

Figure 4. a, Basic search; b, Advance search.

Photographs along with the data are additionally helpful for precise identification of the megaspores.

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ACKNOWLEDGEMENTS. We thank Prof. Sunil Bajpai, Director, Birbal Sahni Institute of Palaeobotany, Lucknow for providing the necessary facilities to carry out this work and the anonymous reviewers for their constructive suggestions.

Received 26 July 2013; revised accepted 11 December 2013

## Observations on reproductive performance of Indian mouse deer (*Moschiola indica*) in captivity

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The study reports some observations on reproductive biology of mouse deer (*Moschiola indica*) maintained under the conservation breeding programme at the

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**Nehru Zoological Park, Hyderabad. The conservation breeding programme was initiated with 6 individuals that bred in captivity reaching a total of 36 individuals within a three-year period. A total of 50 oestrus episodes were recorded from 11 females that resulted in 31 births. Females first gave birth at age of 304 days (mean = 318.6 ± 15.3 days,  $n = 5$ ) and had an average gestation period of 154.1 ± 3.7 days. Females showed post-partum oestrus within 6 h of fawning, which resulted in successful mating. The present observations would help in enhancing knowledge on biology and behaviour of the species that can form the basis for its effective management.**

**Keywords:** Breeding characteristics, captive breeding, mouse deer, post-partum oestrus.

MOUSE deer or the Indian chevrotain (*Moschiola indica*) is an ancient paraphyletic assemblage of primitive deer with a three-chambered stomach, unlike four-chambered in other deer<sup>1,2</sup>. The mouse deer does not belong to the deer family, but is a member of a distinct family Tragulidae. Unlike deer, it lacks antlers though both sexes have canines. It also shares pig-like characters which include the presence of four toes, large hooves, absence of facial scent glands and the oestrus and mating behaviour<sup>3</sup>. Its related species, Javan chevrotain or lesser mouse deer *Tragulus javanicus* and water chevrotain *Hyemoschus aquaticus* are found in Southeast Asia and West Africa respectively. The Indian chevrotain weighs up to 2–4 kg and stands 25–30 cm at shoulder<sup>2</sup>.

Mouse deer is nocturnal and elusive in nature. It plays a major role in the forest ecosystem as seed disperser and forms important prey for many small and large carnivores<sup>4,5</sup>. Though it is commonly found in most of the forested areas, it has been listed in Schedule I of the Wildlife Protection Act (1972). It is found throughout southern India and in some parts of northern India like Mandla, Hoshangabad, Palamau and Udaipur with its relative species in Southeast Asia and West Africa<sup>6</sup>.

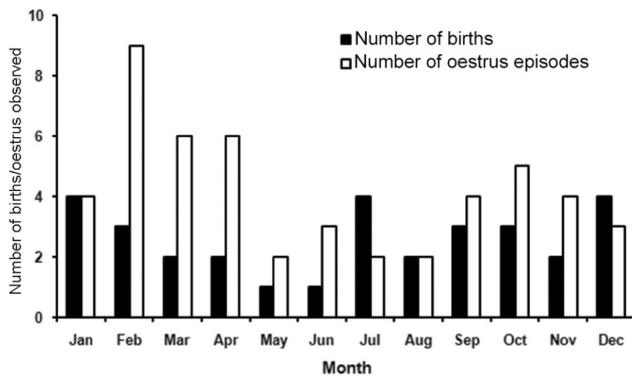
The Indian chevrotain is one of the most frequently hunted animals by local indigenous and settled communities in the Western and Eastern Ghats<sup>7</sup>. Limited information is available on habitat use and distribution<sup>8</sup>, as well as threats<sup>7</sup>. Detailed information on reproductive biology, including age at sexual maturity and oestrus cycle of this species in captivity or wild is altogether lacking, though few reports on reproductive characteristics<sup>9</sup>, semen quality<sup>10</sup> and breeding in captivity<sup>11</sup> are available on its related species, the lesser mouse deer *T. javanicus*.

The Nehru Zoological Park, Hyderabad initiated a conservation breeding programme on mouse deer supported by the Central Zoo Authority, Government of India. For successful breeding, information on reproductive biology is crucial. Hence a study was initiated to understand various reproductive characteristics of Indian chevrotain in captivity at the Nehru Zoological Park.

The breeding programme was initiated in March 2010 with a founder stock of 6 deer (2 males, 4 females), of which 3 were born to a pair brought from the Ahmedabad zoo and three were rescued (one male and two females) from Tirupati forests. An adult male and three adult females were housed in 15 × 8 m enclosure away from the display area. All the enclosures were planted partially with bamboo (*Bambusa vulgaris*), acalypha (*Acalypha indica*), and royal palm (*Roystonea regia*) and the roof of the enclosure partially covered to maintain a natural photoperiod and light. Each animal was fed twice a day with apple (25 g), banana (50 g), carrot (25 g), sweet potato (25 g), soaked black gram and horse gram (25 g), lucerne (*Medicago sativa*; 50 g) and peepal (*Ficus religiosa*; 50 g). These deer had free access to clean water. Oestrus behaviour (flehmen, licking, mounting, presenting, etc.) was observed by *ad libitum* sampling technique<sup>12</sup> using closed-circuit camera between 08.30 and 17.00 h by one of the authors (S.P.). Females in an advanced stage of pregnancy were kept with adult male to facilitate mating following fawning to improve fertility. Body measurements of fawn ( $n = 10$ ; height and weight) were measured at the time of birth and the fawns were removed from parents after 4 months following natural weaning. Data are presented as the mean ± SD. Student's *t*-test was used to estimate differences in the number of births between post-monsoon and other months. Length of gestation was calculated as the number of days between parturition and the last mating day.

A total of 31 births (17 females, 14 males) were observed between March 2010 and February 2013 (Figure 1), though births occurred throughout the year. Most of the births occurred during the post-monsoon season (September–February) than other months ( $P = 0.041$ ) and fewer births was observed during the summer months (May and June). Female mouse deer came to oestrus at an age of 145 days (mean = 162 ± 18.52;  $n = 5$ ) and gestation length ranged from 150 to 163 days (mean = 154 ± 3.7 days;  $n = 13$ ). Age at first fawning was 304 days (mean = 318.6 ± 15.3 days;  $n = 5$ ). The inter-birth interval ranged from 150 to 170 days. The litter size was one, except in a case where a female gave birth to twins. Mean birth weight of fawns was 468.8 ± 63.3 g ( $n = 9$ ) and the average height was 10 ± 3.3 cm (range 9–12 cm;  $n = 9$ ).

Overall 50 oestrus episodes were observed from 11 females, resulting in 24 births. Oestrus was observed during February to April and September to November in 68% of cases (Figure 1) and the duration ranged between 2 and 3 days for the deer which came to oestrus for the first time. Prior to successful copulation, multiple mountings by the male were observed. The successful copulation (coitus) lasted 15–20 min (9 observations). During coitus, the female lay recumbent and was quiet, as when resting, with the male straddling her. The male then grasps the female with his forelegs, while most of his weight rests on his back legs flexed. As copulation



**Figure 1.** The number of oestrus and births observed in mouse deer during the study period (April 2010–February 2013) at captive breeding facility, Nehru Zoological Park, Hyderabad.

proceeded, the female lay quietly, her ears back. From time to time, she turned her head and neck with normal alertness. This observation was similar to that of mating behaviour of camels<sup>13</sup>. After successful copulation, no interaction was noted and the pair parted ways.

All the females showed signs of post-partum oestrus within 4–6 h of fawning until successful copulation occurred. There was an instance where a male was involved in mating successfully with two females that came to post-partum oestrus in a single day. The female mouse deer did not show any significant change in physical appearance even after 3–4 months of conception until 10 days prior fawning when the abdomen started to descend along with enlargement of udder and vulva.

The present study showed some interesting phenomena like post-partum oestrus and mating behaviour in mouse deer. Although births were observed throughout the year, higher percentage of births was recorded following the monsoon period. Similarly, females came to oestrus mostly during pre-monsoon periods. Kusuda *et al.*<sup>9</sup> reported that the lesser mouse deer in Japan gave births in two seasons, viz. May and November–December, though other workers have reported that there is no such specific breeding season for lesser mouse deer in the wild<sup>14,15</sup> or captivity<sup>11</sup>. The mouse deer bred throughout year with less number of births during peak summer (May–June).

The mean gestation length was 154.1 days and it ranged from 150 to 163 days, and the present observation is higher than that of lesser mouse deer which had a gestation length of 140–145 days<sup>9</sup> and 132–136 days<sup>11</sup>. The difference in the gestation period might be attributed to differences at species level. The earliest age of first birth was at 304 days in the present study; while in the lesser mouse deer it was 258 days<sup>11</sup>. As reported in other mouse deer species, litter size was one in the present study, except on a single occasion<sup>9,11</sup>. Similar observation was made in lesser mouse deer, where one in 58 births resulted in twins<sup>15</sup>.

Copulation timing and mating behaviour were different from other deer species. Most of the ungulates mate multi-

ple times during oestrus, unlike single successful mounting in this deer. A similar and long mating behaviour (10–15 min) was observed in camels; however, they mate multiple times during oestrus period<sup>13</sup>. The present observations on breeding characteristics of mouse deer can assist in future breeding programmes in other zoos in India and elsewhere.

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**ACKNOWLEDGEMENTS.** This study was funded by the Central Zoo Authority, Ministry of Environment and Forests, Government of India. We thank the Chief Wildlife Warden of Andhra Pradesh for support and encouragement and Mr M. Sandeep and Dr K. Annapura for help in data analysis.

Received 4 October 2013; revised accepted 23 December 2013