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Non-breeding Ethology of Spot-billed Pelican (*Pelecanus philippensis*) at Adyar Eco-Park, Chennai, India

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ABSTRACT

Spot-billed Pelican is a Near Threatened species according to IUCN red list. There are very limited studies regarding the non-breeding behavior of the Spot-billed Pelican, where behavioural study is very important to understand the species and ecosystem to which they belong. Studying ethology is an important stepping stone for the conservation of the species and its ecosystem. With this aspect an ethological study was carried out at Adyar Eco-park Chennai during the non-breeding season of Spot-billed Pelican for a period of thirteen days continuously. An Ad libitum study was adapted to document their behaviour. The observation was conducted over a period of 7 different time schedules. From the observation 14 individual behaviours and 4 conspecific and group behaviours were recorded. The four most time consuming activities are Alert (193.13 min, 31.15%), Preening (92.36 min, 14.89%), Resting (81.13 min, 13.09%) and Looking around (71 min, 11.45%). The mean population density in the study area showed a declining trend from dawn to noon (2.04-0.55 individuals per 100 sq. m.) and increasing from noon to evening (0.55-3.81 individuals per 100 sq. m.). During the observation it was found that this area is a non-breeding roosting site for the bird and they show some typical pattern as the day progresses. The present study can be helpful to build a comprehensive conservation programme for the Spot-billed Pelican and management plan for Adyar Eco-park can be developed if carried out for a longer period of time.

Keywords: *conservation, ethology, non-breeding behaviour*

INTRODUCTION

Pelicans are colonial birds and prefer to live in groups by forming heronries. They build their nests just before breeding and during non-breeding season they rest in flocks of small population in some roosting sites [1, 2]. Out of the 8 species of pelicans found all over the world, the Spot-billed (*Pelecanus philippensis*) and the Pink-backed Pelican (*P. rufescens*) are the tree nesting species, all the other 6 species are ground nesters [2, 3]. Among the 8 species, 3 are found in India and out of which 2 breed here. These are the Spot-billed Pelican (SBP) and the Great White Pelican (*P. onocrotalus*) [4, 5]. The former one is the near threatened (NT) according to IUCN red list [6]. In India it comes under schedule IV of wildlife protection act, 1972 which require an obvious change due to its current declining trend of population [3, 7, 8, 9].

Historically, Spot-billed Pelican was distributed throughout South-east Asia and has been reported from China, Pakistan, India, Nepal, Bangladesh, Sri Lanka, Myanmar, Vietnam, Laos, Thailand, Malaysia, Hong Kong and Taiwan [10, 11, 12]. Now the only known breeding populations are confined to India, Sri Lanka and Cambodia and probably breeding in small numbers in Sumatra, Indonesia. But probably no longer they breed in Myanmar, which had some earlier records [7, 13]. In India two major populations have been recorded from two distinctly different regions, one is in the Assam valley and the other one is in Southern India distributed over Karnataka, Andhra Pradesh and Tamil Nadu. [7, 11, 14, 15, 16].

This recent scenario of the species has shown rapid declination all over South-east Asia. Total population of SBP estimated in India and globally is 6000-7000 and 13,000-18,000 respectively, roughly equivalent to 8,700-12,000 mature individual [7, 11]. The key threats are a combination of human disturbance at breeding

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colonies and wetlands, extensive felling of nesting trees, the impact of invasive plants on its wetland habitat, hunting and poaching of adults and destruction of eggs and chicks. Additional threats include the loss of important feeding-sites through siltation, agricultural intensification, aquaculture development, building of power stations, drainage and conversion of wetlands, decline in wetland productivity as a result of pesticide use, and over-exploitation of fisheries [11, 17, 18].

Ethology is the science of studying animal behaviour. It actually helps us to understand the activity of different faunal group in a simpler way with an evolutionary perspective [19]. To develop and implement proper conservation measures of this near threatened bird, it is hugely required to understand their individual and conspecific behaviours and interactions with surrounding ecosystem. Lack of comprehensive behaviour study of the Spot-billed Pelican over its' range of distribution is prime reason for its inadequate conservation practice. There are few studies in this region about its behaviour during pre-breeding and breeding season by Gokula in 2011 [3]. The study of non-breeding behaviour is also important as they are residential bird of peninsular India. Hence this study was initiated to get an idea about the non-breeding behaviour of SBP found in the Adyar Eco-park area of Chennai.

MATERIALS AND METHODS

The study was conducted in an island situated just beside Adyar Eco-park (13°01'13"N, 80°15'57"E), located at the midst of highly populated area of Chennai city. It is a protected place surrounded by estuarine back water region under Dept. of Environment and Forest, Govt. of Tamilnadu. Surface Area of this Island is 220 sq m. This park is located within the global distribution territory of SBP [7, 11]. The island is covered with number of mangrove species like *Avicennia* sp., *Acanthus ilicifolius* and *Rizhophora* sp. with dense canopy. Modal height of the trees are roughly 5 m.

Behavioural study is the foundation for any concern focal species to get a better idea on the ecological significance as well as to develop the appropriate conservation strategies for them [3]. For any behavioural study, developing an ethogram is the preliminary approach. Here in this work we concentrated to document the behaviour performed by the Spot-billed Pelican, by preparing an ethogram and to understand and identify patterns in the behaviour of the focal species.

The reconnaissance survey was done and the island area was thoroughly scanned to identify the roosting site of the Spot-billed Pelican. An adlibitum observation method was adapted to study the behaviour of the said bird [20]. The study was conducted between 31/07/13 to 12/08/13 over a period of 13 days continuously. Total 620 minutes of field observation was done from a vintage point (distance: 250 m from the island) using a pair of binocular (resolution: 10 x 25) without disturbing the birds and each behavioural movement was recorded meticulously with time duration. Data was collected over a period of 7 different time schedules i.e., dawn (6:00-8:00), early morning, (8:00-10:00) late morning (10:00-12:00), noon (12:00-14:00), afternoon (14:00-16:00), dusk (16:00-18:00), evening (18:00-20:00) starting from 06:00 hrs in the morning to 20:00 hrs in the evening. Night sampling was not done due to poor availability of light after 20:00 hrs. Their presence was regularly confirmed inside the island at night.

RESULTS AND DISCUSSION

Ethogram

Total 18 different behaviours were recorded during the study and an ethogram was prepared. Out of which few are individual behaviours (14) and others are conspecific and group behaviour (4). Ethogram of SBP is described below:

I. Individual behaviour:

i) Alert: Motionless conditions for long time with the neck tauten, mainly in standing position and sometimes while sitting. It includes very slow movement, such that the bird seems immobile, in between they lower down the neck slowly, rub the bill through the feathers and again return to the erect mode. At this mode the birds are rigid at a place. They stare at a particular direction at a time for long and then change its focus to either side afterwards. The radial vision is mostly horizontal (sideways look) and little vertical (upwards and downwards look). It seems as if it is sensing the surrounding or rather being cautious or waiting for something to happen. The birds spent a huge amount of time in this mode (Fig 1a).

ii) Resting: The SBPs sleep in a typical way. The long neck folded like a stack of pipe, on the shoulder. The head is twisted back and tucked inside the feathers while some preferred to rest it normally over the folded neck. Eyes are closed. Mainly they rest while sitting whereas some do the same in standing posture. It includes opening of eyes in between the nap, checking for any disturbances and then again back to sleep. After alert, this is the most time consuming activity (Fig

1e).

iii) Bill gaping: A stand still position with the bills slight open at least for 5 minutes at a stretch under the sun. It may be attributed to the tendency to increase the rate of evaporative cooling. It is mostly observed at morning (before flying) and noon (Fig 1b).

iv) Looking around: It is exhibited both in sitting and standing postures. It involves rotation of head in different directions with a pause while watching the surrounding. It is far different from alert mode which re-

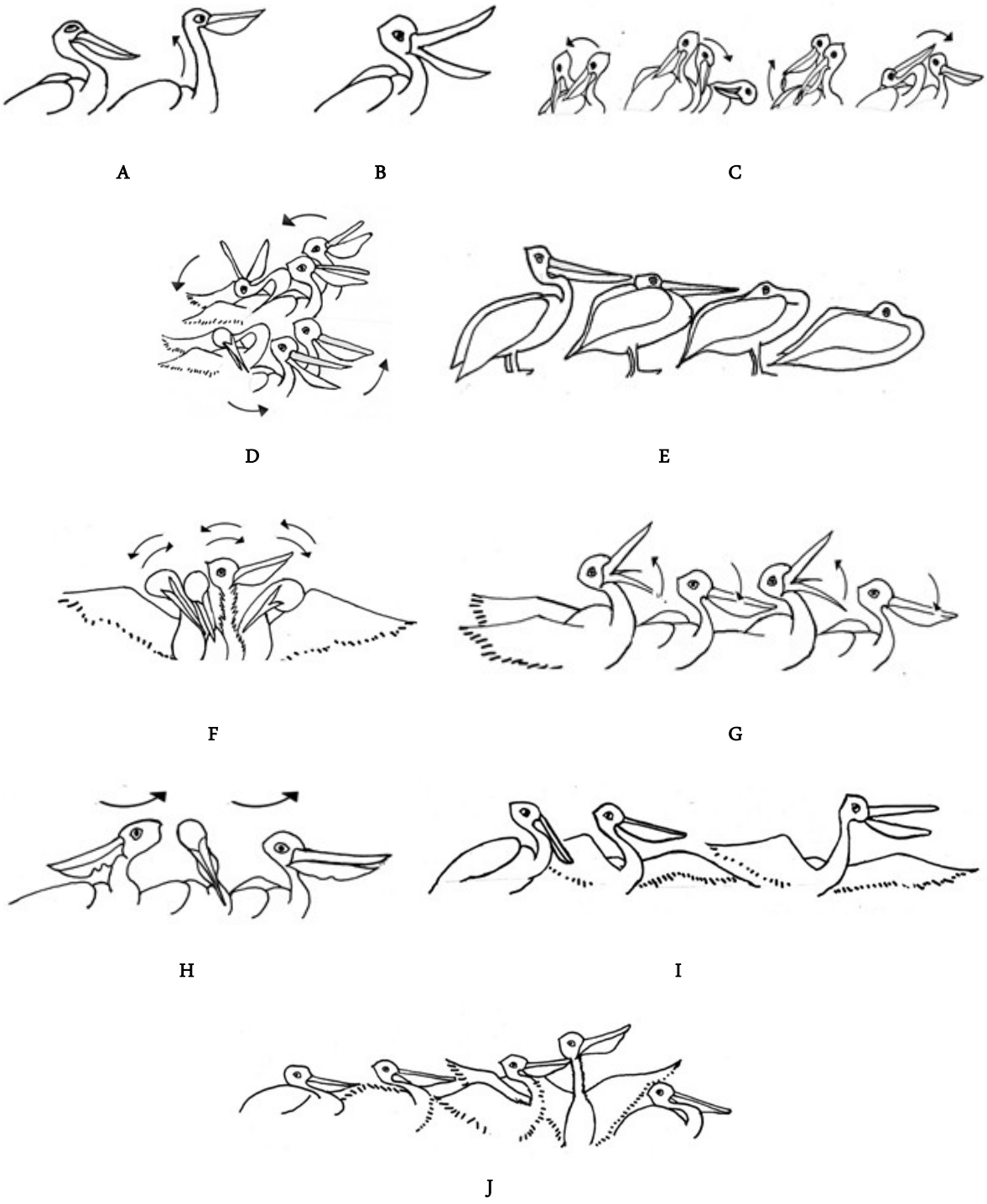

Figure 1. Depiction of different behaviour of SBP: **A.** Alert (From resting to alert), **B.** Bill gaping, **C.** Preening, **D**. Yawning, **E.** Resting (From alert to resting), **F.** Head Swaying, **G.** Bill Clapping, **H**. Pouch Shaking, **I.** Stretching, **J.** Body fluffing.

sembles an immobile phase i.e. movements are not distinguishable.

v) Preening: After landing to the respective places the SBPs devote most of their time in cleaning themselves. They did it in varied ways; one is simply rubbing the head all over the plumage, secondly as if combing the feathers with the bill and another involves supple biting at a particular area like neck, tail, legs or wings. Sometimes the cleaning is continuous while sometimes with breaks involving looking around and alert. It is a common habit for the birds to clean themselves when they return at their roost after foraging (Fig 1c).

vi) Yawning: After landing and settling into the specified places, the birds display some activities prior to sleeping, like stretching of wings and Yawning. It involves swiveling of head in 360^0 with narrow opening of the bill initially. The bill widens maximum when the head touches the back. It is followed by a sudden body shaking. The act is brief and rapid. Sometimes it is repeated twice or thrice with pauses in between. After wards, they slowly push back themselves into sitting position thereby entering the resting phase (Fig 1d).

vii) Head swaying: This behaviour is exhibited instantaneously. They behave strangely as if rebelling against something or exerting its dominance. The wings are flattened accompanied with sudden jolts. The neck is fully extended involving rapid swinging of head up and down and also sideways. It occurs for a brief duration (Fig 1f).

viii) Body fluffing: The birds cuddle in a typical way with erect feathers while drizzling. The neck is folded inside the feathers in such a way that it is barely visible. Only the bill is prominent. The overall body shape is oval. This swollen condition is exhibited in

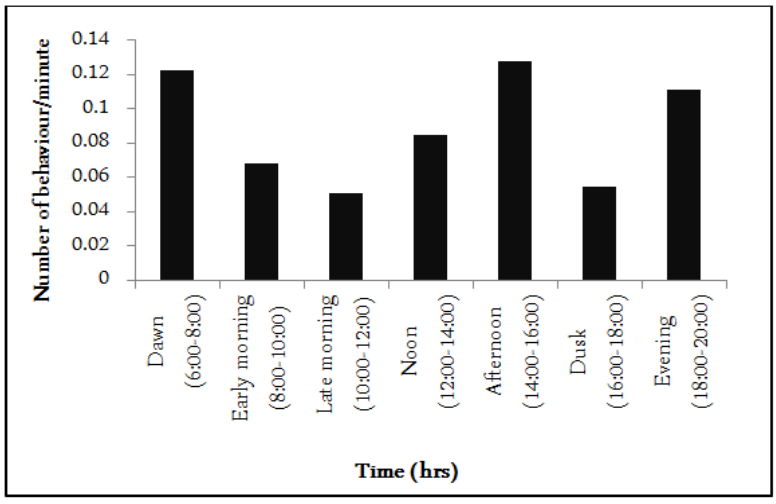

Figure 2. Total number of behaviour per minute in different time period

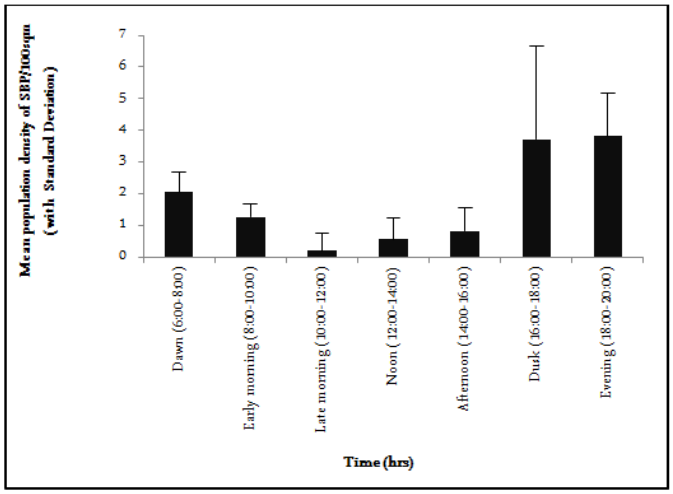

Figure 3. Number of individual Spot-billed Pelicans per unit area in different time intervals

both standing and sitting postures. In the former position, slowly they raise their head from the feathers, look around for once as if inspecting, followed by slight body jerk to shed the droplets over the plumage and again slowly back to the folded condition. Whereas the sitting ones pay least attention to the surrounding being motionless at their respective places with the neck tucked inside. Only thing concluded from this behaviour is to keep the body warmed up and protect against the cold weather.

The same behaviour is displayed at other times but with a different meaning. Unlike protection it is more like setting body fit or may be aggression. The neck is fully extended vertically and the feathers are so erect that they point out separately. This occurs quite rapidly followed by a brief head swiveling which transfers a wave of vibrations all over the body (starting from neck, body and then tail). The wings open and close shortly (Fig 1j).

ix) Pouch shaking: The neck is normally held upright in a standing posture. Slow rotation of the head with simultaneous wobbling of the pouch. It continues for a good amount of time with pause in between (Fig 1h).

x) Swimming: This act as refreshment for the SBPs after daylong activities. It involves pacing up and down through the water. It continues for a long time. Some land directly from the sky whereas some after taking little rest on the tree and then diving straightway into the water. They were observed to swim singly. In between they plunge their head along with the neck under water for a quick bath. The body is partially immersed.

xi) Running on water: Swimming is followed by running on water. To get into the flight mode without the help of the wind they flap their wings strongly with a splash followed by full stretching of the neck in forward direction with the feet pounding on water. It covers a few meters over water before being completely airborne.

xii) Flapping: After landing on the tree top, the SBPs flap their wings lightly while sitting in order to get them dried up after swimming. Other than this, simply sitting and flapping is also observed.

xiii) Stretching: When the SBPs perch on the canopy, a series of activities like; looking around, preening, resting, etc. continues. The resting phase is prolonged and followed by Stretching in order to prepare itself for the rest of the day. It includes stretching of the wings apart along with the neck. Unlike the one described in case of body fluffing, here the neck is not extended vertically but diagonally or with some angle with the horizontal axis. The feathers are not erect. These are the features which distinguish stretching with that of body fluffing (Fig 1i).

xiv) Sun bathing: This behaviour is characterized by simply stretching the wings wide, exposing the body under the Sun while sitting. It continues for long with simultaneous looking around and preening. After swimming they do this in order to dry their body because while flapping the wings are mainly concentrated for drying. Those who were not swimming were found to do the same. This is another way to warm up other than body fluffing.

II. Conspecific and Group behaviour:

i) Fight: The fights are of low intensity. It usually starts within few minutes after landing. It involves locking up each other's neck by winding and then jabbing with the bills against each other. In the play the wings are involuntarily stretched apart. It lasts for few minutes and ends up quite smoothly. Then both the

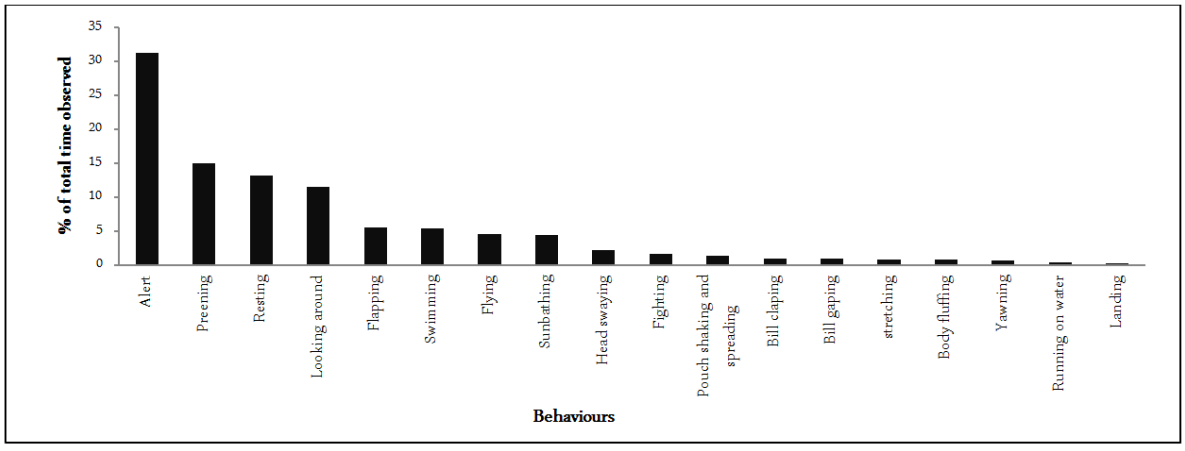

Figure 4. Percentage (%) of total time observed for different behavioural activities

rivals maintain a constant distance and after some time one of them flies away in few cases.

ii) Bill clapping: A sudden outbreak in between a peaceful assemblage, when one of the members raises its neck high with the bill partly vertical and jolts its head with a rapid Bill clapping, in order to intensifying its presence among others or challenging its rival. Generally the dispute remains constrained within two to three members whereas the entire play remains unnoticed for others (Fig 1g).

iii) Flying: At first one takes the initiative to fly off and starts encircling the island. After some time one by one couples with the flock still rounding the area. They ascend gradually with each round. Finally soaring high in the sky they all leave for their respective destinations. The formation is irregular, but one always leads the team. While flying they hold their head back on the shoulder, resting the bill on the folded neck.

iv) Landing: The descending is similar as that of the ascending. Flying straight at first and then encircling the area with larger radius, which shortens gradually with every 2-3 round. Finally landing on respective places on foot. It can be considered as if they try to recognise a proper place or the small area where they settle, before landing. It is followed by vigorous jolting of the wings; to grip the balance. Unlike take off, the birds usually land singly or one after the other at some interval.

A typical behaviour was observed. When the birds return to the study area after foraging in evening, they used to aggregate at a particular site and later on disperse to different points within the study area.

Behavioural Patterns

The association of behaviours observed were analysed against different time frame viz. frequency of behaviours with time and in different time period over the day.

Fig 2 shows frequency of behaviour displayed per unit time. The maximum number of activities per minute was recorded at afternoon whereas the minimum was at late morning.

Fig 4 reveals that they devoted most of their time in four categories, these are alert (193.13 minute,

Table 1. Percentage (%) of total time observed for different behavioural activities in different time period

Behaviour	Duration of observation (%)						
	Dawn (6:00-8:00)	Early morning (8:00-10:00)	Late morning (10:00-12:00)	Noon (12:00-14:00)	Afternoon (14:00-16:00)	Dusk (16:00-18:00)	Evening (18:00-20:00)
Alert	0	9.194	3.145	2.532	1.452	11.763	3.065
Preening	0	2.155	0	3.710	1.613	4.194	3.226
Resting	2.419	2.763	0	1.935	3.226	2.742	0
Looking around	0	0.968	0	0	2.742	5.000	2.742
Flapping	3.226	0	0	0	0	1.935	0.323
Swimming	0	0	0	0	0.645	4.677	0
Flying	0.161	2.258	0	0	0	1.613	0.445
Sunbathing	0.806	0	0	0	0	3.226	0.323
Head swaying	0	0.645	0	0	1.452	0	0
Fighting	0	0	0	0	0	1.613	0
Pouch shaking	0	0	0	1.290	0	0	0
Bill clapping	0	0	0	0	0	0.968	0
Bill gaping	0	0.645	0	0	0	0.323	0
Stretching	0.484	0	0	0	0.323	0	0
Body fluffing	0.806	0	0	0	0	0	0
Yawning	0	0.215	0	0	0.323	0.053	0.026
Landing	0	0	0	0.048	0.161	0	0
Running on water	0	0	0	0	0.161	0.242	0

31.15%), looking around (71 minute, 11.45%), resting (81.13 minute, 13.09%) and preening (92.36 minute, 14.89%). This implies, the birds are very cautious regarding the surrounding and are beware of any sudden attack, hurdles, etc. As the study was conducted just before the breeding period (around late October) (Ali et al. 2007) of SBP little courtship behaviours were documented in low frequency and none of the breeding behaviour were observed. Among the courtship behaviours only bill clapping (6 minute, 0.96%) and head swaying (13minute, 2.1%) were recorded (Gokula 2011).

Table 1 suggests an idea about the time spent for different behaviour at different time period of the day. Time spent on each activity over the total observation time period is calculated at percentage scale. The duration of alert and resting modes are found to be decreasing upto afternoon and showing its maximum value at dusk. At late morning, since the population of the birds is minimum (i.e. 1) or zero, so only one activity (alert) is exhibited. Preening being maximum at dusk and minimum at early morning denotes the birds spend their leisure time by cleaning themselves. Pouch shaking is exhibited only at noon. Sun bathing and body fluffing are highest at dusk and dawn respectively. As the birds swim maximum during dusk that is why sun bathing is exhibited sufficiently in this time interval. Duration for stretching is highest at dawn; this is also because of prolonged resting. Whereas at afternoon, durations of landing as well as yawning are found to be highest. Bill clapping and fighting are found only at dusk. The highest numbers of activities observed are at dawn, afternoon and evening (Fig 2).

The Fig 3 reflects that the number of birds gradually drops towards zero from dawn to noon and then from afternoon onwards it increases again. After coming back from foraging in afternoon they spend the night at the study site.

CONCLUSIONS

The study revealed that this is definitely a roosting site for the Spot-billed Pelican. To reconfirm this incident the study site was revisited in October 2013 (from 3rd October onwards) and no bird was spotted. This affirmed the above mentioned fact more strongly. The ethogram helped to prepare a repertoire of different behaviour exhibited by SBP along with the detail of each behaviours and their intra-specific interactions. It also gives an idea how the SBP are using this area as their roosting site.

Fig 2 shows a typical pattern of behavioural activities as the day progress. Table 1 and Fig 4 both reflect the time budget of SBP with respect to different behaviour and in different observation time schedule. The study also reveals that the Spot-billed Pelican generally goes for foraging during the noon leaving their roosting site (Fig 3). This study can give an idea about the behavioural aspect of SBP at Adyar Eco-Park and how they are adapted to the system. It can help to develop a comprehensive conservation model for the restoration of the habitat of the entire Adyar Eco-Park so that the SBPs can thrive long in the park.

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