

## Diurnal time-activity budgets of Spot-billed Pelican *Pelecanus philippensis* in Karaivetti Lake, Tamil Nadu, India.

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### Abstract

The time-activity budgets of Spot-billed Pelican, *Pelecanus philippensis*, were determined from September 2008 to January 2009 in Karaivetti Lake, Tamil Nadu, India. As the sexes of Spot-billed Pelican were distinguishable during breeding season, behavioural data were collected during the peak breeding months-November, December and January. Time-activity budgets were based on 432 hours of behavioural observations made on 4540 focal individuals. The day was divided into three different time periods viz morning (0600–1000 h), midday (>1000–1400 h) and afternoon (>1400–1800 h). Data were collected on the basis of the time-budgets devoted for five states of behaviours namely comfort, breeding, resting, flying and foraging. The results exhibited a clear diurnal pattern of behaviour of Spot-billed Pelican despite some adult females forage even during night hours. Time of the day had a significant effect on behaviour, with the majority of adult male and female pelicans allocated the midday hours largely for flying (soaring) and the afternoon hours for preening. It is likely that the breeding behaviour of Spot-billed Pelican largely differs with the sexes in their time-allotment to perform various behaviours during the breeding season.

**Keywords:** comfort, breeding, resting, flying, foraging, birds

### INTRODUCTION

Spot-billed Pelican, *Pelecanus philippensis*, (referred henceforth as SP), is under near threatened category among the eight species of pelicans in the world and also listed under the Schedule IV of the Indian Wildlife (Protection) Act, 1972. It is found only in South and southeast Asia over a range of territory between 129,000 and 181,000 km<sup>2</sup> with a stronghold in India, Sri Lanka, southern Cambodia and coastal areas of Sumatra. In India, it is presently distributed in southern and north-eastern India with a stronghold in the states of Andhra Pradesh, Tamil Nadu, Karnataka and Assam (Birdlife International, 2001, 2011). Except few studies on the distributional status (Manakadan and Kannan, 2005; Gokula, 2011a), breeding biology (Nagulu, 1983; Gokula, 2011b), ethogram (Gokula 2011c) and nocturnal foraging behaviour (Gokula 2011d) of SP, no specific attempt has been made to understand its behavioural pattern. However, among the eight species of pelicans, a few attempts have already been made to understand the behaviour of the American White Pelican, *P. erythrorhynchos* (King and Werner, 2001; Werner, 2004), the American Brown Pelican, *P. occidentalis* (Croll *et al.*, 1986), the African Great White Pelican, *P. onocrotalus* (Guillet and Crowe, 1983), the Australian Pelican, *P. conspicillatus* (Robert, 2012; Lindsey, 1986; Reid, 2009) and the African Pink-backed Pelican, *P. rufescens* (Burke and Brown, 1970). The present article deals with the studies on the time-activity budgets of Spot-billed Pelican carried out from September 2008 to January 2009 in Karaivetti Lake, Tamil Nadu, India.

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### MATERIALS AND METHODS

#### Study area

The study was carried out in Karaivetti Lake, situated between 10° 58' 01" N and 79° 11' 07" E, covering an area of about 4.54km<sup>2</sup> in the district of Ariyalur, Tamil Nadu, India. The freshwater lake is fed by Pullambadi and Kattalai canals. The lake was established as Karaivetti Bird Sanctuary in 1989 by the Forest Department of Tamil Nadu, India. Recently, the lake has also been identified as one of the Important Bird Areas (IBA code: IN-TN-13) in India by Indian Bird Conservation Network (Islam and Rahmani 2004). The natural and planted vegetation present inside and the edges of the lake consist of *Acacia nilotica*, *Prosopis chilensis*, *Azadirachta indica* and *Tamarindus indica*. Gokula (2013) reported that the lake harbours a total of 149 species of birds (waterbirds, wetland dependant birds and terrestrial birds). Majority of the breeding species of waterbirds use the above mentioned plant species for nesting largely during November to April. People participatory approach as a strategy towards conservation of the birds has already been initiated by Forest Department of Tamil Nadu has already

The behaviour of the adult male and female of the SP alone were studied during the peak breeding months (November, December and January) when sexes were prominently not alike (sexes become alike as the breeding advances). The male SP develops a bright yellow skin around its pinkish red eyes. The breeding adults are brilliantly white with darker grey primaries. Both sexes develop a grey and white mixed crest during the initial period of breeding, which gradually is shed as the breeding advances. The bill of both sexes becomes

brilliant yellow and with noticeable dark brownish spots during the breeding season (Gokula, 2011b).

Direct observations were made using both descriptive (*ad libitum*) sampling to gain familiarity with the type of behaviours to expect in order to develop an ethogram of the behaviours and instantaneous scan sampling to record the behavioural data (Altmann, 1974). Observations were made from elevated areas throughout the daylight period. Occasionally, observations were also made during moonlit night hours (not presented in the present study). Observation began with the random selection of focal individual. The focal bird of a given sex was identified by selecting a random number (1-20) and counting the number of individuals of the same sex from the left to the right edge of the observation area (i.e., field of view including all birds for which sex and activity could be reliably determined). Once selected, the focal individual was observed for 5 minutes during which instantaneous behaviour was recorded at 15 seconds intervals (20 observations per focal bird) following the method of Weins et al. (1970) and Hohman and Rave (1990). After 5 minutes, another bird was chosen by selecting the fifth bird of the same sex to the right of the previous focal bird. If fewer than five birds were present in that field of view, then the first individual of the same sex in the next field of view to the right was chosen. When the entire observation area had been scanned, observations were resumed with the random selection of a bird as described above. The day was divided into three different time periods (sessions): morning (0600–1000h), midday (>1000–1400h) and evening (>1400–1800h) for analyses. Observations were made ~250m from the birds, from the northern side of the wetland, using binoculars, spotting scope and camcorder (Sony) depending on the need.  $\chi^2$ -tests were made to analyze the behavioural data using SPSS software.

## RESULTS

Time-activity budgets were based on 432 hours of behavioural observation made on 4540 focal individuals. Totally, 25 discrete behavioural groups under nine major categories for SP (see Gokula, 2011c for behavioural types and their descriptions) were identified and for the present study only five behavioural categories were used: resting, comfort, breeding, flying, and foraging behaviours. Resting – SP remains motionless with its eyes closed either in a position of sitting or standing on the ground/water/nest; comfort – behaviour associated with maintaining the body surface by stretching, scratching, preening, body fluffing, dust bathing, and bill gaping; breeding - behaviour includes courtship, nest building, incubation, and feeding the young; flying - SP in flight; and foraging - considered when SP both swims and forages in water. As the occurrence of other 20 behavioural categories

was less frequent and with short timescale, they were clump (for the purpose of statistical analysis) with closely related and frequently occurring major behaviours such as stretching, scratching, preening, body fluffing, bill gaping, and pouch shaking and spreading are clumped with comfort behaviour; individual and communal foraging are clumped with foraging; and courtship, copulation, nest building, incubation, nest relief, feeding the young, begging behaviours are clumped with breeding behaviour.

Among the five behaviours, both sexes spent more time on foraging and flying while less time on comfort behaviour during the entire study period (Fig. 2). Although both sexes showed an increasing trend in time allotment for the breeding behaviour from the month of November to January, it was very prominent in the case of female SP. Although male and female SP showed no significant differences in the time spent on various activities in the month of November, they differed significantly in the months of December ( $\chi^2_{0.00,4} = 27.071$ ) and January ( $\chi^2_{0.00,4} = 23.524$ ).

The SP regardless of sex spent more time on foraging during midday and afternoon hours and flying during the midday hours (Figure 3). The proportion of time spent on performing different behaviours was significantly influenced by the various sessions of the day (morning, midday and afternoon) in all the three study months particularly in the case of male SP (November:  $\chi^2_{0.00,8} = 32.514$ , December:  $\chi^2_{0.01,8} = 18.435$ , January:  $\chi^2_{0.02,8} = 10.488$ ). However, female showed significant difference only in the month of November ( $\chi^2_{0.00,8} = 76.582$ ) but not in December and January.

Session-wise (morning, midday and afternoon) time spent on various activities was significantly differed between sex at least in afternoon hours (November:  $\chi^2_{0.00,4} = 16.189$ , December:  $\chi^2_{0.00,4} = 13.818$ , January:  $\chi^2_{0.00,4} = 20.072$ ). In November and December, sex differed even in midday (November:  $\chi^2_{0.05,4} = 9.724$ , December:  $\chi^2_{0.02,4} = 11.546$ ). Among the activities, both male and female SP showed significant session-wise and moth-wise difference in time allotment for breeding activity ( $\sigma^7$ :  $\chi^2_{0.01,4} = 12.648$ ,  $\phi$ :  $\chi^2_{0.00,4} = 26.877$ ). All other activities were given more or less similar time allotment by both male and female SP in all the sessions and months.

## DISCUSSION

SP colony mostly arrives at the Karaivetti Lake in late November every year while a very few arrive in late December. The colony consists of both non-breeding (not mature enough to breed) and breeding SP. After a few days from their arrival, the adult pelicans perform their breeding activities. During the above said period, both the sexes of the adult SP shared the breeding activities viz. nest building, incubating and raising the

Figure 1. Map showing the study area

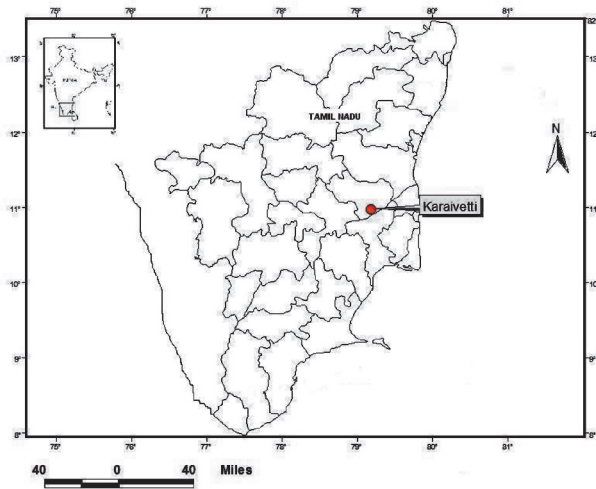


Figure 2. Time-activity budgets of adult male and female Spot-billed Pelican *Pelecanus philippensis* during various months at Karaivetti Lake, Tamilnadu, India.

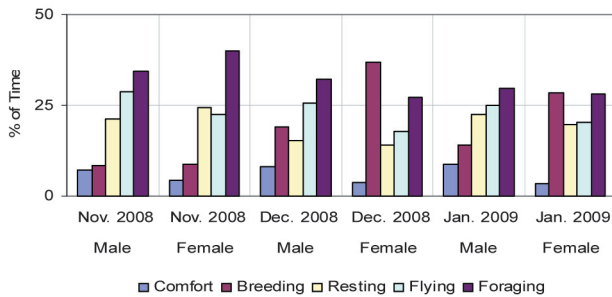
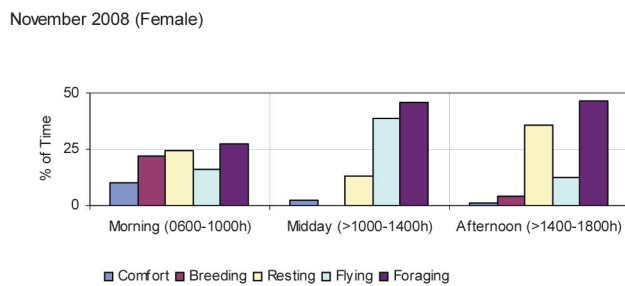
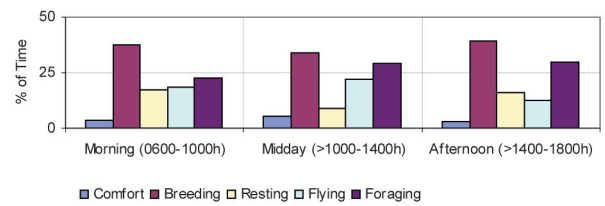


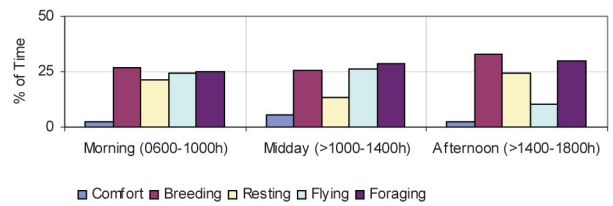
Figure 3. Time-activity budgets of adult male and female Spot-billed Pelican *Pelecanus philippensis* during various hours of the day at Karaivetti Lake, Tamilnadu, India.



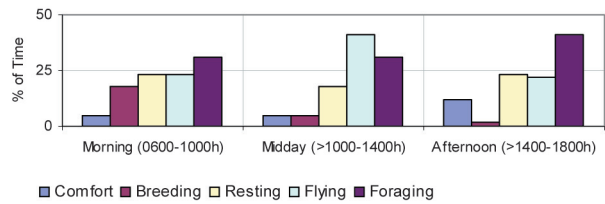
December 2008 (Female)



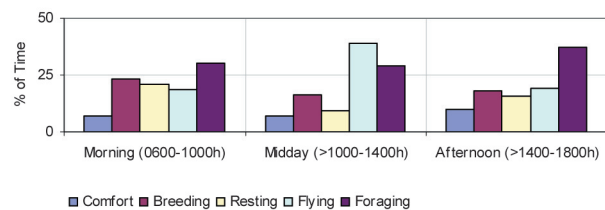
January 2009 (Female)



November 2008 (Male)



December 2008 (Male)



January 2009 (Male)



nestlings (Gokula, 2011b). It was also observed that the female birds had been predominantly involved in all the activities. Among the various activities such as comfort, foraging, flying, breeding and resting behaviour, both the sexes spent more time in performing foraging during the entire study. However, female gradually allotted more time for breeding behaviours viz., incubating the eggs and raising the nestlings as breeding season advances. Although breeding activities are shared by both the sexes, female outweighed male. In particular, share of male in breeding activities declines once incubation is completed. Hence, male and female SP showed distinct difference in time allotment to various behaviours during the months of December and January. Biparental care can improve (1) incubation efficiency, (2) nest and brood survival, and (3) mate condition to the extent it is important for reproductive success (Oring, 1982). Besides, shared incubation enables the nest to be covered almost all the time and reduces the traffic to and from the nest that could often make the nest more detectable to predators.

In general, time activity budgets of both the sexes of SP largely differed due to the influence of breeding behaviour if not, no significant variation would be apparent in behaviours and time allotment between sexes. Moreover, characteristics that determine the time allotment to various activities viz., foods, foraging mode, disturbance levels and physical features of a habitat were uniform to both the sexes of SP in the study area. The greater opportunities of nesting and foraging for SP in Karaivetti Lake explains further the less movement of SP from breeding to foraging.

The elongated bill and large gular pouch of pelicans are adapted for capturing the prey in aquatic environments (Del Hoyo *et al.*, 1992; Johnsgard, 1993). The SP is primarily fish-eating bird that forages on rivers, lakes and other aquatic habitats. Unlike many avian piscivores, the SP forages only from the water surface, and birds in foraging groups frequently coordinate their movements on the water in order to concentrate and capture fish. In addition, pelicans may be more efficient in capturing fishes in the low-gradient, slow-moving waters or lentic habitats than in the swifter, more-turbulent waters like lotic habitats. The SP preys preferentially in the morning and at the end of the afternoon, generally near the breeding or resting grounds through both communal (in large and small groups of mono and poly-specific) and solitary mode. The common fishing behaviour is to swim in an upright position suddenly plunging its head into the water to catch fish. In communal foraging with Little Cormorants *Phalacrocorax niger*, fish swimming upto the surface caused by the diving (foraging) cormorants are caught by the SP. Disturbed school of fish at the bottom by the diving cormorants scatter, swim upto the surface in all directions and become prey to communal SP.

The SP exhibited a clear diurnal pattern of behaviours. Almost all activities occurred during the daylight hours, very little during twilight hours and come to a close once the SP roosted. Certain behaviours are pendent on time of day, and more foraging and flying activity in the daylight hours rather than the late afternoon may indicate a dependence on daylight for vision and prey capture, as suggested by Croll *et al.* (1986). Gokula (2011d) reported that foraging of SP decreased as the night progressed and nocturnal foraging may be a compensatory strategy at least for breeding adults. The proportion of time spent on foraging can be correlated to the available food resources. Foraging time may therefore be a good indicator of the quality of the breeding grounds, and may predict the reproductive success of individuals at the time when energy demands are high (Guillet and Furness, 1985; Ferguson *et al.*, 2011). Flying mostly occurs during the hottest hours of the day as thermal formations that facilitate soaring (O'Malley and Evans, 1982; Pyrovetsi, 1989) and the SP also has the habit of flying during hottest hours.

The present study demonstrates distinct temporal variation in behaviour of the SP, but generalizations must be made with caution because of the limitations presented with the study of only one colony over a brief period of time. Moreover, short-term studies can oversimplify or mask significant patterns. Further study on the behaviour of SP in response to time of day would be required from a number of sites over a longer period of time to conclude such issues occur in response to seasonal changes, fluctuations in food supply, weather and breeding cycles.

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