National Pedigree Book of Tibetan Wolf (*Canis lupus chanco*)

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

केन्द्रीय चिड़ियाघर प्राधिकरण
Central Zoo Authority

August, 2009

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Data till June 2009

Studbook compiled and analysed by

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Himalayan Zoological Park, Gangtok
Pt. Gobind Vallabh Pant High Altitude Zoo, Nainital
Himalayan nature Park, Kufri

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Authors

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Tibetan wolf: Biology and Status

Taxonomy

Kingdom:	Animalia
Phylum:	Chordata
Class:	Mammalia
Order:	Carnivora
Family:	Canidae
Scientific Name:	***Canis lupus chanco***
Species Authority:	Gray, 1863
Common Name:	Tibetan wolf

Historically, wolves had the largest and most extensive range of all mammals, second only to humans. Their former range included most countries in Europe, most of northern Russia, parts of the Middle East, India, and Nepal. They are nearly extinct throughout most of western-Europe, with very few stable populations still alive in Spain, Italy, Poland, Russia, Greece and Turkey.

The Tibetan wolf (***Canis lupus chanco***), also known as the Chinese wolf, Mongolian wolf, Korean wolf, Steppes wolf or Woolly wolf is believed to be a subspecies of gray wolf found in parts of Central China, southwest Russia, Manchuria, Tibet and the Himalayan regions of India, Nepal and Bhutan. In Tibet, it is known as the Chángú, while in Kumaon, Uttarkhand it is known as the Chankodi. There is an ongoing debate about the taxonomy of the species and it is still unclear whether it is a distinct species or a subspecies of ***Canis lupus***.

Taxonomy

The two wolf types are found in India. They are represented by two isolated populations and believed to be two sub-species of ***Canis lupus***. One of these, locally called Himalayan wolf or Tibetan wolf, is found only in the upper Trans-Himalayan region from Himachal Pradesh to Leh in Kashmir and is considered to be ***Canis lupus chanco***. Recent genetic research suggests that the Tibetan Wolf, originally considered only as a subpopulation of the Iranian Wolf (***Canis lupus pallipes***), may represent a distinct species (***Canis lupus chanco / laniger***).

The other relatively larger population is of Indian Gray wolf, which is found in the peninsular India and considered to be ***Canis lupus pallipes***. Molecular characterization studies to understand their genetic structure and taxonomic status were conducted. These studies suggest that Indian subcontinent had been one major center of origin and diversification of

the wolf and related canids. Further, the significant degree of genetic differentiation of Tibetan Wolf from Grey Wolf and of these two from other wolves, suggests the possibility of them to be new wolf species/subspecies in evolution that may need to be described possibly as ***Canis himalayaensis*** and ***Canis indica*** (or as ***Canis lupus himalyaensis*** and ***Canis lupus indica***), respectively.

Reproduction and Biology

Generally, mating occurs between January and April — the higher the latitude, the later it occurs. A pack usually produces a single litter unless the breeding male mates with one or more subordinate females. During this time, the breeding pair prevents other wolves from mating with one another.

The gestation period lasts between 60 and 63 days. The pups, which weigh 0.5 kg at birth, are born blind, deaf, and completely dependent on their mother. The average litter size is 5-6 pups. Wolves typically reach sexual maturity after two or three years, at which point many of them will be compelled to leave their birth packs and seek out mates and territories of their own. Wolves that reach maturity generally live 6 to 10 years in the wild, although in captivity they can live to twice that age.

Sharma D. 2009, collected blood samples from six live, healthy individual Tibetan wolves at the Padmaja Naidu Himalayan Zoological Park and described the hematological and bio-chemical parameters for the species. The information provided by him would be of great help in assessing the health status of other individuals and identifying potentially sick individuals.

Behaviour

Wolves are territorial animals, living in packs. Lone wolves are typically old specimens driven from their pack or young adults in search of new territory. Packs comprise of 2 - 20 wolves, 8 is the usual size. While most breeding pairs are monogamous, there are exceptions. Wolves will usually remain with their parents until the age of two years. Young from the previous season will support their parents in nursing pups of a later year. Wolf cubs are very submissive to their parents, and remain so after reaching sexual maturity. most young wolves between the ages of 1–4 years leave their family in order to search for, or start, a pack of their own. Dispersed wolves search for new territory and companionship. Successful dispersions end when the wolf has found another single wolf of the opposite sex and bonds with it. Thus it takes two such dispersals from two separate packs for a new breeding pair to be formed, for dispersing wolves from the same maternal pack tend not to mate. Once two

dispersing wolves meet and begin traveling together, they immediately begin the process of seeking out territory, preferably in time for the next mating season.

Wolves, like other canines, use scent-marking to mark their claims to anything—from territory to fresh kills. Breeding wolves scent-mark more frequently with males doing so more often. The most commonly used scent marker is urine.

Diet

Wolves are opportunistic feeders predating medium to large sized ungulates. They will however, eat any meat that is available, including non-ungulate species, carrion and garbage. Instances of cannibalism have been reported in wolves, and is believed to occur in times of food scarcity.

Distribution

The animal inhabits the trans-Himalayan region and the Tibetan Plateu. The distribution map of the species is placed below in Figure 1.

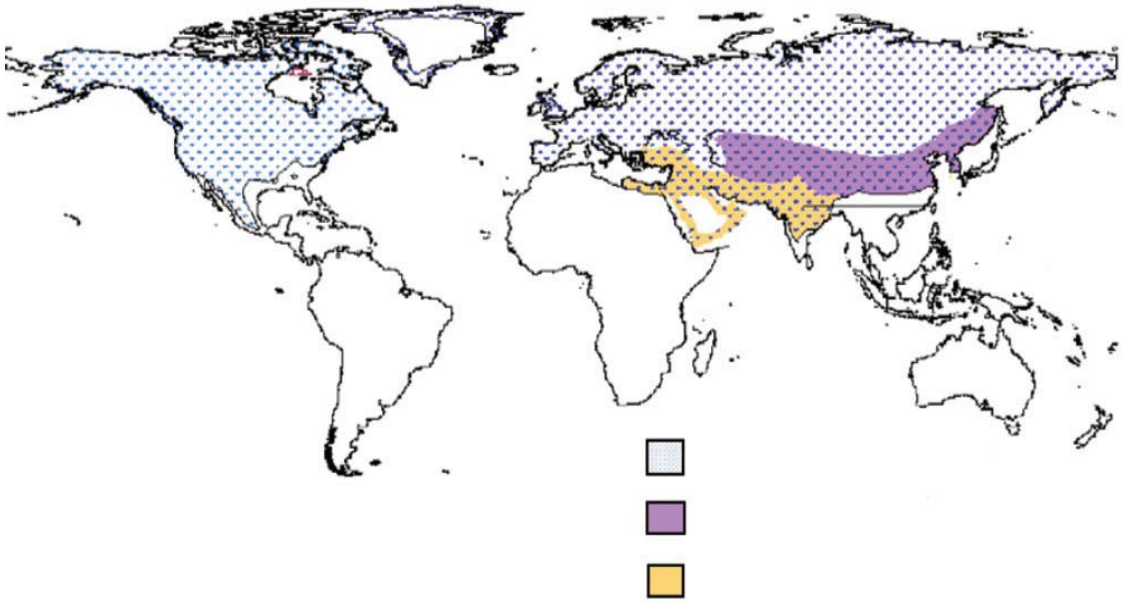

Figure 1. Map of wolf distribution in the Northern Hemisphere showing historical distributions of *Canis lupus*, and the subspecies *C. l. pallipes* and *C. l. chanco*.

Source: http://nationalzoo.si.edu/ConservationAndScience/SpotlightOnScience/fleischer2003108.cfm
downloaded on 21/07/2009

Threats and Status

Tibetan wolves are predatory animals often coming in conflict with nomadic herders. They prey on livestock and are often killed as a result. The movement of herders up the altitudinal gradient due to climate change has reduced the available habitat and increased the level of conflict. The identification of the Tibetan wolf as a unique species increases its threat perception.

The animal is placed in the Schedule I of the Wildlife Protection Act, Govt of India (1972) and in Appendix I of CITES. However it is yet to be listed in IUCN Red List of Threatened species.

Conservation Measures

The animal receives protection in the Protected Area network in the trans-Himalayan region in India and is presently being maintained in 4 captive facilities in the country (Table 1) based on the data provided by the zoos.

Table 1 Status of captive Tibetan Wolf population in Indian zoos as on 31st March 2009

Institution	Male	Female	Unsexed	Total
Padmaja Naidu Himalayan Zoological Park, Darjeeling	2	5	0	7
Himalayan Zoological Park, Gangtok	2	2	0	4
Himalayan Nature Park, Kufri	2	1	0	3
Pt. Gobind Vallabh Pant High Altitude Zoo, Nainital	2	1	0	3
Total	**8**	**11**	**0**	**17**

Methods

The data collected for the compilation of the studbook by was through mailed questionnaire surveys. The data collected was entered in SPARKS 1.5. and studbook report was generated using the reports option. The SPARKS dataset was used to create ~.prn and ~.ped files for demographic and genetic analyses by PM2000. PM 2000 was used to produce the census report, life tables and population projections, as well as founder statistics, inbreeding coefficients, possible pairings and population planning.

Table 2 Listing of live Tibetan wolf in Indian zoos

Sl. No.	Home Name And Transponder No.	National Studbook No.	International Studbook No.	Sex	Sire	Dam	Birth Date	Location	Event	Date	Remarks
1.	Danny	00008		Male	Unk	Unk	13-Mar-1998	Gangtok Gangtok	Birth Transfer	13-Mar-1998 5-Mar-1999	
2.	Shambu 0006B74BB0	00012		Male	Unk	Unk		Darjeeling Nainital	Birth Transfer	 23-Dec-2004	
3.	Babur 00-0610ECB0	00018		Male	Unk	Unk	3-Jan-2002	Darjeeling Kufri	Birth Transfer	3-Jan-2002 1-Jan-2005	
4.	Rosani	00022		Female	00008	00009	10-Apr-2002	Gangtok	Birth	10-Apr-2002	
5.	Rituni	00023		Female	00008	00009	10-Apr-2002	Gangtok	Birth	10-Apr-2002	
6.	Laxmi 00-0617-F26E	00024		Female	Unk	Unk	18-Mar-2003	Darjeeling Kufri	Birth Transfer	18-Mar-2003 1-Jan-2005	
7.	Barun 00-0618-288A	00027		Male	Unk	Unk	17-Mar-2004	Darjeeling Kufri	Birth Transfer	17-Mar-2004 1-Jan-2005	
8.	Depen 981098100800950	00031		Male	00008	00009	22-Mar-2004	Gangtok Darjeeling	Birth Transfer	22-Mar-2004 2-Nov-2007	
9.	Sharad	00036		Male	Unk	Unk	23-Mar-2004	Gangtok	Birth	23-Mar-2004	
10.	Asish 0006B739BF	00037		Male	Unk	Unk	23-Mar-2004	Darjeeling Nainital	Birth Transfer	23-Mar-2004 23-Dec-2004	
11.	Radhika 00-0618-130B	00038		Female	Unk	Unk	23-Mar-2004	Darjeeling	Birth	23-Mar-2004	
12.	Sheela 0006B74BB7	00039		Female	Unk	Unk	24-Mar-2004	Darjeeling Nainital	Birth Transfer	24-Mar-2004 23-Dec-2004	
13.	Jamila 00-061F-7348	00041		Female	Unk	Unk	23-Dec-2004	Darjeeling	Birth	23-Dec-2004	
14.	Denzon	00046		Male	00031	00038	9-Apr-2008	Darjeeling	Birth	9-Apr-2008	
15.	Diki	00047		Female	00031	00038	9-Apr-2008	Darjeeling	Birth	9-Apr-2008	
16.	Denka	00048		Female	00031	00038	9-Apr-2008	Darjeeling	Birth	9-Apr-2008	
17.	Diana	00049		Female	00031	00038	26-Mar-2009	Darjeeling	Birth	26-Mar-2009	

Table 3 Historical listing of Tibetan Wolf in Indian zoos

Sl. No.	Home Name And Transponder No.	National Studbook No.	International Studbook No.	Sex	Sire	Dam	Birth Date	Location	Event	Date	Remarks
1.	Julee	00001		Female	Wild	Wild		India Kufri Kufri	Wild Capture Transfer Death	 15-Jun-1990 30-Nov-2008	
2.	Moti	00002		Female	Wild	Wild		India Darjeeling Darjeeling	Wild Capture Transfer Death	 19-Jan-1990 19-Jan-1992	
3.	Hira	00003		Male	Wild	Wild		India Darjeeling Darjeeling	Wild Capture Transfer Death	 19-Sep-1990 19-Sep-1992	
4.	Kartik	00004		Male	00003	00002	4-Aug-1991	Darjeeling Darjeeling	Birth Death	4-Aug-1991 4-Sep-1991	
5.	Laxmi1	00005		Female	00003	00002	4-Aug-1991	Darjeeling Darjeeling	Birth Death	4-Aug-1991 5-Sep-1991	
6.	Ibee	00006		Female	Unk	Unk	25-Feb-1992	Darjeeling Nainital Nainital	Birth Transfer Death	25-Feb-1992 21-Mar-1997 10-Feb-2006	
7.	Amal	00007		Male	Unk	Unk	25-Feb-1992	Darjeeling Nainital Nainital	Birth Transfer Death	25-Feb-1992 21-Mar-1997 8-Dec-2000	
8.	Danny	00008		Male	Unk	Unk	13-Mar-1998	Gangtok Gangtok	Birth Transfer	13-Mar-1998 5-Mar-1999	
9.	Julie	00009		Female	Unk	Unk	13-Mar-1998	Gangtok Gangtok	Birth Death	13-Mar-1998 5-Nov-2006	
10.	Parbati 00-0611-683C	00010		Female	Unk	Unk	Unknown	Darjeeling	Birth	Unknown	Lost to follow up
11.	Akriti 00-0617FB65	00011		Female	Unk	Unk	Unknown	Darjeeling	Birth	Unknown	Lost to follow up
12.	Shambu 0006B74BB0	00012		Male	Unk	Unk	Unknown	Darjeeling Nainital	Birth Transfer	Unknown 23-Dec-2004	
13.	Vaidya	00013		Male	Unk	Unk	Unknown	Darjeeling Darjeeling	Birth Death	Unknown 26-Mar-2005	
14.	Rohini	00014		Female	Unk	Unk	Unknown	Darjeeling	Birth	Unknown	Lost to

Sl. No.	Home Name And Transponder No.	National Studbook No.	International Studbook No.	Sex	Sire	Dam	Birth Date	Location	Event	Date	Remarks
	00-0618-OCD4										follow up
15.	Rajani Rajini 00-061F-66FC	00015		Female	Unk	Unk	Unknown	Darjeeling Gangtok Gangtok	Birth Transfer Death	Unknown 11-Mar-2005 9-Sep-2005	
16.	Ramu 00-0611-1A53	00016		Male	Unk	Unk	Unknown	Darjeeling	Birth	Unknown	Lost to follow up
17.	Shiva 00-061F476D	00017		Male	Unk	Unk	Unknown	Darjeeling Darjeeling	Birth Death	Unknown 31-May-2005	
18.	Babur 00-0610ECB0	00018		Male	Unk	Unk	3-Jan-2002	Darjeeling Kufri	Birth Transfer	3-Jan-2002 1-Jan-2005	
19.	Abdul 00-0611-48C1	00019		Male	Unk	Unk	3-Jan-2002	Darjeeling Kufri Kufri	Birth Transfer Death	3-Jan-2002 1-Jan-2005 26-Feb-2009	
20.	Rita 00-0617-589D	00020		Female	Unk	Unk	Unknown	Darjeeling	Birth	Unknown	Lost to follow up
21.	Mohani	00021		Female	00008	00009	10-Apr-2002	Gangtok Gangtok	Birth Death	10-Apr-2002 3-Jun-2002	
22.	Rosani	00022		Female	00008	00009	10-Apr-2002	Gangtok	Birth	10-Apr-2002	
23.	Rituni	00023		Female	00008	00009	10-Apr-2002	Gangtok	Birth	10-Apr-2002	
24.	Laxmi 00-0617-F26E	00024		Female	Unk	Unk	18-Mar-2003	Darjeeling Kufri	Birth Transfer	18-Mar-2003 1-Jan-2005	
25.	Saraswati 00-061F-71AC	00025		Female	Unk	Unk	18-Mar-2003	Darjeeling Kufri Kufri	Birth Transfer Death	18-Mar-2003 1-Jan-2005 23-Aug-2007	
26.	Anita 0006B73D67	00026		Female	Unk	Unk	4-Oct-2003	Darjeeling Nainital Nainital	Birth Transfer Death	4-Oct-2003 23-Dec-2004 8-May-2008	
27.	Barun 00-0618-288A	00027		Male	Unk	Unk	17-Mar-2004	Darjeeling Kufri	Birth Transfer	17-Mar-2004 1-Jan-2005	
28.	Bijaya Vijay 00-0618-2DB0	00028		Female	Unk	Unk	20-Mar-2004	Darjeeling Kufri Kufri	Birth Transfer Death	20-Mar-2004 1-Jan-2005 23-Aug-2007	
29.	Basant 00-0618-0962	00029		Female	00017	00010	20-Mar-2004	Darjeeling Darjeeling	Birth Death	20-Mar-2004 15-Jun-2005	

Sl. No.	Home Name And Transponder No.	National Studbook No.	International Studbook No.	Sex	Sire	Dam	Birth Date	Location	Event	Date	Remarks
30.	Badri 00-0617-D734	00030		Male	00017	00010	20-Mar-2004	Darjeeling Darjeeling	Birth Death	20-Mar-2004 30-Jul-2005	
31.	Depen 981098100800950	00031		Male	00008	00009	22-Mar-2004	Gangtok Darjeeling	Birth Transfer	22-Mar-2004 2-Nov-2007	
32.	Rani	00032		Female	00008	00009	22-Mar-2004	Gangtok Gangtok	Birth Death	22-Mar-2004 29-May-2004	
33.	Tripti	00033		Female	00008	00009	22-Mar-2004	Gangtok Gangtok	Birth Death	22-Mar-2004 10-Jun-2004	
34.	Rupa	00034		Female	00008	00009	22-Mar-2004	Gangtok Gangtok	Birth Death	22-Mar-2004 1-Jul-2004	
35.	Raju	00035		Male	00008	00009	22-Mar-2004	Gangtok Gangtok	Birth Death	22-Mar-2004 5-Jul-2004	
36.	Sharad	00036		Male	Unk	Unk	23-Mar-2004	Gangtok	Birth	23-Mar-2004	
37.	Asish 0006B739BF	00037		Male	Unk	Unk	23-Mar-2004	Darjeeling Nainital	Birth Transfer	23-Mar-2004 23-Dec-2004	
38.	Radhika 00-0618-130B	00038		Female	Unk	Unk	23-Mar-2004	Darjeeling	Birth	23-Mar-2004	
39.	Sheela 0006B74BB7	00039		Female	Unk	Unk	24-Mar-2004	Darjeeling Nainital	Birth Transfer	24-Mar-2004 23-Dec-2004	
40.	Heena 00-0610-FED9	00040		Female	Unk	Unk	Unknown	Darjeeling Nainital Nainital	Birth Transfer Death	Unknown 23-Dec-2004 24-Jan-2006	
41.	Jamila 00-061F-7348	00041		Female	Unk	Unk	Unknown	Darjeeling	Birth	Unknown	
42.	Javed Javid 00-0618-18A8	00042		Male	Unk	Unk	Unknown	Darjeeling Gangtok Gangtok	Birth Transfer Death	Unknown 11-Mar-2005 16-Mar-2006	
43.	Nisha 00-0615-8987	00043		Female	Unk	Unk	Unknown	Darjeeling	Birth	Unknown	Lost to follow up
44.	Pushpa 00-0617-BF82	00044		Female	Unk	Unk	Unknown	Darjeeling	Birth	Unknown	Lost to follow up
45.	Reena	00045		Female	Unk	Unk	11-Mar-2005	Gangtok Gangtok	Birth Death	11-Mar-2005 29-Nov-2005	

Sl. No.	Home Name And Transponder No.	National Studbook No.	International Studbook No.	Sex	Sire	Dam	Birth Date	Location	Event	Date	Remarks
46.	Denzon	00046		Male	00031	00038	9-Apr-2008	Darjeeling	Birth	9-Apr-2008	
47.	Diki	00047		Female	00031	00038	9-Apr-2008	Darjeeling	Birth	9-Apr-2008	
48.	Denka	00048		Female	00031	00038	9-Apr-2008	Darjeeling	Birth	9-Apr-2008	
49.	Diana	00049		Female	00031	00038	26-Mar-2009	Darjeeling	Birth	26-Mar-2009	

Totals: 18.31.0 (49)

The pedigree report of all animals was generated using SPARKS 1.54 and is placed as **Annexure I** at the end of this report.

Population Planning and Breeding Recommendations

A total of 3 animals of wild origin have entered the captive population while a total of 30 animals of unknown parentage are present in a total population of 49 animals. However, only two births (Studbook Nos. 00004 and 00005) can be traced back to known founder animals (Studbook Nos. 00002 and 00003). It is therefore not possible to make any recommendations for Tibetan wolf based on the analysis carried out using PM 2000 (See Table 3 and Annexure I).

It is suggested that molecular genetic studies may be carried out to ascertain relatedness of individuals. This information can than be used to make breeding recommendations.

Age Distribution

Age distribution pattern (Figure 3 and Table 4) of the known age individuals of captive Tibetan Wolf population in India zoos was worked out using PM 2000 and is based on the following:

Total Males = 9.0
Total Females = 15.0
Unknown Age Males = 2.0
Unknown Age Females = 7.0

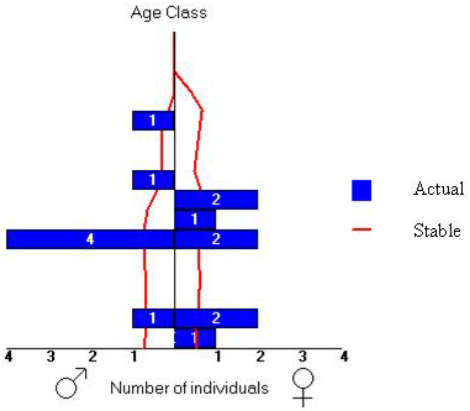

Figure 2 Age structure of known age individuals

The blue boxes in Figure 3 above depict the actual number of individuals in an age class while the red line depicts the number of individuals that are required for a stable population. Though the analysis has been carried out it is not very reliable in terms of its predictive value (stable population). Figure 3 above shows maximum number of individuals to belong to the reproductive age class (5 – 8 years of age).

Table 4 Age distribution of known age individuals

Age (x)	Males		Females	
	Actual	Stable	Actual	Stable
0	0	0.75	1	0.54
1	1	0.69	2	0.51
2	0	0.67	0	0.57
3	0	0.68	0	0.61
4	0	0.70	0	0.58
5	4	0.71	2	0.58
6	0	0.73	1	0.65
7	0	0.64	2	0.73
8	1	0.41	0	0.62
9	0	0.28	0	0.46
10	0	0.29	0	0.52
11	1	0.29	0	0.59
12	0	0.15	0	0.66
13	0	0.00	0	0.37
14	0	0.00	0	0.00
15	0	0.00	0	0.00

Demographic Analyses

Census

The present day captive population of Tibetan Wolf in Indian zoos owes its origin to individuals obtained wild. The year wise trends in census can be inferred from table 5 and figure 2 respectively. The living population has a male biased sex ratio.

Fig.3 Census Trends of Tibetan Wolf in Indian Zoos

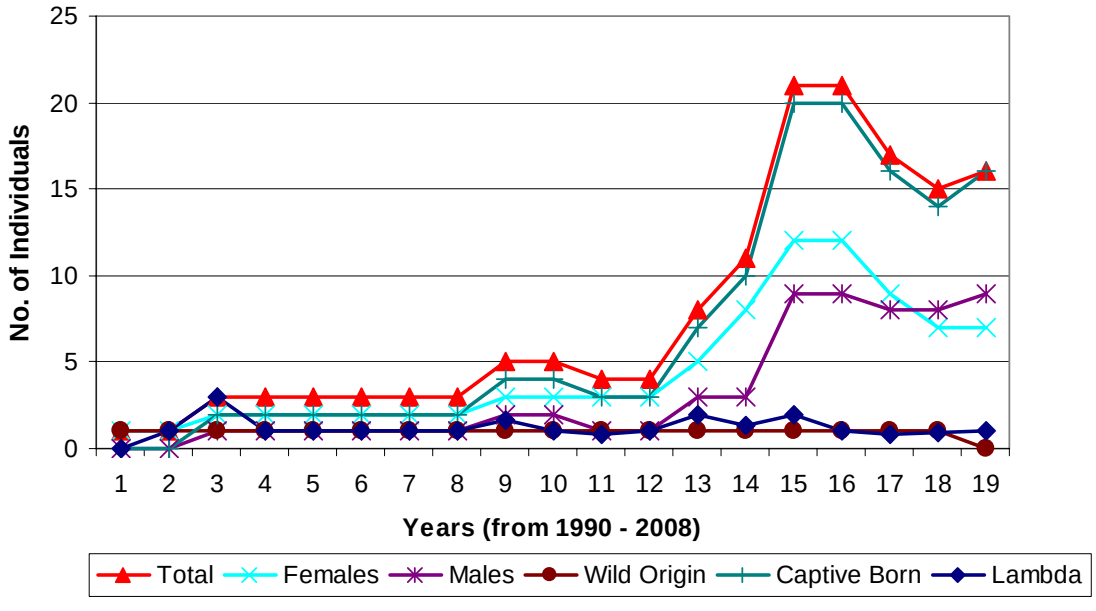

Table 5 Census details of the Indian captive Tibetan Wolf population

Years	Total	Females	Males	Wild Origin	Captive Born
1990	1	1	0	1	0
1991	1	1	0	1	0
1992	3	2	1	1	2
1993	3	2	1	1	2
1994	3	2	1	1	2
1995	3	2	1	1	2
1996	3	2	1	1	2
1997	3	2	1	1	2
1998	5	3	2	1	4
1999	5	3	2	1	4
2000	4	3	1	1	3
2001	4	3	1	1	3
2002	8	5	3	1	7
2003	11	8	3	1	10
2004	21	12	9	1	20
2005	21	12	9	1	20
2006	17	9	8	1	16
2007	15	7	8	1	14
2008	16	7	9	0	16

The census data table provided above does not include new births and losses during 2008 – 2009.

Life Table

The life table of the Captive Tibetan Wolf population was generated using SPARKS 1.54 and is placed below in Table 6. The table suggests that males become sexually active by the fifth year of life [fecundity (Mx)], peaks in the 7th year and then the reproductive activity abruptly ceases. Similar trends were also observed for females. Mortality (Qx) shows initial low levels in the first two years for males and then reaches an abrupt peak in the 9th year, while females show an initial peak in the first year and then another peak in the 9th year. These trends may be a result of the small size of the sampled population and may not depict the actual picture.

The average age of females at first reproduction was 3years, 2months, 10days while the average age of females at reproduction was 3years, 11months, 19days. For males the average age at first reproduction was 2years, 9months, 9days and the average age of males at reproduction was 3years, 7months, 17days.

Table 6 Fecundity and Mortality Report

Age Class	Fecundity [Mx]				Mortality [Qx]				Age-Specific Survivorship [Lx]	
	Male	N	Female	N	Male	N	Female	N	Male	Female
0- 1	0.00	10.3	0.00	13.9	0.09	11.0	0.29	17.4	1	1
1- 2	0.00	8.7	0.00	10.6	0.11	9.3	0.00	10.6	0.91	0.71
2- 3	0.00	8.0	0.00	10.0	0.00	8.0	0.00	10.0	0.81	0.71
3- 4	0.00	8.0	0.00	9.4	0.00	8.0	0.10	10.0	0.81	0.71
4- 5	0.38	8.0	0.37	8.0	0.00	8.0	0.22	9.0	0.81	0.646
5- 6	0.09	5.4	0.09	5.7	0.00	5.4	0.00	5.7	0.81	0.517
6- 7	0.63	4.0	0.57	4.4	0.00	4.0	0.00	4.4	0.81	0.517
7- 8	0.00	2.7	0.00	2.6	0.28	3.6	0.00	2.6	0.81	0.517
8- 9	0.00	1.8	0.00	1.7	0.50	2.0	0.50	2.0	0.583	0.517
9-10	0.00	1.0	0.00	1.0	0.00	1.0	0.00	1.0	0.292	0.346
10-11	0.00	1.0	0.00	1.0	0.00	1.0	0.00	1.0	0.292	0.346
11-12	0.00	0.4	0.00	1.0	0.00	0.4	0.00	1.0	0.292	0.346
12-13	0.00	0.0	0.00	1.0	0.00	0.0	0.00	1.0	0.292	0.346
13-14	0.00	0.0	0.00	1.0	0.00	0.0	1.00	1.0	0.292	0.346
14-15	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.292	0.173
15-16	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.292	0.173

12 birth events to known age parents tabulated for Mx, (Average of 12 births to female parents and 12 births to male parents.)
14 death events with known age tabulated for Qx,
17 specimens of unknown age ignored

Generation length (T), the average age at which a parent produces young for males and females was found to be 5.227 and 5.194 years respectively. The Net Reproductive rate (Ro), the number of same sex offspring produced by an average individual during its life time, was 0.891 and 0.513 respectively for males and females, values less than 1 suggest of a decline in the population as each individual should be able to replace itself and produce surpluses for a growing population. The Population Growth Rate (lambda), a measure of the population for self sustainment was 0.98 and 0.88 respectively, which suggests that the population is declining. All the above mentioned values are based on small sample sizes (~N<30) and therefore warrant less confidence.

Genetic Analyses

It is not possible to carry out genetic analysis of the Indian captive Tibetan Wolf population as the ancestry of only two individuals could be traced back to founder (wild caught) individuals (Details are provided in annexure !). The pedigree of offspring thus produced could not be traced in subsequent generations; therefore the founder statistics (Table 7) or any other genetic analyses are of little relevance.

Table 7 Founder Statistics

Studbook #	Sex	Age	Representation	Contribution	Allele Retent.	Potential Ret.	Descendants
UNK	U	D	0.0000	0.0000	0.0000	0.0000	0.00

It may be possible to test the relatedness of living individuals using molecular genetic techniques.

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Appendix 1

Glossary of Terms

Demographic Terms

Age Distribution -- A two-way classification showing the numbers or percentages of individuals in various age and sex classes.

Ex, Life Expectancy – Average years of further life for an animal in age class x.

Lambda, λ (Population Growth Rate**)** -- The proportional change in population size from one year to the next. Lambda can be based on life-table calculations (the expected lambda) or from observed changes in population size from year to year. A lambda of 1.11 means a 11% per year increase; lambda of .97 means a 3% decline in size per year.

lx, Age-Specific Survivorship – The probability that a new individual (e.g., age 0) is alive at the *beginning* of age *x*. Alternatively, the proportion of individuals which survive from birth to the beginning of a specific age class.

Mx, **Fecundity** – The average number of same-sexed young born to animals in that age class. Because SPARKS is typically using relatively small sample sizes, SPARKS calculates Mx as 1/2 the average number of young born to animals in that age class. This provides a somewhat less "noisy" estimate of Mx, though it does not allow for unusual sex ratios. The fecundity rates provide information on the age of first, last, and maximum reproduction.

Px, Age-Specific Survival – The probability that an individual of age *x* survives one time period; is conditional on an individual being alive at the beginning of the time period. Alternatively, the proportion of individuals which survive from the beginning of one age class to the next.

Qx, Mortality – Probability that an individual of age *x* dies during time period. Qx = 1-Px
The proportion of individuals that die during an age class. It is calculated from the number of animals that die during an age class divided by the number of animals that were alive at the beginning of the age class (i.e.-"at risk").

Risk (Qx or Mx) – The number of individuals that have lived during an age class. The number at risk is used to calculate Mx and Qx by dividing the number of births and deaths that occurred during an age class by the number of animals at risk of dying and reproducing during that age class.

R_0, Net Reproductive Rate – The number of same sex individuals produced by an average individual during its lifetime. R_0 for stable populations is 1, while for declining populations it is less than 1.

T, Generation Length – Average age at which parents produce young. It is calculated from estimates of survival and fecundity rates. It is used to estimate the minimum viable population size for a captive population.

Vx, **Reproductive Value** – The expected number of offspring produced this year and in future years by an animal of age x.

Genetic Terms

Allele Retention – The probability that a gene present in a founder individual exists in the living, descendant population.

Current Gene Diversity (GD) -- The proportional gene diversity (as a proportion of the source population) is the probability that two alleles from the same locus sampled at random from the population will be identical by descent. Gene diversity is calculated from allele frequencies, and is the heterozygosity expected in progeny produced by random mating, and if the population were in Hardy-Weinberg equilibrium.

Effective Population Size (Inbreeding N_e) -- The size of a randomly mating population of constant size with equal sex ratio and a Poisson distribution of family sizes that would (a) result in the same mean rate of inbreeding as that observed in the population, or (b) would result in the same rate of random change in gene frequencies (genetic drift) as observed in the population. These two definitions are identical only if the population is demographically stable (because the rate of inbreeding depends on the distribution of alleles in the parental generation, whereas the rate of gene frequency drift is measured in the current generation).

FOKE, First Order Kin Equivalents – The number of first-order kin (siblings or offspring) that would contain the number of copies of an individuals alleles (identical by descent) as are present in the captive-born population. Thus an offspring or sib contributes 1 to FOKE; each grand-offspring contributes 1/2 to FOKE; each cousin contributes 1/4 to FOKE. FOKE = 4*N*MK, in which N is the number of living animals in the captive population.

Founder – An individual obtained from a source population (often the wild) that has no known relationship to any individuals in the derived population (except for its own descendants).

Founder Contribution -- Number of copies of a founder's genome that are present in the living descendants. Each offspring contributes 0.5 whereas each grand-offspring contributes 0.25, etc.

Founder Genome Equivalents (FGE) – The number wild-caught individuals (founders) that would produce the same amount of gene diversity as does the population under study. The gene diversity of a population is 1 - 1 / (2 * FGE).

Founder Genome Surviving – The sum of allelic retentions of the individual founders (i.e., the product of the mean allelic retention and the number of founders).

Founder Representation – Proportion of the genes in the descendant population that derives from that founder. I.e., proportional Founder Contribution.

GU, Genome Uniqueness – Probability that an allele sampled at random from an individual is not present, identical by descent, in any other living individual in the population. GU-all is the genome uniqueness relative to the entire population. GU-Desc is the genome uniqueness relative to the living non-founder, descendants.

Inbreeding Coefficient (F) -- Probability that the two alleles at a genetic locus are identical by descent from an ancestor common to both parents. The mean inbreeding coefficient of a population will be the proportional decrease in observed heterozygosity relative to the expected heterozygosity of the founder population.

KV, Kinship Value – The weighted mean kinship of an animal, with the weights being the reproductive values of each of the kin. The mean kinship value of a population predicts the

loss of gene diversity expected in the subsequent generation if all animals were to mate randomly and all were to produce the numbers of offspring expected for animals of their age.

Mean Generation Time (T) -- The average time elapsing from reproduction in one generation to the time the next generation reproduces. Also, the average age at which a female (or male) produces offspring. It is not the age of first reproduction. Males and females often have different generation times.

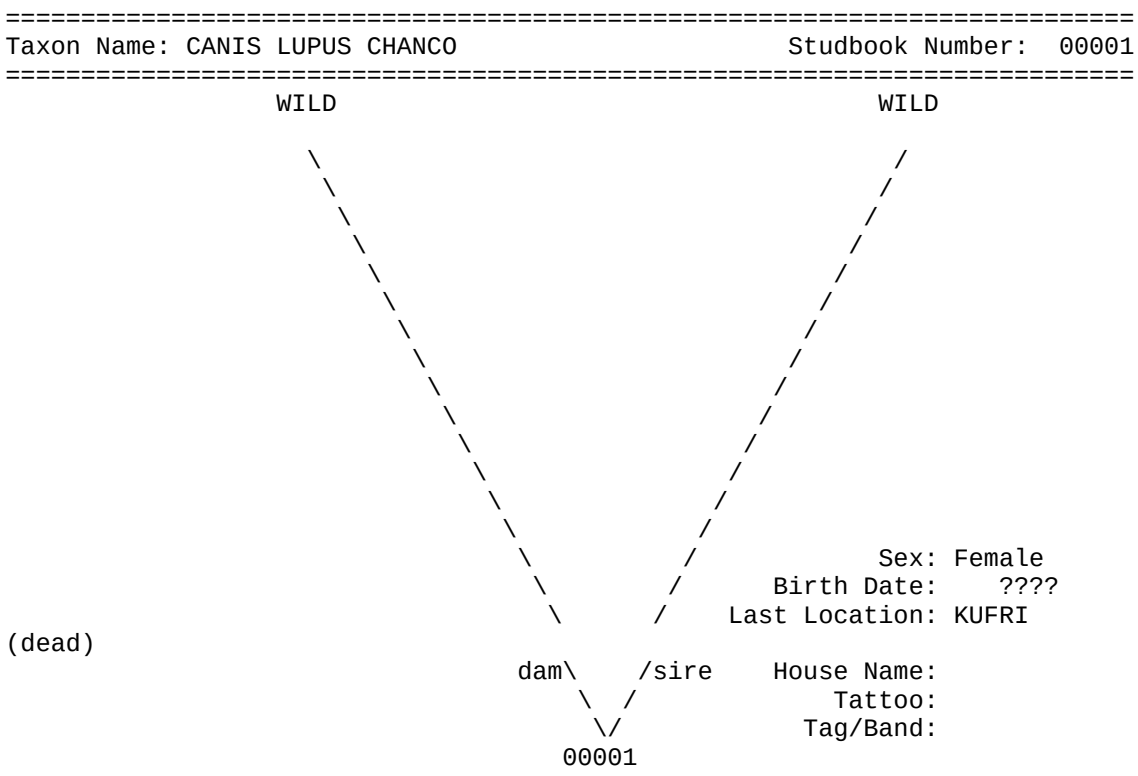
Mean Kinship (MK) -- The mean kinship coefficient between an animal and all animals (including itself) in the living, captive-born population. The mean kinship of a population is equal to the proportional loss of gene diversity of the descendant (captive-born) population relative to the founders and is also the mean inbreeding coefficient of progeny produced by random mating. Mean kinship is also the reciprocal of two times the founder genome equivalents: MK = 1 / (2 * FGE). MK = 1 - GD.

Percent Known -- Percent of an animal's genome that is traceable to known Founders. Thus, if an animal has an UNK sire, the % Known = 50. If it has an UNK grandparent, % Known = 75.

Prob Lost – Probability that a random allele from the individual will be lost from the population in the next generation, because neither this individual nor any of its relatives pass on the allele to an offspring. Assumes that each individual will produce a number of future offspring equal to its reproductive value, Vx.

Annexure 1

Pedigree Chart Report: Live individuals
Tibetan Wolf Studbook



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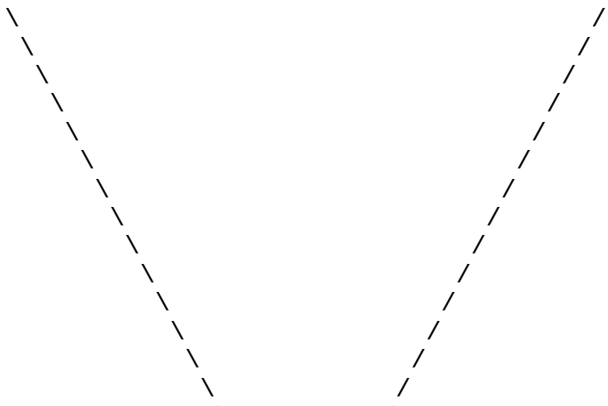

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Tattoo:
Tag/Band:

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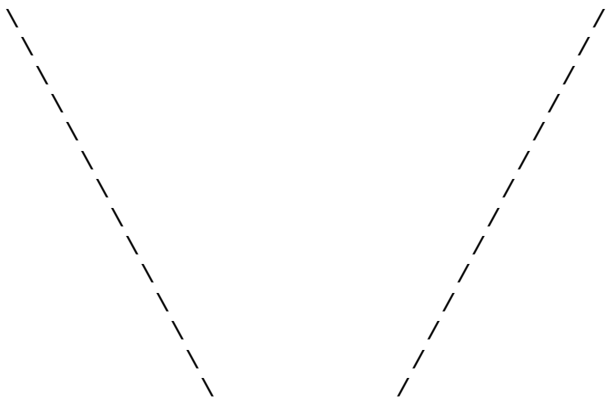
WILD WILD



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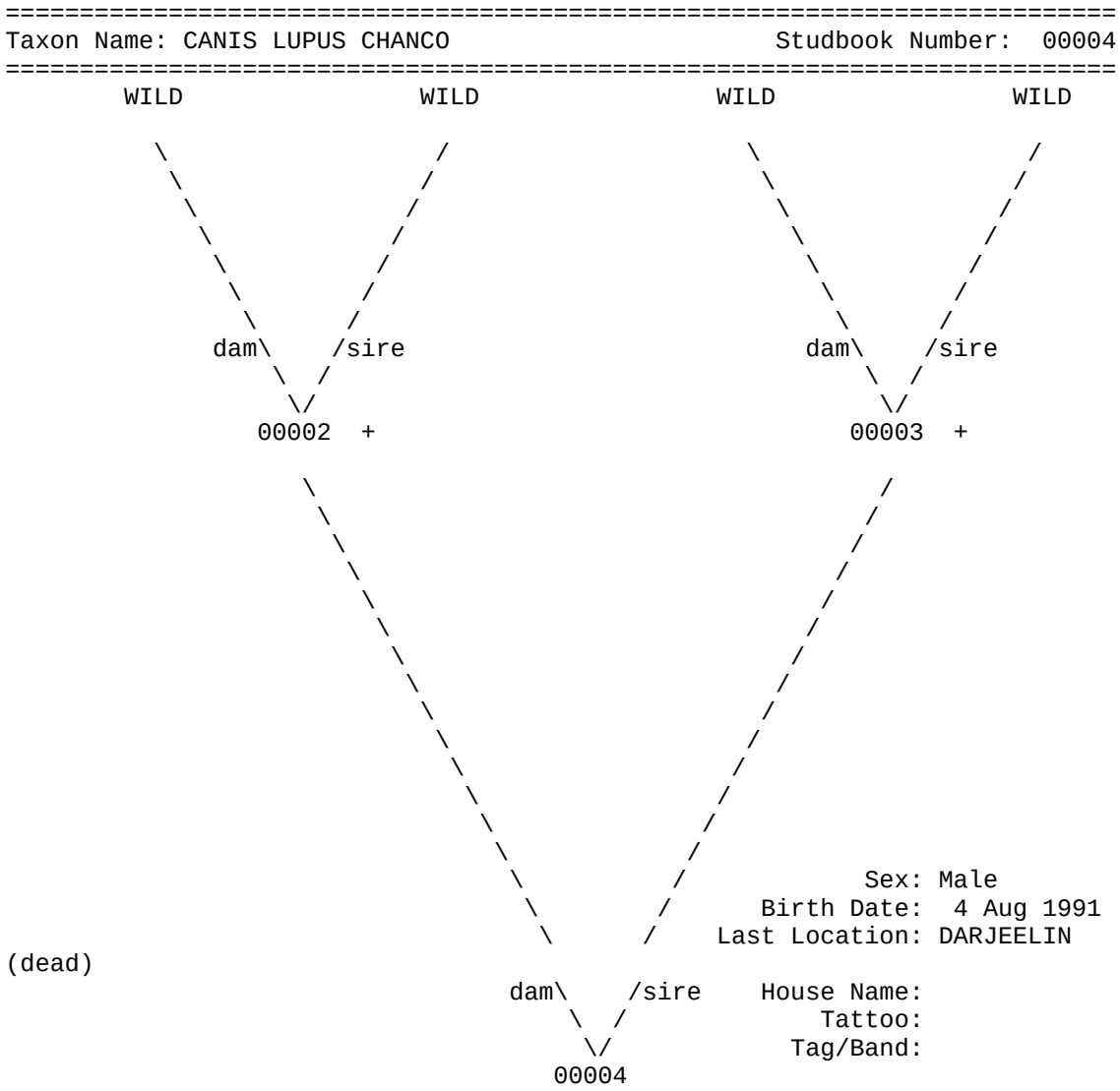
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dam\
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House Name:
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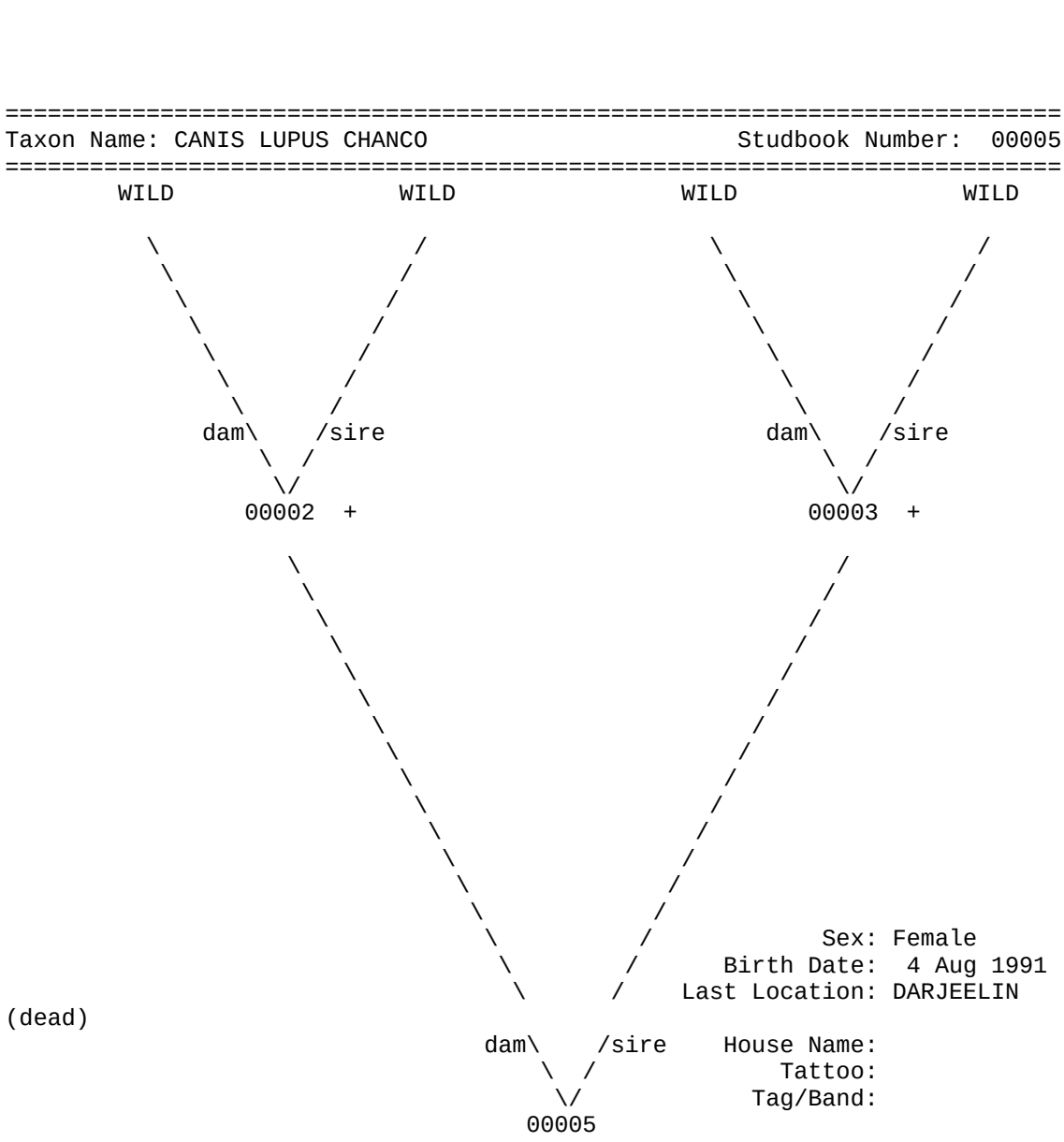
+ Wild-caught...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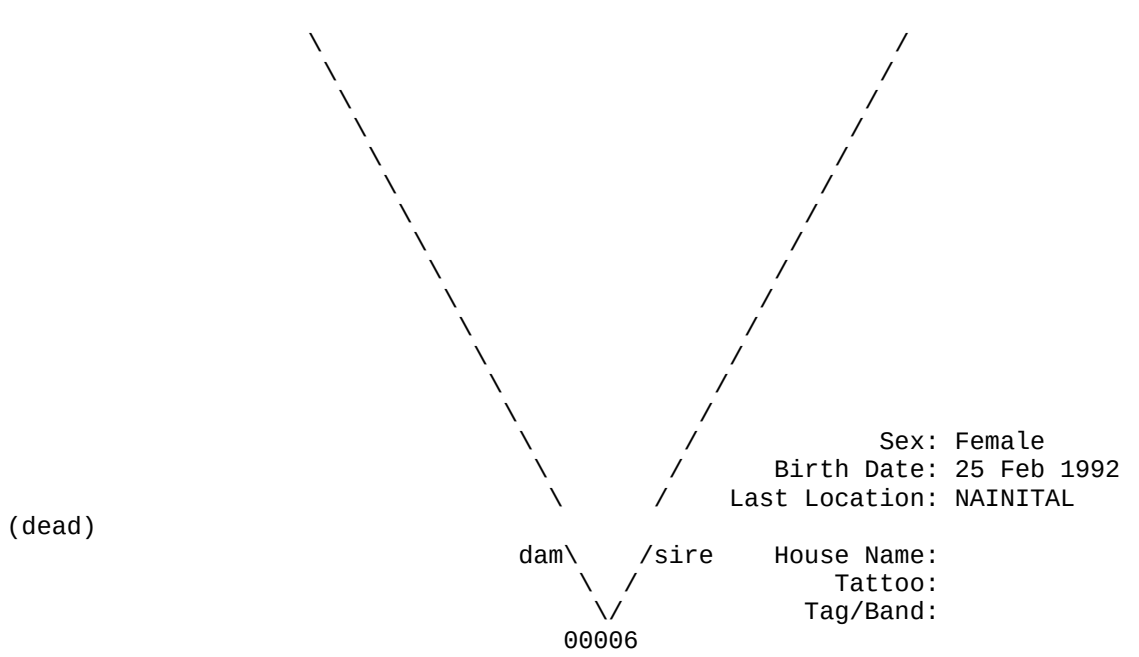

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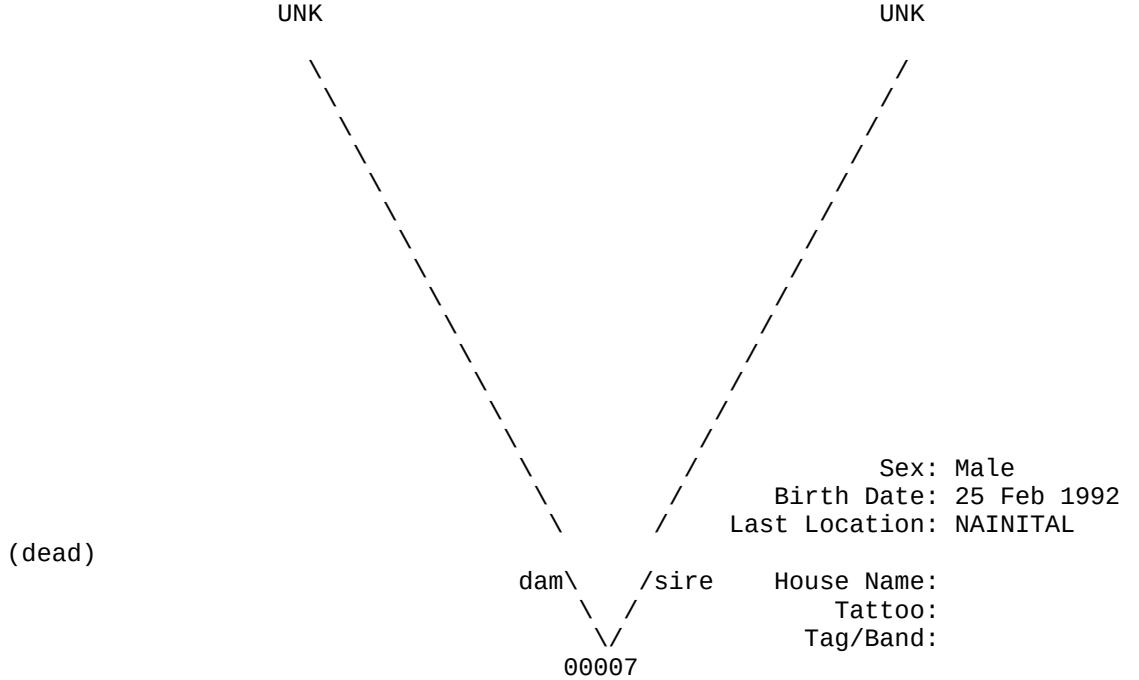

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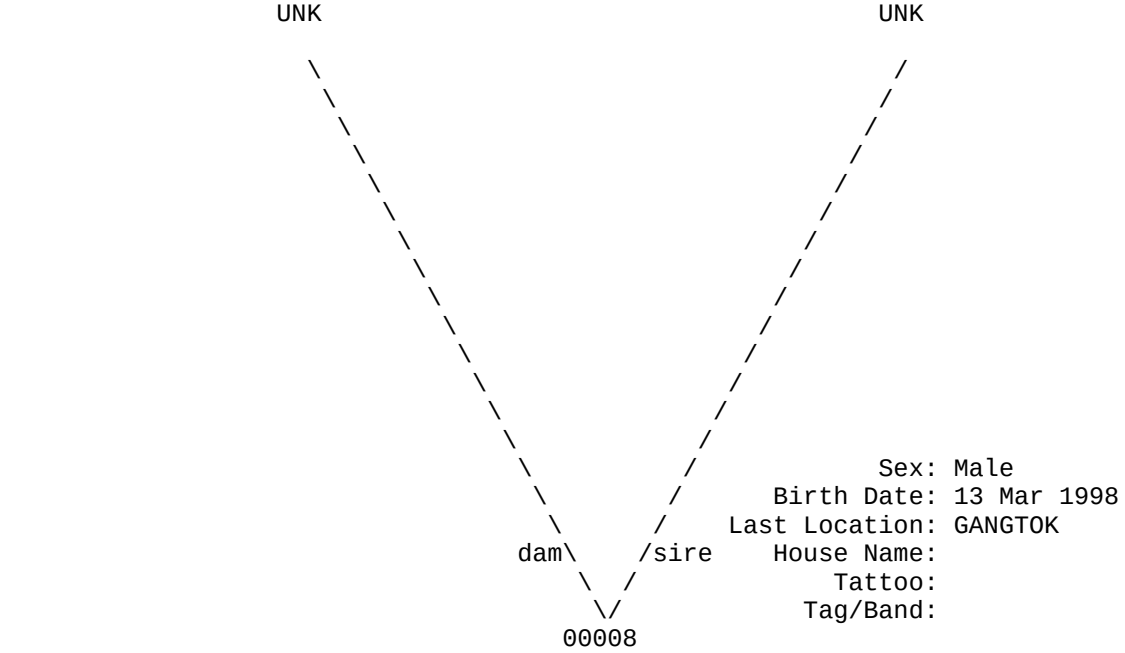

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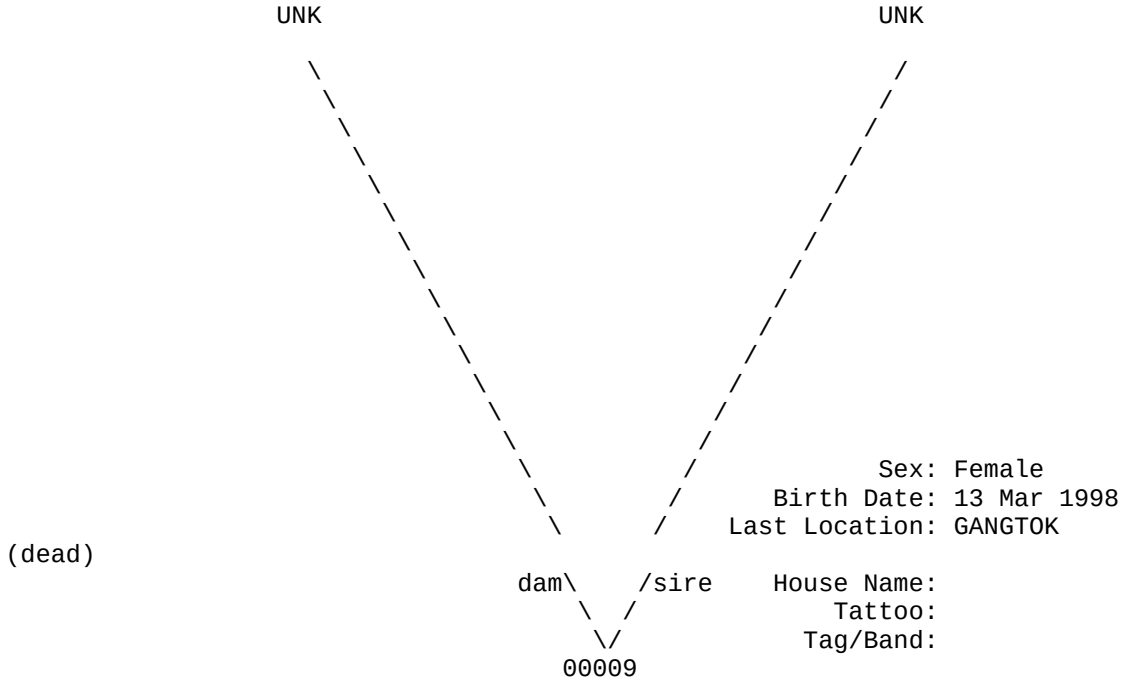

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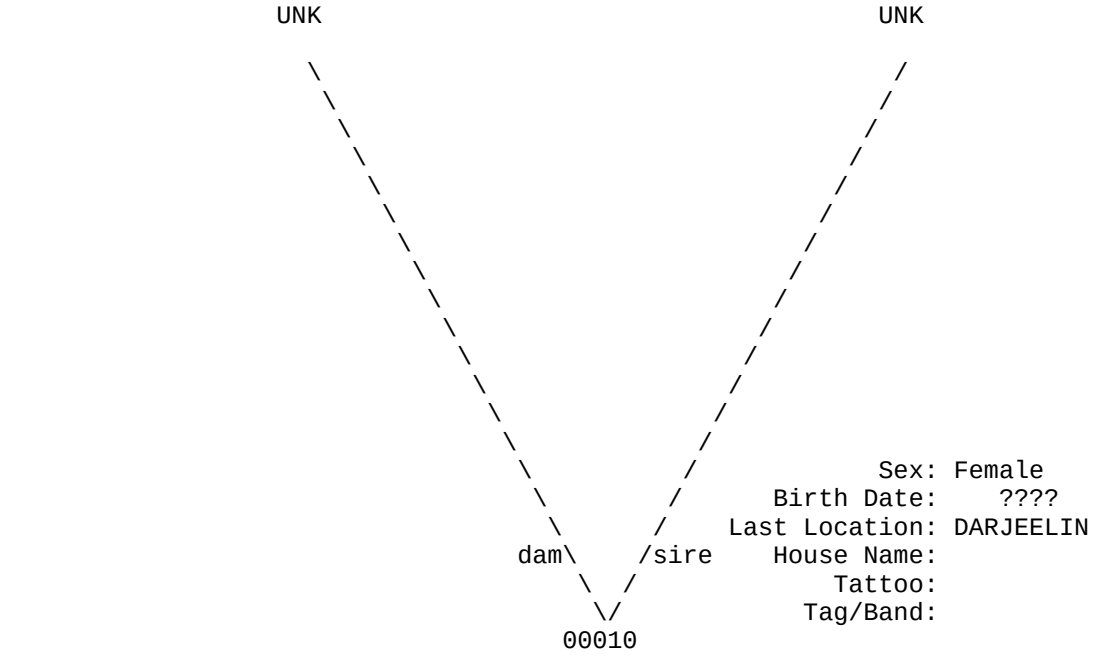

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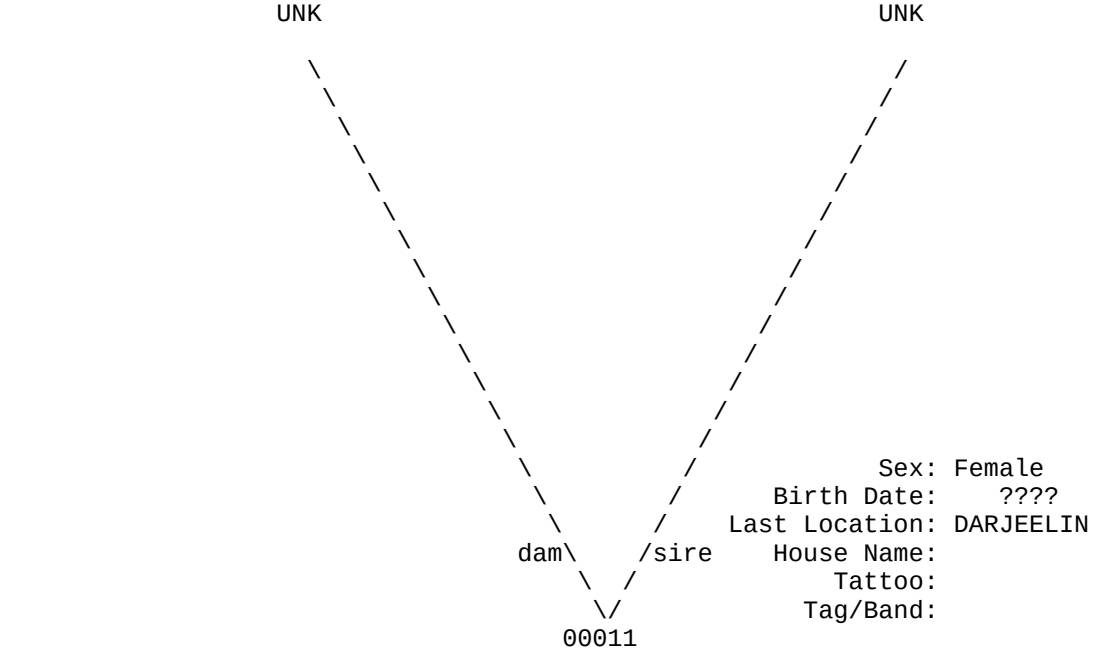

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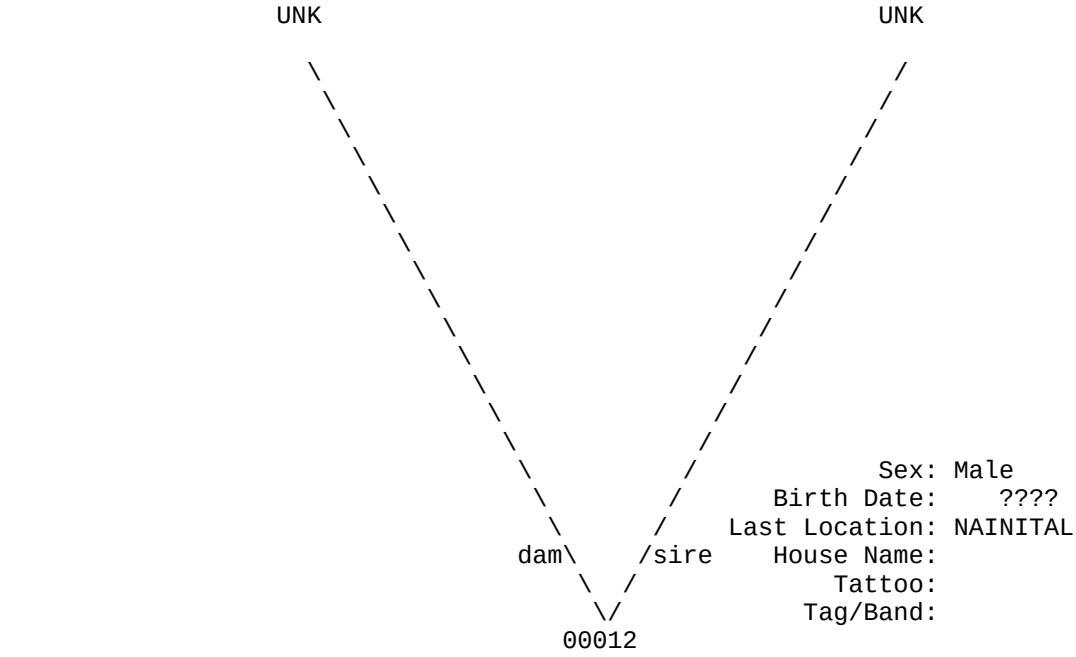

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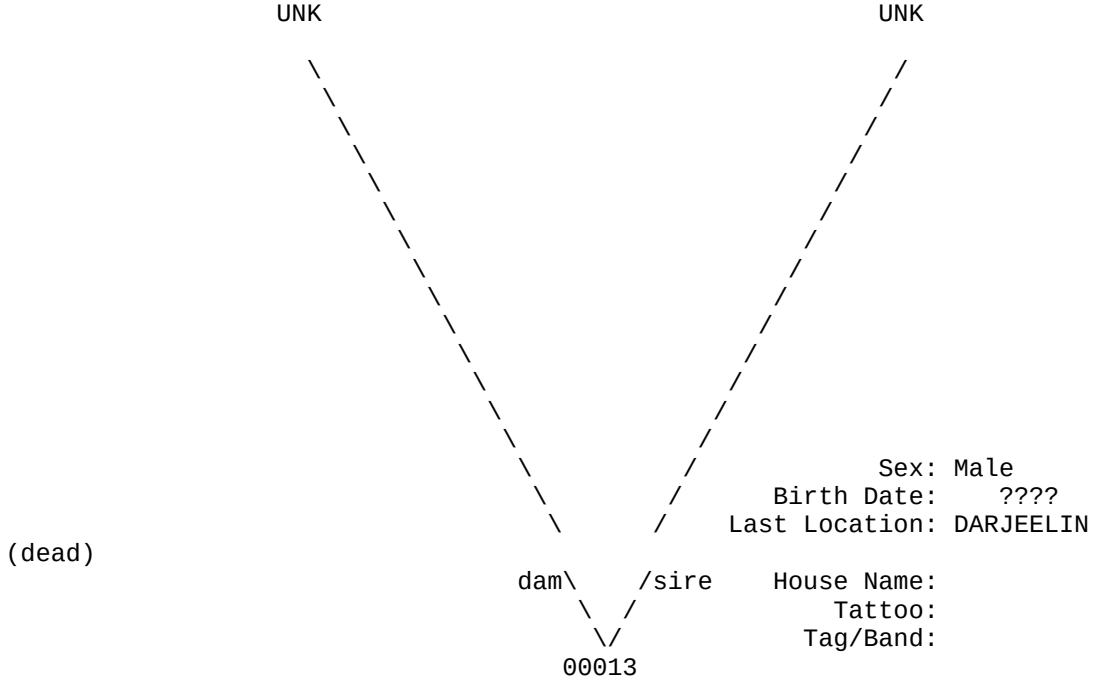

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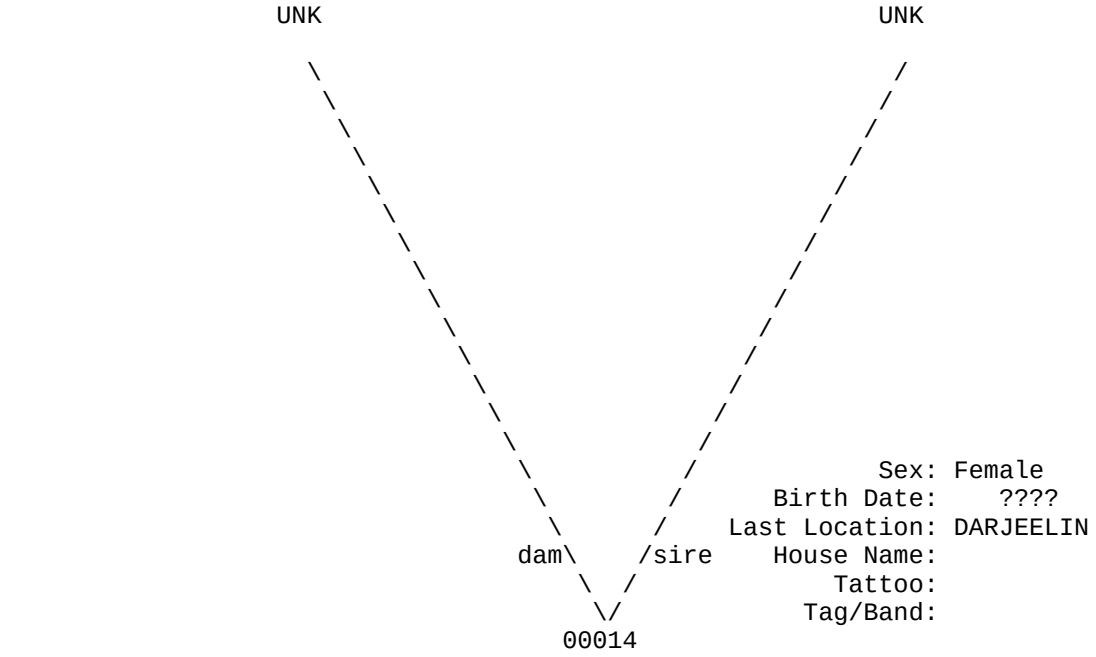

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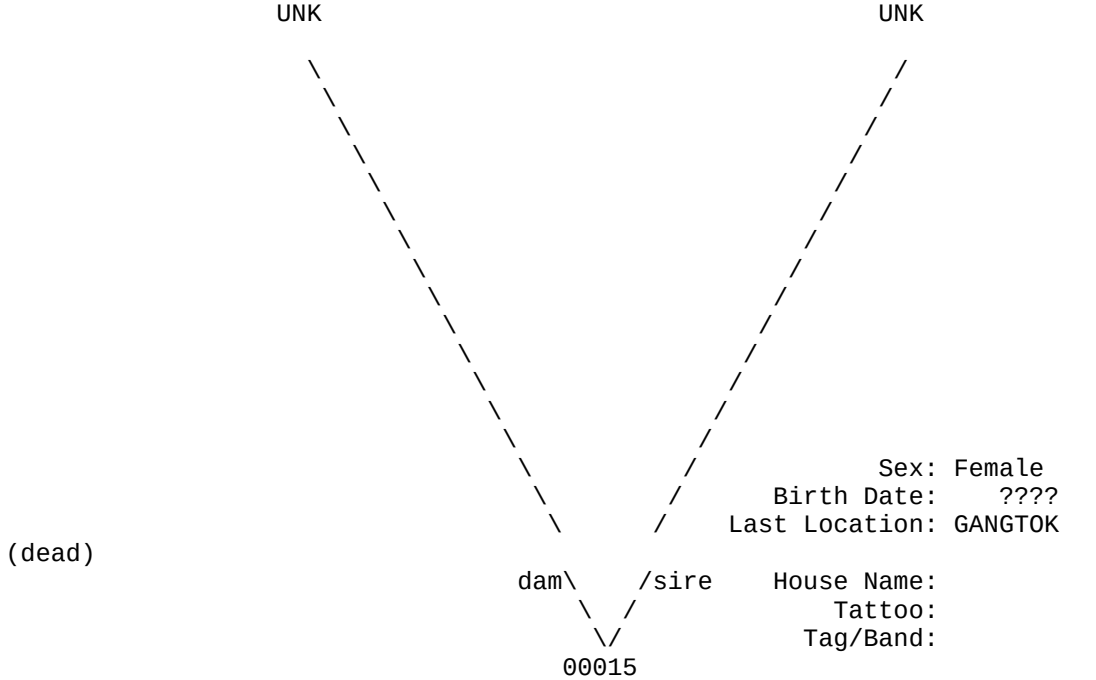

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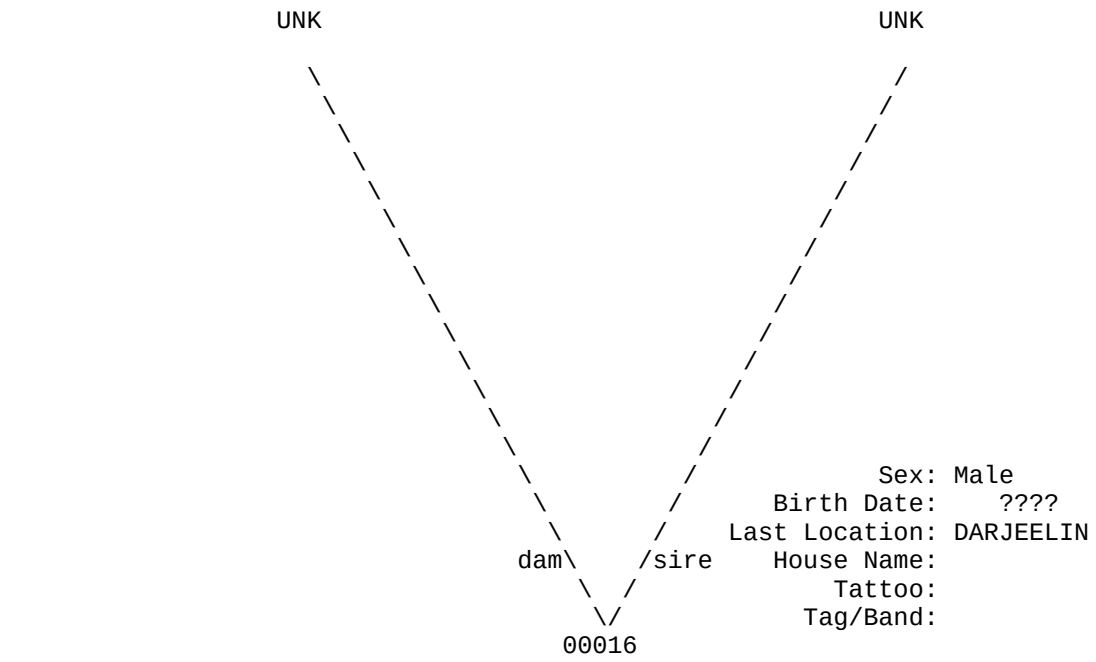

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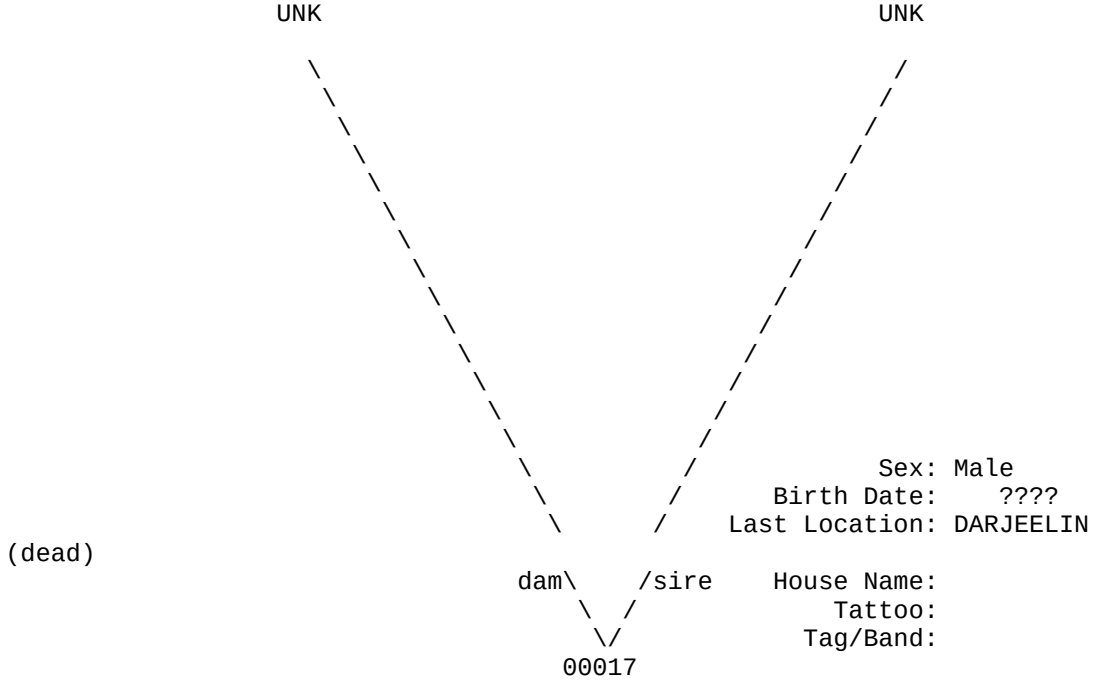

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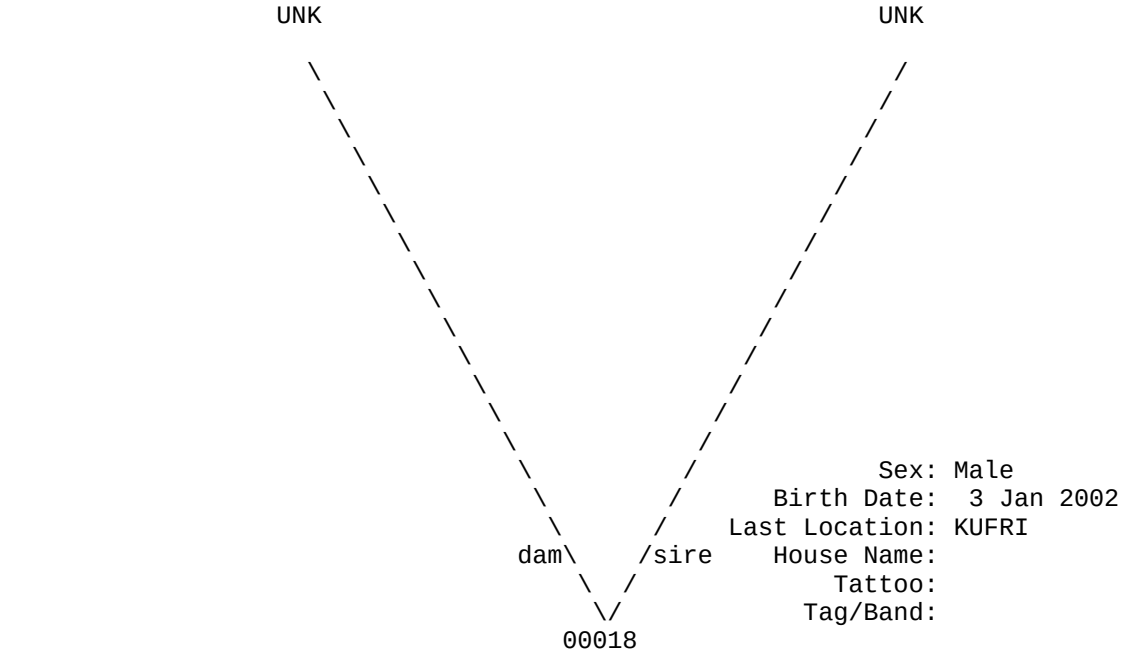

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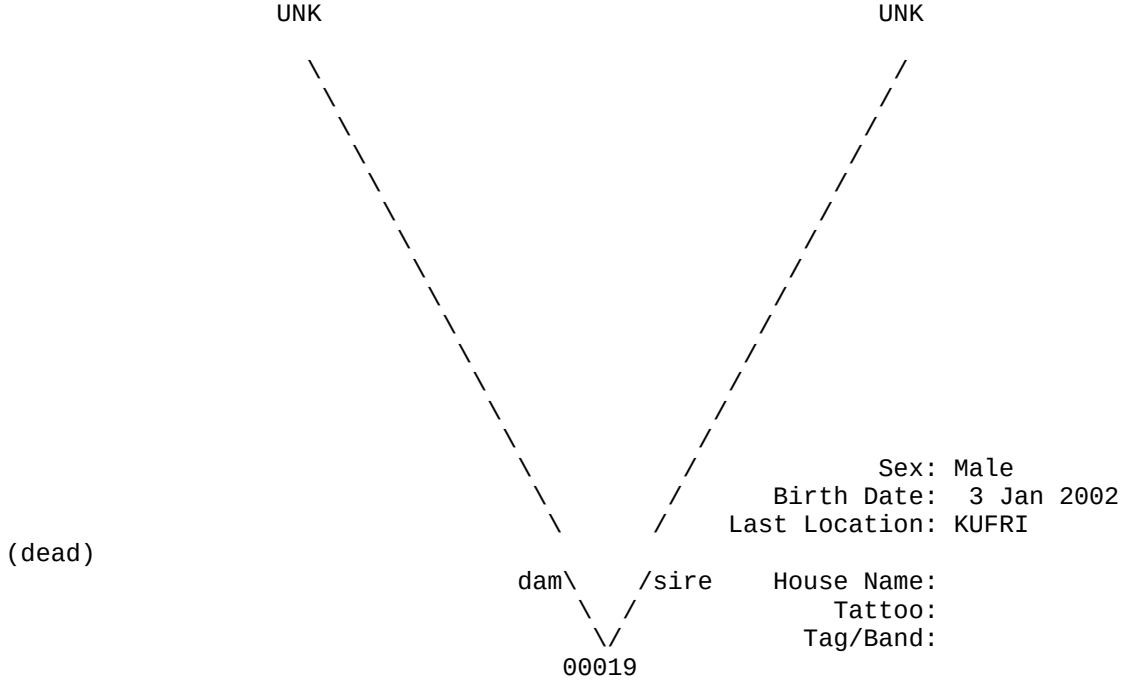

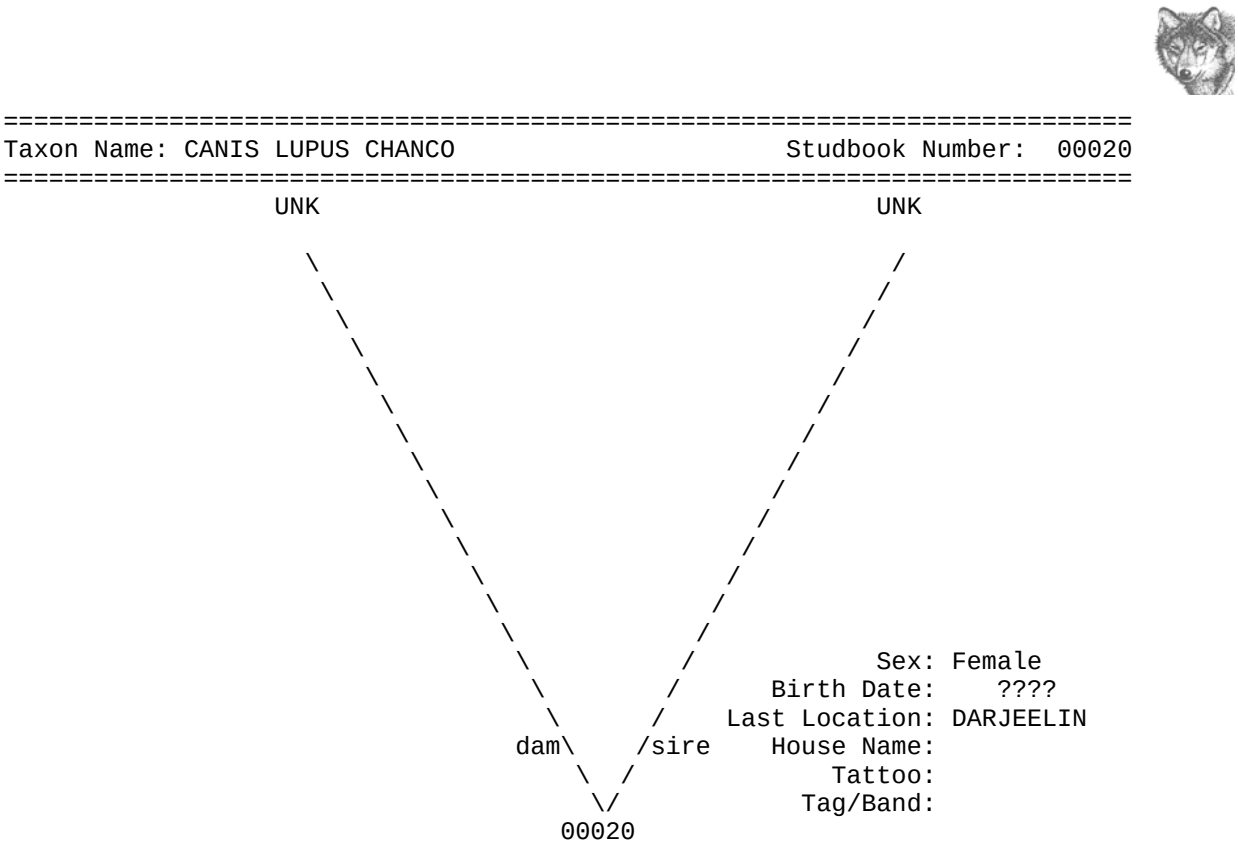
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Tag/Band:
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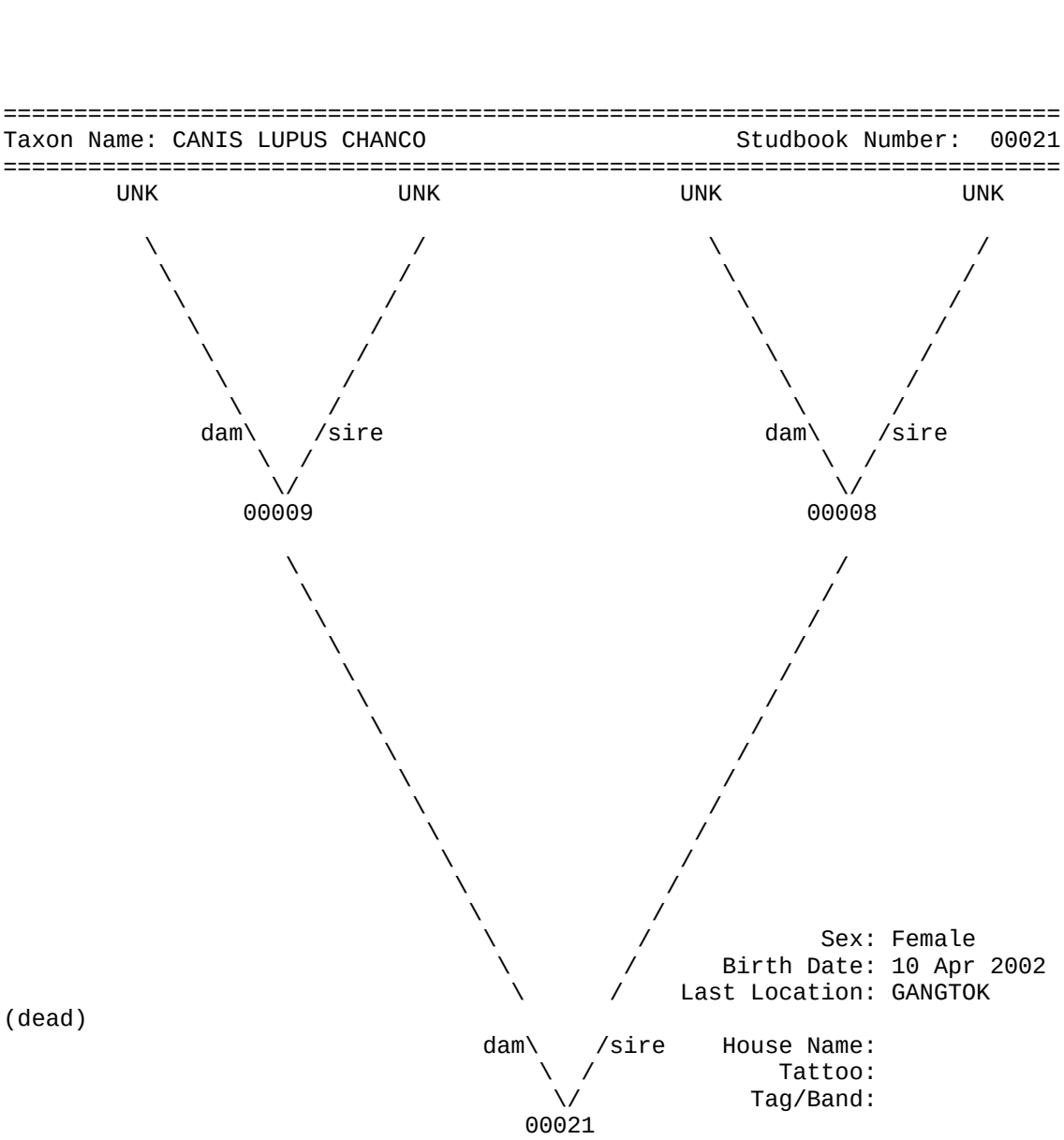
sire
00020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00009
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dam
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House Name:
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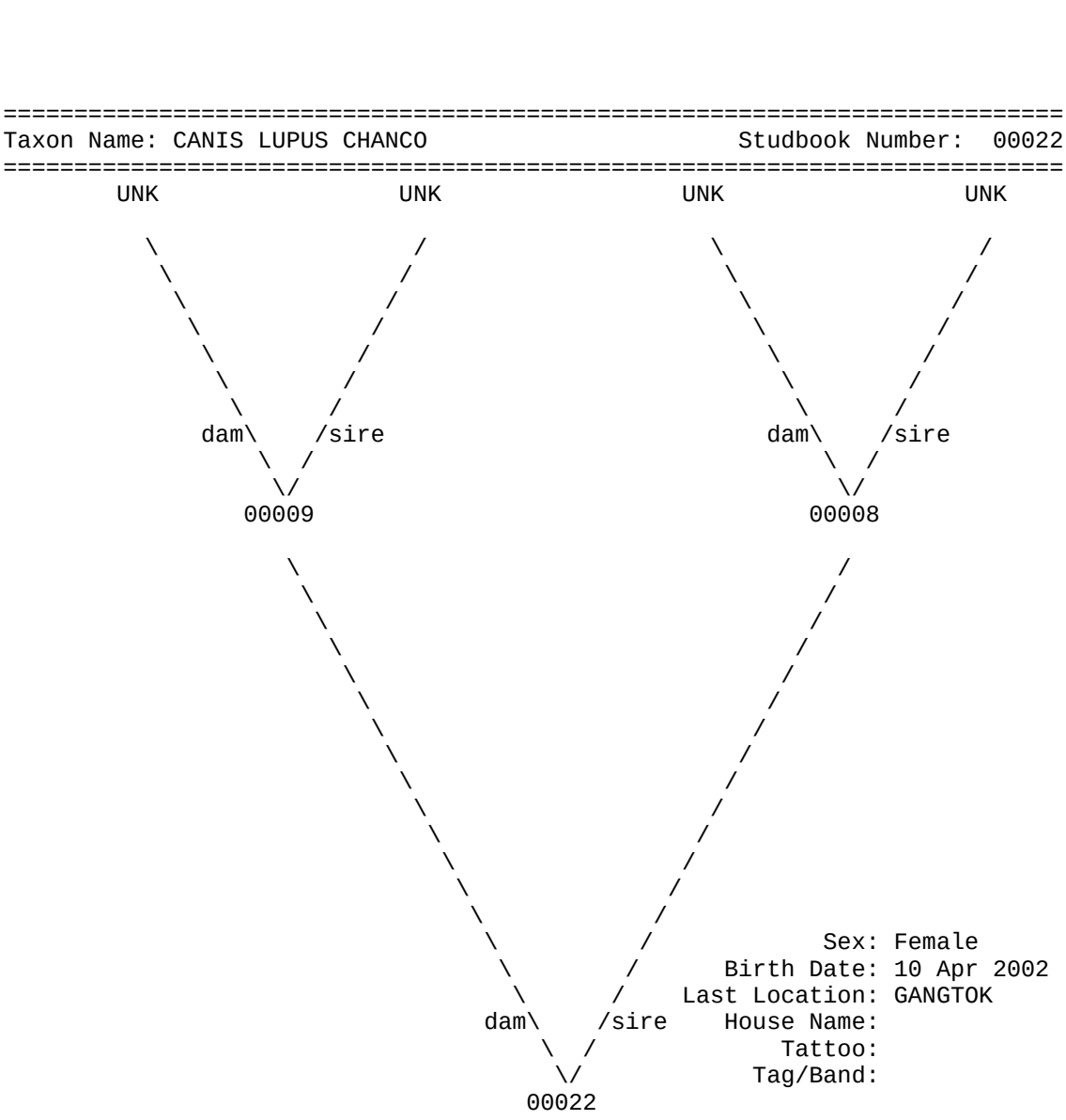
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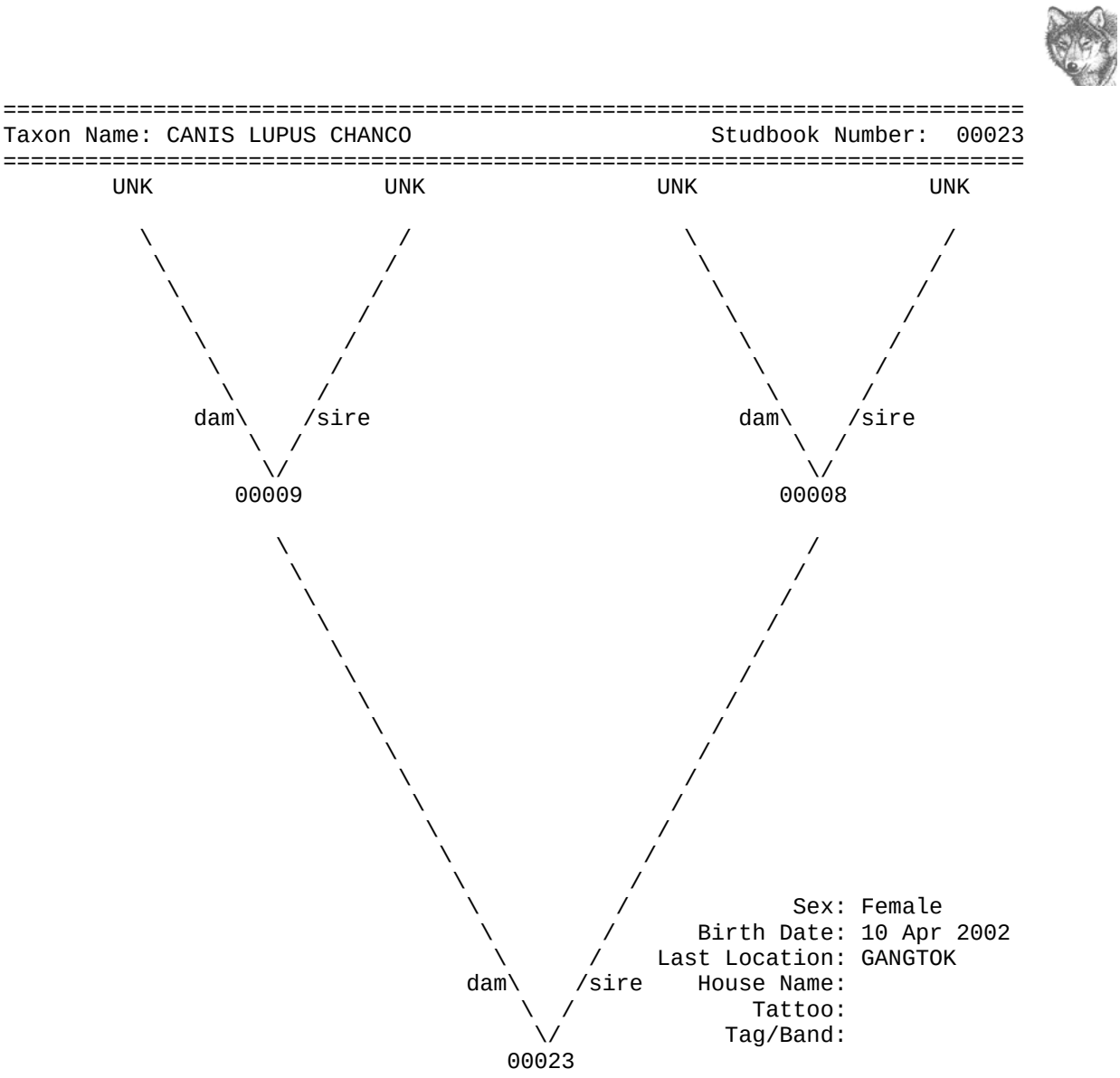
Tag/Band: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sire
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Tag/Band:

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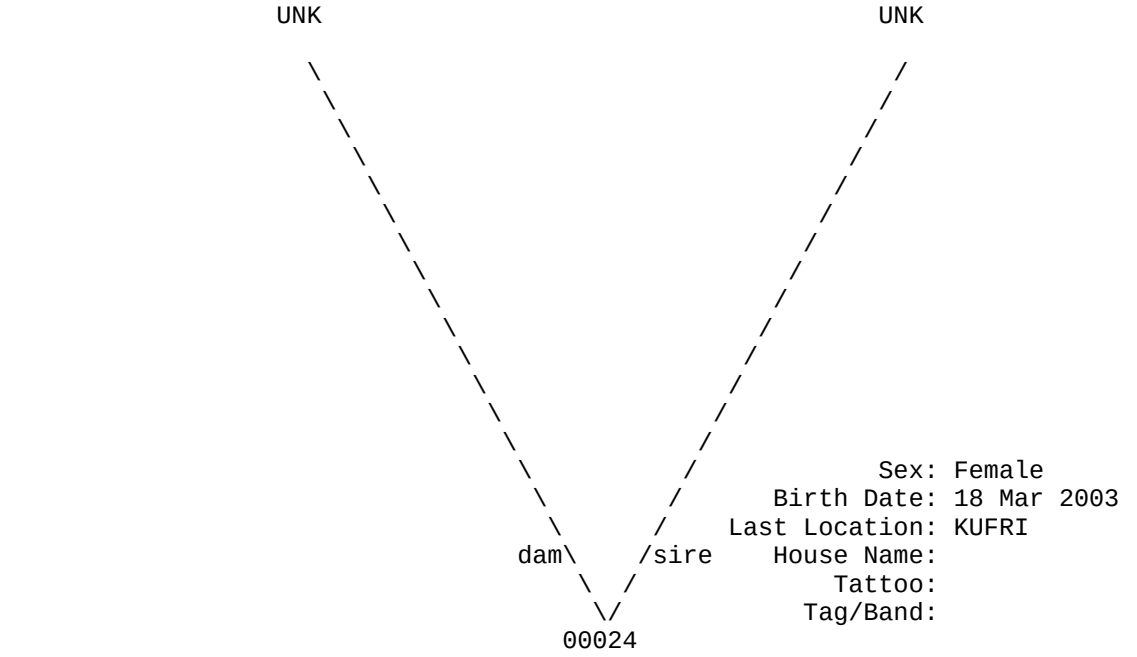

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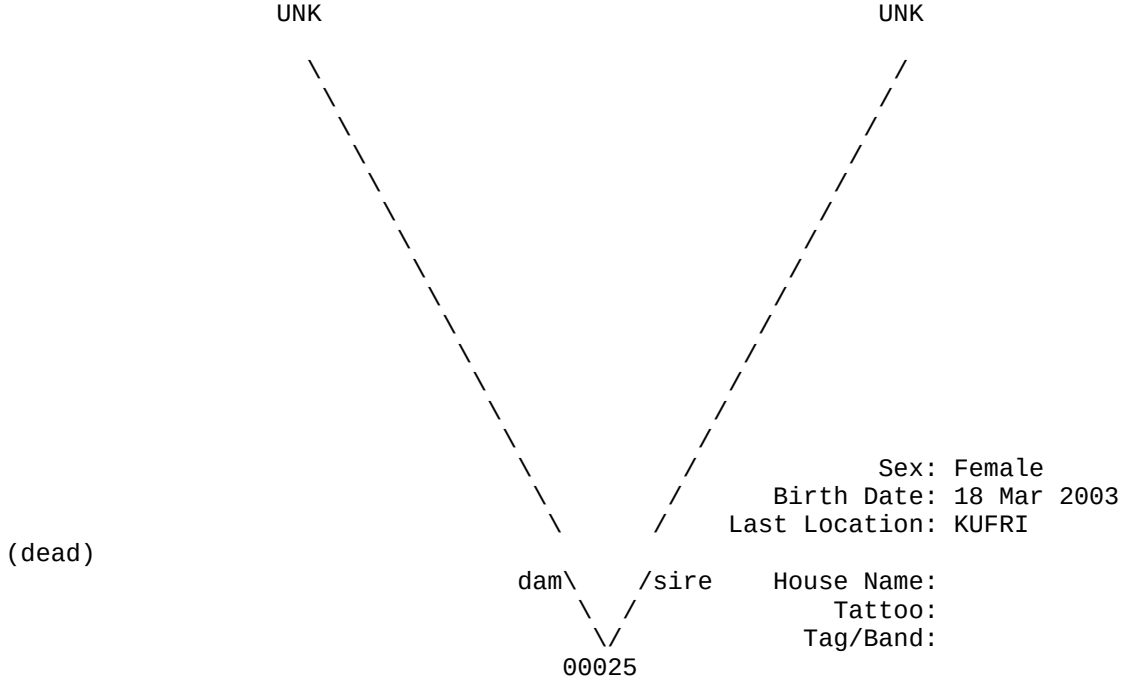

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                               \                   /
                                \                 /
                                 \               /
                                  \             /
                                   \           /
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                                     \       /       Birth Date:  4 Oct 2003
                                      \     /     Last Location: NAINITAL
(dead)
                                  dam\    /sire    House Name:
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                  UNK                                          UNK

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                                 \               /
                                  \             /
                                   \           /
                                    \         /              Sex: Male
                                     \       /       Birth Date: 17 Mar 2004
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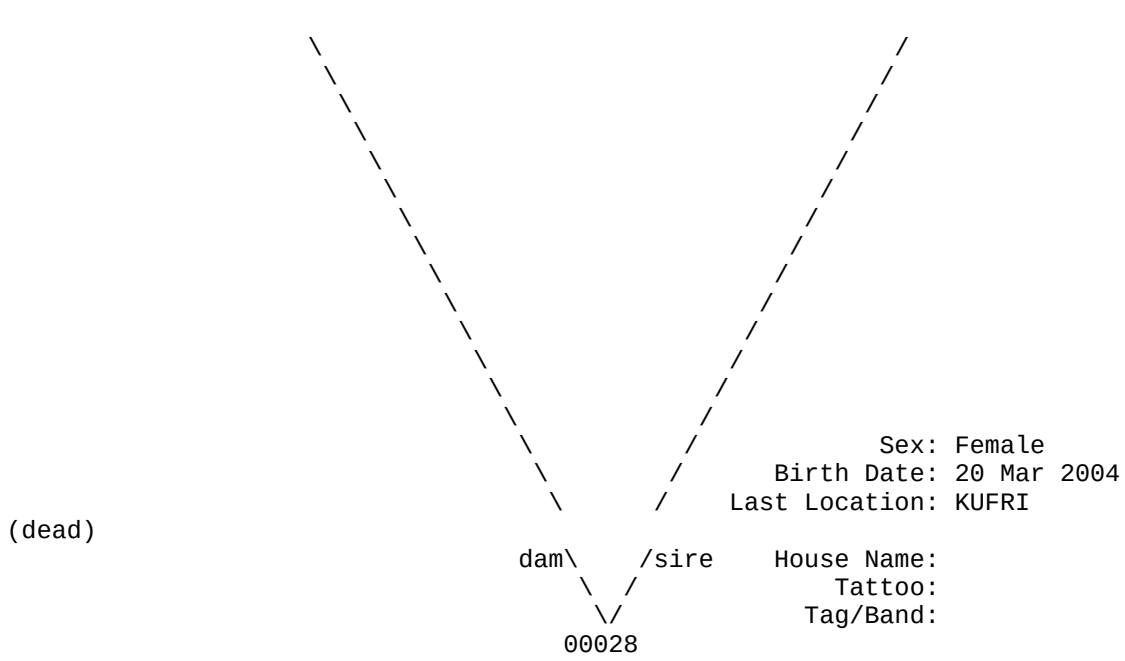
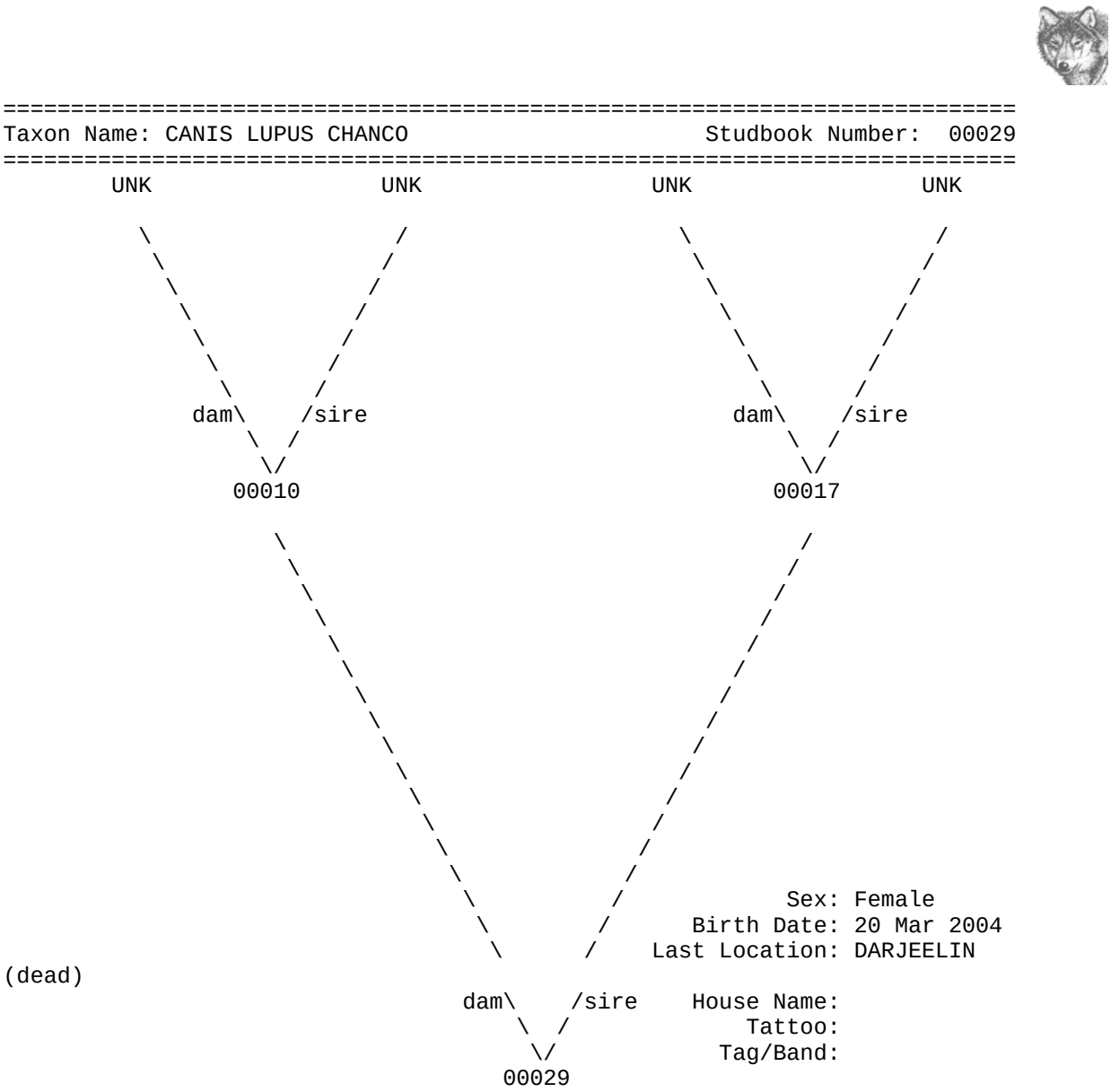
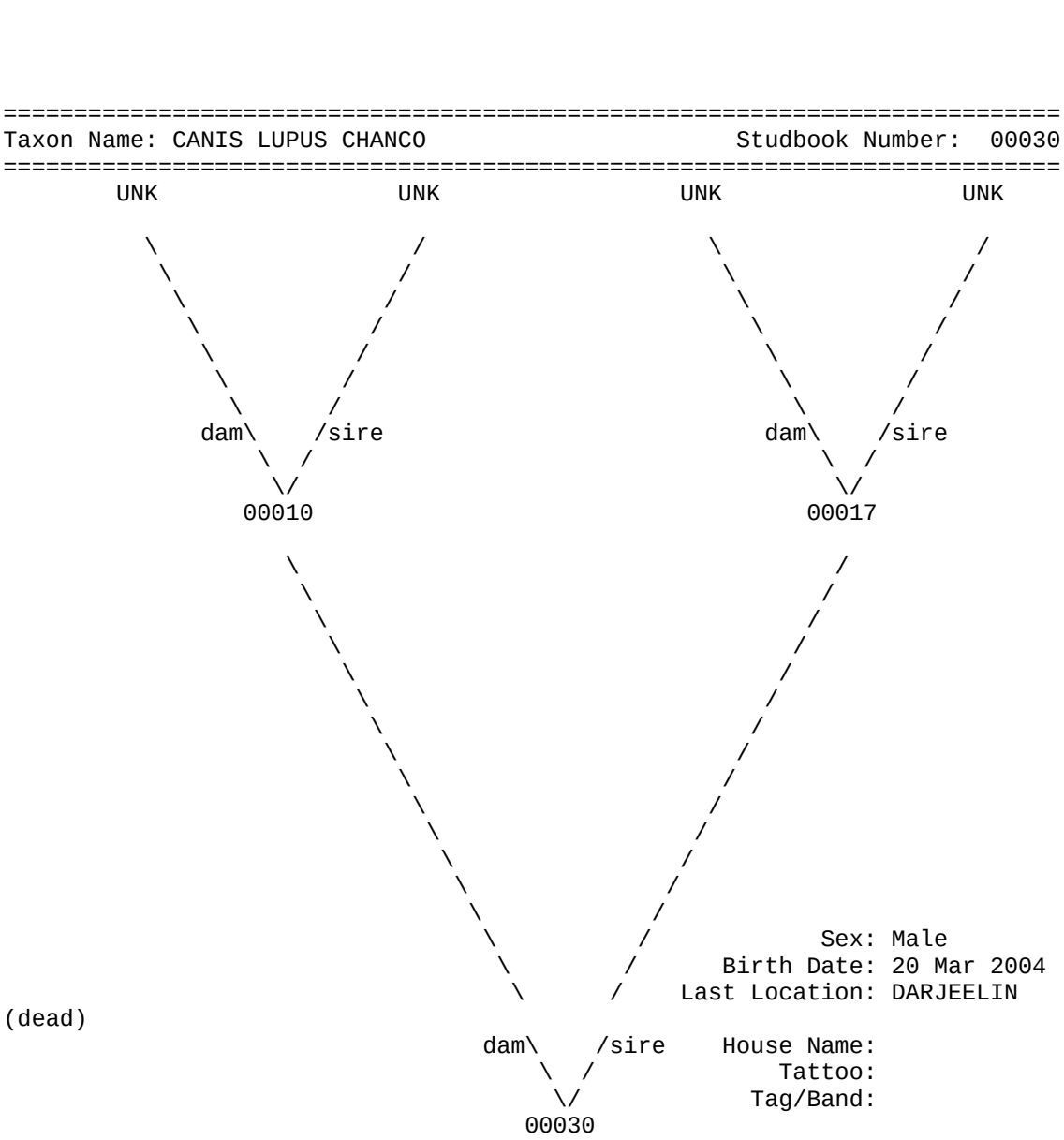
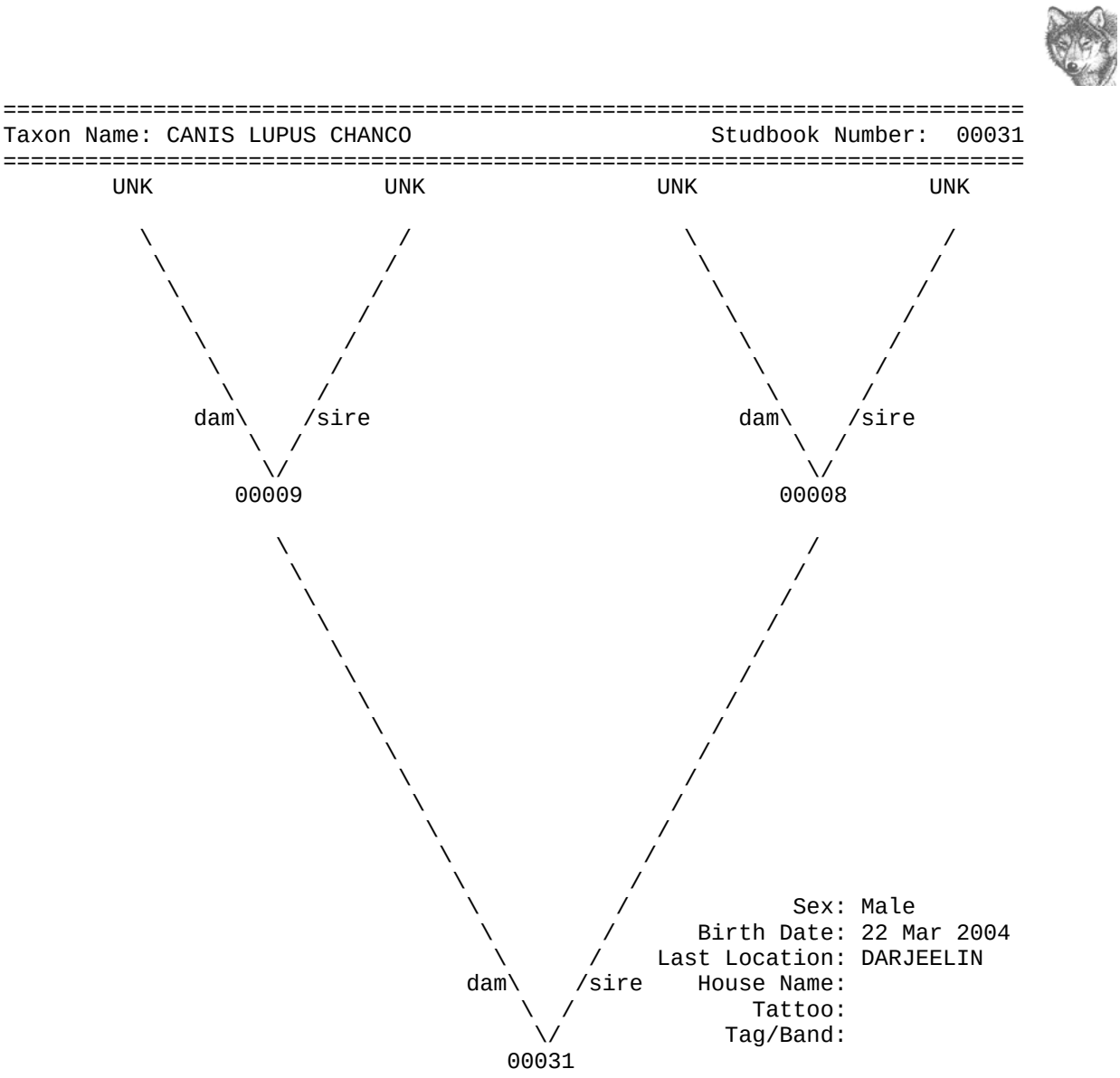
Taxon Name: CANIS LUPUS CHANCO Studbook Number: 00028




Taxon Name: CANIS LUPUS CHANCO
Studbook Number: 00029
UNK
UNK
UNK
UNK
dam\
/sire
dam\
/sire
00010
00017
Sex: Female
Birth Date: 20 Mar 2004
Last Location: DARJEELIN
(dead)
House Name:
Tattoo:
Tag/Band:
dam\
/sire
00029


Taxon Name: CANIS LUPUS CHANCO
Studbook Number: 00030
UNK
UNK
UNK
UNK
dam
sire
dam
sire
00010
00017
Sex: Male
Birth Date: 20 Mar 2004
Last Location: DARJEELIN
(dead)
House Name:
Tattoo:
Tag/Band:
dam
sire
00030


Taxon Name: CANIS LUPUS CHANCO
Studbook Number: 00031
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UNK
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UNK
dam
sire
dam
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00009
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sire
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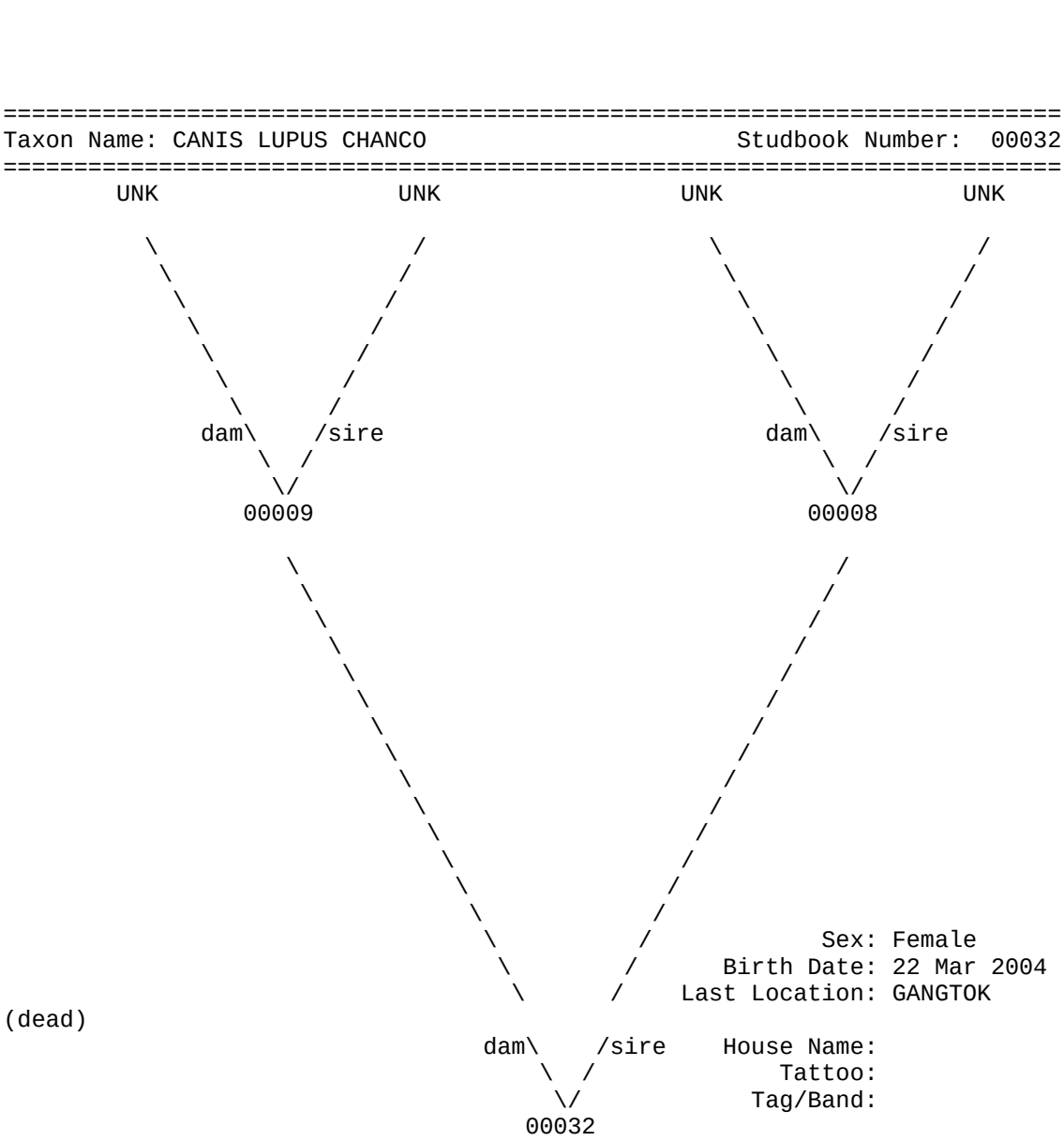
Sex: Male
Birth Date: 22 Mar 2004
Last Location: DARJEELIN
House Name:
Tattoo:
Tag/Band:


Taxon Name: CANIS LUPUS CHANCO
Studbook Number: 00032
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UNK
UNK
UNK
dam
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dam
sire
00009
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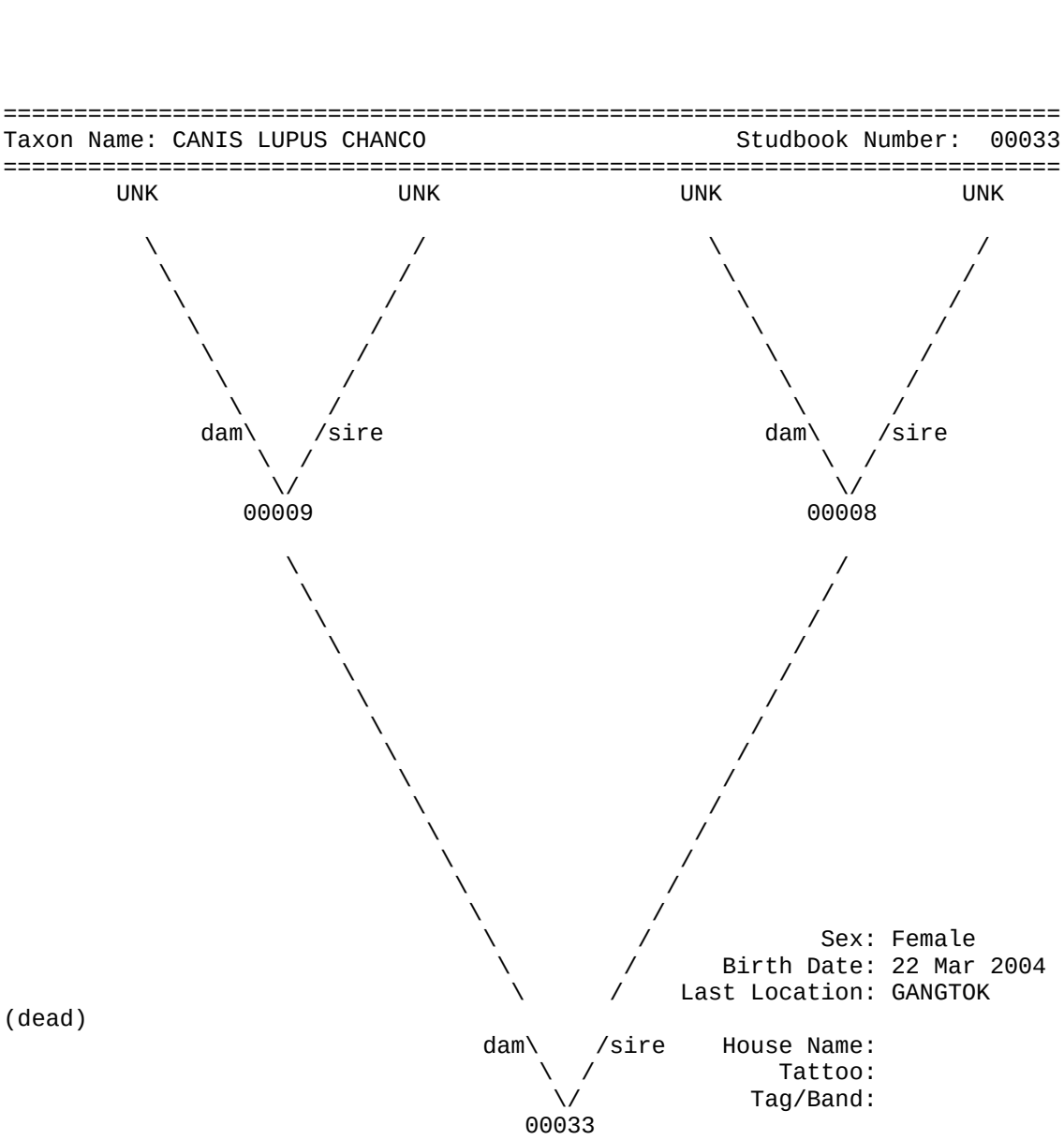
sire
00032
Sex: Female
Birth Date: 22 Mar 2004
Last Location: GANGTOK
(dead)
House Name:
Tattoo:
Tag/Band:


Taxon Name: CANIS LUPUS CHANCO
Studbook Number: 00033
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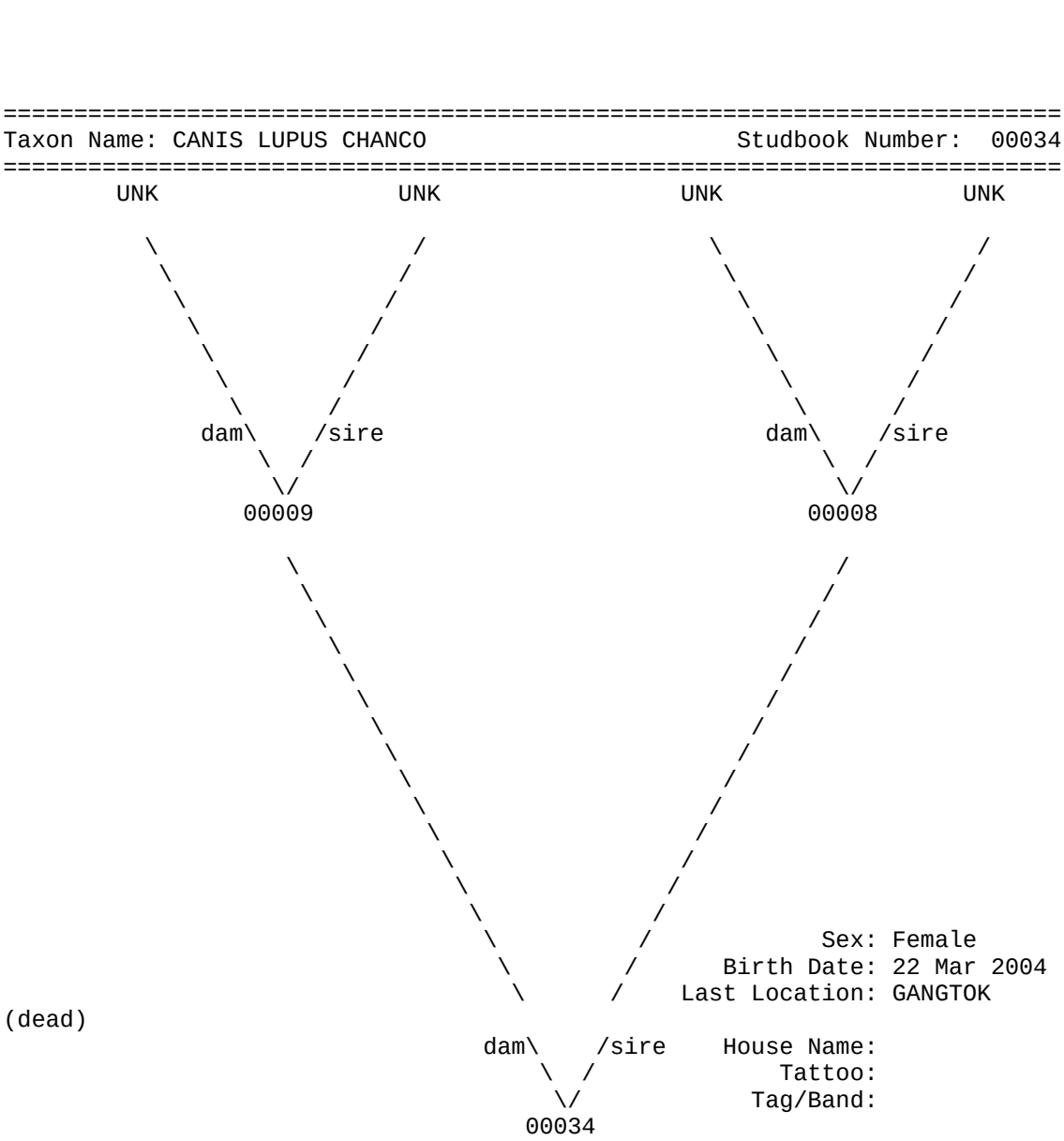
UNK
UNK
UNK
dam
sire
dam
sire
00009
00008
Sex: Female
Birth Date: 22 Mar 2004
Last Location: GANGTOK
(dead)
dam
sire
House Name:
Tattoo:
Tag/Band:
00033


Taxon Name: CANIS LUPUS CHANCO
Studbook Number: 00034
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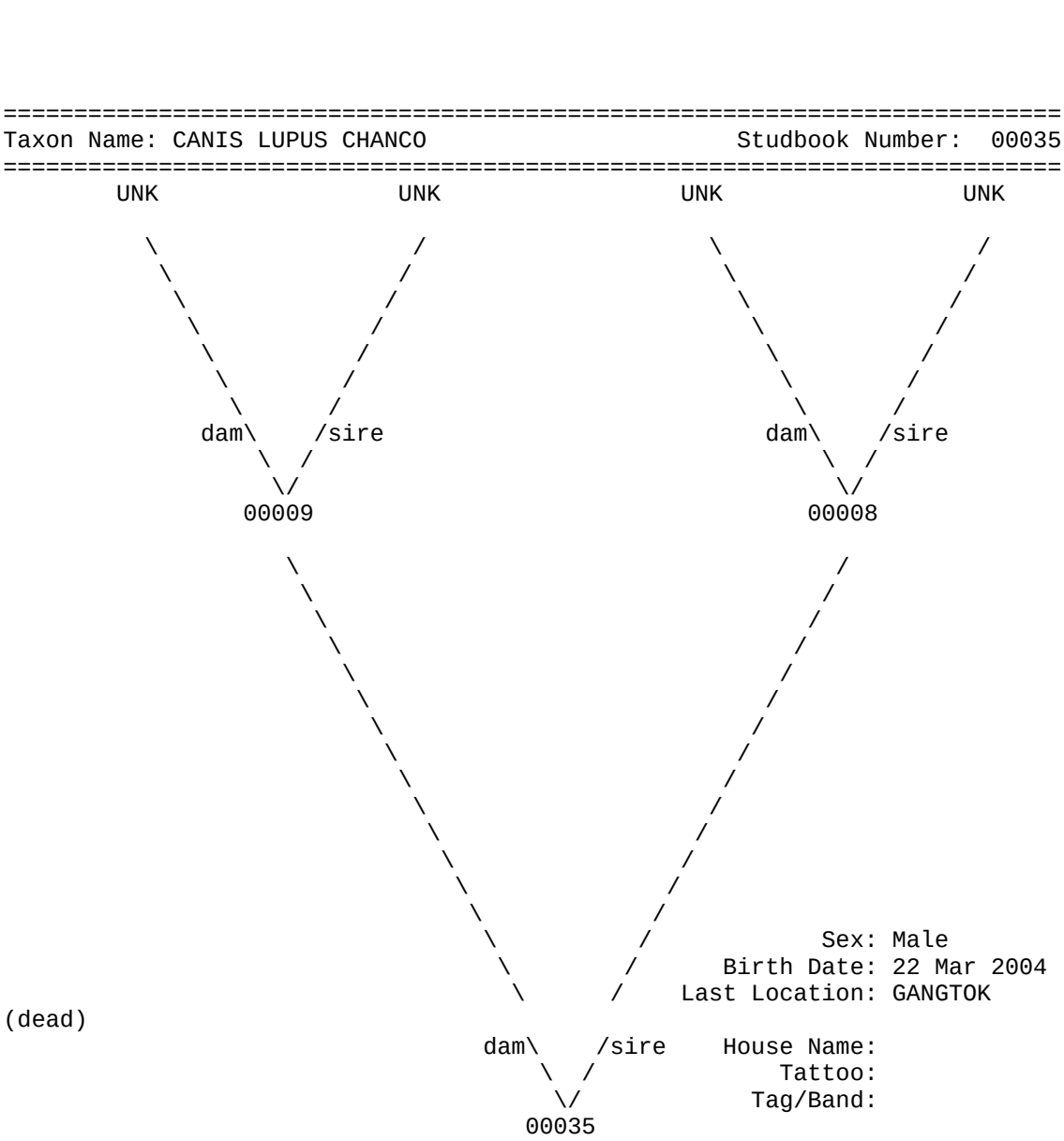
UNK
dam
sire
dam
sire
00009
00008
dam
sire
00034
Sex: Female
Birth Date: 22 Mar 2004
Last Location: GANGTOK
(dead)
House Name:
Tattoo:
Tag/Band:


Taxon Name: CANIS LUPUS CHANCO
Studbook Number: 00035
UNK
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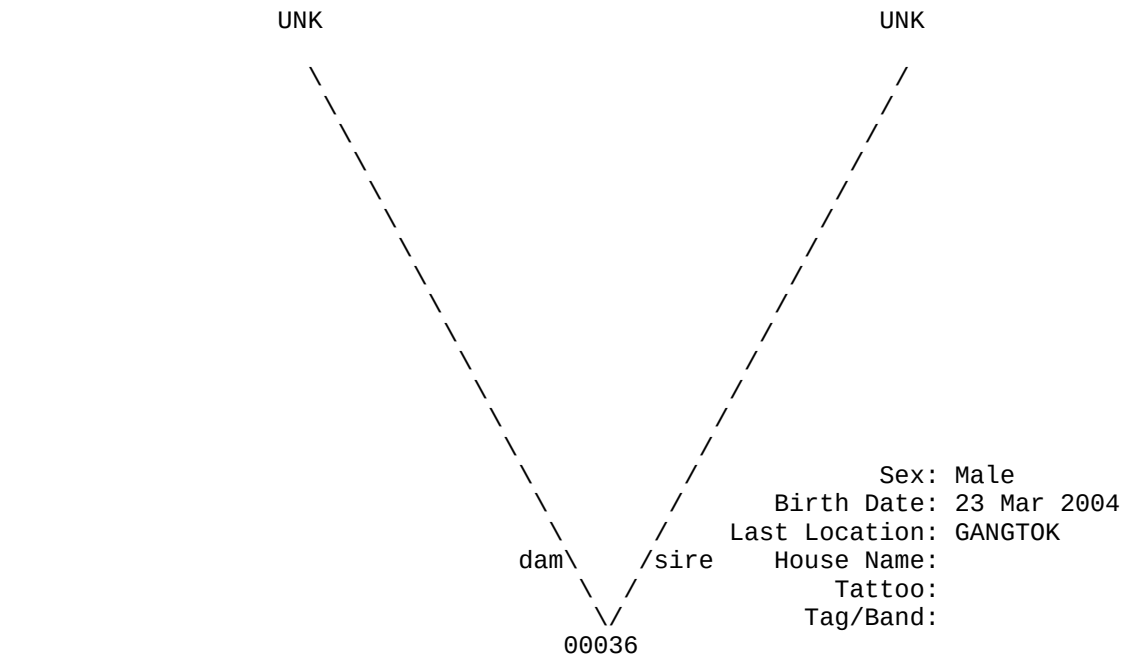
UNK
dam\
/sire
dam\
/sire
00009
00008
Sex: Male
Birth Date: 22 Mar 2004
Last Location: GANGTOK
(dead)
House Name:
Tattoo:
Tag/Band:
dam\
/sire
00035

Taxon Name: CANIS LUPUS CHANCO Studbook Number: 00036



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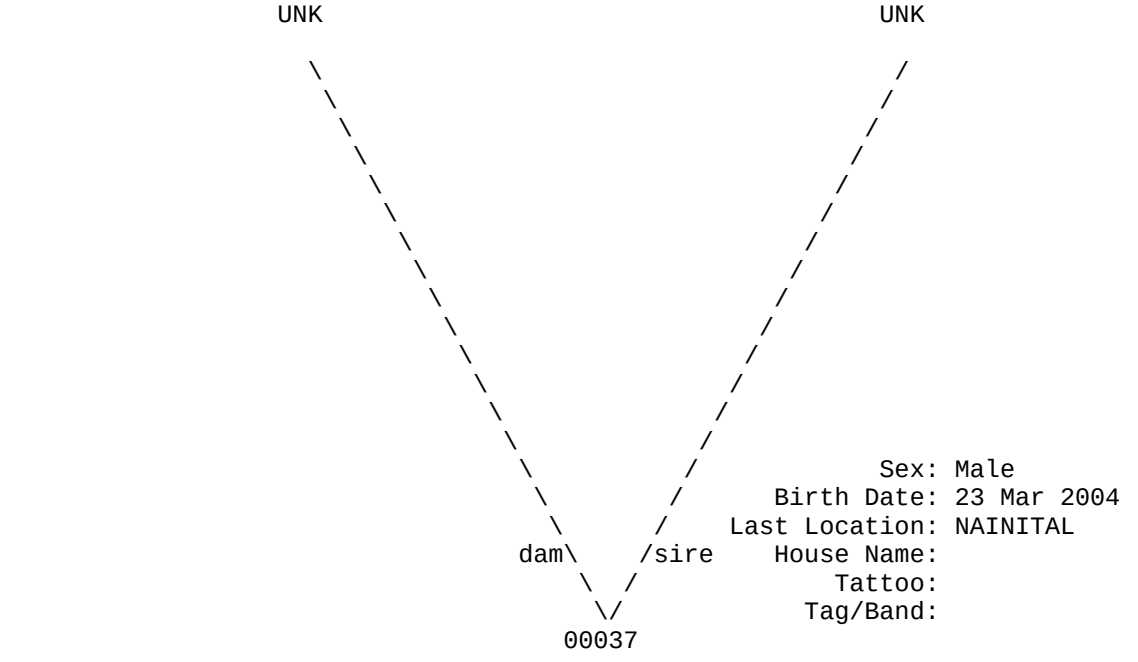
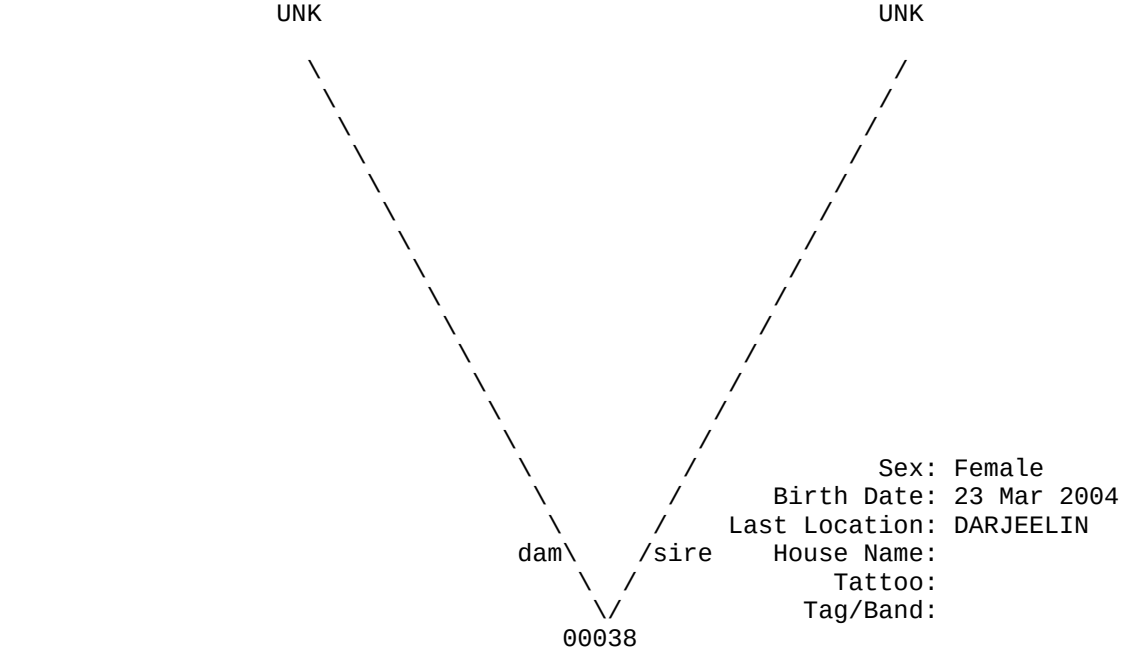
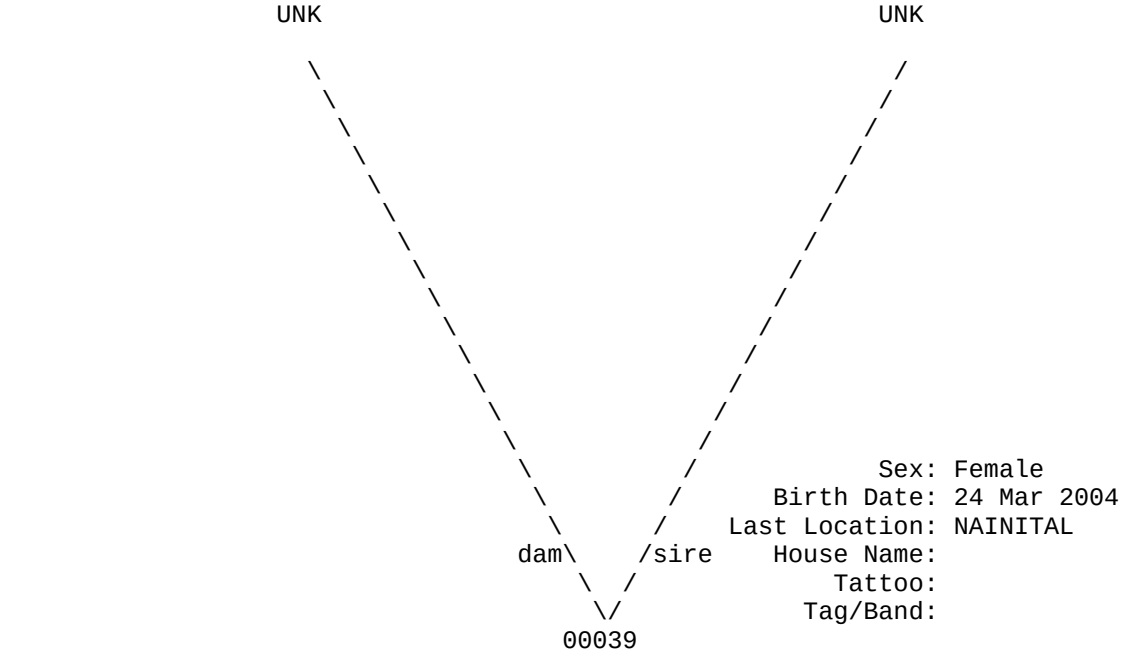


Taxon Name: CANIS LUPUS CHANCO Studbook Number: 00038



Taxon Name: CANIS LUPUS CHANCO Studbook Number: 00039



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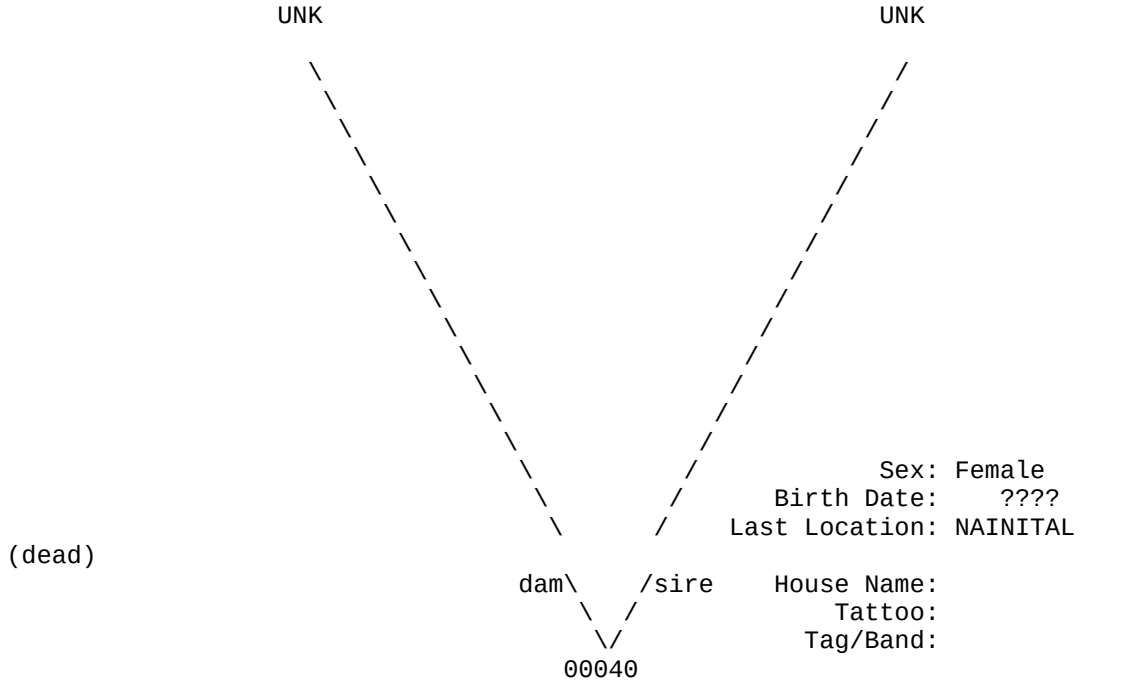
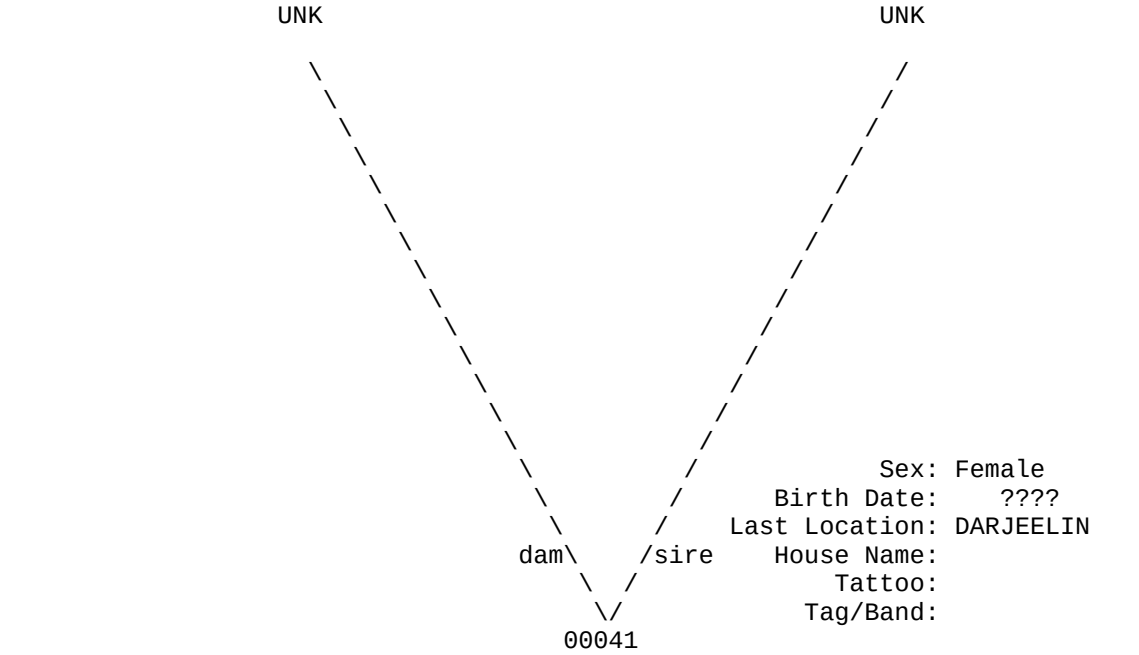
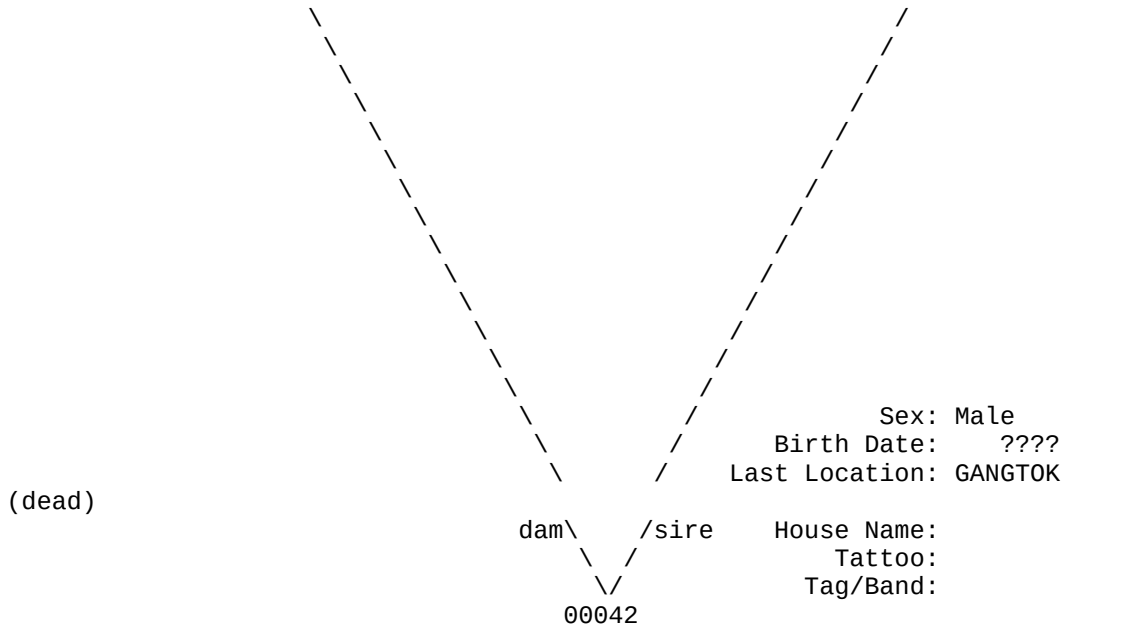


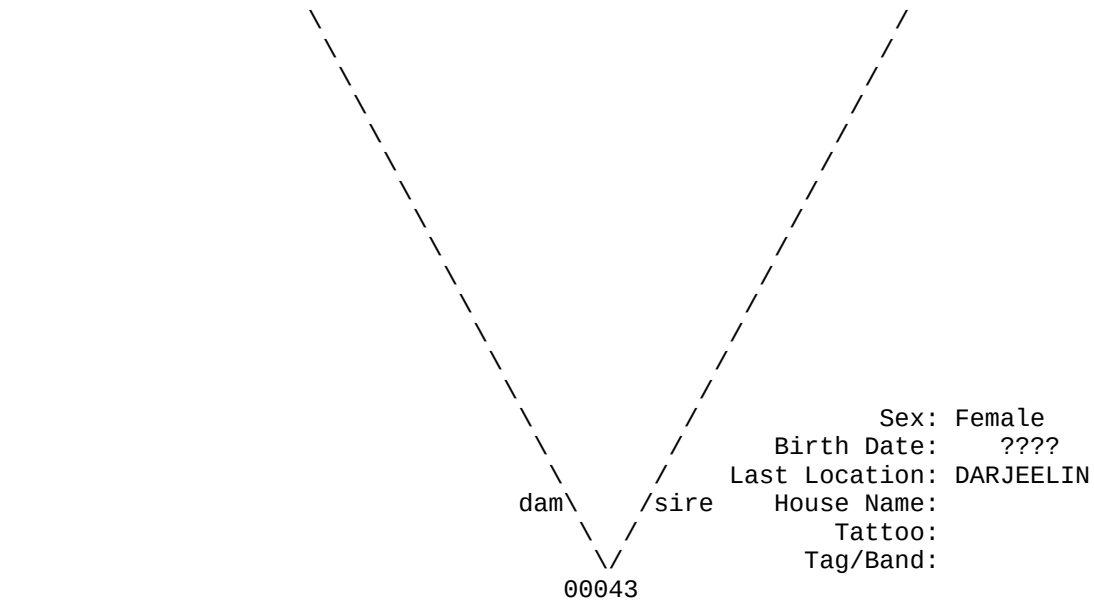
Taxon Name: CANIS LUPUS CHANCO Studbook Number: 00041



Taxon Name: CANIS LUPUS CHANCO Studbook Number: 00042



Taxon Name: CANIS LUPUS CHANCO Studbook Number: 00043



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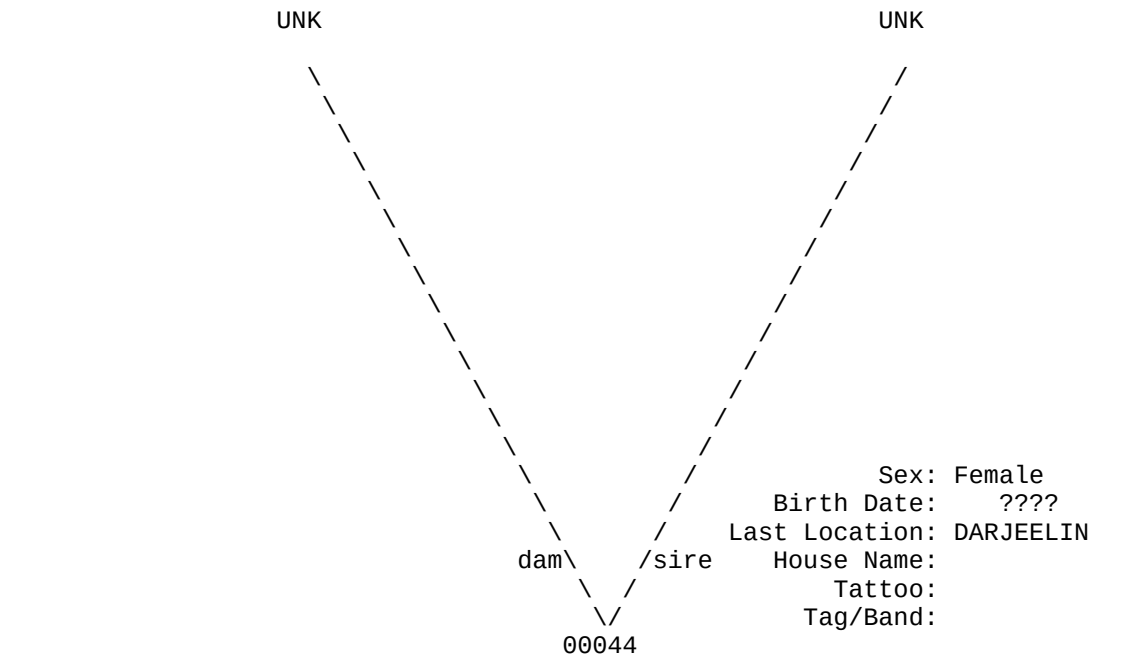

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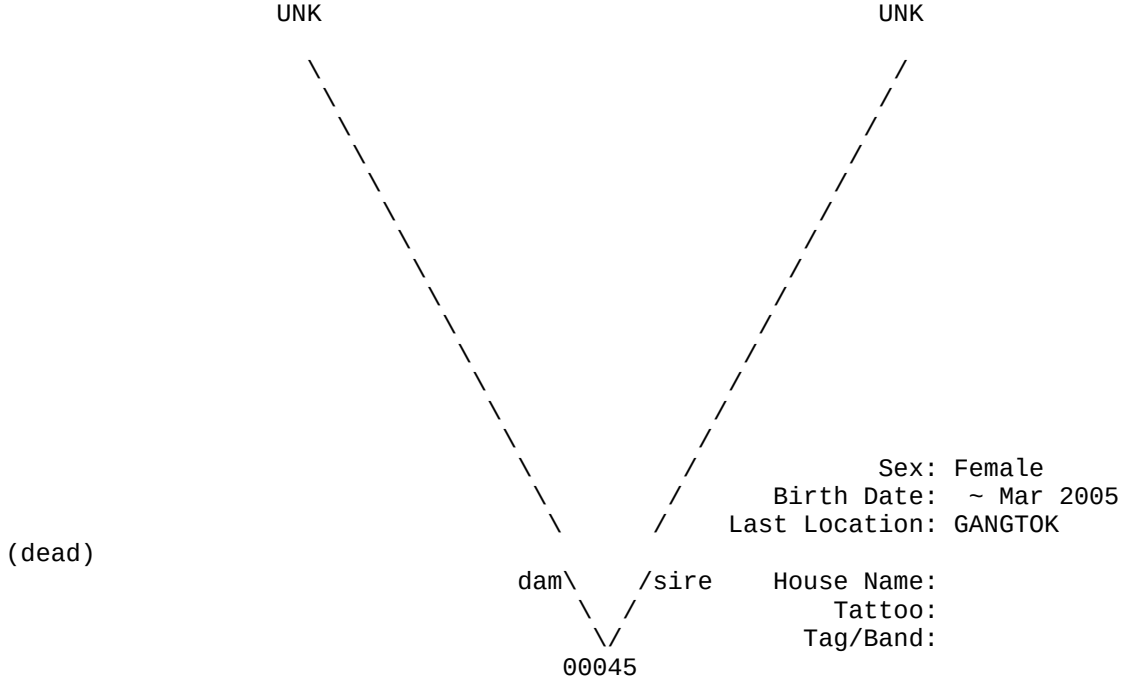

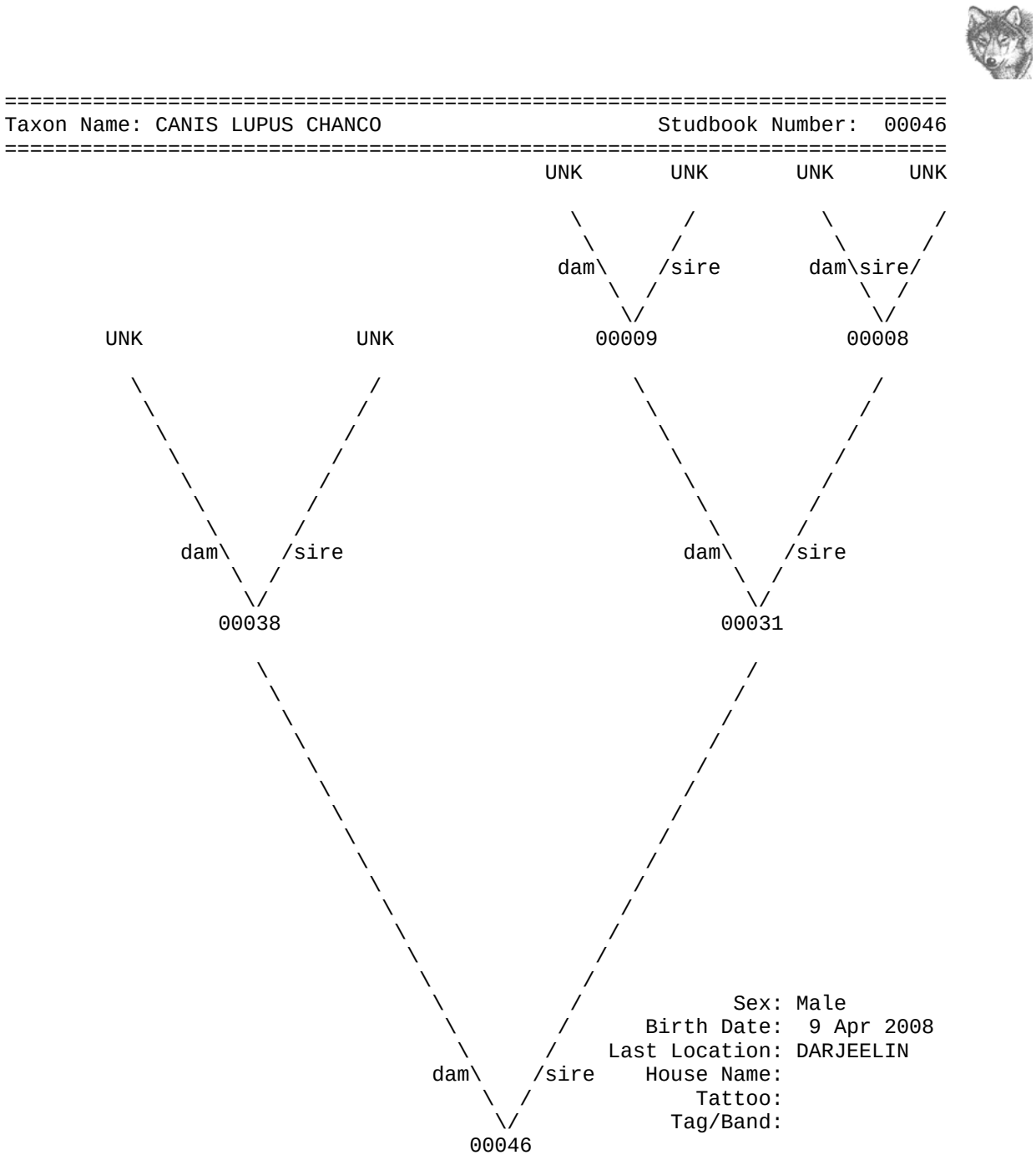
Taxon Name: CANIS LUPUS CHANCO
Studbook Number: 00046
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UNK
dam\
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dam\
/sire
00038
00031
dam\
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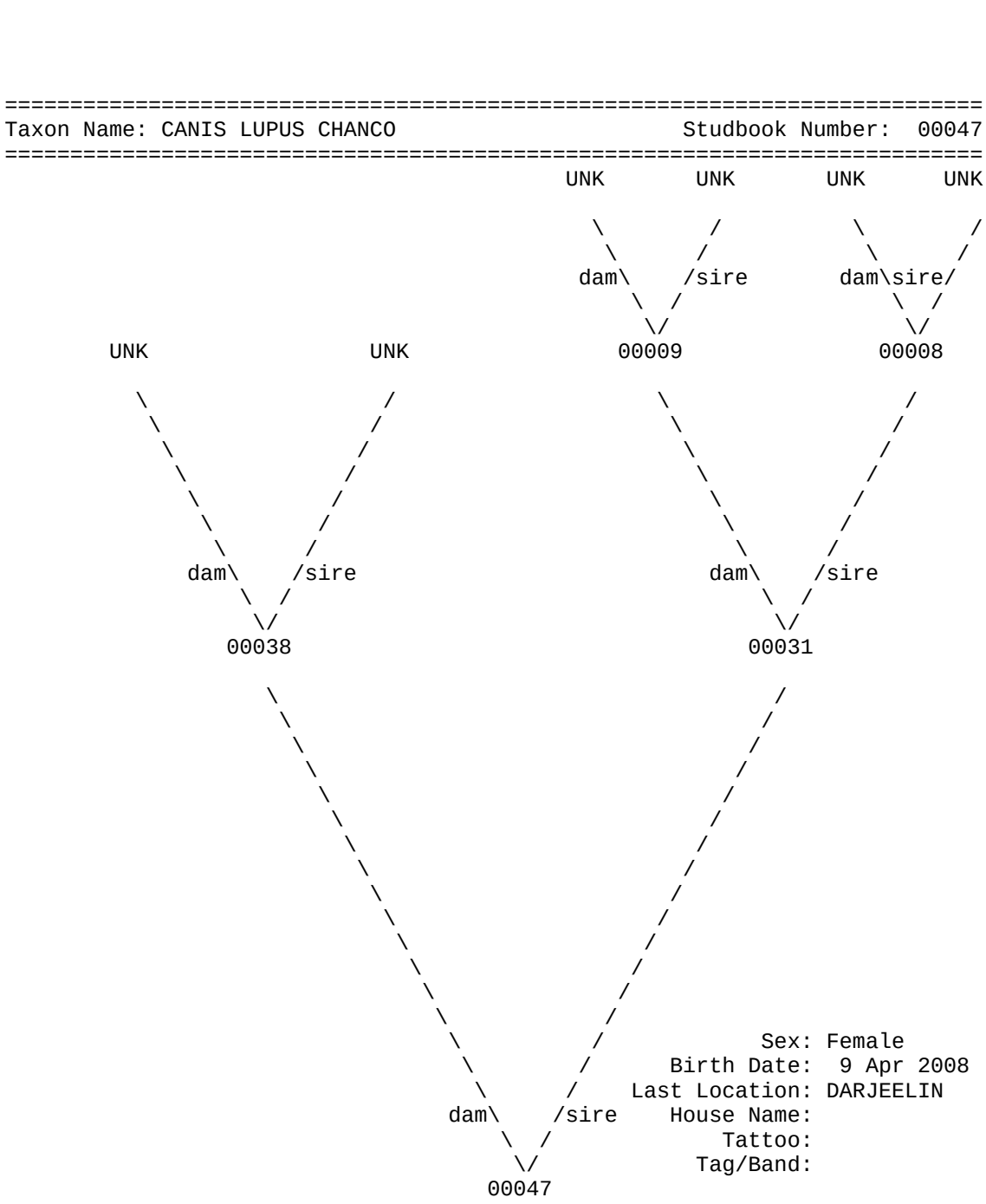
00046
Sex: Male
Birth Date: 9 Apr 2008
Last Location: DARJEELIN
House Name:
Tattoo:
Tag/Band:


Taxon Name: CANIS LUPUS CHANCO
Studbook Number: 00047
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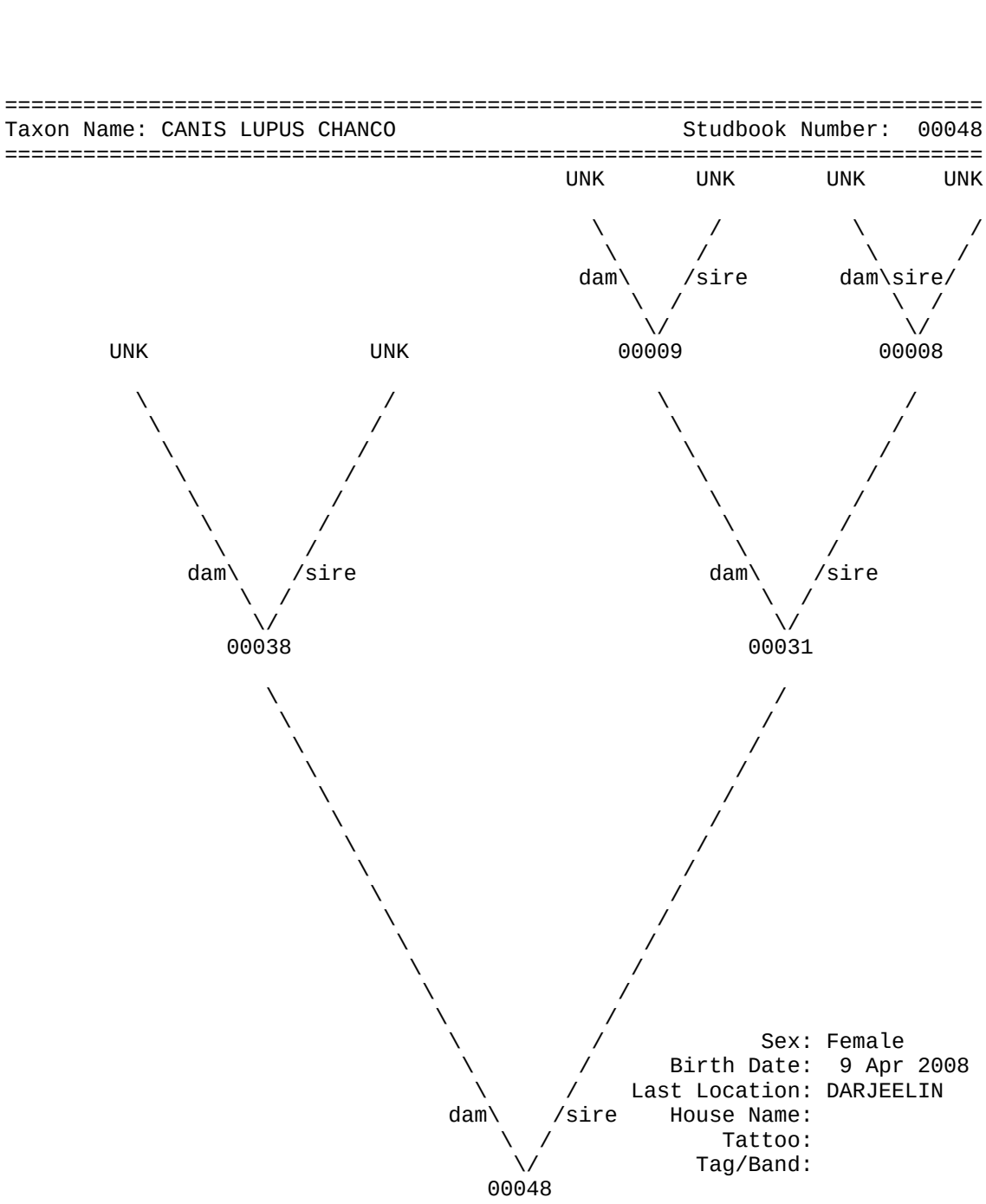
00047
Sex: Female
Birth Date: 9 Apr 2008
Last Location: DARJEELIN
House Name:
Tattoo:
Tag/Band:


Taxon Name: CANIS LUPUS CHANCO
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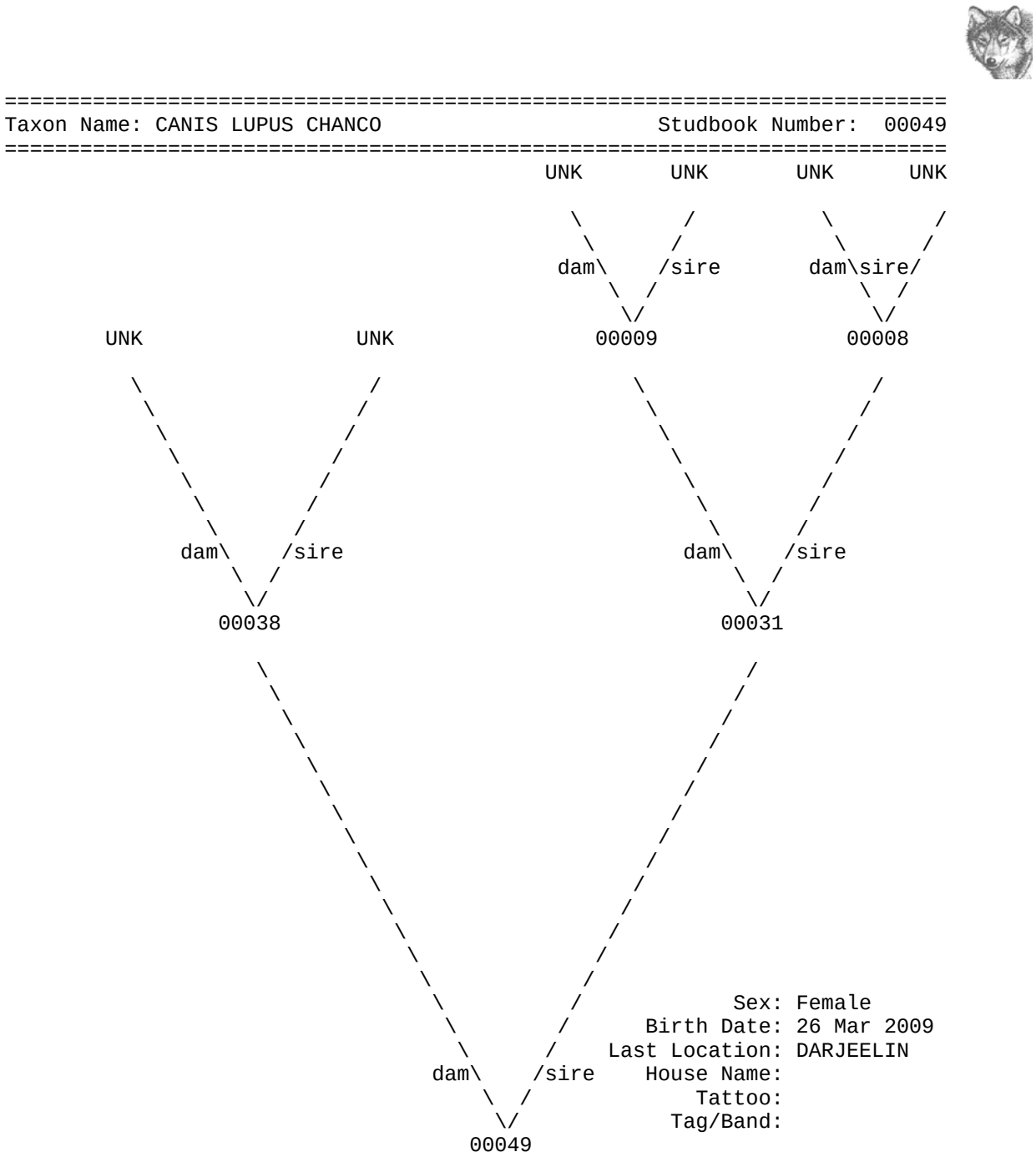
00048
Sex: Female
Birth Date: 9 Apr 2008
Last Location: DARJEELIN
House Name:
Tattoo:
Tag/Band:



Compiled by: Anupam Srivastav thru Wildlife Institute of India
Data current thru: 30 Jun 2009 Indian region
Printed on 30 Jul 2009 using Sparks v1.54