

ORIGINAL ARTICLE

Time Budget Pattern of Three Antidae Family Members (Ruddy Shelduck, Bar-Headed Goose And Indian Spot Billed Duck) from Foy Sagar Wetland Ajmer, Rajasthan

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ABSTRACT

A quantitative analysis of the microhabitat utilization was carried out at Foy Sagar Lake. Three bird species were selected out of which one was resident and two were Palaearctic migrants. The species-specific diurnal time budgets and related characteristics of the terrain were also assessed. Five major activities per day were studied: feeding, preening, swimming, walking and flying. Indian Spot-billed Duck, a resident species of Foy Sagar Lake, showed a lesser feeding time as compared to the migratory birds (i.e. is Bar-Headed Goose and Ruddy-Shel Duck). The time budget activity from winter to early summer, showed variations in the activities of migratory birds, but in contrast to this; the resident bird behaved in a uniform pattern during daytime throughout the season. The utilization of this artificial lake in a complementary manner by a high number of water birds (residents as well as migrants), is mainly due to presence of numerous types of micro-habitats. A comprehensive analysis of the behavioural requirements of these water-birds can be used for conservation and efficient management of such wetlands.

KEYWORDS: Diurnal behaviour, microhabitats, ordination method, seasonal period, water-birds.

Received 03.04.2019 Accepted 28.05.2019

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INTRODUCTION

Time Budgeting and its importance:

Each individual species has a peculiar pattern of its daily behaviour and its behaviour is also affected by the surrounding environmental conditions. Thus the time spent for a particular behaviour or activity is highly related to both temporal and spatial distribution. Time-activity budgets quantify how birds apportion time to various activities [27]. These may reveal critical aspects of their use to the spatial and temporal dimensions, and are important to understand the niche partitioning among sympatric species [33]. This approach has been extensively used in birds, showing that patterns of daily activity can vary widely between species and that they are important to determine the life history and ecological adaptations of birds [15].

Studies on activity time budget of birds in their suitable habitats have been recognized as an important tool for understanding habitat use and niche separation and consequently it is an invaluable aid for managing waterfowl communities and habitats [16].

Time or activity budget is a quantitative description of how animals apportion their time for feeding and other activities [1]. These time budgets, which are, the pattern of time allocation for maintenance and breeding activities are important in understanding the evolution of avian reproductive and foraging behaviour [39]; [32] and the way natural selection operates to produce efficient individuals [4]. The amount of time and energy which a bird devotes to different activities must inevitably influence its survival [26]. Although some types of behaviour require more time and energy than others, the optimizing paradigm predicts that the individual performs at the most opportune time [35]. Because of the chance component, the underlying rhythm of any behaviour repertoire can be modified in most cases and, therefore, the behavioural pattern is probabilistic [29]. The behavioural patterns of animals are the product of their interaction to external biotic and abiotic stimuli [1]. Activity budgets of birds greatly vary according to the types of habitats and food used [28]. [6] proposed that variations in the time budgets of marine birds would correlate with prey availability and several studies have demonstrated a link

between avian activity pattern and prey abundance [24]. Birds that maintain feeding territories exclusive of the breeding season often utilize resources relatively stable in time and space [32]. Time budgets have been increasingly used in ecological studies [13]. They can be expected to throw much light on how the behaviour of any organism is structured in relation to its ecology [34]. Examining the influences of temporal and environmental factors on species time budget enables to understand the ecological significance of behavioural pattern [3]. [40] suggested that each species exhibited an optimal time budget for each environmental condition and that selection favoured individuals whose time budgets were most adapted. [12] and [31] considered analysis of activity budgets a useful tool in determining the needs of wintering waterfowl. Time budget study of the birds is more important mainly to know their behavioural changes according to seasons within and between habitats [20].

Birds selected for the Presented Study:

Antidae Family:

There are about 158 species in this family found in all parts of the world. They live on lakes, ponds, rivers and streams, and marshes. Many birds in this family are migratory and live in flocks. Most of the species in this family are herbivores and eat leaves, stems, roots, seeds and other plant parts. Many species also eat insects, small fish, molluscs, and crustaceans. The birds in this family have webbed feet and broad bills. Chicks are precocial-that means they can feed themselves and swim a few hours after birth.

Ruddy-Shel Duck (*Tadorna ferruginea*):

The Ruddy-Shel Duck (*Tadorna ferruginea*) is mainly a Palaearctic species with three different populations: a large population occupying a stronghold spanning from south-eastern Europe to Mongolia and China, a north-west African population, considered both small and declining, and an even smaller population in the highlands of Ethiopia [7] ; [19]. Ruddy-Shel Duck is a migratory bird. Eastern populations are mostly migratory, wintering in the Indian subcontinent. The Ruddy-Shel Duck is a common winter visitor in India where it arrives by October and departs by April.

Bar-Headed Goose (*Anser indicus*):

A significant proportion of the world's Bar-Headed Goose (*Anser indicus*) make biannual migration between breeding areas in Mongolia, northern China and the Tibetan Plateau (latitude between 29°N and 37°N, mean elevation of 4800 m) and wintering areas in India , crossing the Himalayan mountains (along the southern plateau) enroute. This species has become renowned for a paradigm of extreme high-altitude migration, being frequently cited as flying regularly above 8000 m.

Indian Spot-Billed Duck (*Anas poecilorhyncha*):

Indian Spot-Billed Duck (*Anas poecilorhyncha*) is a resident throughout Pakistan and India in freshwater wetlands. Some individuals may however migrate as a bird ringed at Bharatpur in Rajasthan on 5 December 1969 was recovered near Novosibirsk in August 1970. It is quite gregarious outside the breeding season and forms small flocks. The northernmost populations have expanded their range northwards by more than 500 km since the early 20th century, possibly in reaction to global warming.

REVIEW OF LITERATURE

Time activity budgets have been reported in many species of water birds, especially ducks [1], geese [30]; [5]; [9]; [22] and waders [3]. [22] studied the activity rhythm of wintering European Green-winged Duck (*Anas crecca*) and [11] added data on the Tufted Duck (*Aythya fuligula*). There are a few studies from India on ducks [36] and other taxa of water birds, namely Purple Moorhen (*Porphyrio porpyiro*) [2] and Coot (*Fulica atra*) [17].

Many field studies have been undertaken on birds and small mammals of temperate region as regards their timings of activity in relation to environmental factors over the seasons [41]; [8]; [10]. Their activity rhythms are mainly regulated by light / darkness cycle of nature. Other extrinsic factors such as temperature, sound [23]; [14] and social cues [21] and intrinsic factors such as hormones [38], can also eventually modify several such activity rhythms. Daily beginning and end of activities, in day active birds correspond to timings of sunrise and sunset respectively, and keep closer pace with them in temperate regions [8]. Such systematic study, however, is not available for activity patterns of tropical birds [25]. As far as the cormorants are concerned little is known about the movements and daily activity budgets [18]. They describe the time allocation patterns of the two species of cormorants occurring in Sheikhha Jheel. And also try to find out the adaptive significance of the activity pattern followed by the cormorants and to determine differences in activity pattern of two con-generic species that allows resource partitioning between them.

Species select often the available resources and the microhabitats in different ways throughout the wetlands, depending on their behaviour or spatial location for feeding. Hence, behavioural responses are the first line of defence to selective environmental factors.

THE PRESENT STUDY IS CONDUCTED:

- (1) To study the habitat utilization, time allocation and adaptive strategies of these three species:- Ruddy-Shel Duck, Bar-Headed Goose, Indian Spot-Billed Duck.
- (2) To study the behavioural ecology, particularly how it allocates time and effort differently between winter and summer; and
- (3) To prepare a comparative account of daily rhythm between summer and winter.

EXPECTED OUTCOMES OF PRESENT STUDY:

The expected results may help to better understand how these birds are adapted to their migrated microhabitat and on what basis they select new locations to spend their migration period under harsh environmental conditions.

MATERIAL AND METHODS

The study was conducted during the November 2018 to April 2019. Observations for daily time budget were randomly distributed over daylight hours between 08:00 am and 12:00 pm. A scan session method was chosen as being the most appropriate method for the study of unmarked birds under restricted visibility. Two hides were built, from which known roosts and feeding areas could be observed. A total of 4 hours of scan sessions were undertaken for observation on a daily basis. Under the scan sessions we categorized the activities under the feeding; preening; swimming; walking and flying categories for the convenience of the study.

PROFILE OF STUDY AREA

Foy Sagar Lake is an artificial man-made lake, located at the west of Ajmer city. Constructed by the English architect Mr. Foy in 1892 A.D., the lake was named after him. Lake Foy Sagar was build for a sole purpose to remove the scarcity of water in Ajmer during drought. This lake is an important source of water and very beautiful. It is also a famous picnic spot. It is now emerging as an important habitat for avian diversity.

Table 1: Physical Characteristics of Study Site (Foy Sagar Lake)

Characteristics	Description
Geographical Location	26.4458° N, 74.5800°E
Location in Ajmer	West of Ajmer
Lake type	Artificial lake / Manmade Lake
Catchment Area	5 million cubic feet
Storage Capacity of the Lake	15 million cubic feet
Circumference	14,000,000 square feet (1,300,000 m2)

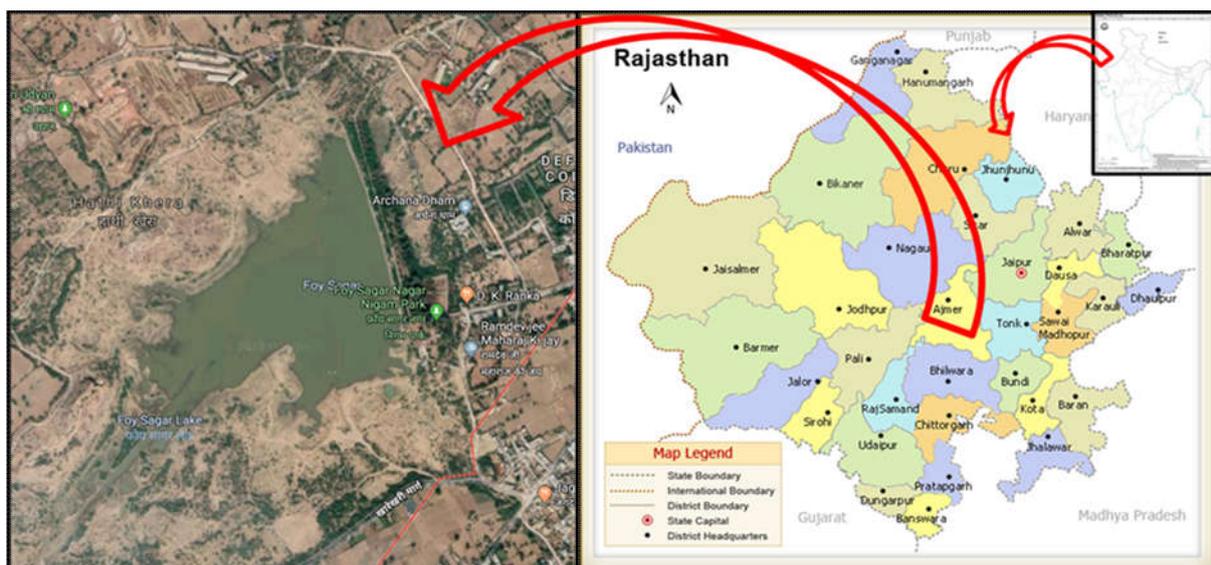
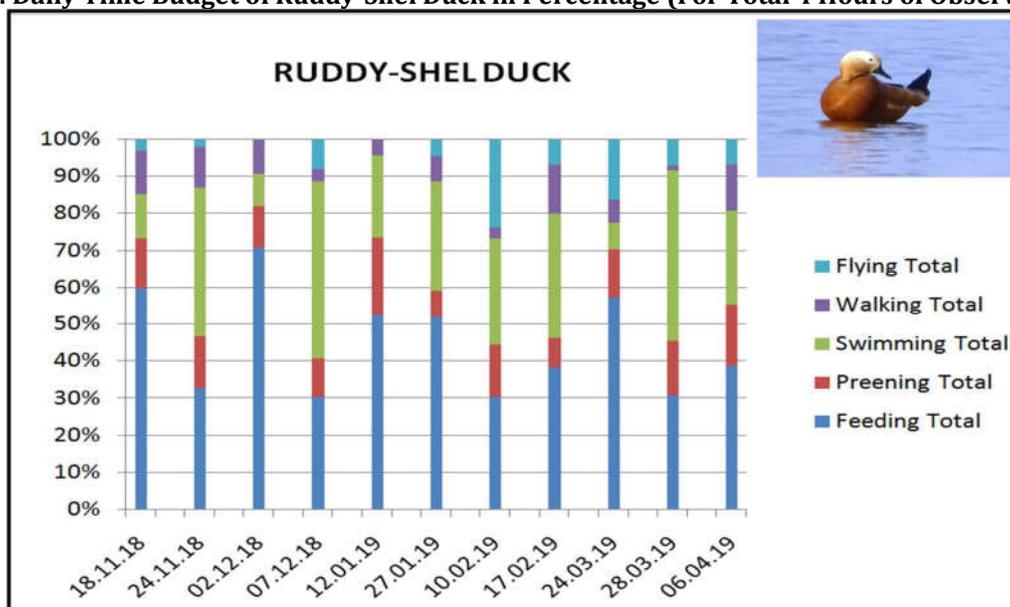


Fig. 1: Map showing the location of Study Area (Foy Sagar)

RESULT AND DISCUSSION

During the present study Ruddy-Shel Duck was observed to study its time budgeting at Foy Sagar Lake and it was assessed that it spends maximum time (during observation time period) in feeding activities (45% of an average on the daily basis) followed by the swimming activities (27.46%) and preening activities (13.03%) subsequently on an average daily basis. The least time was spent on the flying activities (7.08%).

Fig 2: Daily Time Budget of Ruddy-Shel Duck in Percentage (For Total 4 Hours of Observation)



The possible clarification for its time budgeting is that it is a migratory species to Foy Sagar Lake (Rajasthan) region and is only available during peak winters at study site. Hence, it used its maximum time to get energy (feeding) for its migratory activities. On the other hand Foy Sagar is situated at outskirts of Ajmer city and have few disturbances in comparison to Anasagar Lake (another lake situated at the centre of the city). Thus, the movements are more energy conserving (walking-7.46% or swimming- 27.46%) in comparison to flying (7.08%) as it requires more energy consumption.

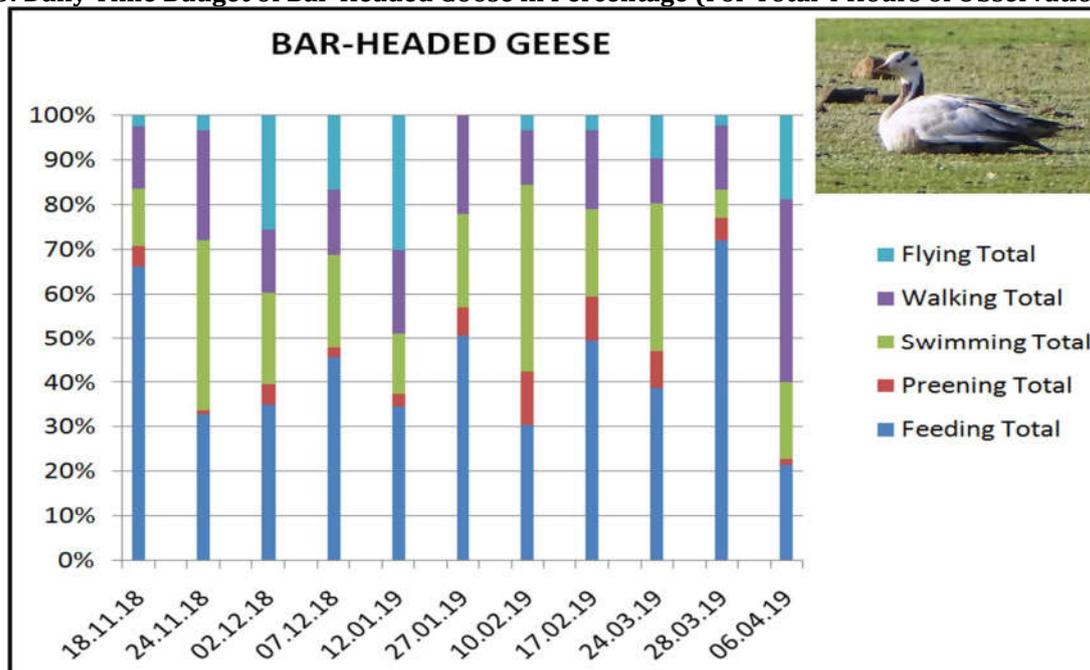
Table 2: Time Budgeting by Ruddy-Shel Duck at Foy Sagar Lake

Ruddy-Shel Duck (Time in %) 4hrs.duration								
Activity	Feeding	Preening	Swimming	Walking	Flying	STDEVA	AVERAGE	ERROR
Date								
18.11.18	60%	13.34%	12.09%	11.67%	2.92%	0.2273759	20.00%	3
24.11.18	32.92%	13.75%	40.42%	10.84%	2.09%	0.1602549	20.00%	3
02.12.18	70.84%	11.26%	8.75%	9.17%	0%	0.287447	20.00%	3
07.12.18	30.42%	10.42%	48%	3.33%	7.92%	0.1873207	20.00%	3
12.01.19	52.50%	21.25%	22.08%	4.16%	0%	0.2069455	20.00%	3
27.01.19	52.08%	7.08%	29.58%	6.66%	4.58%	0.2063759	20.00%	3
10.02.19	30.42%	14.16%	28.75%	2.92%	23.75%	0.1145739	20.00%	3

17.02.19	38.33%	7.92%	33.75%	13.33%	6.66%	0.1494589	20.00%	3
24.03.19	57.50%	12.92%	7%	6.25%	16.25%	0.2136824	20.00%	3
28.03.19	30.83%	14.58%	46.25%	1.25%	7.08%	0.1839909	20.00%	3
06.04.19	38.75%	16.66%	25.42%	12.50%	6.66%	0.1251256	20.00%	3
AVERAGE	45%	13.03%	27.46%	7.46%	7.08%	100%		
STDEVA	0.141814	0.039566	0.1421136	0.042565	0.071533			
ERROR	3	3	3	3	3			

Another migratory species, Bar-Headed goose was also observed to study its time budgeting at Foy Sagar Lake and found nearly similar time budgeting pattern as followed by Ruddy-Shel Duck. Bar-Headed Goose spends maximum time (during observation time period) in feeding activities (43.45% an average on the daily basis) followed by the swimming activities (22.35%) and walking activities (18.48%) subsequently on an average daily basis. The least time was spent on the preening activities (5.26%).

Fig 3: Daily Time Budget of Bar-Headed Goose in Percentage (For Total 4 Hours of Observation)



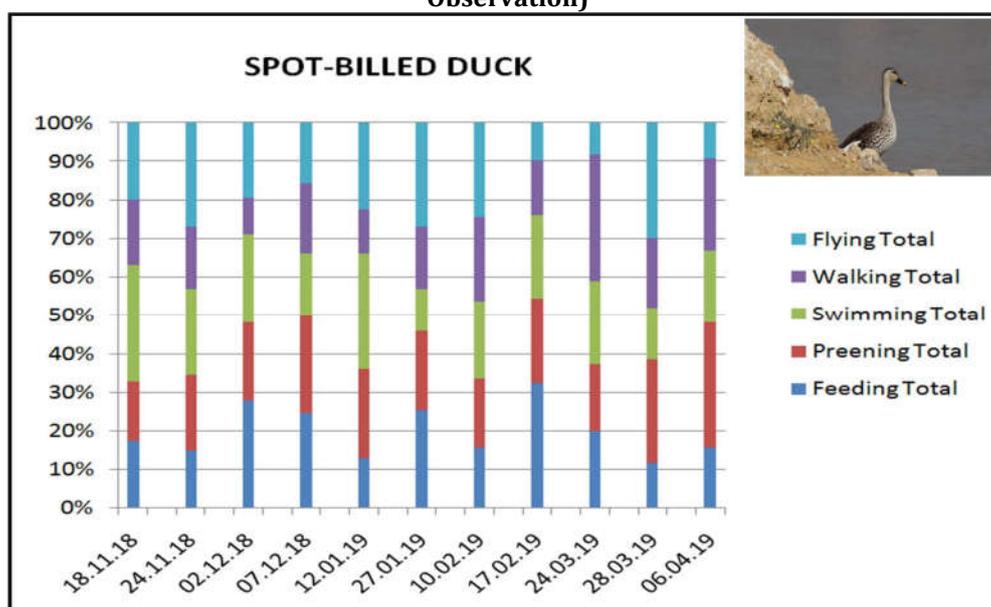
The possible clarification for Bar-Headed goose's time budgeting is as it is also a migratory species to Foy Sagar Lake (Rajasthan) region and available during winters (for longer period in comparison to Ruddy-Shel Duck) at the study site. Hence, it used its maximum time to get energy (feeding) for its migratory activities. The movements are also based on energy conservation (walking-18.48% or swimming-22.35%) in comparison to flying (10.46%) as it requires more energy.

Table 3: Time Budgeting by Bar-Headed Goose at Foy Sagar Lake

Bar-Headed Geese (Time in %) 4hrs.duration								
Activity	Feeding	Preening	Swimming	Walking	Flying	STDEVA	AVERAGE	ERROR
Date								
18.11.18	66.25%	4.58%	12.92%	13.75%	2.50%	0.2632604	20.00%	3
24.11.18	32.92%	0.83%	38.33%	24.58%	3.34%	0.170943	20.00%	3
02.12.18	35.00%	4.58%	20.83%	14.16%	25.42%	0.1147619	20.00%	3
07.12.18	45.83%	2.08%	20.83%	14.58%	16.66%	0.160421	20.00%	3
12.01.19	34.58%	2.92%	13.75%	18.75%	30%	0.1269992	20.00%	3
27.01.19	50.83%	6.25%	20.83%	22.08%	0.00%	0.1965057	20.00%	3
10.02.19	30.42%	12.08%	42.08%	12.08%	3.34%	0.1580437	20.00%	3
17.02.19	49.58%	10.00%	19.58%	17.50%	3.34%	0.1774213	20.00%	3
24.03.19	38.75%	8.33%	33.34%	10.00%	9.58%	0.1478414	20.00%	3
28.03.19	72.08%	5.00%	6.25%	14.58%	2.08%	0.2948332	20.00%	3
06.04.19	21.66%	1.25%	17.08%	41.25%	18.75%	0.1428244	20.00%	3
AVERAGE	43.45%	5.26%	22.35%	18.48%	10.46%	100.00%		
STDEVA	0.146635	0.036285	0.1109068	0.086832	0.105284			
ERROR	3	3	3	3	3			

Indian Spot Billed duck's time budgeting at Foy Sagar Lake was observed to be completely different in comparison to both the migratory species: Ruddy-Shel Duck and Bar-Headed goose. Indian Spot-Billed Duck spent its time (during observation time period) on preening activity (22.01%), swimming activities (20.76%), feeding activities (20%), flying (19.13%) and walking activities (18.18%) subsequently on an average daily basis.

Fig 4: Daily Time Budget of Indian Spot-Billed Duck in Percentage (For Total 4 Hours of Observation)



The possible clarification could be that the Indian Spot-Billed Duck is resident species at study site and is found here throughout the year showing a nearly stable population trend. Hence, there is no clear cut demarcation under its time budgeting activities.

Table 4: Time Budgeting by Indian Spot-Billed Duck at Foy Sagar Lake
Spot-Billed Duck (Time in %) 4hrs.duration

Activity	Feeding	Preening	Swimming	Walking	Flying	STDEVA	AVERAGE	ERROR
Date								
18.11.18	17.50%	15.42%	30.42%	17.08%	19.58%	0.0601	20.00%	3
24.11.18	15.00%	19.58%	22.50%	16.25%	26.66%	0.0474	20.00%	3
02.12.18	27.92%	20.42%	22.92%	9.58%	19.17%	0.0672	20.00%	3
07.12.18	24.58%	25.42%	16.25%	18.33%	15.42%	0.047	20.00%	3
12.01.19	12.92%	23.33%	30.00%	11.66%	22.08%	0.0767	20.00%	3
27.01.19	25.42%	20.83%	10.83%	16.25%	26.66%	0.0657	20.00%	3
10.02.19	15.83%	17.92%	20.00%	22.08%	24.17%	0.0329	20.00%	3
17.02.19	32.50%	22.08%	21.66%	14.17%	9.58%	0.0874	20.00%	3
24.03.19	20.00%	17.50%	21.66%	32.50%	8.33%	0.0868	20.00%	3
28.03.19	11.66%	27.08%	13.33%	18.33%	29.58%	0.0804	20.00%	3
06.04.19	15.83%	32.50%	18.75%	23.75%	9.17%	0.0876	20.00%	3
AVERAGES	20%	22.01%	20.76%	18.18%	19.13%	100%		
STDEVA	0.067	0.0438	0.0515	6.2548	0.076			
ERROR	3	3	3	3	3			

CONCLUSION

The overall conclusion is that the migratory species were involved maximum in feeding activities as they had to again migrate back to their residential places (breeding grounds) (Palaeartic regions) and for that energy storage is must. On the other hand, Foy Sagar Lake is situated at outskirts to Ajmer city hence birds are more comfortable in walking and swimming in comparison to flying. In terms of preening activities Ruddy-Shel Duck spend more time preening itself in comparison to Bar-Headed Goose as they visit the study area in large flocks.

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CITE THIS ARTICLE

C Sharma, R Bhardwaj, V Sharma and P Mathur. Time Budget Pattern of Three Antidae Family Members (Ruddy Shelduck, Bar-Headed Goose And Indian Spot Billed Duck) from Foy Sagar Wetland Ajmer, Rajasthan . Res. J. Chem. Env. Sci. Vol 7 [3] June2019. 59-66