1. STUDY AREA

The present study was carried out in Panamaram heronry of Wayanad District from December to April 2021-22. The Wayanad is situated at the confluence of three biologically distinct regions of Western Ghats: The Niligiri hills, the Deccan plateau, and the Wayanad sub-plateau. The plateau rises abruptly from Kerala's coastal plains and gently slopes eastwards, merging with the Deccan plateau in the east (Nair, 1986). Wayanad lies between North latitude 11' 26' to 12' 00' and East longitude 75 75' to 76 56°'. The altitude varies from 600-to 2100 meters above Mean Sea Level. The plateau has a monsoon climate, although it has shifted dramatically in recent decades, with hotter summers and reduced rainfall (Kumar and Srinath, 2011). The southwest (June to August) and northeast monsoons (September to December) both are received in the region, with the former contributing the most of the water availability for several wetlands and water bodies. The Kabani and its tributaries, such as the Panamaram, Manathavady, and Kalindi are the major rivers flowing through the district of Wayanad district.

The Panamaram heronry (11˚45 ′N, 76˚05′E) is a small natural islet formed by the Panamaram River's bifurcating flow that covers almost one acre. It lies 650 meters above sea level and is located near Panamaram town, around 500 meters downstream of the bridge on the Manathavady – Panamaram route. The heronry's vegetation comprises Bambusa spp., with grass, weeds, and bushes covering the rest of the sandy land (Anoop *et al.*, 2015). The study area is receiving both southwest and northeast monsoons. Heronry birds gather here to breed during the southwest monsoon. The Panamaram River's floodplain areas and nearby agricultural fields are all key foraging habitats for heronry birds (Anoop *et al.*, 2015).

A

B

C

D

Plate 1. Field photos: (A),(B) and (C) Field visit at Panamaram Heronry (D) Flocks of birds arriving to the roost.

3.2. SPECIES COMPOSITION OF ROOST

Panamaram Heronry is observed to be rich in a total of 9 species belonging to 3 families which include Cattle Egret (*Bubulcus ibis*), Little Egret (*Egretta garzetta*), Intermediate Egret (*Mesophoyx intermedia*), Great Egret (*Casmerodius albus*), Little Cormorants (*Phalacrocorax niger*), Indian Cormorants (*Phalacrocorax fuscicollis*), Indian Pond Heron (*Ardeola grayii*), Black-Crowned Night Heron (*Nycticorax nycticorax) and* Near-Threatened Black-headed Ibis (*Threskiornis melanocephalus* ; Anoop *et al*., 2015). Along with these waterbirds, a huge number of Jungle Myna are also communally roosting in Panamaram heronry.

A

B

Plate 2. Bird species at the Heronry. (A) Mixed-species of Black headed Ibis, Egret sp., Cormorant sp. and Jungle Myna (B) Little Egret (*Egretta garzetta*)

3.3. SAMPLING METHODS

To determine the abundance of each species, repeated counts were carried out with care to avoid double counting (Anoop *et al.*, 2015). The roosting population is estimated by counting birds arriving at the roost by flight from a vantage point. These observations started before sunset in the hours of 17:19 ± 0.009255 and lasted for an hour after sunset during the hours of 06:35 ± 0.006749 (Verma, 2002). The first and last timings that birds arrived at the roost were recorded, as well as the presence or absence of predators in the area (Sarangi *et al.*, 2014). The bird species that visit the roost site, the number of individuals, the and direction of flight will be recorded.

The birds were first identified, and then flocks were counted using a simple point count method (Vasundriya *et al*., 2011).

The roosting birds was observed by 17:00hrs and 19:00 hrs in the evening. The direction from which birds visit the roost and the direction of departure the next morning can be used as indicators to test the information-sharing hypothesis (Sarangi *et al.*, 2014). The roost partitioning behaviour was recorded based on which canopy levels, the different bird species prefer to roost as there was different canopy levels which was provided by short trees, shrubs as well as Bamboo sp. found in the sandy shore of the islet. The roost partitioning was evident as the area was big and easily visible from the vantage point (Anoop *et al.*, 2015). The interaction within species and between species was also recorded (Altmann, 1974).

The photographs were taken with a Canon 1200D DSLR camera with 55-250 mm to count and document the birds which are already occupying before other birds starts arriving to the roost. Photographs were helpful to estimate the number of individuals with a species level identification.

Since it is difficult to count large flocks, apart from direct observation, we also recorded a video of roosting using Sony Handy-cam HDRCX405 from 17:00

upto 19:00 hrs at the Vantage point. Later the video was analysed to estimate the number of individuals of respective species. We have clubbed all white egrets into egret species and all cormorants into cormorant species as the species level identification was difficult in dim light. The Light intensity was estimated using Sigma Lux Meter. Wind speed and wind direction were estimated using Anemometer and Wind vane (Witeg) respectively.

RESULTS

4. RESULTS

Panamaram heronry was found to have a total of 10 waterbird species and one major passerine species. Waterbird species include Cattle Egret (Bubulcus ibis), Little Egret (*Egretta garzetta*), Intermediate Egret (*Mesophoyx intermedia*), Great Egret (*Casmerodius albus*), Little Cormorants (*Phalacrocorax niger*), Indian Cormorants (*Phalacrocorax fuscicollis*), Indian Pond Heron (*Ardeola grayii*), Black-Crowned Night Heron (*Nycticorax nycticorax*), White-breasted Waterhen (*Amaurornis phoenicurus*) *and* Near-Threatened Black-headed Ibis (*Threskiornis melanocephalus* while Jungle Myna is the major passerine bird species seen at roost along with House Crow. In the roost, occasional visits of waterbird species such as Great Cormorant (*Phalacrocorax carbo*), Asian Openbill Stork (*Anastomus oscitans*), Glossy Ibis (*Plegadis falcinellus*), and Purple Heron (*Ardea purpurea*) and passerine bird species of Chestnut-tailed Starling (*Sturnia malabarica*) were observed.

4.1. ABUNDANCE OF BIRDS IN THE HERONRY

In the present study, egret species is estimated as the most abundant species of birds roosting at Panamaram heronry as they are in highest number then comes Black-headed Ibis and least is the number of Cormorants species as shown in the Figure 1.

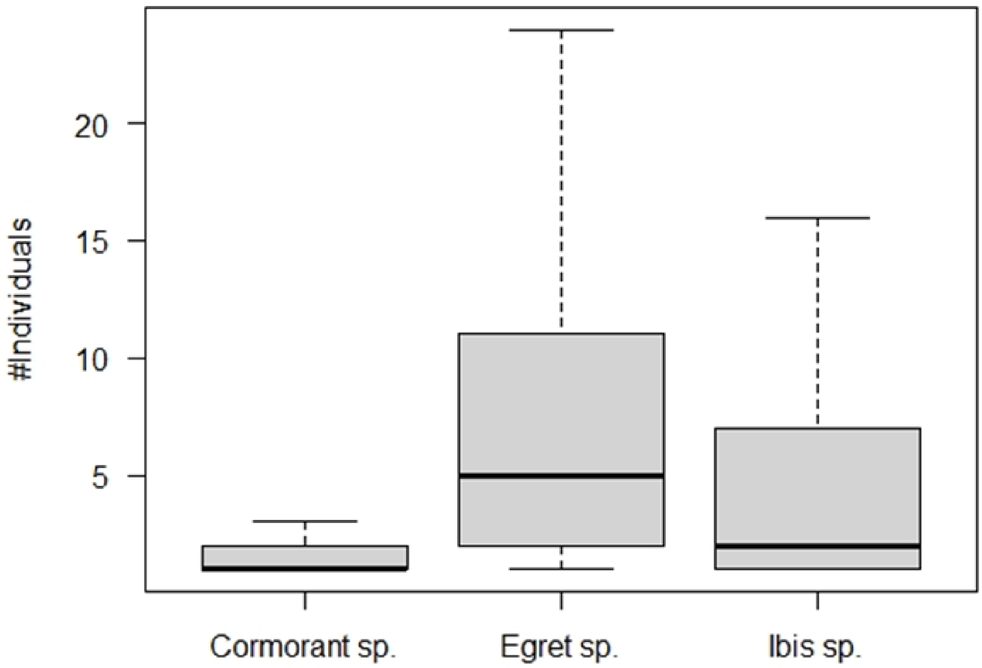

Figure 1. Abundance of different species of birds of Heronry

Among different species, Egret species were abundant (9.615033 ± 13.49887) followed by Ibis (5.613508 ± 7.369973) and Cormorants (1.395 ± 0.833743) as shown in (Fig1).

Table 1: Number of birds present in the roost during the study period.

Species	**Dates of Observation**										**Total**
	10-12-2021	11-12-2021	12-12-2021	13-12-2021	14-12-2021	15-12-2021	16-12-2021	17-12-2021	19-12-2021	20-12-2021	
Cormorant Sp.	26	72	27	61	70	36	69	71	45	65	583
Egret Sp.	2164	1981	2023	2090	2167	2150	1981	2358	2154	2023	23153
Black- headed Ibis	292	261	211	294	438	255	243	211	261	234	2992
Total No.	2482	2314	2261	2445	2675	2441	2293	2640	2460	2322	26728

4.2. ARRIVAL TIME AT THE ROOST

During each visit an average of number of birds were found to occupy the roost. Cormorants are the first to occupy the roost followed by egrets and Ibis. Cormorants start arriving at the roost at 17:00 to17:20 hrs with a peak roosting observed at 17:45 to 17:50 hrs. Cormorants arrives by small group of 2-5 or were found alone. Cormorants were first to occupy the roost and Egrets also starts to join around soon after the hours of 17:00.

The Egrets arrived the roost in flocks of 20-30 individuals together and also as individuals of small flocks of 5-10 individuals. Black-headed Ibis arrived to the roost in flocks of 9-12 individuals on an average in Echleon Formation (V-formation) in the hours of 17: 30 to late evening of 18: 30, even after sunset they were found arriving and most number of individuals were observed in the hour of 18:00 which found to be the peak time for Black-headed Ibis as in Figure 2.

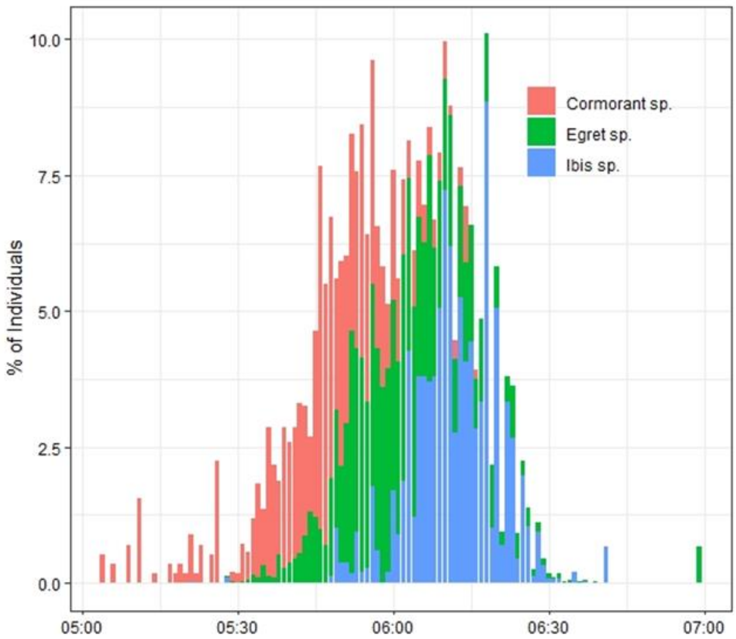

Figure 2. Graph showing the different species arriving at the roost at the hours of 17:00 to 19:00.

4.3. ABIOTIC ENVIRONMENTAL FACTORS AND THEIR RELATION WITH NUMBER OF BIRDS

When we are considering different environmental factors and their relatedness with the roosting behaviour of the birds is found to be significant in the present study. The major abiotic factors such as light intensity, wind speed as well as direction were considered in the study. The wind was actually not experienced during the study so the wind speed and direction becomes irrelevant in the present scenario, but light intensity is found to be significant.

4.3.1. Light Intensity

The activity of different species differed according to light intensity (Figure 3). Cormorants actively roost at an average light intensity of 4444.51 Lux ± 1275.49 SE followed by Egrets at 930.08 ± 773.59SE and Ibis at 277.12 ± 224.87SE.

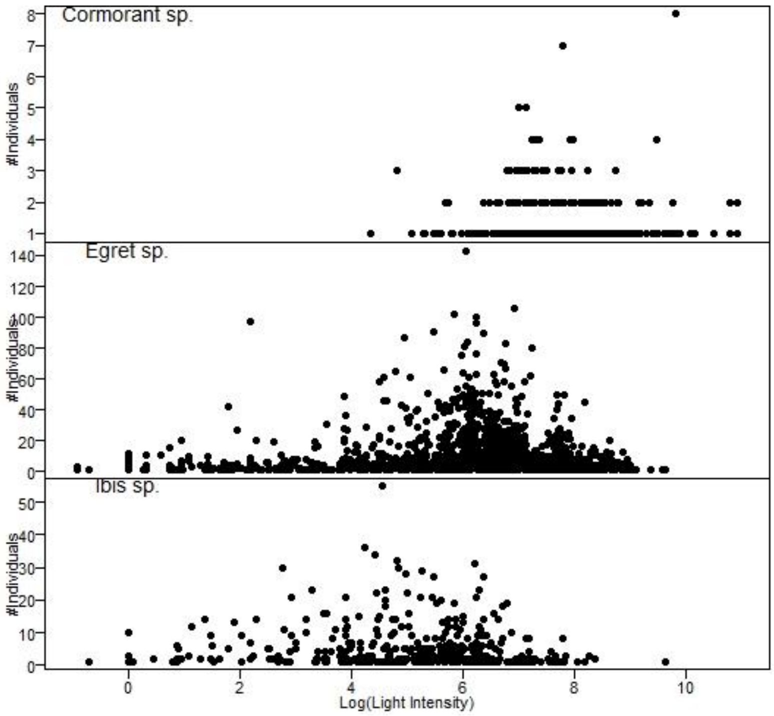

Figure 3. Activity of different species of birds roosting with respect to the light intensity.

4.3.2. Flight Direction of Roost Members

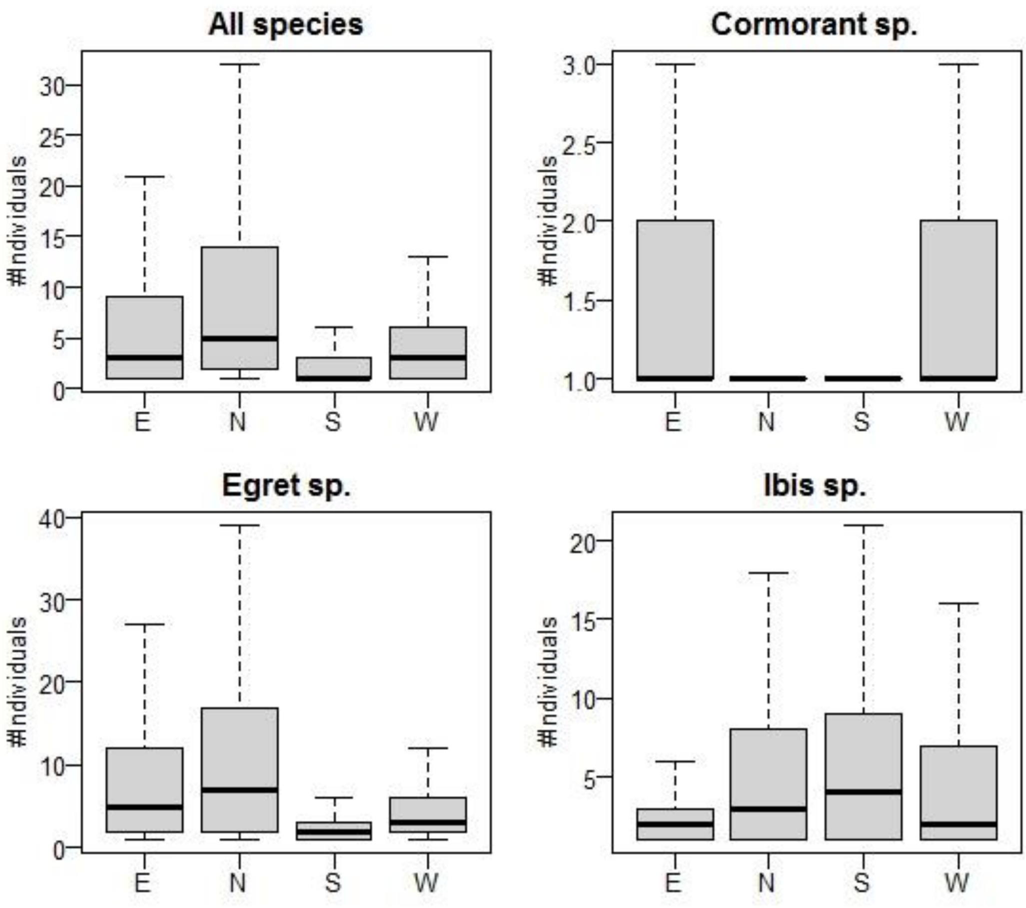

Figure 4. Direction of the arrival of different species of birds roosting at Panamaram Heronry illustrated in box-plot.

In General, most of the birds were found coming from Northern Direction. Ibis was found arriving from the south while Egrets species were found arriving from the North (Figure 4)

4.4. INDIVIDUAL SITE FIDELITY

In the study area, the roost is composed of different levels of vegetation as we go up from the sandy river shore. Differences in choosing different vegetation of the roost site was observed within different species of birds of Panamaram heronry. The Egret sp. being the most abundant ones roosted almost all the regions of the roost. They were occupying almost all the regions, on the branches of roost trees with and without foliage, also in the shrubs seen near to the river banks as well as in the grass sp. Whereas the Cormorants more confined to the upper parts of the trees of roost which the branches without foliage and was also in a less number compared to others, Ibis occupied the uppermost portion of trees of roost which were without foliage and also the top portion of the bamboo sp. found in the roost. It was occupying the roost after soaring one or two rounds above the roost.

DISCUSSION

5. DISCUSSION

Present study identifies Panamaram Heronry as a mixed communal roost which is occupied by waterbirds including different species of Egrets and Cormorants as well as Black Headed Ibis along with Passeriforms like Jungle Myna. It is already reported as the largest traditional mixed-species heronry in Wayanad district and support the breeding of maximum number of species of waterbirds in north Kerala (Sashikumar *et al*., 2012). The reason behind such formation of mixed species roosts could be when there only few roosting locations or could be because one species adopts another species' roost as a secure place (predator protection) and also species with same foraging demands roost together so that information can be shared (Ward and Zahavi, 1973). All the species residing in the study area, are in good number where the number of Egret species is observed to be higher than the others. Anoop *et al.*, (2015) had a similar observation where Intermediate Egret *Mesophoyx intermedia* had the largest population size (52 per cent) of the nine species which were roosting at Panamaram Heronry, followed by Black-headed Ibis *Threskiornis melanocephalus* (20 per cent) and Indian Pond Heron *Ardeola grayii* (12 per cent)).

5.1. LIGHT INTENSITY AND COMMUNAL ROOSTING

Studies demonstrate that light intensity and time of sunset have a function in the roosting behaviour of Passeriformes. In the roosting behaviour of starlings (*Sturnus vulgaris*), a relationship was established between light intensity and departure time of starlings from the foraging area to the roost (Davis and Lussenhop, 1970). While exploring the impacts of the intensity of light during the winter upon the roosting hours of Rooks (Corvus frugilegus) were described as at lower light intensities, arrival to the roost from feeding sites occurred earlier, and at higher light intensities, arrival of birds was later (Swingland, 1976). In colder season, Reebs (1986) observed that while all other factors being equal, Black – billed Magpies are found to arrive to the roost relative to the sunset as well as their departure was also relative to sunrise. Here in the case of Waterbirds, a similar significant relationship is found between the arrival time of the birds and the light intensity in the present study. Seibert (1951) observed the mean arrival time of herons residing at the roost, which included Black-crowned Night Herons, Little Blue Herons, and American Egrets, being relative to sunset and concluded that the most essential element controlling the arrival and departure of species of Herons was the light intensity as well as time of sunset and sunrise. During the dry season, the cattle egrets were observed to leave the roost relative to sunrise which was much later than at any other period of the year and relatedness with sunset was also observed in their arrival to the roost (Siegfried, 1971). In fact, in the present study, it was observed that in mixed species roost, the relatedness about light intensity and arrival of birds is species specific.

5.2. FLIGHT DIRECTION OF ROOST INMATES

The initial flight-direction of birds was broadly associated with a feeding area. Individuals of the cattle egret species were also consistent in their preference of flight direction in their departure, according to Siegfried (1971). In this present study also the arrival of birds was observed from mainly from the Northern direction and from the Eastern direction of the roost as the more of the foraging grounds and fields are found in those directions. So, the direction is found relative to the foraging benefits of the roost inmates. This differences in flight direction were observed being species specific. In the present study the Cormorant species were found to arrive more from the Eastern and Western directions where as Black-headed Ibis arrived majorly from Northern and Western directions. The directions of the arrival of egrets were similar to the directions of majority of birds which were Northern and Eastern directions since egrets were most abundant. Black- headed Ibis were the next species of communal roost to second in the abundancy and Cormorant species came less in numbers than the others.

5.3. TIME OF ARRIVAL OF ROOST INMATES

The differences within the species were not just for the flight direction but also for the time of arrival of individuals. It is already explained as there will be differences in the arrival of species to the roost in a mixed species roost. In a communal roost of Sacred Ibises and Marabou Storks, it was observed that both of these birds arrived to the roost separately in different timings were Sacred Ibises arrived later than Marabou Storks even it was late evening (Evans *et al.*, 1981). In the present study also, the Black headed Ibises were the late comers to the roost, they started arriving in the hours of 17:50. Whereas the cormorants were first to occupy the roost, they occupied the roost from 17:00 hrs to 18:15 hrs of the day. In the findings of the present study, the Egrets started arriving from 17:20 hrs to 19:00 hrs and along with the flocks of Egrets sp., Jungle Myna are also occupying the roost in high numbers from the hrs after 17:51, in flocks looked like murmuration.

Jungle Myna which are arriving to the roost and instantly disappears into the insides of the roosts because of its small size. And there was a size wise differences in the positions occupied by the birds while roosting in the mixed species roost.

SUMMARY

6. SUMMARY

Communal roosting behaviour is a behaviour shown by birds also animals where individuals of the same species or related/ different species gather together and rest in the same place. The major functions of this behaviour are to provide thermoregulation, more foraging efficiency, and predator mitigation. But these roosting communities can be affected by various ecological changes happening to the preferrable conditions of the environment. In this present study, we are analysing the major ecological factors which are affecting the communal roosting behaviour of the birds residing at the Panamaram Heronry of Wayanad district.

Panamaram heronry (11˚45΄ N, 76˚05΄ E) is a lesser-known Heronry of Kerala consisting of an islet-like area of almost one acre but ecologically it's very important as it is the only place in Kerala where the Cattle Egret is found breeding and it's here a mixed-species roost of Passeriformes as well as heronry birds are found. The mixed-species roost and the various factors affecting the roosting of birds were investigated by directly observing the roost in the hours of 17:00hrs and 19:00hrs in the late evening.

The bird species that visit the roost site, abundance of each species that are roosting, and direction of their flight were recorded with help of photographs and videos and it's identified that how rich the heronry is being home to a total of 9 species belonging to 3 families which include species of Egrets, species of Cormorants, as well as Near Threatened Black-headed Ibis (*Threskiornis melanocephalus*). The major egret species seen are Cattle Egret (*Bubulcus ibis*), Little Egret (*Egretta garzetta*), Intermediate Egret (*Mesophoyx intermedia*), and Great Egret (*Casmerodius albus*). Little Cormorants (*Phalacrocorax niger*) and Indian Cormorants are the Cormorant species seen along with egrets and Black-headed Ibis. Great Cormorant *Phalacrocorax carbo* and species of Herons such as Indian Pond Heron (*Ardeola grayii*) and Black-Crowned Night Heron (*Nycticorax nycticorax*) were observed during the study. Along with these waterbirds, a huge number of Jungle Myna *Acridotheres fuscus* were also communally roosting in Panamaram heronry.

By the findings of the present study, the Egret species is estimated to be the most abundant among the birds roosting at the heronry then comes the Black-headed Ibis and the least is the number of Cormorants species. And the environmental factors such as light intensity, time as well as the direction of arrival are significant. The wind was not experienced during the study so the wind speed and wind direction are irrelevant in the present scenario. There were differences in the activity of each species of birds according to the light Intensity and most of the birds were most active when the light intensity was dropping. When light intensity crossed zero, almost all birds arrived at the roost.

The differences in the direction of arrival of birds are reasoned as the area preferred for foraging and here a maximum number of birds were found arriving from Northern and Eastern directions because of the presence of fields and foraging areas in those directions. According to the size differences, the birds occupied different positions in the roost. Bigger and heavier birds like Black-headed Ibises were roosting in the uppermost niche of the roost whereas Egret species being abundant took almost all areas of the roost. Cormorants and Jungle Myna being smaller than the others moved to the insides of the roost. The major statistical conclusions were obtained with help of R – software and SPSS software.

Studying the roosting behaviour, its relatedness to the different environmental factors, and the abundance of the species will give an idea about the current status of different species of birds of the heronry. This study area is also where the Near Threatened Black-headed Ibis breed and nest. So, by conserving the roosting sites, we are conserving the birds also. Since very few studies have been done on the communal roosting behaviour of birds in India and not many in Kerala, these studies are very much relevant and needed.

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FACTORS AFFECTING THE COMMUNAL ROOSTING BEHAVIOUR OF BIRDS AT PANAMARAM HERONRY, WAYANAD DISTRICT

ROSE FRANCIS
(19-MSVP-07)

DISSERTATION

Submitted in partial fulfilment of the requirement for the degree of

MASTER OF SCIENCE
(Wildlife Studies)
2022

Faculty of Veterinary and Animal Sciences
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8. ABSTRACT

Communal roosting of birds can be observed all over the world, it's a common behaviour shown by birds to attain benefits of better thermoregulation, information attained on food, predators as well as breeding mates and also lower predation. Sometimes in the communal roost only, birds are found to nest and rear young ones. So, the conservation of such roosts is essential for the protection of birds and it can only happen with the help of scientific studies about it.

In this present study, we are looking into various environmental factors affecting the communal roosting behaviour of birds in a mixed-species roost situated in a Heronry at Panamaram of Wayanad District, Kerala. The major objectives of the study also include the abundance of different species residing in the communal roost as well as the roost partitioning of the birds roosting. The inferences are made by directly observing the roost in the hours of 17:00hrs and 19:00hrs in the late evening with simple point count method and the data was documented with the help of photographs and videos. From the observations, it is identified that heronry is home to a total of 9 species belonging to 3 families which include species of Egrets, species of Cormorants and even Near Threatened Black-headed Ibis (*Threskiornis melanocephalus*). It's a mixed-species roost since along with these heronry birds Passeriformes such as Jungle Myna (*Acridotheres fuscus*) are found communally roosting in the same heronry. Observations were also made on how light intensity, wind speed, and wind direction affect the roost and also time of arrival as well as the direction of arrival of roosting birds. Our results could significantly favour the relatedness of these factors with roosting behaviour and find an abundance of various roosting species of this heronry.

Acad. Form No.19a

KERALA VETERINARY AND ANIMAL SCIENCE UNIVERSITY

Faculty of Veterinary and Animal Sciences

PROGRAMME OF RESEARCH WORK FOR DISSERTATION FOR MASTER OF SCIENCE DEGREE

1. Title of dissertation:

   Factors affecting the communal roosting behavior of birds at Panamaram Heronry, Wayanad District.

2. a) Title of the department /KVASU research:

   NIL

   b) Project of which this forms a part:

   NIL

   c) Code No. if any, and order by which the departmental/KVASU research project is approved:

   NIL

3. a) Name of student: Rose Francis

   b) Admission No: 19-MSVP-07

   c) Name of the programme: Master of Science (Wildlife Studies)

4. a) Name of Guide: Dr. Biju S.

   b) Address:
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   Department of Livestock Production and Management
   College of Veterinary and Animal Sciences,
   Mannuthy, Thrissur – 680651

5. Objectives of the study:

   To evaluate the most significant factors influencing roosting behavior.
   To estimate species abundance and resource partitioning by time and space.
   To estimate the roost partitioning and its influence on roost site selection.

6. Practical /Scientific utility:

Communal roosting behavior of winged species is observed all around the world. Avian communal roosting is a behavior seen in birds where they assemble by night fall and spend night time together (Councilman, 1974; Eiserer, 1984; Francis and Bhujbal (2021). It has a number of advantages for birds, including lower thermoregulation requirements, reduced predation risk, and increased foraging efficiency (Krebs and Davis, 1998).

In Kerala studies have shown that, there are communities were the land birds and wetland birds are seen roosting together forming a mixed species roosting community. (Jayson, 2018). Studying about the roosting activities and the abundance of the species, gives an idea about the current status of different birds of a particular area.

Initially the birds were identified and later flocks were counted by simple approximate point count method (Vasundriya et. al., 2011). This type of sampling method provides us data on the roost partitioning and the major factors affecting their roosting. (Tolonen and Korpimäki, 1994; Gaibani and Csermely, 2007).

We're testing the Recruitment centre hypothesis, which states that birds tend to recruit their roost-mates to foraging sites to obtain benefits while feeding. They do this either by reducing the chances of predation or increasing the period of time expended for foraging. The information centre hypothesis claimed that communal roosts originated as information centres where unsuccessful foragers find experienced foragers to accompany to a successful foraging site following days (Sarangi et al, 2014). Panamaram heronry (11˚45 ′N, 76˚05′E), a small natural islet covering roughly one acre which is developed by the branching flow of the Panamaram river, was chosen for the study. It is also one of Kerala's lesser-known heronries, located near Panamaram town, around 500 metres downstream of the Manathavady – Panamaram road bridge and 650 meters above the sea level (Anoop et al., 2015). No roosting studies have been conducted in that area and the roosting activities are not yet documented.

7. Important publications on which the study is based:

Councilman (1974) conducted a study on the waking and roosting behavior of Indian Myna (Acridotheres tristis) and recommended that communal sleeping provided more protection from predators than solitary sleeping and also additional benefits of forage efficiency and maintaining the unity of juvenile flocks were also observed.

Mahabal and Vaidya (1989) concluded that communal roosting of Indian Myna (Acridotheres tristis) showed a systematic diurnal and seasonal changes for roosting activities with respect to the light and dark periods throughout all years of their study.

Kelvin (2002) studied roosting behavior of House Crow (Corvus splendens) in relation to the environmental variables and found that it is influencing their roosting behavior.

Fischer et al. (2004) investigated the roosting site and roosting behavior of Male Common Nighthawks (Chordeiles minor) and suggests that the roosts chosen by them may provide selective benefits with respect to microclimate, energetics and predator avoidance.

8. Outline of the technical programme:

The proposed study will be carried out in the Panamaram area where these birds were observed to roost communally. The total area of the roost site is about one hectare. The roost site located near the Panamaram river (11°44' N and 76°6'E). The specific vantage points for the bird counts were identified in the study area.

The bird species that visit the roost site, number of individuals, direction of flight will be recorded. The roosting behavior is observed and analyzed by point count. The roosting community will be observed from 17:00hrs and 19:00hrs in the late evening. The direction from which birds visit the roost and direction of departure in the next morning can be used as indicators to test the information-sharing hypothesis (Sarangi et al., 2014).

The roost partitioning behavior will be recorded based on which canopy levels the different bird species prefers to roost. The time of arrival and departure of the birds will be recorded.

9. Main items of observations to be made:
   Species involved in the communal roosting behaviour
   The species abundance/density in the roost sites
   Factors affecting the roosting behavior.
   Roost partitioning how do they communally share the roost site?

10. Duration of research work:
   One Semester

Signature of the Student

Project coordination group proposed:

NIL

Place:

Date:

Signature of Guide

Name, address and signature of members of the Advisory committee

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11. References:

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CERTIFICATE

Certified that the research project has been formulated observing the stipulations laid down under the Prevention of Cruelty to Animals Act (Amendment, 1998).

Place:

Date:

Dr. Biju S.

(Major Advisor)

CURRICULUM VITAE

1.	Name of the Candidate	Rose Francis
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8.	Professional Experience	Nil
9.	Publications Made	Nil
10.	Membership in Professional Societies	Nil