BREEDING ACTIVITIES OF THE PIG-TAILED MACAQUE (*MACACA LEONINA*) IN BANGLADESH

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Abstract

Breeding activities of Pig-tailed Macaques (*Macaca leonina*) were studied from May 1996 to September 1997 in the West Bhanugach Forest Reserve of Bangladesh. This species is not a seasonal breeder and breeding activities and births were recorded throughout the year. Swelling of the sexual skin is most important signal of female receptivity in this species. Both copulatory and non-copulatory mounts were observed. Most copulation were single mount (66.3%) and some were multi-mount. Overall, 62% adult females of the study area gave birth during this period.

Keywords

Bangaldesh, Birth, copulation, Macaca leonina, *mating, Pig-tailed Macaque*

Introduction

It is not easy to gain adequate understanding of a social species' ecology and evolution without a detailed knowledge of its sexual contacts under more or less natural conditions (Kaufmann, 1965). Macaques are widely distributed, ranging from tropical to cool temperate zones (Fleagle, 1988). Their behaviour and social structure might be related to differences in their habitats (Mah, 1980; Shiveley *et al.*, 1982; Thierry, 1985; Caldecott, 1986) and mating seasonality is related to the environment (van Schaik & van Noordwijk, 1985; Lindburg, 1987). At the onset of breeding several changes are observed in females of which swelling of the sexual skin is most important. In some species swelling is observed synchronously in all adult females of the group (seasonal breeder) while swelling is observed asynchronously among the adult females (*Macaca leonina*) of the group in some species ie., adult females of the group become receptive in different times of the year (year round breeder; Oi, 1996). Since female receptivity plays an important role in determining the number of males in the group (Trivers,1972; Bernstein & Wade, 1983; Ridley, 1986; Oi, 1996) study of the breeding activities are prerequisite for understanding the social organisation of a species.

The sexual behaviour and mating system of Pig-tailed Macaques (*Macaca nemestrina nemestrina*) of Indo-malayan region have been studied under laboratory conditions (e.g. Kuehn *et al.*, 1965; Tokuda *et al.*, 1968) and briefly in the wild based on fragmentary observations (Bernstein, 1967; Caldecott, 1986) while detailed in natural forest at the provisioning site in Sumatra (Oi, 1991, 1996). No information is available on the breeding activities of other subspecies of Pig-tailed Macaque (*Macaca leonina*) in mainland Asia. Breeding activities of this subspecies have been analysed here and hence a comparison can be made with the other subspecies of pig-tailed macaque (*Macaca nemestrina nemestrina*) as well as with other species of macaques.

Methods

Study area: The study was conducted in the West Bhanugach Forest Reserve (24^{0}32' N and 91^{0}47' E; altitude 22m), situated 7km east of Srimangal Upazila headquarter, in the north-east of Bangladesh. The total area is 2,738ha (6,760acres). This forest is not very markedly evergreen, but the majority of the small trees are evergreen and most of the tall trees are deciduous (Ahsan, 1994; Feeroz, 1999). According to MacKinnon (1997), West Bhanugach Forest Reserve is tropical wet semi-evergreen type. Temperature varies from 4.9^0 to 35.5^{0}C and monthly rainfall varies from 0 to 573mm. During this study period four seasons were recognized, *viz*., winter (December to February), pre-monsoon (March to May), monsoon (June to September) and post monsoon (October-November).

Data collection: Behavioural data were collected by scan sampling methods (Altmann, 1974), using 15-min intervals. An interval of 15 minutes ensures that each scan is usually independent from the previous one, an essential requirement to

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satisfy conditions for statistical analysis. Data on sexual behaviour of the study species was derived from (1) a group studied for 17 months between May 1996 and September 1997 in the West Bhanugach Forest Reserve; and (2) four other groups studied occasionally (1 day/group /month) in the same site. Quantitative data on duration, intervals and frequencies of mounting were collected through *ad libitum* notes. Because of the occurrence of sexual and non-sexual mounting in macaques, and the ambiguity between them, the term mounting rather than mating is used and interactions related to mounting have been termed sexual interactions as used in other studies (Oi, 1996). All copulatory mounts were separately recorded from non-copulatory ones. Ejaculation was not seen during copulation, so the number of mounts in a complete series was recorded until the male left the female. If the adult male fed or left the female between mounts, copulation was recorded as a different mounting. Swelling was recorded as either full swelling or beginning of swelling. Thrusts/mounts were also recorded wherever possible.

Results and Discussion

Female sexual activities

No distinct season was recorded for sexual activities. Females with sexual swellings were observed throughout the study period and were not concentrated in any particular month; at least one adult female was fully swollen in each month. Initially, the skin around the anus turned red and then it became swollen, but swelling extending to the tail base was not observed, as noted by Oi (1996). Frequency distribution of females with full swelling are shown in Figure 1 on the basis of observation of five groups in the main study site. There is no significant differences between the number of swollen females observed in different months ($c^2 = 9.37$, df =15, $P > 0.05$), but in one year, the number of swollen females observed in different seasons varied significantly ($c^2 = 9.05$, df = 3, $p < 0.05$) with a peak in the monsoon (between June and September).

Female sexual maturity varied from species to species. Macaques living in broadleaf evergreen forest tend to have a later age at first reproduction than the macaques living in other habitats (Ross, 1992). All pig-tailed females who appeared to have reached 3.5-4 years of age showed swelling of the sexual skin (Fooden, 1975; Oi, 1996). Thereafter, regular menstrual cycles occur within a period of 25 to 40 days (Eaton, 1973; Hadidian & Bernstin, 1979; Matsumura, 1993; Oi, 1996). Except for *Macaca sinica* and *M. assamensis*, perineal swellings are observed in all macaque species (Fooden, 1980). Strong-smelling vaginal discharge has been observed in *Macaca sinica* and in *Macaca radiata* (Glick, 1980), and "sharp-smelling" secretion in *M. fuscata*.

Like other species of macaques, e.g. *Macaca silenus* (Kumar, 1987), *M. sylvenus* (Taub, 1980, 1982), *M. n. nemestrina* (Caldecott, 1986; Oi, 1996), female sexual activities were mainly observed during the follicular phase of the menstrual cycle, *i.e.* when the imminence of ovulation is revealed by maximum

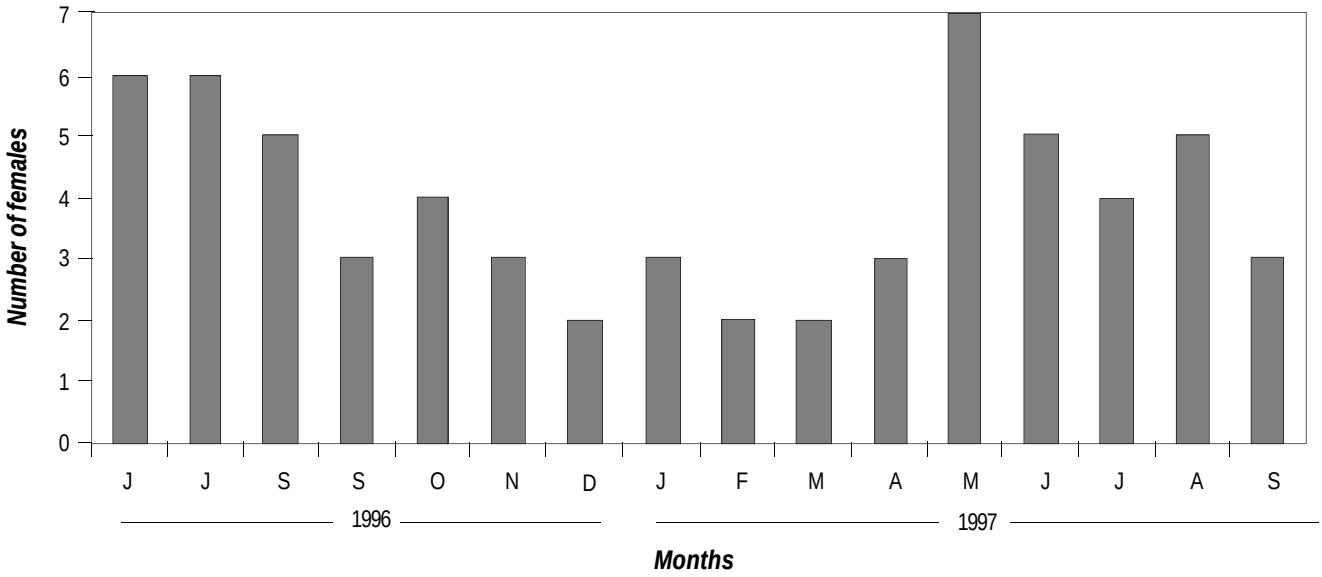

Figure 1. Frequency distribution of fully swollen adult females observed in four groups in the main study site.

Table 1. Frequency distribution of number of mounts in each series of copulation

No. of mounts in a series of copulation	Frequency	% of observations
1	57	66.3
2	11	12.8
3	5	5.8
4	3	3.5
5	4	4.6
6	3	3.5
7	2	2.3
8	1	1.2
Total	86	100

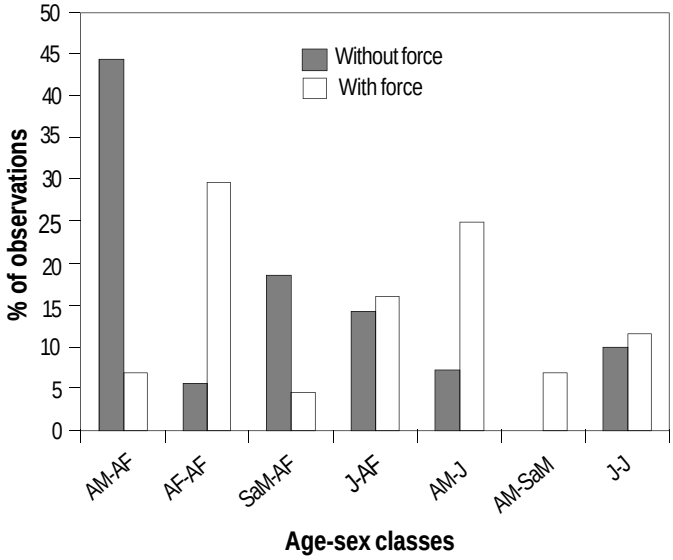

Figure 2. Percentage of observations on non-copulatory mounting by force or without force between different age-sex classes
AM-AF = Adult Male- Adult female; AF-AF = Adult female-Adult female; SaM-AF = Sub-adult male - Adult female; J-AF = Juvenile - Adult female; AM-J = Adult male - Juvenile; AM - SaM = Adult male -Sub-adult male; J-J = Juvenile - Juvenile

perineal tumescence (fully swollen stage). In this study, most of the solicitations by females were observed during swelling when the adult male was frequently groomed by the swollen female, who spent most of her time near adult male and presented her genitalia to him repeatedly.

Copulation

Both copulatory and non-copulatory mountings were observed in pig-tailed macaques of the West Bhanugach Forest Reserve. A single mount was observed during each non-copulatory mount, but copulation was observed in one or a series of mounts. The number of mounts in a complete copulation varied from one to eight (Table 1). A total of 166 copulatory mounts were recorded during 86 copulations. Sixty-six percent of copulations were single mount; most of the multi-mounts (23 cases) were observed when the first or second nearest member was either sub-adult male or juvenile male. Copulation was mainly observed between the adult male and swollen female (84.9%), adult male and non-swollen female (8.1%), adult male and sub-adult female (1.2%), and sub-adult male and swollen female (5.8%). The number of pelvic thrusts varied from eight to 17 in each mount (mean = 11.4, sd ± 3.9, n = 43).

A total of 114 non-copulatory mountings were observed, where both the participants were recognized; 61% of these non-copulatory mountings were mutual and the rest (39%) were performed by force. No non-copulatory mount was observed between the swollen female and other members of the group. Force was applied in the form of biting, scratching and sometimes pressing the monkey down on the branches. Non-copulatory mounts were observed mutually between adult male and adult female in 44.3% cases, while these mounts were not observed between adult male and sub-adult male without force applied by the adult male (Fig. 2). On the other hand, 29.5% female-female non-copulatory mounts involved force and in all these cases the dominant female was observed to apply force to the subordinate. Non-copulatory mounting between sub-adult male and adult female was mutual in 17.3% cases. No observation was recorded where sub-adult or juvenile male mounted the adult female by force and in all these mounts, sub-adult or juveniles were solicited by the adult female. Juvenile-juvenile non-copulatory mounting was observed both by mutual cooperation and by force in 10% and 11.5% of the cases respectively (Fig. 2). Thus, non-copulatory mounting in pig-tailed macaque occurred in the following ways: (1) mutual between adult male and adult female; (2) adult females by force; (3) subordinate males mount high-ranking adult female by soliciting; and (4) young mounting each other both by mutual and force.

Copulatory behaviour varies in different species of macaques. Fooden (1980) classified macaques into four species groups on the basis of their penile structure and suggested that these

Table 2. Newborn infants recorded in five groups of Pig-tailed macaques in the main study site

No of birth	Approximate date of birth	Group identification
1	6.6.96 (±8 days)	Group-3
2	12.7.1996 (±4)	Group -5
3	25.9.1996 (±5)	Group-4
4	8.10.1996 (± 1)	Main study group
5	2.11.1996 (± 8)	Group-2
6	7.11.1996 (±1)	Main study group
7	3.12.1996 (Specific date)	Main study group
8	21.12.1996 (±10)	Group-3
9	5.12.1996 (± 3)	Group-5
10	16.1.1997 (±6)	Main study group
11	28.1.1997 (± 9)	Group-2
12	14.2.1997 (±5)	Group-5
13	8.3.1997 (± 7)	Group-4
14	18.4.1997 (±15)	Group-3
15	12.5.1997 (±5)	Main study group
16	20.6.1997 (±12)	Group-4
17	19.7.1997 (± 14)	Group2
18	9.8.1997 (±2)	Group-5

( ) approximate date of birth within this limit

characteristics are related to mount-ejaculation pattern. Males of some species typically ejaculate at the end of one isolated intromissive mount (single-mount ejaculator) and in some species, males ejaculate during the last series of the mount (multi-mount ejaculator). Fooden's hypothesis was supported by subsequent studies (Shiveley *et al.*, 1982; Caldecott, 1986; Dixson, 1995), but at least two species are now reclassified. *Macaca sylvanus* (Barbary Macaque) previously considered to be a multi-mount ejaculator, was shown to be a single-mount ejaculator (Taub, 1982), and *M. fascicularis* (Long-tailed Macaque) previously considered to be multi-mount ejaculator, was found to perform both types of copulation (Shiveley *et al.*, 1982). In this study, Pig-tailed Macaques performed both single-mount and multi-mount ejaculations, with single mount more frequent. Oi (1996) showed that in Sumatra they performed both single- and multi-mount ejaculations with 83.5% copulation single-mount. Previous laboratory studies suggested that Pig-tailed Macaques are multi-mount ejaculators (Tokuda *et al.*, 1968; Nadler & Rosenblum, 1973). Busse and Estep (1984) suggested that multiple intromissions prior to ejaculation in Pig-tailed Macaques may serve to dislodge copulatory plugs deposited by previous males. Multi-mount ejaculation in the wild Pig-tailed Macaque was reported by Bernstein (1967) and Caldecott (1986), but Bernstein also mentioned that among 113 potentially reproductive mountings, many were in a single copulatory sequence. On the other hand, on only 17 observations, Caldecott concluded that copulation was composed of a series of mounts with an inter-mount interval ranging from 1-20 min. None of his observations were a complete set of mountings, as he stated, because of poor visibility and they are not conclusive, since he could not discern when ejaculation occurred (Oi, 1996).

No infantile copulatory mounting was observed in this study, but it has been reported for various species of macaques (e.g. *Macaca nemestrina*: Zuckerman, 1932; *M. mulatta* : Lindburg, 1971; *M. arctoides* : Trollope & Jones, 1972). Non-copulatory mounting was observed between the juveniles in this study, but no infant was observed to mount any group members. The pattern and function of the non-copulatory mounts relate to the dominance of the participants. Adult males mounted any members of the group with or without force. Low-ranking sub-adult or juvenile males were observed to mount high-ranking adult female by prolonged solicitation, but high-ranking adult females were observed to mount low- ranking female and juvenile by force.

Birth

A total of 16 new-born infants were recorded in five groups of Pig-tailed Macaques at the main study site between June 1996 and June 1997. Another two infants were recorded at other times (July & August 1997; Table 2); there was no specific birth peak. At least one newborn baby was recorded in each month, except in August 1996 and September 1997. Two infants were recorded in November 1996 and January 1997, while three infants were recorded in December 1996. Overall, 62% adult females of the five groups gave birth in the WBFR during the study period. It is very difficult to estimate gestation period in the wild. Since each female copulated several times with the adult male throughout the swollen period, specific dates of conception are very difficult to determine. Only once I was able to recognise the female in the main study group that last copulated on 3 December 1996; swelling was not observed again in that female until she gave birth on 12 May 1997. Thus, the gestation period was about 160 days.

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