

# NATIONAL STUDBOOK

## Pig Tailed Macaque (*Macaca leonina*)

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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भारतीय वन्यजीव संस्थान  
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केन्द्रीय चिड़ियाघर प्राधिकरण  
Central Zoo Authority



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"Development and maintenance of studbooks for selected endangered species in Indian zoos"

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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 Pig tailed macaque (*Macaca leonina*) 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 on a regular basis to enable the timely update of the studbook.

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



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Authors sincerely acknowledge the support from zoo directors, biologists, curators and veterinarians from the following contributing zoos for providing pedigree information that led to the successful establishment of the studbook.

Alipore Zoological Garden, Kolkata  
Aizawl Zoological Park, Aizawl  
Arignar Anna Zoological Park, Chennai  
Assam State Zoo cum Botanical Garden, Guwahati  
Maitri Bagh Zoo, Bhillai  
Kamla Nehru Zoological Garden, Ahmedabad  
Kanpur Zoological Park, Kanpur  
Lucknow Zoological Garden, Lucknow  
Mahendra Chaudhury Zoological Park, Chhatbir  
Nagaland Zoological Garden, Dimapur  
National Zoological Park, New Delhi  
Nehru Zoological Park, Hyderabad  
Sepahijala Zoological Park, Agartala  
Sayajibaug Zoo, Vadodara

**Authors**





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## Pig-Tailed Macaque (*Macaca leonina*) Blyth, 1863

### Species Biology

#### Taxonomy

Phylum- Chordata

Sub-phylum- Vertebrata

Class- Mammalia

Order- Primates

Family- Cercopithecidae

Sub- family- Cercopithecinae

Genus- *Macaca*

Species- *Macaca leonina*



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Species of *Macaca* have been variously separated into several species groups according to different authors (Fooden 1976; Delson 1980; Fa 1989; Groves 2001). On the basis of male genitalia morphology, Fooden (1976) classified the macaques into four species groups: the *silenus-sylvanus* group, the *fascicularis* group, the *sinica* group, and the *arctoides* group. Pig tailed macaques were classified under the *silenus-sylvanus* group. The *silenus* group which consists of *Macaca silenus*, *Macaca nemestrina* and *Macaca nigra* forms a monophyletic clad and this group is considered the most diverse lineage within the macaque genus.

Based on morphological characteristics, such as pelage color, pattern, and tail morphology Fooden (1975) recognized three subspecies of pigtail macaques (*nemestrina*, *leonina*, *pagensis*), although he was not fully conclusive about the subspecies status of the three forms (Gippoliti 2001). Groves (1993) confirmed Fooden's conclusion but later recognised *M. pagensis* (the Mentawai macaque) as a full species (Groves 1997). Until recently, *M. nemestrina* included *M. leonina* and the nominal form as subspecies. Based on genetic evidences (Evans *et al.* 1999; Morales and Melnick 1998; Tosi *et al.* 2000) and sexual swelling distinctions, Groves (2001) proposed full specific treatment for *Macaca leonina* and *Macaca nemestrina*. They are now recognized as two species of pig tailed macaques, *Macaca nemestrina*, or the southern pig tailed macaque and the northern pig tailed macaque *Macaca leonina*. The two species are known to hybridize in a small area of southern peninsular Thailand, as well as on the islands of Phuket and Yao Yai (Groves 2001).

#### Morphology

The macaques are characterised by their short, 'pig-like' tail, with the tip partially resting on the rump. The macaque possesses a relatively long, uniformly agouti golden-brown coat, with markings confined only to the brown crown, buff-coloured cheek whiskers and the red streak extending from the outer corner of each eye.

*Macaca leonina* and *Macaca nemestrina* differ in morphological characters such as the crown patch, the white color of the triangle above the eyes, the red streak at the external rim of the eyes, pelage color, ischial callosity, tail length and carriage, facial height, and limb length in both sexes, and patterns of sex skin swelling and reddening in females.

In particular, there are differences in the sexual swellings in the two species (Gippoliti 2001). Sexual-skin swelling during and after the menstrual period is particularly developed in the macaques of the *silenus-sylvanus* group (Fa 1989). In *M. nemestrina* the swelling forms a “continuous pillow like mass” while in *M. leonina* (like *silenus*) the development of the swelling is mainly limited under the tail. Gippoliti (2001) observed that adult female *Macaca leonina* in captivity demonstrate a highly developed subcaudal swelling resembling that of *Macaca silenus*.

## Distribution

The northern pig tailed macaque (*Macaca leonina*) is distributed throughout northeastern India (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura), eastern Bangladesh, Cambodia, southern China (southwestern Yunnan), Lao PDR, Myanmar, Thailand (from about 8°N and including adjacent islands), and central and southern Vietnam (Boonratana *et al.* 2008). In India it is found towards north of the Brahmaputra river (Groves 2001). Recently it has also been recorded from Namdapha National Park in Arunachal Pradesh (Chetry *et al.* 2003). In central and northeastern Myanmar, it has not been recorded between 20 and 25°N except on the coast at Arakan.

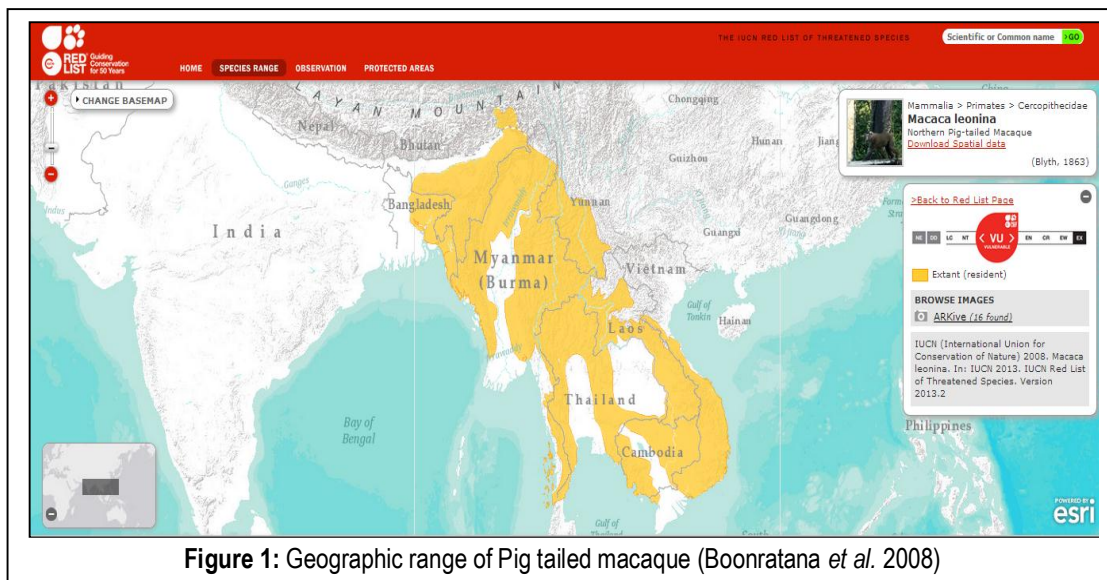


Figure 1: Geographic range of Pig tailed macaque (Boonratana *et al.* 2008)

The precise taxonomic boundary between *M. leonina* and *M. nemestrina* is not well defined. There are populations of the two species found on either side of the distribution limits in the Isthmus of Kra, but many of these populations might be due to release by humans. In Vietnam, there are historical records from the Nghe An province, but there is uncertainty as to whether the species was ever found north of this province in areas of human settlements (Boonratana *et al.* 2008)

### **Habitat**

It occupies tropical evergreen and semi-evergreen forest, tropical wet evergreen forest, tropical moist deciduous forest, coastal forest, swamp forest, low elevation pine forests (in Lao PDR and China) and montane forest, including degraded forests. In China the species occupies elevations between 50-2,000 m (Molur *et al.* 2003; Choudhury 2003). In Lao PDR and Vietnam the species is associated with lowlands, usually below 500 m.

### **Behavioural ecology**

#### *Activity patterns*

Pig tailed macaques are diurnal. While northern pig tailed macaques (*Macaca leonina*) are predominantly arboreal (Gippoliti 2001, Feeroz 2012), the southern pigtailed macaques (*Macaca nemestrina*) spend most of their time on the ground, and ascend to trees to escape predators or to sleep (Caldecott 1985).

Because of their large group size, pigtail macaques often split up into foraging groups to decrease direct competition for fruit at feeding sites (Crockett & Wilson 1980; Caldecott 1986). Their arboreal time is also divided between different canopy levels, with most time spent in the middle canopy (47.4%), then the lower canopy (33.8%), and finally the upper canopy (10.4%) (Rowe 1996).

The day range length varies between 825 and 2964 meters, depending on weather conditions and seasonal fruit availability (Caldecott 1986). In Bangladesh the day range of *M. leonina* was reported to vary between 950 to 3340 meters (mean=1746±527.8) (Feeroz 2012). Although *M. leonina* are chiefly arboreal, the macaques of the Nambor and Garampani Wildlife Sanctuaries of central Assam come down to the ground and frequent the highway in search of sugarcane left over by the elephants (Choudhury 2010).

#### *Foraging and feeding behaviour*

Pigtail macaques are primarily frugivorous, with 74% of their diet consisting of fruits, but they also consume a wide variety of food including insects, seeds, young leaves, leaf stems, dirt, and fungus (Crockett & Wilson 1980; Caldecott 1986). They also feed on nestling birds, termite eggs and larvae, and river crabs (Rowe, 1996). Northern pigtailed macaques (*Macaca leonina*) were reported to spend most of their feeding time in the middle canopy (Feeroz 2012). While foraging they may divide into groups of 2-6, but remain in close contact with other groups through vocalizations. Southern pig tailed macaques being ground foragers also raid crops particularly during rainstorms, when most farmers are inside (Crockett & Wilson 1980). In a study on captive pig tail macaques, it was found that they preferred food rich in

carbohydrates and fructose over food that is low in these nutrients and they also tend to prefer foods that are low in zinc (Laska 2001).

#### *Social and breeding behaviour*

Macaques live in female-bonded, multimale-multifemale groups (containing both adult males and females, with their dependent offspring) with the adult sex ratio biased towards females, who are usually philopatric. Females form kin-bonded subgroups (matrilines) within their natal groups and most males usually disperse at sexual maturity (Thierry 2007). The basic social unit of pigtails consists of an average of 20-40 individuals. The male to female sex ratio is about 1:8 (Caldecott 1986) and mean ratios of immature to mature animals (adult and adolescent, juvenile and infant) is 1:1.2 (Oi 1989). Most adult males live as peripherals or solitaries. Caldecott (1986) suggested the mechanism for this 'shedding' of males from groups in pig-tails involves displays and antagonism by the group-living adult males towards adolescent and other adult males. Pigtail juveniles and adolescent males associate with one another.

Males leave the natal group at the age of 5-6 years either roam independently as solitaries or try joining another group first as the lowest-ranking male and then work their way up through competition with other males (Oi 1989). Males of 5-6 years of age live as temporal troop individuals, not yet as complete solitaries. After repeating temporal stays, they may become complete solitaries at an older age (Oi 1989). Immigration into and emigration from the troop is mainly restricted to males, and is never observed in females (Oi 1989). The dominant male pig tail is responsible for group defence and control of internal disturbance and aggression (Sackett, Oswald, and Erwin 1975; Erwin 1976). They are known to be more sociable toward humans and less aggressive than other related species (Sussman *et al.* 2013) and can also be easily trained to perform certain tasks (picking coconuts) (Crockett & Wilson 1980).

Sackett, Oswald, and Erwin (1975) found that all-female groups in captivity exhibited more aggression than groups containing an adult male. Female pig tails are known to spend more time in social interactions, including agonistic as well grooming behaviour (Bernstein 1972). The species is reported to make use of a large range of affiliative behaviors (Maestripieri 2005; Oi 1990a, b; Thierry 2000). Females both groom as well as receive more grooming than male pig tails (Bernstein 1972). High-ranking males tend to associate with females by grooming and agonistic alliances, while low-ranking males do not get this chance, and frequently suffer from allied attacks involving females and juveniles (Oi 1989).

Pig-tail macaques are non-seasonal breeders. Estrus in females occurs throughout the year, with a peak from November to January (Oi 1990). The males compete for mating partners. Wild troops show a tendency towards mate monopolisation by a few top-ranking males. The tendency to mate monopolisation by pig tail males was also reported from a laboratory study (Tokuda *et al.* 1968). Sexual access by subordinate males to the females in estrus is restricted by the presence of dominant males.

The monopoly of copulation by the dominant males is achieved by the presence of only a few females in estrus with conspicuous sexual signs at a given time. The smaller the number of females in estrus, the more conspicuous is the mate monopolisation by the dominant males. However, as the number of females in estrus increases, the rates of copulation by the subordinate males also increase. Females solicit even the lower-ranking males and tend to copulate with many males and sometimes they may reject attempts by top ranking males to copulate. Hence, female choice counteracts the monopolistic tendency of the dominant males. The mating relationship is rightly called a superficial promiscuous state, because of the inability of the dominant males to exert mate monopolisation at times when too many females are in estrus.

When a female reaches sexual maturity at 3 years of age, she starts cycling and might present herself to males with her anogenital swelling for reproduction. It has been studied in captivity that females showing delayed swelling are usually of lower weight (Erwin and Erwin 1976). In females, an external indicator of ovarian condition is provided by the swelling of the perineal or sexual skin (Bullock *et al.* 1972), particularly prominent during the middle 12 days of the 32 day cycle (Mitchell 1979). Laboratory studies have shown that pig-tails are multi mount ejaculators (Tokuda *et al.* 1968; Nadler and Rosenblum 1973). Pigtail males are known to use elaborate non-copulatory mounting for conciliatory purpose more frequently than other macaque males (Oi 1989). Among males, non-copulatory mounting tend to be performed in the direction from the subordinate to the dominant, while among females, it tends to be in the reverse direction; and grooming is an important form of conciliation among females.

Male infant pigtails attain independence from their mothers earlier and to a greater extent than female infants and mothers play a major role in developing the male's greater independence (Mitchell 1979). Adult males are indifferent to infants but will protect them when they are attacked (Mitchell 1977).

**Table 1:** Life history traits of Pig tailed macaque (*Macaca leonina*)

Mating system	Promiscuous or polygynandrous
Breeding season	Non seasonal (Kuehn <i>et al.</i> 1965; Bernstein and Gordon, 1977)
Inter birth interval	2 years (Bernstein 1967)
Maximum lifespan in captivity	26 years (Ha <i>et al.</i> 2000)
Age at sexual maturity	3-4 years (Erwin & Erwin 1976)
Average gestation period	170±8.5 days (Sirianni and Swindler 1985)
Number of offspring	1 (twinning is rare)

### Population status in the wild

Although there is no precise information available on the total number of individuals in India or Myanmar, but populations have been reported to decline in both the countries (Boonratana *et al.* 2008). A group density of 0.07 individuals/km<sup>2</sup> was recorded in Namdapha National Park, India, by Chetry *et*

*al.* (2003). In China, the species' population is estimated to be less than 1,000 individuals (Zhanget *al.* 2002). No information is available on the status of the population, but is thought to be declining rapidly.

A small isolated population occurs in Bangladesh, whose habitat is degrading rapidly, thereby leading to the continuous decline in the number of mature individuals in the country (Molur *et al.* 2003). In Thailand the populations have been reported to be stable. During the last 30-35 years more than 30% of the population has been reported to decline in countries like India, Bangladesh, China, Vietnam and Myanmar (Boonratana *et al.* 2008). In Lao PDR and Cambodia, there has been perceptible decline in population size but the rates are close to or lower than 30% (Boonratana *et al.* 2008). In most of the countries, the species is predicted to decline at a rate higher than 30% over the next three generations.

### **Threats and conservation measures**

The species is threatened by habitat disturbances such as selective logging; timber and firewood collection for making charcoal; building roads, dams, power lines; and deliberately setting fires. Deterioration in habitat quality due to the loss of fruiting trees and sleeping sites through monocultures and plantations, selective felling, and a subsequent increase in the canopy gaps lead to forest fragmentation and soil erosion

Other threats include hunting and trade for food, sport and traditional "medicine", and accidental mortality due to trapping occurs. There is a local trade for bones, meat for food and the live animals as pets (Molur *et al.* 2003). Habitat loss and poaching are the major threats in India and Bangladesh. There has been a reduction in forest cover in Assam by over 10% in two years between 2001 and 2003 (Forest Survey of India 2003).

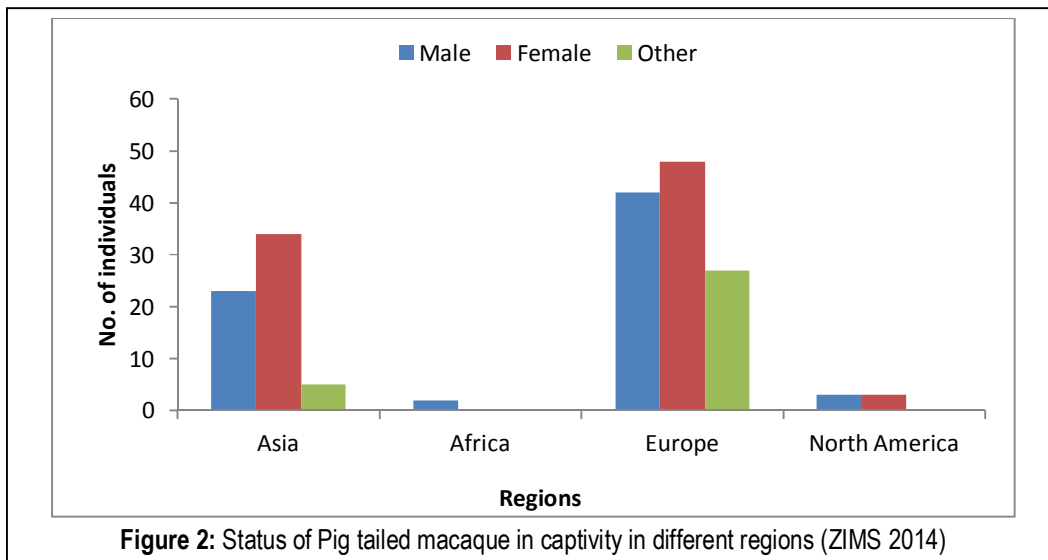
In Lao PDR, Vietnam and Cambodia, hunting for food and trade is the primary threat, but as a predominantly lowland species habitat loss likely is also a major threat to the species. In Thailand, the males of this species are exploited for picking coconuts by the industry. Habitat loss and disturbance are the major threats in China and Myanmar (Boonratana *et al.* 2008).

Northern pig-tailed macaques are known to occur in several protected areas of Bangladesh, China, India, Myanmar, Thailand and Vietnam (Boonratana *et al.* 2008). The species is listed as Vulnerable A2cd in the IUCN Red list of threatened species (2008), as the species has declined by at least 30% over the past 30-36 years (three generations) due to hunting and habitat loss. It is listed under CITES Appendix II. In Bangladesh it comes under Schedule III Bangladesh Wildlife (Preservation) (Amendment) Act, 1974. In China it is listed in Category I under the Chinese Wildlife Protection Act (1989) and as Schedule II in India under the Indian Wildlife (Protection) Act, 1972 (Chetry *et al.* 2003) amended up to 2002. Moreover, the Central Zoo Authority (CZA), India identifies Pig tailed macaque among the 73 critically endangered species for planned and coordinated conservation breeding in Indian zoos.

## Status in captivity

The global captive population of Pig tailed macaque consists of 187 individuals (70 males, 85 females, 32 unknowns) and are currently maintained in captivity in 37 institutions across four regions- Africa, Asia, North America and Europe (Figure 2) (ZIMS data until 2014). This record includes individuals housed in Indian zoos and they have been pooled together as *Macaca nemestrina* however the Central Zoo Authority website refers to it as *Macaca leonina*.

This Pig tailed macaque National Studbook records all the individuals from the Indian captive population for this species. Pig tailed macaques have been kept in Indian zoos since 1962 and the living population is housed at 7 institutions (Table 2).



**Table 2:** Current status of captive Pig tailed macaques in Indian zoos (March 2014)

Location	Total (M.F.U)	Living (M.F.U)	Time span in each zoo (duration/years)	Births (M.F.U)	Deaths (M.F.U)
Ahmedabad	1.2.0	0.0.0	1990-01 (12)	0.0.0	1.2.0
Aizawl	4.3.0	4.3.0	2001-14 (14)	1.1.0	0.0.0
Assam	2.1.0	2.1.0	1991-14 (24)	2.1.0	0.0.0
Bhilai	0.1.0	0.0.0	1974 (1)	0.0.0	0.0.0
Calcutta	2.2.0	0.0.0	1985-05 (21)	0.0.0	2.2.0
Chatbir	2.3.2	1.2.2	1984-14 (30)	0.0.2	1.1.0
Delhi	3.3.1	0.0.0	1962-95 (34)	0.1.1	2.2.1
Dimapur	2.0.0	2.0.0	2010-14 (5)	0.0.0	0.0.0
Hyderabad	2.1.0	0.1.0	1993-14 (22)	0.0.0	1.0.0
Kanpur	9.3.0	0.0.0	1976-97 (22)	7.1.0	8.2.0
Lucknow	0.1.1	0.0.0	1976-09 (34)	0.0.0	0.1.1
Chennai	0.1.0	0.1.0	2003-14 (12)	0.0.0	0.0.0
Sepahijala	12.13.4	9.8.4	1993-14 (22)	4.6.4	1.3.0
Vadodara	2.4.0	2.2.0	2005-14 (10)	1.3.0	0.2.0
VOC Park	0.1.0	0.0.0	2000 (1)	0.0.0	0.0.0



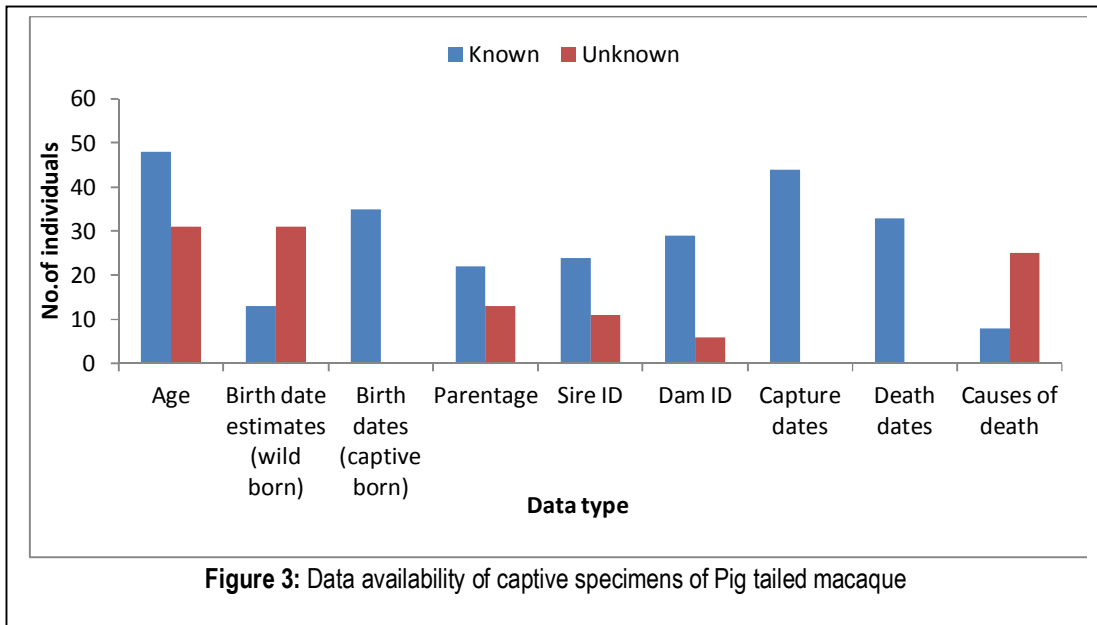
## Methods

Pedigree data was collected by means of mailed questionnaires, zoo visits and from the websites of CZA and ZIMS (Zoological Information Management System). Questionnaires were sent to 14 institutions housing Pig tailed macaques in India, requesting information for each captive specimen. Data was entered in the 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). Data was exported from SPARKS and used as input files in PMx for further analysis. Further visualization and analysis of pedigree data was performed using the program Lineage v 1.06 (Pollak *et al.* 2001).

## Results

### Data quality

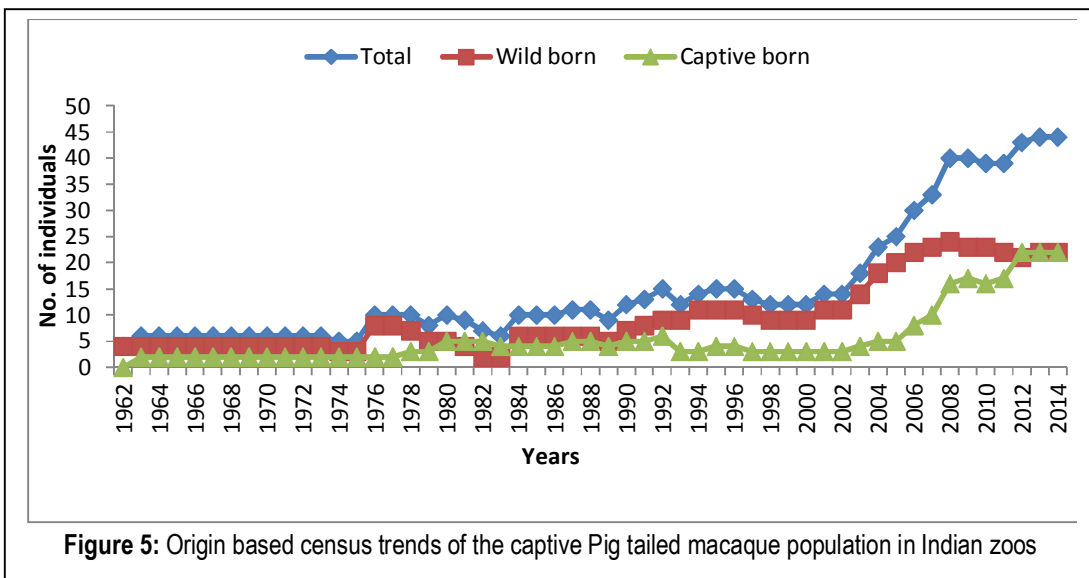
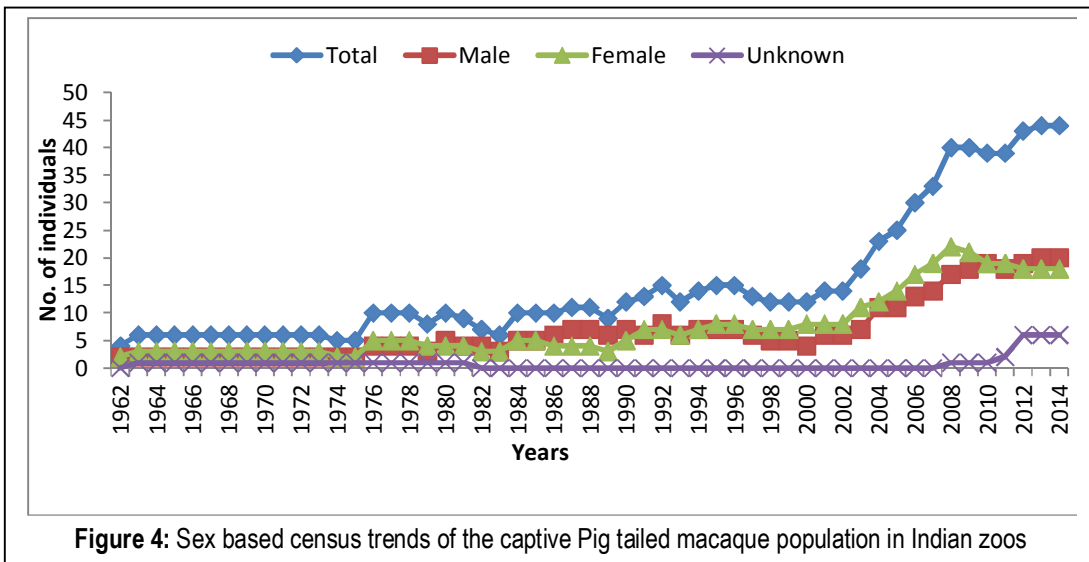
The development of effective population management plans is dependent on data availability in terms of knowledge of complete pedigree records and dates of events. The availability of data with reference to the Pig tailed macaque captive population in Indian zoos is summarised in Figure 3. A total of 14 institutions have housed the species since 1962; however data was available from only 11. These data limitations in conjunction with the small population size and the larger percentage of animals being of wild origin without birth date estimates limited demographic analysis of the population. Birth date estimates were unavailable for more than 70% of the wild-born individuals and complete parentages were recorded for 22 out of 35 captive births.



The results for select demographic and genetic parameters are provided in the following sections.

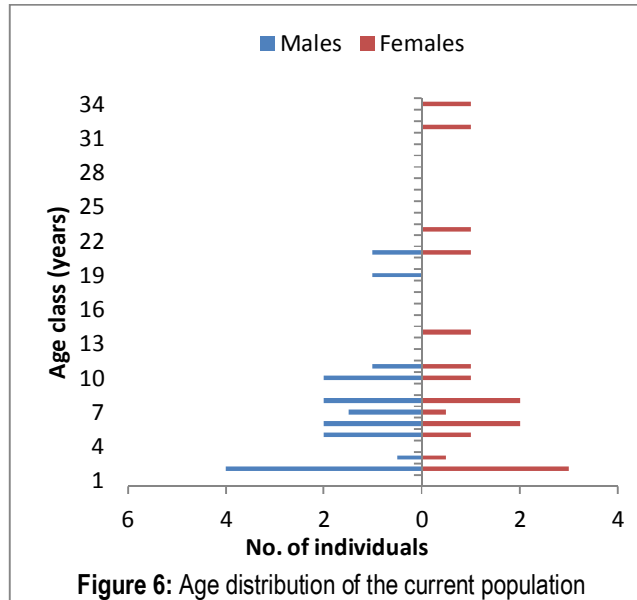
## Historical population

The historical population includes a total of 79 individuals (37: 34: 8) that have been recorded in Indian institutions from 1962 to 2013. Of these, 44 (22: 21: 1) were wild-born and 35 (15: 13: 7) were captive-born individuals. The sex based population trends are depicted in Figure 4. During the first 40 years the population remained small with a median of 10 ( $9.36 \pm 3.31$ ) individuals only, the numbers increased to a median of 39 ( $36.36 \pm 8.89$ ) individuals from 2003 to 2014. Figure 5 represents the population trends based on origin of animals over the years. The population reached a maximum of 44 in 2013. Figure 5 indicates that the increase in the population from 2000 to 2013 was due to both acquisitions from the wild as well as births in captivity. During the period 2000-2013, there were 20 acquisitions from the wild and 26 captive births.



### **Living population**

The current population contains 44 individuals (20: 18: 6), of which 22 are captive-born (7: 9: 6) and 22 wild-born (13: 9: 0). The sex ratio of the living individuals is 1.3:1. The ages of 33 (14: 13: 6) individuals are known. The current age–sex pyramid is shown in Fig. 6. The age distribution suggests that 8 individuals (24.24%) are in their pre reproductive ages (0-3 years); 18 individuals (57.57%) are in their reproductive ages (3-13 years) and 6 individuals (18.18%) are in their post reproductive ages. This suggests that with appropriate management interventions the species is capable of rapid growth required to provide a demographically stable captive population.



A total of 22 individuals (10 males, 12 females), or 50% of the current population, have bred at least once. Of these, 5 were captive-born and 17 were wild-born individuals. Among the females that had bred, 7 (58.3%) had one off spring each and 5 (41.6%) had two or more off springs.

#### **Data deficiency for construction of life tables**

Of the total 79 individuals data for life table analysis was available for only 48 individuals. And of the 48 individuals, 35 were captive-born and the rest were wild born for which only birth date estimates and not exact birth dates was available. Death dates were available for all the 15 dead individuals from the group. Age distribution of these 48 individuals showed that for each age class the number of individuals varied between 0 to 7 individuals. Since, for a life table analysis to provide valid results the data should be sufficient in terms of total numbers, age structure of the population (at least 30 individuals in each age class) and precise birth and death dates, the results of the life table for Pig tailed macaque population could not be used for drawing conclusions about the population.

#### **Captures, births and mortalities**

A total of 44 (22: 21: 1) individuals are of wild origin with a mean of  $0.78 \pm 1.3$  captures per year. The sex ratio of wild born individuals was 1.05:1. Birth date estimates were available for 13 individuals and the median age at capture for these individuals was 0.3 years ( $1.3 \pm 1$ ). The median time spent in captivity by all wild born individuals was 10 years ( $11.6 \pm 7.9$ ).

At present the captive population of Pig tailed macaques has reached a total of 44 individuals and is being maintained by a combination of acquisitions from the wild as well as captive births. The captive population had few individuals in the breeding pool (only 30% of the population has bred at least once) highlighting poor overall breeding success in the population.

In the current population however; out of a total of 44 individuals 22 individuals (10 males, 12 females), or 50% of the current population, have bred at least once. Of these, 5 were captive born and 17 were wild born individuals. Among the females that had bred, 7 (58.3%) had one off spring each and 5 (41.6%) had two or more off springs.

There were a total of 35 (15: 13: 7) births with a mean of  $0.67 \pm 1.3$  births per year. The sex ratio of captive births was 1.15:1. Out of 35 births, parentage for 22 was known, for the remaining births either or both the parent's identification was unknown. From a total of 42 wild origin individuals (excluding one that was lost to follow up and another that escaped) 19 have reproduced, 18 died without breeding and 6 are yet to contribute to breeding.

Of the 42 wild-born individuals (excluding one that was lost to follow up and another that escaped) 19 have reproduced, 18 died without breeding and 6 are yet to contribute to breeding. The wild-born individuals to have reproduced spent a median of 6 ( $7.36 \pm 3.9$ ) years before they reproduced for the first time in captivity, with about 26% (5 individuals) to have spent more than 10 years in captivity before breeding. Similar trends were also observed for the potential founders – they have been housed for a median of 7.5 ( $8 \pm 4.6$ ) years in captivity.

The fecundity of females (Table 3) of wild origin was the highest with 11 out of the 21 females breeding (slightly more than 50%) this declined in the F1 generation in captivity where only 3 of the 12 females reproduced (25%) while in the F2 generation the lone female reproduced. The wild born individuals to have reproduced spent a median of 6 ( $7.36 \pm 3.9$ ) years before they reproduced for the first time in captivity, with about 26% (5 individuals) to have spent more than 10 years in captivity before breeding. Similar trends were also observed for males (Table 4). The lowered reproductive rates over generations suggest deficiencies in husbandry probably in the nutritional aspects as literature suggests that low weights of females result in delayed age of sexual maturity and lowered reproductive potential.

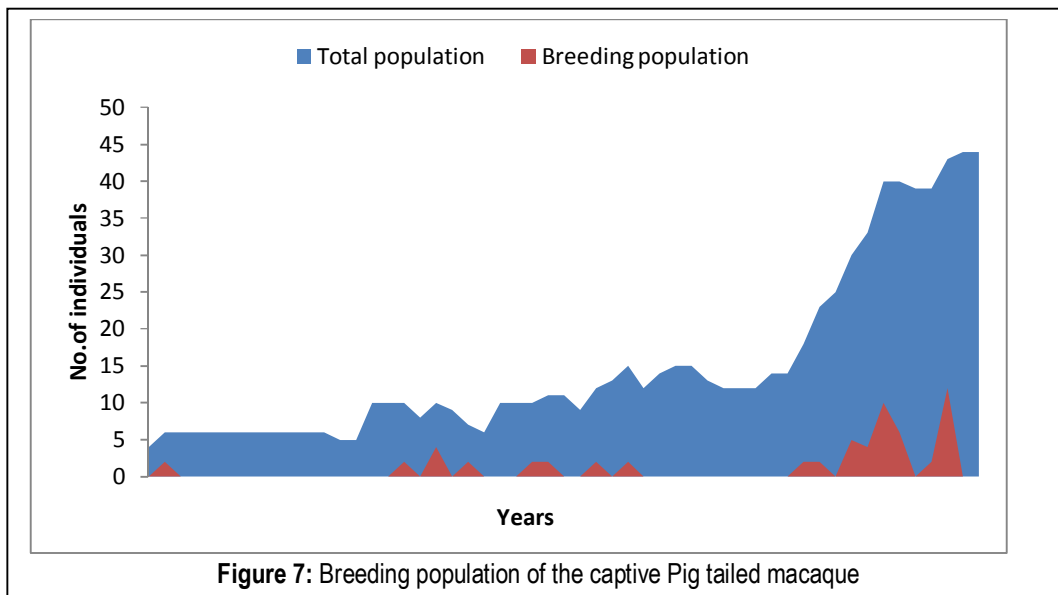
**Table 3:** Reproductive output per generation: female

	No. of females	No. of reproducing females	No. of infants	Mean no. of infants per reproducing female
F0	21	11	22	2
F1	12	3	6	2
F2	1	1	2	2
Total	34	15	30	2

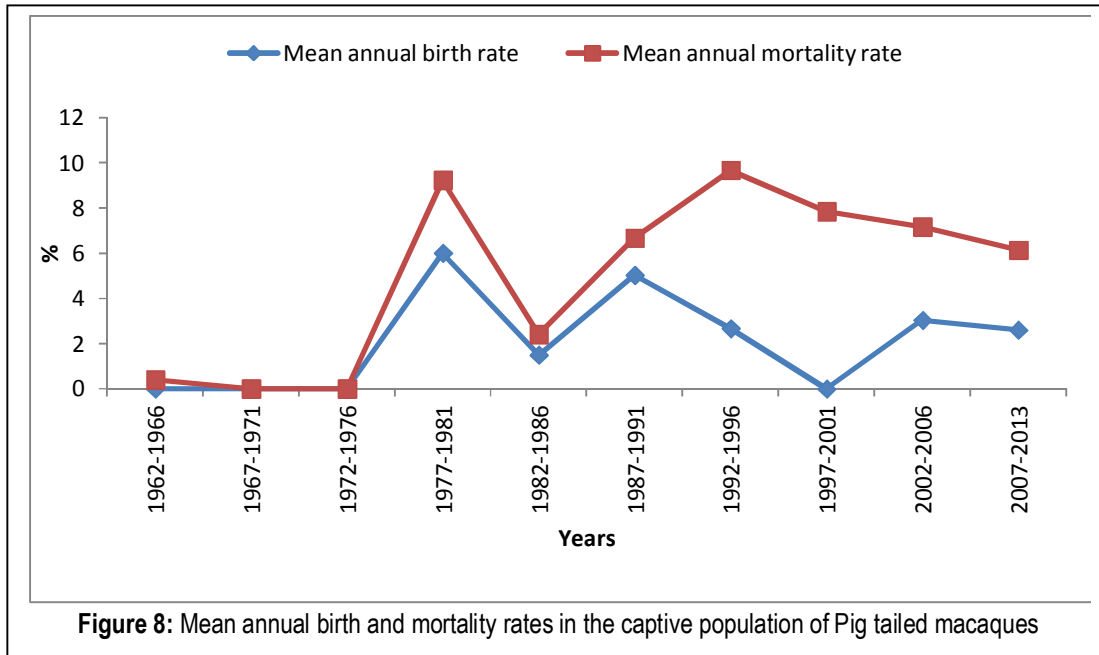
**Table 4:** Reproductive output per generation: male

	No. of males	No. of reproducing males	No. of infants	Mean no. of infants per reproducing male
F0	24	11	23	2.1
F1	8	0	0	0
F1.75	1	1	1	1
F2	4	0	0	1
Total	37	12	24	2

The breeding pool of the captive population (Figure 7) is a very small proportion of the total animals that form the living population throughout the history of the species in captivity. This lowered effective population size of the population results in poor retention of founder genetic diversity in the captive population and low population growth rates.



The cumulative birth and mortality rates of the captive population are depicted in Figure 8. A total of 33 (17: 14: 2) deaths were recorded. Of these 21 were wild born and 12 were captive born individuals. The mean annual mortality rate (Figure 8) was high during 1977-1981 and 1992-1996 and has decreased in the following years. The population shows a higher death rate than the birth rate throughout its history indicating that the growth in population observed is a result of inclusion of wild origin animals rather than captive births. This suggests that the population is currently demographically unstable as the population is unable to produce enough individuals to maintain itself.

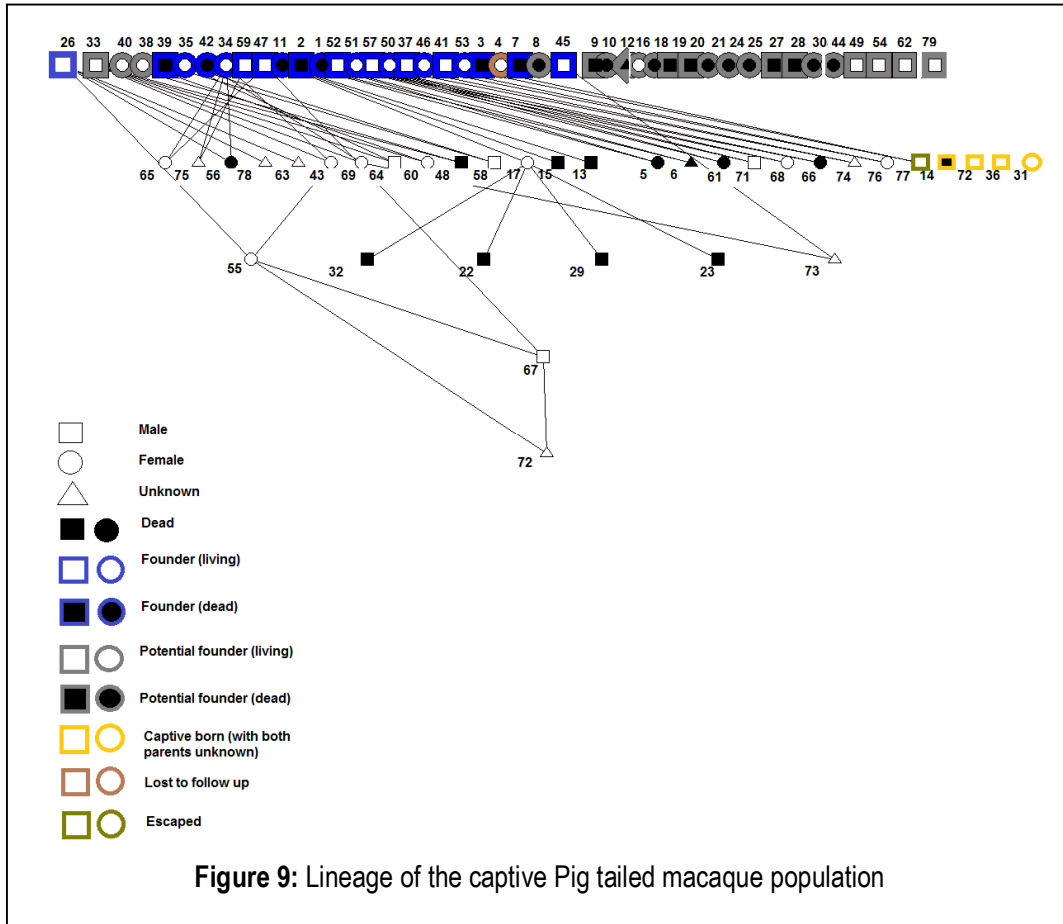


### Genetic analysis

Of the 22 captive born individuals in the living population complete parentage was known for 16 individuals, identification of one of the parents was known for 3 individuals and identification of both parents was unknown for 3 individuals. Therefore there are 17.5 descendants from the historical population. There are 16 founders and 6 potential founders in the current population (Figure 9).

The number of descendants is a fractional number as PMx excludes the 3 individuals with unknown parents from genetic analyses, and includes the 16 individuals with complete known parentage and calculates the individuals with one known parent as half an animal in genetic analyses.

The lineage of the captive population is summarized in Figure 9. Of the 21 wild-born females 11 have reproduced and of the remaining 10 only one is living. The population had a total of 22 wild origin males of which only 12 animals have contributed to the captive gene pool and additional 5 potential founders are present in the living population while the remaining animals have died without contributing to the gene pool of the captive population.



Based on birth date estimates and dates of capture, the median age of the founders was 10.5 years ( $12.5 \pm 5.13$ ) and the potential founders (excluding 1 individual of age 33 years) was 6 years ( $7 \pm 4.4$ ). The age distribution of the founders is shown in Figure 10. The founders reproduced for the first time in captivity after spending a median of 7.5 years ( $8.1 \pm 3.8$ ). The founders are housed in 4 institutions with more than 56% in Sepahijala Zoological Park, followed by Aizawl Zoo (25%), Sayajibaug Zoo (12.5%) and M.C. Zoological Park (6.25%). The 6 potential founders are housed in 5 institutions. The age as well as the zoos housing the potential founders is shown in Table 4.

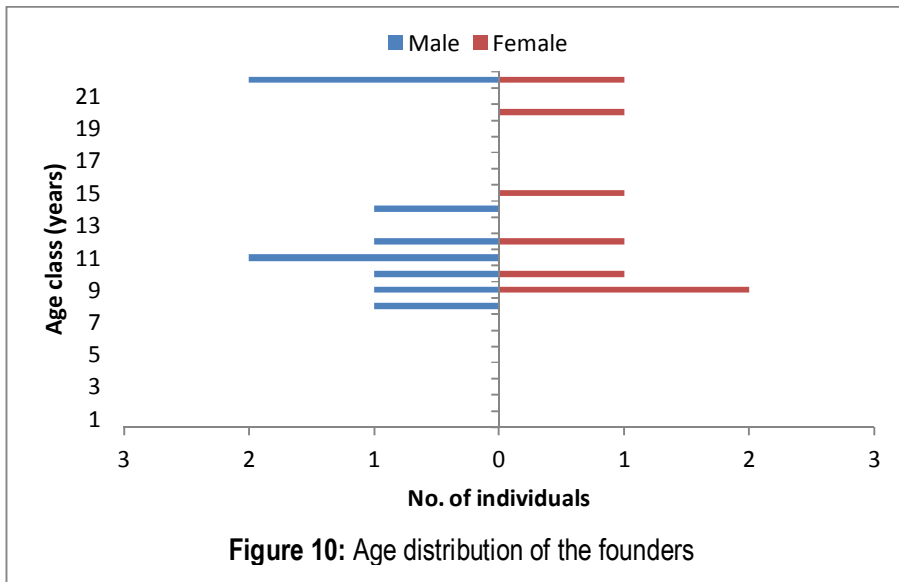


Figure 10: Age distribution of the founders

National Studbook No.	Sex	Location	Age (years)
16	Female	Chennai	33
40	Female	Chatbir	>13
49	Male	Sepahijala	9
54	Male	Aizawl	>6
62	Male	Dimapur	6
79	Male	Dimapur	1

Table 4: Age distribution of potential founders

*Founder representation and contribution*

The founder representations are depicted in figure 11. The distribution is skewed due to disproportionate breeding among the founders. More than 25% of the gene pool has been contributed by one male, NSN 33 with 8 descendants in the living population.

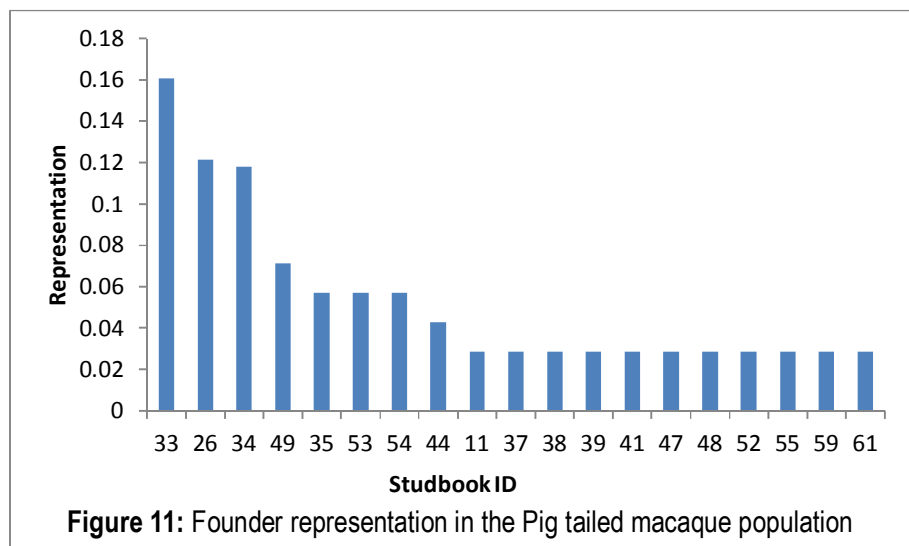


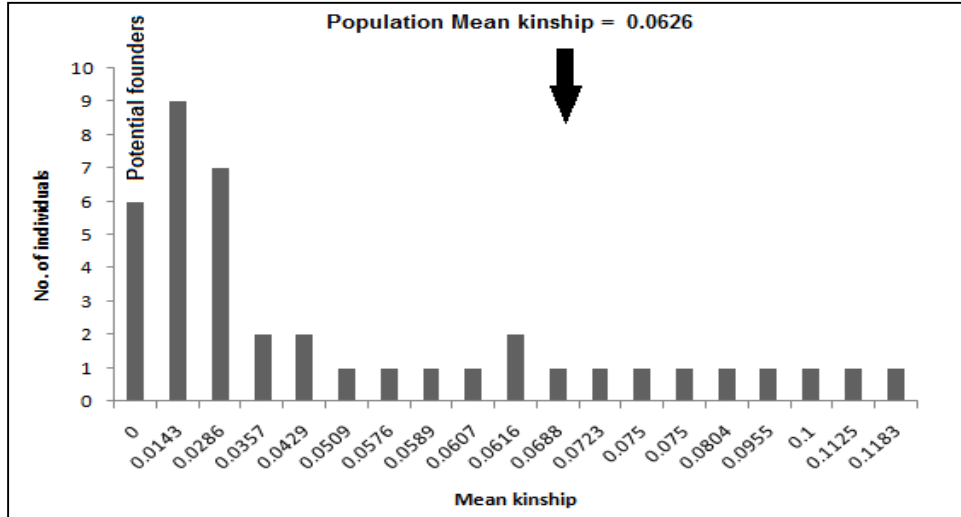
Figure 11: Founder representation in the Pig tailed macaque population

More than 86% of the captive born individuals in the current population have descended from 3 founders (NSN 33, 26 and 34), indicating over-representation of these founders. This has resulted in the over-representation of a few animals in the captive gene pool at the expense of other animals with no or under-representation resulting in lower gene diversity.



## Population mean kinship

The population mean kinship was 0.0626. A mean kinship of 0.063 is equivalent to an individual being related to the population on average at the level of first cousin. This indicates a lower retention of genetic diversity due to unequal founder representation and unplanned mating choices.



**Figure 13:** Mean kinship values in the living population of Pig Tailed macaque

Mean kinship (MK) is a measure of relatedness of individuals in a population. Mean kinship gives a numerical value to how closely related each animal is to the others in the population. Animals with a lower mean kinship values have relatively fewer genes in common with the rest of the population, and are therefore more genetically valuable in a breeding program.

## Gene diversity

Gene diversity is the principal measure of genetic diversity in populations and ranges between 0 and 1. Current retained gene diversity is 0.9374. This signifies that the population has retained 93.74% of the founder gene diversity. However; a large part of this may be ascribed to the fact that the current population comprises of 50% wild origin individuals.

## Inbreeding

The mean inbreeding coefficient is the average of the inbreeding coefficients among the living individuals, weighted by the % known for each individual. Over 93 % of the living population shows an inbreeding coefficient of zero. For the remaining ~7% either the inbreeding coefficient is not known or have relatively high inbreeding coefficient of 0.25. The mean inbreeding coefficient of the population is 0.0156.

## Summary

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

- The animals are maintained in inappropriate social groups at most institutions.
- 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) and lineages 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 zoos need to be assessed and shortcomings identified and addressed.

The species shows female 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 across the various holding institutions 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 all holding zoos to maintain complete records of all events in each individual's life history.

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Historical population *Macaca nemestrina*

Sl. no.	Studbook no.	House name Local ID Transponder	Sex	Birth date	Sire	Dam	Location	Date	Event
1.	1		F	????	Wild	Wild	India Delhi	~ 1962 ~ 1962 30-Oct-79	Capture Transfer Death
2.	2		M	????	Wild	Wild	India Delhi	~ 1962 ~ 1962 05-Jan-78	Capture Transfer Death
3.	3		M	????	Wild	Wild	India Delhi	~ 1962 ~ 1962 ~ 1995	Capture Transfer Death
4.	4						India Delhi	~ 1962 ~ 1962	Capture Transfer
5.	5		F	07-Mar-19	63	21	Bhilai Delhi	07-Aug-74 07-Mar-63 11-Jan-86	Death Birth Death
6.	6		?	07-Mar-19	63	21	Delhi	07-Mar-63 08-Sep-82	Birth Death
7.	7		M	????	Wild	Wild	India Kanpur	~ 1976 01-Apr-76 23-Apr-81	Capture Transfer Death
8.	8		F	????	Wild	Wild	India Lucknow	~ 1976 ~ 1976 31-Jan-09	Capture Transfer Death

Sl. no.	Studbook no.	House name Local ID Transponder	Sex	Birth date	Sire	Dam	Location	Date	Event
9.	9		M	????	Wild	Wild	India Kanpur	~ 1976 01-Apr-76 23-Feb-79	Capture Transfer Death
10.	10		F	????	Wild	Wild	India Kanpur	~ 1976 01-Apr-76 07-Jul-82	Capture Transfer Death
11.	11		F	????	Wild	Wild	India Kanpur	~ 1976 01-Apr-76 13-Jul-82	Capture Transfer Death
12.	12		?	????	Wild	Wild	India Lucknow	???? ???? 30-Nov-89	Capture Transfer Death
13.	13		M	~ Apr 1978	Unk	11	Kanpur	~ Apr 1978 23-Aug-89	Birth Death
14.	14		M	01-Mar-1980	Unk	11	Kanpur Delhi India	01-Mar-80 10-Mar-83 20-Nov-91	Birth Transfer Release
15.	15		M	10-Jul-1980	Unk	11	Kanpur	10-Jul-80 20-Mar-83	Birth Death
16.	16		F	~ 1980	Wild	Wild	India Voc Pk Zoo Chennai	???? ???? 06-Dec-03	Capture Transfer Transfer
17.	17		F	20-Mar-82	Unk	11	Kanpur Chatbir Z	20-Mar-82 14-Jul-00	Birth Transfer

Sl. no.	Studbook no.	House name Local ID Transponder	Sex	Birth date	Sire	Dam	Location	Date	Event
18.	18		F	????	Wild	Wild	India Chhat Bir	~ Feb 1984 01-Apr-84 ~ 2006	Capture Transfer Death
19.	19		M	????	Wild	Wild	India Chhat Bir	~ Feb 1984 01-Apr-84 ~ 2000	Capture Transfer Death
20.	20		M	????	Wild	Wild	Burma Yangon Calcutta	~ 1984 ~ 1984 ~ Apr 1985 01-Oct-05	Capture Transfer Transfer Death
21.	21		F	????	Wild	Wild	Burma Yangon Calcutta	~ 1984 ~ 1984 ~ Apr 1985 ~ Jan 1989	Capture Transfer Transfer Death
22.	22		M	10-Jun-1986	Unk	17	Kanpur	10-Jun-86 16-Jun-93	Birth Death
23.	23		M	07-Aug-1987	Unk	17	Kanpur	07-Aug-87 12-Jul-93	Birth Death
24.	24		F	????	Wild	Wild	India Ahmedabad	~ 1990 ~ 1990 12-Mar-97	Capture Transfer Death
25.	25		F	????	Wild	Wild	India Ahmedabad	~ 1990 ~ 1990 11-Jan-01	Capture Transfer Death



Sl. no.	Studbook no.	House name Local ID Transponder	Sex	Birth date	Sire	Dam	Location	Date	Event
26.	26	Bejoy	M	????	Wild	Wild	India Sepahijal Chatbir Z	10-Apr-93 10-Apr-93 15-Dec-06	Capture Transfer Transfer
27.	27		M	????	Wild	Wild	India Hyderabad Ahmedabad	???? ???? 26-Oct-94 02-May-98	Capture Transfer Transfer Death
28.	28		M	????	Wild	Wild	India Calcutta	~ Aug 1992 ~ Aug 1992 01-Jul-93	Capture Transfer Death
29.	29		M	07-Oct-1990	Unk	17	Kanpur	07-Oct-90 12-Jul-93	Birth Death
30.	30		F	????	Wild	Wild	India Calcutta	~ Oct 1991 ~ Oct 1991 ~ Jun 1993	Capture Transfer Death
31.	31		F	29-Oct-91	Unk	Unk	Assam	29-Oct-91	Birth
32.	32		M	~ 1992	Unk	17	Kanpur	~ 1992 02-Sep-97	Birth Death
33.	33	Swapan 0006b72f99	M	~ Apr 1993	Wild	Wild	India Sepahijal	14-Jun-93 14-Jun-93	Capture Transfer
34.	34	Aisharia 0006b71222	F	~ May 1993	Wild	Wild	India Sepahijal	20-Jul-94 20-Jul-94	Capture Transfer
35.	35	Sonali/Hyder 20136 0006B722E1	F	????	Wild	Wild	India Sepahijal Hyderabad	14-Apr-95 14-Apr-95 18-Mar-11	Capture Transfer Transfer

Sl. no.	Studbook no.	House name Local ID Transponder	Sex	Birth date	Sire	Dam	Location	Date	Event
36.	36	Unnamed	M	25-Nov-95	Unk	Unk	Assam	25-Nov-95	Birth
37.	37	Patea 089102058423	M	????	Wild	Wild	India Aizawl	12-Apr-01 13-Apr-01	Capture Transfer
38.	38	Milli 0006b722c3	F	~ May 2000	Wild	Wild	India Sepahijal	20-Aug-00 20-Aug-00	Capture Transfer
39.	39	Amit 0006B727B5 PMSP11 PTM1	M	????	Wild	Wild	India Sepahijala Hyderabad	16-Mar-01 16-Mar-01 18-Mar-11 01-Jul-11	Capture Transfer Transfer Death
40.	40	Sonali	F	????	Wild	Wild	India Sepahijal Chatbir Z	23-Oct-01 23-Oct-01 15-Dec-06	Capture Transfer Transfer
41.	41	Hunter 089102058423	M	????	Wild	Wild	India Aizawl	09-May-03 10-May-03	Capture Transfer
42.	42	Kajali 000658EF7E	F	~ 2003	Wild	Wild	India Sepahijala	16-Mar-05 06-Nov-12	Capture Death
43.	43	Sarabani	F	12-Jul-03	33	34	Sepahijal	12-Jul-03	Birth
44.	44	PMSP7	F	~ Oct 2003	Wild	Wild	India Sepahijala	23-Oct-03 23-Oct-03 06-Jul-10	Capture Transfer Death
45.	45	Sudhir 0006B7EB25	M	~ Jan 2004	Wild	Wild	India Sepahijal	09-May-04 09-May-04	Capture Transfer
46.	46	Nutei 089102058424	F	????	Wild	Wild	India Aizawl	10-Jun-04 11-Jun-04	Capture Transfer

Sl. no.	Studbook no.	House name Local ID Transponder	Sex	Birth date	Sire	Dam	Location	Date	Event
47.	47	Manish 0006b74444	M	~ Mar 2004	Wild	Wild	India Sepahijal	21-May-04 21-May-04	Capture Transfer
48.	48	Pradip 0006B8A2E7 PMSP15	M	23-Mar-2004	33	40	Sepahijala	23-Mar-04 07-Dec-09	Birth Death
49.	49	Ripan 0006B88519	M	~ Sep 2004	Wild	Wild	India Sepahijal	12-Oct-04 12-Oct-04	Capture Transfer
50.	50	Rina 0006B88519	F	~ Sep 2004	Wild	Wild	India Sepahijal	16-Mar-06 16-Mar-06	Capture Transfer
51.	51	Babli	F	????	Wild	Wild	India Vadodara	21-Apr-05 21-Apr-05	Capture Transfer
52.	52	Banty	M	????	Wild	Wild	India Vadodara	21-Apr-05 21-Apr-05	Capture Transfer
53.	53	Govi 089102058425	F	????	Wild	Wild	India Aizawl	03-May-06 06-May-06	Capture Transfer
54.	54	Tea 098102058427	M	????	Wild	Wild	India Aizawl	19-Mar-08 20-Mar-08	Capture Transfer
55.	55	BURI 0006B72F3A	F	22-Jul-06	26	45	Sepahijal	22-Jul-06	Birth
56.	56	Minu 0006B89508 PMSP-9	F	22-Jul-2006	26	34	Sepahijala	22-Jul-06 02-Feb-10	Birth Death
57.	57	Ritesh 0006B71AC6	M	~ Aug 2006	Wild	Wild	India Sepahijal	25-Oct-06 25-Oct-06	Capture Transfer
58.	58	Kumar 0006B74968	M	18-Oct-06	39	35	Sepahijal	18-Oct-06	Birth

Sl. no.	Studbook no.	House name Local ID Transponder	Sex	Birth date	Sire	Dam	Location	Date	Event
59.	59	Mir	M	????	Wild	Wild	India Sepahijal	02-Jan-07 02-Jan-07	Capture Transfer
60.	60	Shashi 0006B72897	F	23-Jan-07	33	38	Sepahijal	23-Jan-07	Birth
61.	61	Geeta	F	04-Aug-2007	54	53	Vadodara	04-Aug-07 30-Apr-12	Birth Death
62.	62	Buda	M	~ 2008	Wild	Wild	India Dimapur	~ 2010 ~ 2010	Capture Transfer
63.	63		?	~ 2008	26	Unk	Chatbir Z	~ 2008	Birth
64.	64	Misthu 00065659038F	M	16-Mar-08	33	35	Sepahijal	16-Mar-08	Birth
65.	65	Maman 0006590471	F	05-Jun-08	49	34	Sepahijal	05-Jun-08	Birth
66.	66	Sita	F	~ 2008	54	53	Vadodara	~ 2008 13-Sep-09	Birth Death
67.	67	Manik 0006B72897	M	02-Jul-08	49	57	Sepahijal	02-Jul-08	Birth
68.	68	Janki	F	16-Aug-08	54	53	Vadodara	16-Aug-08	Birth
69.	69	Trisha 0006584D34	F	12-Mar-09	33	44	Sepahijal	12-Mar-09	Birth
70.	70	Unnamed	M	24-Sep-09	Unk	Unk	Assam	24-Sep-09	Birth
71.	71	Jugnu	M	03-Dec-09	54	53	Vadodara	03-Dec-09	Birth
72.	72	PMSP30	?	22-Feb-11	69	57	Sepahijal	22-Feb-11	Birth
73.	73	PMSP29	?	11-Feb-12	47	71	Sepahijal	11-Feb-12	Birth
74.	74	PMSP31	?	05-Mar-12	59	52	Sepahijal	05-Mar-12	Birth
75.	75	PMSP32	?	19-Apr-12	61	34	Sepahijal	19-Apr-12	Birth
76.	76	Latei	F	06-Jun-12	37	48	Aizawl	06-Jun-12	Birth

Sl. no.	Studbook no.	House name Local ID Transponder	Sex	Birth date	Sire	Dam	Location	Date	Event
		089102058426							
77.	77	Papuia 089102058428	M	07-Aug-12	41	55	Aizawl	07-Aug-12	Birth
78.	78	Unnamed	?	~ 2012	26	Unk	Chatbir Z	~ 2012	Birth
79.	79	PTM02	M	~ Dec 2012	Wild	Wild	India	17-Oct-13	Capture
Totals I= 37.34.8 (79)									

Living population listing of *Macaca nemestrina*

Sl. no	National Studbook no.	Local identifiers House name Local ID. Transponder ID	Sex	Date of birth	Sire	Dam	Location	Date	Event
1.	16		F	~ 1980	Wild	Wild	India Voc Pk zoo Chennai	???? ???? 06-Dec-03	Capture Transfer Transfer
2.	17		F	20-Mar-82	Unk	11	Kanpur Chatbir Z	20-Mar-82 14-Jul-00	Birth Transfer
3.	26	Bejoy	M	????	Wild	Wild	India Sepahijal Chatbir Z	10-Apr-93 10-Apr-93 15-Dec-06	Capture Transfer Transfer
4.	31		F	29-Oct-91	Unk	Unk	Assam	29-Oct-91	Birth
5.	33	Swapan 0006b72f99	M	~ Apr 1993	Wild	Wild	India Sepahijal	14-Jun-93 14-Jun-93	Capture Transfer
6.	34	Aisharia 0006b71222	F	~ May 1993	Wild	Wild	India Sepahijal	20-Jul-94 20-Jul-94	Capture Transfer
7.	35	Sonali/Hyder 20136 0006B722E1	F	????	Wild	Wild	India Sepahijal Hyderabad	14-Apr-95 14-Apr-95 18-Mar-11	Capture Transfer Transfer
8.	36	Unnamed	M	25-Nov-95	Unk	Unk	Assam	25-Nov-95	Birth
9.	37	Patea 089102058423	M	????	Wild	Wild	India Aizawl	12-Apr-01 13-Apr-01	Capture Transfer
10.	38	Milli 0006b722c3	F	~ May 2000	Wild	Wild	India Sepahijal	20-Aug-00 20-Aug-00	Capture Transfer

Sl. no	National Studbook no.	Local identifiers House name Local ID. Transponder ID	Sex	Date of birth	Sire	Dam	Location	Date	Event
11.	40	Sonali	F	????	Wild	Wild	India Sepahijal Chatbir Z	23-Oct-01 23-Oct-01 15-Dec-06	Capture Transfer Transfer
12.	41	Hunter 089102058423	M	????	Wild	Wild	India Aizawl	09-May-03 10-May-03	Capture Transfer
13.	43	Sarabani	F	12-Jul-03	33	34	Sepahijal	12-Jul-03	Birth
14.	45	Sudhir 0006B7EB25	M	~ Jan 2004	Wild	Wild	India Sepahijal	09-May-04 09-May-04	Capture Transfer
15.	46	Nutei 089102058424	F	????	Wild	Wild	India Aizawl	10-Jun-04 11-Jun-04	Capture Transfer
16.	47	Manish 0006b74444	M	~ Mar 2004	Wild	Wild	India Sepahijal	21-May-04 21-May-04	Capture Transfer
17.	49	Ripan 0006B88519	M	~ Sep 2004	Wild	Wild	India Sepahijal	12-Oct-04 12-Oct-04	Capture Transfer
18.	50	Rina 0006B88519	F	~ Sep 2004	Wild	Wild	India Sepahijal	16-Mar-06 16-Mar-06	Capture Transfer
19.	51	Babli	F	????	Wild	Wild	India Vadodara	21-Apr-05 21-Apr-05	Capture Transfer
20.	52	Banty	M	????	Wild	Wild	India Vadodara	21-Apr-05 21-Apr-05	Capture Transfer
21.	53	Govi 089102058425	F	????	Wild	Wild	India Aizawl	03-May-06 06-May-06	Capture Transfer
22.	54	Tea 098102058427	M	????	Wild	Wild	India Aizawl	19-Mar-08 20-Mar-08	Capture Transfer
23.	55	BURI	F	22-Jul-06	26	45	Sepahijal	22-Jul-06	Birth

Sl. no	National Studbook no.	Local identifiers House name Local ID. Transponder ID	Sex	Date of birth	Sire	Dam	Location	Date	Event
		0006B72F3A							
24.	57	Ritesh 0006B71AC6	M	~ Aug 2006	Wild	Wild	India Sepahijal	25-Oct-06 25-Oct-06	Capture Transfer
25.	58	Kumar 0006B74968	M	18-Oct-06	39	35	Sepahijal	18-Oct-06	Birth
26.	59	Mir	M	????	Wild	Wild	India Sepahijal	02-Jan-07 02-Jan-07	Capture Transfer
27.	60	Shashi 0006B72897	F	23-Jan-07	33	38	Sepahijal	23-Jan-07	Birth
28.	62	Buda	M	~ 2008	Wild	Wild	India Dimapur	~ 2010 ~ 2010	Capture Transfer
29.	63		?	~ 2008	26	UNK	Chatbir Z	~ 2008	Birth
30.	64	Misthu 00065659038F	M	16-Mar-08	33	35	Sepahijal	16-Mar-08	Birth
31.	65	Maman 0006590471	F	05-Jun-08	49	34	Sepahijal	05-Jun-08	Birth
32.	67	Manik 0006B72897	M	02-Jul-08	49	57	Sepahijal	02-Jul-08	Birth
33.	68	Janki	F	16-Aug-08	54	53	Vadodara	16-Aug-08	Birth
34.	69	Trisha 0006584D34	F	12-Mar-09	33	44	Sepahijal	12-Mar-09	Birth
35.	70	Unnamed	M	24-Sep-09	Unk	Unk	Assam	24-Sep-09	Birth
36.	71	Jugnu	M	03-Dec-09	54	53	Vadodara	03-Dec-09	Birth
37.	72	PMSP30	?	22-Feb-11	69	57	Sepahijal	22-Feb-11	Birth
38.	73	PMSP29	?	11-Feb-12	47	71	Sepahijal	11-Feb-12	Birth
39.	74	PMSP31	?	05-Mar-12	59	52	Sepahijal	05-Mar-12	Birth



Sl. no	National Studbook no.	Local identifiers House name Local ID. Transponder ID	Sex	Date of birth	Sire	Dam	Location	Date	Event
40.	75	PMSP32	?	19-Apr-12	61	34	Sepahijal	19-Apr-12	Birth
41.	76	Latei 089102058426	F	06-Jun-12	37	48	Aizawl	06-Jun-12	Birth
42.	77	Papuia 089102058428	M	07-Aug-12	41	55	Aizawl	07-Aug-12	Birth
43.	88	Unnamed	?	~ 2012	26	UNK	Chatbir Z	~ 2012	Birth
44.	79	PTM02	M	~ Dec 2012	Wild	Wild	India Dimapur	17-Oct-13 17-Oct-13	Capture Transfer
Totals: 20.18.6 (44)									

## Pedigree Chart Report Pig Tailed Macaque Studbook

=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 1  
 =====

WILD

WILD



Sex: Female  
 Birth Date: ????  
 Last Location: DELHI (dead)  
 House Name:  
 Tattoo:  
 Tag/Band:

=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 2  
 =====

WILD

WILD

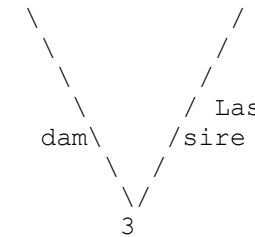


Sex: Male  
 Birth Date: ????  
 Last Location: DELHI (dead)  
 House Name:  
 Tattoo:  
 Tag/Band:

=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 3  
 =====

WILD

WILD

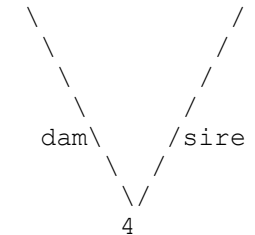


Sex: Male  
 Birth Date: ????  
 Last Location: DELHI (dead)  
 House Name:  
 Tattoo:  
 Tag/Band:

=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 4  
 =====

WILD

WILD



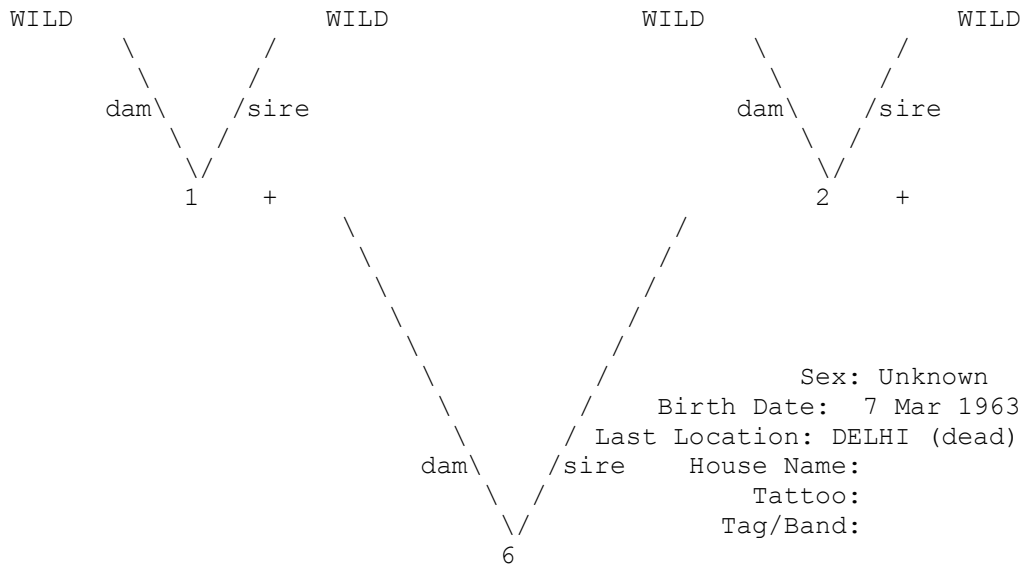
Sex: Female  
 Birth Date: ????  
 Last Location: BHILAI  
 House Name:  
 Tattoo:  
 Tag/Band:

=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 5  
 =====



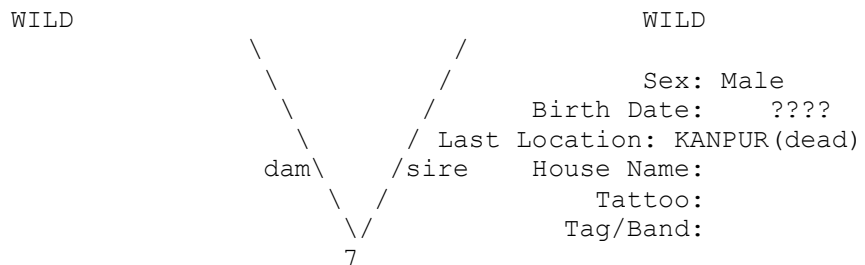
+ Wild-caught...

=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 6  
 =====



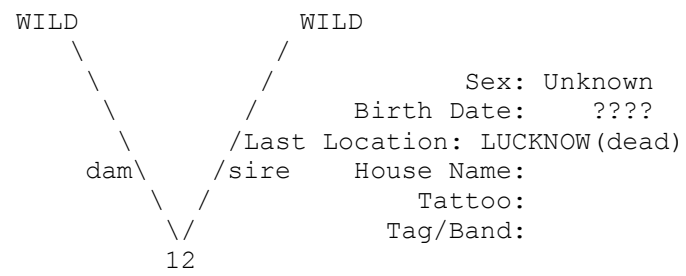
+ Wild-caught...

=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 7  
 =====

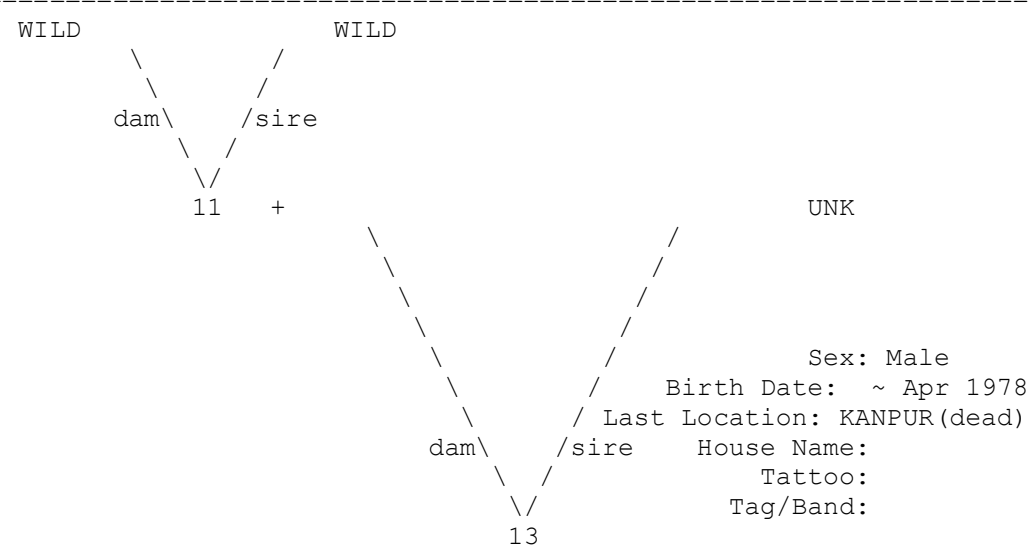




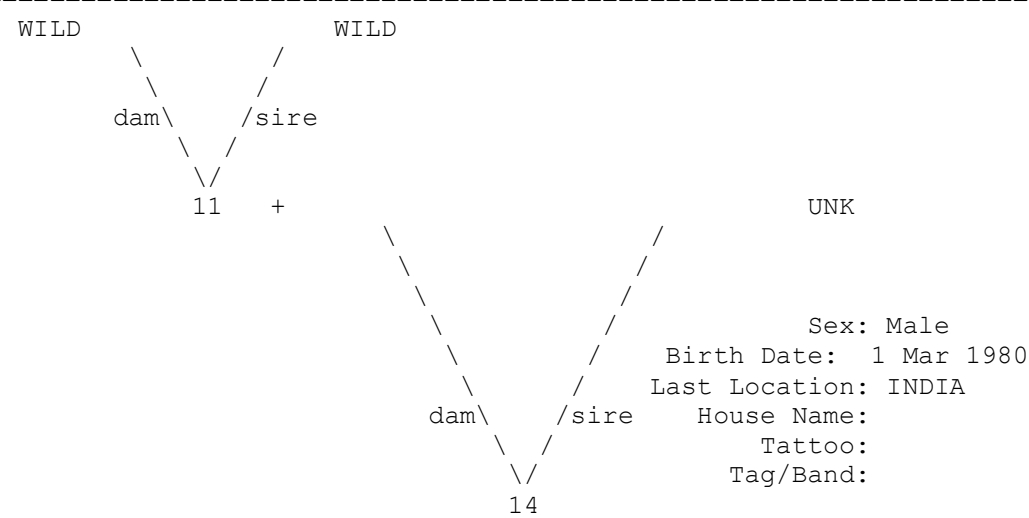
=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 12  
 =====



=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 13  
 =====

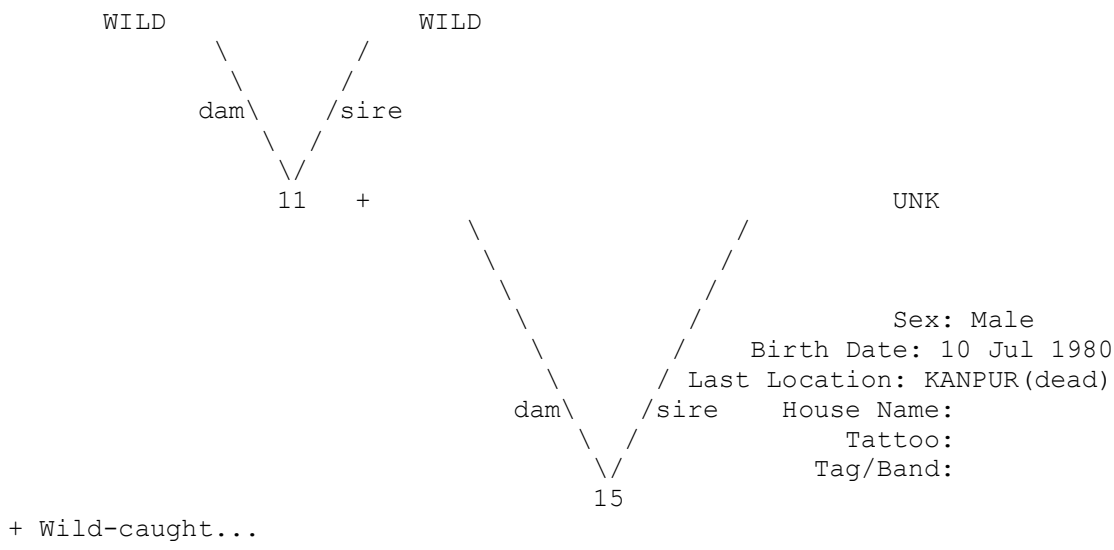


=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 14  
 =====

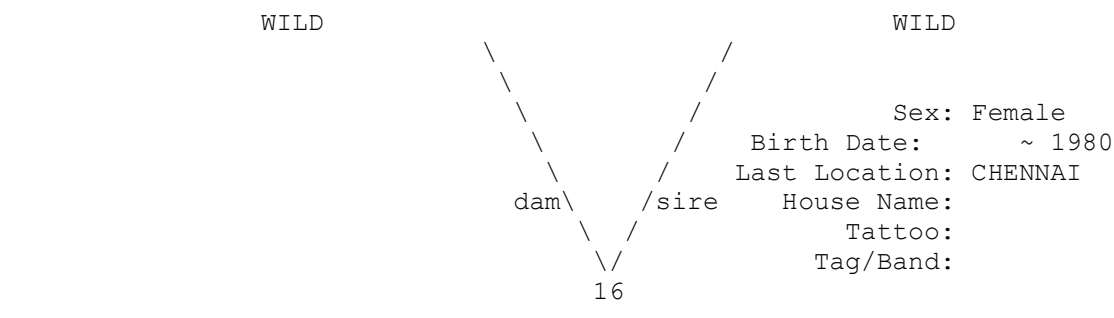


+ Wild-caught...

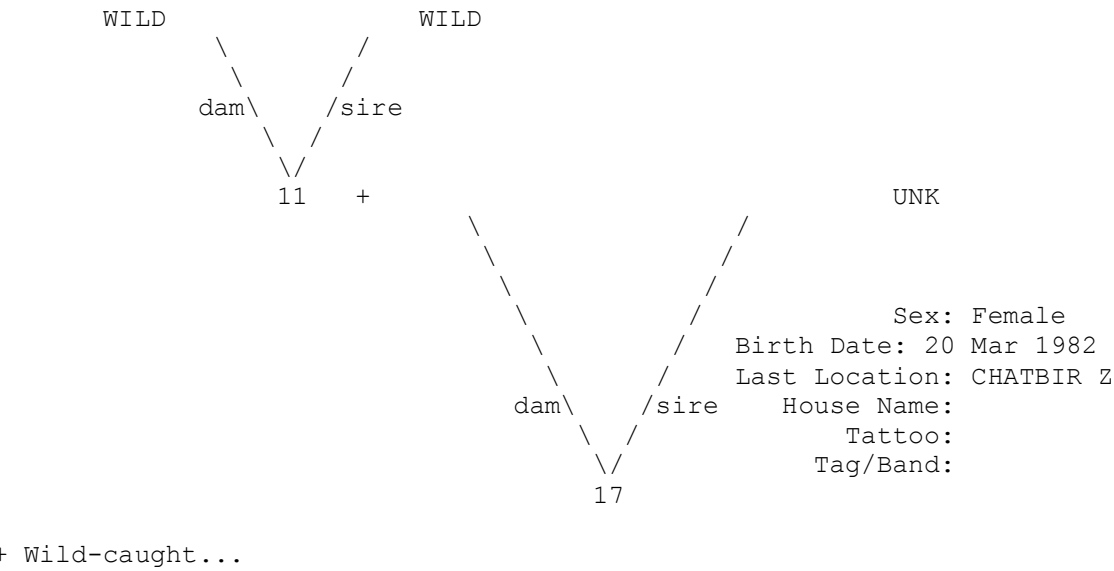
=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 15  
 =====



=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 16  
 =====



=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 17  
 =====



```

=====
Taxon Name: MACACA NEMESTRINA                      Studbook Number: 18
=====
                                WILD                WILD
                                \                    /
                                \                  /
                                \                /
                                \              /
                                \            /
                                \          /
                                \        /
                                \      /
                                \    /
                                \  /
                                \ /
                                \/
                                18
                                Sex: Female
                                Birth Date:  ???
                                Last Location: CHHATBIR (dead)
                                House Name:
                                Tattoo:
                                Tag/Band:

```

```

=====
Taxon Name: MACACA NEMESTRINA                      Studbook Number: 19
=====
                                WILD                WILD
                                \                    /
                                \                  /
                                \                /
                                \              /
                                \            /
                                \          /
                                \        /
                                \      /
                                \    /
                                \  /
                                \ /
                                \/
                                19
                                Sex: Male
                                Birth Date:  ???
                                Last Location: CHHATBIR (dead)
                                House Name:
                                Tattoo:
                                Tag/Band:

```

```

=====
Taxon Name: MACACA NEMESTRINA                      Studbook Number: 20
=====
                                WILD                WILD
                                \                    /
                                \                  /
                                \                /
                                \              /
                                \            /
                                \          /
                                \        /
                                \      /
                                \    /
                                \  /
                                \ /
                                \/
                                20
                                Sex: Male
                                Birth Date: ???
                                Last Location: CALCUTTA (dead)
                                House Name:
                                Tattoo:
                                Tag/Band:

```

```

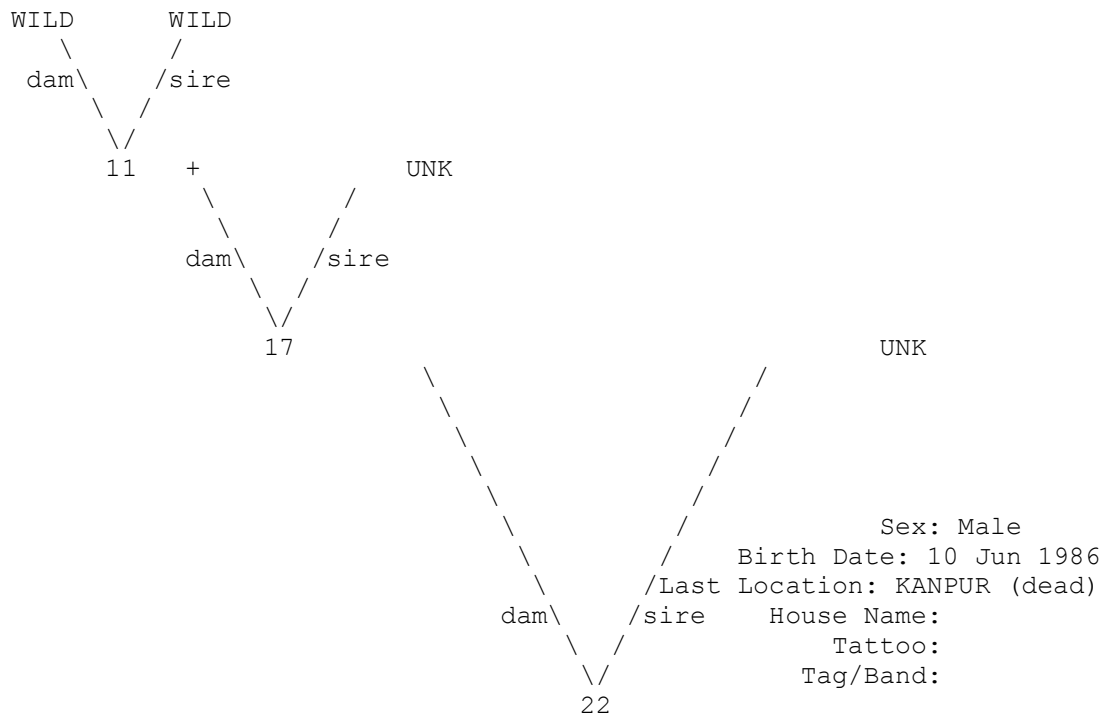
=====
Taxon Name: MACACA NEMESTRINA                      Studbook Number: 21
=====
                                WILD                WILD
                                \                    /
                                \                  /
                                \                /
                                \              /
                                \            /
                                \          /
                                \        /
                                \      /
                                \    /
                                \  /
                                \ /
                                \/
                                21
                                Sex: Female
                                Birth Date:  ???
                                Last Location: CALCUTTA (dead)
                                House Name:
                                Tattoo:
                                Tag/Band:

```

```

=====
Taxon Name: MACACA NEMESTRINA                               Studbook Number: 22
=====

```

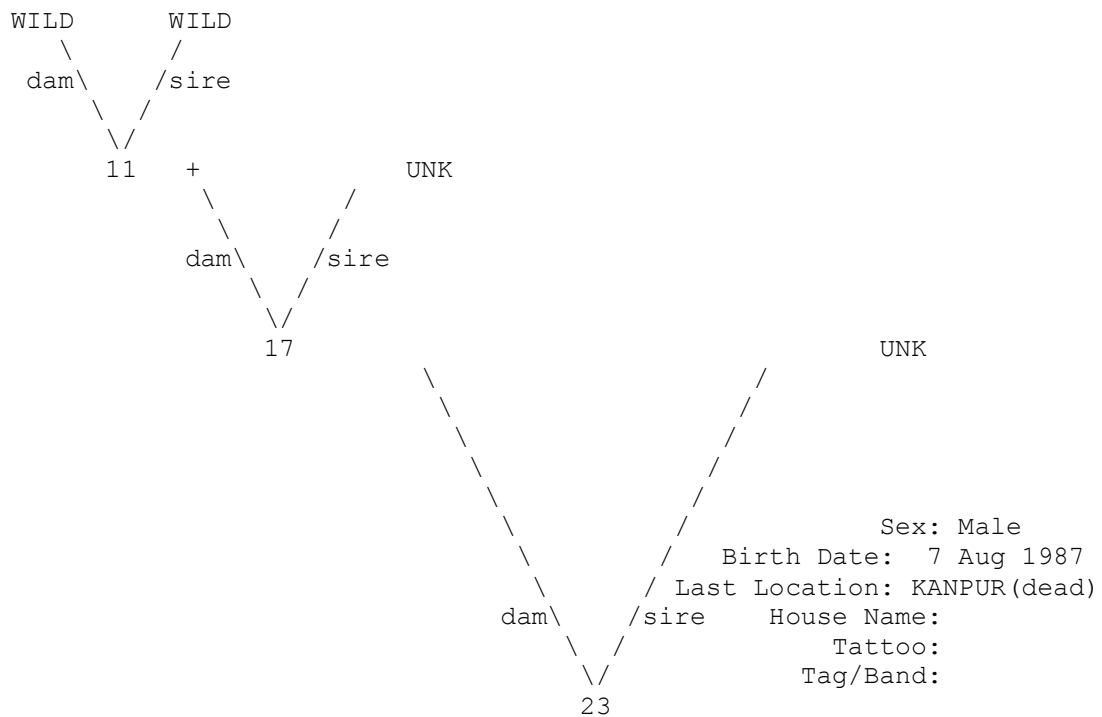


+ Wild-caught...

```

=====
Taxon Name: MACACA NEMESTRINA                               Studbook Number: 23
=====

```



+ Wild-caught...





```

=====
Taxon Name: MACACA NEMESTRINA                      Studbook Number: 28
=====
                                WILD                WILD
                                \                    /
                                dam\                /sire
                                      \            /
                                      \          /
                                      \        /
                                      \      /
                                      \    /
                                      \  /
                                      \ /
                                      \/
                                      28
                                Sex: Male
                                Birth Date:  ???
                                Last Location: CALCUTTA (dead)
                                House Name:
                                Tattoo:
                                Tag/Band:

```

```

=====
Taxon Name: MACACA NEMESTRINA                      Studbook Number: 29
=====
                                WILD                WILD
                                \                    /
                                dam\                /sire
                                      \            /
                                      \          /
                                      \        /
                                      \      /
                                      \    /
                                      \  /
                                      \ /
                                      \/
                                      11
                                +
                                \                    /
                                dam\                /sire
                                      \            /
                                      \          /
                                      \        /
                                      \      /
                                      \    /
                                      \  /
                                      \ /
                                      \/
                                      17
                                UNK
                                \                    /
                                dam\                /sire
                                      \            /
                                      \          /
                                      \        /
                                      \      /
                                      \    /
                                      \  /
                                      \ /
                                      \/
                                      29
                                UNK
                                Sex: Male
                                Birth Date:  7 Oct 1990
                                Last Location: KANPUR (dead)
                                House Name:
                                Tattoo:
                                Tag/Band:

```

+ Wild-caught...

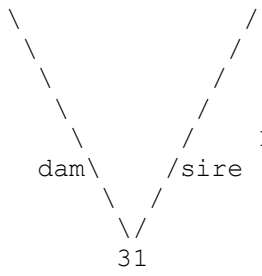
```

=====
Taxon Name: MACACA NEMESTRINA                      Studbook Number: 30
=====
                                WILD                WILD
                                \                    /
                                dam\                /sire
                                      \            /
                                      \          /
                                      \        /
                                      \      /
                                      \    /
                                      \  /
                                      \ /
                                      \/
                                      30
                                Sex: Female
                                Birth Date:  ???
                                Last Location: CALCUTTA (dead)
                                House Name:
                                Tattoo:
                                Tag/Band:

```

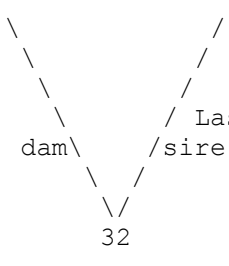
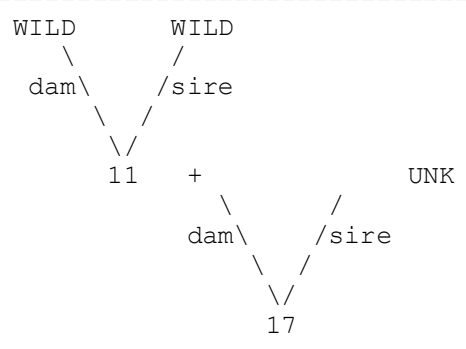
=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 31  
 =====

UNK UNK



Sex: Female  
 Birth Date: 29 Oct 1991  
 Last Location: ASSAM  
 House Name:  
 Tattoo:  
 Tag/Band:

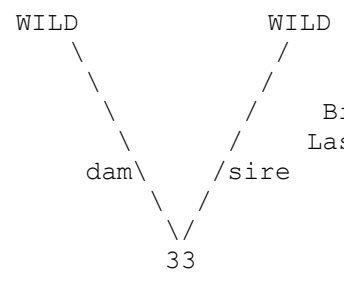
=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 32  
 =====



Sex: Male  
 Birth Date: ~ 1992  
 Last Location: KANPUR (dead)  
 House Name:  
 Tattoo:  
 Tag/Band:

+ Wild-caught...

=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 33  
 =====



Sex: Male  
 Birth Date: ~ Apr 1993  
 Last Location: SEPAHIJAL  
 House Name: SWAPAN  
 Tattoo:  
 Tag/Band:

=====  
Taxon Name: MACACA NEMESTRINA Studbook Number: 34  
=====

WILD WILD  
  \  
  \  
dam \ /sire  
  \  
  \  
    34

Sex: Female  
Birth Date: ~ May 1993  
Last Location: SEPAHIJAL  
House Name: AISHARIA  
Tattoo:  
Tag/Band:

=====  
Taxon Name: MACACA NEMESTRINA Studbook Number: 35  
=====

WILD WILD  
  \  
  \  
dam \ /sire  
  \  
  \  
    35

Sex: Female  
Birth Date: ????  
Last Location: HYDERABAD  
House Name: SONALI/HYDERABA  
Tattoo:  
Tag/Band:

=====  
Taxon Name: MACACA NEMESTRINA Studbook Number: 36  
=====

UNK UNK  
  \  
  \  
dam \ /sire  
  \  
  \  
    36

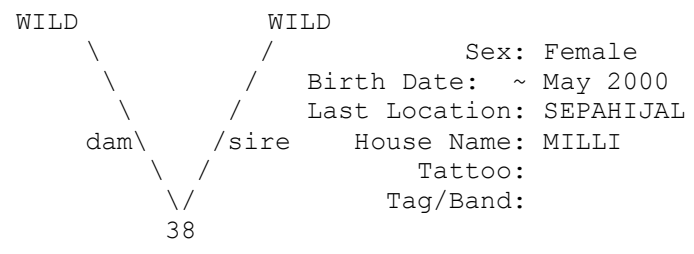
Sex: Male  
Birth Date: 25 Nov 1995  
Last Location: ASSAM  
House Name:  
Tattoo:  
Tag/Band:

=====  
Taxon Name: MACACA NEMESTRINA Studbook Number: 37  
=====

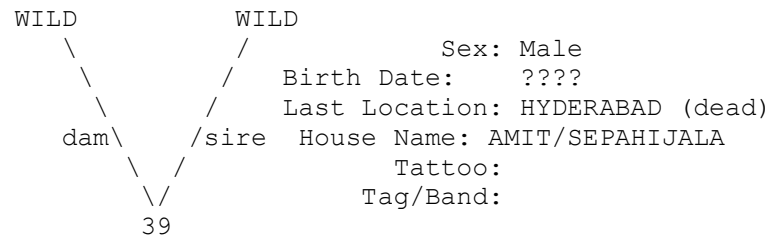
WILD WILD  
  \  
  \  
dam \ /sire  
  \  
  \  
    37

Sex: Male  
Birth Date: ????  
Last Location: AIZAWL  
House Name: PATEA  
Tattoo:  
Tag/Band:

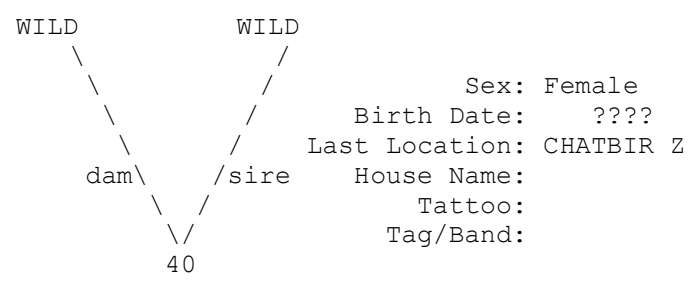
=====  
Taxon Name: MACACA NEMESTRINA Studbook Number: 38  
=====



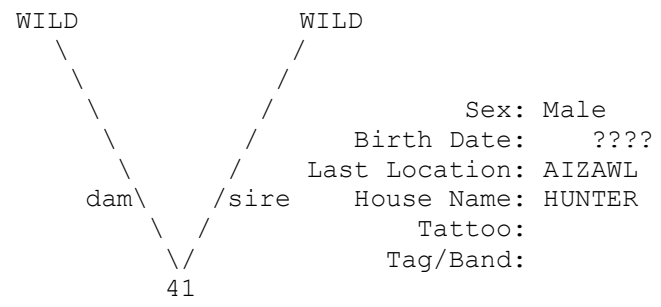
=====  
Taxon Name: MACACA NEMESTRINA Studbook Number: 39  
=====



=====  
Taxon Name: MACACA NEMESTRINA Studbook Number: 40  
=====



=====  
Taxon Name: MACACA NEMESTRINA Studbook Number: 41  
=====



```

=====
Taxon Name: MACACA NEMESTRINA                      Studbook Number: 42
=====
              WILD            WILD
              \                /
              dam\            /sire
                \  /
                42
Sex: Female
Birth Date: ~ 2003
Last Location: SEPAHIJAL (dead)
House Name: KAJALI
Tattoo:
Tag/Band:

```

```

=====
Taxon Name: MACACA NEMESTRINA                      Studbook Number: 43
=====
    WILD            WILD            WILD            WILD
    \                /                \                /
    dam\            /sire            dam\            /sire
        \  /                            \  /
        34 +                            33 +
    AISHARIA                           SWAPAN
          \  /                            \  /
          dam\            /sire            dam\            /sire
              \  /                            \  /
              43
Sex: Female
Birth Date: 12 Jul 2003
Last Location: SEPAHIJAL
House Name: SARABANI
Tattoo:
Tag/Band:

```

+ Wild-caught...

```

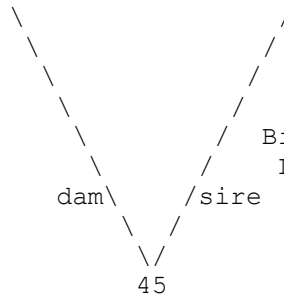
=====
Taxon Name: MACACA NEMESTRINA                      Studbook Number: 44
=====
              WILD            WILD
              \                /
              dam\            /sire
                \  /
                44
Sex: Female
Birth Date: ~ Oct 2003
Last Location: SEPAHIJAL (dead)
House Name:
Tattoo:
Tag/Band:

```

=====  
Taxon Name: MACACA NEMESTRINA Studbook Number: 45  
=====

WILD

WILD

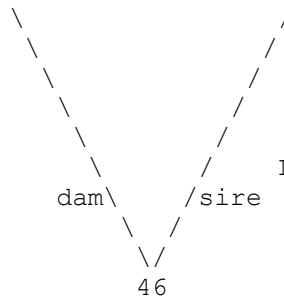


Sex: Male  
Birth Date: ~ Jan 2004  
Last Location: SEPAHIJAL  
House Name: SUDHIR  
Tattoo:  
Tag/Band:

=====  
Taxon Name: MACACA NEMESTRINA Studbook Number: 46  
=====

WILD

WILD

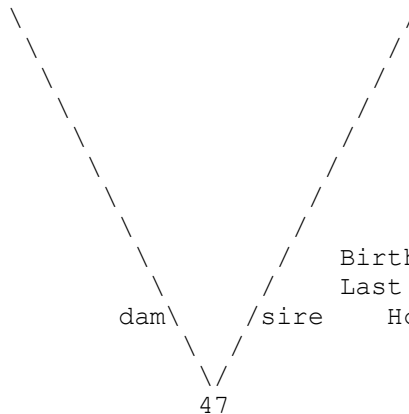


Sex: Female  
Birth Date: ????  
Last Location: AIZAWL  
House Name: NUTEI  
Tattoo:  
Tag/Band:

=====  
Taxon Name: MACACA NEMESTRINA Studbook Number: 47  
=====

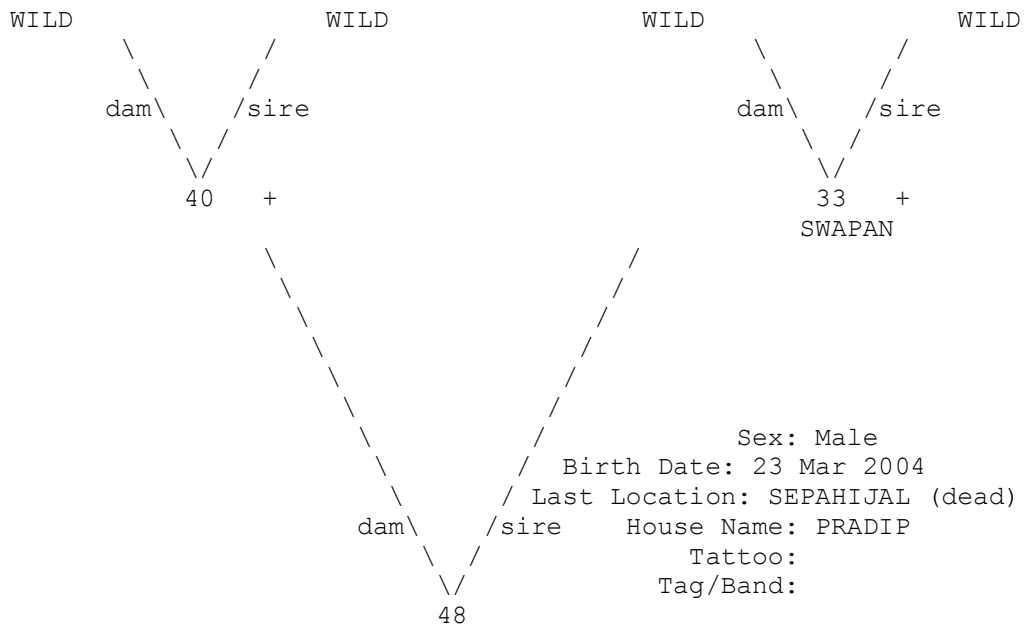
WILD

WILD



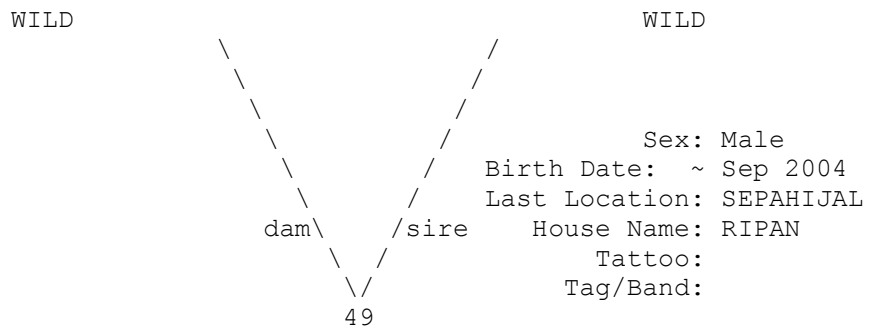
Sex: Male  
Birth Date: ~ Mar 2004  
Last Location: SEPAHIJAL  
House Name: MANISH  
Tattoo:  
Tag/Band:

=====  
Taxon Name: MACACA NEMESTRINA Studbook Number: 48  
=====

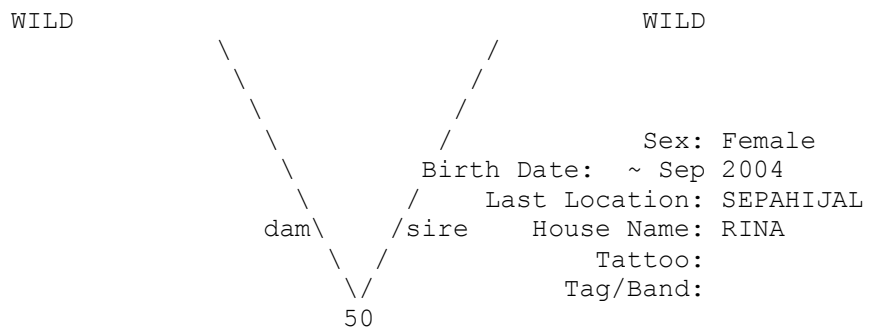


+ Wild-caught...

=====  
Taxon Name: MACACA NEMESTRINA Studbook Number: 49  
=====



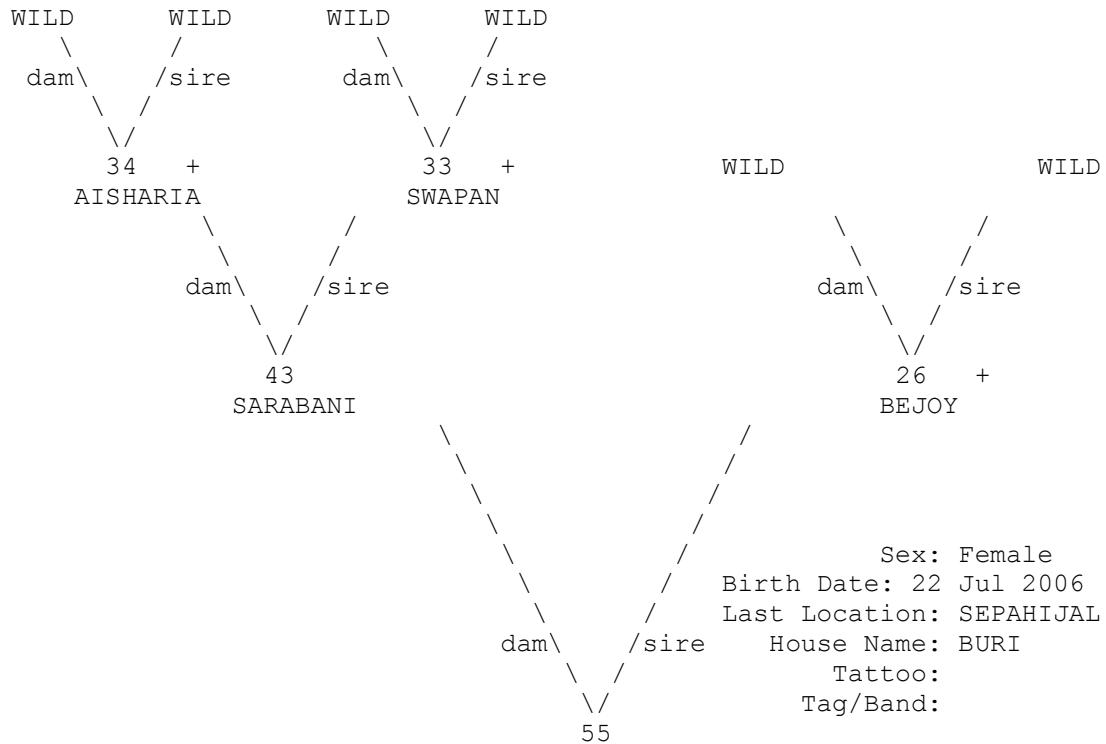
=====  
Taxon Name: MACACA NEMESTRINA Studbook Number: 50  
=====





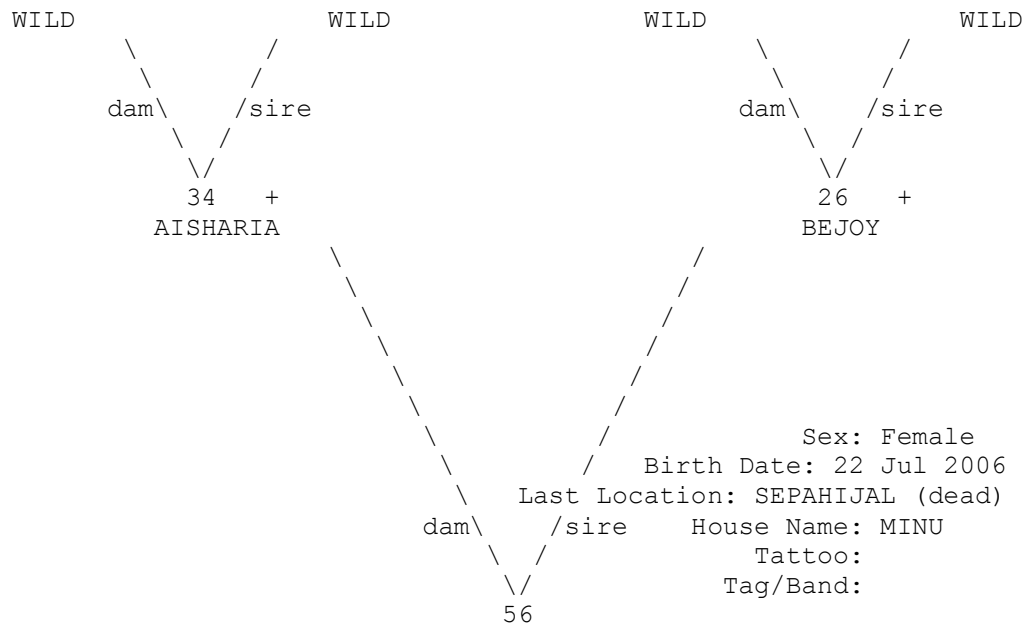


=====  
Taxon Name: MACACA NEMESTRINA Studbook Number: 55  
=====



+ Wild-caught...

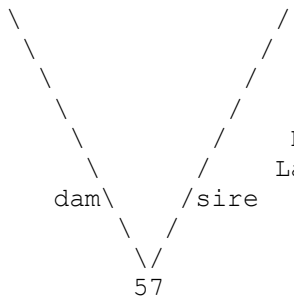
=====  
Taxon Name: MACACA NEMESTRINA Studbook Number: 56  
=====



+ Wild-caught...

=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 57  
 =====

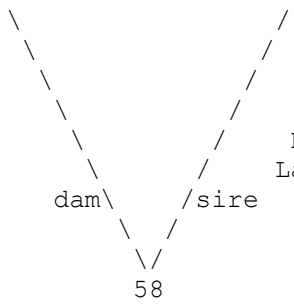
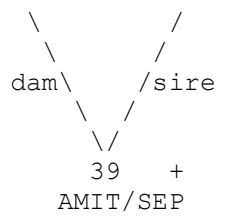
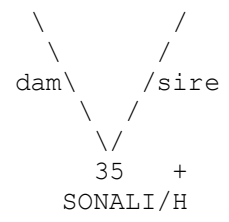
WILD WILD



Sex: Male  
 Birth Date: ~ Aug 2006  
 Last Location: SEPAHIJAL  
 House Name: RITESH  
 Tattoo:  
 Tag/Band:

=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 58  
 =====

WILD WILD WILD WILD

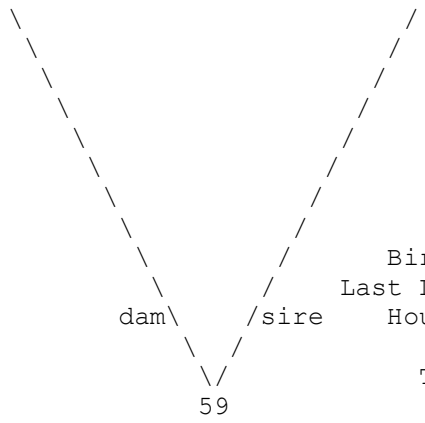


Sex: Male  
 Birth Date: 18 Oct 2006  
 Last Location: SEPAHIJAL  
 House Name: KUMAR  
 Tattoo:  
 Tag/Band:

+ Wild-caught...

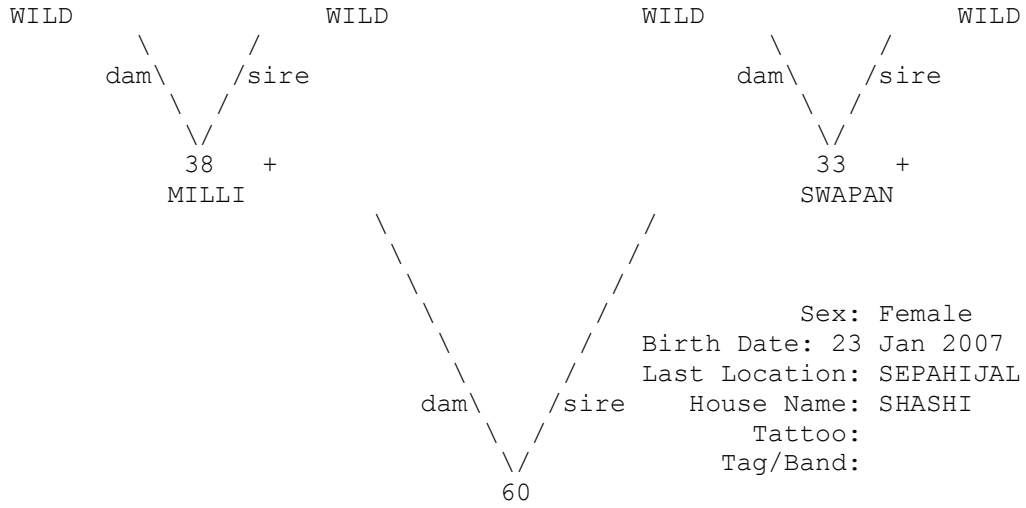
=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 59  
 =====

WILD WILD



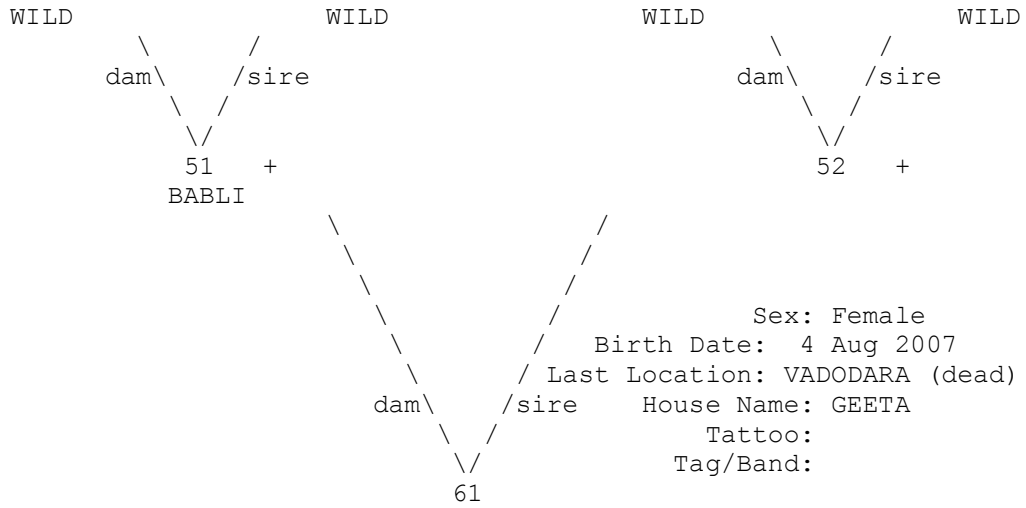
Sex: Male  
 Birth Date: ????  
 Last Location: SEPAHIJAL  
 House Name: MIR  
 Tattoo:  
 Tag/Band:

=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 60  
 =====



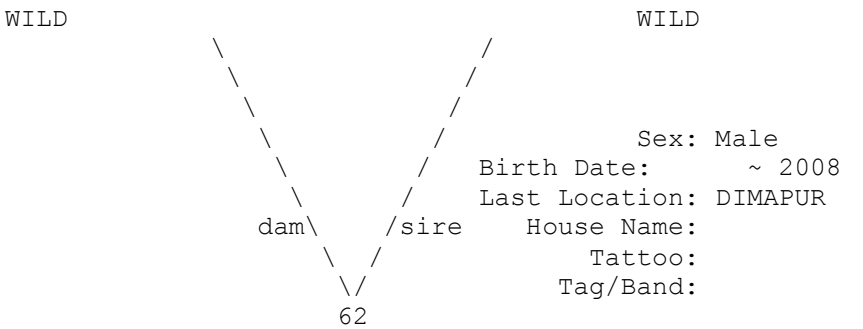
+ Wild-caught...

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 Taxon Name: MACACA NEMESTRINA Studbook Number: 61  
 =====

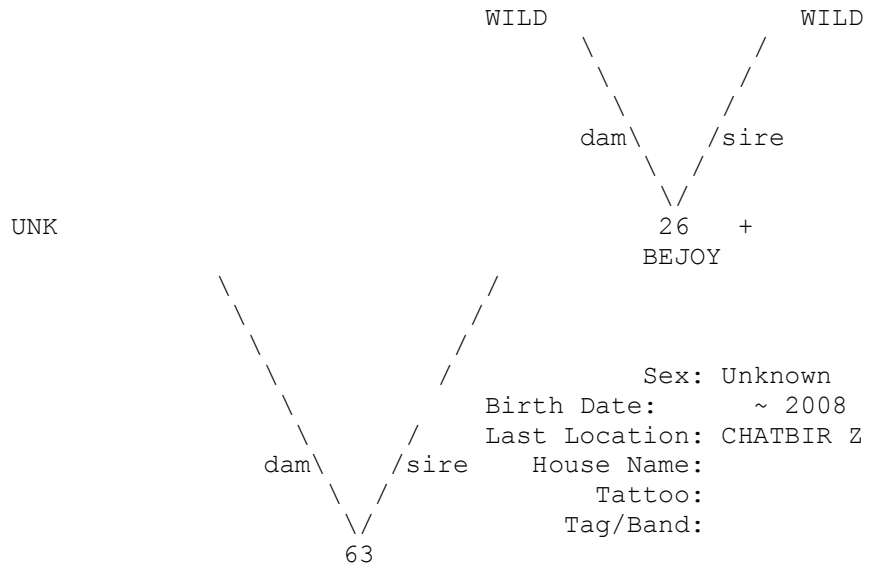


+ Wild-caught...

=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 62  
 =====

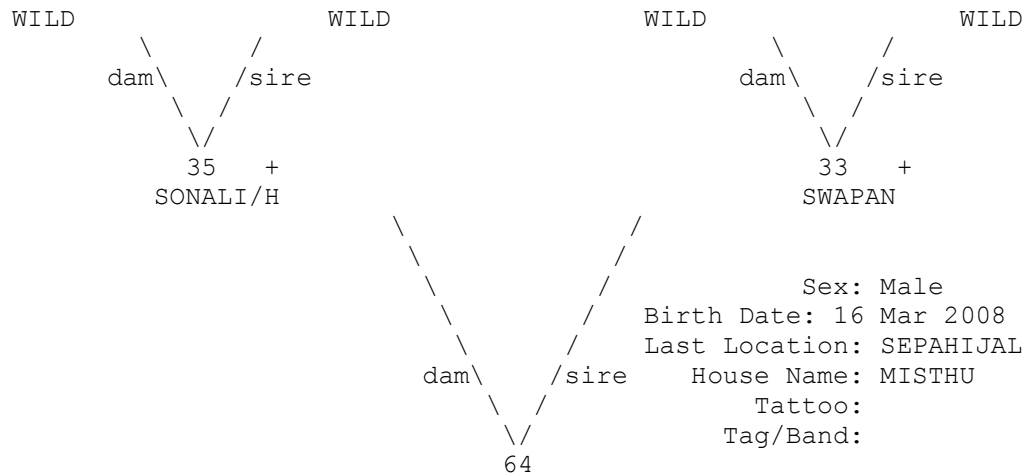


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 Taxon Name: MACACA NEMESTRINA Studbook Number: 63  
 =====

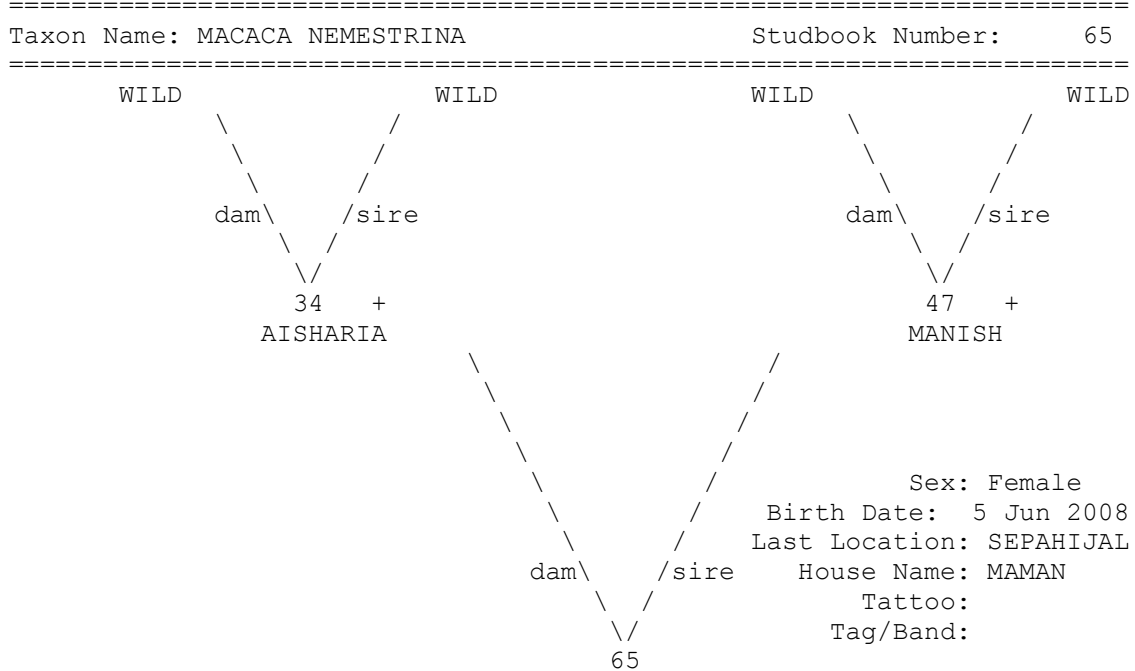


+ Wild-caught...

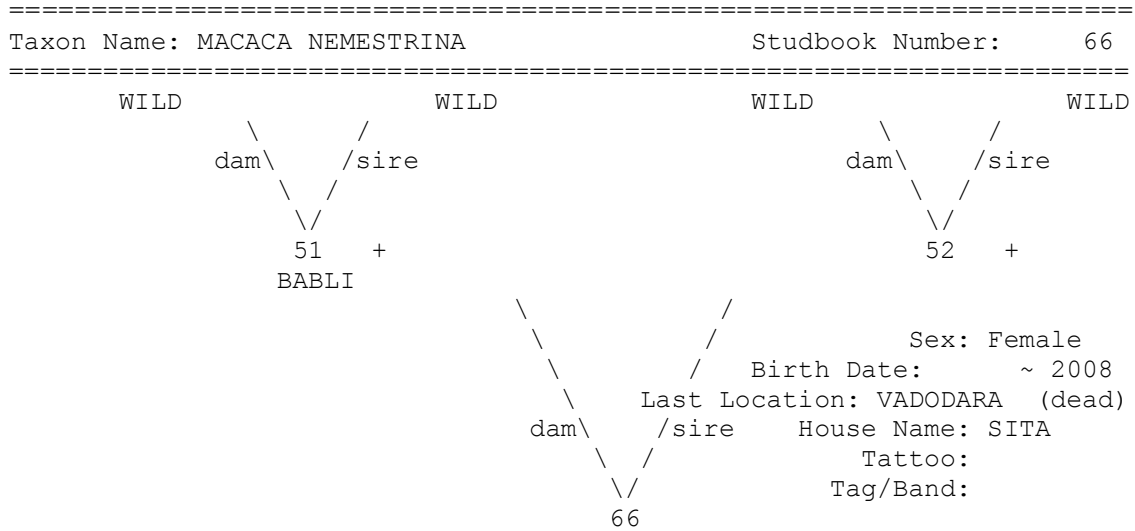
=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 64  
 =====



+ Wild-caught...

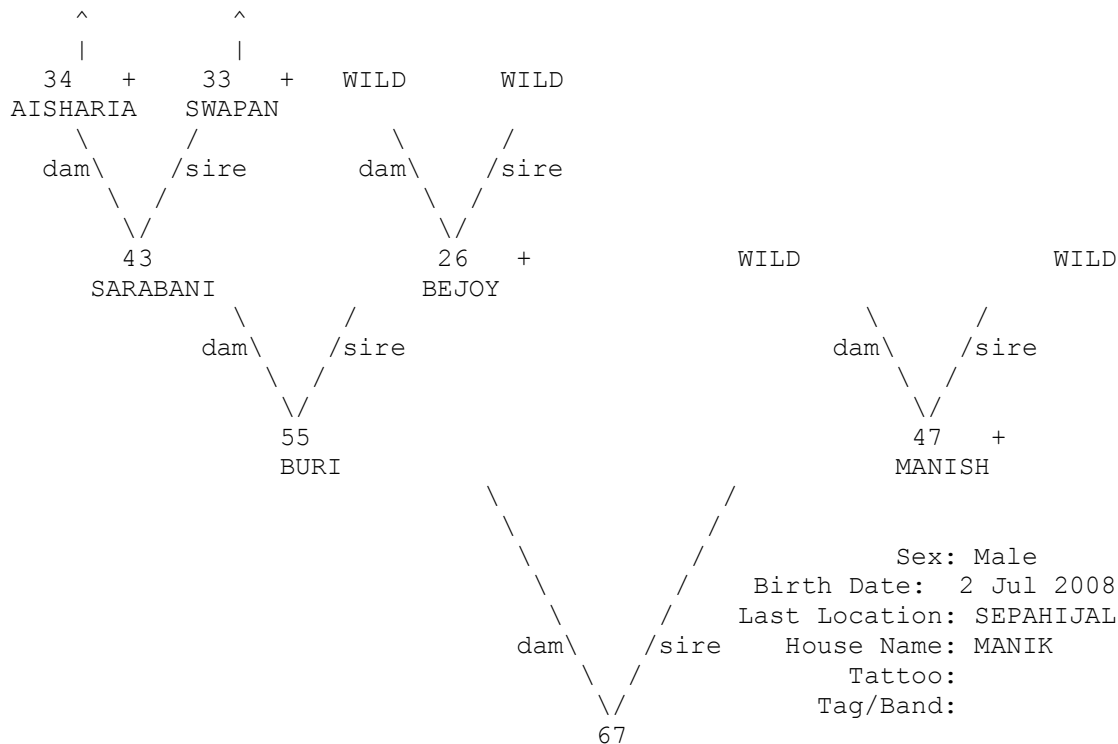


+ Wild-caught...



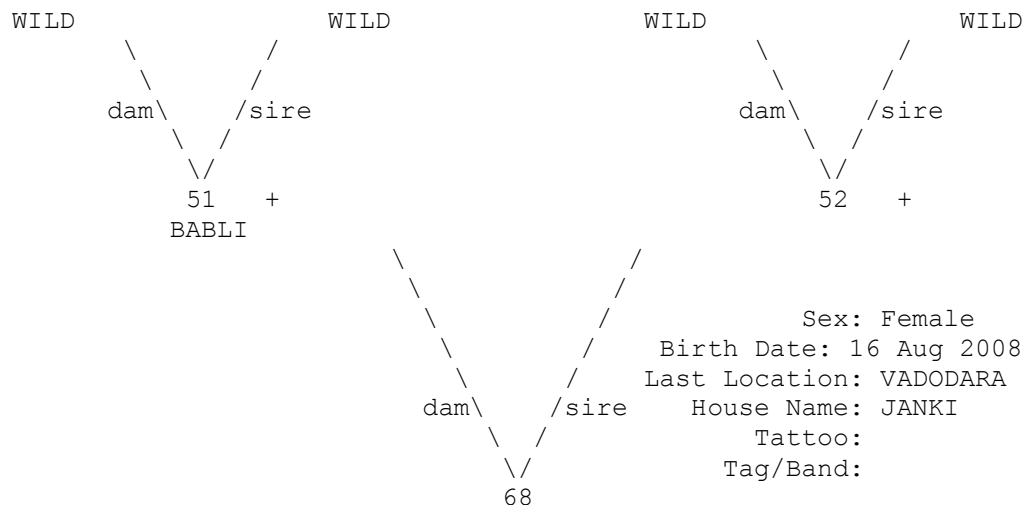
+ Wild-caught...

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 Taxon Name: MACACA NEMESTRINA Studbook Number: 67  
 =====



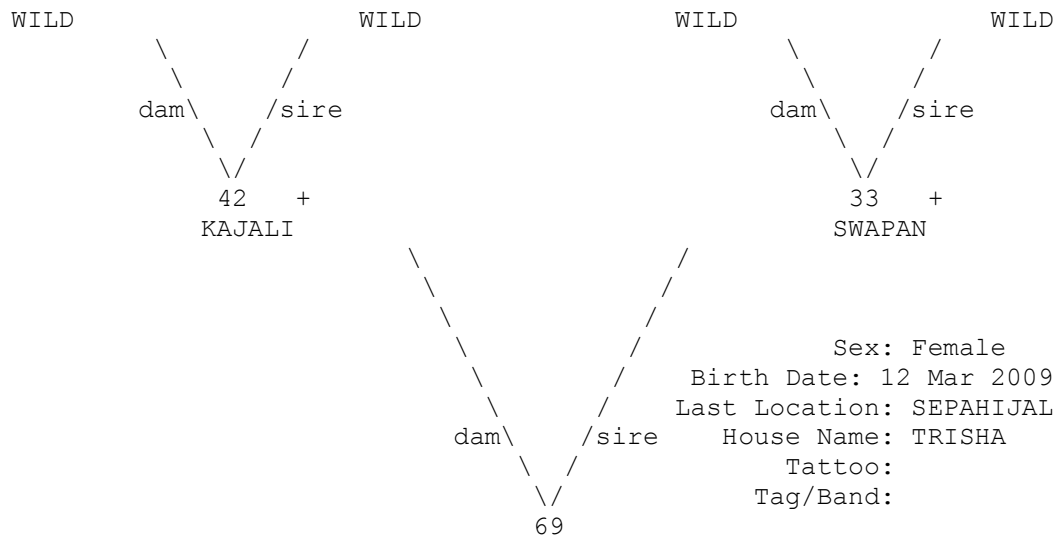
+ Wild-caught...  
 ^ Pedigree continues beyond top of page...

=====  
 Taxon Name: MACACA NEMESTRINA Studbook Number: 68  
 =====



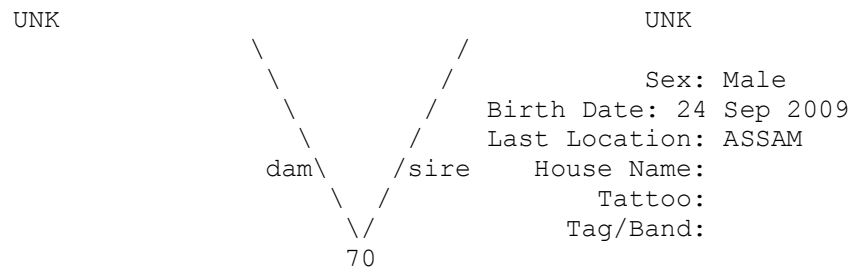
+ Wild-caught...

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 Taxon Name: MACACA NEMESTRINA Studbook Number: 69  
 =====

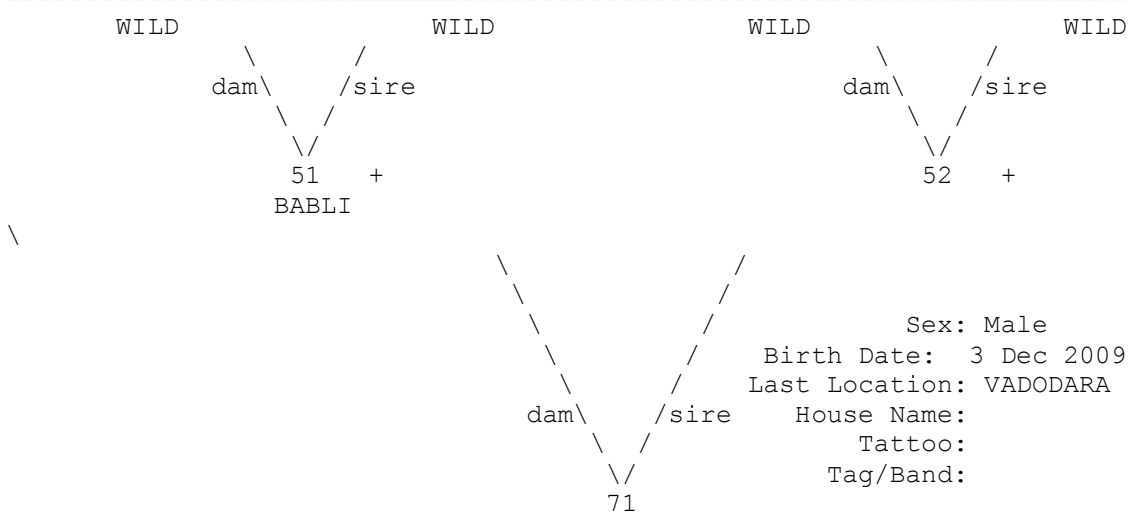


+ Wild-caught...

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 Taxon Name: MACACA NEMESTRINA Studbook Number: 70  
 =====



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 Taxon Name: MACACA NEMESTRINA Studbook Number: 71  
 =====

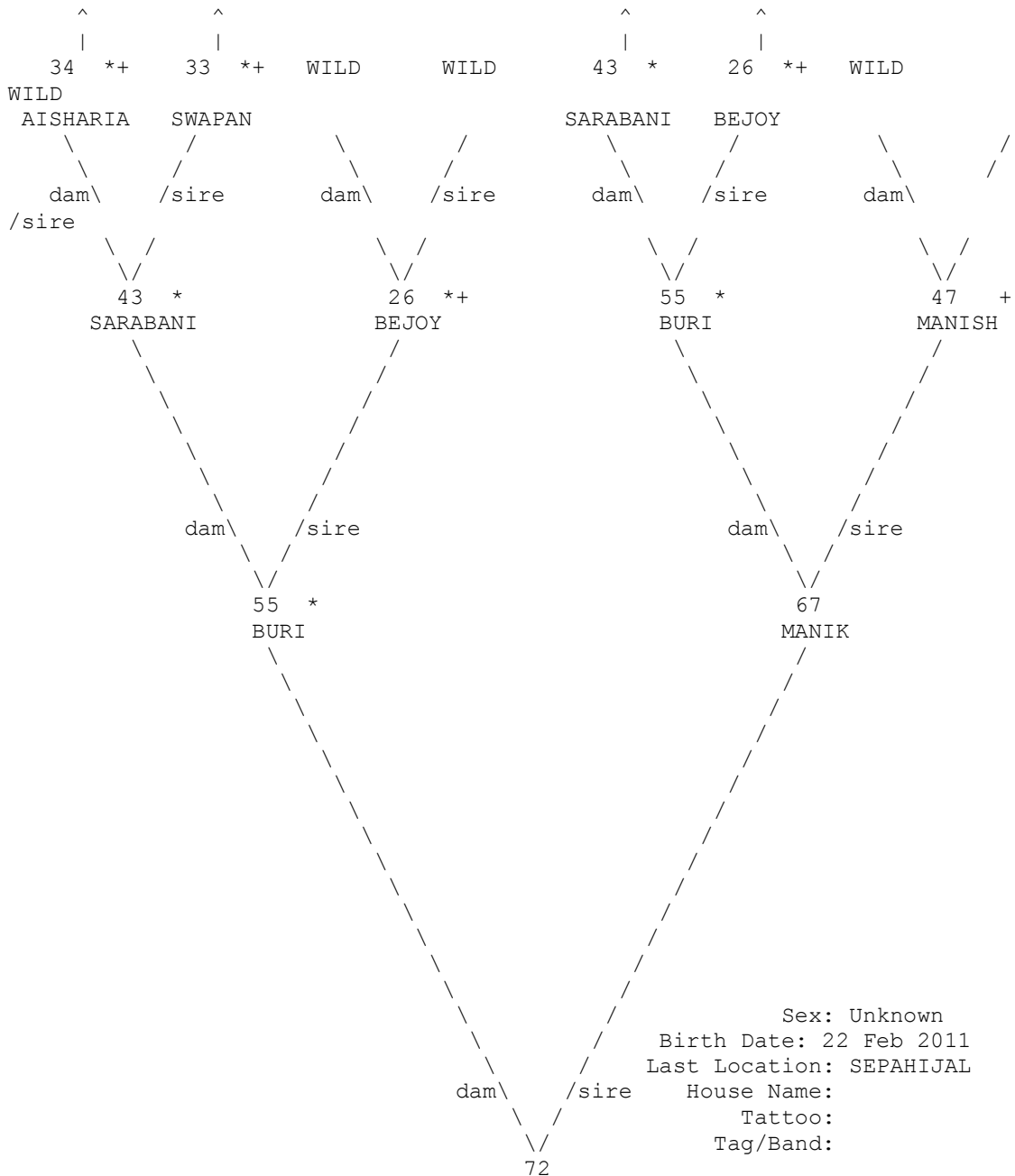


+ Wild-caught...



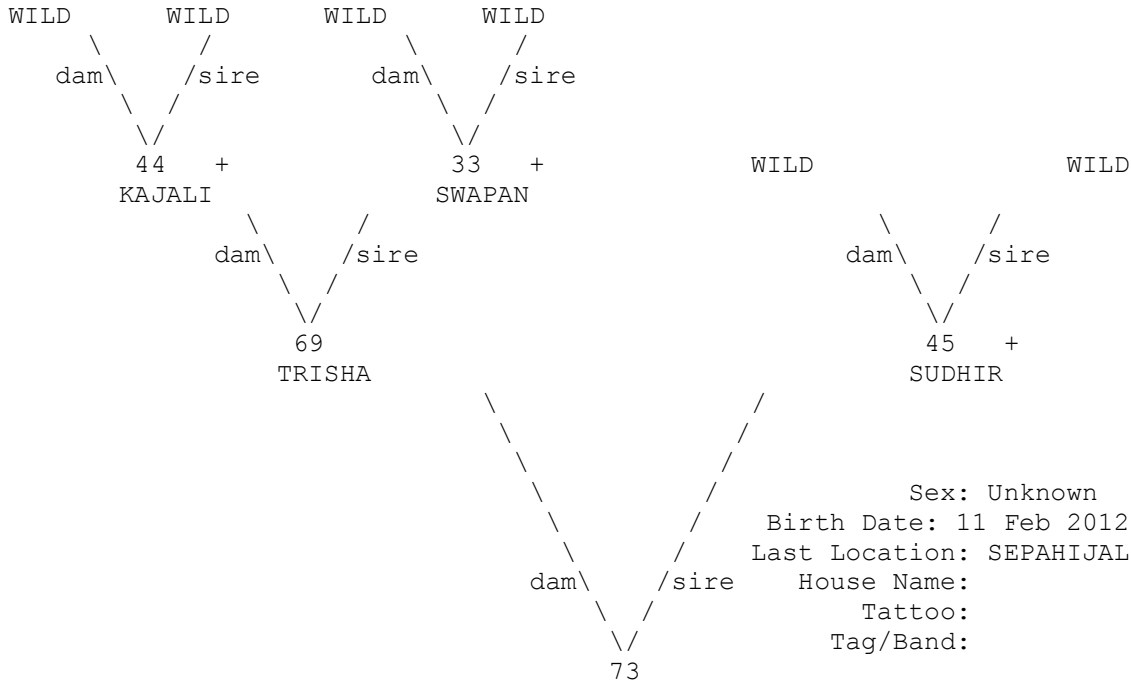
=====  
Taxon Name: MACACA NEMESTRINA

Studbook Number: 72  
=====



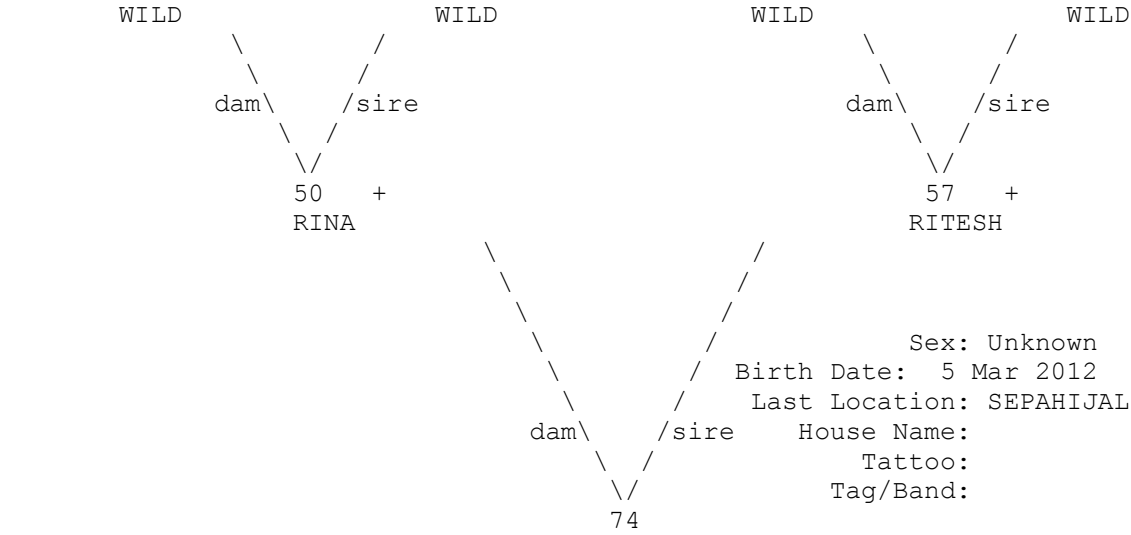
+ Wild-caught... \* Appear more than once...

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 Taxon Name: MACACA NEMESTRINA Studbook Number: 73  
 =====



+ Wild-caught...

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 Taxon Name: MACACA NEMESTRINA Studbook Number: 74  
 =====

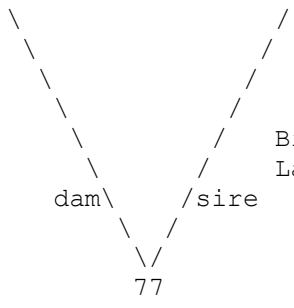
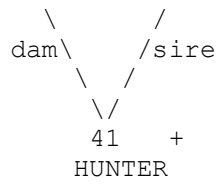
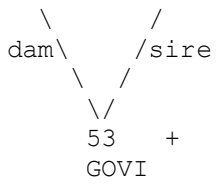


+ Wild-caught...



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Taxon Name: MACACA NEMESTRINA Studbook Number: 77  
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WILD WILD WILD WILD



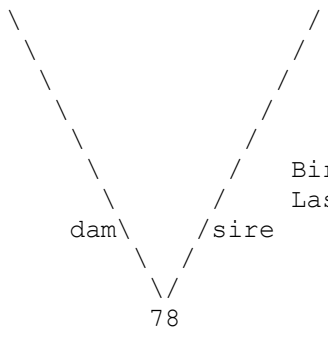
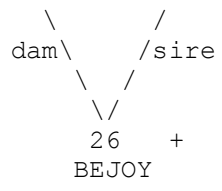
Sex: Male  
Birth Date: 7 Aug 2012  
Last Location: AIZAWL  
House Name: PAPUIA  
Tattoo:  
Tag/Band:

+ Wild-caught...

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Taxon Name: MACACA NEMESTRINA Studbook Number: 78  
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WILD WILD

UNK



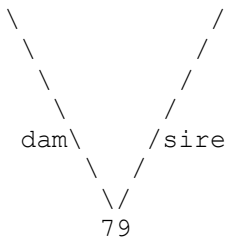
Sex: Unknown  
Birth Date: ~ 2012  
Last Location: CHATBIR Z  
House Name:  
Tattoo:  
Tag/Band:

+ Wild-caught...

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Taxon Name: MACACA NEMESTRINA Studbook Number: 79  
=====

WILD

WILD



Sex: Male  
Birth Date: ~ Dec 2012  
Last Location: DIMAPUR  
House Name:  
Tattoo:  
Tag/Band: