Research Article

Behavioural aspects and Activity budgeting of Black Headed Ibis, *Threskiornis melanocephalus* and Red Naped Ibis, *Pseudibis papillosa* in Dighal (Potential IBA site), Jhajjar, Haryana, India

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ABSTRACT

Behaviour and activity budgeting of Black Headed Ibis and Red Naped Ibis were studied at village Dighal from November 2020 to October 2021. In the current study, different behaviours were recorded and their frequency was also calculated among different time blocks (morning, afternoon and evening) of a day for both the Ibises. A total of 72 hours were spent to record their activity budgeting and behaviour. To collect the data, scan and focal sampling methods were adopted. A number of behavioural activities were recorded like, resting, preening, feeding, movement, alert, neck scratching, aggression and so on. The result revealed that the main activities performed by both the Ibises were resting, feeding and movement. Feeding was observed at its peak in morning hours. Black Headed Ibis was observed to be engaged in feeding (47.82±2.78%), followed by resting (23.27±1.87), movement (14.23±0.53), preening (6.98±1.00), alert (4.62±0.57) and other activities (3.06±0.18) respectively. Whereas, the time devoted by Red Naped Ibis in different activities includes feeding (44.50±2.49%), followed by resting (20.78±2.14), movement (18.01±1.65), preening (10.13±1.77), other activities (3.73±0.19) and alert (2.63±0.31).

Keywords: Activity budgetting, Behaviour, Dighal, Feeding, Resting, Movement.

INTRODUCTION

Ibises are the medium sized waders that come under order Pelecaniformes and family Threskiornithidae of class Aves (IUCN, 2016). In India, only three species of Ibises were found : Black Headed Ibis, Red Naped Ibis and Glossy Ibis. Out of which only two i.e*.,* Black Headed Ibis *Threskiornis malanocephalus* and Red Naped Ibis *Pseudibis papillosa* were the residents of state Haryana as well as found to be most commonly distributed in the Northern and Western India (Hancock *et al.,* 2001; Ali & Ripley, 2007; BirdLife International, 2012). Black Headed Ibis is near threatened, while Red Naped Ibis is considered as least concern of IUCN Red List (IUCN, 2016). Both of these species are popularly known to utilize the area in and around the shallow water land, but the preferred habitat of Black Headed Ibis includes wetlands, freshwater ponds, riverine lakes, marshland, paddies and swamps; whereas Red Naped Ibis prefers the agricultural land and open dry areas near the shallow water land (Thapa & Saund, 2012; Paliwal & Bhandarkar, 2017; Chaudhury & Koli, 2018). They use these habitats for diverse activities which include, nesting, foraging and roosting.

The amount of the time spent on the various mutual activities performed by individual animals, reliant on intra- and inter-specific interactions, and the existing abiotic environment is known as time budgeting (Willmere *et al.,* 2005). Animal metabolism is directly allied with its activity patterns and time budgeting, so it is a key for behaviour and ecological research (Halle & Stenaeth, 2000). In nut shell, time budgeting is the expenditure of time by animals for various activities like feeding, breeding, maintenance and roosting, and this devotion of time inevitably affects the survival of that animal (Baidassarre & Bolen, 1994).

Time spent by the bird on its various daily activities is highly immense and majorly depends upon the type of habitat and available food material (Paulus, 1984); So time budgeting seems to be a useful tool for determining the habitat use, exploitation of resources and variables that restrict the survival of a bird (Khan, 2014). Furthermore, it is also a useful tool to determine the significance of the seasonal usage of habitat use by migratory birds (Paulus, 1988). However, the distribution of energy and survival of a bird is directly related to the activity budgeting and its behavioural patterns (Maheswaran & Rahmani, 2007) which provides a key to understand the ability of bird to adapt in the changing environment with human interference. In order to conserve the endangered bird species, it is obligatory to be familiar with the different behavioural aspects, activity budgeting, characteristics of their habitat as well as their home range (Xu *et al.,* 2021).

Investigating how animals cope with their surroundings may reveal information about their mental and physical stability, and thus their welfare. To assess this animal welfare observing the animal behavior is a non invasive technique Hill & Broom,

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2009). (In breif, it is more important to be aware about behavior of a species with the members of their own species as well as with the other one is normal or not to find their wellbeing (Garner, 2005). Till now a number of studies have been conducted on the foraging behavior and activity budgets of Red Naped Ibis and Herring Gulls (Soni *et al.,* 2010; Van Donk, *et al.,* 2020). Along with that time invested on the social behavior by Black Headed Weaver and Northern Bald Ibis were also documented (Spiezio *et al.,* 2018; Dismas & Rija, 2021).

The current study has been planned to determine the preliminary information related to behaviour patterns and activity budgeting of Black Headed Ibis and Red Naped Ibis. As activity budgeting has been identified as a major tool to provide valuable information regarding the habitat use and niche separation which can be useful in management of bird's habitat (Rave & Baldassarre, 1989). To the best of our knowledge, no previous study is reported dealing with activity budgeting and behavioural aspects of both the Ibises. Hence, this work will be helpful in conserving the habitat of the respective bird species, which ultimately conserve their population status.

MATERIALS AND METHODS

Study area

The present study was conducted at village Dighal of district Jhajjar (Figure 1), which is located at 28.76948° N and 76.63261° E with an elevation of 222 meters. Village Dighal constitute a number of freshwater ponds and marshland areas that endows a suitable habitat to the migratory bird species; so, considered as potential Important Bird Area (IBA) with code IN-HR-06 by ENVIS (Rahmani *et al.,* 2016). It lies 20 km away from the district headquarters and 70 km away from Delhi in the north west of state Haryana. It is surrounded by village Sampla from East, Kalanaur from West; while from district Rohtak from North, and Jhajjar towards South.

Methodology

The current study was conducted from November 2020 to October 2021. Throughout the study period, various behavioural observations were made on a monthly basis to observe both the Ibises. To learn about the different diurnal activities of both Ibises in their respective study sites, groundwork was done conducted to become acquainted with the Ibises as well as their activity patterns (Altmann, 1974). A continuous scan sampling and focal sampling methods were used to collect data on activity budgeting and behavior (Altmann, 1974; Martin & Bateson, 2007). Nikon 10x50 binoculars and a Nikon Coolpix P-900 point-and-shoot camera were used to make the observations. For the various behavioural postures, videos and still images were also recorded. Time taken during each activity was determined from the recorded videos using stopwatch. Complete day was divided into three time blocks- morning (09:00am to 11:00am), afternoon (01:00pm to 03:00pm) and evening (04:00pm to 06:00pm). Each hour of these time blocks were further subdivided into three 10-minute observation periods, with alternate 10-minute break. Time used during each activity was estimated in percentages in each and every time block of the day of every month. Maps were generated with the aid of ArcGIS version 10.8 and Google earth explorer.

Data analysis

Different activity patterns of both the Ibises were compared in between different time blocks of the day by using one way analysis of variance (ANOVA). All statistical analysis was made by using IBM SPSS 23.
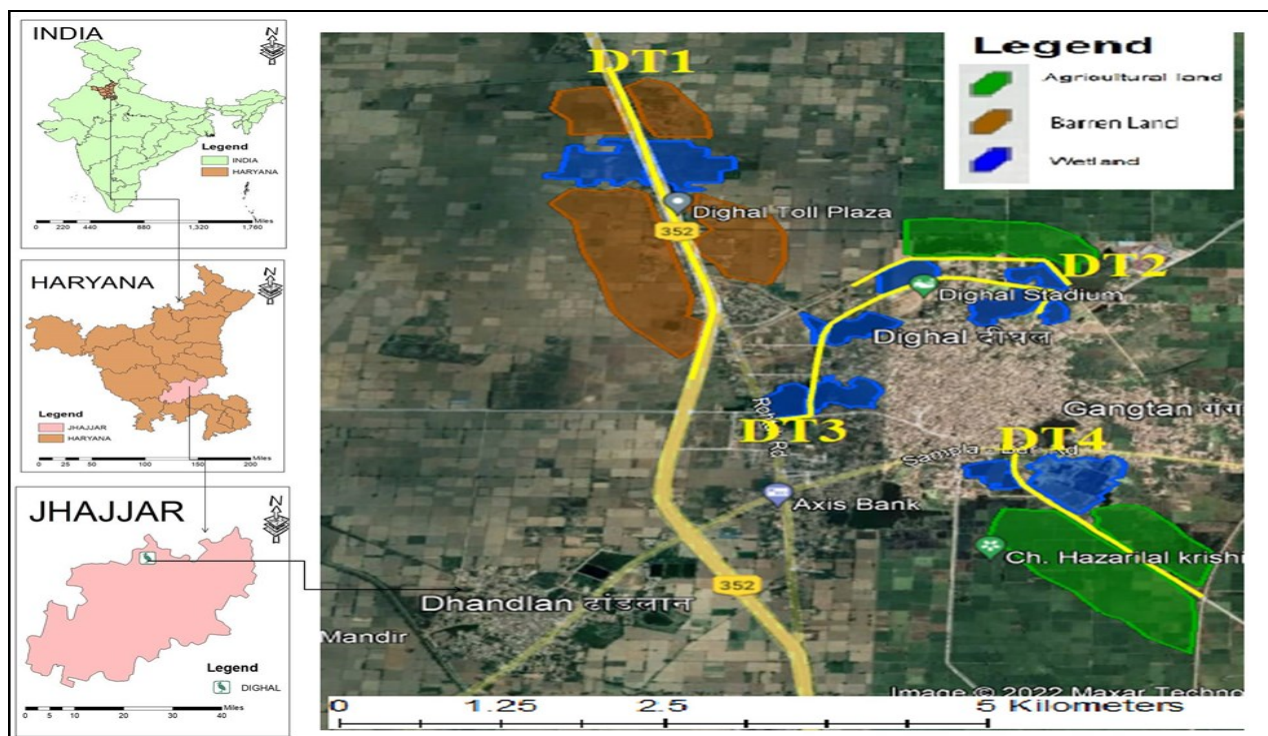
Figure 1. Map showing the location of village Dighal visited during study period November 2020 to October 2021. Yellow lines shows the different transects DT1, DT2, DT3 and DT4 visited during the study period.

RESULTS

A total of 72 hours were spent to record the data regarding behaviour and activity budgeting of both the Ibis species. Ethogram is also prepared for both the Ibises, which includes a set of behavioural patterns describing the behaviour of any species (Table 1) (Haccou & Meelis, 1992; Hancock *et al.,* 2001). The behavioural patterns recorded during the present study includes resting, preening, feeding, movement, alert and some other activities which includes aggression, copulation, neck scratching, etc (as shown in Table 1. and Figure 2). The activity budgeting of both the Ibises were found to be different throughout the different time blocks of the day (Figure 3 and 4). Resting, feeding and movement were the major activities performed by both the Ibises in between different time blocks of a day (Figure 5). Both of them were found to be engaged more than 80% of their diurnal time in performing these activities. Black Headed Ibis was observed to be engaged in feeding (47.82±2.78%) followed by resting (23.27±1.87), movement (14.23±0.53), preening (6.98±1.00), alert (4.62±0.57) and other activities (3.06±0.18) respectively (Table 2). Whereas, the time devoted by Red Naped Ibis in different activities

include feeding (44.50±2.49%) followed by resting (20.78±2.14), movement (18.01±1.65), preening (10.13±1.77), other activities (3.73±0.19) and alert (2.63±0.31) (Table 3).

Statistical analysis depict that the resting and other activities shown by the both the Ibis species does not varied significantly among the different time blocks of a day (P>0.05). However activities by Black Headed Ibis (preening, feeding and Alert) and Red Naped Ibis (preening, feeding, movement and Alert) was significantly different (P<0.05) in morning, afternoon and evening hours (Table 2, 3).

Among these activities, preening and alert for both Black Headed Ibis and Red Naped Ibis was found to be maximum in afternoon. However, feeding was at its peak in the morning hours i.e., (58.07±4.23%) and (59.41±4.24%) for both Black Headed Ibis and Red Naped Ibis respectively (Table 2, 3). Whereas the time spent in movement by Red Naped Ibis was maximum during evening hours (27.35±3.44) followed by morning (14.80±0.66) and afternoon (11.88±1.19), while for Black Headed Ibis it does not varied significantly (P>0.05) among the time blocks (Table 2, 3). Behaviour associated with the breeding like copulation was

One Leg Stand

Preening

Feeding

Walking

Alert

Flight

Neck Scratching

Wing Raising

Figure 2. Behavioural aspects of Black Headed Ibis and Red Naped Ibis observed at the study site.

Table 1. Ethogram of Black Headed Ibis and Red Naped Ibis showing the names and decription of the different behaviour observed during study period November 2020 to October 2021 (Hancock *et al.,* 2001).

Sl. no.	Behavioural Categories	Description
1.	Preening	Ibises twist their head on both the sides of their body one after another to clean their feathers by using their bill
2.	Feeding	During feeding, Ibises keep probing and pecking on the substratum in search of food and swallow after getting it.
3.	Resting/ One leg stand	During the resting, Ibises usually stand only on their one leg or sometimes on both the legs. At that time they mostly keep their neck down to appear shorter and sometimes also close their eyes.
4.	Walking	They always walk slowly probing their beak on ground in search of food.
5.	Alert	They stand erect keeping their neck extended straight in the upward direction and sensing the noise or any other movement happening around them.
6.	Neck Scratching	Ibises scratch their neck behind their chin by using one of its legs.
7.	Wing Raising	Wing raising is usually done for sunbathing and occur for many purposes like absorption of heat, to dry their wet plumage, to increase the secretion of preen gland, for moulting of eggs as well as protection of the chicks from direct sunrays.
8.	Other Behaviours	Other behaviour includes aggression, copulation, incubation, flight, fight and caring of their young ones.

Table 2. % of time spent by Black Headed Ibis to perform various behavioural activities at study site Dighal from November 2020 to October 2021 in different time blocks of a day (morning, afternoon and evening).

Time block	Number of observation days	Activities					
		Resting	Preening	Feeding	Movement	Alert	Others
Morning	12	16.72^A ±2.76	$4.20^A \pm0.52$	$58.07^B \pm$ 4.23	15.31^A ± 0.89	2.91^A ± 0.50	2.77^A ± 0.22
Afternoon	12	28.60^B ±2.64	$14.02^B \pm1.56$	$32.83^A \pm$ 2.37	13.19^A ± 0.79	7.96^B ± 1.06	3.38^A ± 0.35
Evening	12	24.48^{AB} ±3.51	$2.71^A \pm0.17$	$52.56^B \pm$ 4.27	14.18^A ± 1.03	2.99^A ± 0.45	3.03^A ± 0.33
Total	36	$23.27\pm$ 1.87	6.98 ± 1.00	47.82 ± 2.78	14.23 ± 0.53	$4.62\pm$ 0.57	$3.06\pm$ 0.18
P-Value		0.27	0.00	0.00	0.27	0.00	0.38

*This mean does not differentiated in columns denoted by same capital letter (P>0.05)

Table 3. % of time spent by Red Naped Ibis to perform various behavioural activities at study site Dighal from November 2020 to October 2021 in different time blocks of a day (morning, afternoon and evening).

Time block	Number of observation days	Activities					
		Resting	Preening	Feeding	Movement	Alert	Others
Morning	12	14.83^A ±2.84	$5.15^A \pm0.92$	$59.41^B \pm$ 4.24	14.80^A ± 0.66	1.98^A ± 0.18	3.68^A ± 0.31
Afternoon	12	23.50^A ±4.25	$22.50^B \pm2.81$	$33.89^A \pm$ 2.70	11.88^A ± 1.19	3.91^B ± 0.79	4.22^A ± 0.41
Evening	12	24.01^A ±3.57	$2.74^A \pm0.27$	$40.21^A \pm$ 1.42	27.35^B ± 3.44	1.99^A ± 0.21	3.29^A ± 0.20
Total	36	$20.78\pm$ 2.14	10.13 ± 1.77	44.50 ± 2.49	18.01 ± 1.65	$2.63\pm$ 0.31	3.73 ± 0.19
P-Value		0.14	0.00	0.00	0.00	0.01	0.14

*This mean does not differentiated in columns denoted by same capital letter (P>0.05)
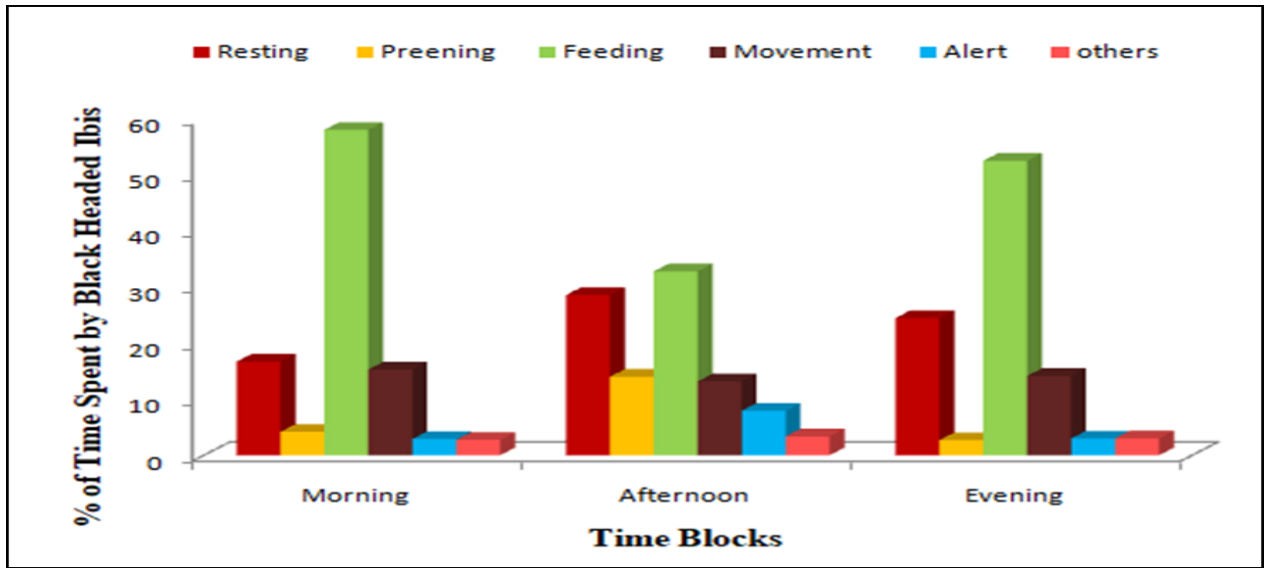
Figure 3. % of time spent by Black Headed Ibis on different behavioural activities in between different time blocks of a day.
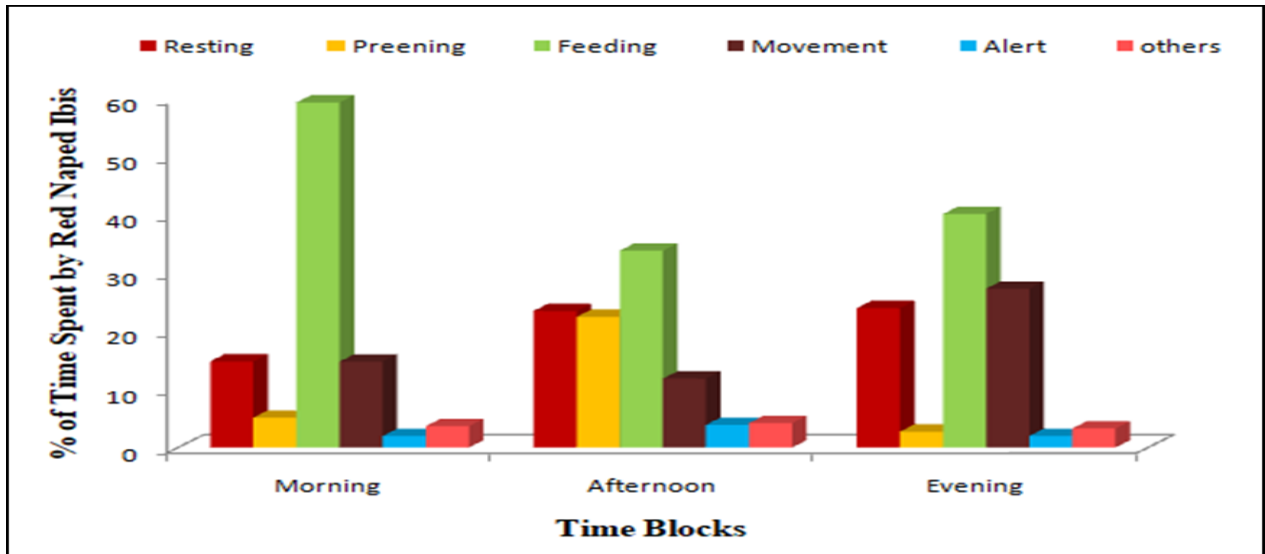

Figure 4. % of time spent by Red Naped Ibis on different behavioural activities in between different time blocks of a day.
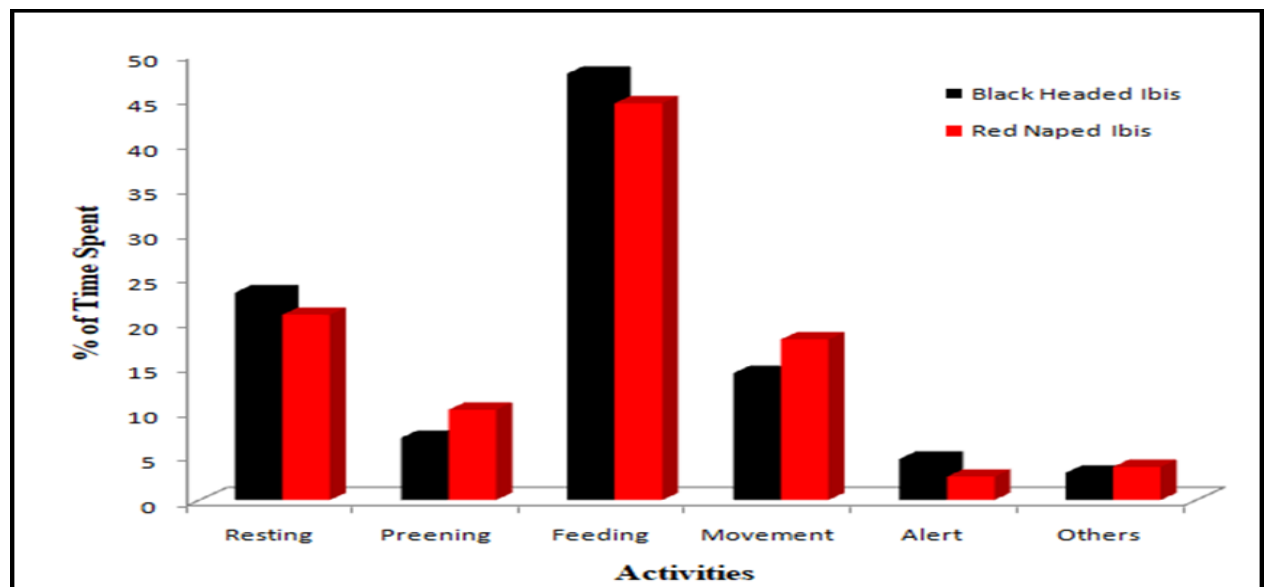

Figure 5. Comparison of % time spent by Black Headed Ibis and Red Naped Ibis to perform various activities.

observed for both the Ibises but the activities like: egg laying, incubation and caring of their young ones were observed only in case of Black Headed Ibis at Village Dighal.

DISCUSSION

Survival of a species is directly related to the time and energy spent on different activities. Activities budgeting of any species vary among the species depending on the different environmental conditions. The major activities performed by both the Ibises include resting, feeding and movement, whereas these activities were also observed to be dominant in other waders like Oriental White Stork (Shao *et al.,* 2015), Lesser Flamingos (Rameshchandra, 2014) as well as Greater Flamingos (Kumar & Rana, 2021). Both of the species usually feed on a variety of worms, aquatic insects, crustaceans, some fishes, frogs, mollusks, reptiles (Hancock *et al.,* 2001), though data was not collected in the present study for feeding habits. Sometimes, they were observed to feed upon vegetable matter, when animal matter is not present abundantly (Ali & Ripley, 2007; Soni *et al.,* 2010; Matheu & Del Hoyo, 2016). These were also found to be feeding in open sewage line during all the seasons, since the density of Oligochaetes and Chironomid larvae remains elevated here in every season (Frederick & Bildstein, 1992; Safran *et al.,* 2000; Sundar, 2006; Chaudhury & Koli, 2018). Feeding of Black Headed Ibis is not only restricted to these food material but also on carcass (Hancock *et al.,* 2001; Chaudhury & Koli, 2016).

Habitat use by the birds varies seasonally (Ali, 2004), which can be better estimated with the help of activity budgeting of that particular bird species. The way how a bird species uses their habitat for feeding, breeding, resting and other activities is influenced by their time budgeting and dietary requirements (Kushlan, 1978; Hancock *et al.,* 2001). During the present study, feeding was the major activity as reported for both Black Headed Ibis (47.82±2.78%) and Red Naped Ibis (44.50±2.49%) in all the time blocks of a day among different months, which clearly indicates their efforts of collecting large amount food particles (Figure 5 and Table 2,3) (Kushlan, 1978; Hancock *et al.,* 2001; Soni *et al.,* 2010). Feeding was found to be significantly different ($P<0.05$) among different time blocks of a day i.e., morning, afternoon and evening for both the Ibises but, it was not much different in between Black Headed Ibis and Red Naped Ibis during the different months. Similar observations were reported for the feeding behaviour of Red Naped Ibis (Soni *et al.,* 2010) as well as by some other waders like Oriental White Stork, Lesser Flamingo and Greater Flamingo (Rameshchandra, 2014; Shao *et al.,* 2015; Kumar & Rana, 2021). It was also observed that feeding performed by a bird species is maximum during morning and evening hours (Espino-Barros & Baldassarre, 1989), similar observations were made during the present study for Black Headed Ibis and Red Naped Ibis. In case of Northern Bald Ibis comfort maintenance activities are seems to be higher all throughout the diurnal time, which is not observed in our present study (Spiezio *et al.,* 2018).

There was a very little time when both the Ibis species spent for alert and other activities like neck scratching, wing raising, aggression, copulation, etc. In the current study alert activity varies significantly different i.e., $P<0.05$; but other activities does not vary, among the different time blocks of a day. However, these activities remain almost same for both the Ibises among different months of a year. Similar reporting was also shown by Ibises (Table 2,3) (Hancock *et al.,* 2001) and other waders. Whereas, aggression and alert activities were observed for a very little time in nature and (Bildstein *et al.,* 1991) as well as captive environment (Rose *et al.,* 2018) among the time block of a day.

Being a potential IBA site, village Dighal is supporting a huge population for both Black Headed Ibis and Red Naped Ibis as well as a number of other wetland bird species (Rahmani *et al.,* 2016) which are crucial for conservation priorities. So by knowing the activity and behaviour patterns of both the Ibises we can conserve their habitat and strengthen long term conservation and management plans for both the Ibises.

CONCLUSION

The present study on the Black Headed Ibis and Red Naped Ibis at Potential IBA site Dighal provides baseline information regarding the activity budgeting and behaviour patterns of these species. Resting, feeding and movement were the major activities performed by both the Ibises. These species were observed throughout the year at village Dighal, establishing this area for conservation of wetland bird species along with associated flora and fauna. In short, by observing their activity budgets we came to know that the major activities highly depend upon the habitat and its utilization. So, in order to conserve both the species, their habitat should be conserved.

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Author's contribution

This present study was performed by both the authors. Both the auths helped to shape the research, data analysis, field visits and ultimately this into a form of manuscript.

Conflict of interest

The authors have no conflict of interest and this manuscript content has been reviewed by both the authors.

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