Indian National Studbook of Snow Leopard (*Uncia uncia*)

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

केन्द्रीय चिड़ियाघर प्राधिकरण
Central Zoo Authority

August, 2009

Indian National Studbook of Snow Leopard (*Uncia uncia*)

Data current till June 30th 2009

Studbook compiled and analysed by

Anupam Srivastav
Parag Nigam
Debashis Chakraborty
&
Anup Kumar Nayak

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Cover photo: Dr. Parag Nigam, WII, Dehradun

Srivastav, A., Nigam, P., Chakraborty, D. and Nayak, A.K. 2009. Indian National Studbook of Snow Leopard (*Uncia uncia*). Wildlife Institute of India, Dehradun and Central Zoo Authority, New Delhi.

Published as a Technical Report of the CZA assignment for the compilation and publication of the Indian National Studbooks for selected endangered species of wild animals in Indian Zoos.

Acknowledgements

This Studbook is a part of the Central Zoo Authority, New Delhi, assignment to the Wildlife Institute of India, Dehradun, for the compilation and publication of studbooks of selected endangered species of wild animals in Indian zoos. The authors wish to thank the Central Zoo Authority for financial support and the opportunity to compile the National Studbook for Snow Leopard.

We are thankful to Dr. B.R. Sharma, IFS for his kind support and encouragement in the compilation of this work. We are thankful to Shri. P. R. Sinha, Director WII for his guidance and support. We would also like to express our appreciation for the advice and support extended by Dr. V.B. Mathur, Dean Faculty of Wildlife Sciences, WII. The authors also wish to thank all the staff members of the Central Zoo Authority, specially Dr. Brij.K. Gupta, Evaluation and Monitoring Officer, Dr. Naim Akhtar, Scientific Officer and Shri. Vivek Goyal, Data Processing Assistant, for their advice and support.

The help of the following Zoos holding Snow Leopards in India is gratefully acknowledged in compilation of the studbook data.

Padmaja Naidu Himalayan Zoological Park, Darjeeling
Hiamalayan Zoological Park, Gangtok
Himalayan Nature Park Kufri
Pandit Gobind ballabh Pant high Altitude Zoo, Nainital

We also wish to thank Ms. Laurie Bingmann Lackey of ISIS for providing the SPARKS software. Her kind advice and timely help were of great help in compilation of this studbook.

We also wish to express gratitude for all the faculty and staff members of the WII, for their help and encouragement.

Authors

Contents

Snow Leopard: Biology and Status

Taxonomy of Snow Leopard

Kingdom:	**Animalia**
Phylum:	**Chordata**
Class:	**Mammalia**
Order:	**Carnivora**
Family:	**Felidae**
Scientific Name:	***Uncia uncia***
Species Authority:	**(Schreber, 1775)**
Common Name/s:	**Ounce, Snow Leopard, Shaan (Ladakhi)**

The snow leopard is an animal adapted to high altitude life. It is smaller in size than the other big cats, but like them it exhibits a range of sizes. It weighs between 27 – 54 kg, and body length ranges from 74 – 130 cm. The animal is crepuscular or nocturnal depending on the degree of human presence.

The species is an inhabitant of alpine forests and sub-alpine scrub, however it does equally well even in flat terrain with adequate cover. The home ranges of several individuals overlap. The preferred prey are large ungulates, however it also feeds on birds and small mammals found in its habitat. It is in increasing conflict with nomadic herders inhabiting the area for lifting their livestock.

Mating usually takes place in winter and after a gestation period of 93 – 108 days 2 - 3 cubs are borne. The cubs are dependent on their mothers for the initial 18 – 22 months. After learning the requisite skills for survival in their harsh habitat they disperse and form new territories. In the wild, snow leopards have been reported to live upto 18 years and in captivity the maximum longevity achieved is 20 years.

The species is distributed in parts of India, Pakistan, Nepal, Bhutan, Tibet, Afghanistan, China, Kazakhstan, Uzbekistan, Tajikistan, Mongolia and the Russian Federation. In India the species occupies trans-Himalayan region in the states of Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim and Arunanchal Pradesh.

Several protected areas have been established across its entire range to ensure the protection of the species *in-situ.* The protected areas established in India for its protection are:

- Hemis National Park, in East Ladakh, India.
- Nanda Devi National Park, in state of Uttarakhand, India, a UNESCO Natural World Heritage Site.
- Valley of Flowers National Park, Uttaranchal, India, a UNESCO Natural World Heritage Site.

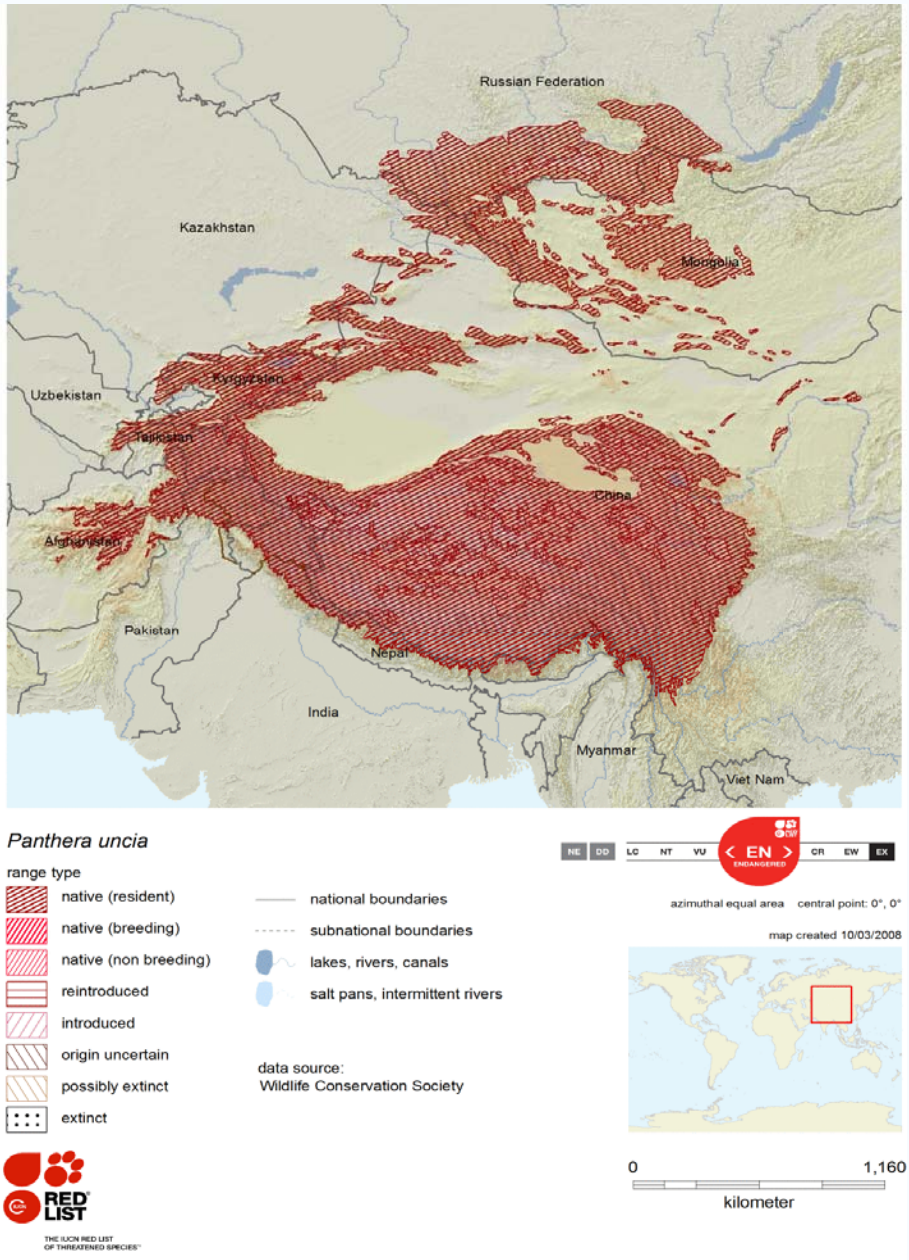


Figure 1 Global Distribution of Snow Leopard;

Map Source: IUCN Red List of Threatened Species (2008)

Threats

Free ranging population of Snow leopard is believed to have declined by atleast 20% over the past 2 generations. This decline is attributed to loss of habitat and reduction of prey base. Additionally poaching for skin and bones is believed to be an important reason for its decline. Reduction in prey base has resulted in snow leopards hunting on livestock of nomadic herders resulting in retaliatory killing. The current global snow leopard population is estimated at 4,080 - 6,590.

Status

Due to the threats and the declining population trends the species has been listed in Schedule I of the Wildlife Protection Act (1972) of India and is listed as endangered in the 2008 IUCN Red List of Threatened Species.

Scope of the Studbook

The present studbook of snow leopard has been compiled for the India region and the data used is current till June 30th 2009. The data has been provided by four zoos.

Methods Used

The data collected for the compilation of the studbook was by through mailed questionnaire surveys. The data collected was entered in SPARKS 1.5. and studbook report was generated using the reports option. The SPARKS software 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.

Census

The present snow leopard captive population in India was founded by the acquisition on breeding loan of a male in 1978 and a female in 1980 from Helsinki and San Antonio zoos respectively. Two males were further added to this population from Littlerock and Zurich Zoos and two additional females were added to the population from Zurich Zoo. Two females of wild origin were further added in 2000, however, only one survived and contributed to the population.

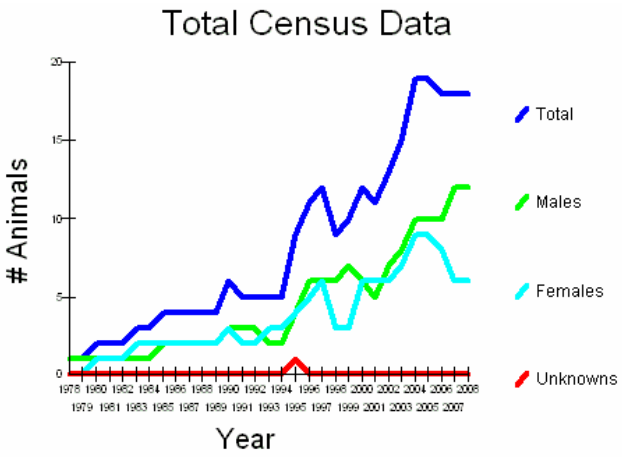


Figure 2 – Census trends of Captive Indian Snow Leopard Population

The present status of the captive snow leopard population (Table 1) in India is given below:

Table 1 Status of Snow Leopard in Indian Zoos (**Based on data provided by zoos)**

Zoo Name	**Captive Indian Population as on 31st June 2009**			
	Male	**Female**	**Unsexed**	**Total**
Pt. Govind Ballabh Pant High Altitude Zoo, Nainital	9	5	3	17
Himalayan Nature Park, Kufri	1	0	0	1
Himalayan Zoological Park, Gangtok	1	0	0	1
Padmaja Naidu Himalayan Zoological Park, Darjeeling	1	1	0	2
Total	**12**	**6**	**3**	**21**

The location wise listing of live snow leopards is given below in table 2 and the historical listing of snow leopards in captivity in India is given below in table 3.

Table 2 Location wise listing of live snow leopards 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
Padmaja Naidu Himalayan Zoological Park, Darjeeling											
1.	Tyson 00-0611-163B	00014	1850	Male	ISB1723	ISB1285	8-Aug-1995	Helsinki Darjeeling	Birth Transfer	8-Aug-1995 28-Jan-2000	
2.	Karan	00016	1897	Male	00004	00005	23-Oct-1995	Darjeeling	Birth	23-Oct-1995	
3.	Kush	00017	1972	Male	00007	00009	31-Oct-1996	Darjeeling Gangtok Darjeeling	Birth Transfer Transfer	31-Oct-1996 11-Mar-2005 3-Apr-2007	
4.	Karish	00022	2046	Male	00004	00006	22-Mar-1998	Darjeeling	Birth	22-Mar-1998	
5.	Unk1 Neeta	00028	2228	Female	WILD	WILD	17-May-2000	India Darjeeling	Wild Capture Transfer	17-May-2000 17-May-2000	
6.	Prabahat 00-0618-24EO	00034	2406	Male	UNK	00015	8-Jun-2002	Darjeeling	Birth	8-Jun-2002	
7.	Ritu	00037		Female	00016	00028	11-Mar-2003	Darjeeling	Birth	11-Mar-2003	
8.	Buddha 00-0610-FA9B	00038	2401	Male	00014	00009	29-Mar-2003	Darjeeling	Birth	29-Mar-2003	
9.	Teesta 00-0611-4DB1	00040	2399	Female	00016	000028	29-Mar-2003	Darjeeling	Birth	29-Mar-2003	
10.	Shibu	00042		Male	00014	UNK	24-May-2004	Darjeeling	Birth	24-May-2004	
11.	Yasmin	00044	2540	Female	00014	00009	25-May-2004	Darjeeling	Birth	25-May-2004	
12.	Malaika	00045	2541	Female	00014	00009	25-May-2004	Darjeeling	Birth	25-May-2004	
13.	Akriti	00046		Male	00016	00028	1-May-2007	Darjeeling	Birth	1-May-2007	
14.	Prakriti	00048		Male	00016	00028	1-May-2007	Darjeeling	Birth	1-May-2007	
15.	Uncub5	00049		Unknown	00016	00028	18-Apr-2009	Darjeeling	Birth	18-Apr-2009	
16.	Uncub6	00050		Unknown	00016	00028	18-Apr-2009	Darjeeling	Birth	18-Apr-2009	
17.	Uncub7	00051		Unknown	00016	00028	18-Apr-2009	Darjeeling	Birth	18-Apr-2009	
Himalayan Nature Park, Kufri											
18.	Subhash 00-0617-C8C5	00035	2404	Male	UNK	00015	8-Jun-2002	Darjeeling Kufri	Birth Transfer	8-Jun-2002 31-Dec-2004	
Pandit Gobind Ballabh Pant High Altitude Zoo, Nainital											
19.	Sujan Rani	00026	2226	Female	00007	00015	8-Apr-2000	Darjeeling Nainital	Birth Transfer	8-Apr-2000 23-Dec-2004	
20.	Dev 00-0617-D41B	00039	2402	Male	00014	00009	29-Mar-2003	Darjeeling Nainital	Birth Transfer	29-Mar-2003 23-Dec-2004	

Sl. No.	Home Name and Transponder No.	National Studbook No.	International Studbook No.	Sex	Sire	Dam	Birth Date	Location	Event	Date	Remarks
Hiamalayan Zoological Park, Gangtok											
21.	Ravi	00043	2538	Male	00014	00009	25-May-2004	Darjeeling Gangtok	Birth Transfer	25-May-2004 3-Apr-2007	

Totals: 12:6:3 = 21

Table 3 Historical listing of snow leopards 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
22.	_____ Visna	00001	620	Male	ISB620	ISB356	21-Jun-1978	Helsinki Darjeeling Darjeeling	Birth Transfer Death	21-Jun-1978 21-Mar-1986 10-Sep-1993	
23.	Persia	00002	697	Female	ISB236	ISB279	23-Apr-1980	San Antonio Darjeeling Darjeeling	Birth Transfer Death	23-Apr-1980 16-Jan-1989 24-Aug-1991	
24.	Kashi	00003	1005	Female	ISB377	ISB406	26-Aug-1983	Darjeeling Darjeeling	Birth Death	26-Aug-1983 7-Sep-1990	
25.	Hank	00004	1059	Male	ISB380	ISB420	6-Jun-1985	Littlerock Darjeeling Darjeeling	Birth Transfer Death	6-Jun-1985 16-Jan-1989 28-Aug-1998	
26.	Quetta	00005	1474	Female	ISB1101	ISB1125	23-May-1990	Zurich Darjeeling Darjeeling	Birth Transfer Death	23-May-1990 28-Jan-1992 5-Aug-1998	
27.	Quila 00-0610-F6F8	00006	1473	Female	ISB1101	ISB1125	23-May-1990	Zurich Darjeeling Darjeeling	Birth Transfer Death	23-May-1990 28-Jan-1992 4-Jun-2003	
28.	Quizil	00007	1472	Male	ISB1101	ISB1125	23-May-1990	Zurich Darjeeling Darjeeling	Birth Transfer Death	23-May-1990 28-Jan-1992 23-Nov-2000	
29.	Unkcub	00008		Female	UNK	UNK	1-Sep-1991	Darjeeling Darjeeling	Birth Death	1-Sep-1991 30-Sep-1991	
30.	Rambha	00009	1797	Female	00004	00005	15-Oct-1993	Darjeeling Darjeeling	Birth Death	15-Oct-1993 21-May-2006	
31.	Un_Cub	00010	1894	Female	00004	00006	2-May-1994	Darjeeling Darjeeling	Birth Death	2-May-1994 4-May-1994	
32.	Uncub1	00011	1893	Male	00004	00006	2-May-1994	Darjeeling Darjeeling	Birth Death	2-May-1994 3-May-1994	
33.	Uncub2	00012	1896	Female	00004	00006	18-May-1995	Darjeeling Darjeeling	Birth Death	18-May-1995 7-Nov-1995	
34.	Uncub3	00013	1898	Unknown	00004	00005	23-May-1995	Darjeeling Darjeeling	Birth Death	23-May-1995 12-Apr-1996	
35.	Tyson 00-0611-163B	00014	1850	Male	ISB1723	ISB1285	8-Aug-1995	Helsinki Darjeeling	Birth Transfer	8-Aug-1995 28-Jan-2000	
36.	Urbashi	00015	1899	Female	00004	00005	23-Oct-1995	Darjeeling	Birth	23-Oct-1995	

Sl. No.	Home Name and Transponder No.	National Studbook No.	International Studbook No.	Sex	Sire	Dam	Birth Date	Location	Event	Date	Remarks
								Gangtok Gangtok	Transfer Death	11-Mar-2005 29-Mar-2007	
37.	Karan	00016	1897	Male	00004	00005	23-Oct-1995	Darjeeling	Birth	23-Oct-1995	
38.	Kush	00017	1972	Male	00007	00009	31-Oct-1996	Darjeeling Gangtok Darjeeling	Birth Transfer Transfer	31-Oct-1996 11-Mar-2005 3-Apr-2007	
39.	Lav 00-0610-EB06	00018	1971	Male	00007	00009	31-Oct-1996	Darjeeling Darjeeling	Birth Death	31-Oct-1996 17-Oct-2003	
40.	Menoka	00019	2041	Female	00004	00005	31-Oct-1996	Darjeeling Darjeeling	Birth Death	31-Oct-1996 25-May-1998	
41.	Meghna	00020	2040	Female	00004	00005	15-Dec-1997	Darjeeling Darjeeling	Birth Death	15-Dec-1997 27-Aug-1998	
42.	Kanjha	00021		Male	00004	00006	15-Dec-1997	Darjeeling Darjeeling	Birth Death	15-Dec-1997 15-Dec-1997	
43.	Karish	00022	2046	Male	00004	00006	22-Mar-1998	Darjeeling	Birth	22-Mar-1998	
44.	Ravi	00023		Male	00004	00006	23-Mar-1998	Darjeeling Darjeeling	Birth Death	23-Mar-1998 23-Mar-1998	
45.	Uncub4	00024		Male	UNK	UNK	31-Mar-1999	Darjeeling Darjeeling	Birth Death	31-Mar-1999 30-Jun-1999	
46.	Raja	00025	2180	Male	00016	00009	20-Jun-1999	Darjeeling Darjeeling	Birth Death	20-Jun-1999 10-May-2001	
47.	Sujan Rani	00026	2226	Female	00007	00015	8-Apr-2000	Darjeeling Nainital	Birth Transfer	8-Apr-2000 23-Dec-2004	
48.	Meeta	00027	2227	Female	WILD	WILD	17-May-2000	India Darjeeling	Wild Capture Death	17-May-2000 24-Jun-2000	
49.	Unk1 Neeta	00028	2228	Female	WILD	WILD	17-May-2000	India Darjeeling	Wild Capture Transfer	17-May-2000 17-May-2000	
50.	Sapna	00029	2229	Female	00014	00006	18-Jul-2000	Darjeeling Kufri Kufri	Birth Transfer Death	18-Jul-2000 23-Dec-2004 26-Jul-2007	
51.	Bijay	00030	2304	Male	00014	00009	18-Mar-2001	Darjeeling Darjeeling	Birth Death	18-Mar-2001 27-May-2001	
52.	Dolma	00031	2303	Female	00014	00009	18-Mar-2001	Darjeeling Darjeeling	Birth Death	18-Mar-2001 29-Jul-2001	
53.	Jay	00032	2302	Male	UNK	00009	18-Mar-2001	Darjeeling Darjeeling	Birth Death	18-Mar-2001 25-Sep-2001	
54.	Lama	00033	2305	Male	00016	00028	8-May-2001	Darjeeling	Birth	8-May-2001	

Sl. No.	Home Name and Transponder No.	National Studbook No.	International Studbook No.	Sex	Sire	Dam	Birth Date	Location	Event	Date	Remarks
								Darjeeling	Death	6-Jun-2001	
55.	Prabahat 00-0618-24EO	00034	2406	Male	UNK	00015	8-Jun-2002	Darjeeling	Birth	8-Jun-2002	
56.	Subhash 00-0617-C8C5	00035	2404	Male	UNK	00015	8-Jun-2002	Darjeeling Kufri	Birth Transfer	8-Jun-2002 31-Dec-2004	
57.	Tilottama	00036	2403	Female	00014	00009	19-Jun-2002	Darjeeling Darjeeling	Birth Death	19-Jun-2002 7-Nov-2002	
58.	Ritu	00037		Female	00016	00028	11-Mar-2003	Darjeeling	Birth	11-Mar-2003	
59.	Buddha 00-0610-FA9B	00038	2401	Male	00014	00009	29-Mar-2003	Darjeeling	Birth	29-Mar-2003	
60.	Dev 00-0617-D41B	00039	2402	Male	00014	00009	29-Mar-2003	Darjeeling Nainital	Birth Transfer	29-Mar-2003 23-Dec-2004	
61.	Teesta 00-0611-4DB1	00040	2399	Female	00016	000028	29-Mar-2003	Darjeeling	Birth	29-Mar-2003	
62.	Torsa	00041	2400	Female	00016	00028	29-Mar-2003	Darjeeling Darjeeling	Birth Death	29-Mar-2003 1-Oct-2003	
63.	Shibu	00042		Male	00014	UNK	24-May-2004	Darjeeling	Birth	24-May-2004	
64.	Ravi	00043	2538	Male	00014	00009	25-May-2004	Darjeeling Gangtok	Birth Transfer	25-May-2004 3-Apr-2007	
65.	Yasmin	00044	2540	Female	00014	00009	25-May-2004	Darjeeling	Birth	25-May-2004	
66.	Malaika	00045	2541	Female	00014	00009	25-May-2004	Darjeeling	Birth	25-May-2004	
67.	Akriti	00046		Male	00016	00028	1-May-2007	Darjeeling	Birth	1-May-2007	
68.	Uncub4	00047		Female	00016	00028	1-May-2007	Darjeeling Darjeeling	Birth Death	1-May-2007 7-Jun-2007	
69.	Prakriti	00048		Male	00016	00028	1-May-2007	Darjeeling	Birth	1-May-2007	
70.	Uncub5	00049		Unknown	00016	00028	18-Apr-2009	Darjeeling	Birth	18-Apr-2009	
71.	Uncub6	00050		Unknown	00016	00028	18-Apr-2009	Darjeeling	Birth	18-Apr-2009	
72.	Uncub7	00051		Unknown	00016	00028	18-Apr-2009	Darjeeling	Birth	18-Apr-2009	

Total 24.23.4 (51)

ISB: International Studbook Number

Location Glossary

Darjeeling – Padmaja Naidu Himalayan Zoological Park, Darjeeling
Gangtok – Hiamalayan Zoological Park, Gangtok
Kufri – Himalayan Nature Park, Kufri
Nainital – Pandit Gobind Ballabh Pant High Altitude Zoo, Nainital

Population Planning/ Recommendations

The current population of captive snow leopard in India has a size of 21 with genetic diversity of 0.4286. The objective of maintaining a species in captivity is to maintain genetically and demographically viable populations for future reintroductions if required. Keeping this in view, it is suggested that new founders be added to the captive population and the population size be increased to at least 100 individuals with equal sex ratio in the period of the next 10 years.

The population projections for both actual and modeled populations suggest that the goal of maintaining at least 100 genetically viable and demographically stable individuals in captivity in India cannot be achieved without the addition of fresh founders and utilizing the reproductive potential of the captive population to the maximum.

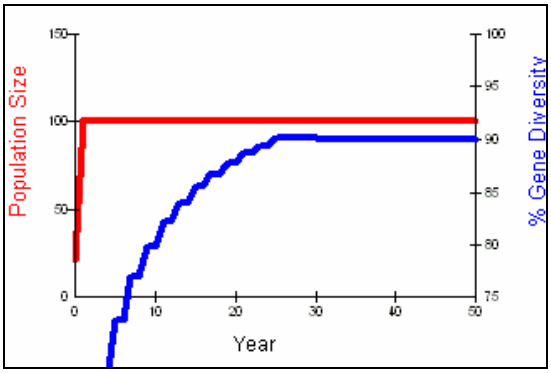


Figure 3 Projections for population size and genetic diversity based on goal settings

Goal settings

New Founders per Addition Event Needed = 2
Program Objectives: 90% Gene Diversity at the end of 50 years
Other variables:
Generation Length = 50.0000
Maximum Potential Population Growth Rate = 5.0000
Current Population Size = 21.0000
Current Effective Size = 42.0000
Ratio of Ne/N = 2.0000
Current Gene Diversity = 0.4286
Maximum Allowable Population Size = 100.0000
Population Size Needed to Meet Goals = 100.0000
Year to Start Adding Founders = 1.0000
Year to Stop Adding Founders = 25.0000
Years Between Addition Events = 2.0000
FGE Recruited per New Founder = 0.4000

The mean kinship coefficient for the snow leopard captive population is 0.5535. It is a measure of the loss of genetic diversity of the descendant population relative to the founders. It is also the mean of inbreeding coefficient of progeny produced as result of random mating. The genetic diversity (GD) of the population is 0.4286 while the genetic variability of the population (GV) is 0.4270 and the founder genome equivalents (fge) 0.88.

Hypothetical pairings of the living population were carried out using PM2000 to determine possible mating choices for the living population. The details of individuals available for pairing are included in table 4 where F represents the inbreeding coefficient, MK the mean kinship and % known is the percentage of known ancestry

of the individual. The results of the hypothetical pairings suggest that mating can be carried out between the various individuals and this would raise the genetic variability of the population from the present value of 0.4286 to 0.4465 if all the mating options (Table - 5) can be exercised.

Table 4 Mean kinship of living individuals

Males						Females				
Stbk#	**MK**	**%Known**	**Age**	**Location**		**Stbk#**	**MK**	**%Known**	**Age**	**Location**
00014	0.500	0.0	14	Darjeelingg		00026	0.500	0.0	9	Nainital
00016	0.500	0.0	14	Darjeeling		00028	0.500	100.0	0	Darjeeling
00017	0.500	0.0	13	Darjeeling		00037	0.595	50.0	6	Darjeeling
00022	0.500	0.0	11	Darjeeling		00040	0.595	50.0	6	Darjeeling
00034	0.500	0.0	7	Darjeeling		00044	0.500	0.0	5	Darjeeling
00035	0.500	0.0	7	Kufri		00045	0.500	0.0	5	Darjeeling
00038	0.500	0.0	6	Darjeeling		00049	0.514	50.0	U0	Darjeeling
00039	0.500	0.0	6	Nainital		00050	0.514	50.0	U0	Darjeeling
00042	0.500	0.0	5	Darjeeling		00051	0.514	50.0	U0	Darjeeling
00043	0.500	0.0	5	Gangtok						
00046	0.554	50.0	2	Darjeeling						
00048	0.554	50.0	2	Darjeeling						
00049	0.514	50.0	U0	Darjeeling						
00050	0.514	50.0	U0	Darjeeling						
00051	0.514	50.0	U0	Darjeeling						

Table 5 below provided detailed information on the animal pairing recommended for breeding. The mating options can be used keeping in view the fact that animal movements are kept at a minimum as the inbreeding coefficients between all the pairings suggested is 0.

Table 5 Pairings recommended for breeding

Sl.No.	**Sire**	**Dam**	**Inbreeding coefficient**	**Sl.No.**	**Sire**	**Dam**	**Inbreeding coefficient**
1.	00014	00026	F = 0.000	34.	00035	00040	F = 0.000
2.	00014	00028	F = 0.000	35.	00035	00044	F = 0.000
3.	00014	00037	F = 0.000	36.	00035	00045	F = 0.000
4.	00014	00040	F = 0.000	37.	00038	00026	F = 0.000
5.	00014	00044	F = 0.000	38.	00038	00028	F = 0.000
6.	00014	00045	F = 0.000	39.	00038	00037	F = 0.000
7.	00016	00026	F = 0.000	40.	00038	00040	F = 0.000
8.	00016	00028	F = 0.000	41.	00038	00044	F = 0.000
9.	00016	00037	F = 0.000	42.	00038	00045	F = 0.000
10.	00016	00040	F = 0.000	43.	00039	00026	F = 0.000
11.	00016	00044	F = 0.000	44.	00039	00028	F = 0.000
12.	00016	00045	F = 0.000	45.	00039	00037	F = 0.000
13.	00017	00026	F = 0.000	46.	00039	00040	F = 0.000
14.	00017	00028	F = 0.000	47.	00039	00044	F = 0.000
15.	00017	00037	F = 0.000	48.	00039	00045	F = 0.000

Sl.No.	Sire	Dam	Inbreeding coefficient	Sl.No.	Sire	Dam	Inbreeding coefficient
16.	00017	00040	F = 0.000	49.	00042	00026	F = 0.000
17.	00017	00044	F = 0.000	50.	00042	00028	F = 0.000
18.	00017	00045	F = 0.000	51.	00042	00037	F = 0.000
19.	00022	00026	F = 0.000	52.	00042	00040	F = 0.000
20.	00022	00028	F = 0.000	53.	00042	00044	F = 0.000
21.	00022	00037	F = 0.000	54.	00042	00045	F = 0.000
22.	00022	00040	F = 0.000	55.	00043	00026	F = 0.000
23.	00022	00044	F = 0.000	56.	00043	00028	F = 0.000
24.	00022	00045	F = 0.000	57.	00043	00037	F = 0.000
25.	00034	00026	F = 0.000	58.	00043	00040	F = 0.000
26.	00034	00028	F = 0.000	59.	00043	00044	F = 0.000
27.	00034	00037	F = 0.000	60.	00043	00045	F = 0.000
28.	00034	00040	F = 0.000	61.	00046	00026	F = 0.000
29.	00034	00044	F = 0.000	62.	00046	00044	F = 0.000
30.	00034	00045	F = 0.000	63.	00046	00045	F = 0.000
31.	00035	00026	F = 0.000	64.	00048	00026	F = 0.000
32.	00035	00028	F = 0.000	65.	00048	00044	F = 0.000
33.	00035	00037	F = 0.000	66.	00048	00045	F = 0.000

Pairings between individuals listed in table 6 below are not recommended due to relatively higher degree of inbreeding coefficients.

Table 6 Pairings not recommended for breeding

Sl. No.	Sire	Dam	Inbreeding coefficient
1.	00046	00028	F = 0.500
2.	00046	00037	F = 0.500
3.	00046	00040	F = 0.500
4.	00048	00028	F = 0.500
5.	00048	00037	F = 0.500
6.	00048	00040	F = 0.500

Demographic Analysis

Census

The year wise trends in population can be referred to in Figure 1 and Table 4 respectively. The sex ratio is strongly biased in favour of males in the present living population.

Table 7 – Census details of the captive Indian Snow Leopard Population

YEARS	Total	Females	Males	Unsexed	Wild Caught	Captive Born
1978	1	0	1	0	0	1
1979	1	0	1	0	0	1
1980	2	1	1	0	0	2
1981	2	1	1	0	0	2
1982	2	1	1	0	0	2
1983	3	2	1	0	0	3

YEARS	Total	Females	Males	Unsexed	Wild Caught	Captive Born
1984	3	2	1	0	0	3
1985	4	2	2	0	0	4
1986	4	2	2	0	0	4
1987	4	2	2	0	0	4
1988	4	2	2	0	0	4
1989	4	2	2	0	0	4
1990	6	3	3	0	0	6
1991	5	2	3	0	0	5
1992	5	2	3	0	0	5
1993	5	3	2	0	0	5
1994	5	3	2	0	0	5
1995	9	4	4	1	0	9
1996	11	5	6	0	0	11
1997	12	6	6	0	0	12
1998	9	3	6	0	0	9
1999	10	3	7	0	0	10
2000	12	6	6	0	1	11
2001	11	6	5	0	1	10
2002	13	6	7	0	1	12
2003	15	7	8	0	1	14
2004	19	9	10	0	1	18
2005	19	9	10	0	1	18
2006	18	8	10	0	1	17
2007	18	6	12	0	1	17
2008	18	6	12	0	1	17

Figure 4 represents the age structure of the living population of captive snow leopard in India. The red line depicts the age structure of a stable population while the blue boxes reflect the actual population age structure. The males are depicted on the right side while the females are depicted on the left side. The figure suggests that the population is susceptible to random stochastic events and the population has a biased sex ratio in favour of males. The population has 8 males and 5 females in the reproductive age group. For a stable population it is desirable to have a conical shape for the age distribution of captive snow leopard *i.e* more number of individuals in the lower age classes and reproductive age class and

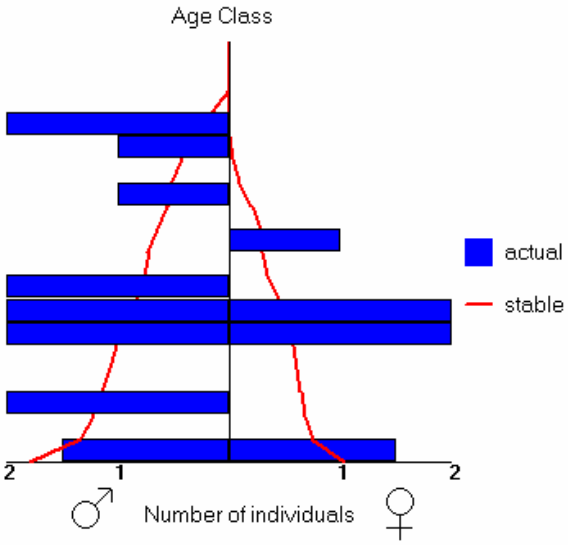


Figure 4 Age Distribution of Captive Snow leopard

lesser number of individuals in the older age classes which have already contributed to the population.

Life tables

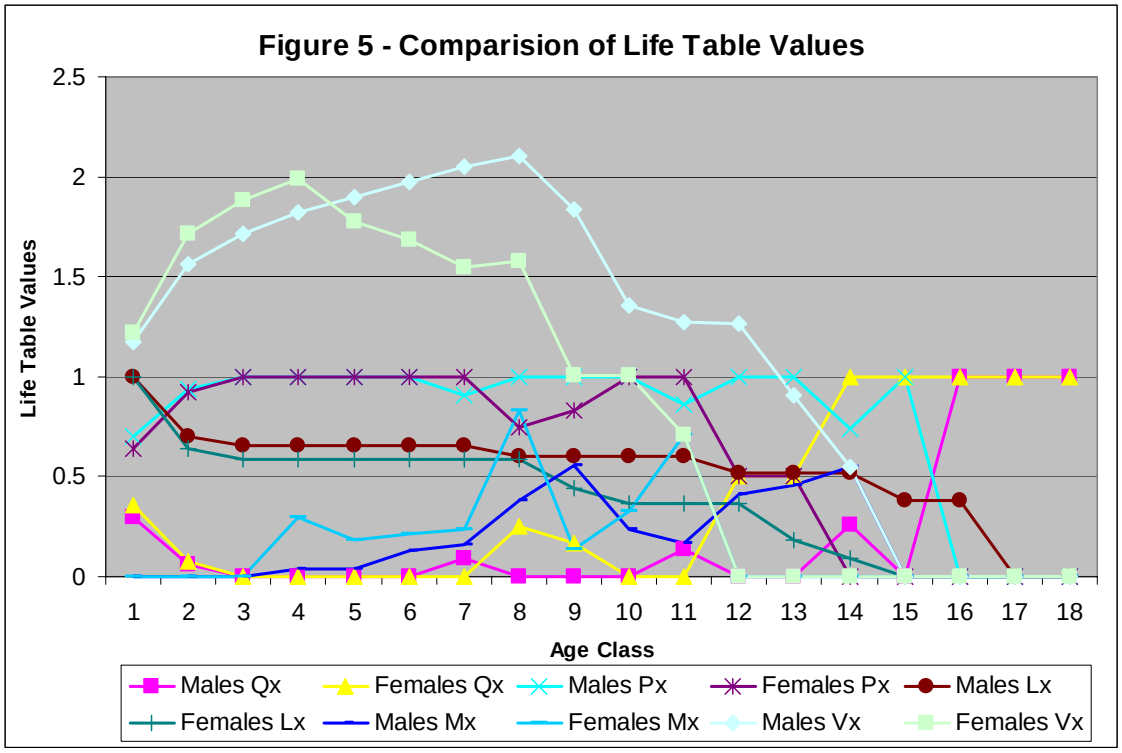
The life tables on the basis of sex were generated using PM 2000. Table 8 below depict the male and female actual and modelled life tables for the captive Indian population. The indicators of importance are fecundity (Mx) and mortality (Qx).

Table 8 Life Table data for males and females

Age Class	Males					Females				
	Qx	Px	Lx	Mx	Vx	Qx	Px	Lx	Mx	Vx
0	0.300	0.700	1.000	0.000	1.176	0.360	0.640	1.000	0.000	1.220
1	0.060	0.940	0.700	0.000	1.565	0.080	0.920	0.640	0.000	1.715
2	0.000	1.000	0.658	0.000	1.716	0.000	1.000	0.589	0.000	1.885
3	0.000	1.000	0.658	0.040	1.823	0.000	1.000	0.589	0.300	1.986
4	0.000	1.000	0.658	0.040	1.895	0.000	1.000	0.589	0.180	1.776
5	0.000	1.000	0.658	0.130	1.971	0.000	1.000	0.589	0.210	1.682
6	0.090	0.910	0.658	0.160	2.048	0.000	1.000	0.589	0.240	1.550
7	0.000	1.000	0.599	0.380	2.106	0.250	0.750	0.589	0.830	1.578
8	0.000	1.000	0.599	0.560	1.834	0.170	0.830	0.442	0.140	1.004
9	0.000	1.000	0.599	0.240	1.354	0.000	1.000	0.367	0.330	1.004
10	0.140	0.860	0.599	0.170	1.272	0.000	1.000	0.367	0.710	0.710
11	0.000	1.000	0.515	0.410	1.267	0.500	0.500	0.367	0.000	0.000
12	0.000	1.000	0.515	0.460	0.910	0.500	0.500	0.183	0.000	0.000
13	0.260	0.740	0.515	0.550	0.550	1.000	0.000	0.092	0.000	0.000
14	0.000	1.000	0.381	0.000	0.000	1.000	0.000	0.000	0.000	0.000
15	1.000	0.000	0.381	0.000	0.000	1.000	0.000	0.000	0.000	0.000
16	1.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000
17	1.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000

Qx = mortality; Px = survival; Lx = cumulative survivorship; Mx = fecundity; Vx = expected future reproduction

The male life table suggests that mortality shows a peak at the age class 0 – 1 years and then again peaks at 11th and 14th years of age and achieves a plateau from the 16th year. Reproductive activity in males is initiated in the 4th year of life and peaks in the 9th year and 14th years respectively. Female life table also shows an initial peak in mortality in the first year and then peaks at 8 years, and then shows an increasing trend from 11th to 14th years and thereafter achieves a plateau. Reproductive activity in females is initiated in the 4th year and peaks in the 7th and 10th years respectively and then suddenly drops. Survival and cumulative survivorship show an inverse relationship to mortality for both males and females. The male and female expected



future reproduction show peaks in the 9th and 4th year respectively and then shows a decline till the 15th and 12th years respectively. The sample size is however too small to make meaningful predictions based on the life table analyses.

Projected population growth rates

Generation length (T), the average age at which a parent produces young was found to be 9.08 and 6.82 years for males and females respectively. The Net Reproductive rate (Ro), the number of same sex offspring produced by an average individual during its life time, was 1.736 and 1.427 respectively for males and females. Values of less than 1 suggest 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 1.0626 and 1.0535 respectively, which suggests that the population is just able to maintain itself and have a marginal increase.

Population Projections

Figure 7 shows the population projections for the captive snow leopard population for the next 20 years. The blue line shows the population projections based on actual population figures while the red lines depict the population projections for stable populations.

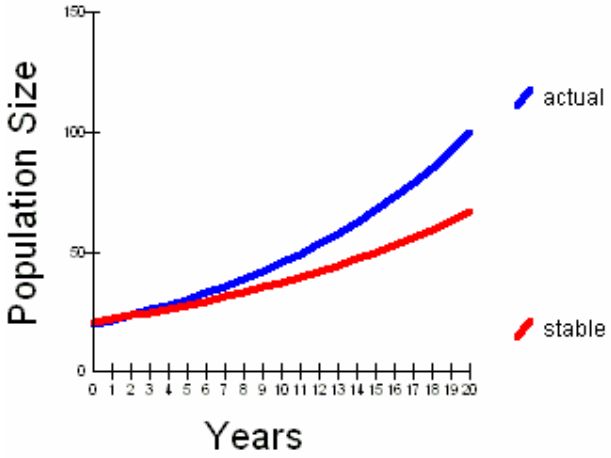


Figure 7 Population Projection for 20 years
Current Population Size: 21
New Population Size: 100

Table 9 below shows the number of individuals required in each age class for the next 20 years. The number of individuals required in each age class, every year for the next 20 years are listed in columns. While the last row shows the number of individuals that are required each year to achieve a population target of 100 individuals in the next 20 years.

Table 9 Population projections for the captive snow leopard population for the next 20 years

	Years																				
Age Class		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	#Born	0.00	4.86	6.57	5.99	5.51	5.65	5.94	6.62	7.92	8.86	8.92	9.11	9.22	10.70	11.99	12.78	14.23	15.51	16.67	17.74	19.05
	0.00	3.00	4.06	5.48	5.00	4.60	4.72	4.96	5.53	6.61	7.40	7.45	7.61	7.70	8.93	10.01	10.67	11.89	12.95	13.92	14.82	15.91
	1.00	0.00	2.32	3.14	4.25	3.87	3.56	3.65	3.84	4.28	5.12	5.73	5.77	5.89	5.96	6.92	7.75	8.26	9.20	10.03	10.78	11.47
	2.00	2.00	0.00	2.24	3.03	4.09	3.74	3.43	3.52	3.70	4.13	4.94	5.52	5.56	5.68	5.75	6.67	7.47	7.97	8.87	9.67	10.39
	3.00	0.00	2.00	0.00	2.24	3.03	4.09	3.74	3.43	3.52	3.70	4.13	4.94	5.52	5.56	5.68	5.75	6.67	7.47	7.97	8.87	9.67
	4.00	0.00	0.00	2.00	0.00	2.24	3.03	4.09	3.74	3.43	3.52	3.70	4.13	4.94	5.52	5.56	5.68	5.75	6.67	7.47	7.97	8.87
	5.00	4.00	0.00	0.00	2.00	0.00	2.24	3.03	4.09	3.74	3.43	3.52	3.70	4.13	4.94	5.52	5.56	5.68	5.75	6.67	7.47	7.97
	6.00	4.00	3.91	0.00	0.00	1.91	0.00	2.19	2.96	4.00	3.65	3.35	3.44	3.62	4.03	4.82	5.39	5.43	5.54	5.61	6.51	7.29
	7.00	2.00	3.66	3.57	0.00	0.00	1.82	0.00	2.00	2.71	3.66	3.34	3.07	3.15	3.31	3.69	4.41	4.93	4.97	5.07	5.13	5.96
	8.00	0.00	2.00	3.28	3.19	0.00	0.00	1.82	0.00	1.80	2.44	3.29	3.00	2.76	2.83	2.98	3.32	3.97	4.44	4.47	4.57	4.62
	9.00	1.00	0.00	2.00	3.15	3.07	0.00	0.00	1.82	0.00	1.73	2.35	3.17	2.89	2.66	2.73	2.87	3.19	3.82	4.28	4.31	4.40
	10.00	0.00	1.00	0.00	1.86	3.02	2.94	0.00	0.00	1.69	0.00	1.65	2.25	3.03	2.77	2.54	2.61	2.74	3.06	3.66	4.09	4.12
	11.00	1.00	0.00	0.75	0.00	1.72	2.57	2.50	0.00	0.00	1.57	0.00	1.41	1.92	2.59	2.37	2.17	2.23	2.35	2.61	3.13	3.50
	12.00	0.00	1.00	0.00	0.38	0.00	1.72	2.11	2.03	0.00	0.00	1.57	0.00	1.16	1.59	2.14	1.95	1.80	1.84	1.94	2.16	2.58
	13.00	1.00	0.00	0.87	0.00	0.13	0.00	1.50	1.58	1.52	0.00	0.00	1.36	0.00	0.87	1.20	1.62	1.48	1.36	1.39	1.47	1.63
	14.00	2.00	0.85	0.00	0.74	0.00	0.00	0.00	1.27	1.21	1.16	0.00	0.00	1.16	0.00	0.67	0.93	1.25	1.14	1.05	1.08	1.13
	15.00	0.00	1.00	0.43	0.00	0.37	0.00	0.00	0.00	0.64	0.61	0.58	0.00	0.00	0.58	0.00	0.34	0.46	0.63	0.57	0.52	0.54
	16.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	17.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	"Total"	20.00	21.80	23.76	25.84	28.04	30.43	33.01	35.82	38.85	42.10	45.59	49.36	53.42	57.82	62.57	67.69	73.21	79.15	85.58	92.54	100.06

Genetic Analyses

Founder Statistics

The captive snow leopard population has only one founder of wild origin which has contributed to the population. One additional wild founder who was included in the program died without making any contribution. Table 7 below depicts the founder statistics. The founder (studbook number 00024), a female is still alive and has produced seven offspring of which three are dead.

Table 10 Founder Statisitics

Studbook #	Sex	Age	Representation	Contribution	Allele Retent.	Potential Ret.	Descendants
00028	F	-1	1.0000	3.5000	0.9915	1.0000	7.00

Inbreeding Statistics

The inbreeding statistics of the population was analyzed using PM2000 and is presented below in Table 11. Inbreeding Coefficient (F) is a measure of the inbreeding occurring due to mating between closely related individuals *viz*. siblings, parents and offspring and vice versa.

Table 11 Inbreeding Statistics

Studbook #	Sex	Age	Location	% Known	Inbreeding Coefficient
00001	M	15	Darjeeling	0.0	0.0000
00002	F	11	Darjeeling	0.0	0.0000
00003	F	7	Darjeeling	0.0	0.0000
00004	M	13	Darjeeling	0.0	0.0000
00005	F	8	Darjeeling	0.0	0.0000
00006	F	13	Darjeeling	0.0	0.0000
00007	M	10	Darjeeling	0.0	0.0000
00009	F	13	Darjeeling	0.0	0.0000
00010	F	0	Darjeeling	0.0	0.0000
00011	M	0	Darjeeling	0.0	0.0000
00012	F	0	Darjeeling	0.0	0.0000
00013	U	1	Darjeeling	0.0	0.0000
00014	M	14	Darjeeling	0.0	0.0000
00015	F	12	Gangtok	0.0	0.0000
00016	M	14	Darjeeling	0.0	0.0000
00017	M	13	Darjeeling	0.0	0.0000
00018	M	7	Darjeeling	0.0	0.0000
00019	F	2	Darjeeling	0.0	0.0000
00020	F	1	Darjeeling	0.0	0.0000
00021	M	0	Darjeeling	0.0	0.0000
00022	M	11	Darjeeling	0.0	0.0000

Studbook #	Sex	Age	Location	% Known	Inbreeding Coefficient
00023	M	0	Darjeeling	0.0	0.0000
00024	M	0	Darjeeling	0.0	0.0000
00025	M	2	Darjeeling	0.0	0.0000
00026	F	9	Nainital	0.0	0.0000
00028	F	0	Darjeeling	100.0	0.0000
00029	F	7	Kufri	0.0	0.0000
00030	M	0	Darjeeling	0.0	0.0000
00031	F	0	Darjeeling	0.0	0.0000
00032	M	0	Darjeeling	0.0	0.0000
00033	M	0	Darjeeling	50.0	0.0000
00034	M	7	Darjeeling	0.0	0.0000
00035	M	7	Kufri	0.0	0.0000
00036	F	0	Darjeeling	0.0	0.0000
00037	F	6	Darjeeling	50.0	0.0000
00038	M	6	Darjeeling	0.0	0.0000
00039	M	6	Nainital	0.0	0.0000
00040	F	6	Darjeeling	50.0	0.0000
00041	F	0	Darjeeling	50.0	0.0000
00042	M	5	Darjeeling	0.0	0.0000
00043	M	5	Gangtok	0.0	0.0000
00044	F	5	Darjeeling	0.0	0.0000
00045	F	5	Darjeeling	0.0	0.0000
00046	M	2	Darjeeling	50.0	0.0000
00047	F	0	Darjeeling	50.0	0.0000
00048	M	2	Darjeeling	50.0	0.0000
00049	U	0	Darjeeling	50.0	0.0000
00050	U	0	Darjeeling	50.0	0.0000
00051	U	0	Darjeeling	50.0	0.0000

Bibliography

1. Blomqvist, L. (2003): The global snow leopard population in captivity 2001. Int. Ped. Book of Snow leopards 8: 21-24. Helsinki Zoo
2. Blomqvist, L. (2004): The global studbook report 2002 for snow leopards: Decline of a pedigree species. Helsinki Zoo Ann. Rep.2003: 26-28. Helsinki Zoo
3. Dexel, B. (2003a): The great snow leopard conservation challenge in Central Asia. Cat News 38: 20-21
4. Dexel, B. (2003b): The illegal trade in snow leopards – A global perspective. Int. Ped. Book of Snow leopards 8: 5-17. Helsinki Zoo
5. Dexel, B. (2003c): Snow leopard conservation in Kyrgyzstan: Enforcement, education and research activities by the German Societyfor Nature Conservation (NABU). Int. Ped. Book of Snow leopards 8: 18-20. Helsinki Zoo
6. Heptner, V. G., N. P. Naumov, P. B. Juergenson, A. A. Sludski, A. F. Cirkova & A. G. Bannikov (1974): DieSäugetiere der Sowietunion, Band II, Seekuhe und Raubtiere. VEB Gustav Fischer Verlag, Jena
7. Jackson, R. (1991): Snow leopard on the roof of the world. Cat News 14: 16-17
8. Jackson, R., Mallon, D., McCarthy, T., Chundawat, R.A. & Habib, B. 2008. ***Panthera uncia***. In: IUCN 2008. 2008 IUCN Red List of Threatened Species. <http://www.iucnredlist.org/>. Downloaded on 25 November 2008.
9. Koshkarev, E. P (1994): Snow leopard poaching in Central Asia. Cat News 21: 18
10. Mccarthy, T. and G. Chapron (2003): Snow leopard Survival Strategy. Int. Snow Leopard Trust and the Snow leopard Network.Seattle
11. Nowak, Ronald M. (1999). Walker's Mammals of the World. Johns Hopkins University Press. ISBN 0-8018-5789-9.
12. Nowell, K. (2000): Far from a cure: the Tiger Trade Revisited. Species in Danger report series. Traffic International, Cambridge
13. Nowell, K. and P. Jackson (1996): Wild cats: Status Survey and Conservation Action Plan. IUCN, Gland, Switzerland
14. Oli, M. K., I. R. Taylor and M. E. Rogers (1994): Snow leopard Panthera uncial predation of livestock: an assessment of local perceptions in the Annapurna Conservation Area, Nepal. Biol. Cons. 68: 63-68
15. Population and Protections. Snow Leopard Trust (2008). Retrieved on 2008-07-03.
16. Spearing, A. (2002): The snow leopard in Zanskar, Jammu and Kashmir, NW India. Proc. of the Snow Leopard Survival Strategy Summit, May 2002. Int. Snow Leopard Trust, Seattle
17. Sumiya, G. and B. Buyantsog (2002): Conservation of snow leopard in the Turgen and Tsagaan Shuvuut mountains through local involvement. Proc. of the Snow Leopard Survival Strategy Summit, May 2002. Int. Snow Leopard Trust, Seattle
18. Theile, S. (2003): Fading footprints: The killing and trade of snow leopards. Traffic Report
19. Theile, Stephanie Fading footprints; the killing and trade of snow leopards TRAFFIC International, 2003
20. Wen, B. (2002): Illegal trade of snow leopards in China: an overview. Proc. of the Snow Leopard Survival Strategy Summit, May 2002. Int. Snow Leopard Trust, Seattle
21. Wozencraft, W. C. (16 November 2005). in Wilson, D. E., and Reeder, D. M. (eds): Mammal Species of the World, 3rd edition, Johns Hopkins University Press, 548. ISBN 0-801-88221-4.

Glossary of Terms

Demographic Terms

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

Population Growth Rate (Lambda, λ) -- 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.

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).

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.

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

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

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.

Genetic Terms

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

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 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).

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.

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

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

Annexure 1

Pedigree Chart Report
SNOW LEOPARD Studbook

```
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 Taxon Name: UNCIA UNCIA                          Studbook Number:  00001
==========================================================================
                ISB356                                  ISB620
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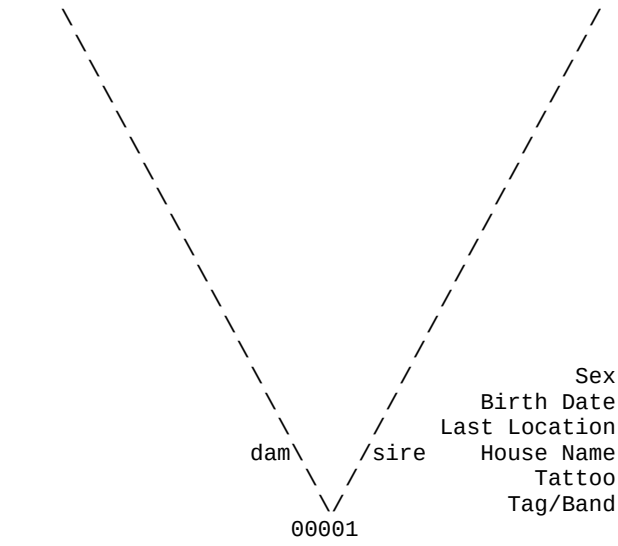

```
                                                    Sex: Male
                                              Birth Date: 21 Jun 1978
                                          Last Location: DARJEELIN (dead)
                                        dam\    /sire    House Name:
                                            \  /            Tattoo:
                                             \/           Tag/Band:
                                           00001
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```
==========================================================================
Taxon Name: UNCIA UNCIA                          Studbook Number:  00002
==========================================================================
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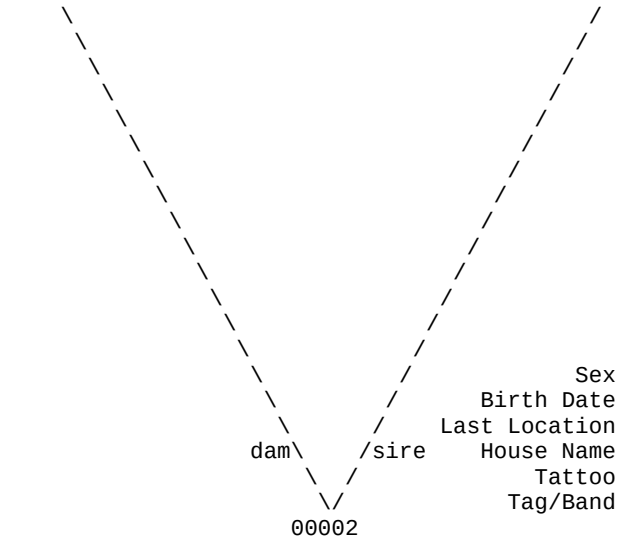

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                                                    Sex: Female
                                              Birth Date: 23 Apr 1980
                                          Last Location: DARJEELIN (dead)
                                        dam\    /sire    House Name:
                                            \  /            Tattoo:
                                             \/           Tag/Band:
                                           00002
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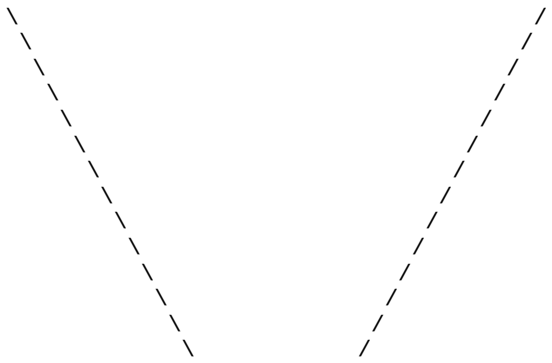
Taxon Name: UNCIA UNCIA Studbook Number: 00003

ISB406 ISB377



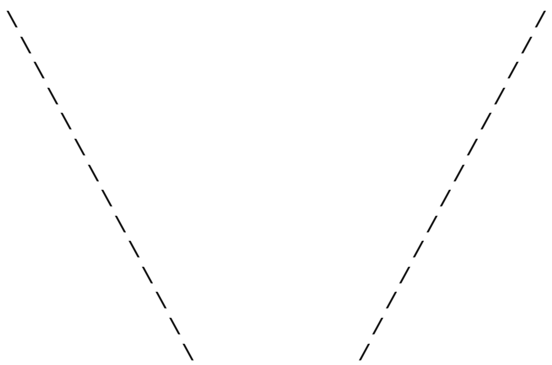
Sex: Female
Birth Date: 26 Aug 1983
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band:

dam sire

00003

Taxon Name: UNCIA UNCIA Studbook Number: 00004

ISB420 ISB380



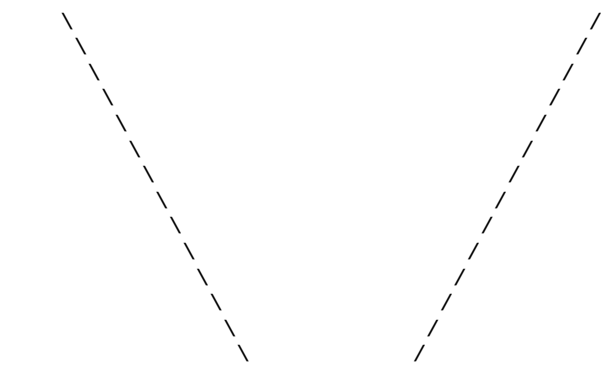
Sex: Male
Birth Date: 6 Jun 1985
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band:

dam sire

00004

Taxon Name: UNCIA UNCIA Studbook Number: 00005

IS1125 IS1101



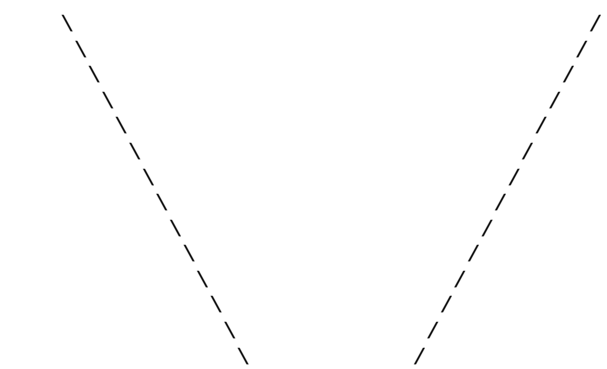
Sex: Female
Birth Date: 23 May 1990
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band:

dam sire

00005

Taxon Name: UNCIA UNCIA Studbook Number: 00006

IS1125 IS1101

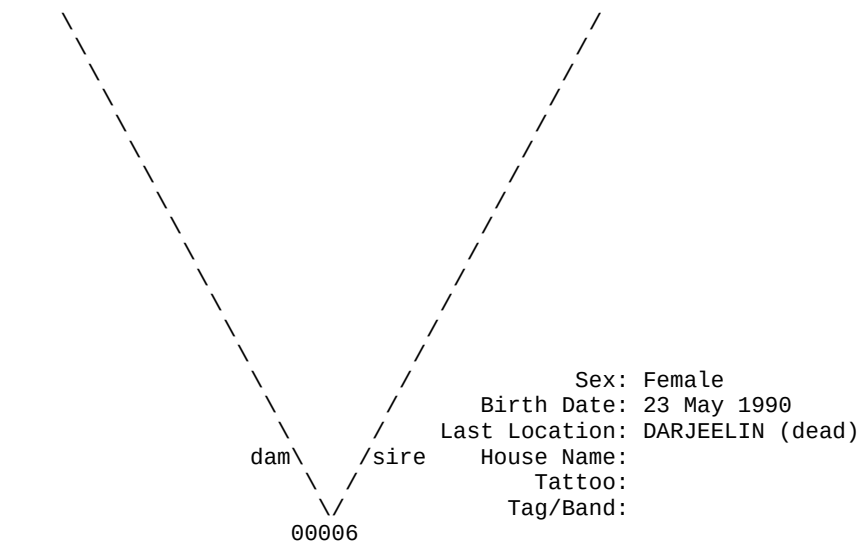


Sex: Female
Birth Date: 23 May 1990
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band:

dam sire

00006

Taxon Name: UNCIA UNCIA Studbook Number: 00006



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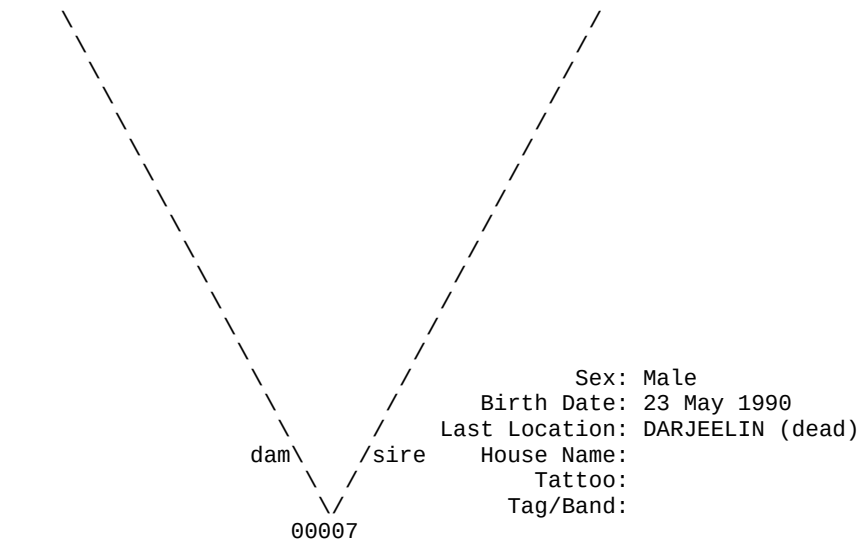

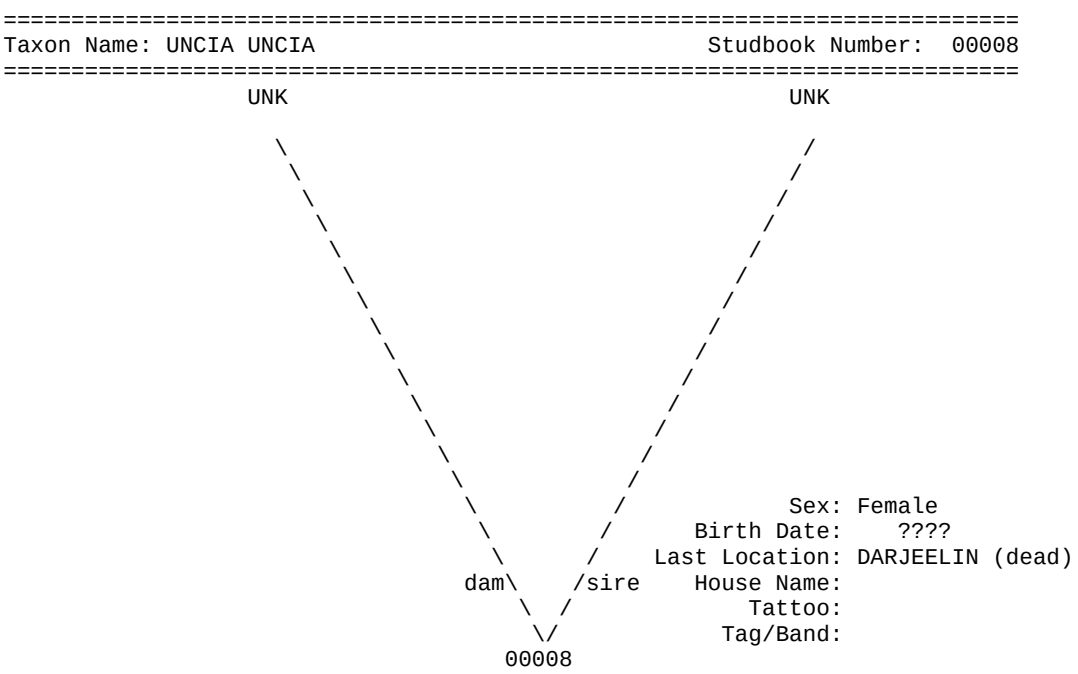
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UNK
UNK
Sex: Female
Birth Date: ????
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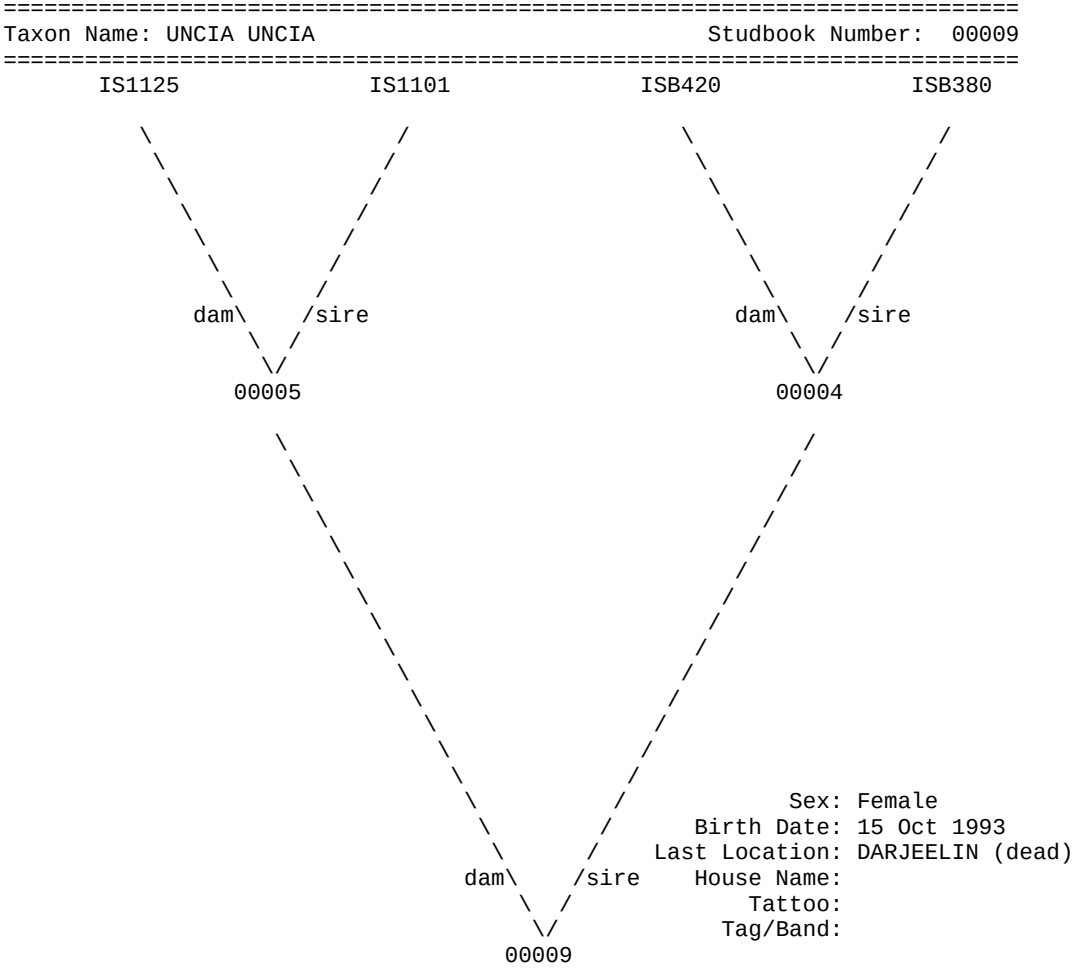
House Name:
Tattoo:
Tag/Band:
dam
sire
00008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ISB380
dam
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00005
dam
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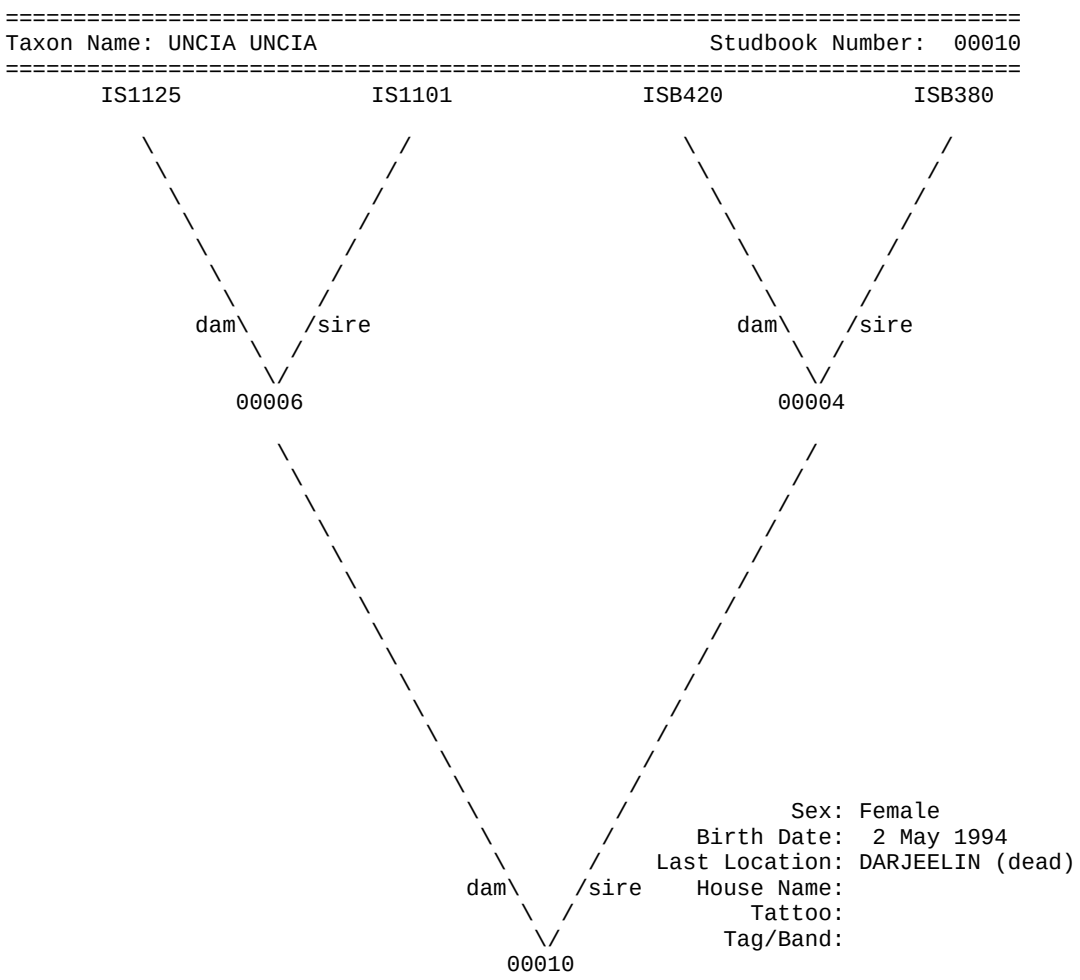
Sex: Female
Birth Date: 15 Oct 1993
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band:
dam
sire
00009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ISB420
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dam
sire
dam
sire
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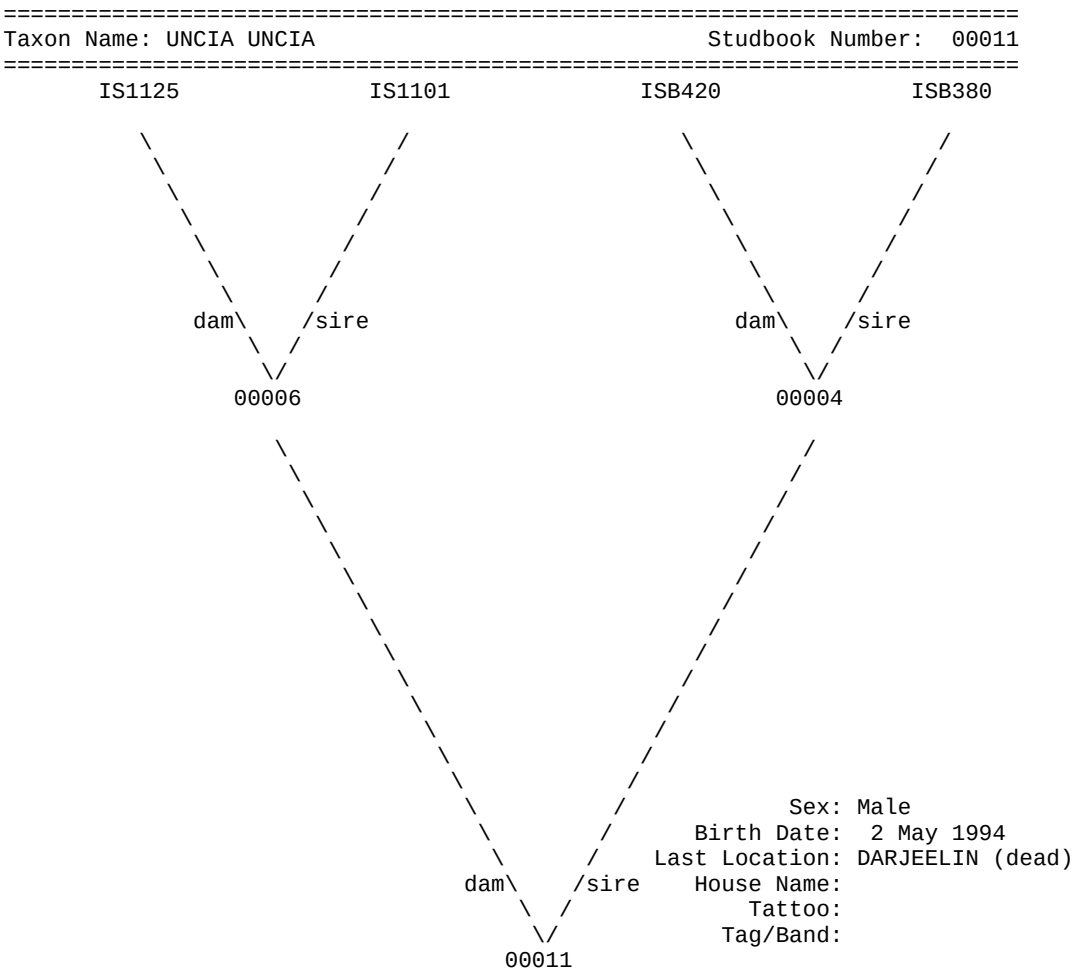
00010
Sex: Female
Birth Date: 2 May 1994
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band: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Studbook Number: 00011
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ISB420
ISB380
dam
sire
dam
sire
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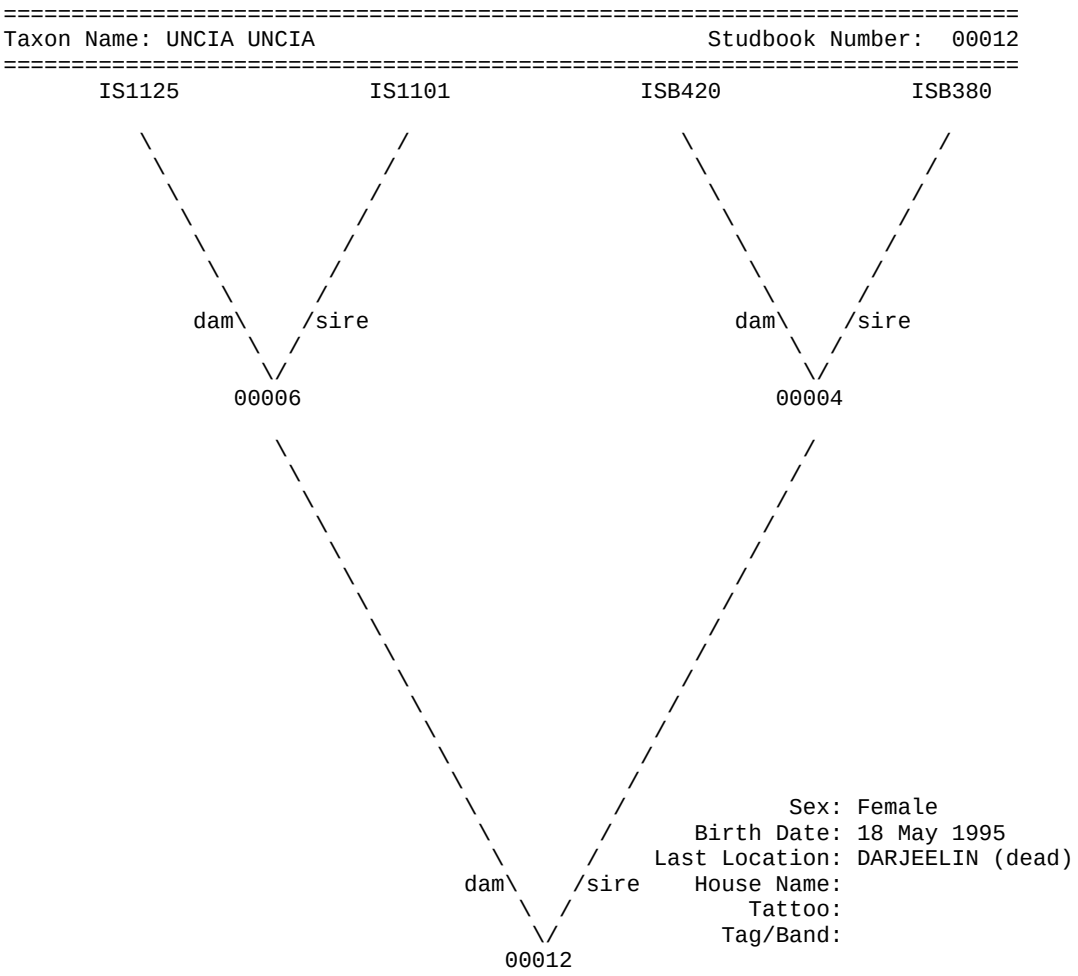
Sex: Male
Birth Date: 2 May 1994
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band: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dam
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Sex: Female
Birth Date: 18 May 1995
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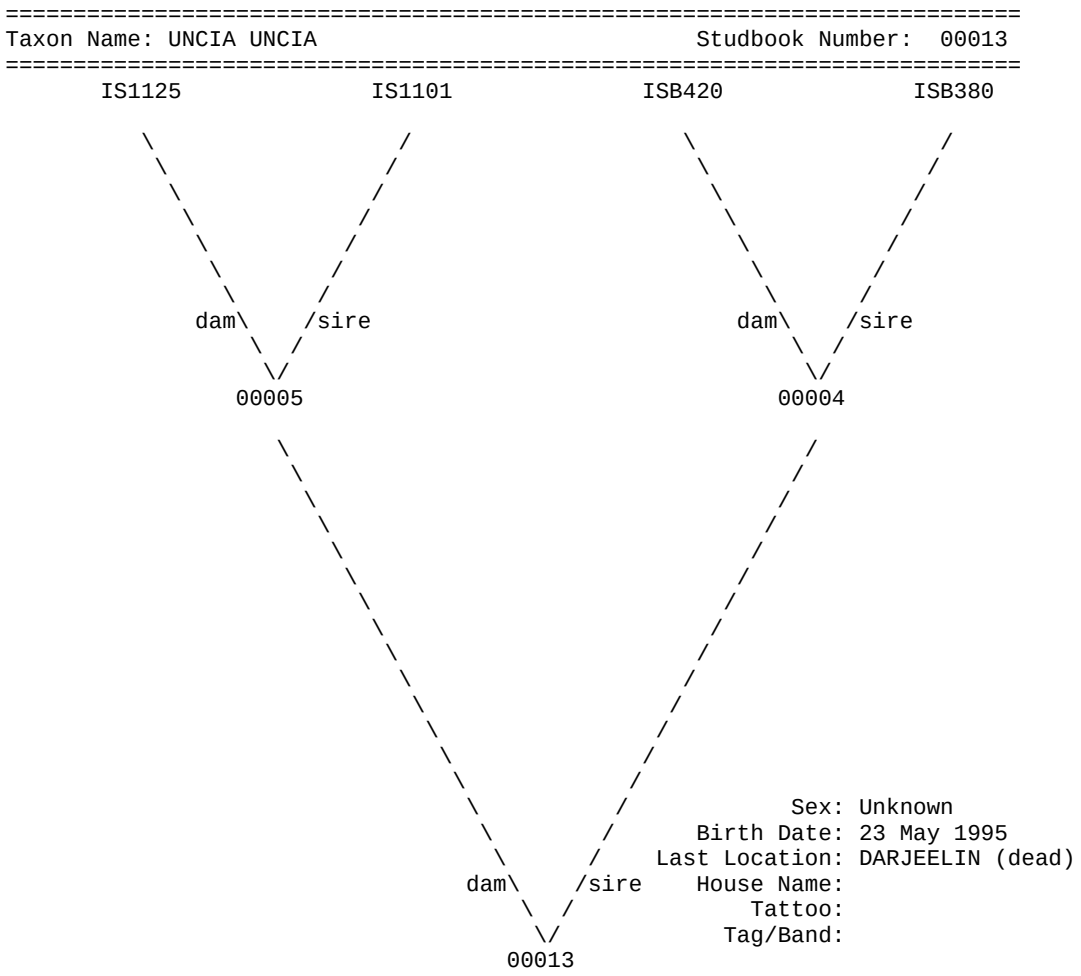
House Name:
Tattoo:
Tag/Band: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ISB420
ISB380
dam
sire
dam
sire
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dam
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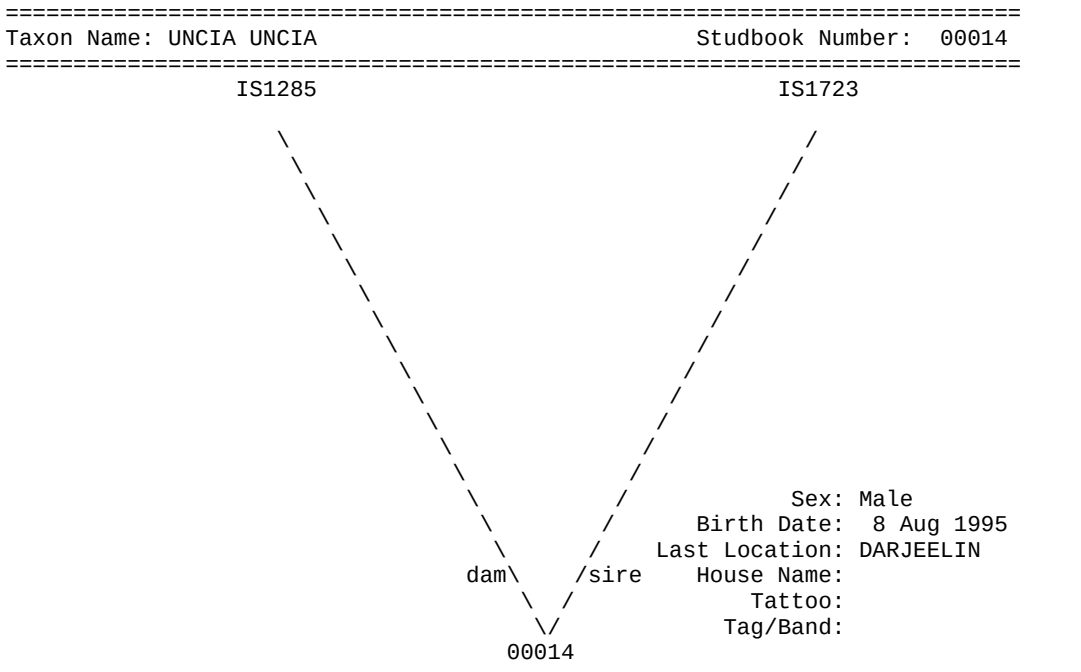
00013
Sex: Unknown
Birth Date: 23 May 1995
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band: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Studbook Number: 00014
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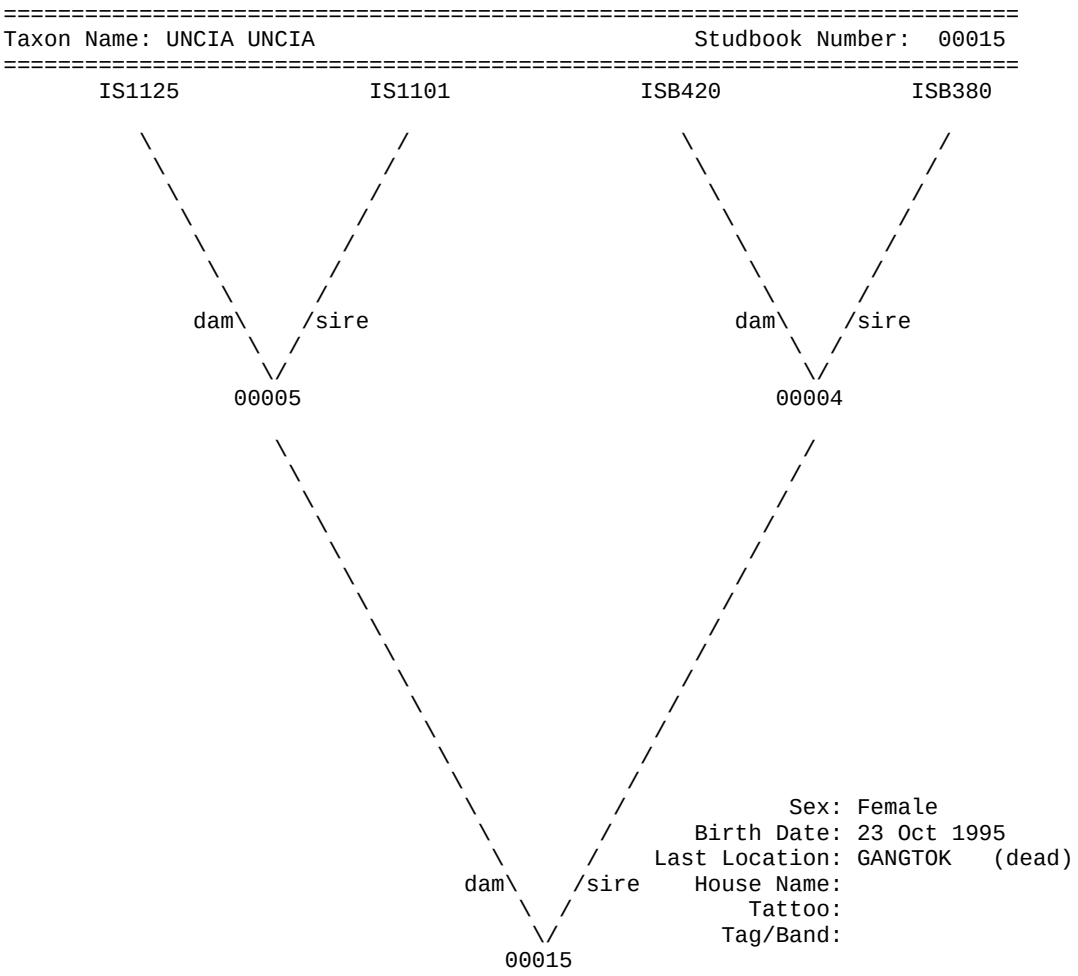
dam
sire
00014
Sex: Male
Birth Date: 8 Aug 1995
Last Location: DARJEELIN
House Name:
Tattoo:
Tag/Band: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Studbook Number: 00015
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IS1101
ISB420
ISB380
dam
sire
dam
sire
00005
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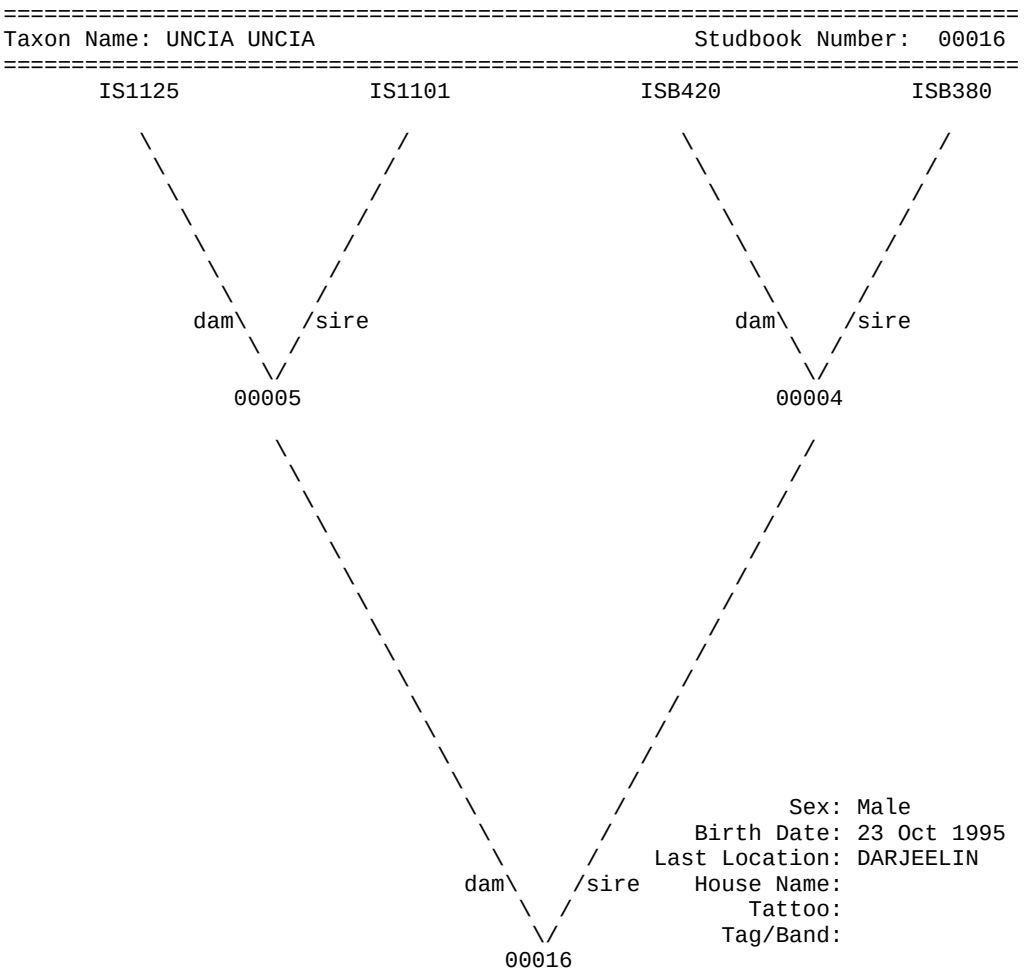
dam
sire
00015
Sex: Female
Birth Date: 23 Oct 1995
Last Location: GANGTOK (dead)
House Name:
Tattoo:
Tag/Band: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ISB380
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sire
00005
dam
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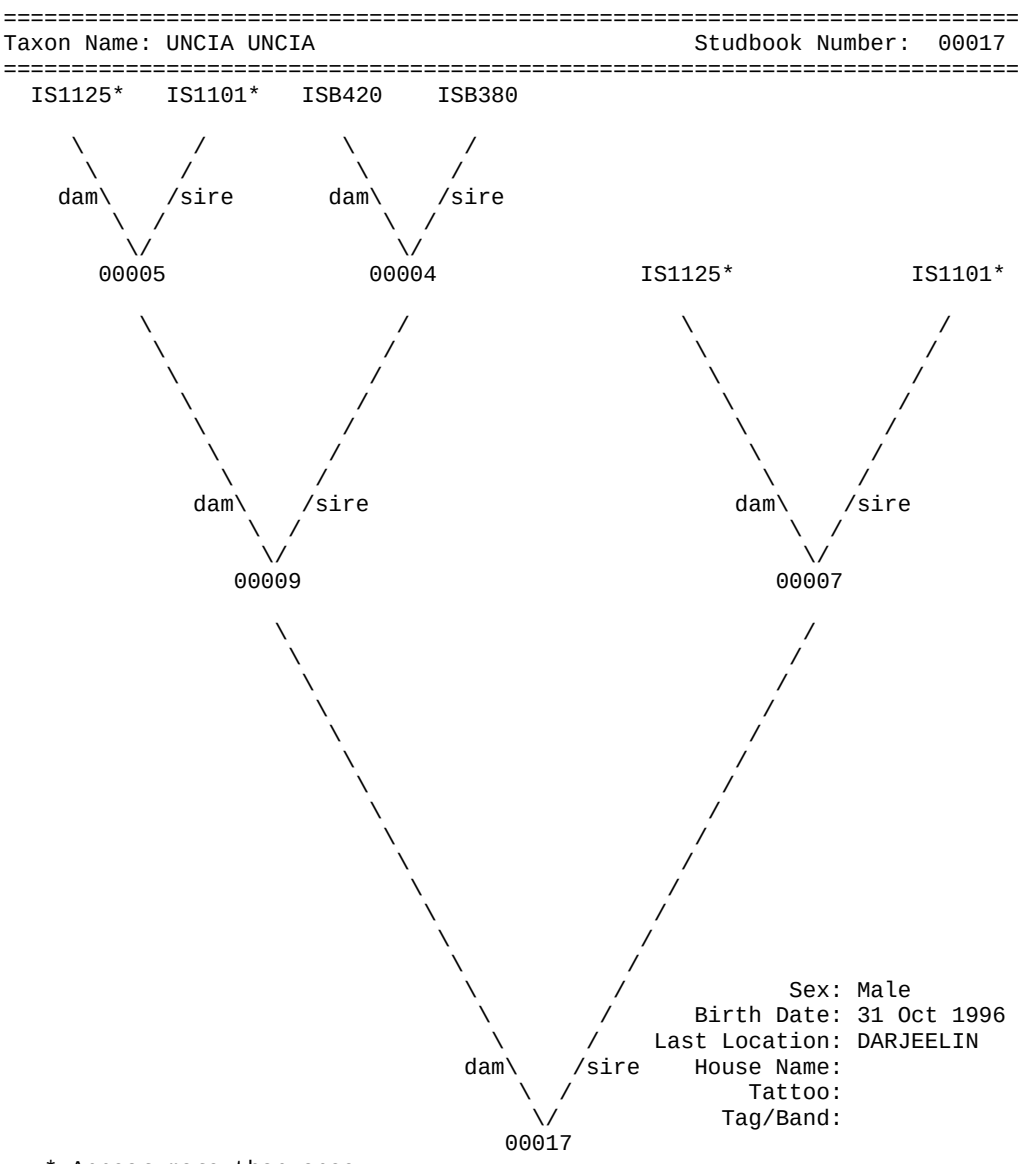
dam
sire
00016
Sex: Male
Birth Date: 23 Oct 1995
Last Location: DARJEELIN
House Name:
Tattoo:
Tag/Band:



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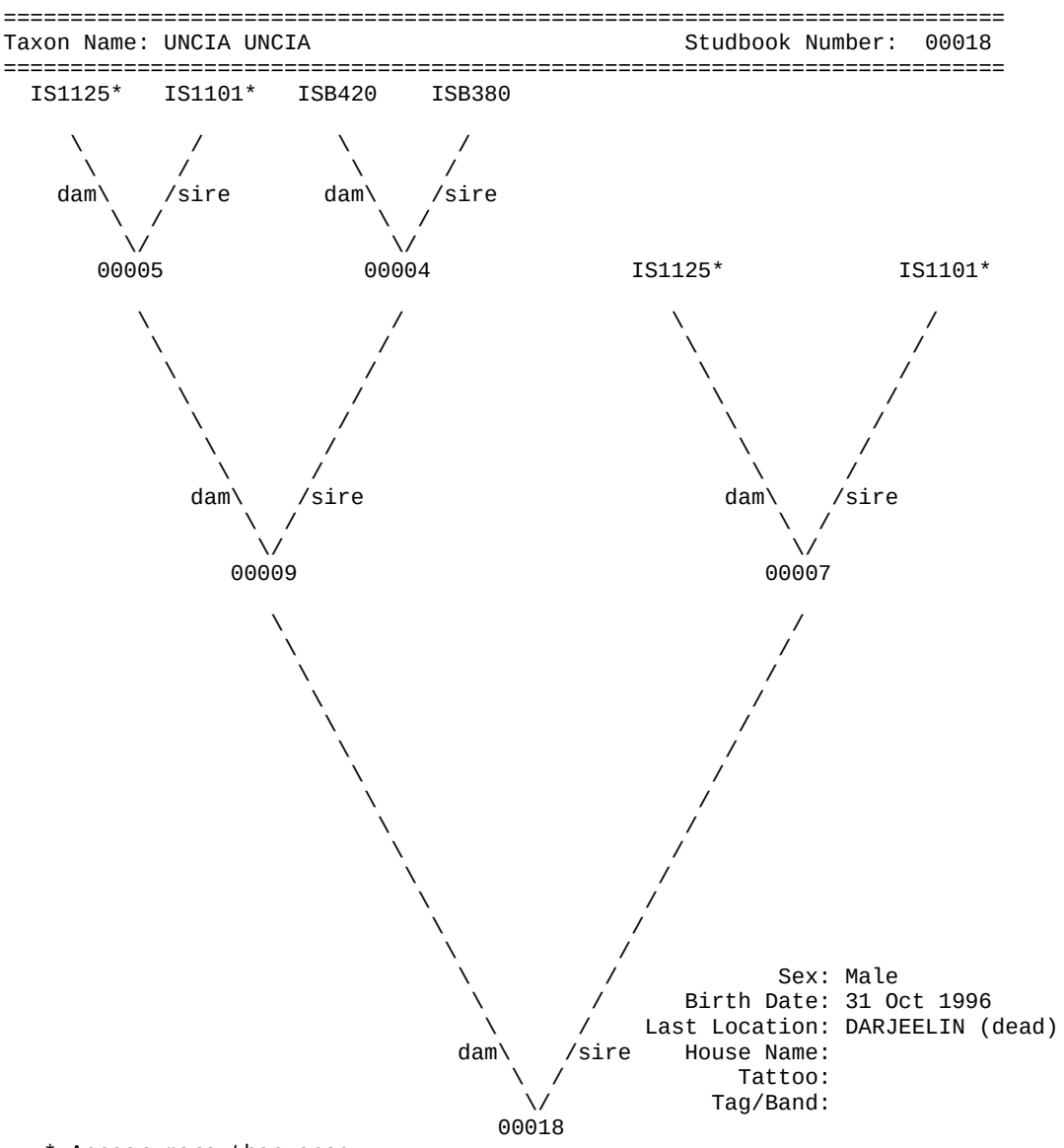
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dam\ /sire
dam\ /sire
00005
00004
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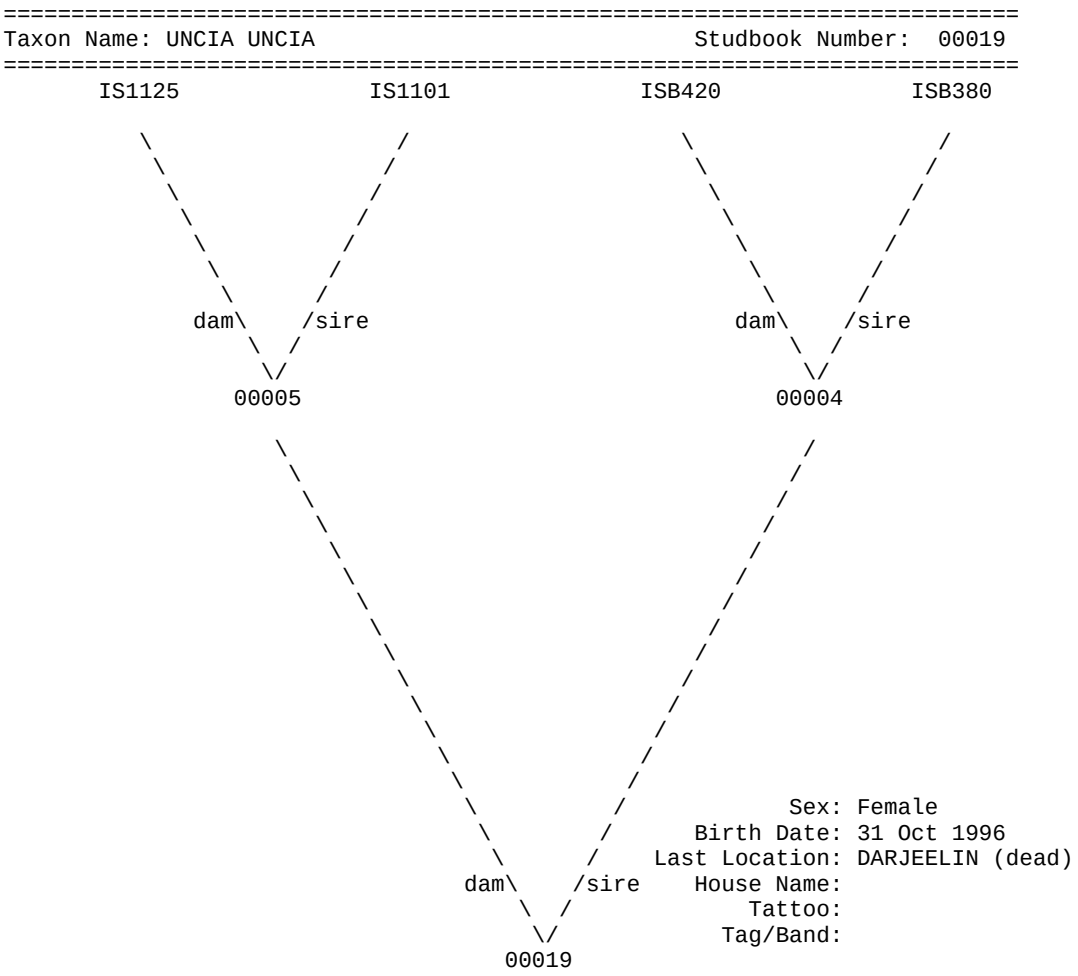
IS1101*
dam\ /sire
dam\ /sire
00009
00007
dam\ /sire
00018
Sex: Male
Birth Date: 31 Oct 1996
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band:
* Appear more than once...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ISB420
ISB380
dam
sire
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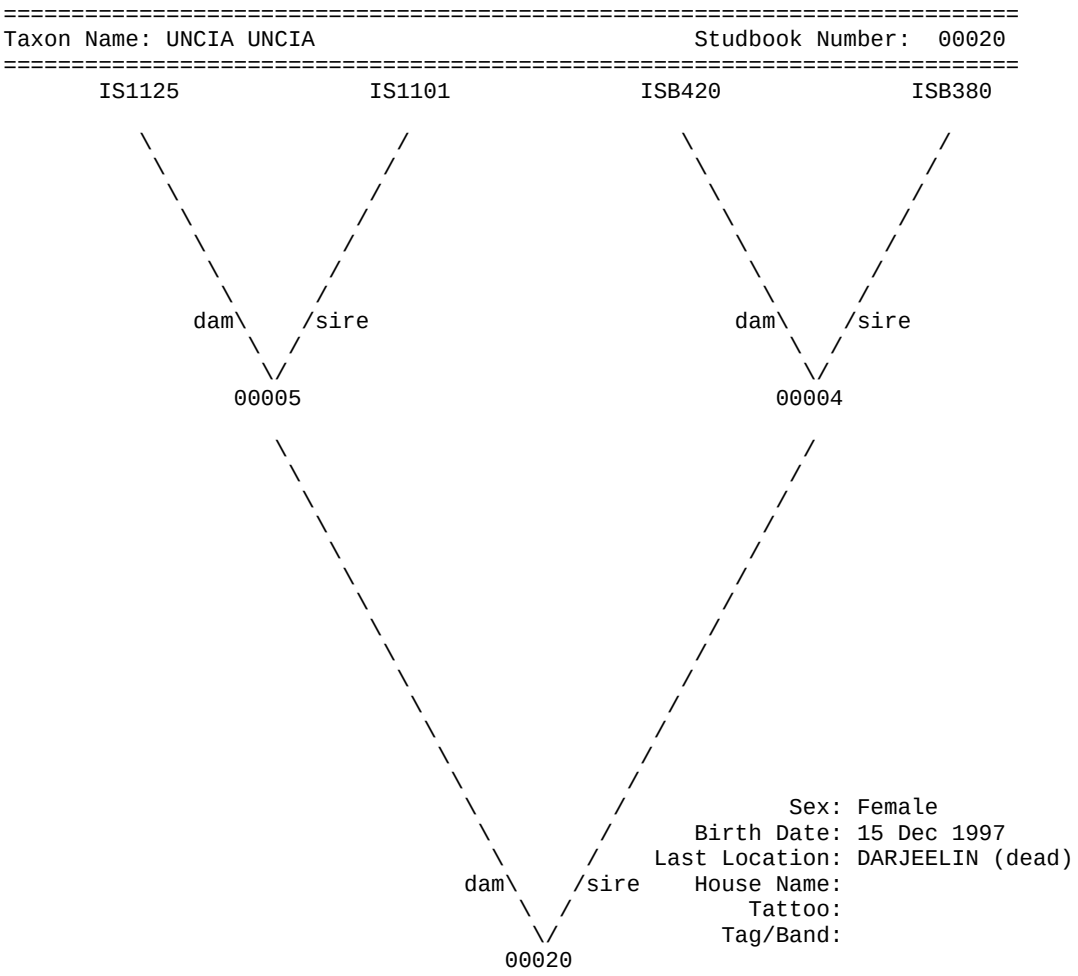
00019
Sex: Female
Birth Date: 31 Oct 1996
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band: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ISB420
ISB380
dam
sire
dam
sire
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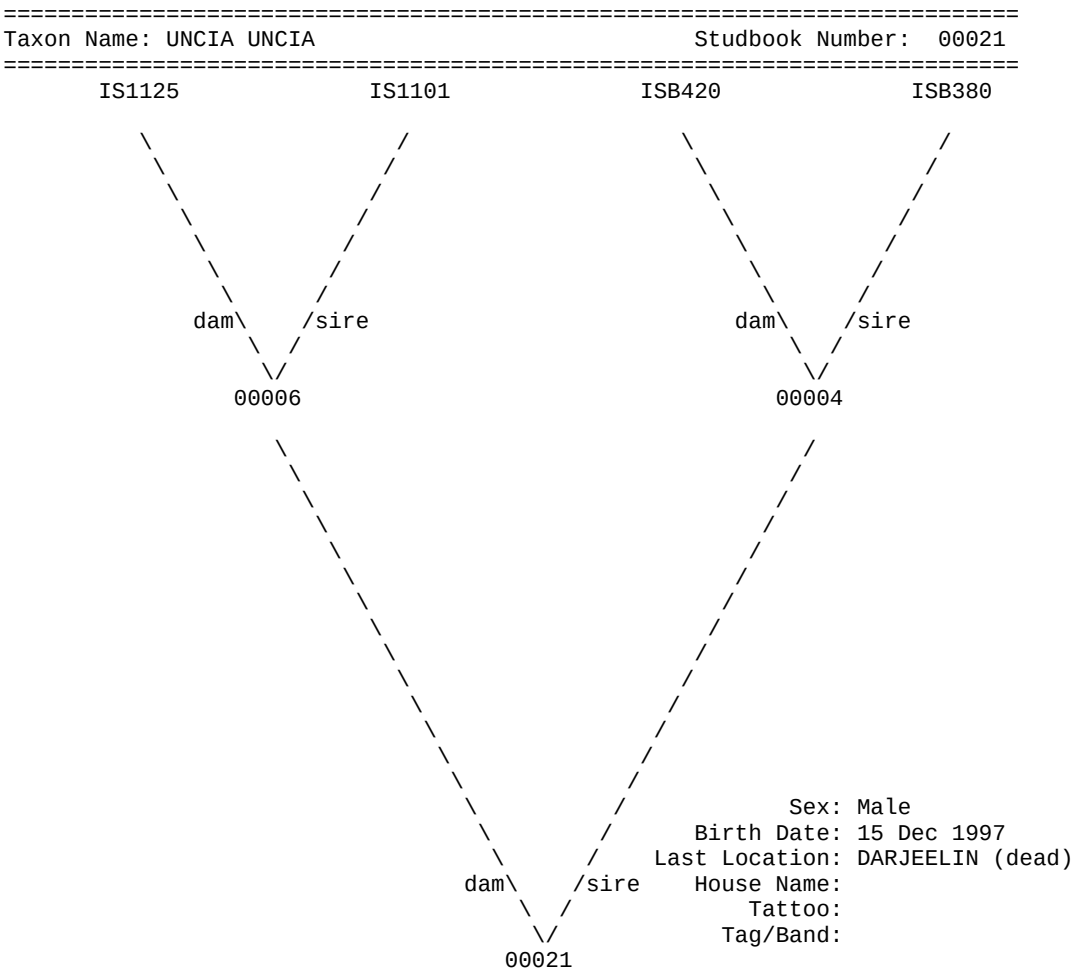
dam
sire
00020
Sex: Female
Birth Date: 15 Dec 1997
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band: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Studbook Number: 00021
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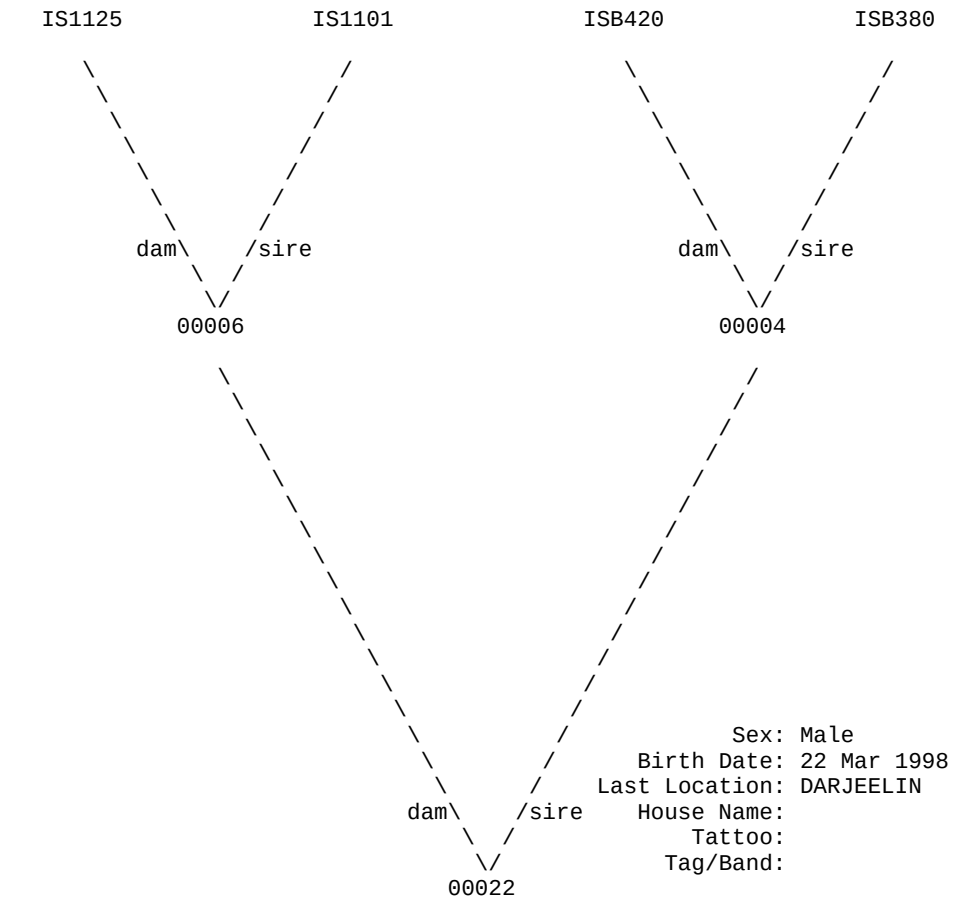
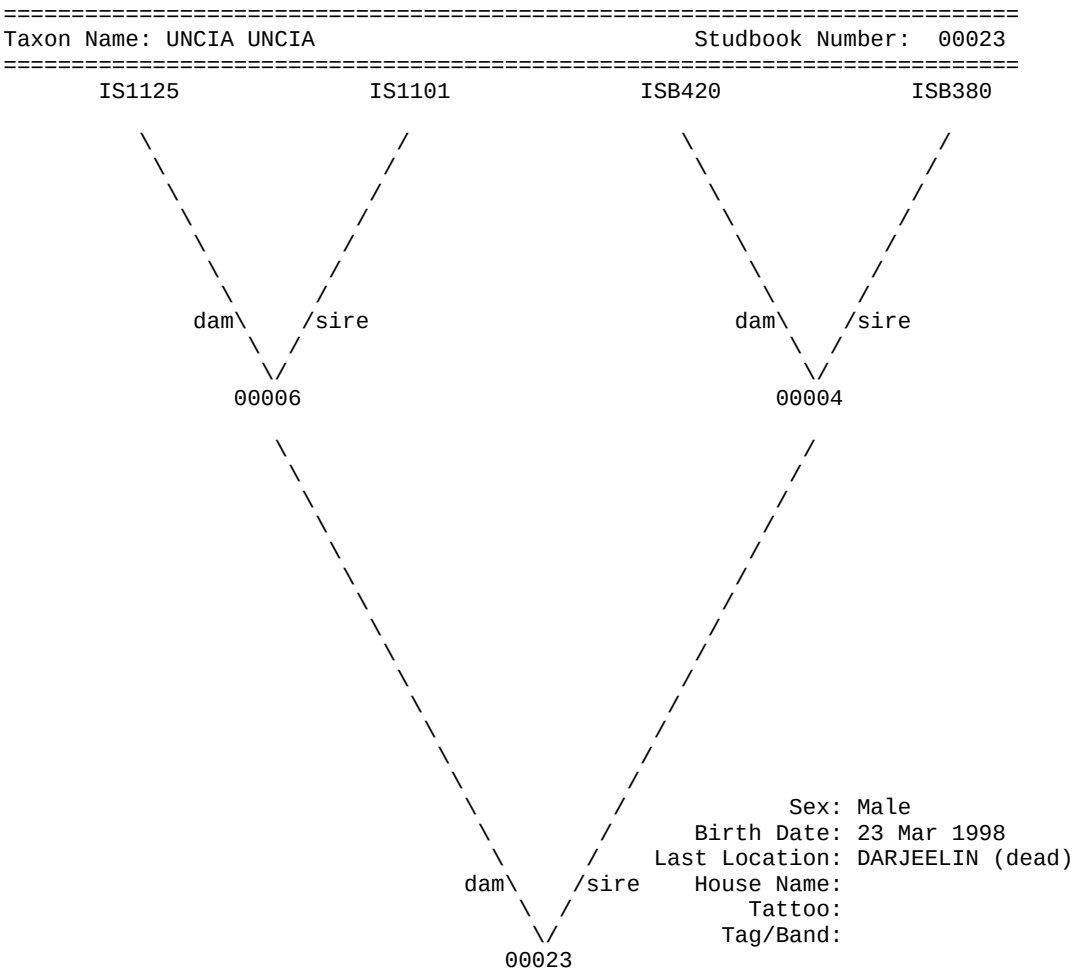
dam
sire
dam
sire
00006
00004
dam
sire
00021
Sex: Male
Birth Date: 15 Dec 1997
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band:

Taxon Name: UNCIA UNCIA Studbook Number: 00022

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dam
sire
dam
sire
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Sex: Male
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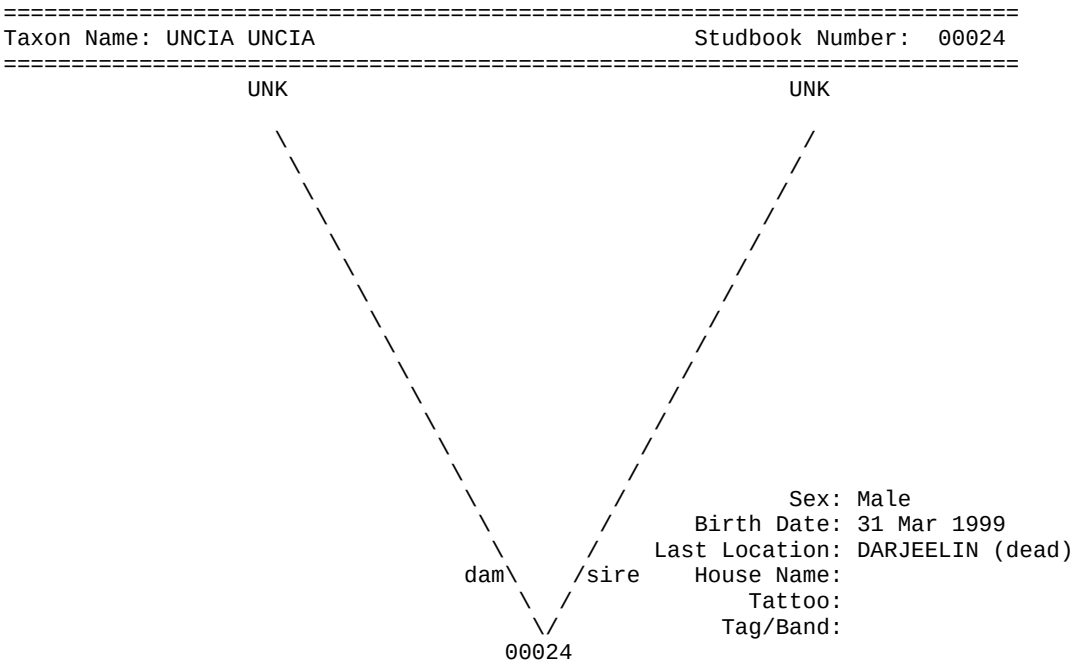
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band:
dam
sire
00023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UNK
Sex: Male
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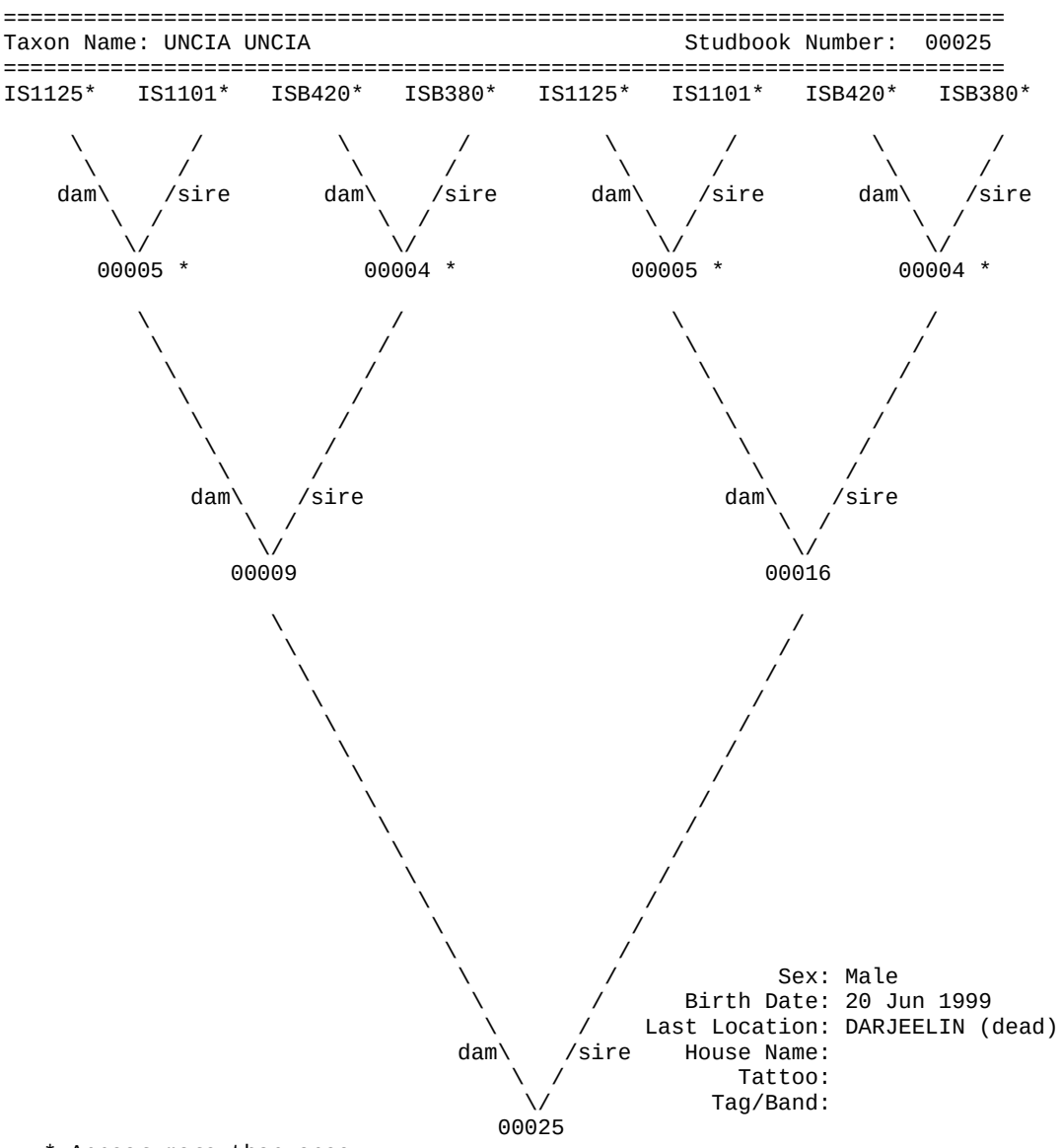
House Name:
Tattoo:
Tag/Band:
dam
sire
00024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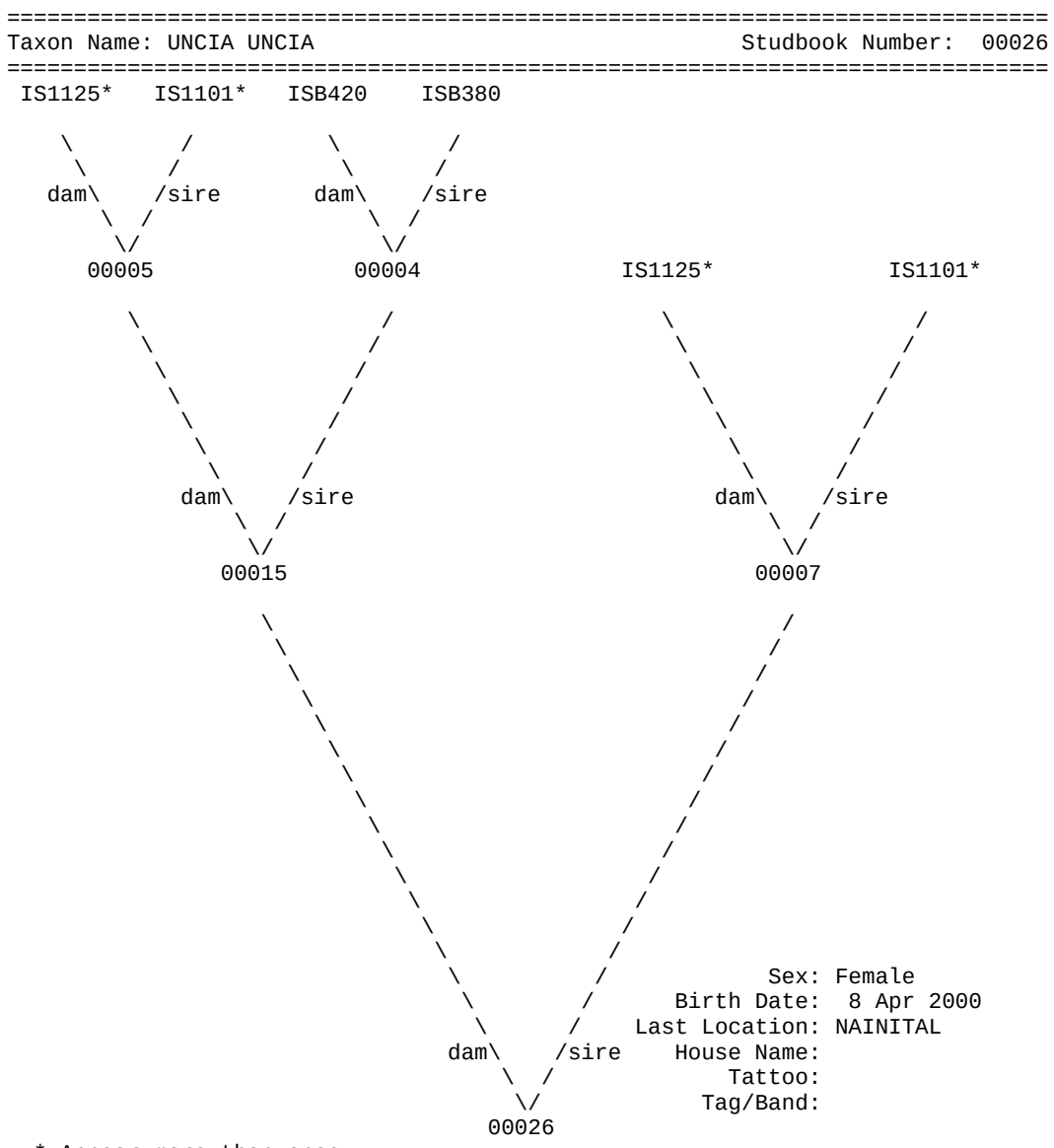
IS1125* IS1101* ISB420* ISB380* IS1125* IS1101* ISB420* ISB380*
dam\ /sire
00005 *
00004 *
00005 *
00004 *
00009
00016
00025
Sex: Male
Birth Date: 20 Jun 1999
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band:
* Appear more than once...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00005 00004
IS1125* IS1101*
dam\ /sire dam\ /sire
00015 00007
dam\ /sire
00026
Sex: Female
Birth Date: 8 Apr 2000
Last Location: NAINITAL
House Name:
Tattoo:
Tag/Band:
* Appear more than once...

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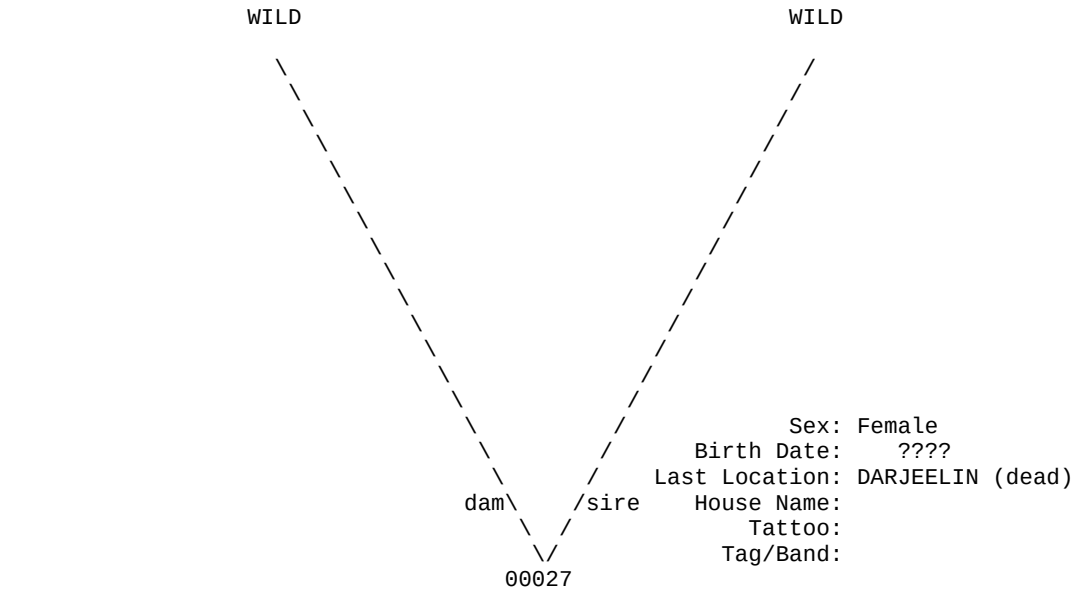

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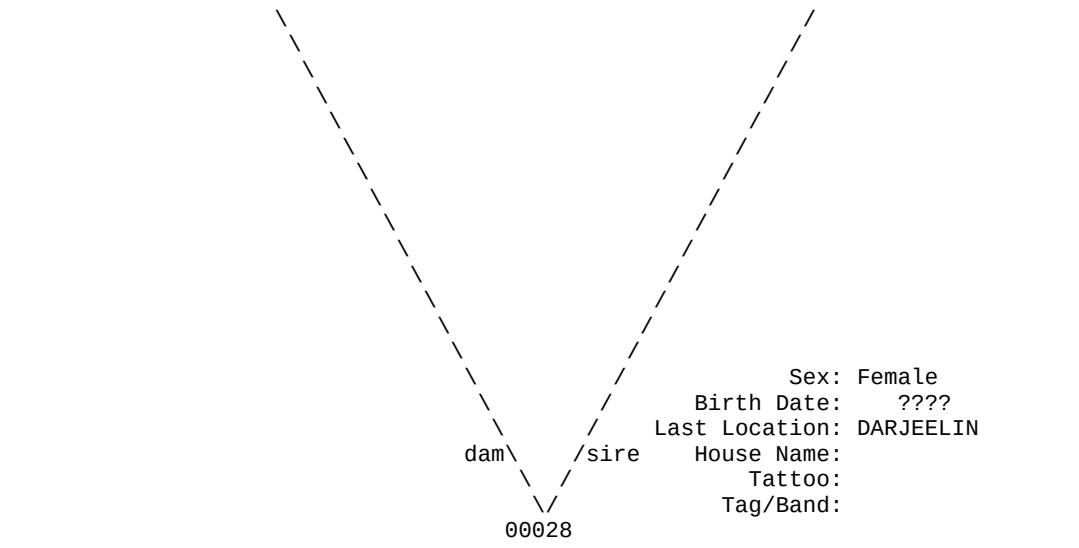

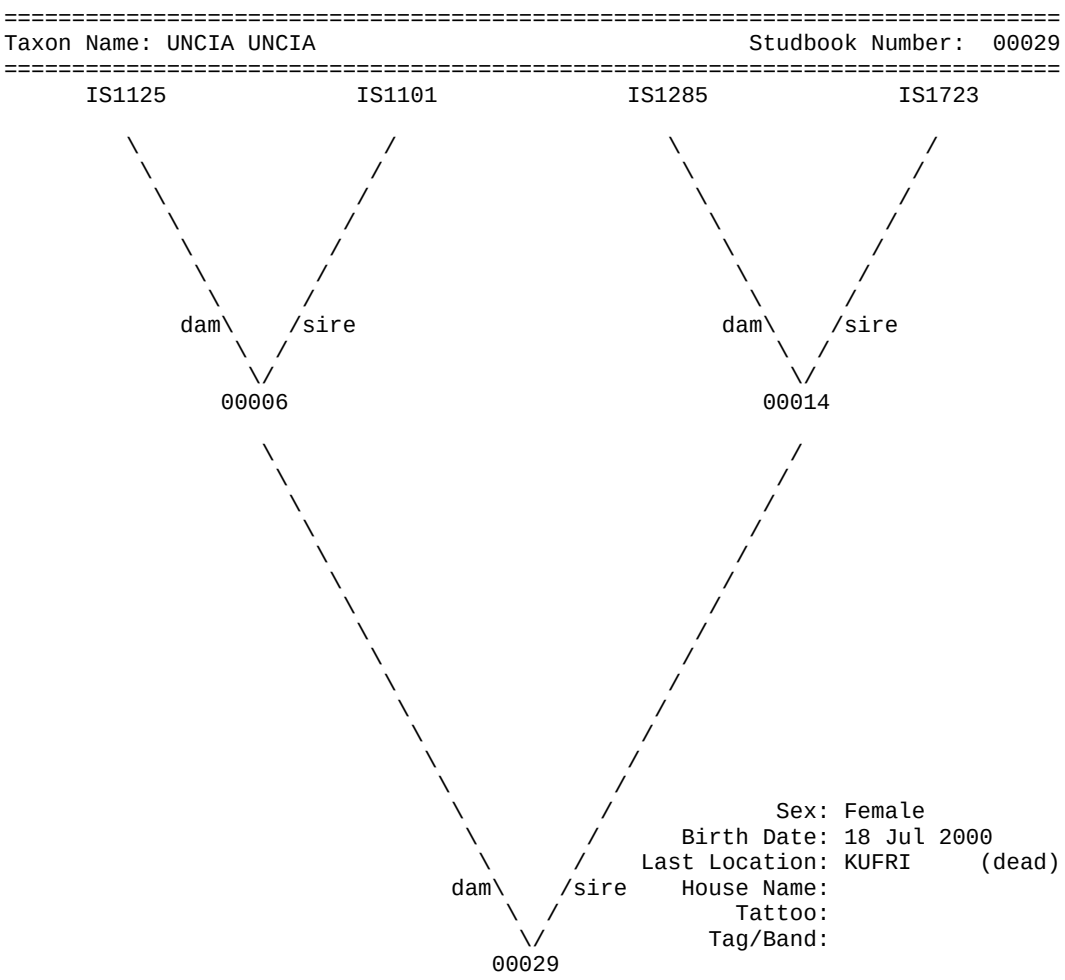
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sire
00006
dam
sire
00014
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sire
00029
Sex: Female
Birth Date: 18 Jul 2000
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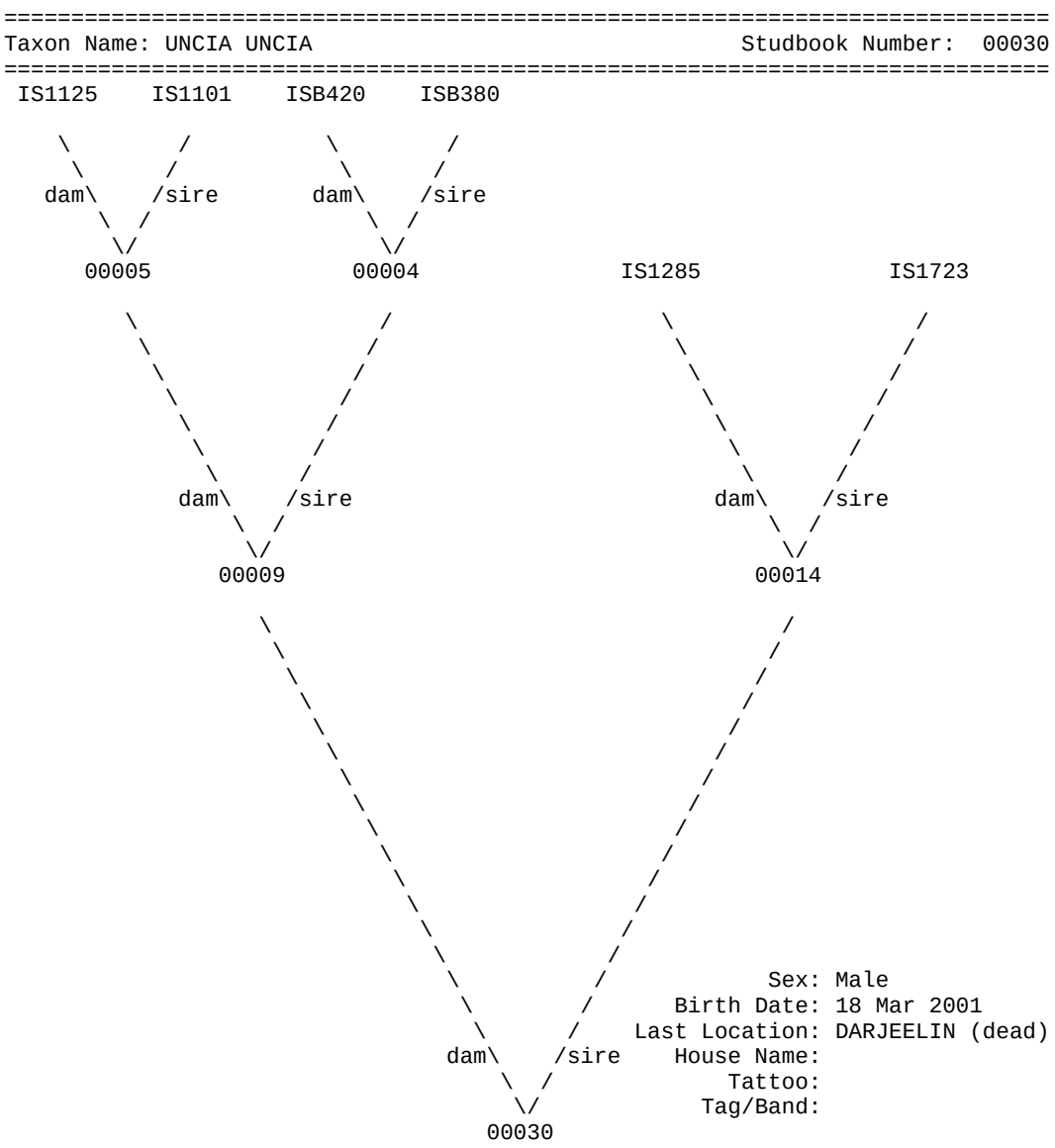
House Name:
Tattoo:
Tag/Band: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sire
00005
00004
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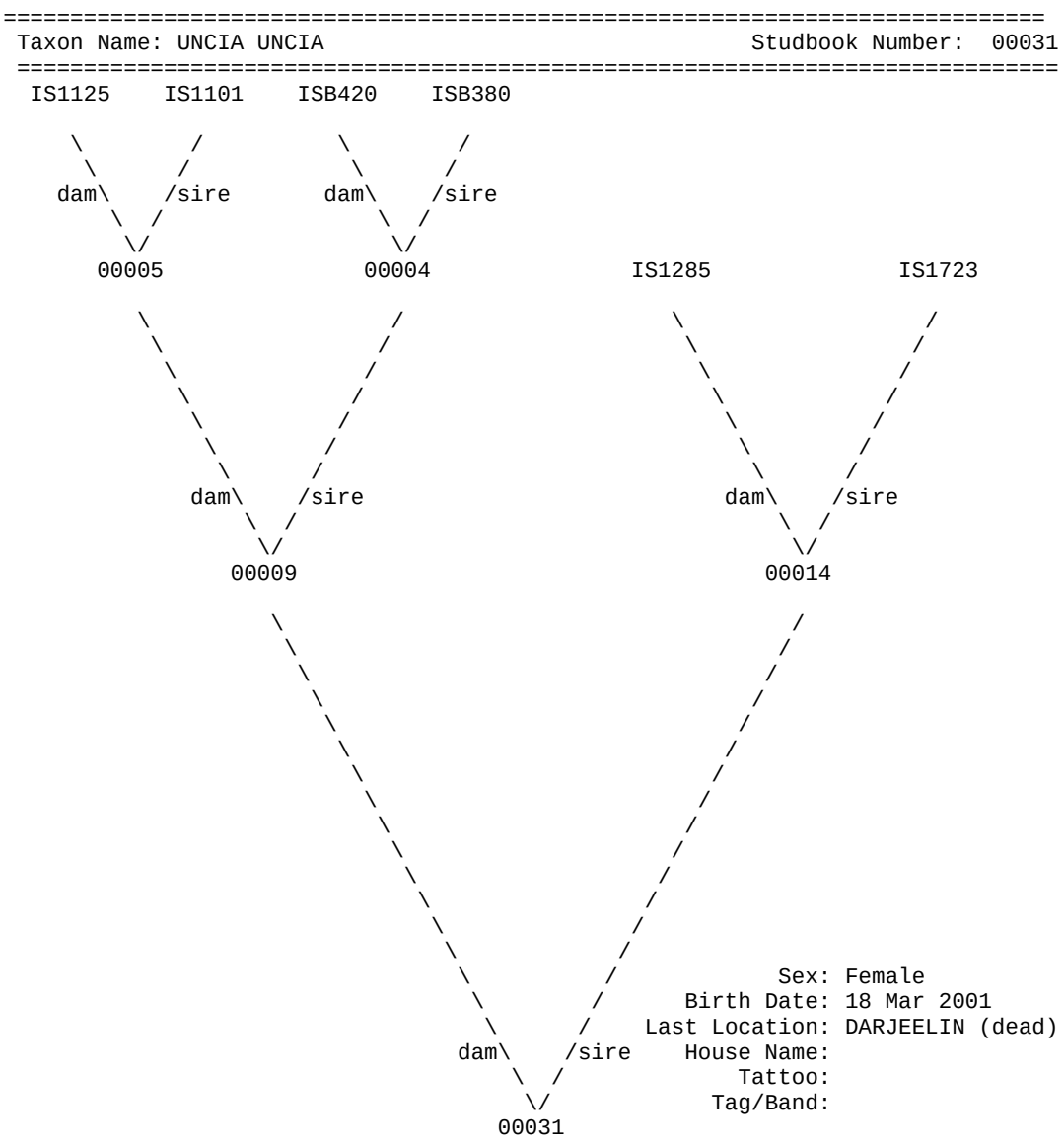
00030
Sex: Male
Birth Date: 18 Mar 2001
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band: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sire
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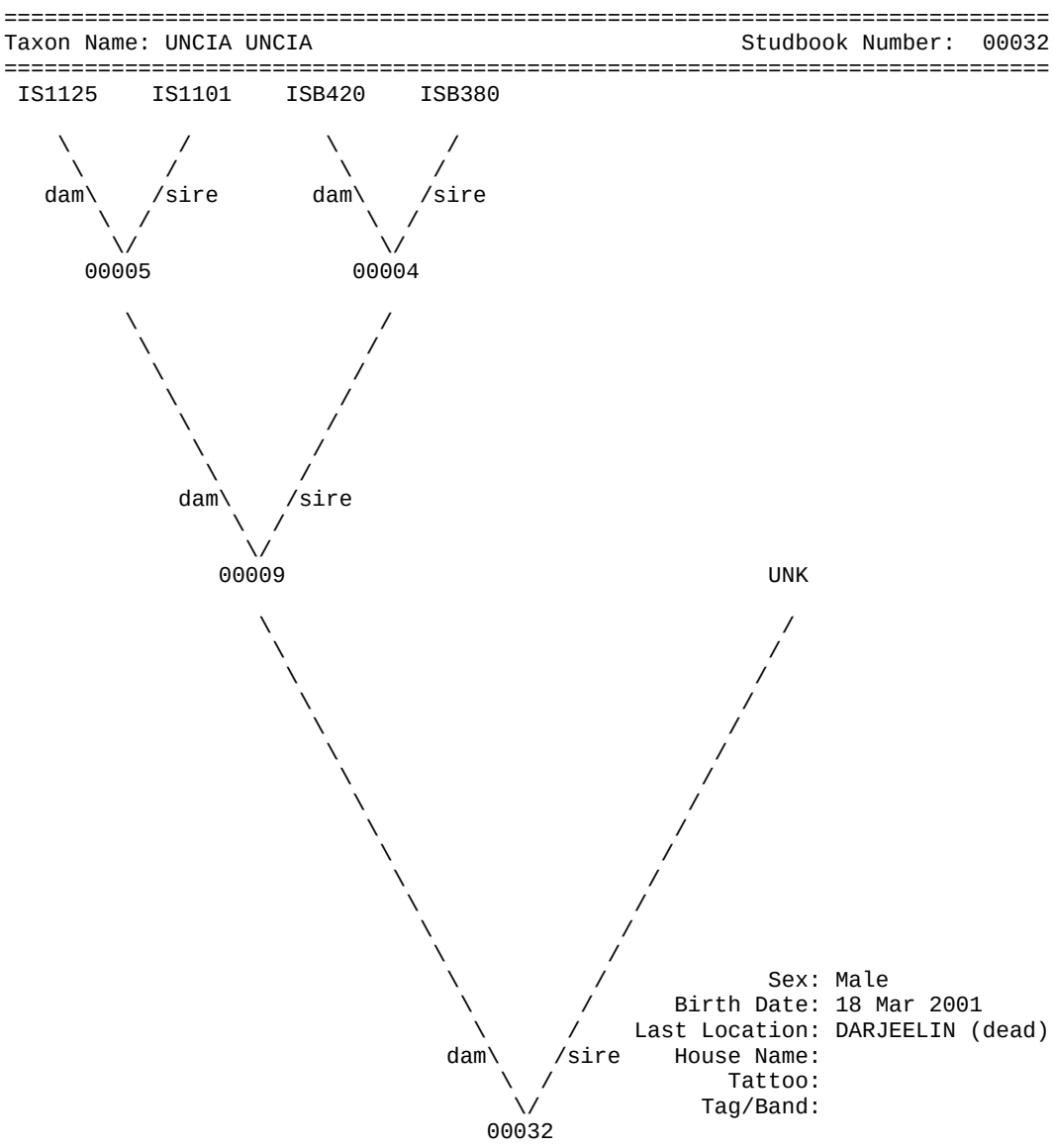
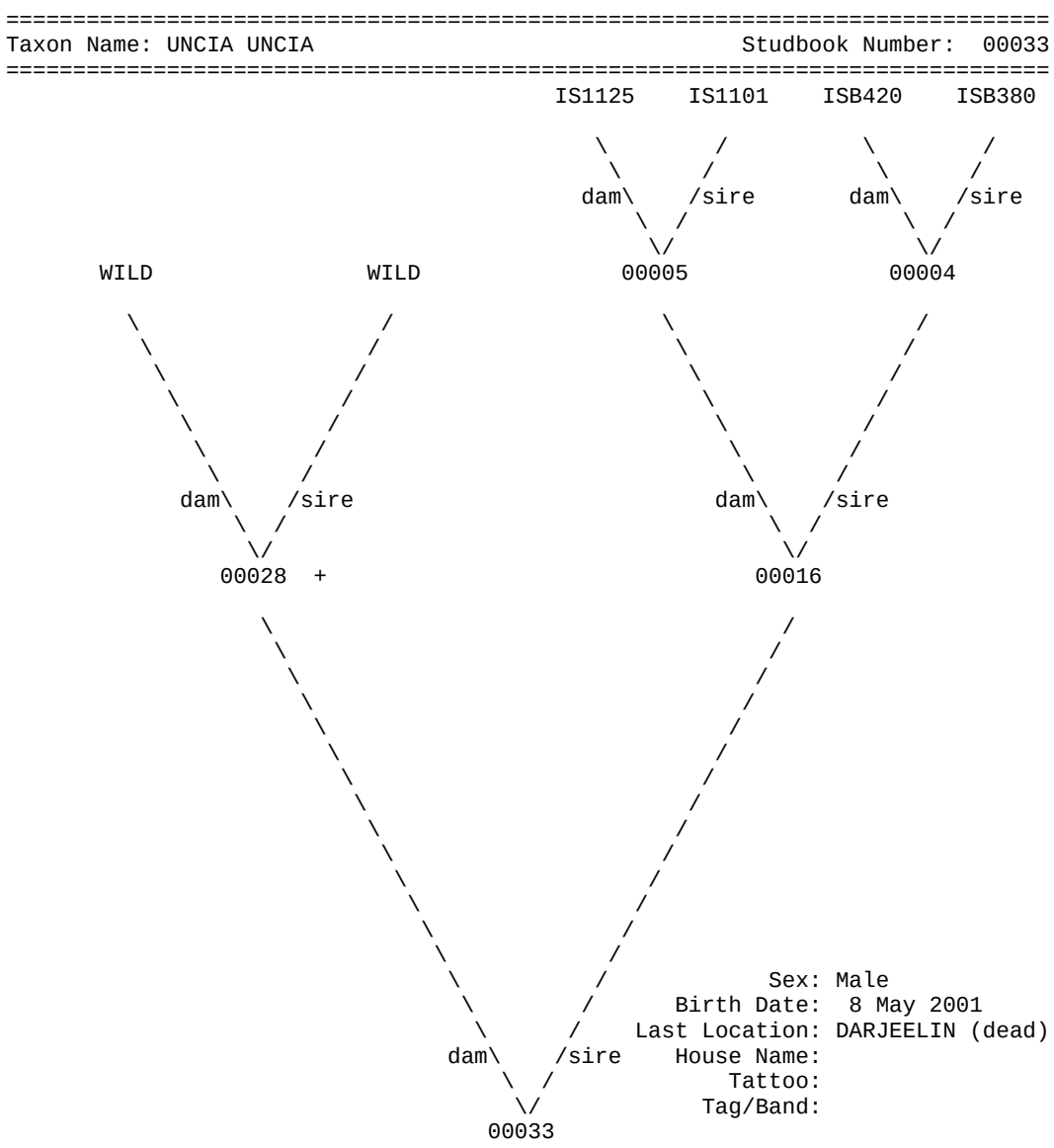
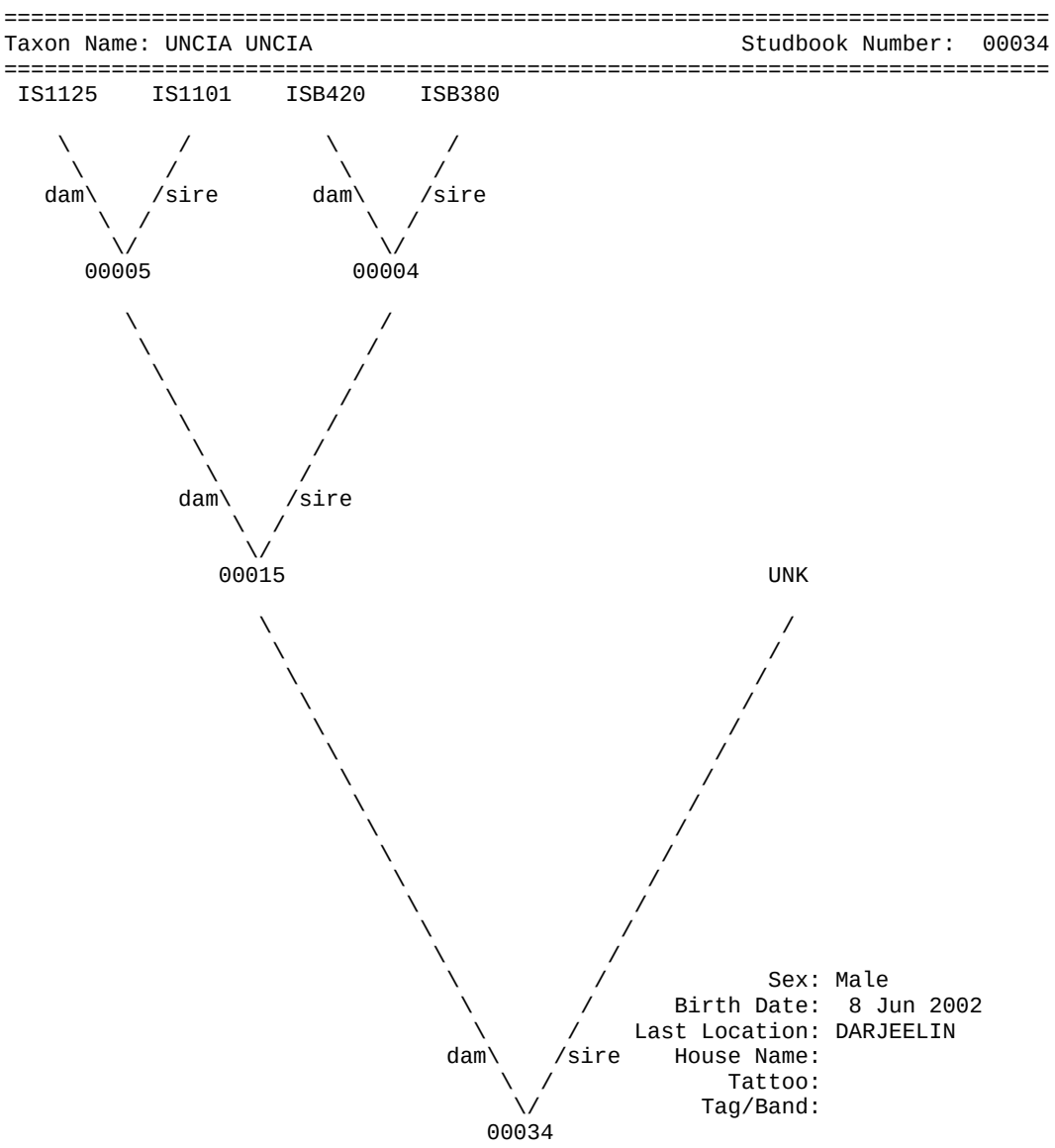
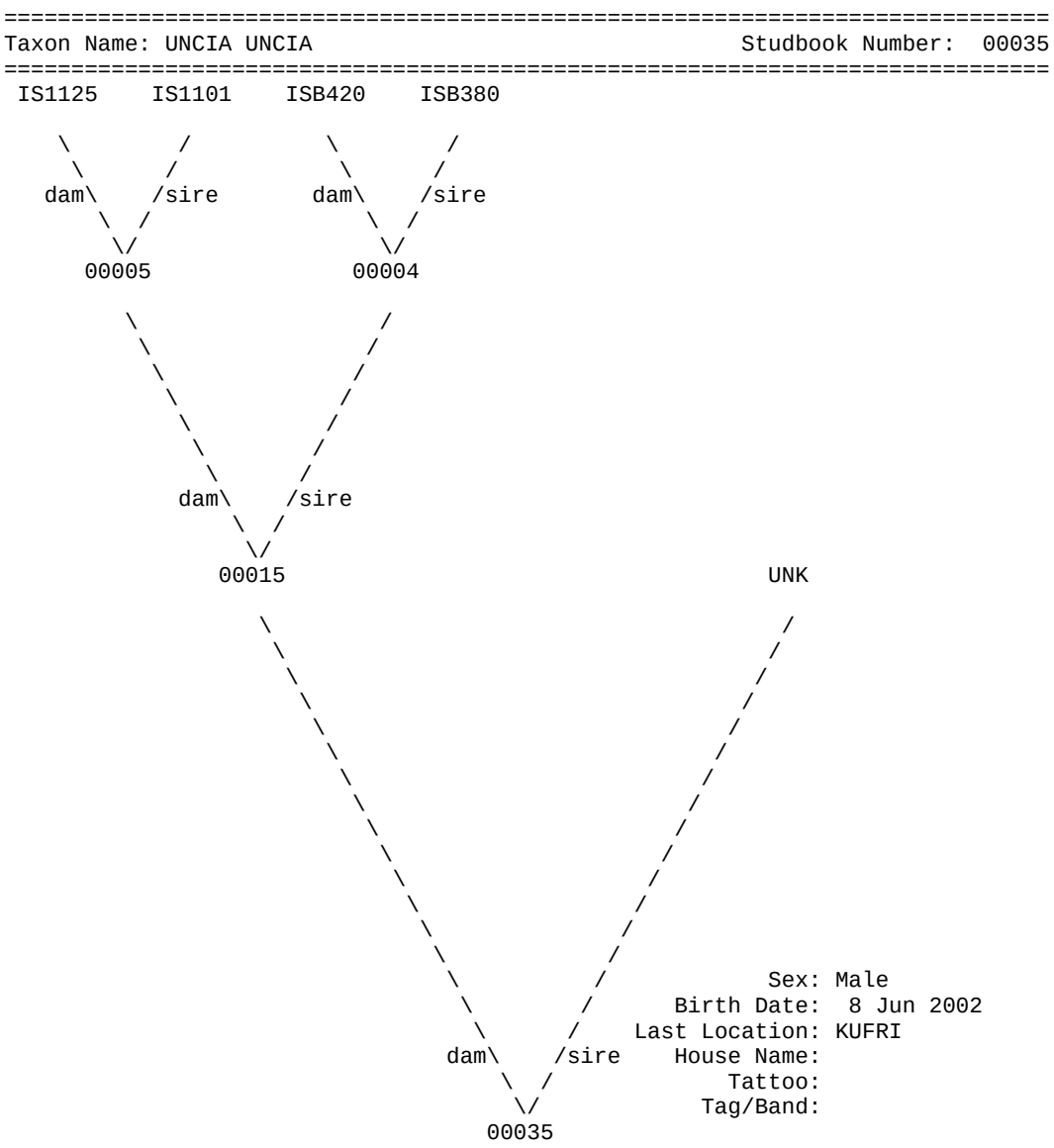
00014
00031
Sex: Female
Birth Date: 18 Mar 2001
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band:

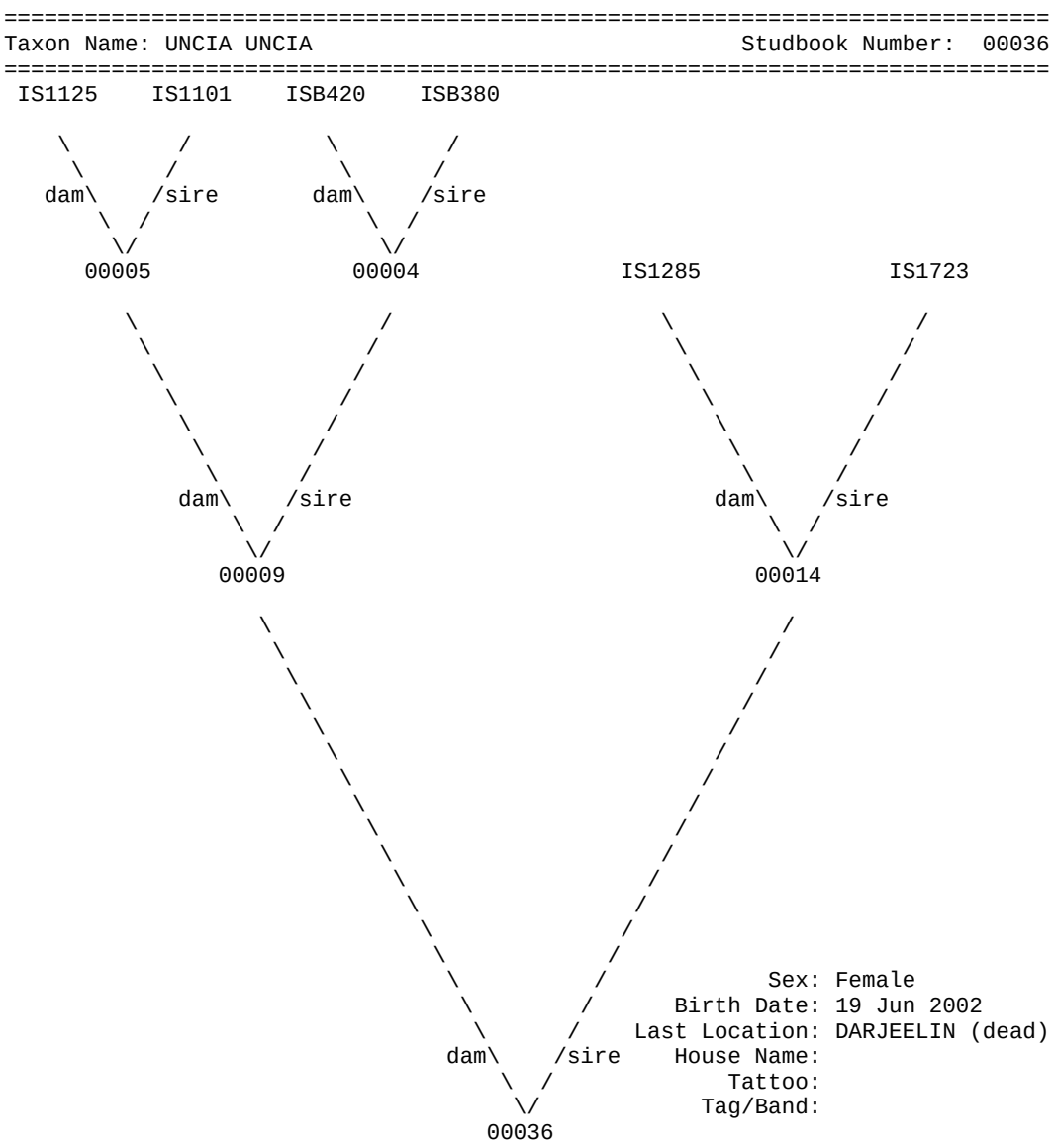

Taxon Name: UNCIA UNCIA
Studbook Number: 00032
IS1125
IS1101
ISB420
ISB380
dam
/sire
dam
/sire
00005
00004
dam
/sire
00009
UNK
Sex: Male
Birth Date: 18 Mar 2001
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band:
dam
/sire
00032

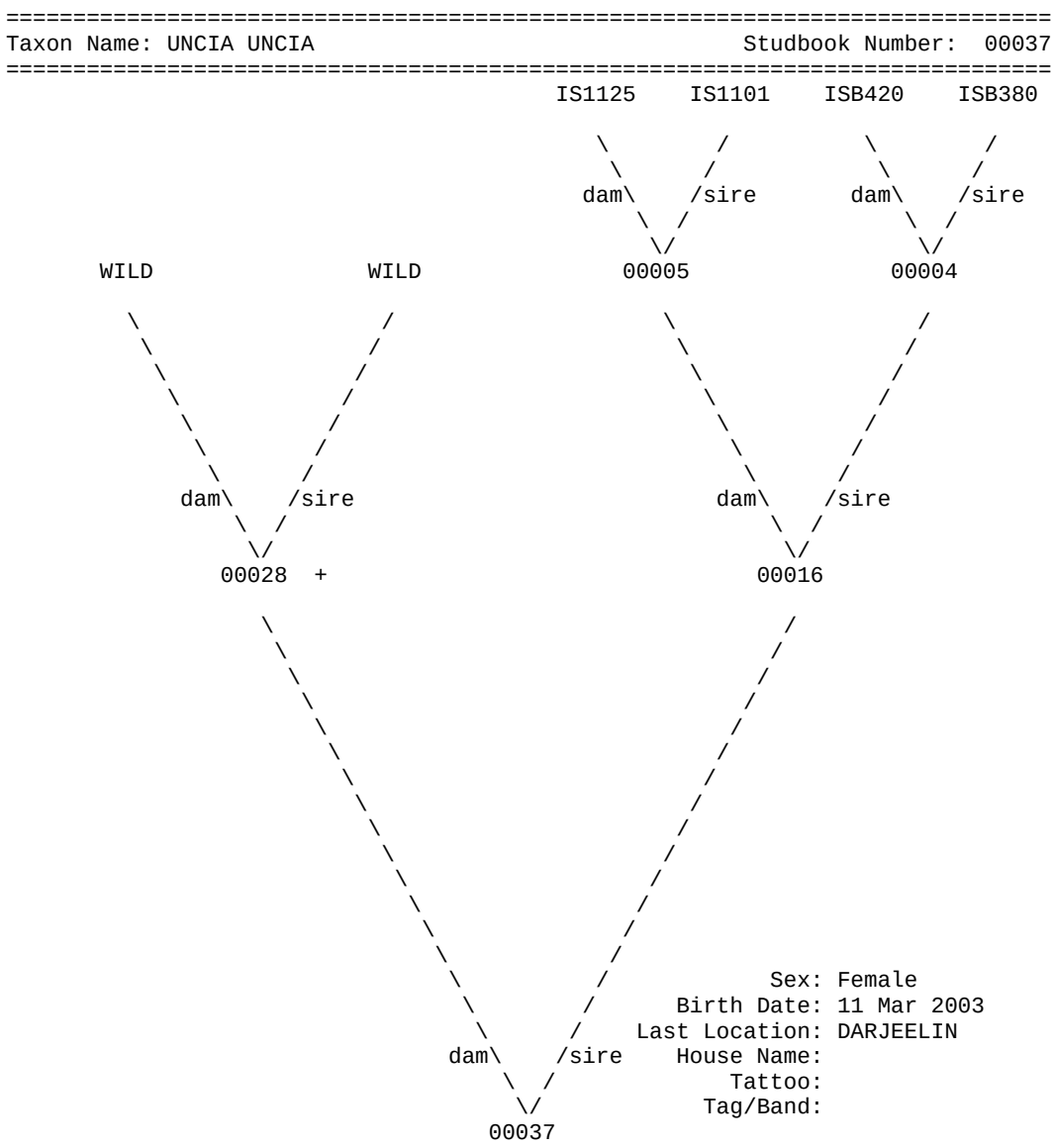

Taxon Name: UNCIA UNCIA
Studbook Number: 00033
IS1125
IS1101
ISB420
ISB380
dam
sire
dam
sire
WILD
WILD
00005
00004
dam
sire
dam
sire
00028 +
00016
Sex: Male
Birth Date: 8 May 2001
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band:
dam
sire
00033

+ Wild-caught...

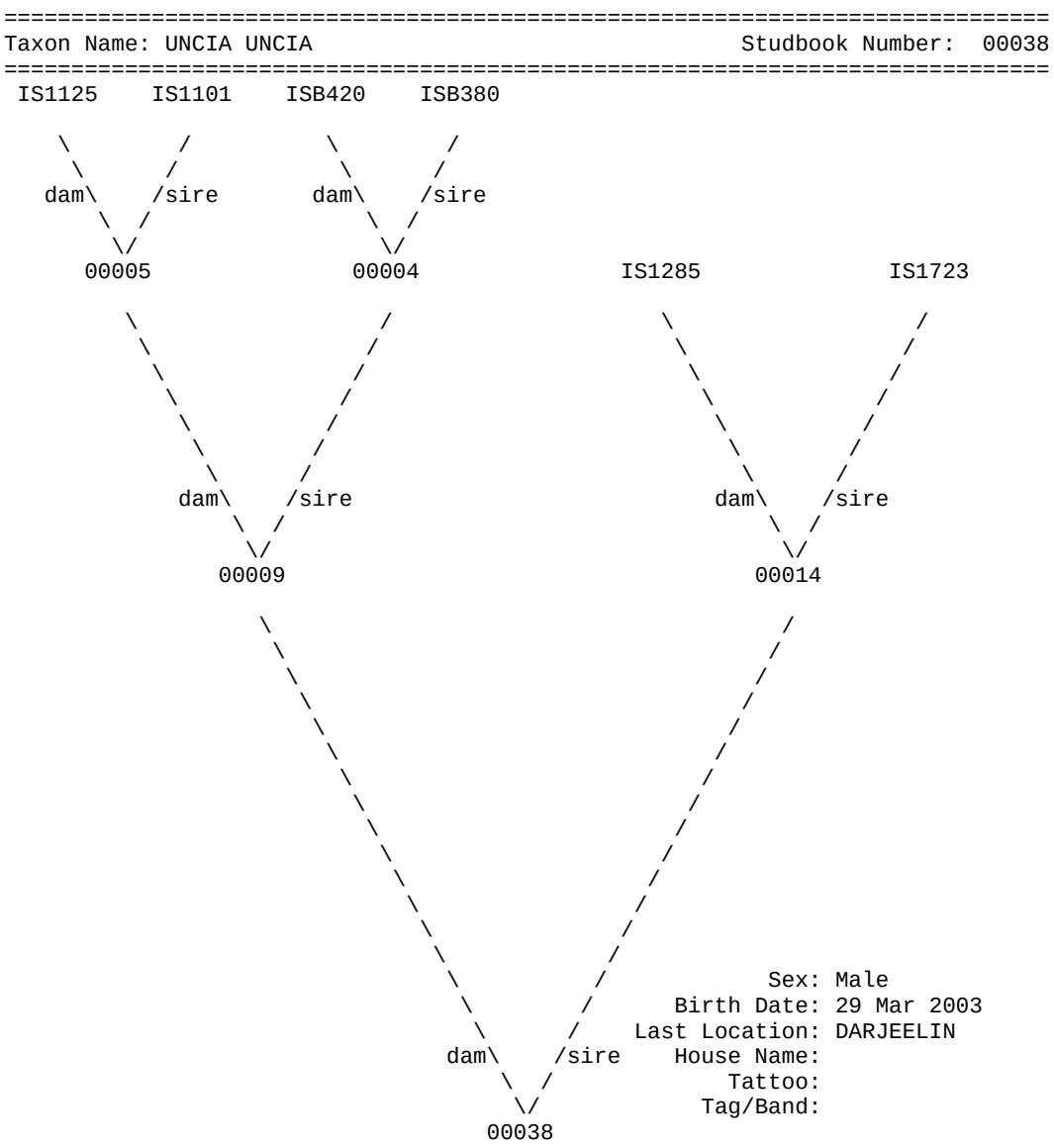

Taxon Name: UNCIA UNCIA
Studbook Number: 00034
IS1125
IS1101
ISB420
ISB380
dam
sire
00005
00004
00015
UNK
00034
Sex: Male
Birth Date: 8 Jun 2002
Last Location: DARJEELIN
House Name:
Tattoo:
Tag/Band:

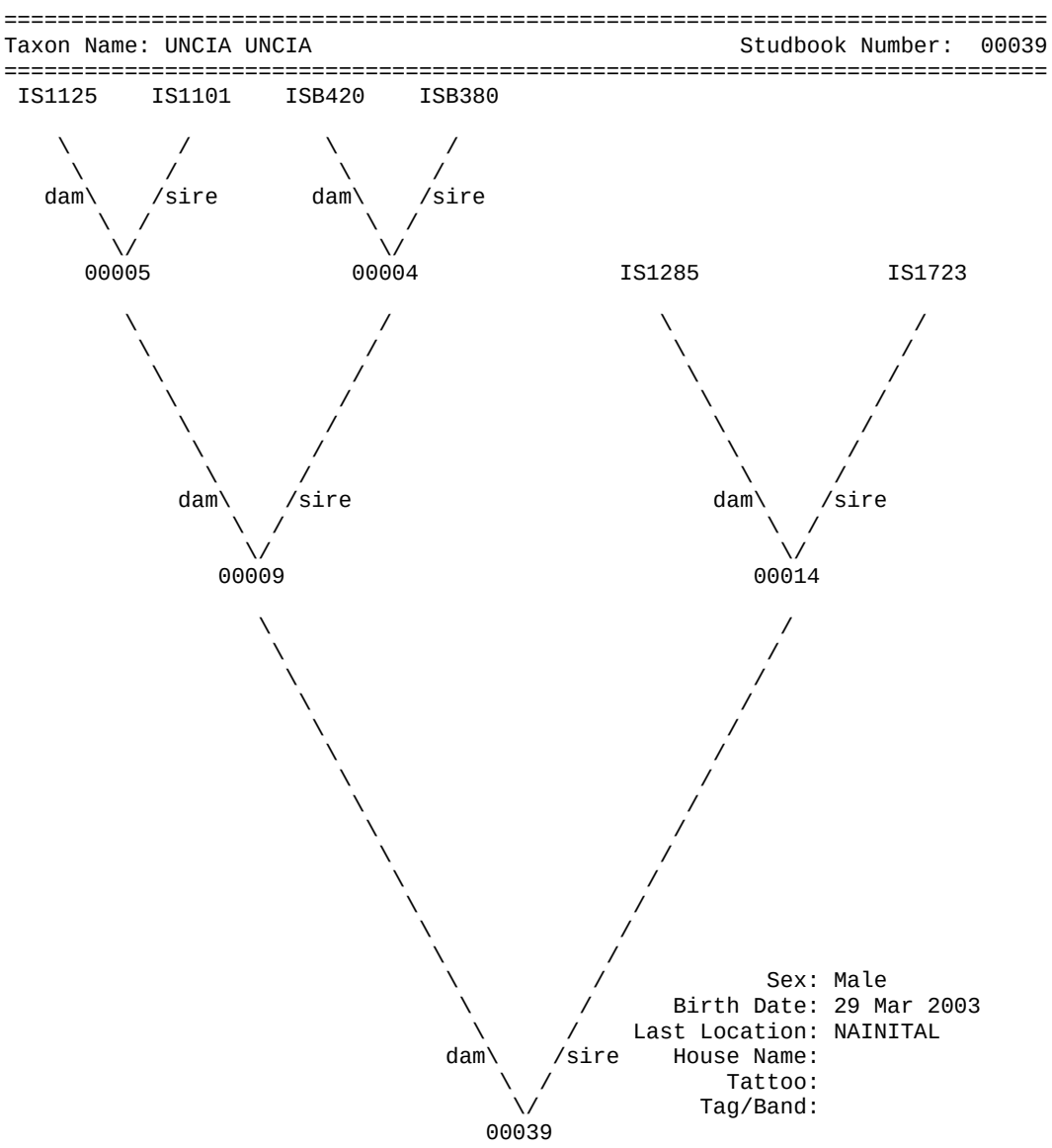

Taxon Name: UNCIA UNCIA
Studbook Number: 00035
IS1125
IS1101
ISB420
ISB380
dam
sire
00005
00004
00015
UNK
Sex: Male
Birth Date: 8 Jun 2002
Last Location: KUFRI
House Name:
Tattoo:
Tag/Band:
00035

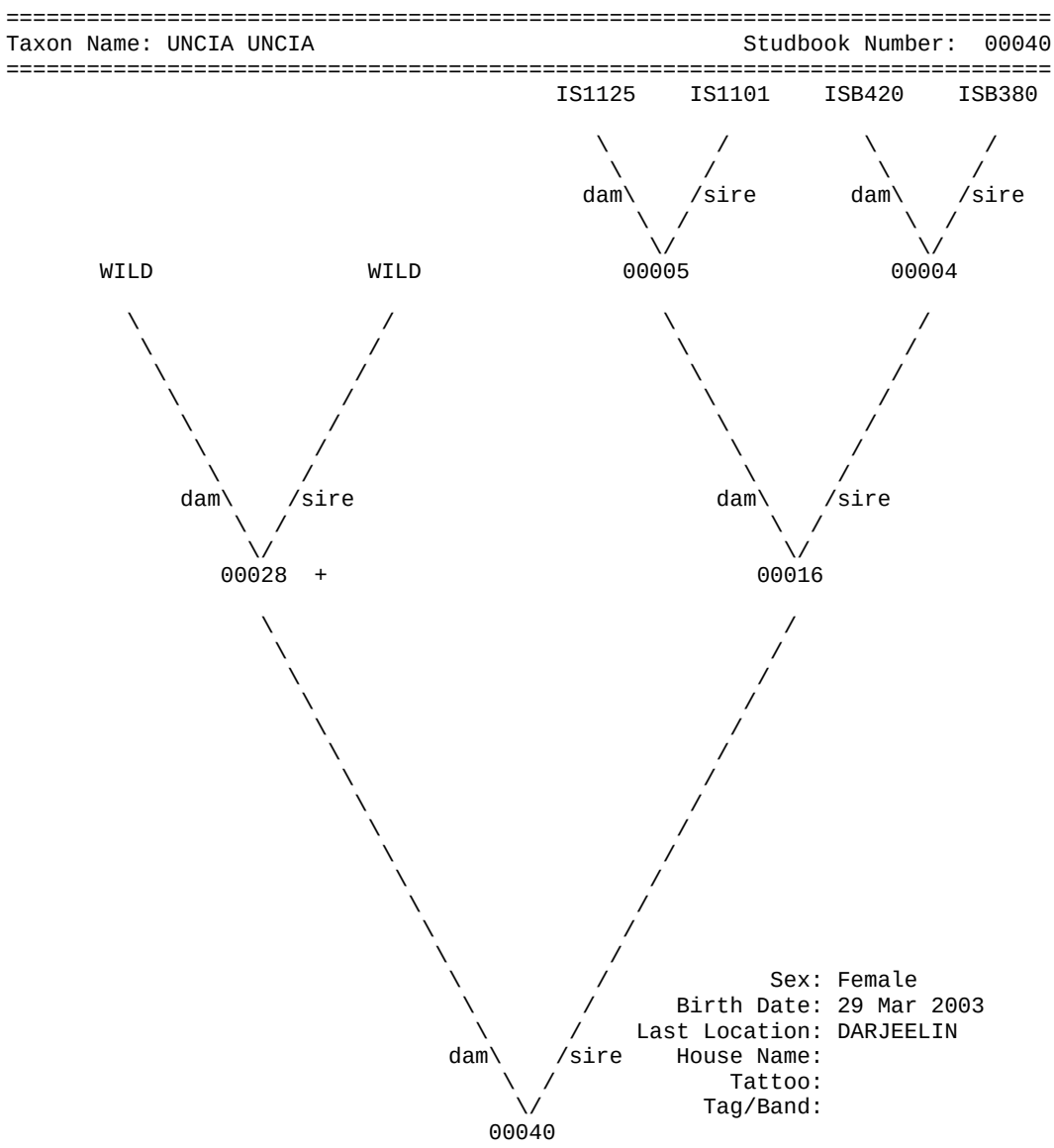

Taxon Name: UNCIA UNCIA
Studbook Number: 00036
IS1125
IS1101
ISB420
ISB380
dam
sire
00005
00004
IS1285
IS1723
00009
00014
00036
Sex: Female
Birth Date: 19 Jun 2002
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band:


Taxon Name: UNCIA UNCIA
Studbook Number: 00037
IS1125
IS1101
ISB420
ISB380
dam
sire
dam
sire
WILD
WILD
00005
00004
dam
sire
dam
sire
00028 +
00016
Sex: Female
Birth Date: 11 Mar 2003
Last Location: DARJEELIN
House Name:
Tattoo:
Tag/Band:
dam
sire
00037

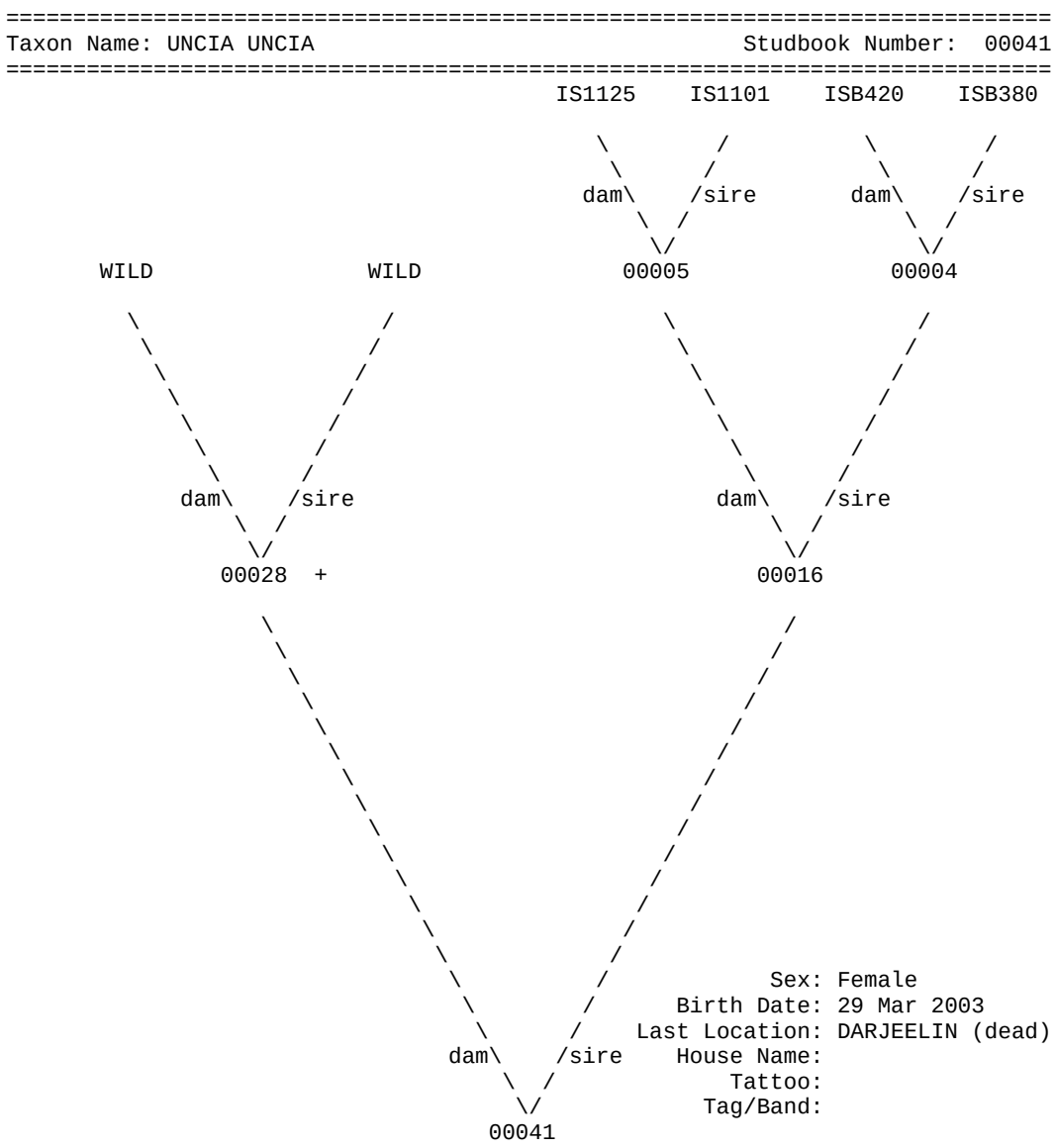
+ Wild-caught...


Taxon Name: UNCIA UNCIA
Studbook Number: 00038
IS1125
IS1101
ISB420
ISB380
dam
sire
00005
00004
IS1285
IS1723
00009
00014
00038
Sex: Male
Birth Date: 29 Mar 2003
Last Location: DARJEELIN
House Name:
Tattoo:
Tag/Band:

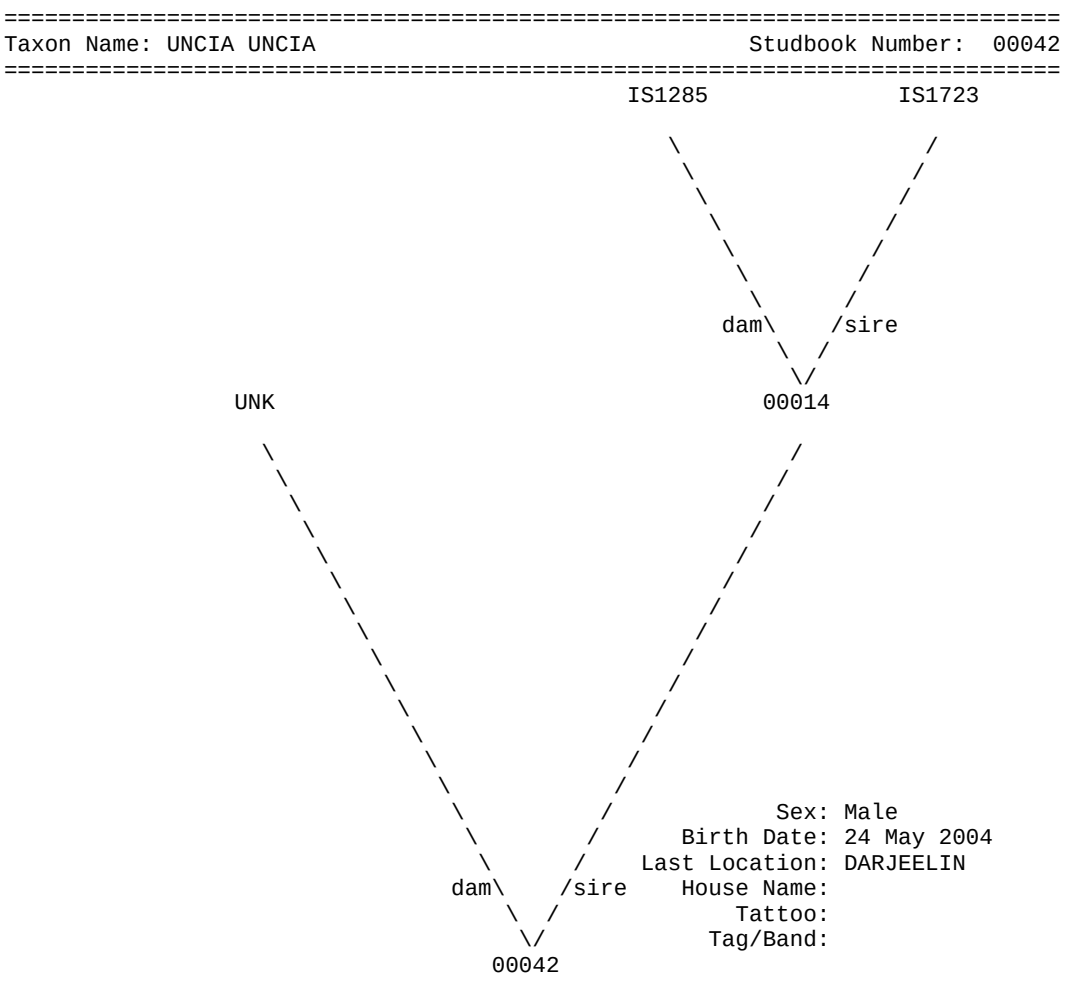

Taxon Name: UNCIA UNCIA
Studbook Number: 00039
IS1125
IS1101
ISB420
ISB380
dam
sire
00005
00004
IS1285
IS1723
00009
00014
00039
Sex: Male
Birth Date: 29 Mar 2003
Last Location: NAINITAL
House Name:
Tattoo:
Tag/Band:

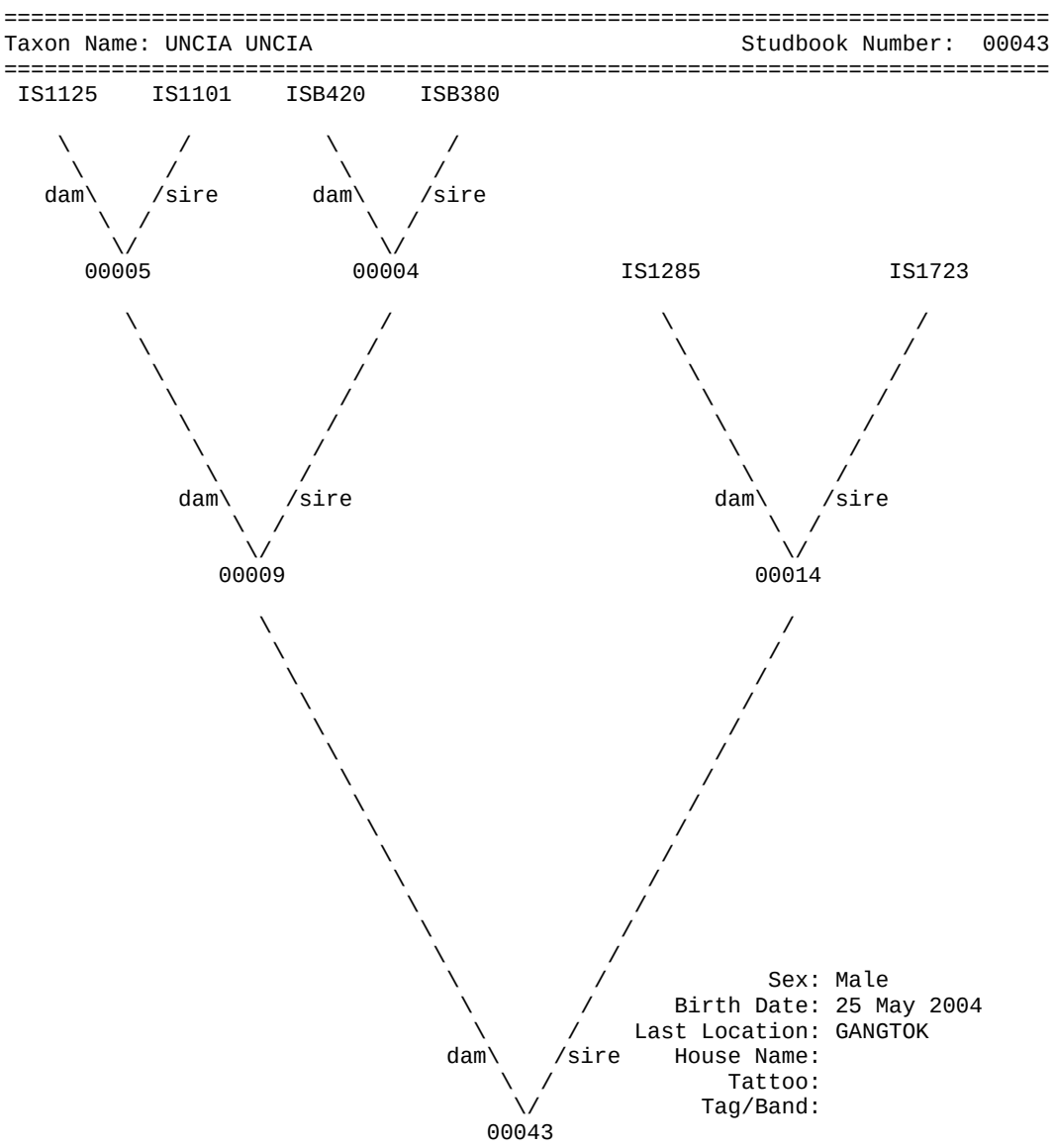

Taxon Name: UNCIA UNCIA
Studbook Number: 00040
IS1125
IS1101
ISB420
ISB380
dam
sire
dam
sire
WILD
WILD
00005
00004
dam
sire
dam
sire
00028 +
00016
Sex: Female
Birth Date: 29 Mar 2003
Last Location: DARJEELIN
House Name:
Tattoo:
Tag/Band:
dam
sire
00040

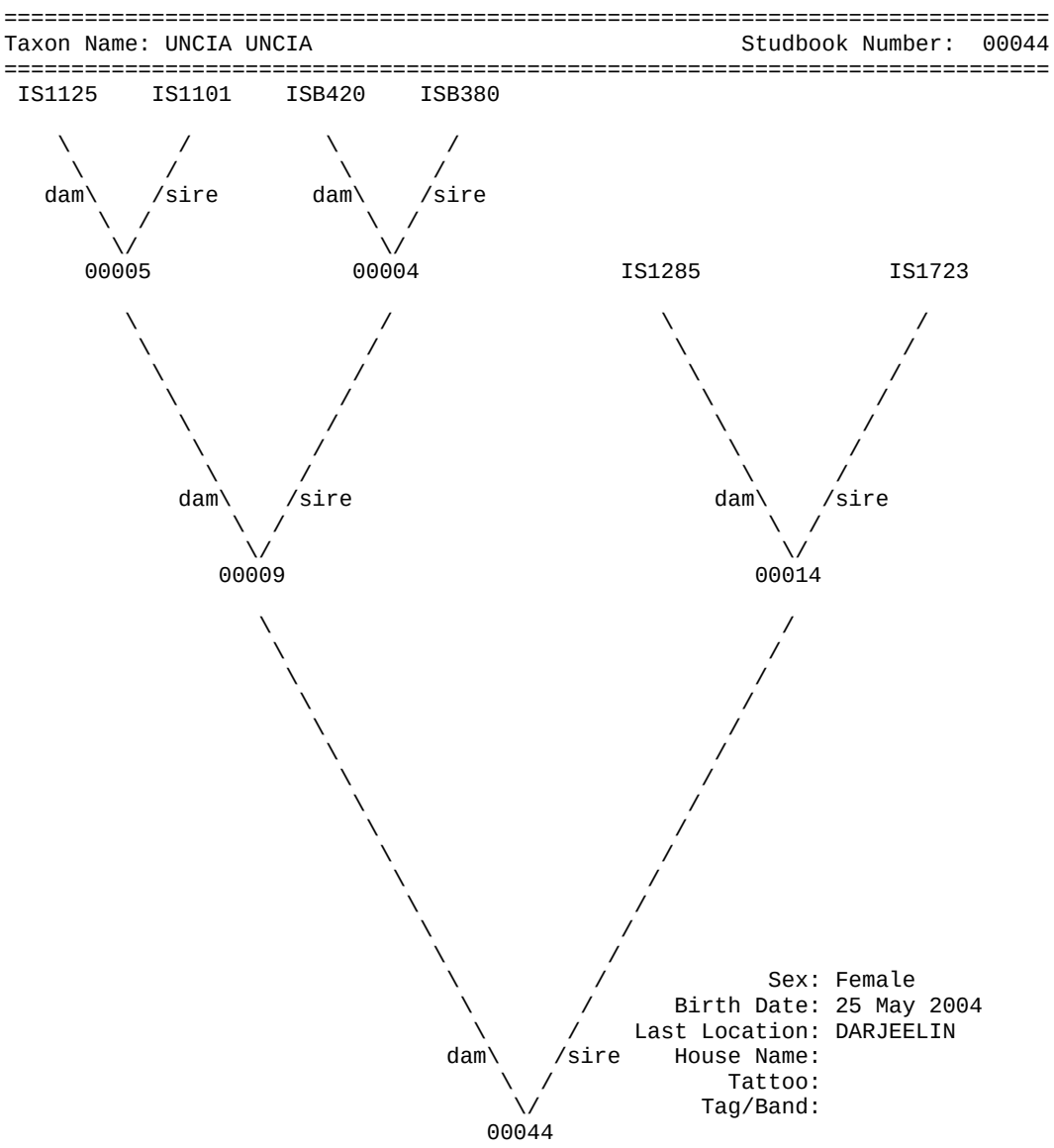
+ Wild-caught...

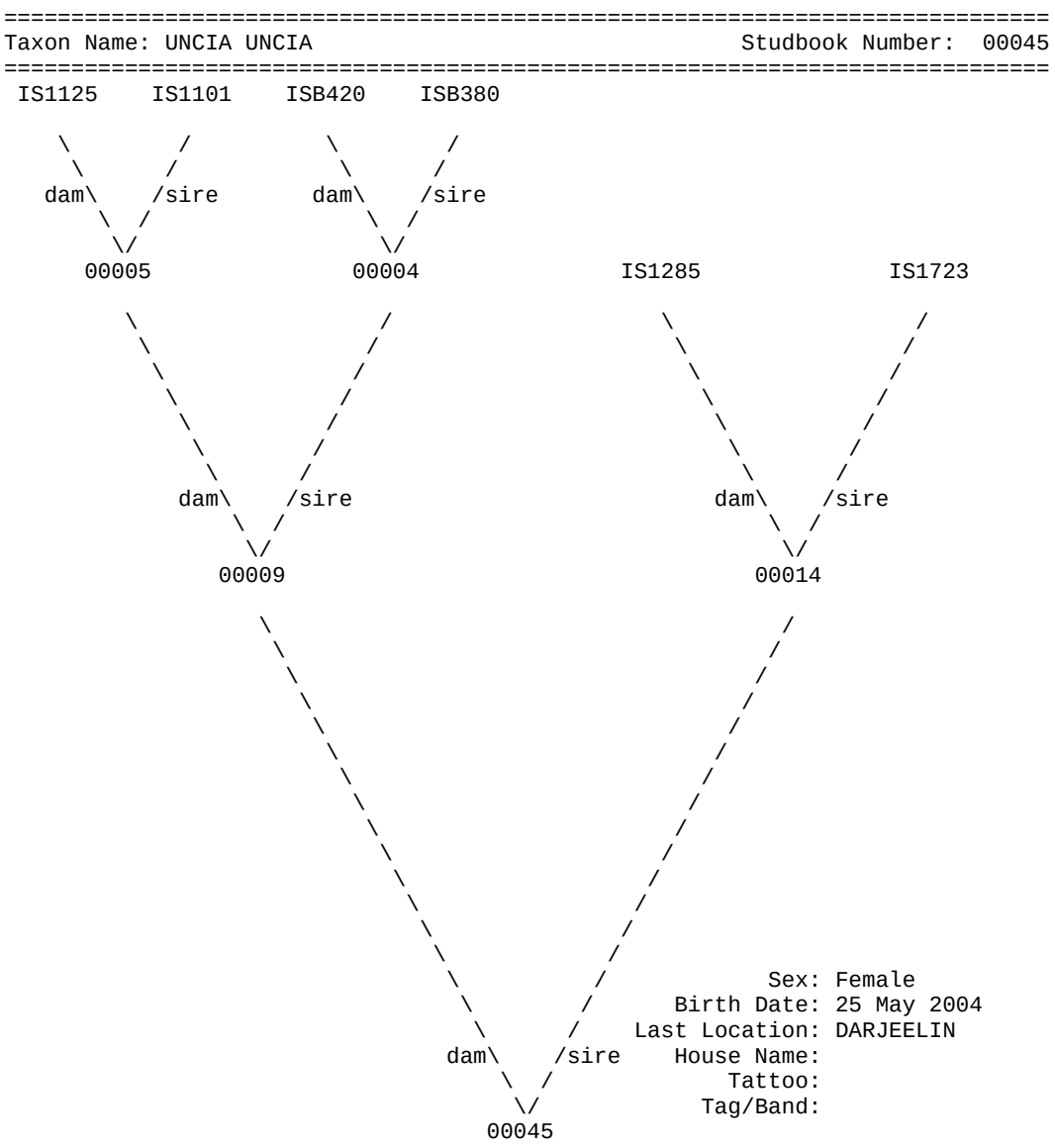

Taxon Name: UNCIA UNCIA
Studbook Number: 00041
IS1125
IS1101
ISB420
ISB380
dam
sire
dam
sire
WILD
WILD
00005
00004
dam
sire
dam
sire
00028 +
00016
Sex: Female
Birth Date: 29 Mar 2003
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band:
dam
sire
00041

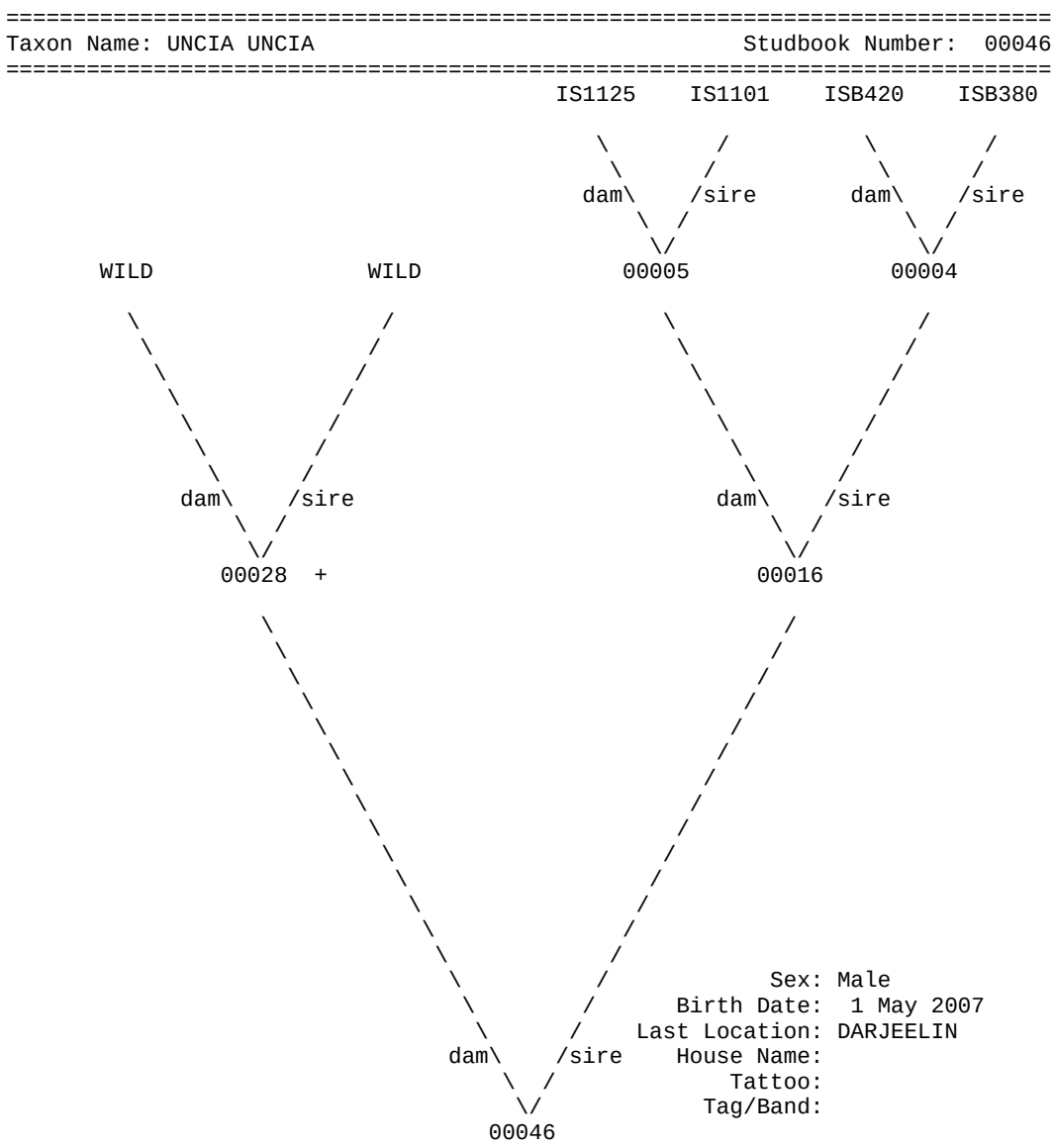
+ Wild-caught...


Taxon Name: UNCIA UNCIA
Studbook Number: 00042
IS1285
IS1723
dam
sire
00014
UNK
dam
sire
00042
Sex: Male
Birth Date: 24 May 2004
Last Location: DARJEELIN
House Name:
Tattoo:
Tag/Band:

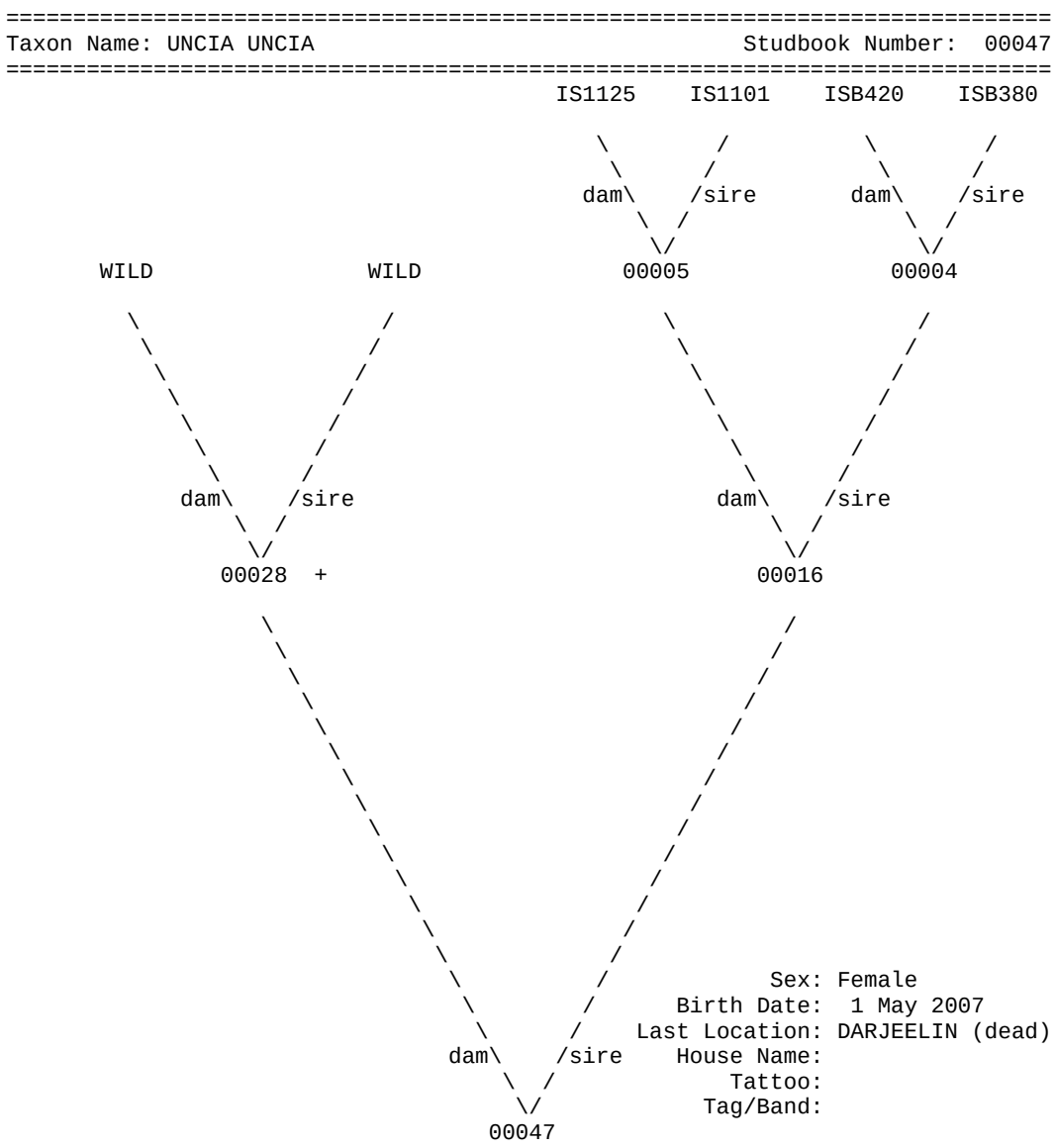

Taxon Name: UNCIA UNCIA
Studbook Number: 00043
IS1125
IS1101
ISB420
ISB380
dam
sire
00005
00004
IS1285
IS1723
00009
00014
00043
Sex: Male
Birth Date: 25 May 2004
Last Location: GANGTOK
House Name:
Tattoo:
Tag/Band:


Taxon Name: UNCIA UNCIA
Studbook Number: 00044
IS1125
IS1101
ISB420
ISB380
dam
sire
00005
00004
IS1285
IS1723
00009
00014
00044
Sex: Female
Birth Date: 25 May 2004
Last Location: DARJEELIN
House Name:
Tattoo:
Tag/Band:

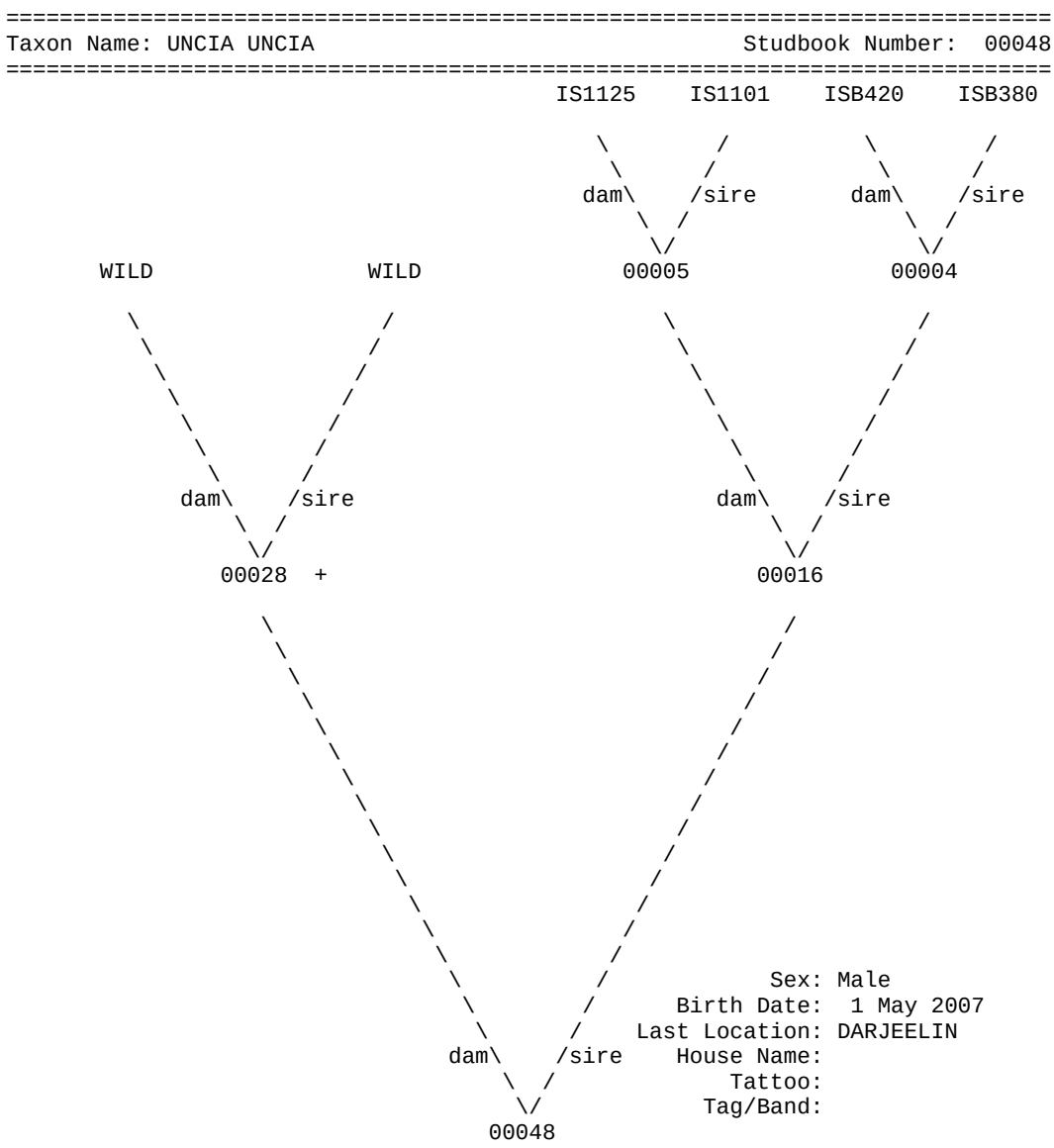

Taxon Name: UNCIA UNCIA
Studbook Number: 00045
IS1125
IS1101
ISB420
ISB380
dam
/sire
dam
/sire
00005
00004
IS1285
IS1723
dam
/sire
dam
/sire
00009
00014
dam
/sire
00045
Sex: Female
Birth Date: 25 May 2004
Last Location: DARJEELIN
House Name:
Tattoo:
Tag/Band:


Taxon Name: UNCIA UNCIA
Studbook Number: 00046
IS1125
IS1101
ISB420
ISB380
dam
sire
dam
sire
WILD
WILD
00005
00004
dam
sire
dam
sire
00028 +
00016
Sex: Male
Birth Date: 1 May 2007
Last Location: DARJEELIN
House Name:
Tattoo:
Tag/Band:
dam
sire
00046

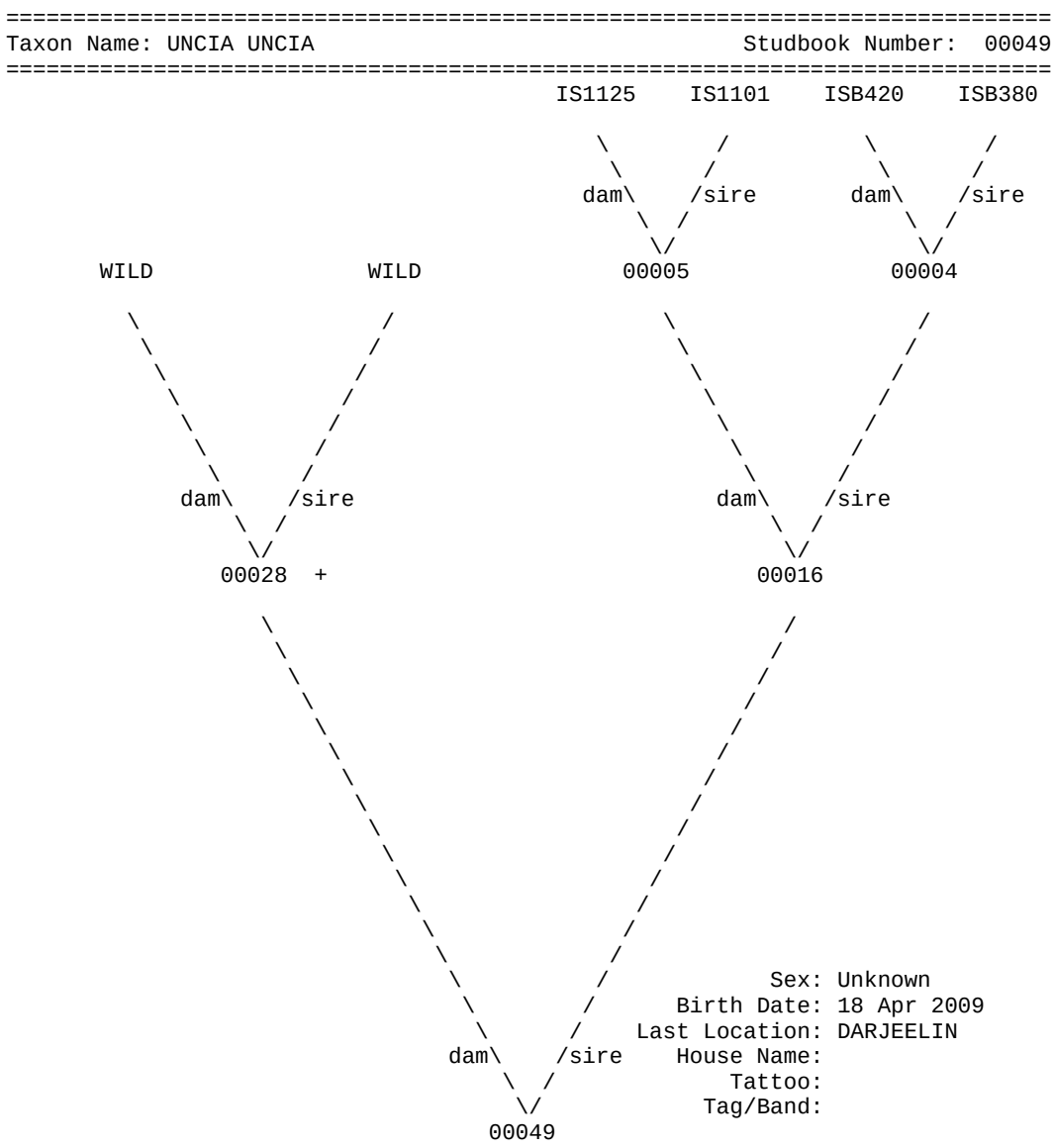
+ Wild-caught...


Taxon Name: UNCIA UNCIA
Studbook Number: 00047
IS1125
IS1101
ISB420
ISB380
dam
sire
dam
sire
WILD
WILD
00005
00004
dam
sire
dam
sire
00028 +
00016
Sex: Female
Birth Date: 1 May 2007
Last Location: DARJEELIN (dead)
House Name:
Tattoo:
Tag/Band:
dam
sire
00047

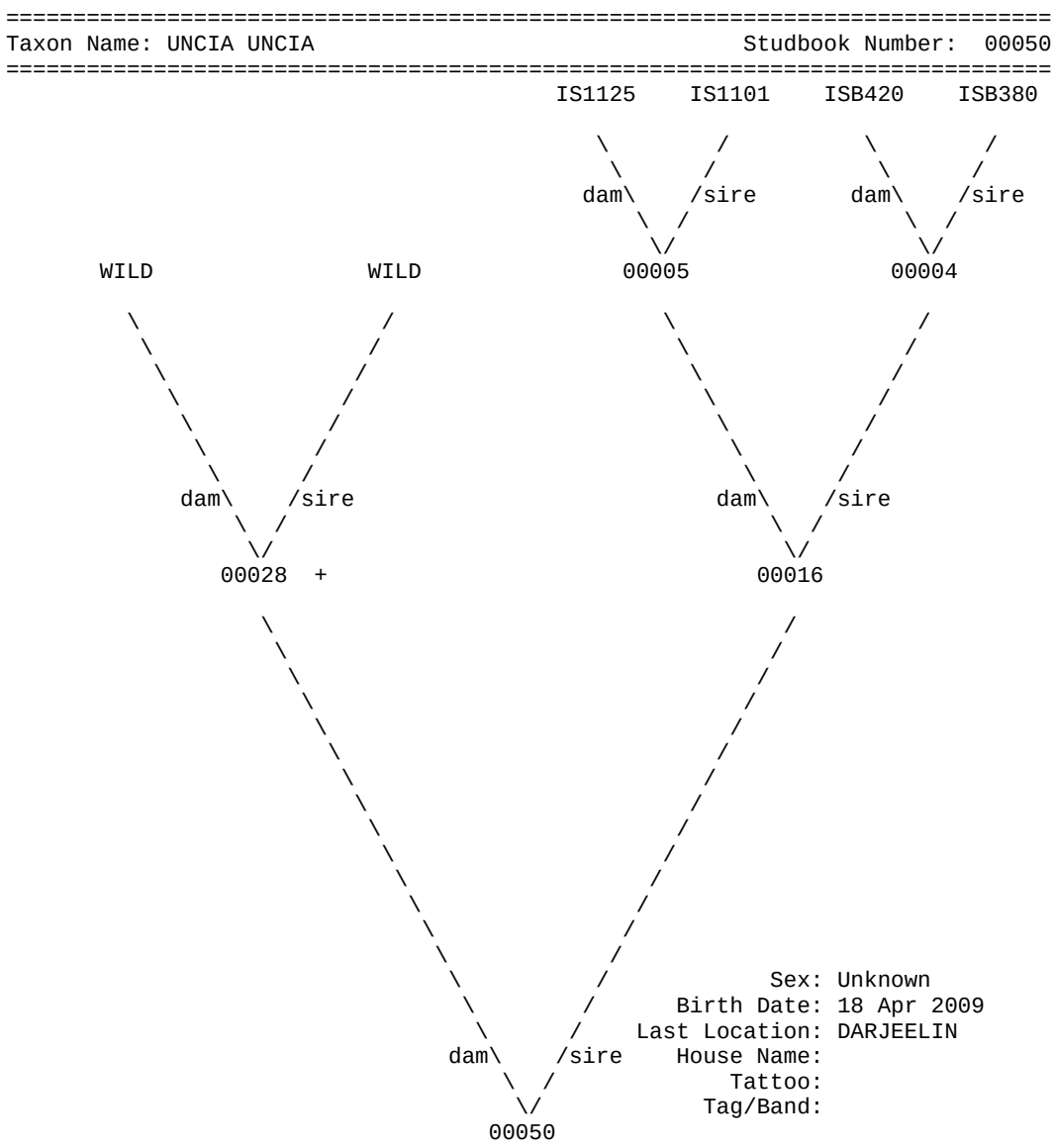
+ Wild-caught...


Taxon Name: UNCIA UNCIA
Studbook Number: 00048
IS1125
IS1101
ISB420
ISB380
dam
sire
dam
sire
WILD
WILD
00005
00004
dam
sire
dam
sire
00028 +
00016
Sex: Male
Birth Date: 1 May 2007
Last Location: DARJEELIN
House Name:
Tattoo:
Tag/Band:
dam
sire
00048

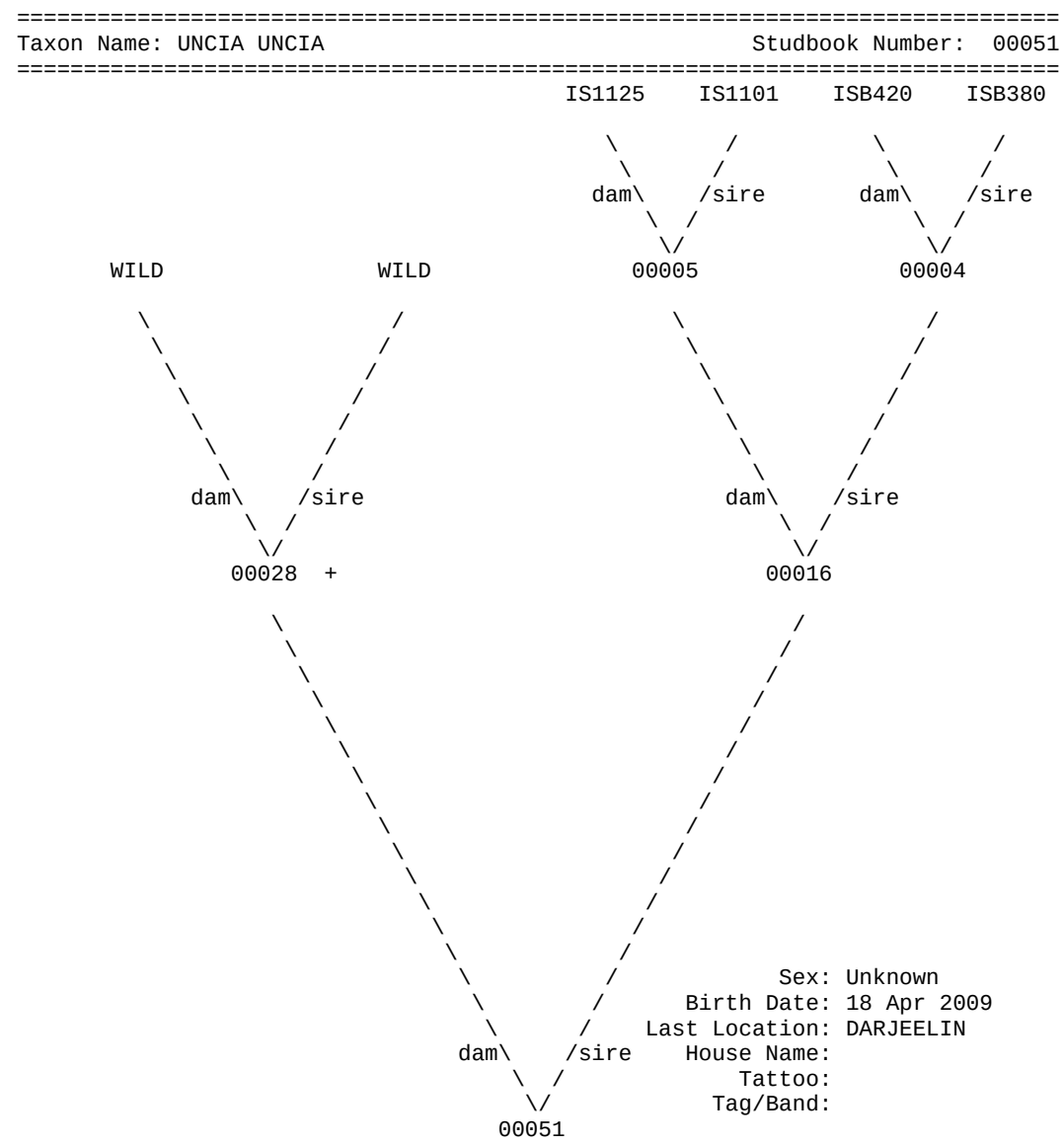
+ Wild-caught...


Taxon Name: UNCIA UNCIA
Studbook Number: 00049
IS1125
IS1101
ISB420
ISB380
dam
sire
dam
sire
WILD
WILD
00005
00004
dam
sire
dam
sire
00028 +
00016
dam
sire
00049
Sex: Unknown
Birth Date: 18 Apr 2009
Last Location: DARJEELIN
House Name:
Tattoo:
Tag/Band:

+ Wild-caught...


Taxon Name: UNCIA UNCIA
Studbook Number: 00050
IS1125
IS1101
ISB420
ISB380
dam
sire
dam
sire
WILD
WILD
00005
00004
dam
sire
dam
sire
00028 +
00016
dam
sire
00050
Sex: Unknown
Birth Date: 18 Apr 2009
Last Location: DARJEELIN
House Name:
Tattoo:
Tag/Band:

+ Wild-caught...



+ Wild-caught...

Compiled by: Anupam Srivastav thru Wildlife Institute of India
Data current thru: 31 Jul 2009 Indian Regional
Printed on 12 Aug 2009 using Sparks v1.54