International Journal of Geography and Geology
2012 Vol. 1 No. 1, pp. 1-9
ISSN(e): 2305-7041
ISSN(p): 2306-9872
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EMERGENCE AND RETURNING ACTIVITY IN THE INDIAN FLYING FOX, PTEROPUS GIGANTEUS (CHIROPTERA: PTEROPODIDAE)

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ABSTRACT

Approach: After a diurnal resting in the roost, bats adapts some behavioural pattern to get themselves active towards foraging there by involving in various activities. Their activity pattern differs from time to time depending on the change in climatic factors. But the behavioural activities they involved varies from time to time. Observation was done on the emergence and returning gate i. e the emergence or returning of first to last bat, pre emergence behaviour and post return behaviour, and influence of moonlight on foraging activity.

Key Words: Post return activity, Emergence gate, Behaviour, Pre-emergence behaviour.

INTRODUCTION

Most of the megachiropteran's found in the sub tropics roost in tents, in manmade structures like old houses and temples and in foliages or hollows in trees, mainly to evade from the climatic factors, which affect them. Indian flying fox, *Pteropus giganteus* roosts in open foliages of trees, a peculiar character of this genus. Papers dealing with behavioural aspects of *P. giganteus* are scarce. Apart from Neuweiler (1969), other works on behavioural aspects focused on copulatory behaviour (Koilraj *et al*., 2001), roost preference (Acharya, 1936), mating (Bhatt, 1942), local migration (Breadow, 1931; Nelson, 1965a) and general ecology and biology (Brosset, 1962). Bats roosting in closed environments involved in various behavioural activities during their emergence (Kunz, 1982) like light sampling, flying inside its roost etc. In some bats a particular intensity of light was needed for the bats to start their emergence from diurnal roost for foraging, as demonstrated by Aschoff (1969) and Erkert (1974). There is an alternation and variation in the foraging activity of bats according to various moon phases.

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Gopukumar *et al*., studied (1998) the effect of moonlight on the foraging behaviour of *Cynopterus sphinx*. Emergence gate, the emergence of first bat to the last bats in a colony shows a variation with return to change in own place. Similarly the returning gates of bats also vary with sunrise (Racey, 1979). *Pteropus giganteus* is a species roosting in an open environment, hence it is very important to study the behavioural changes during the emergence and returning pattern. The present study focused on the pre-emergence and post-return behaviour of *P. giganteus*, and assessed the effect of sunlight, light intensity and lunar phase on their emergence and returning activity.

METHODOLOGY

This study was conducted in Srivaikundam, Tamilnadu, South India during the period of October 2009 to September 2010. In this study we monitored a colony consisting of about 16,000 Pteropus giganteus (on September 2010), roosting in 29 emergent trees (Terminalia arjuna). The emergence and returning activity was studied on different moon phase's viz., new moon, last quarter, full moon and first quarter regularly throughout the study period. Behaviour delineator was studied as described by Burnets and Augusts (1981) and Winchell and Kunz (1993). The pre-emergence activity, one hour before the emergence of first bat, was estimated by observing the various behaviours of bats at every fifteen minutes interval. The returning and post return behaviours were monitored for ninety minutes (using ten-minute intervals) after the bats have returned to roosts. The emergence pattern of Pteropus giganteus was estimated by evening dispersal counts (EDC) (Racey, 1979 and Powell and Wehnelt, 2003), four observers standing at four directions to count the number of bats emerging at various directions for every minute from the emergence of the first bat. Temperature and humidity in the roost site was measured using thermo-hygrometer (Barigo, made in Germany), and the light intensity was measured using lux meter (Lutron LX- 101 – Lux meter). The behavioural observations were done using binocular (Super Zenith, 12 x 50, Field5 0).

RESULTS

Pre Emergence Behaviour

During the pre emergence period, the bats were involved in various behavioural activities. The rate of time spent in each activity was, fighting (13.67%), flying (30.48%), calling (25.72%), wing flapping (<2%) and auto grooming (27.11%), wing flapping was found to be absent in course of emergence time and other behaviours were found to be increased at a greater rate with reference to the emergence time (figure 1). The movement of bats from tree to tree and from branches to branches was found to be high, calling was found to be more (70 to 90%) and auto grooming was at a greater rate (80 to 90%). The bats were found to fly to a distance of 1km and then returned to their roosting tree often before emergence. During the post partum periods, the adult female bats

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with their young volant pups were found to fly from their day-roosting tree to another tree, which is having high clusters of leaves and leave their pups as groups and they emerge for foraging activity. A Volant stage pup group of around 15 to 25 was observed.

Emergence Activity

The study of the emergence behaviour of P. giganteus reveals that the colony's mean emergence time of first bat was 18: 25 hrs (n = 52). A positive correlation exhibits between the emergence of the first bat and the light intensity period ($r = 0.978635$; $df = 49$; $P < .01$). The emergence of the first bat occurs mostly after a light intensity (lux), less than one was recorded. A positive correlation was also observed between the emergence of the first bat and sun set time. The emergence of first bat mostly occurred after 10 to 20 minutes after sun set and a positive correlation exhibits between the emergence of the first bat and the sun set time ($y = 0.0102x + 0.0102$;$R2 = 0.853$; $P < .01$).

The bats emerged in various directions in various seasons and months (figure 2). Even though bats were found to move in all directions, the rate of dispersion was high towards one or two directions and not towards the other direction in the same proportion.

The study on emergence pattern of Pteropus giganteus with relation to different moon phases reveals that, the emergence gate in the colony during the new moon was 22.3 ± 5.44 minutes (mean ± SD, n = 10). In the second quarter of the moon phase, the emergence gate of bats from the colony occurs at a mean period of 26.1 ± 6.42 minutes (mean ± SD, n = 10).

During the full moon phase the emergence gate was found to be 28.89 ± 7.37 (mean ± SD, n = 9). In the last quarter of the moon phase, the emergence gate was found to be 22.44 ± 4.83 minutes (mean ± SD, n = 9).

The above all excludes the emergence of post-partum adult female bats with volant to weaning staged pups. The mean emergence gate of these adult female bats was 55.3 ± 30.26 minutes (mean ± SD, n = 12) (Figure 3).

Returning Activity

The mean returning time of first bat to its roost was at around 4:30 hrs and the returning time may stretched to a period of 1:30 hrs after the returning of first bat. During the post partum period, the adult post-partum female bats return to their roost at around 2:30 hrs in the morning (figure 4). In the month of September, when the population of the bats was high, the bats returned to their roost until 6:10 hrs in the morning, where a lux of 023 x 101 was recorded. Returning of bats to its roost mostly occurred before the sunrise time and in some days a delay in returning

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was noticed mainly during the short day periods and also when the population size of the colony was maximum.

Post-Return Behaviour

In the post return activity the bats, which returned to the roost, were found to involve in various behavioural activities. The post-return activity mostly comprised with calling (43.07%), autogrooming (42.19%), flying (3.86%), crawling (6.67%), and fighting (4.19%). This period includes the most heterogeneous behavioural activities in the roost. The bats return to the roosting site in tree throughout the day. In the morning, fighting occurred more frequently among those individuals occupying sites in close proximity. The bats were found to defend its territories from the intrusion of other bats and they had an inter-roosting distance in between themselves.

DISCUSSION

Pteropus giganteus was found to involve in various activities on its pre emergence period and an increase and decrease in some behavioural activities were found towards its emergence time. Winchell and Kunz (1996) noticed a similar pattern on the behaviour of Pipistrellus subfvalus. Even though P.giganteus found to roost in an open foliage roost it had a peculiar light sampling behaviour there by a few bats flying around and returning to the roost. Calling was found to be more at the time of pre emergence and post return activity might be a process of communication and territory defending behaviour. Bats produce a wide variety of signals within a range of their vocal repertoire (Hill and Smith 1986). These vocalizations generally facilitate social interaction such as territorial spacing among individuals, mother infant communication and recognition and warning. This observation has been well observed in Megaderma lyra by Marimuthu and Neuweiler (1987), and Neuweiler et al., (1984). Some bats are known to exhibit rapid vocal communication prior to emergence (O'shea and Vaughan, 1977)

The emergence of P.giganteus mostly occurs at 10 to 20 minutes after sun set. Jacobsen and Duplessis (1976) reported that in Africa the time of emergence of Rousettus aegyptiacus usually 20 to 40 minutes after sunset and may be mainly to avoid dehydration. Eisentraut (1952) and Gaisler (1963) said that, the subtropical bats leave the roost relatively at the same time in relation to sunset throughout the year. P.giganteus leaves its volant young ones in trees as groups, as identified in Australian Pteropus species. As in other chiropterans the returning of the bats to the roost mostly occurs before sunrise, a slighter delay was observed in some days. Erkert (1982) had reported that sunset time is the major factor determining the time of emergence .Gopukumar et al., (1998) reported the influence of moon phase in the emergence period of C.sphinx, and a similar pattern of delay in mean emergence during the full moon than the new moon phase was observed.

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According to Thomas and Fenton (1978), Pteropodid that live in large colonies forage in groups. P.giganteus was found to emerge in various directions in various seasons and months, and the rate of dispersion was high in one direction or in two directions and this led to forage in groups in trees with high fruiting. Australian Pteropus species are probably known to forage in groups on Eucalyptus flowers (Nelson 1965 b). Studies by several authors led to the conclusion, that in microchiropterans the factors like weather and quantity of insects may regularly influence flight time and flight duration but convincing evidence is lacking (Lunde and Harestad, 1986) and in our studies also the variation in returning period may be mainly due to the availability of food sources. A greater difference in the evening gate of P. giganteus was observed during the lactation periods, and may be due to maternal – infant relationship encountered after parturition (Kunz, 1973 and Gould, 1971).

ACKNOWLEDGEMENT

Financial assistance given to Dr. M. R. Sudhakaran from UGC is greatly acknowledged

REFERENCES

Acharya, H. G. (1936). Roosts of flying fox. J. Bombay Nat. Hist. Soc. Vol.38, No.4, pp.812-813

Aschoff, J. (1969). Phasenlage def Tagesperiodik in Abhangigkeit Von Jahreszeitand Breitengrad, Oceologia (Berlin). Vol.3, pp.125-165.

Bhatt, J. R. (1942). On the mating of flying fox (Pteropus giganteus). J. Bombay Nat. Hist. Soc. Vol.43, No.3, pp.514-516

Breadow, G. (1931). Local migration of the flying fox (Pteropus giganteus) in Punjab. J. Bombay Nat. Hist. Soc. Vol.35, No.1, misc. notes on 1.

Brosset, A. (1962). The bats of central and western India. Pt. 1. J. Bombay Nat. Hist. Soc. Vol.59, pp. 1 – 57.

Burnett, C. D and P. V. August. (1981). Time and energy budgets for day roosting in a maternity colony of Myotis lucifugus. J. Mammal. Vol.62. pp.758-766.

Eisentraut, M. (1952). Becobachtungen uber Jagdroute and Fluuubeginn bei Fledermausen. Boon.Zool.Beitr. Vol.3 pp.211-220.

Erkert, H. G.,1974. DerEinfluss des Mondlichtes auf die Aktivitatsperiodik nachtaktiver saugetiere. Oceologia. Vol.14, pp.269- 287

Erkert, H.G.(1982). Ecological aspects of bat activity rhythms. In: Ecology of bats, Ed. T.H.kunz, New York Plenum Press. Pp. 201 – 242.

Gaisler, J. (1963). Nocturnal activity in the lesser horse-shoe bat, Rhinolophus hipposiderous (Beschstein, 1800). Zool. Listy. Vol.12, pp.223-230

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Gopukumar Nair, N. V. Elangovan and R. Subburaj. (1998). Influence of moonlight on the foraging behaviour of the Indian short-nosed fruit bat Cynopterus sphinx: Radio telemetry studies. Curr. Sci. Vol. 74. N0. 8, pp.688-689.

Gould, E. (1971). Studies on maternal-infant communication and development of vocalizations in the bats Myotis and Eptesicus. Comm. Behav. Biol. (Part A) Vol.5, pp.263-313

Hill, J. E. and J. D. Smith. (1986). Bats: A Natural History. British Museum (Natural History). London.

Jacobsen, N. H. G and E. Duplessis.(1976). Observations on the ecology and biology of the cape fruit bat Rousettus aegyptiacus Leachi in the Eastern Tansvall. S. Afr. J. Sci. Vol.72, pp.270-273

Koilraj, B. J., G. Agoramoorthy, and G. Marimuthu.(2001). Copulatory Behaviour of Indian Flying Fox Pteropus giganteus. Curr. Sci. Vol.80, No.1, pp.15-16

Kunz, T. H.(1973). Population studies of the cave bat (Myotis velifer): Reproduction, growth and development. Mus. Nat. Hist. Univ. Kans. Vol.15, pp.1-43

Lunde, R. E. and Harestad. (1986). Activity of little Brown bat in coastal forests. Northwest Science. Vol.60, pp.206 – 209.

Marimuthu, G and G. Neuweiler. (1987). The use of acoustical cues for prey detection by the Indian False Vampire Bat, Megaderma lyra. J. Comp. Physiol. A. Vol.160, pp.509-515.

Mc cann, C.(1941). Further observations on the flying fox (Pteropus giganteus Brunn). J.Bombay Nat. Hist.Soc. Vol.42, pp.587-592

Nelson, J. E. (1965a). Behaviour of Australian Pteropodidae (Megachiroptera). Anim. Behav., Vol.8, pp.544-557.

Nelson, J. E. (1965b). Movements of the Australian foxes. (Pteropodidae, Megachiroptera). Aust. J. Zool. Vol.13, pp.53-73.

Neuweiler, V. G., Saatpal Singh, and K. Sripathi. (1984). Audiograms of a South Indian bat community. J. Comp. Physio. A. Vol.154, pp.133 – 142.

Neuweiler, V.G.(1969). Verhaltensbeobachtungen an einer indischen Flughundkolonie (Pteropus giganteus Brunn). Z. Tierpsychol. Vol.26, pp.166-199

O'shea, T. J., and T. A. Vaughan. (1977). Nocturnal and seasonal activities of the pallid bat Antrozous pallidus. J. Mammal. Vol.58, pp.269-284.

Powell, P. V. and S. C. Wehnelt. (2003). A new estimate of the population size of the critically endangered Rodrigues Fruit bat, Pteropus rodricensis. Oryx, Vol.37, No.3, pp.353-357

Racey, P. A. (1979). Two bat species of the Seychelles. Oryx, Vol.15, pp.148-152.

Thomas, D. W. and M. B. Fenton. (1978). Notes on the dry season roosting and foraging behaviour of Epomophorous gambianus and Rousettus aegyptiacus (Chiroptera:Pteropodidae) J. Zool. (London). Vol.186, pp.403-406

Winchell, J. M. and T. H. Kunz.(1993). Sampling protocols for estimating time budgets of roosting bats. Can. J. Zool. Vol.71, pp.2244 - 2249

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Winchell, J. M. And T. H.Kunz.(1996). Day-roosting activity budgets of the eastern pipistrelle bat, Pipistrellus subfvalus (Chiroptera:Vespertilionidae) Can. J. Zool. Vol.74, pp.431-441

Figure 1. Pre-emergence activity of *P. giganteus*

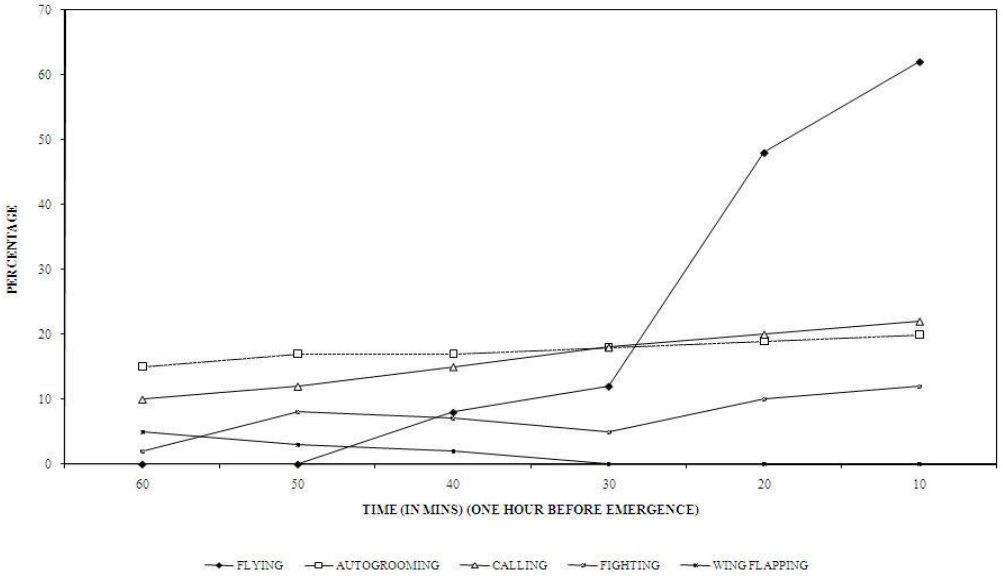

Figure 1a. Post rerurn activity of *P. giganteus*

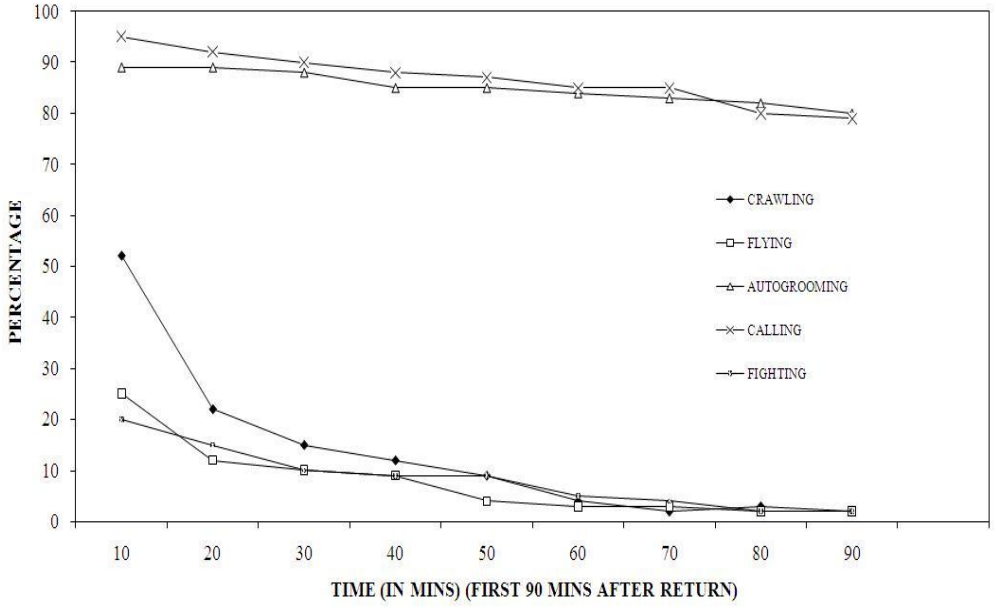

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Figure 2. Month wise emergence direction of *P. giganteus*

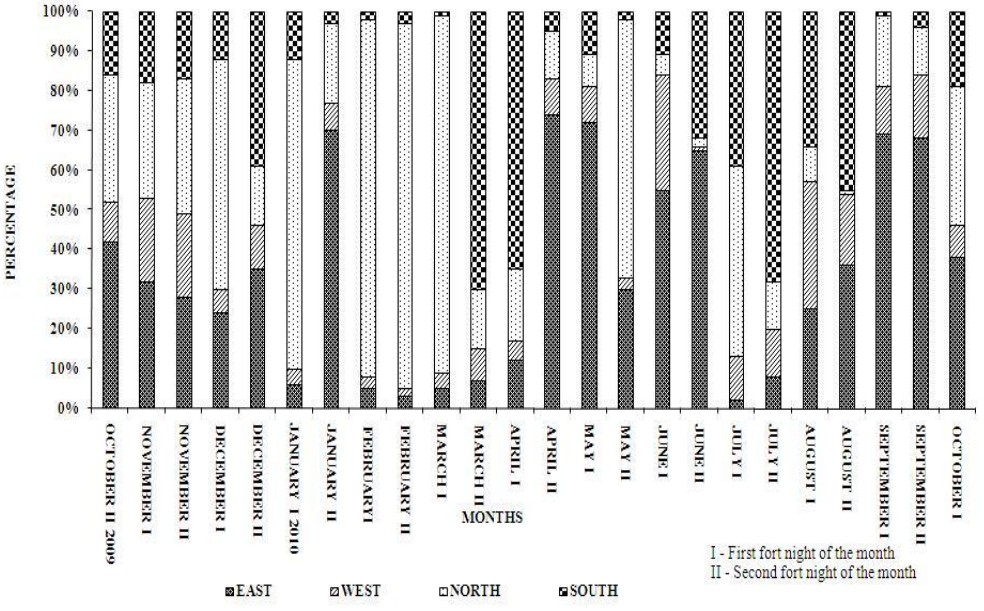

Figure 3. Emergence pattern of *P. giganteus*

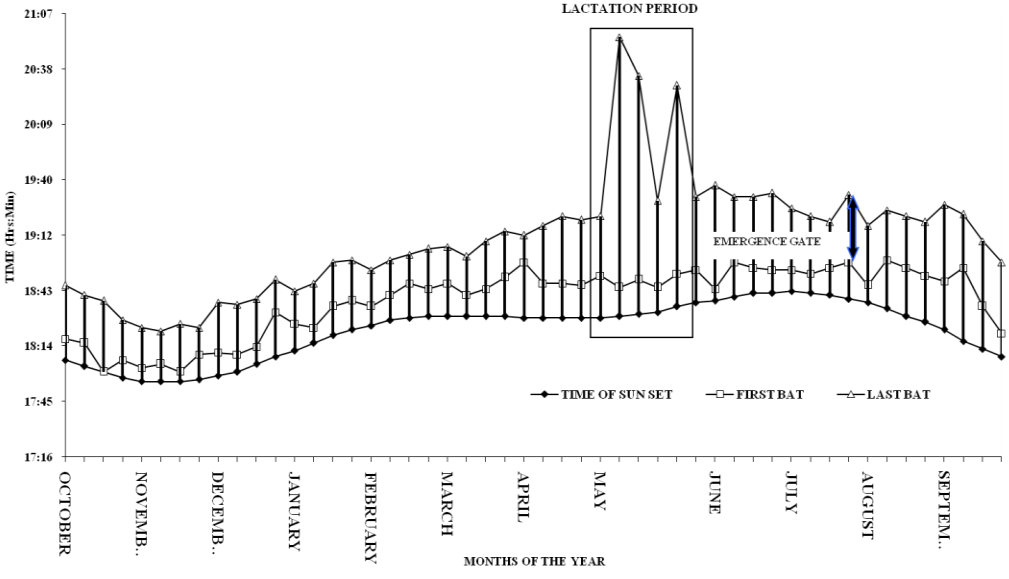

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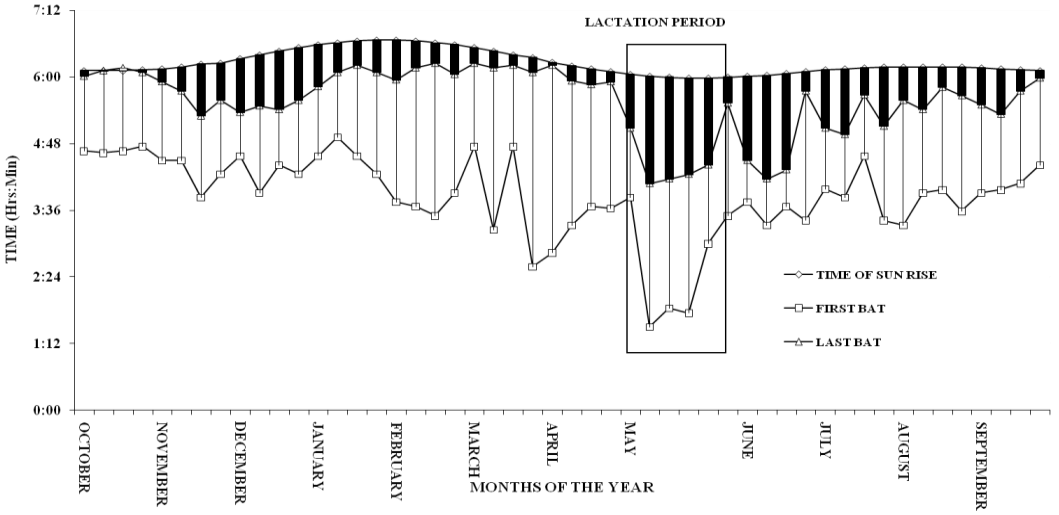
Figure 4. Returning Pattern of *P. giganteus*



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