

NATIONAL STUDBOOK

Phayre's Leaf Monkey (*Trachypithecus phayrei*)

Published as a part of the Central Zoo Authority sponsored project titled
“Development and maintenance of studbooks for selected endangered species in Indian zoos”

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केन्द्रीय चिड़ियाघर प्राधिकरण
Central Zoo Authority

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FOREWORD

For species threatened with extinction in their natural habitats ex-situ conservation offers an opportunity for ensuring their long-term survival. This can be ensured by scientific management to ensure their long term genetic viability and demographic stability. Pedigree information contained in studbooks forms the basis for this management.

The Central Zoo Authority (CZA) in collaboration with zoos in India has initiated a conservation breeding program for threatened species in Indian zoos. As a part of this endeavor a Memorandum of Understanding has been signed with the Wildlife Institute of India for compilation and update of studbooks of identified species in Indian zoos.

As part of the project outcomes the WII has compiled the studbook for Phayre's leaf monkey (*Trachypithecus phayrei*) in Indian zoos. The recommendations contained in the studbook will form the basis for the long term management of the species in captivity. It is hoped that the zoos will adopt the recommendations and keep the WII informed of changes in their populations to enable the timely update of the studbook.

**(B.S. Bonal, I.F.S.)
Member Secretary
Central Zoo Authority**

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Authors

TABLE OF CONTENTS

Species biology.....	1
Status in captivity.....	6
Methods.....	7
Analysis.....	7
Conclusions	12
References.....	13
Appendix I - Historical Population	19
Appendix II - Living Population.....	22
Appendix II - Pedigree Chart Report	24

Phayre's Leaf Monkey (*Trachypithecus phayrei*) Blyth, 1847

Species Biology

The Phayre's leaf monkey or Phayre's langur is a medium-sized Colobine found in the tropical forests of Southeast Asia. The species epithet commemorates Arthur Purves Phayre. It is one of the most enigmatic and least known primate species found in India. Like other leaf monkeys it is characterized by a ruminant-like digestive system.

Taxonomy

Phylum	Chordata
Sub-phylum	Vertebrata
Class	Mammalia
Order	Primates
Family	Cercopithecidae
Sub- family	Colobinae
Species	<i>Trachypithecus phayrei</i>



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The genus *Trachypithecus* is the most diverse langur taxon, distributed in southwestern China, south and southeastern Asia. There are 3 known sub-species namely, *Trachypithecus phayrei phayrei* (Bangladesh, India), *Trachypithecus phayrei crepuscula* (southwestern China), *Trachypithecus phayrei shanicus* (southwestern China and northeastern Myanmar).

Recent genetic analyses have demonstrated that *T. p. crepuscula* and *T. p. phayrei* do not form a monophyletic clade. *T. p. phayrei* from India is the sister taxon of *T. barbei* and *T. obscurus*, but *T. p. crepuscula* from Vietnam represents a distinct lineage, being a close relative of the *T. francoisi* species group (Karanth *et al.* 2008; Nadler *et al.* 2003). He *et al.* (2012) suggest a sister relationship of *T. p. shanicus* and *T. p. Phayrei* while *T. p. crepuscula* may represent a distinct species throughout its distribution range, although incongruence between nuclear and mitochondrial genes suggests that hybridization may have occurred with *T. p. phayrei* (He *et al.* 2012).

Morphology

The species is easily identified in the field by a distinct white patch seen around the eyes and on upper and lower lips (Choudhury 1987). This is also why they are often referred to as spectacled langurs. They are greyish to black in colour. Their brow, hands and feet are jet black, and their upper arms, legs and tail are silvery grey (Rowe 1996).

The sexes are alike and females are larger. The head to body length ranges from 44 – 61 centimeters in males and from 65 – 86 cm in females. The tail constitutes 68 % of the overall length, ranging from 65 to 86 cm (Choudhury 1987). The average body mass of an adult male Phayre's leaf-monkey is around 7.3 kilograms, and for the female it is around 6.2 kilograms (Fleagle 1988). Male Phayre's leaf monkeys can be distinguished from females in the field by observing differences between ocular markings. In males, the white ocular rings around the eyes are parallel to the side of the nose, resulting in a black strip uniform in width. In females, the white ocular rings around the eyes bend inwards toward the nose causing more of black triangular shape (Bhattacharya and Chakraborty 1990). Other than newborns, individuals have an extended cap of hair on the head (Srivastava 1999). Infants are orange colored that begins to change after 3 months of age (Srivastava 1999).

Distribution

Phayre's leaf monkeys (*Trachypithecus phayrei*) occur in eastern Bangladesh, southwestern China (southern, western and central Yunnan), northeastern India (Assam, Mizoram, and Tripura), Lao PDR, Myanmar, Thailand (north of the peninsular zone) and northern Vietnam (Groves 2001).

This species has three subspecies occupying different ranges

Trachypithecus phayrei phayrei: This sub species is found in Bangladesh, northeastern India (Assam, Mizoram, and Tripura), and western Myanmar (Groves 2001).

Trachypithecus phayrei crepuscula: This subspecies is found in Bangladesh, southern China, southwestern Laos, central and northwestern Thailand, and northern Vietnam (Groves 2001). In Bangladesh this subspecies occurs to the south of the range of the subspecies *Trachypithecus phayrei phayrei* (Groves, 2001).

Trachypithecus phayrei shanicus: This subspecies is found in southwestern China in the Yingjiang-Namting river and Tunchong- Homushu Pass districts and northern and eastern Myanmar (Groves 2001).

Habitat

Phayre's leaf monkeys are primarily arboreal and prefer primary and secondary evergreen and semi-evergreen forest, mixed moist deciduous forest, but are also found in bamboo-dominated areas, light woodlands, and near tea plantations. In thick evergreen forests, Phayre's leaf monkeys can be found 15 to 50 m above the ground. In areas lacking primary and secondary forests, this species depend on bamboo and small shrubs like *Macaranga denticulata* and the herb *Alpinia allughas* (Choudhury, 1987, 1994, 1996). Phayre's leaf monkeys may also be found along stream banks containing thick bamboo forests (Bose 2003). In Mizoram this species was found in secondary forests and a dense bamboo forest with a few scattered trees (Raman *et al.*, 1995). In Bangladesh this species lives in semi-evergreen forests and semi-deciduous/evergreen forests (Feeroz *et al.*, 1995; Gittins and Akonda, 1982). In Lao PDR, the species occurs mostly in forests with a heavily broken canopy and tall bamboo (Timmins *et al.* 2011).

Behavioural ecology

Activity patterns

Phayre's leaf monkeys are very shy and typically flee when threatened. Inactive and feeding are the predominant activities of the species (Koenig *et al.* 2004). Phayre's leaf monkeys are strongly territorial against other groups of the same species, although sympatric groups of other species may share the same territory. Gupta (1997) found in a study in Tripura, India, daily activity consisted of 41.7% feeding, 28.3% resting, 8.2% travelling, and 21.8% other activities (grooming, calling, playing, suckling, aunting, etc.). Bose and Bhattacharjee (2002) found in southern Assam, group daily activity consisted of 39.4% feeding, 14.8% moving (travelling), 34.4% resting, 7.2% grooming, 1% playing, and 3.2% other activities. Groups wake up shortly before dawn, feed, then find a place to rest and feed again in the late afternoon (Choudhury 1994). Like capped langurs, Phayre's leaf monkeys are also fond of basking in the sun during winter (Choudhury 1994). Sleeping sites range in height from 8 to 29 meters (Gupta 2002).

The daily range is more than 1 kilometre per day while the home range for the species in Thailand is on average 87.7 ha (Koenig *et al.* 2004). They are also known to visit salt licks and significantly increase their home range on such occasions (Pages 2005). Phayre's leaf-monkeys are sympatric with capped langurs, (*Trachypithecus pileatus*) in the West Bhanugach Reserve Forest of Sylhet, Bangladesh (Feeroz *et al.*, 1995) and in Rajkandi Reserve Forest where they feed in the same or adjacent trees (Stanford, 1988). They rest in plants with extensive (*Artocarpus chaplasha*, *Gmelina arborea*) and moderate shade (*Albizia chinensis*, *Melocanna baccifera*, *Melocanna bambusoides*, *Bambusa tulda* or *Acacia mangium*) (Aziz and Feeroz 2009).

Foraging and feeding behaviour

The diet of *Trachypithecus phayrei* consists of fibre rich foliage, shoots, petioles, leaves, flowers and buds. *Leguminosae* and *Moraceae* provide the highest proportion (32%) of their food plants. They feed early in the morning (0600-0800 hrs) and in the late afternoon (1400-1600 hrs) (Aziz and Feeroz 2009). Like other colobine monkeys they have a unique digestive system, analogous to that of ruminants, which allows them to exploit foliage as a food source.

Their diet comprises of young and matures leaves and shoots (66%), followed by flowers and buds (16%) and fruits and seeds (14%) (Aziz and Feeroz 2009). There is a noticeable seasonal variation in their diet. Aziz and Feeroz (2009) observed that Phayre's leaf monkeys in Bangladesh consume more leaves during winter (76%), fruits and seeds during monsoon (57%) and flowers and buds are consumed mostly during summer (41%). However, bamboo shoots form a significant part (19%) of their diet throughout the year. Various observations from India and Myanmar also stress the importance of shoots of tall bamboos (for example, *Melocanna*) in this leaf monkey's diet (Green 1978, Mukherjee 1982, Choudhury 1994a, 1994b, Gupta and Kumar 1994, Raman 1996, Srivastava 1999, 2006, Platt *et al.* 2010). Bose and Bhattacharjee (2004) reported that plants like *Havea brasiliensis* (67.4%), *Delonix regia* (5.8%) and *Acacia auriculiformis* (4.3%) contribute more than 75% of the annual diet of the

species in Tripura. Bose and Bhattacharjee (2002) observed that in Tripura the species has changed its food habits to include twigs and leaves of *Havea brasiliensis* or rubber tree which are also used for night roosting. Exotic plant species also form an important part of their diet (24.3%) (Gupta and Dasgupta 2004).

Phayre's leaf monkeys divide into sub-troops during foraging and feeding particularly when food is scarce, but maintain close association among the dispersed members through visual and vocal contact. Although they feed primarily in trees, they were also reported to spend a large amount of time feeding in climbers and epiphytes (Suarez 2013). They occasionally come close to the ground when consuming bamboo shoots or soil, or when drinking water from creeks (Suarez 2013).

Social organization and behaviour

Phayre's leaf monkeys live in groups containing 1–5 adult males and 3–12 adult females (Koenig and Borries 2012). They have group density of 3.4 groups/square kilometre in Thailand (Borries *et al.* 2008) while in Tripura, India the group density is 7.6 groups/square kilometre (Gupta and Kumar 1994). Groups are generally cohesive, but individuals or subgroups may occasionally range >300 m apart (Lu *et al.* 2012). Phayre's leaf monkeys show a linear dominance hierarchy in their social organization with unidirectional and transitive relationships (Koenig *et al.* 2004), similar to those observed in other colobines (Borries *et al.* 1991; Koenig 2000). The adult females in the group are ranked inversely to age. Younger adult females occupy the highest rank; older adults occupy the middle ranks while sub-adult females are found at the bottom of the hierarchy (Koenig *et al.* 2004). Adult females of this species are known to show dispersal (2.3 female disappearances, 1.0 female immigrations/group-year; Borries *et al.* 2004; Koenig *et al.* 2004). However, male immigration or infanticide is not seen in this species (Borries *et al.* 2008). On the contrary the males frequently associate and occasionally care for infants and also act as mediators on behalf of infants, if the infants are involved in conflicts with females (Koenig *et al.* 2004).

It is a territorial species and defends its territory against conspecific groups. However, intergroup aggression has not been observed (Gupta 2000). Most of the interactions consist of displacements rather than overt aggression or submissive signals (Koenig *et al.* 2004).

Mating patterns in Phayre's leaf monkeys range from polygynous to promiscuous, depending on the composition of the group (Lu *et al.* 2012). Males are philopatric and begin mating with adult females as adolescents. Once they are adult, young males commonly outrank older adult males (Koenig & Borries 2012).

In females sexual swellings are absent (Nunn 1999). Menstrual cycles are 30 days long, on average (Lu *et al.* 2010). In Phayre's leaf monkeys females show a preference for mating with adult males during post ovulatory period (POP) while they choose to mate with adolescents during the pre-conceptive period (PC) (Lu *et al.* 2012). Proceptive behaviour during mating includes female

presentation and head shaking toward any adolescent or adult male. Attractive behaviour includes male solicitations and inspections of female hindquarters. Receptive behaviour includes copulations (mount with intromission) as well as attempted copulations (mounting only) (Sommer *et al.* 1992). Displacement events such as a male displacing another male involved in a sexual encounter, or a male approaching a female directly following termination of mating and the female subsequently leaving and vocalizing are common forms of agonistic behaviour in Phayre's leaf monkeys (Lu *et al.* 2012). Females in larger groups reproduce at a slower pace and have lower reproductive rates as compared to those in smaller groups (Borries *et al.* 2008).

Table 1: Life history traits of Phayre's leaf monkeys (*Trachypithecus phayrei*)

Mating System	Multi-male-multi-female groups (Koenig and Borries 2012)
Breeding season	December-April (peak) (Borries <i>et al.</i> 2005)
Average gestation period	205.3 days (Lu <i>et al.</i> 2010)
Weaning age (mean)	depending on group size (small to large)- 18.3 to 21.4 months (Borries <i>et al.</i> 2008)
Inter birth interval	22.3 6 ± 3.99 months (Borries <i>et al.</i> 2011)
Age at first reproduction	5 years; 5.3 years (female) (Ossi <i>et al.</i> 2006; Borries <i>et al.</i> 2011)
Lifespan in captivity	28.3 years (maximum) (Weigl 2005)

Even though Phayre's leaf monkeys give birth throughout the year, they show birth peaks during certain months of the year (Lu *et al.* 2010). The mean gestation period from conception to birth is 205.3 days (Lu *et al.* 2012). At the time of first birth, female Phayre's leaf monkeys are at an average of 5.3 years of age (Borries *et al.* 2011). The interbirth interval following a surviving infant is at an average of 22.3 ± 3.99 months (median= 23.0, range = 14–32, n= 40) with a notably large range of 18 months (Borries *et al.* 2011).

Females give birth to one offspring at a time, which is nursed for almost a year, which greatly increases its chance of survival. Mothers are the main caregivers as they feed, protect and groom newborns. Adolescent Phayre's leaf monkeys tend to keep some contact with their mothers, even after she gives birth to additional offspring (Larney *et al.* 2007).

Both male and female Phayre's leaf monkeys use vocal calls for communication. A loud I- "kah kah kah" alarm call is used by adult males while a softer "whoo" call is used when adult males detect a predator within the area (Srivastava 1999). The "cheng-kong" call is emitted by the dominant male to bring the group together (Srivastava 1999).

Population status in the wild

The Phayre's leaf monkey population is small and isolated in India and Bangladesh (Choudhury 2001; Molur *et al.* 2003). The status of Phayre's leaf monkey in Lao PDR is localized due to hunting pressure

and habitat fragmentation, and it inhabits three national protected areas. In Vietnam the species is rare and there are records only from a handful of areas (Nadler *et al.* 2004). In Thailand, there are good populations in Nam Nao National Park and Phukhio Wildlife Sanctuary (Borries *et al.* 2002), but much of northern Thailand has been hunted out. In China, healthy populations of *T. p. shanicus* survive mainly in Gaoligongshan Nature Reserve and Tongbiguan Nature Reserve, and healthy populations of *T. p. crepuscula* survive mainly in Nangunhe Nature Reserve, Ailaoshan Nature Reserve, Wuliangshan Nature Reserve, Daxueshan Nature Reserve, Huanlianshan Nature Reserve, and Xishuanbanna Nature Reserve (Zhang *et al.* 2002). Overall, the population is declining globally and is predicted to decline further (Molur *et al.* 2003).

Threats and conservation measures

The species is threatened by habitat fragmentation and human interference especially due to the establishment of tea gardens and paper mills, timber plantations, livestock ranching, shifting agriculture, firewood collection, charcoal production, and human settlement (Molur *et al.* 2003). Interspecific competition from exotics, pollution, inbreeding, and local trade in the animals for zoos and as food are other threats faced by the species (Molur *et al.* 2003).

The species is listed as Endangered in the IUCN Red List of Threatened Species (2008) because its population is at risk of becoming extinct or threatened by anthropogenic activities. It is also listed as CITES Appendix II species in order to control the illegal trade in the region. Further, it is given priority in national legislation as being listed under Schedule I, part I of the Indian Wildlife (Protection) Act (amended up to 2002). In Bangladesh it is listed as Schedule III in the Bangladesh Wildlife (Preservation) (Amendment) Act, 1974. It is listed as Category I under wildlife Protection Act, 1989 in China, and has been a completely protected species in Myanmar since 1994, though a priority for this species is survey work in order to determine the current status of populations there. It is listed on Appendix 1B of Decree 32 (2006) in Vietnam.

Besides *in-situ* conservation measures the species has been identified by the Central Zoo Authority (CZA), India, as one of the 73 species for conservation breeding in Indian zoos. The co-ordinating institution for the conservation breeding of Phayre's leaf monkey in India is Sepahijala Zoological Park, Agartala.

Status in captivity

The global captive population consists of 15 living individuals (2 males, 10 females, 3 unknowns) housed in India and Thailand. A historical total of 41 individuals have been housed in captivity in 8 institutions world-wide. This Studbook contains information on the Indian captive population of Phayre's leaf monkey consisting of 24 individuals (7 males, 13 females, 4 unknowns) over time with a median of 11.5 individuals per year (Mean \pm SD = 10.6 \pm 4.3). All the individuals have been housed at Sepahijala Zoological Park, Agartala.

Methods

Pedigree data was collected by means of mailed questionnaires sent to zoos requesting information for each captive specimen and from ZIMS (Zoological Information Management System, 2014). Data was entered in Single Population Analysis and Records Keeping System (SPARKS v 1.66) (ISIS 2004) and subsequently exported to population management program PMx v 1.2 (Ballou *et al.* 2010) for further data analysis. Further visualization and analysis of pedigree data was performed using the program Lineage v 1.06 (Pollak *et al.* 2001).

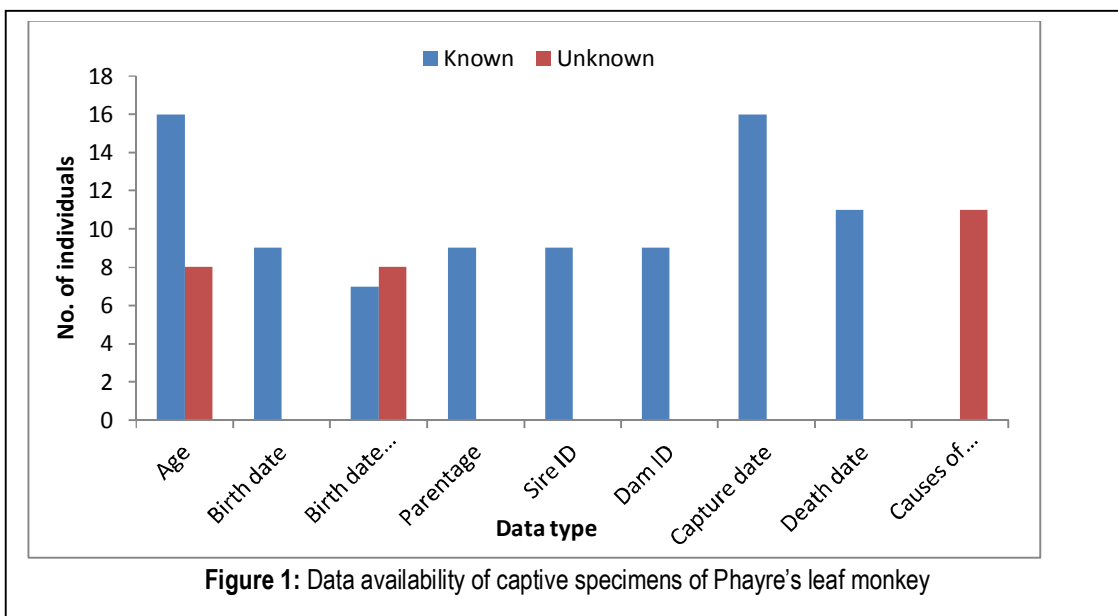
Analysis

Data availability

Among the questionnaires sent to 4 institutions to have housed the species (living and historic), data on the living collection of Phayre's leaf monkeys was obtained from Sepahijala Zoological Park, Agartala and information on the historical population from the same zoo was obtained from ZIMS. No response was received from the other three institutions to have housed the species earlier (records from CZA website).

For all the captive-born individuals, birth dates and parentage records were available. Birth estimates were available for 7 out of 15 wild-born individuals. Causes of deaths were unavailable for all the 11 mortalities recorded. Analysis based on life table data could not be conducted due to the small number of individuals and more than 90% of breeding contributed by wild-born individuals. Moreover 50% of these births were contributed by parents without birth date estimates.

“Data analysis by population management programs depends on adequate sample sizes, accuracy of birth and death dates and parentage information. Uncertainty in birth and death dates, affects demographic analysis while unknown parentage affects the results of genetic analysis. Due to the small population size and the limited reproductive data; analysis was limited to descriptive accounts of the population only.”
Traylor-Holzer 2011

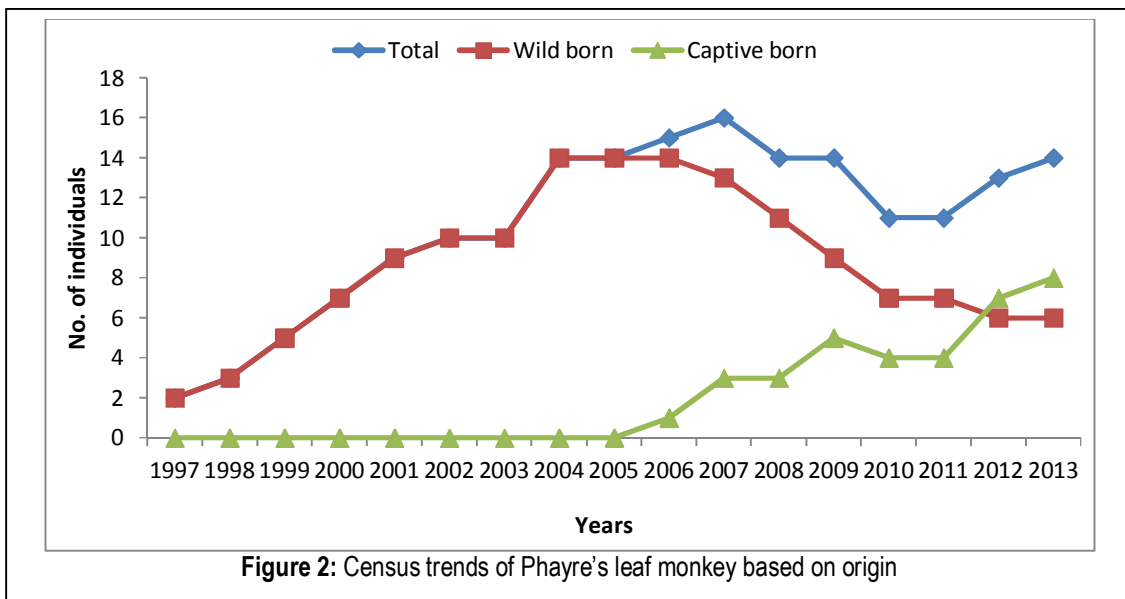


The results of the analysis of the historical trends and present population status are detailed in the following sections.

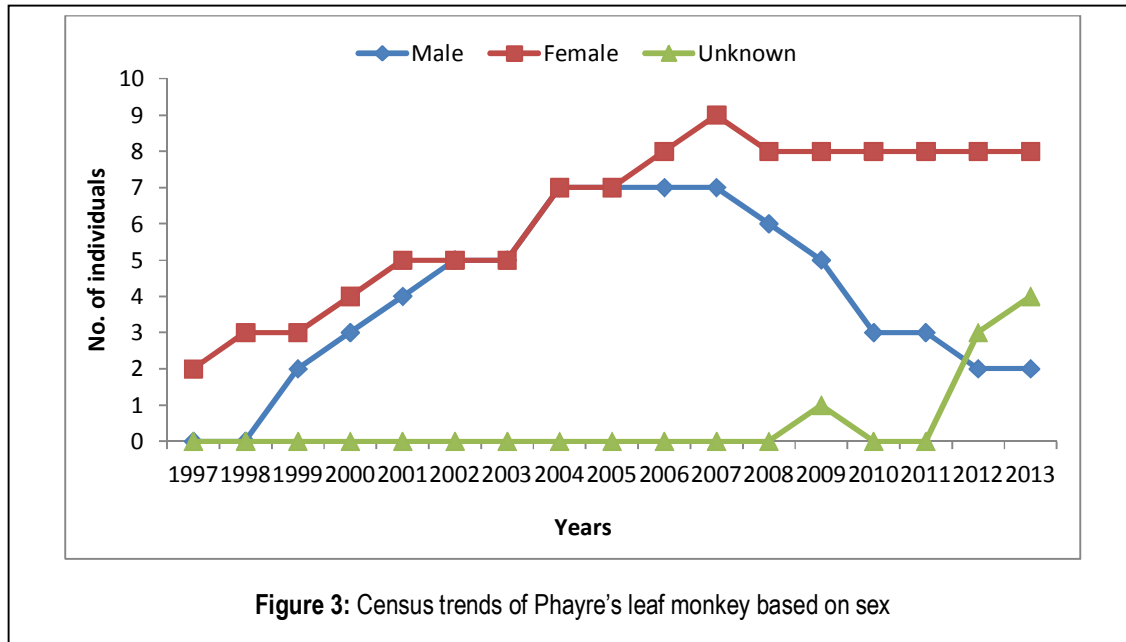
Historical population

The captive population of the species was initiated with two females in 1997. Subsequently another female was added in 1998 and two males were added in 1999. The population was gradually increased by additions from the wild till 2006 when the first captive birth occurred. Since then the population has increased by way of addition of wild origin animals and captive births to a total of 24 individuals (7: 15: 4) over time. Of these, 9 (5: 4: 0) were wild-born and 2 (0: 1: 1) were captive-born individuals.

Records of birth date estimates were available for 7 wild-born individuals and their median age at the time of entry in the zoo was 1.03 years (1.53Mean±0.99SD). Based on the dates of acquisition from wild the median number of years spent by all the wild-born individuals was 10.21 years (10.18Mean±4.46SD). For the captive-born individuals the median number of years spent in captivity was 1.97 years (3.57Mean±2.71SD). The census over the years based on birth origin and sex is represented in figures 2 and 3 respectively.



During the first 8 years, the population comprised of wild-born individuals. The total number of individuals reached a maximum of 16 in 2007. The number decreased to 11 in 2010-2011 and increased again to 13 by the end of 2013. The number of captive-born individuals has gradually increased to 7 in 2012-2013. Figure 3 represents the population census trend by sex. The first individuals brought into captivity were females and the first male was introduced in 1999. The graph indicates that the number of males have declined from 2007 onwards.

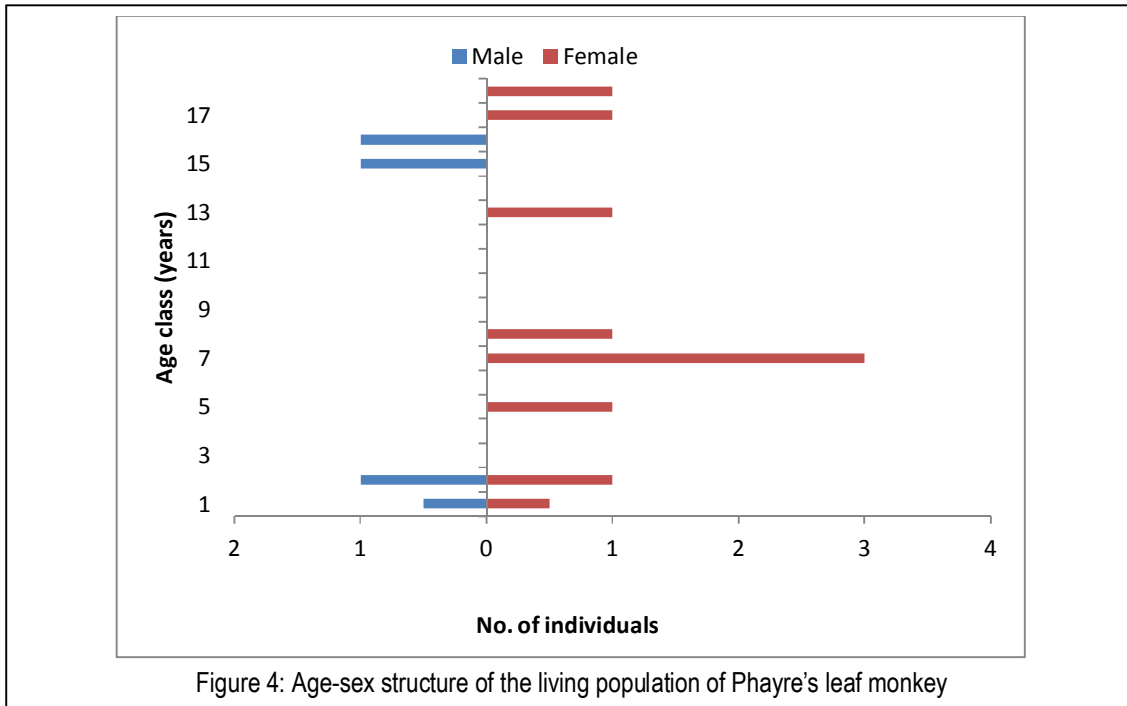


Living population

The living population includes 13 individuals (2: 8: 3), of which, 6 (2: 4: 0) are wild-born and 7 (0: 4: 3) are captive-born individuals. All the 7 captive-born individuals (except one having a captive-born mother) in the living population are descendants of 8 founders (NSN. 3, 4, 5, 6, 8, 10, 11, 13), which corresponds to 53.3% of all the wild-born individuals in the captive population. This suggests the poor reproductive potential of captive born individuals.

The age distribution of the individuals based on birth date estimate records is represented in Figure 4. The number of males and females in different age classes are shown on the left and right sides of the Y-axis respectively. As the size of the Phayre's leaf monkey population is small, age gaps can be found where there is no animal representation. The individuals with unknown sex at the time of data analysis were considered 0.5 of each sex. The median age of the captive-born individuals is 4.9 years (4.26_{Mean}±2.68_{SD}) and that of the wild-born individuals is 14.9 years (13.9_{Mean}±3.8_{SD}). The age pyramid reflects that the population is highly skewed towards females with males absent in the pre-reproductive and reproductive age classes.

In the living population, breeding has been recorded in 6 individuals (2: 4: 0), of which, 1 (female) is captive-born and 5 (2: 3: 0) are wild-born individuals. The captive born individuals are in the pre-reproductive age classes or have just become reproductively active. The absence of captive born individuals in the reproductive age classes may be one of the reasons for their poor reproductive performance. Limitations in sample size precluded life table analysis of the population; however the two males present in the population are above 15 years of age.



Captures, births and mortalities

A total of 15 (7: 8: 0) individuals have been acquisitioned during 1997-2014, with a mean of 0.833 ± 1.15 individuals per year. The sexual proportion of these individuals was 0.88:1:0. Records on the birth date estimates were available for 6 out of 15 wild-born individuals and the median age at capture was 1.01 years ($1.22_{\text{Mean}} \pm 0.65_{\text{SD}}$). Based on the dates of acquisition, the median number of years spent by each wild-born individual was 9.22 years ($9.16_{\text{Mean}} \pm 4.42_{\text{SD}}$).

A total of 9 (0: 5: 4) births have been recorded till March 2014. Parents of all the captive-born individuals except for one individual were of wild origin. The lineage of the captive population is presented in Figure 6. Of the total 15 wild-born individuals 12 (6: 6: 0) have bred, 2 (1: 1: 0) died without breeding and 1 (female) is yet to contribute to breeding. The reproducing wild-born females contributed to a mean of 1.3 infants while reproducing wild-born males contributed to a mean of 1.5 infants (Table 2 and 3). Founders with studbook numbers 10, 8, 6 and 5 contributed their genes more than once, while 13, 12, 11, 7, 4, 3, 2 and 1 have reproduced only once so far.

A total of 11 (5: 5: 1) mortalities have been recorded, including that of two captive-born individuals that did not survive to their weaning ages *i.e.* < 18 months. The first deaths in captivity were recorded in 2007; thereafter individual deaths have been recorded during 2008-2010 and 2012, the highest in 2010. The causes of mortality were not available from the data provided by the holding zoo.

The details of acquisitions, births and mortalities are shown in Figure 6. More than 50% of the wild-born individuals were acquired during the month of December and births were concentrated during the dry season of November-May. The birth seasonality is in conjunction with that observed in the wild

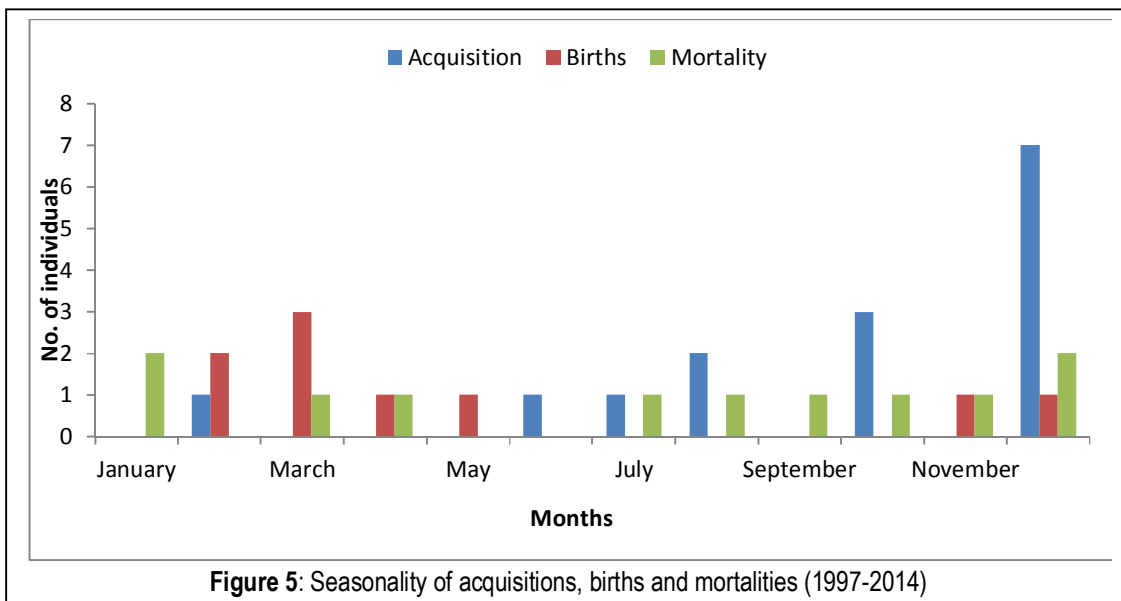
(December- April, Borries *et al.* 2005). Mortalities were recorded during most of the months with the exception of February, May and June.

Table 2: Reproductive output per generation/ female

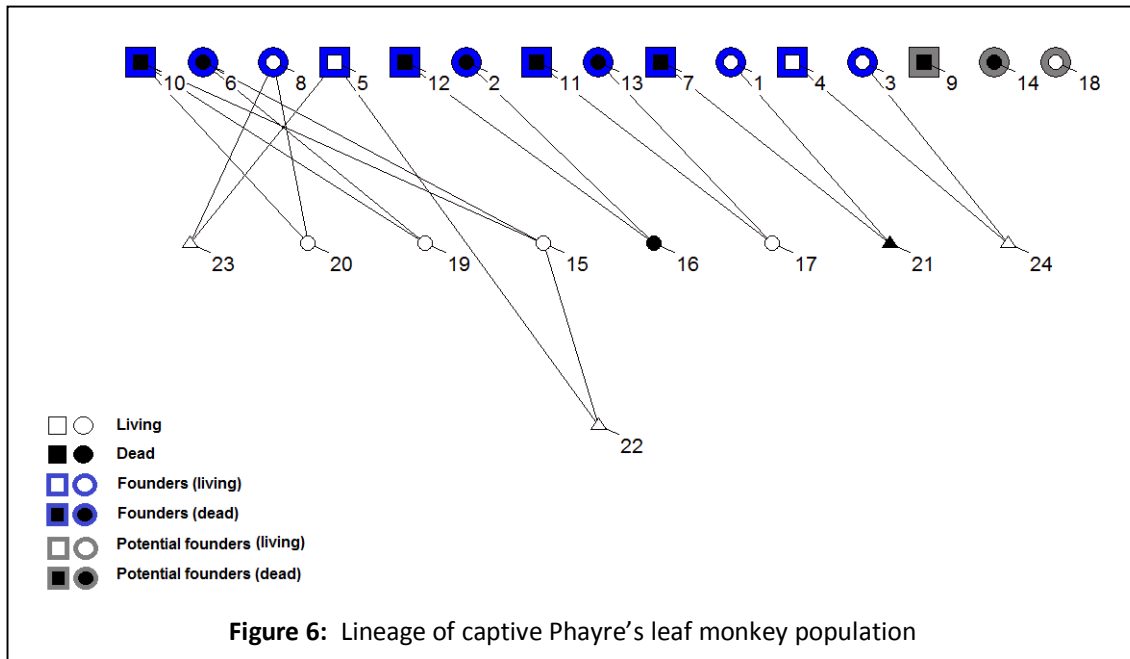
Generation	No. of females	No. of reproducing females	No. of infants	Mean no. of infants per reproducing female
F0	8	6	8	1.3
F1	5	1	1	1
Total	13	7	9	1.3

Table 3: Reproductive output per generation/ male

Generation	No. of males	No. of reproducing males	No. of infants	Mean no. of infants per reproducing male
F0	7	6	9	1.5
F1	3	0	0	0
Total	10	6	9	1.5



Of the 5 wild-born individuals to have reproduced, one individual (NSN 1) does not have a living descendant and hence can be referred to as a potential founder (Figure 6). At present all the 4 founders are more than 12 years of age (range: 12 – 16 years) and the 2 potential founders are of 6 and 17 years respectively. Little is known of the average reproductive tenure of breeders both in wild and captive populations; therefore it is not known whether the founders and potential founder (NSN 1) are still capable of breeding.



Summary

Based on the analysis of data received from the holding zoo it is inferred that:

- The population is characterized by low population growth rate and a lower reproductive potential of captive bred animals as compared to the wild origin animals.
- A large number of wild origin animals are a part of the captive population. However; the contribution by wild origin animals to the gene pool has been limited with skewed founder representation.
- Limitations of data quality in terms of dates of events (captures, births and deaths), lineages and the small population size of the species in captivity rendered analysis and subsequent recommendations redundant.

Conclusion

The results of the analysis carried out suggests the need for improvements in husbandry practices in management of zoos as suboptimal conditions have been associated with reduced reproductive potential. The current husbandry practices followed by the holding zoo need to be assessed and shortcomings identified and addressed.

The species shows male philopatry and lives in troops comprising multiple males and females. Accordingly the social organization of the species must be maintained in captivity. It may not be possible to capture entire troops for conservation breeding, however; with appropriate socialization process the troop organization can be recreated in captive environments. This can be achieved by

pooling together the single/pairs of animals housed received by way of rescue at the holding institution to form viable social groups with appropriate socialization process.

With appropriate management interventions and modifications in the husbandry practices the species is capable of the rapid growth required to provide a demographically stable captive population. Once the population has achieved demographic stability the genetic diversity can be managed by regulation of mating choices and inclusion of additional founder animals as required. This will require the holding zoo to maintain complete records of all events in each individual's life history.

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Historical population of Phayre's leaf monkey (*Trachypithecus phayrei*)

Sl. No.	National Studbook No.	House Name Local ID Transponder No. Global Accession No.	Sex	Birth Date	Sire	Dam	Location	Date	Event
1.	1	Bulti SL-1 00065921B1 MIG12-29927875	Female	~ 1996	Wild	Wild	India Sepahijala	14-Dec-98 14-Dec-98	Capture Transfer
2.	2	Anjana SL-2 MIG12-2992778	Female	~ 1997	Wild	Wild	India Sepahijala	18-Jun-97 18-Jun-97 18-Aug-07	Capture Transfer Death
3.	3	Ruma SL-4 MIG12-29927870	Female	~ 1997	Wild	Wild	India Sepahijala	28-Jul-97 28-Jul-97	Capture Transfer
4.	4	Bishu 0006B71CF7 MIG12-29927871	Male	~ 1998	Wild	Wild	India Sepahijala	17-Aug-99 17-Aug-99	Capture Transfer
5.	5	Nemai SL-5 MIG1229927788 0006B7DBF6	Male	~ 1999	Wild	Wild	India Sepahijala	20-Oct-01 20-Oct-01	Capture Transfer
6.	6	Jhuma SL-7 MIG12-29927810	Female	~ 2000	Wild	Wild	India Sepahijala	25-Oct-00 25-Oct-00 27-Dec-09	Capture Transfer Death

Sl. No.	National Studbook No.	House Name Local ID Transponder No. Global Accession No.	Sex	Birth Date	Sire	Dam	Location	Date	Event
7.	7	Pallab SL-6 0006B7495F MIG12-29927833	Male	10-Dec-00	Wild	Wild	India Sepahijala	20-Dec-00 20-Dec-00 21-Dec-10	Capture Transfer Death
8.	8	Sharmista SL-13 0006B7DBF6 MIG12-29927876	Female	~ 2001	Wild	Wild	India Sepahijala	12-Feb-02 12-Feb-02	Capture Transfer
9.	9	Tapas SL-8 0006B77C9EA MIG12-29927940	Male	~ 2001	Wild	Wild	India Sepahijala	25-Oct-02 25-Oct-02 10-Jan-12	Capture Transfer Death
10.	10	Dugu SL-10 0006B7F2AD MIG12-29927826	Male	~ 2001	Wild	Wild	India Sepahijala	20-Dec-01 20-Dec-01 10-Apr-10	Capture Transfer Death
11.	11	Santu SL-9 0006B7E82A MIG12-29927793	Male	~ 2004	Wild	Wild	India Sepahijala	18-Dec-04 18-Dec-04 13-Jul-08	Capture Transfer Death
12.	12	Rajesh SL-11 0006B71BBA MIG12-29927807	Male	~ 2004	Wild	Wild	India Sepahijala	18-Dec-04 18-Dec-04 21-Sep-09	Capture Transfer Death
13.	13	Sampa SL-14 MIG12-29927791	Female	~ 2004	Wild	Wild	India Sepahijala India	24-Dec-04 24-Dec-04 01-Jan-10	Capture Transfer Release

Sl. No.	National Studbook No.	House Name Local ID Transponder No. Global Accession No.	Sex	Birth Date	Sire	Dam	Location	Date	Event
14.	14	Malina SL-12 MIG12-29927792 0006B737A2	Female	~ 2004	Wild	Wild	India Sepahijala	24-Dec-04 24-Dec-04 20-Mar-08	Capture Transfer Death
15.	15	Rina SL-15 0006590E01 MIG12-29927790	Female	11-Nov-06	10	6	Sepahijala	11-Nov-06	Birth
16.	16	Unnamed SL-16 MIG12-29927789	Female	15-Feb-07	12	2	Sepahijala	15-Feb-07 18-Oct-07	Birth Death
17.	17	Reshmi SL-17 0006B718CC MIG12-29927874	Female	01-Mar-07	11	13	Sepahijala	01-Mar-07	Birth
18.	18	Lipika SL-22 HQQ12-00053	Female	~ 2007	Wild	Wild	India Sepahijala	07-Aug-10 07-Aug-10	Capture Transfer
19.	19	Chumki SL-18 00065903B6 MIG12-29927873	Female	25-Dec-07	10	6	Sepahijala	25-Dec-07	Birth
20.	20	Risha SL-19 0006B72830 MIG12-29927872	Female	13-Mar-09	10	8	Sepahijala	13-Mar-09	Birth

Sl. No.	National Studbook No.	House Name Local ID Transponder No. Global Accession No.	Sex	Birth Date	Sire	Dam	Location	Date	Event
21.	21	Unnamed SL-20 MIG12-29927832	Unknown	13-Apr-09	7	1	Sepahijala	13-Apr-09 27-Nov-10	Birth Death
22.	22	Unnamed SL-23 HQB12-00054	Unknown	15-Feb-12	5	15	Sepahijala	15-Feb-12	Birth
23.	23	Unnamed SL-24 HQB12-00055	Unknown	04-Mar-12	5	8	Sepahijala	04-Mar-12	Birth
24.	24	Unnamed SL-25 HQB13-00070	Unknown	28-May-13	4	3	Sepahijala	28-May-13	Birth

Appendix II

Living population of Phayre's leaf monkey (*Trachypithecus phayrei*)

Sl. No.	National Studbook No.	House Name Local ID. Transponder No. Global Accession No.	Sex	Birth Date	Sire	Dam	Location	Date	Event
1.	1	Bulti	Female	~ 1996	Wild	Wild	India	14-Dec-98	Capture
		Sepahijala					14-Dec-98	Transfer	
2.	3	Ruma	Female	~ 1997	Wild	Wild	India	28-Jul-97	Capture
		Sepahijala					28-Jul-97	Transfer	
3.	4	Bishu	Male	~ 1998	Wild	Wild	India	17-Aug-99	Capture
		Sepahijala					17-Aug-99	Transfer	
4.	5	Nemai	Male	~ 1999	Wild	Wild	India	20-Oct-01	Capture
		Sepahijala					20-Oct-01	Transfer	
5.	8	Sharmista	Female	~ 2001	Wild	Wild	India	12-Feb-02	Capture
		Sepahijala					12-Feb-02	Transfer	
6.	15	Rina SL-15	Female	11-Nov-06	10	6	Sepahijala	11-Nov-06	Birth

Sl. No.	National Studbook No.	House Name Local ID. Transponder No. Global Accession No.	Sex	Birth Date	Sire	Dam	Location	Date	Event
		0006590E01 MIG12-29927790							
7.	17	Reshmi SL-17 0006B718CC MIG12-29927874	Female	01-Mar-07	11	13	Sepahijala	01-Mar-07	Birth
8.	18	Lipika SL-22 HQK12-00053	Female	~ 2007	Wild	Wild	India Sepahijala	07-Aug-10 07-Aug-10	Capture Transfer
9.	19	Chumki SL-18 00065903B6 MIG12-29927873	Female	25-Dec-07	10	6	Sepahijala	25-Dec-07	Birth
10.	20	Risha SL-19 0006B72830 MIG12-29927872	Female	13-Mar-09	10	8	Sepahijala	13-Mar-09	Birth
11.	22	Unnamed SL-23 HQK12-00054	Unknown	15-Feb-12	5	15	Sepahijala	15-Feb-12	Birth
12.	23	Unnamed SL-24 HQK12-00055	Unknown	04-Mar-12	5	8	Sepahijala	04-Mar-12	Birth
13.	24	Unnamed SL-25 HQK13-00070	Unknown	28-May-13	4	3	Sepahijala	28-May-13	Birth

PEDIGREE REPORT

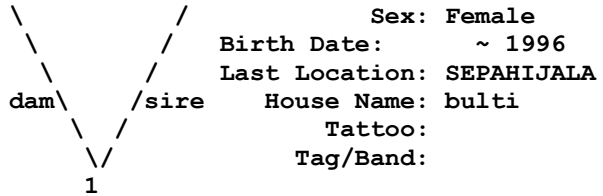
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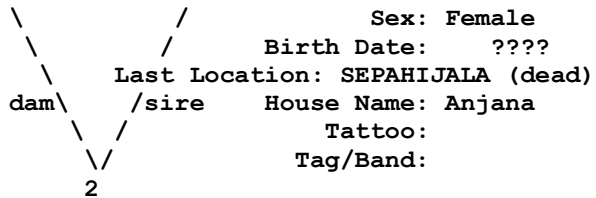
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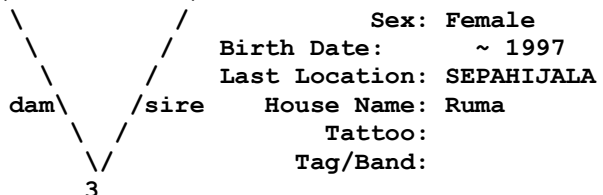
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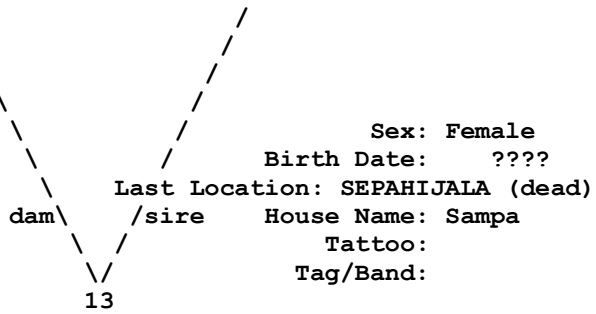
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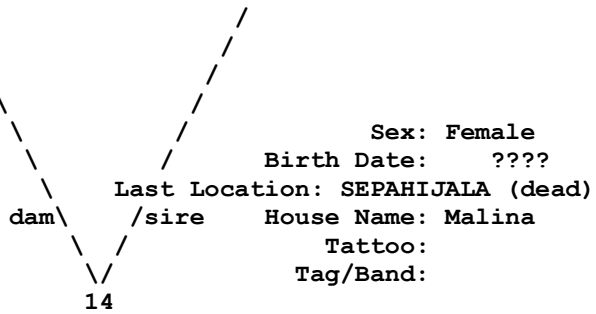
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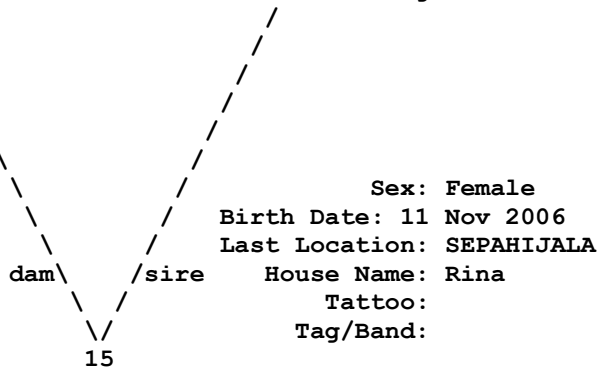
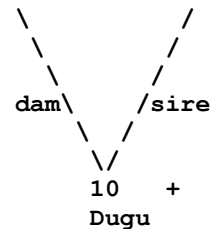
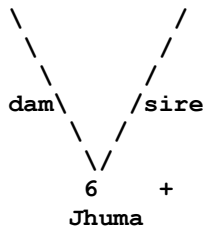
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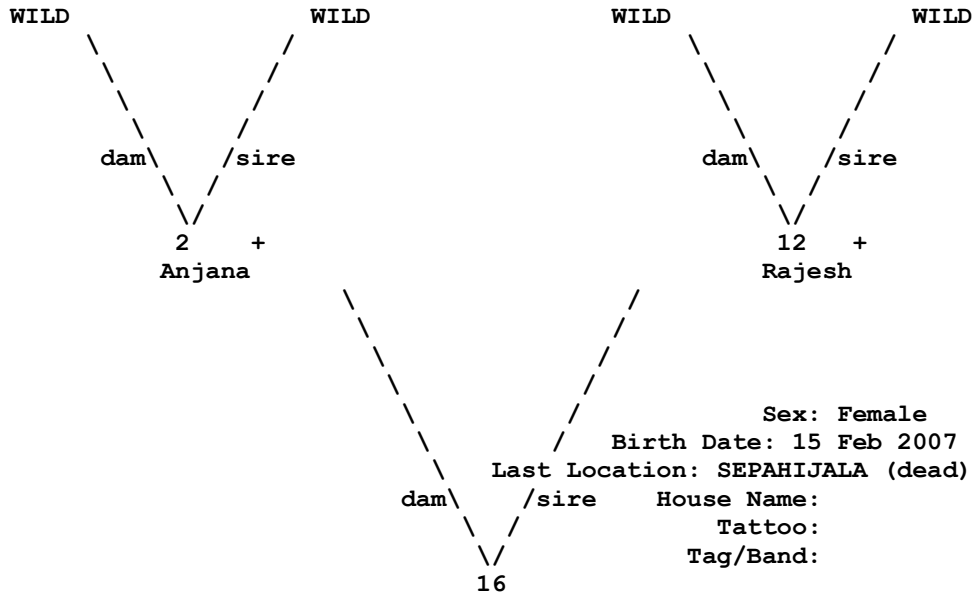
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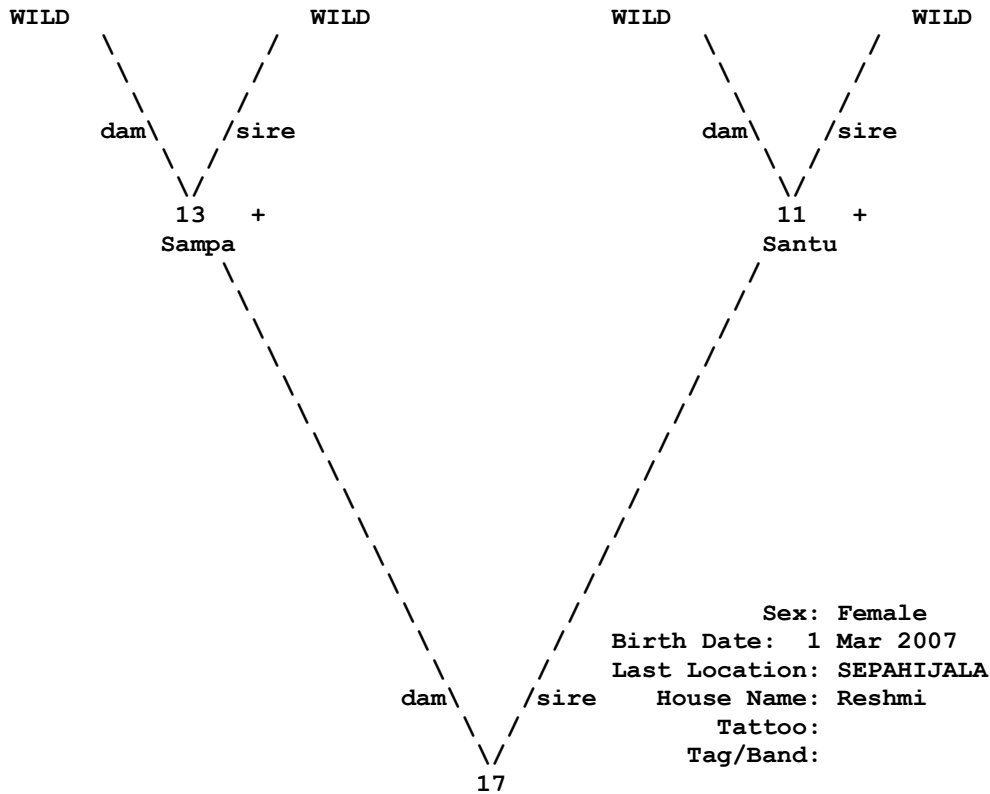
Studbook Number: 16



+ Wild-caught...

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Taxon Name: TRACHYPITHECUS PHAYREI

Studbook Number: 17



+ Wild-caught...

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Taxon Name: TRACHYPITHECUS PHAYREI Studbook Number: 18
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WILD

WILD

dam \ /sire

18

Sex: Female
Birth Date: ~ Apr 2007
Last Location: SEPAHIJALA
House Name: Lipika
Tattoo:
Tag/Band:

=====
Taxon Name: TRACHYPITHECUS PHAYREI Studbook Number: 19
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WILD

WILD

WILD

WILD

dam \ /sire

dam \ /sire

6 +
Jhuma

10 +
Dugu

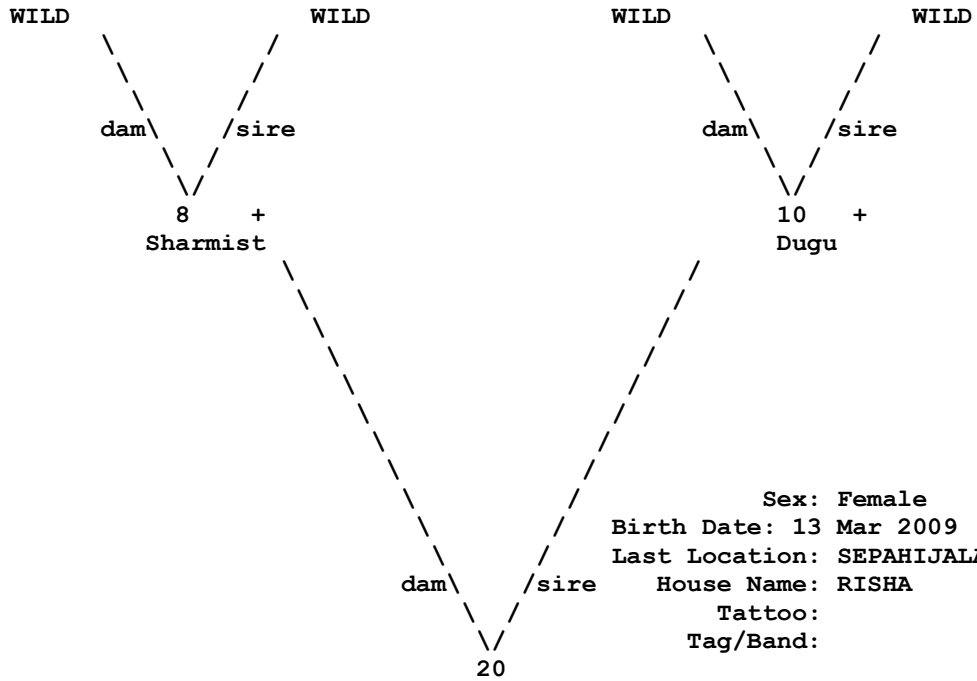
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19

Sex: Female
Birth Date: 25 Dec 2007
Last Location: SEPAHIJALA
House Name: CHUMKI
Tattoo:
Tag/Band:

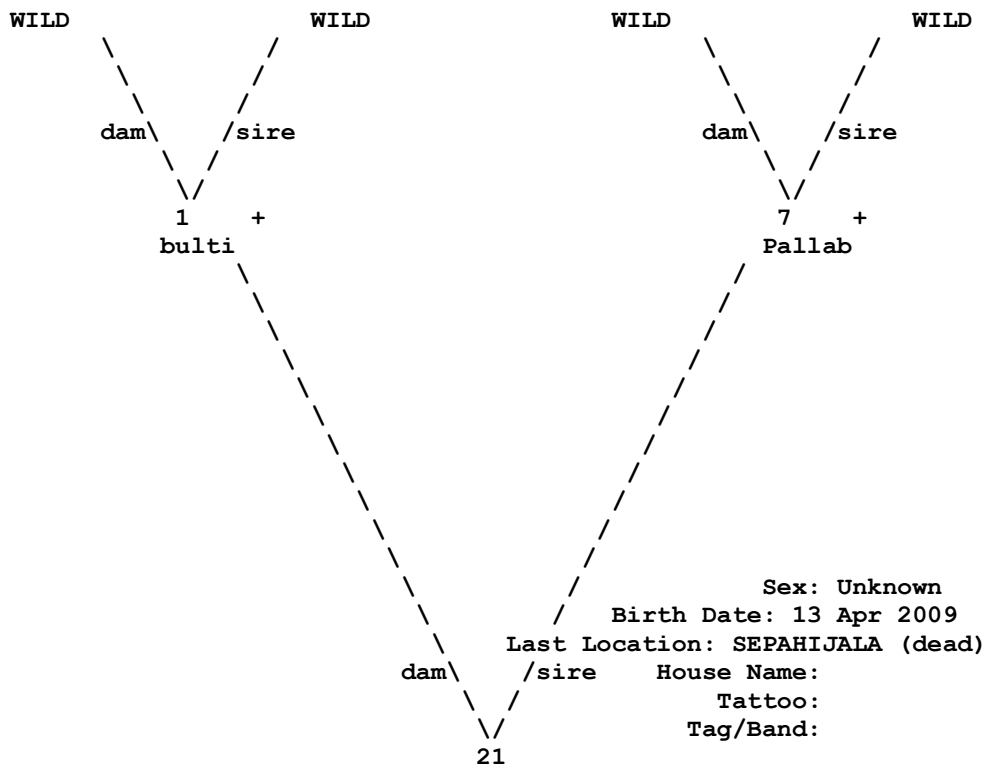
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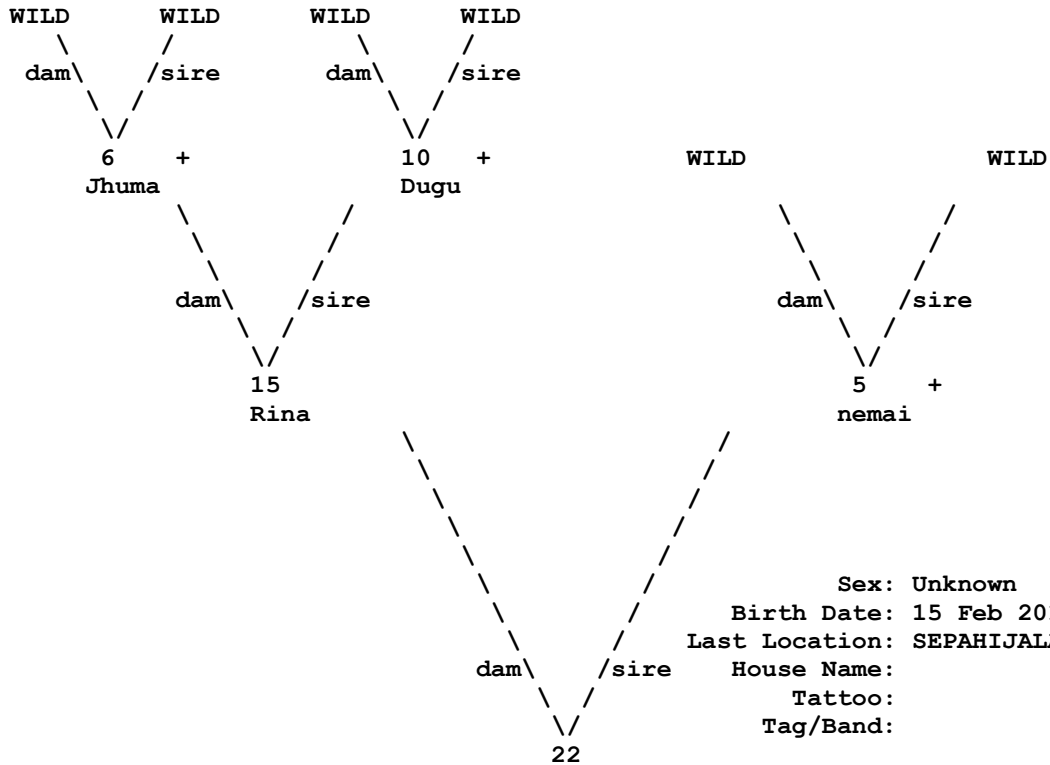
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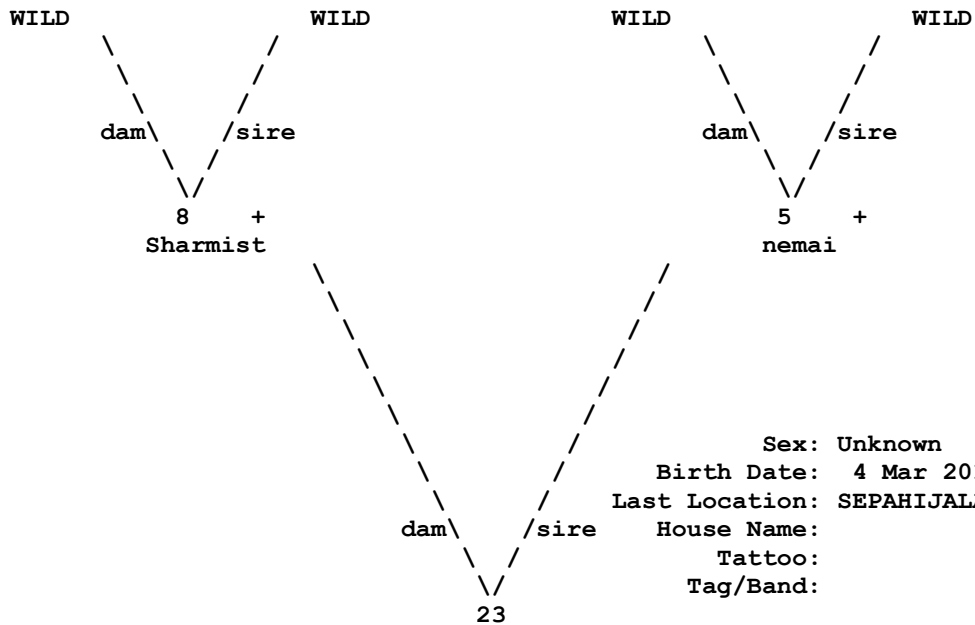
+ Wild-caught...

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Taxon Name: TRACHYPITHECUS PHAYREI Studbook Number: 22
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+ Wild-caught...

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Taxon Name: TRACHYPITHECUS PHAYREI Studbook Number: 23
=====



+ Wild-caught...

Taxon Name: TRACHYPITHECUS PHAYREI

Studbook Number: 24

WILD

WILD

WILD

WILD

dam \ /sire

3 +
Ruma

dam \ /sire

4 +
Bishu

dam \ /sire

24

Sex: Unknown
Birth Date: 28 May 2013
Last Location: SEPAHIJALA
House Name:
Tattoo:
Tag/Band:

+ Wild-caught...