

Male Bias Infanticide after Resident Male Replacement in *Semnopithecus entellus* Around Jodhpur (India)

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ABSTRACT

*Male takeover and infanticide are a well-known occurrence among primate. Observed mostly in old world monkey. In this study, we report male bias infanticide in Hanuman langur, *Semnopithecus entellus*, in study bisexual troop (B-1) near Jodhpur, India. After the takeover, the resident male and two other subadult male left the group and joined the all-male band (AMB) of the Daijar band (AMB-01). The new male was a member of a unimale Bisexual Troop after takeover the multi-male Bisexual troop.*

Keywords: *Semnopithecus entellus, all- male band, infanticide, Male Replacement, Jodhpur.*

Introduction

Infanticide has been described as a behaviour that may cause the death of an embryo or newly produced or born member of the committers' conspecific (Hrdy and Hausfater, 1984). Infanticide is observed in a wide range of mammalian species (Lyon et al., 2011). Where newly immigrated male sire and kills the infants that basically dependent on their mother nourishment. The process of takeover by newly immigrated male by discarding the old residential alpha male.

Although rare, infanticide is observed in more than 40 species of primates (Van Schaik et al., 1999). It mainly observed in species with a long lactation period in relation to gestation period (Borries et al., 2011). It impacts primate social behaviour (Belle et al., 2010) as it tends to modify grouping pattern with dominant males preferring single male groups and female preferring multi-male groups (Pradhan and van Schaik, 2008). In non-human primate changes in the social relationship, especially in dominance relationships and increase in intergroup aggression after a male replacement, were observed in Hanuman langur (Sharma et al., 2010). The infanticide risk may be an important factor influencing dispersal in females, since, in langurs, females tend to disperse out of the group during interaction with extra-group males (Sterck, 1999). This dispersal may result in changes in social organization, in turn affecting the female social relationship in the group (Sterck et al., 1997). The shifting of home ranges and sleeping sites is also reported among Hanuman langur after takeover (Agoramoorthy, 1994).

The Hanuman Langur, *Semnopithecus entellus* (Dufresne, 1797), is the most widely distributed of 19 non-human primate species found in the Indian subcontinent (Roonwal and Mohnot, 1977; Wolfheim, 1983). Social units in common langurs include one male bisexual troops, multi-male bisexual troops and all-male bands. Multi male condition mainly found during residential male replacement. Dominantly unimale bisexual troop and AMB are found in Jodhpur langur population. In the western parts of the habitat in India (i.e. Jodhpur), langur usually forms unimale bisexual troops (Mohnot, 1974). Bisexual troops are commonly matrilineal, with females' residual for life in their natal troops and with males emigrating, usually as juveniles, to join the all-male band. Resident male of troops are usually replaced after a 2-3 year of tenureship, ranging from 3-60 months (Rajpurohit, 1987; Rajpurohit and Mohnot, 1988; Sommer and Rajpurohit, 1989; Rajpurohit and Sommer, 1993). In Hanuman langur, two types of residential replacement have been seen i.e. rapid changes and gradual male change. In both the replacement condition infanticide is observed in Langur population.

Materials and Methods

The study followed to the ethical guidelines of the University of Jai Narayan Vyas Jodhpur.

Study area

The study was carried out in Daijar temple near Jodhpur Rajasthan. The Jodhpur city (altitude 241m, latitude 26° 18'N and longitude 73° 08'E) is situated on the eastern edge of the Great Indian Desert. In its vicinity, a 26 km long diagonal ridge runs from the village Arna in the west to Daijar in the northeast passing through the Jodhpur fort. The ridge forms a plateau with an area of about 150 km reaching a maximum width of 6 km. the area is covered with open scrub dominated by *Euphorbia caducifolia* and *Anagyrous pendula* in the rocky and *Prosopis juliflora*, *Prosopis cineraria*, *Acacia sengal* and *Ziziphus numilaria* on the plains (Mohnot

1974; Winkler 1981). There are a large number of irrigated fields and parks in the area where the langurs feed on about greater than 208 natural and cultivated plant species.

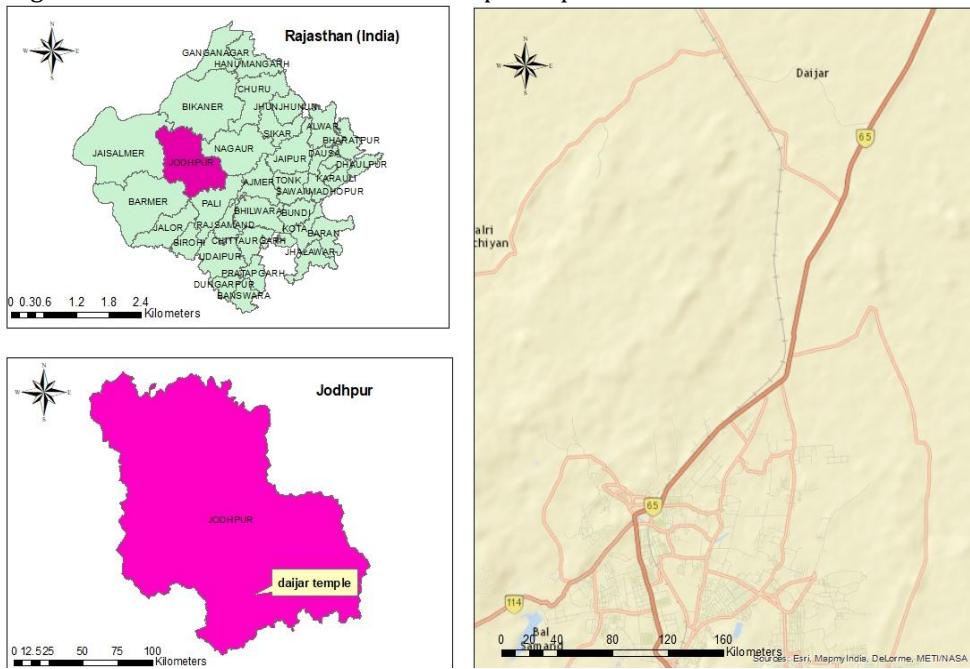


Fig.1 location of daijar in Jodhpur map.

The climate is dry with a maximum temperature of up to 53.2°C (recorded on 18 May 2016) during May and June and minimum temperature around 0°C during December and January months. Jodhpur receives 90% of its scanty rainfall (annual average 360mm) during the Monsoon (July to September).

Our study emphasis on one focal troop of Daijar temple. (Fig. 1). The troop from the low provisioned area. Data presented here are half and month study of a unimale bisexual troop of Daijar temple. For a collection of data focal, scans and ad libitum samplings were used (Altman, 1974).

Study group (Bisexual troop B1)

The unimale bisexual troop (troop B1) of the daijar temple, consists of 93 members on Feb 17, 2018. The composition of one male bisexual troop B1 was follows on February 2018. (Table 1)

Table 1 Composition of Bisexual troop.

Adult Male (Dominant)	Adult Females	Sub Adults Females	Juveniles (Both sexes)	Infants (Both sexes)	Total
1	36	12	18	26	93

Troop B1 roosting near Daijar temple. During night time they stay in Daijar Mountain. The mountain is totally distributed habitat due to huge amount of mining activity. Due to mining langur reduce their fundamental niche and they restricted in short area.

Result

Final decision to stay in the troop

Present study carried out during February 2019. When the takeover is completed and residential male are finally discarded by invaders males. the invaders male sometimes fight it self for a new residential ship or one most dominant male are stay in troop and others are finally emigré from troop after takeover done. these process might take time. sometimes other invaders male is emigrant within a day or fight are occur between invaders male then this process may take time 1-6 days. In this observation, we observed that invaders male (two are adult and one are an old male) they make a self-decision and there is no fight are occurs in troop B-01. Basically, two adult male are an emigrant from the troop and new residential male are an old one.

Infanticide during takeover in troop B-01

In the field, we observe that invaders males attempt to attacks more frequent in a pregnant female who is carrying their kid. However, if mothers are already pregnant once more, males could attempt to attack

previous infants, and thus, force the pregnant female to shield their infants in a extremely aggressive manner. Thus, the type of event is already observed in Jodhpur langur population (Agoramoorthy et al., 1988). Sometime invaders males are trying to attack the independent infants (Juvenile ♀ or ♂) who have no longer context with a pregnant female. During this style of fascinating interesting observation, we cannot explain why invaders male is attacked, independent infants. In present study, we observed that after takeover done new residential male attacks more frequent in mother that carries a male child. After two or three-time attacks, male succeeds in their task. In this study, we have found that male kills two black coat infants (♂) and one changing coat infant (♂) is highly wounded by the new residential male after the takeover. It is generally accepted that male infanticide can impose an important constraint on female reproduction, as females invest a disproportionate amount of energy in parental care. Under such conditions, a strategy that prematurely returns anestrous females to reproductive condition would be beneficial for males, especially when male-male competition is intense (Palombit, 2012).

After 4 to 5 days, the new resident was partially accepted by all the troop member. Some female who carry their child was seen keeping a safe distance from him. Some time resident male observed a bit aggressive towards a female who carries a infants (BC, CC and WC).

Mode of infants killing by New residential Male

After observing the dead body of two black coat infants we tend to found that the frequency of attacks is different. When invader male attack immatures, they restrict their bites to certain foci and seen to bite their victims on the head region for an effective and easy way of killing the immature. Out of mean 21 described wound, 44% were received in head region (neck, forehead, face, throat), 23% wound is groin region (tail, hip, flank) and 33% wound is received in other body regions. In the evolutionary point of view, attacker male knows that the most effective way of killing. So more bites are seen into the throat and neck for an effective mode of killing (Fig. 2).

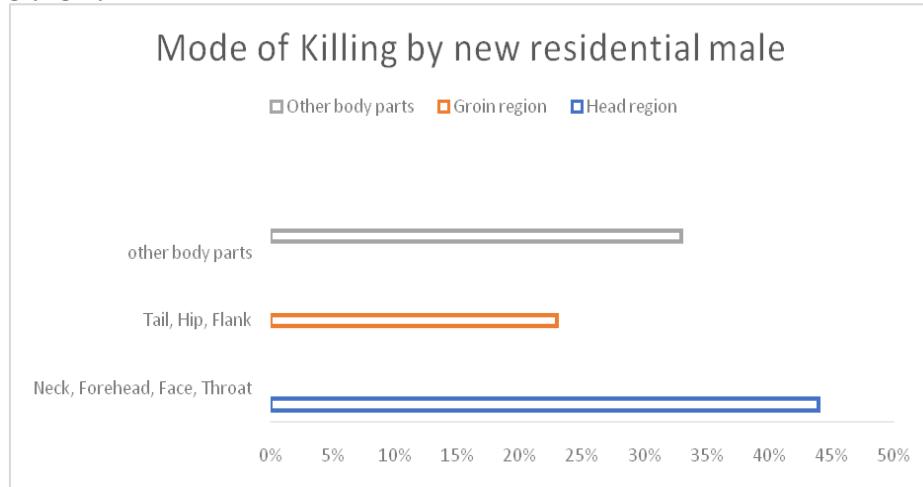


Fig: 2 Mode of effective killing in *Semnopithecus entellus*

The response of mother for her death infant

We observed individual hanuman langur (mother of death infant) carried her dead infant for a period of 15 days. In a Hanuman langur the range of carrying dead infants to be 3–27 days (average: 9.4 days). (Sharma et al., 2011). Mother of dead infant responses to range from interested observation and passive investigation (smelling, grooming and kisses) of the body.

The observation took place one day after the infants died, Mother carries death infant long after its death and try to avoid corps from other troop's members. Mother show grieving for dead corpse and occasionally show on feeding site for some time for feeding purpose only then directly return to the roosting site. At feeding time the mother lay the infant on the ground and picked it up after eating. Mother managed to walk on three limbs (One forelimb use for carrying a dead infant). In the first 2–3 days, the mother treats the dead corpse very carefully. She watches its eyes and face again and again and the mother also removes the flies from the mouth. Sometimes a mother of a dead infant, grooms and kisses the corpse. The particular behaviour toward dead infant shows that mother is grieving for her Dead child.

In a human population, mother grieve more strongly than fathers, and both grieve more strongly for a male than females, and parents with fewer children will grieve more intensely than those with several children. But in langur, there is no correlation between the number of children, sex of infant carrying the dead infant.

However, the age of the mother, the causation of death may affect this period of carrying a dead infant. (Sharma et al., 2011)

Discussion

Replacement is one of the important social changes seen periodically after a 2-3 year in Hanuman langur. Replacement is followed by infanticide in most of the non-human primate species. Many workers have reported such replacement in Hanuman langur (Jay, 1962; Hardy, 1977; Mohnot, 1971; Sugiyama, 1965; Makwana and Advani, 1981; Rajpurohit, 1987; Rajpurohit, 1991; Rajpurohit, 2006; Sharma, 2010). Different langur population have seen in the different pattern of resident male change, which may either rapid or slow process. Male bias infanticide is seen in recent observation of unimale bisexual troop.

The sexual selection hypothesis suggests that infanticide results in increased reproduction output for incoming male and hence infanticide behaviour is selected (Hrdy, 1974; 1977). But in our study new residential male kill male infants only, when the mother is carrying baby either female or male, mother engaged in both the condition for maternal care whatever male or female child. So residential male why select only male infants, the theory does not support this fact in the present study.

Leland *et al.*, (1984) suggest that infanticide behaviour is more likely to occur in one male group than in multi-male groups. In multi-male groups, paternity may confuse leading to the possibility that more than one male may defend an infant from attack and the chances of infanticide male siring the mother's next infant are lower than in one-male groups. Hence, the costs of infanticide are increased, whereas the benefits are decreased in multi-male groups. Although, the present infanticide attacks occurred in a one-male situation. Curtin and Dolhinow (1978) suggested that infanticide is linked to an unnaturally high primate population density brought about by human disturbance. However, other studies have seen infanticide in undisturbed populations of langurs (Newton, 1986) and other primate species (Struhsaker and Leland, 1987). This study offers little support for the social pathology theory. Although the Jodhpur langur population is found near human habitation, the density of langurs in the area (appx. 14.5/km², this study and Rajpurohit *et al.*, 2003) is not high.

Rudran (1973) suggested that an infanticide male might kill infants in order to increase the resources available for himself and his relatives. However, this hypothesis does not explain why the male attacked the youngest infant (the animal consuming the least resources) but not older infants and juveniles who consume more (Hrdy, 1977; Sommer and Mohnot, 1985; Agarwal and Mohnot, 1988).

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References

1. Agarwal G (1994). Adult male replacement and social change in two troops of Hanuman langurs (*Presbytis entellus*) at Jodhpur, India. International Journal of Primatology 15: 225-238.
2. Agarwal, G., Mohnot, S.M. (1988). Infanticide and juvenilicide in Hanuman Langurs (*Presbytis entellus*) around Jodhpur, India. Hum. Evol., 3: 275-296.
3. Altmann J. (1974). Observational study of behaviour: Sampling methods. Behaviour, 49, 227-267
4. Borries, C., Savini, T., & Koenig, A. (2011). Social monogamy and the threat of infanticide in larger mammals. Behavioral Ecology and Sociobiology, 65(4), 685-693.
5. Curtin, R.A., Dolhinow, P. (1978). Primate social behaviour in a changing world. Amer. Scient., 66: 468-475.
6. Hardy SB, Hausfater G. (1984). Comparative and evolutionary perspectives on infanticide: introduction and overview. In Infanticide: Comparative and Evolutionary Perspectives (Hausfater G, Hrdy SB, eds.) pp 13-55. New York, Aldine.
7. Hrdy, S.B. (1974). Male-Male Competition and infanticide among the Langurs (*Presbytis entellus*) Of Abu, Rajasthan. Folia Primatol., 22: 19-58.
8. Hrdy, S.B. (1977). In: Female and Male Strategies of Reproduction. The Langurs of Abu: Cambridge, Mass Harvard University Press.
9. Jay, P. (1962). The common langur of North India. Devore I (ed) Primate Behaviour, Holt. Rienhart. Winston, New York, (pp 197-249).
10. Leland, L., Struhsaker, T.T., Butynski, T.M. (1984). Infanticide by adult males in three primates species of Kibale forest,
11. Lyon, J. E., Pandit, S. A., van Schaik, C. P., & Pradhan, G. R. (2011). Mating strategies in primates: A game theoretical approach to infanticide. Journal of theoretical biology, 274(1), 103-108.

12. Makwana, S.C., Advani, R. (1981). Social change in Hanuman langurs, *Presbytis entellus* around Jodhpur. *J. Bomb. Nat. Hist. Soc.* 78: 152-154.
13. Mohnot, S. M. (1974). Ecology and Behaviour of the Common Indian Langur, *Presbytis entellus*. PhD thesis, Univ. of Jodhpur, Jodhpur.
14. Mohnot, S.M. (1971). Some aspects of Social changes and infant killing in the Hanuman Langurs, *Presbytis Entellus* (Primates: Cercopithecidae), in Western India. *Mammalia*, 35: 175-198.
15. Newton, P.N. (1986). Infanticide in an undisturbed population of forest Hanuman Langurs (*Presbytis entellus*). *Animal Behaviour*, 34: 785-789.
16. Palombit RA (2012). Infanticide: male strategies and female counter strategies. The evolution of primate societies. The University of Chicago Press, London, pp 432-468
17. Pradhan, G. R., & van Schaik, C. (2008). Infanticide-driven inter sexual conflict over matting's in primates and its effects on social organization. *Behaviour*, 145(2), 251-275.
18. Rajpurohit, L. S., & Mohnot, S. M. (1988). Fate of ousted male residents of one-male bisexual troops of Hanuman langurs (*Presbytis entellus*) at Jodhpur, Rajasthan, India. *Human Evolution*, 3(4), 309-318.
19. Rajpurohit, L. S., & Sommer, V. (1993). Juvenile male emigration from natal one-male troops in Hanuman langurs. In M. E. Pereira & L. A. Fairbanks (Eds.), *Juvenile primates: Life history, development and behaviour* (pp. 86-103). New York: Oxford University Press.
20. Rajpurohit, L.S. (1987). Male Social Organization of Hanuman Langurs (*Presbytis entellus*) PhD thesis, University of Jodhpur, Jodhpur.
21. Rajpurohit, L.S. (1991). Resident male replacement, the formation of the new male band and paternal behaviour in *Presbytis entellus*. *Folia Primatol.*, 57: 159-164.
22. Rajpurohit, L.S., Chhangani, A. K. (2006). Observation on male change and infanticide in a free-ranging unimale bisexual troop of Hanuman langur (*Semnopithecus entellus*) around Jodhpur (India). *Him. J. Env. Zool.*, 20 (1):17-25.
23. Rajpurohit, L.S., Chhangani, A.K. (2003). Resident male change and infanticide in a free-ranging unimale bisexual troop of Hanuman Langur (*Semnopithecus entellus*) around Jodhpur (India). *Proceedings 73rd Annual Session of the National Academy of Science, Ahmedabad, India*, (pp.72- 73).
24. Roonwal, M. L., &Mohnot, S. M. (1977). *Primates of south Asia: Ecology, sociobiology, and behavior*. Cambridge, MA: Harvard University Press.
25. Rudran, R. (1973). Adult male replacement in One-Male Troops of purple-faced Langurs (*Presbytis senex senex*) and its effect on population structure. *Folia Primatol.*, 19: 166- 192.
26. Sharma, G., Ram, C., Rajpurohit, L.S. (2010). A case study of infanticide after resident male replacement in *Semnopithecus entellus* around Jodhpur (India). *Proc. Zoo. Soc.*, 63(2): 93-98.
27. Sharma, G., Swami, B., Ram, C., & Rajpurohit, L. S. (2011). Dead infant carrying in the Hanuman langur (*Semnopithecus entellus*) around Jodhpur (Rajasthan). *Laboratory Primate Newsletter*, 50(1), 1-5.
28. Sommer, V., & Rajpurohit, L. S. (1989). Male reproductive success in harem troops of Hanuman langur (*Presbytis entellus*). *International Journal of Primatology*, 10, 293-317.
29. Sommer, V., Mohnot, S.M. (1985). New observations on infanticide among Hanuman langurs (*Presbytis entellus*) Near Jodhpur (Rajasthan, India). *Behaviour. Ecol. Sociobiol.*, 16: 245-248.
30. Sterck EH, Watts DP, van Schaik CP (1997). The evolution of female social relationships in nonhuman primates. *Behav Ecol Sociobiol* 41:291-309
31. Sterck, E. H. (1999). Variation in langur social organization in relation to the socio ecological model, human habitat alteration, and phylogenetic constraints. *Primates*, 40(1), 199-213.
32. Struhsaker, T.T., Leland, L. (1987). Infanticide in a Patrilineal Society of Red Colobus Monkeys. *Zeit. Fur Tierpsychol.* 69: 89-132.
33. Sugiyama, Y. (1965). On the social change of Hanuman Langurs (*Presbytis entellus*) in their natural condition. *Primates*, 6: 213-247.
34. Van Belle, S., Kulp, A. E., Thiessen-Bock, R., Garcia, M., & Estrada, A. (2010). Observed infanticides following a male immigration event in black howler monkeys, Alouattapigra, at Palenque National Park, Mexico. *Primates*, 51(4), 279-284.
35. Van Schaik, C. P., Van Noordwijk, M. A., & Nunn, C. L. (1999). Sex and social evolution in primates. Comparative primate socio ecology, 204-231.
36. Winkler, P. (1981). Zur Öko-Ethologie freilebender Hanuman- Languren (*Presbytis entellus entellus* Dufresne, 1797) in Jodhpur (Rajasthan), Indien [On the eco-ethologie of free-living Hanuman langurs in Jodhpur (Rajasthan), India]. PhD thesis. University of Göttingen, Göttingen.
37. Wolfheim, J. H. (Ed.). (1983). *Primates of the world: Distribution, abundance and conservation*. Seattle: University of Washington Press.