National Studbook of Indian Wild Ass (*Equus hemionus khur*)

Data current till July 31st 2008

Studbook compiled and analysed by

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Acknowledgements

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Indian Wild Ass: Biology and Status

Taxonomy

The taxonomy of asian wild asses is still to be completely deciphered. It is however, widely accepted from morphological, chromosomal and mitochondrial DNA studies six geographically isolated subspecies of asian wild asses are recognised, namely:

1. Syrian Wild Ass (*Equus hemionus hemippus*)
2. Iranian Wild Ass (*Equus hemionus onager*)
3. Trans-caspian Wild Ass (*Equus hemionus kulan/finschii*)
4. Mongolian Wild Ass (*Equus hemionus hemionus/ dzigettai*) (from northern Mongolia)
5. Southern Mongolia and northern China Wild Ass (*Equus hemionus luteus*)
6. Indian Wild Ass (*Equus hemionus khur*)

Of the six subspecies the *Equus hemionus hemippus* is considered extinct since 1927. The holotype of *Equus hemionus*, described by Pallas in 1775, was based on a specimen collected close to the northeastern boundary of Mongolia

Kingdom:	Animalia
Phylum:	Chordata
Class:	Mammalia
Order:	Perissodactyla
Family:	Equidae
Scientific Name:	*Equus hemionus* ssp. *Khur*
Infra-specific Authority:	(Lesson, 1827)
Common Name/s:	Indian wild ass, Khur, *Ghorkhar* or *Ghorkhad* (Gujarati)

Distribution

The subspecies khur was once widely distributed across the arid region of north-west India (Including present day Pakistan) and westwards through much of central Asia towards Syria. However, the range is now restricted to the Little Rann of Kutch (Wild Ass Sanctuary) in Gujarat and in adjoining districts. Surveys conducted Shah 1993 show the emigration from the Sanctuary into adjoining areas that are interspersed with fallow and saline lands in Surendranagar, a breeding herd
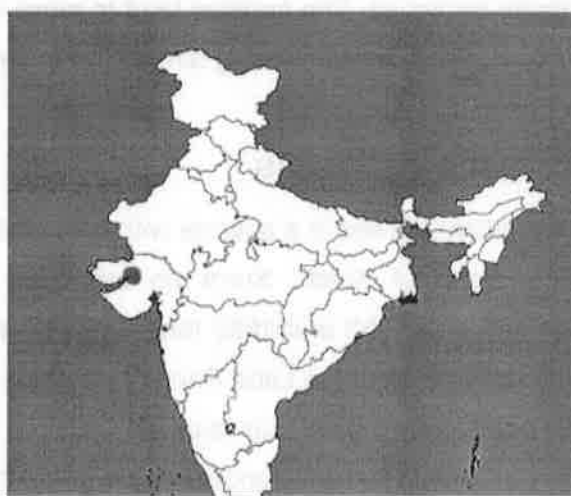
Map Source: http://www.wii.gov.in/envis/ungulates ofindia/indian_wild.htm

was also recorded in the north-eastern part of the Nal Sarovar Bird Sanctuary.

Biology

Generalist herbivores, equids are hindgut fermenters, *i.e.* they effectively utilize coarse plants. Water availability restricts equids' ranges, as they have large water requirements. The activity pattern of the khur remains consistent throughout the year. Annual time budget of family bands suggest that they spend 28%, and all-male herds 24% of the daytime feeding. In winters, less time is spent in feeding during the day, as they raid agricultural fields by night. Wild asses in the Little Rann of Kutch are active during the night, to maximise resource utilization at the natural vegetation-agriculture interface. In the Wild Ass Sanctuary Khur occupy the saline mudflats, grassland, Bets (vegetated islands on the barren Rann), and the fringes where natural vegetation is interspersed with croplands. An introduced exotic shrub *Prosopis juliflora* dominates the scrubland. Scrubland with low to medium density of shrubs and Rann grassland were the most preferred habitat, providing thermal cover during the hot day, and foaling ground for gravid mares.

Behaviour

Studies on social organization and behavioural ecology of the Indian wild ass (*Equus hemionus khur*) suggest that breeding is a seasonal activity (Monsoon). During the breeding season males depending on their dominance hierarchy protect territories, males higher up in the hierarchy tend to have better habitat conditions in their territories while subordinate males are relegated to inferior territories. The females tend to move between territories and select mates with the best territory. Females with young tend to live in small groups of 2 – 5 adults.

Threats & Status

The Indian wild ass is a species with a small distribution range restricted to the salt desert in the Little Rann of Kutch. Surra an arthropod transmitted protozoan disease devastated the population in 1958 and 1960 this coupled with drought reduced the population to 720 in 1976. The declaration of the Little Rann of Kutch as a wildlife sanctuary in 1973 led to the recovery of the population to 2839 individuals in 1999.

The species is currently under severe threat from anthropogenic activities. The area has a large reserve of table salt and its extraction is a serious threat to the habitat of the wild ass. The construction of the Sardar Sarovar Dam in Madhya Pradesh has led to an improvement in irrigation facilities in the area. This is threatening to alter the fragile landscape of the area.

Due to the various threats faced by it E. h. khur Indian wild ass has been listed as **EN** Endangered B1ab(iii,v)C2a(ii) by the IUCN Red List and in Schedule I of the Wildlife Protection Act (1972)

Conservation Measures

As of March 2008, there were 15 (8:7) khur in captivity in four Indian zoos of which Sakkar Baugh Zoo (Gujarat) have Thirteen (8:5). The only captive breeding khur population is based in Sakkar Baugh Zoo. The rest of the zoos have only solitary individuals. In view of this the Central Zoo Authority, an Autonomous Organization under the Ministry of Environment and Forests, Government of India has initiated a conservation breeding programme for the species.

Bibliography

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3. Shah, N. 2004. Indian Wild Ass or Khur (*Equus hemionus khur* Pallas, 1775). Pp. 115-124. in K. Shankar and S.P. Goyal (Eds.) Ungulates of India. ENVIS Bulletin: Wildlife and Protected Areas, Vol. 07, No. 1. Wildlife Institute of India, Dehradun India. Pp 448.

Methods Used

The data collected for the compilation of the studbook by was way of field visits to collect the data from the concerned zoos and 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 imported in poplink 1.3 and ~.prn and ~.ped files were created from this dataset 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.

For the purpose of genetic and demographic analysis the population present in Sakkarbaug Zoo, Junagadh only was used. The animals present in other zoos were not used for analyses as there was a conflict in dates of acquisition and identity.

Amar Stud no. 45 was attributed to be the sire for stud nos. 53 – 61. However, these stud nos. (53 – 61) are being listed as Sire Unknown as the data obtained form Sakkarbaug Zoo, Junagadh Shows that Amar was transferred to Kamala Nehru Zoological Garden, Ahmedabad on 24.02.1989 and hence could not have sired any of the offspring attributed to it. Attempts will be made in verifying the data from concerned institutions in removing these conflicts in future versions of the Indian Wild Ass Studbook.

Census

The captive Indian Wild Ass population originates from individuals captured/rescued from the wild. Of the 70 individuals listed in the present studbook as many as 51 individuals are of wild origin. The population was initiated in 1958 by way of capture of a male the first female entered the population in 1964. The first captive bred individual was born in 1985. The population since its inception has been unstable with a low population growth rate (lambda) which at times has dipped below 1 indicating a negative growth rate.
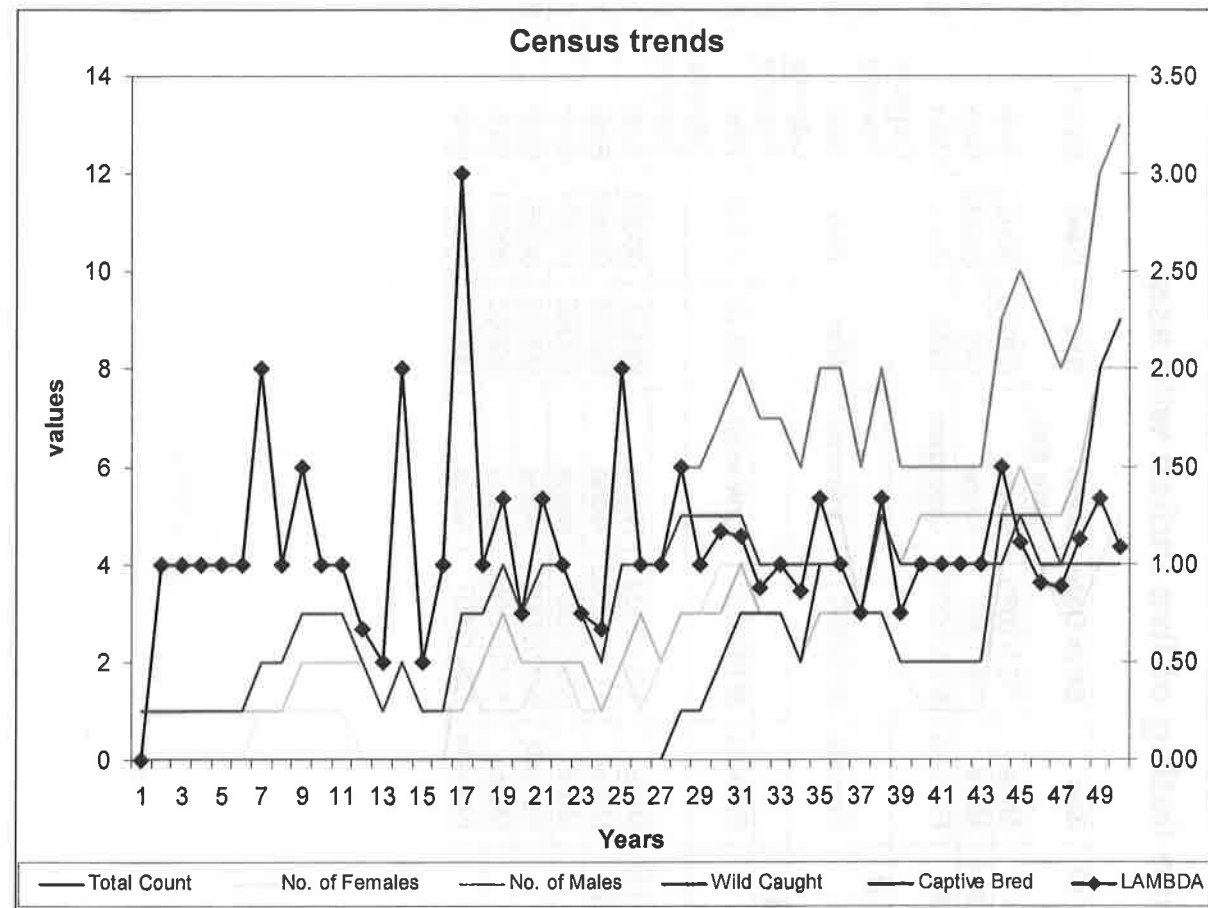
Table 1 Status of Indian Wild Ass in Indian Zoos as on 31st March 2008

Zoo Name	Male	Female	Unsexed	Total
Nehru Zoological Park, Hyderabad	0	1	0	1
Sakkarbaug Zoo, Junagadh	8	5	0	13
Arignar Anna Zoological Park, Chennai	0	1	0	1
Total	8	7	0	15

Table 2 Location wise listing of live Indian wild ass

Studbook ID	Local ID	Sex	Birth Date	Birth Date Est.	Sire	Dam	Event	Date	Location
00051	JOHN	Male	7/23/1989	None	00033	00032	Birth	7/23/1989	Junagadh
00061	RAUDRA	Male	1/5/1997	None	Unk	00032	Birth	1/5/1997	Junagadh
00062	BEGUM	Female	8/18/2001	Unknown	Wild	Wild	Wild Capture	8/18/2001	Wild Ass Sanctuary
	BEGUM						Transfer	8/18/2001	Junagadh
00063	AISHA	Female	8/18/2001	Unknown	Wild	Wild	Wild Capture	8/18/2001	Junagadh
	AISHA						Transfer	8/18/2001	Junagadh
00064	SITA	Female	8/18/2001	Unknown	WILD	WILD	Wild Capture	8/18/2001	Junagadh
	SITA						Transfer	8/18/2001	Junagadh
00065	RUSTAM	Male	1/31/2002	None	WILD	00062	Birth	1/31/2002	Junagadh
00066	ABHEE	Male	11/12/2005	None	00065	00063	Birth	11/12/2005	Junagadh
00067	67	Male	6/6/2006	None	00065	00064	Birth	6/6/2006	Junagadh
00068	68	Female	8/27/2006	None	00065	00062	Birth	8/27/2006	Junagadh
00069	69	Male	11/25/2006	None	00065	00063	Birth	11/25/2006	Junagadh
00070	70	Female	7/27/2007	None	00065	00064	Birth	7/27/2007	Junagadh

Table 3 Historical Listing of Indian Wild Ass in Indian Zoos

Studbook ID	Local ID/ Home Name	Tag No.	Sex	Birth Date	Sire	Dam	Event	Date	Location
00001	1	--	Male	1/6/1958	Wild	Wild	Wild Capture	1/6/1958	Wild Ass Sanctuary
	1	--					Transfer	1/6/1958	Junagadh
							Death	10/9/1972	Junagadh
00002	2	--	Female	5/31/1960	Wild	Wild	Wild Capture	5/31/1960	Wild Ass Sanctuary
	2	--					Transfer	5/31/1960	Junagadh
							Death	11/15/1960	Junagadh
00003	3	--	Female	11/18/1964	Wild	Wild	Wild Capture	11/18/1964	Wild Ass Sanctuary
	3	--					Transfer	11/18/1964	Junagadh
							Death	7/19/1969	Junagadh
00004	4	--	Male	12/6/1966	Wild	Wild	Wild Capture	12/6/1966	Wild Ass Sanctuary
	4	--					Transfer	12/6/1966	Junagadh
							Death	12/14/1966	Junagadh
00005	5	--	Male	12/6/1966	Wild	Wild	Wild Capture	12/6/1966	Wild Ass Sanctuary
	5	--					Transfer	12/6/1966	Junagadh
	5	--					Transfer	12/31/1970	Ahmedabad
	5	--					Go LTF	12/31/1970	Ahmedabad
00006	6	--	Female	10/30/1969	Wild	Wild	Wild Capture	10/30/1969	Wild Ass Sanctuary
	6	--					Transfer	10/30/1969	Junagadh
							Death	11/2/1969	Junagadh
00007	7	--	Female	5/25/1970	Wild	Wild	Wild Capture	5/25/1970	Wild Ass Sanctuary
	7	--					Transfer	5/25/1970	Junagadh
							Death	6/24/1970	Junagadh
00008	8	--	Female	5/30/1970	Wild	Wild	Wild Capture	5/30/1970	Wild Ass Sanctuary
	8	--					Transfer	5/30/1970	Junagadh
							Death	7/25/1970	Junagadh
00009	9	--	Female	6/23/1970	Wild	Wild	Wild Capture	6/23/1970	Wild Ass Sanctuary
	9	--					Transfer	6/23/1970	Junagadh
							Death	7/25/1970	Junagadh

Studbook ID	Local ID/ Home Name	Tag No.	Sex	Birth Date	Sire	Dam	Event	Date	Location
00010	10	--	Male	6/4/1971	Wild	Wild	Wild Capture	6/4/1971	Wild Ass Sanctuary
	10	--					Transfer	6/4/1971	Junagadh
	10	--					Transfer	1/7/1977	Ahmedabad
	10	--					Go LTF	1/7/1977	Ahmedabad
00011	11	--	Female	6/4/1971	Wild	Wild	Wild Capture	6/4/1971	Wild Ass Sanctuary
	11	--					Transfer	6/4/1971	Junagadh
		--					Death	8/7/1971	Junagadh
00012	Juliyet	--	Female	10/11/1974	Wild	Wild	Wild Capture	10/11/1974	Wild Ass Sanctuary
	Juliyet	--					Transfer	10/11/1974	Junagadh
		--					Death	9/4/1983	Junagadh
00013	13	--	Female	10/11/1974	Wild	Wild	Wild Capture	10/11/1974	Wild Ass Sanctuary
	13	--					Transfer	10/11/1974	Junagadh
		--					Death	4/22/1975	Junagadh
00014	14	--	Male	1/10/1975	Wild	Wild	Wild Capture	1/10/1975	Wild Ass Sanctuary
	14	--					Transfer	1/10/1975	Junagadh
		--					Death	3/30/1975	Junagadh
00015	15	--	Male	1/18/1975	Wild	Wild	Wild Capture	1/18/1975	Wild Ass Sanctuary
	15	--					Transfer	1/18/1975	Junagadh
	15	--					Transfer	1/7/1977	Ahmedabad
	15	--					Go LTF	1/7/1977	Ahmedabad
00016	16	--	Male	7/31/1976	Wild	Wild	Wild Capture	7/31/1976	Wild Ass Sanctuary
	16	--					Transfer	7/31/1976	Junagadh
		--					Death	8/15/1976	Junagadh
00017	17	--	Male	11/13/1976	Wild	Wild	Wild Capture	11/13/1976	Wild Ass Sanctuary
	17	--					Transfer	11/13/1976	Junagadh
		--					Death	7/16/1981	Junagadh
00018	18	--	Male	11/13/1976	Wild	Wild	Wild Capture	11/13/1976	Wild Ass Sanctuary
	18	--					Transfer	11/13/1976	Junagadh
		--					Death	12/3/1976	Junagadh
00019	19	--	Male	3/23/1977	Wild	Wild	Wild Capture	3/23/1977	Wild Ass Sanctuary

Studbook ID	Local ID/ Home Name	Tag No.	Sex	Birth Date	Sire	Dam	Event	Date	Location
	19	--					Transfer	3/23/1977	Junagadh
00020	20	--				Wild	Death	9/12/1977	Junagadh
	20	--	Unknown	8/15/1977	Wild		Wild Capture	8/15/1977	Wild Ass Sanctuary
							Transfer	8/15/1977	Junagadh
						Wild	Death	8/19/1977	Junagadh
00021	21	--	Male	10/24/1977	Wild		Wild Capture	10/24/1977	Wild Ass Sanctuary
	21	--					Transfer	10/24/1977	Junagadh
	21	--					Transfer	11/15/1977	Hyderabad
	21	--					Go LTF	11/15/1977	Hyderabad
00022	22	--	Male	10/24/1977	Wild	Wild	Wild Capture	10/24/1977	Wild Ass Sanctuary
	22	--					Transfer	10/24/1977	Junagadh
							Death	12/1/1981	Junagadh
00023	23	--	Female	1/8/1978	Wild	Wild	Wild Capture	1/8/1978	Wild Ass Sanctuary
	23	--					Transfer	1/8/1978	Junagadh
	23	--					Transfer	2/23/1978	Ahmedabad
	23	--					Go LTF	2/23/1978	Ahmedabad
00024	24	--	Female	1/8/1978	Wild	Wild	Wild Capture	1/8/1978	Wild Ass Sanctuary
	24	--					Transfer	1/8/1978	Junagadh
							Death	1/24/1980	Junagadh
00025	25	--	Female	6/1/1978	Wild	Wild	Wild Capture	6/1/1978	Wild Ass Sanctuary
	25	--					Transfer	6/1/1978	Junagadh
							Death	9/4/1978	Junagadh
00026	26	--	Male	6/1/1978	Wild	Wild	Wild Capture	6/1/1978	Wild Ass Sanctuary
	26	--					Transfer	6/1/1978	Junagadh
							Death	9/6/1978	Junagadh
00027	27	--	Male	6/1/1978	Wild	Wild	Wild Capture	6/1/1978	Wild Ass Sanctuary
	27	--					Transfer	6/1/1978	Junagadh
							Death	9/23/1978	Junagadh
00028	28	--	Female	7/3/1979	Wild	Wild	Wild Capture	7/3/1979	Wild Ass Sanctuary
	28	--					Transfer	7/3/1979	Junagadh

Studbook ID	Local ID/Home Name	Tag No.	Sex	Birth Date	Sire	Dam	Event	Date	Location
00029	29	--					Death	7/17/1979	Junagadh
	29	--	Female	12/3/1979	Wild	Wild	Wild Capture	12/3/1979	Wild Ass Sanctuary
		--					Transfer	12/3/1979	Junagadh
00030	30	--					Death	12/6/1979	Junagadh
	30	--	Male	5/1/1981	Wild	Wild	Wild Capture	5/1/1981	Wild Ass Sanctuary
	30	--					Transfer	5/1/1981	Junagadh
	30	--					Transfer	10/30/1984	Nandankan
00031	31	--					Go LTF	10/30/1984	Nandankan
	31	--	Male	6/27/1982	Wild	Wild	Wild Capture	6/27/1982	Wild Ass Sanctuary
	31	--					Transfer	6/27/1982	Junagadh
00032	Tepudi	Tag No. 12	Female	6/27/1982	Wild	Wild	Transfer	9/4/1985	Ahmedabad
	Tepudi	--					Wild Capture	6/27/1982	Wild Ass Sanctuary
		--					Transfer	6/27/1982	Junagadh
		--					Death	8/29/2004	Junagadh
00033	Halaman	--	Male	9/18/1983	Wild	Wild	Wild Capture	9/18/1983	Wild Ass Sanctuary
	Halaman	--					Transfer	9/18/1983	Junagadh
		--					Death	5/16/1989	Junagadh
00034	34	--	Male	8/18/1984	Wild	Wild	Wild Capture	8/18/1984	Wild Ass Sanctuary
	34	--					Transfer	8/18/1984	Junagadh
		--					Death	8/24/1984	Junagadh
00035	35	--	Male	8/18/1984	Wild	Wild	Wild Capture	8/18/1984	Wild Ass Sanctuary
	35	--					Transfer	8/18/1984	Junagadh
		--					Death	8/24/1984	Junagadh
00036	36	--	Female	8/18/1984	Wild	Wild	Wild Capture	8/18/1984	Wild Ass Sanctuary
	36	--					Transfer	8/18/1984	Junagadh
	36	--					Transfer	9/19/1984	Madras
	36	--					Go LTF	9/19/1984	Madras
00037	37	--	Female	8/18/1984	Wild	Wild	Wild Capture	8/18/1984	Wild Ass Sanctuary
	37	--					Transfer	8/18/1984	Junagadh
		--					Death	9/6/1984	Junagadh

Studbook ID	Local ID/ Home Name	Tag No.	Sex	Birth Date	Sire	Dam	Event	Date	Location
00038	38	--	Male	8/23/1984	Wild	Wild	Wild Capture	8/23/1984	Wild Ass Sanctuary
	38	--					Transfer	8/23/1984	Junagadh
							Death	10/18/1984	Junagadh
00039	39	--	Male	8/23/1984	Wild	Wild	Wild Capture	8/23/1984	Wild Ass Sanctuary
	39	--					Transfer	8/23/1984	Junagadh
							Death	9/9/1984	Junagadh
00040	40	--	Male	8/23/1984	Wild	Wild	Wild Capture	8/23/1984	Wild Ass Sanctuary
	40	--					Transfer	8/23/1984	Junagadh
							Death	9/11/1984	Junagadh
00041	41	--	Male	8/23/1984	Wild	Wild	Wild Capture	8/23/1984	Wild Ass Sanctuary
	41	--					Transfer	8/23/1984	Junagadh
	41	--					Transfer	9/19/1984	Madras
	41	--					Go LTF	9/19/1984	Madras
00042	42	--	Female	8/23/1984	Wild	Wild	Wild Capture	8/23/1984	Wild Ass Sanctuary
	42	--					Transfer	8/23/1984	Junagadh
							Death	8/23/1984	Junagadh
00043	43	--	Female	8/23/1984	Wild	Wild	Wild Capture	8/23/1984	Wild Ass Sanctuary
	43	--					Transfer	8/23/1984	Junagadh
	43	--					Transfer	10/30/1984	Nandankannan
	43	--					Go LTF	10/30/1984	Nandankannan
00044	Jethi	Tag No. 13	Female	8/23/1984	Wild	Wild	Wild Capture	8/23/1984	Wild Ass Sanctuary
	Jethi						Transfer	8/23/1984	Junagadh
							Death	10/19/1994	Junagadh
00045	Amar	Tag No. 14	Male	10/4/1985	Unk	00032	Birth	10/4/1985	Junagadh
	Amar						Transfer	2/24/1989	Ahmedabad
	Amar						Go LTF	2/24/1989	Ahmedabad
00046	Gajara	Tag No. 15	Female	10/25/1985	Wild	Wild	Wild Capture	10/25/1985	Wild Ass Sanctuary
	Gajara						Transfer	10/25/1985	Junagadh
							Death	10/2/1996	Junagadh
00047	Soniya	Tag No. 16	Female	9/27/1987	00033	00032	Birth	9/27/1987	Junagadh

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Studbook ID	Local ID/ Home Name	Tag No.	Sex	Birth Date	Sire	Dam	Event	Date	Location
00048	48	--					Death	6/23/1994	Junagadh
	48	--	Male	6/15/1988	Wild	Wild	Wild Capture	6/15/1988	Wild Ass Sanctuary
		--					Transfer	6/15/1988	Junagadh
							Death	8/16/1988	Junagadh
00049	Rajiv	--	Male	11/13/1988	00033	00047	Birth	11/13/1988	Junagadh
	Rajiv	--					Transfer	9/12/1991	Ahmedabad
	Rajiv	--					Go LTF	9/12/1991	Ahmedabad
00050	50	--	Female	2/28/1989	Wild	Wild	Wild Capture	2/28/1989	Wild Ass Sanctuary
	50	--					Transfer	2/28/1989	Junagadh
		--					Death	3/3/1989	Junagadh
00051	John	Tag No. 17	Male	7/23/1989	00033	00032	Birth	7/23/1989	Junagadh
00052	Madhav	--	Male	1/31/1990	Wild	Wild	Wild Capture	1/31/1990	Wild Ass Sanctuary
	Madhav	--					Transfer	1/31/1990	Junagadh
							Death	2/18/1990	Junagadh
00053	Revati	Tag No. 18	Female	2/10/1991	Unk	00047	Birth	2/10/1991	Junagadh
							Death	7/6/1991	Junagadh
00054	Sujata	--	Female	6/27/1992	Unk	00046	Birth	6/27/1992	Junagadh
	Sujata	--					Transfer	5/27/1993	Delhi
	Sujata	--					Go LTF	5/27/1993	Delhi
00055	Moti	--	Male	7/9/1992	Unk	00032	Birth	7/9/1992	Junagadh
	Moti	--					Transfer	5/27/1993	Delhi
00056	Radha	Tag No. 19	Female	7/19/1993	Unk	00047	Birth	7/19/1993	Junagadh
							Death	8/15/1996	Junagadh
00057	57	--	Male	6/11/1994	Unk	00046	Birth	6/11/1994	Junagadh
							Death	6/11/1994	Junagadh
00058	58	Tag No. 20	Male	6/23/1995	Unk	00032	Birth	6/23/1995	Junagadh
							Death	8/15/1996	Junagadh
00059	Akbar	Tag No. 21	Male	7/23/1995	Unk	00046	Birth	7/23/1995	Junagadh
							Death	6/11/2003	Junagadh
00060	60	--	Female	8/17/1996	Unk	Unk	Birth	8/17/1996	Junagadh

Studbook ID	Local ID/ Home Name	Tag No.	Sex	Birth Date	Sire	Dam	Event	Date	Location
							Death	9/10/1997	Junagadh
00061	Raudra	Tag No. 24	Male	1/5/1997	Unk	00032	Birth	1/5/1997	Junagadh
00062	Begum	--	Female	8/18/2001	Wild	Wild	Wild Capture	8/18/2001	Wild Ass Sanctuary
	Begum	--					Transfer	8/18/2001	Junagadh
00063	Aisha	--	Female	8/18/2001	Wild	Wild	Wild Capture	8/18/2001	Wild Ass Sanctuary
	Aisha	--					Transfer	8/18/2001	Junagadh
00064	Sita	--	Female	8/18/2001	Wild	Wild	Wild Capture	8/18/2001	Wild Ass Sanctuary
	Sita	--					Transfer	8/18/2001	Junagadh
00065	Rustam	--	Male	1/31/2002	Wild	00062	Birth	1/31/2002	Junagadh
00066	Abhee	--	Male	11/12/2005	00065	00063	Birth	11/12/2005	Junagadh
00067	67	--	Male	6/6/2006	00065	00064	Birth	6/6/2006	Junagadh
00068	68	--	Female	8/27/2006	00065	00062	Birth	8/27/2006	Junagadh
00069	69	--	Male	11/25/2006	00065	00063	Birth	11/25/2006	Junagadh
00070	70	--	Female	7/27/2007	00065	00064	Birth	7/27/2007	Junagadh

Location Glossary:

Junagadh: Sakkarbaug Zoo, Junagadh
Madras: Arignar Anna Zoological Park, Vandalur, Chennai
Delhi: National Zoological Park, Delhi
Hyderabad: Nehru Zoological Park, Hyderabad
Ahmedabad: Kamala Nehru Zoological Park, Ahmedabad

Population Planning/ Recommendations

Pairings

The pairings report generated using PM2000 indicates the possible mating choices available (Table 11). Individuals at Sakkarbaug Zoo, Junagadh were only selected for this purpose. Table 12 lists the consequences of these mating choices on the level of inbreeding in the captive population. All individuals included in this report may not actually be used for breeding as some of the individuals may be past the breeding age and some pairings may not be compatible. Therefore the genetic diversity indicated below table 12 may not actually be realized.

Table 4 Individuals selected for pairings

Males					Females				
Stud No.	MK	% Known	Age	Location	Stud No.	MK	% Known	Age	Location
00051	0.060	100.0	19	JUNAGADH	00062	0.157	100.0	0	JUNAGADH
00061	0.072	50.0	12	JUNAGADH	00063	0.090	100.0	0	JUNAGADH
00065	0.210	100.0	7	JUNAGADH	00064	0.093	100.0	0	JUNAGADH
00066	0.174	100.0	3	JUNAGADH	00068	0.211	100.0	2	JUNAGADH
00067	0.176	100.0	2	JUNAGADH	00070	0.179	100.0	1	JUNAGADH
00069	0.174	100.0	2	JUNAGADH					

Table 5 Possible mating of live individuals at Sakkarbaug zoo, Junagadh
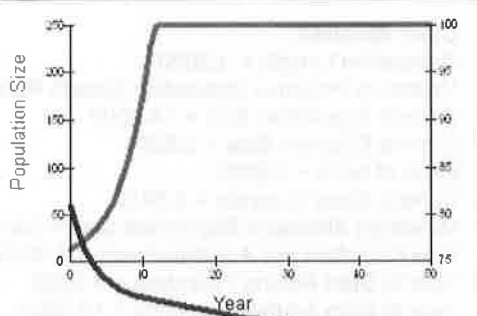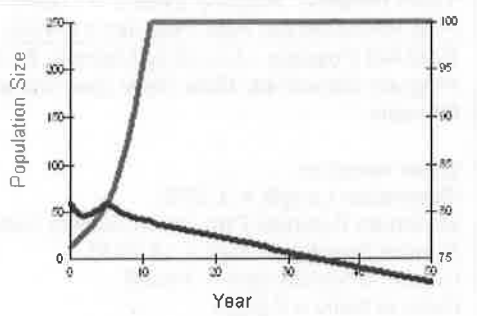
Sl. No.	Sire	Dam	Inbreeding coefficient
1.	00051	00062	0.000
2.	00051	00063	0.000
3.	00051	00064	0.000
4.	00051	00068	0.000
5.	00051	00070	0.000
6.	00061	00062	0.000
7.	00061	00063	0.000
8.	00061	00064	0.000
9.	00061	00068	0.000
10.	00061	00070	0.000
11.	00065	00062	0.250
12.	00065	00063	0.000
13.	00065	00064	0.000
14.	00065	00068	0.375
15.	00065	00070	0.250
16.	00066	00062	0.125
17.	00066	00063	0.250
18.	00066	00064	0.000
19.	00066	00068	0.188
20.	00066	00070	0.125
21.	00067	00062	0.125
22.	00067	00063	0.000
23.	00067	00064	0.250
24.	00067	00068	0.188
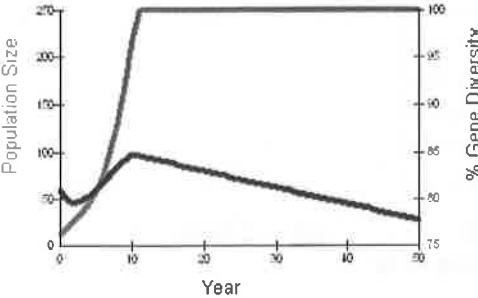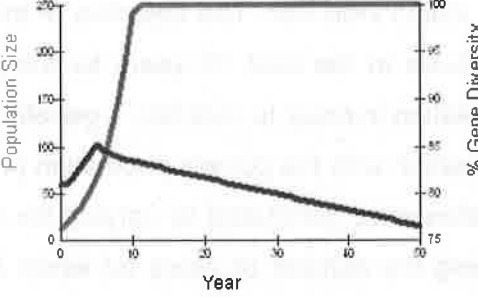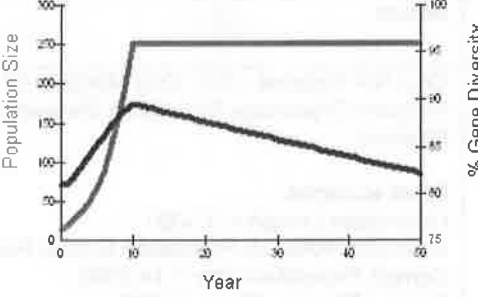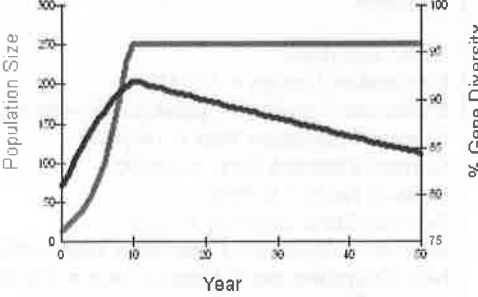
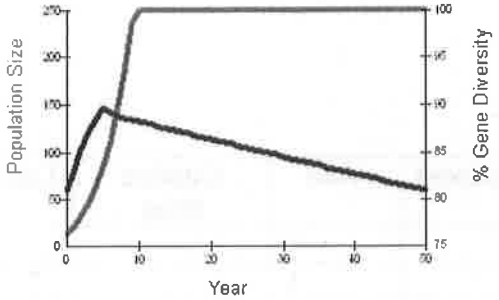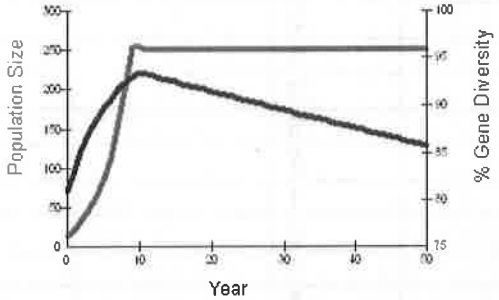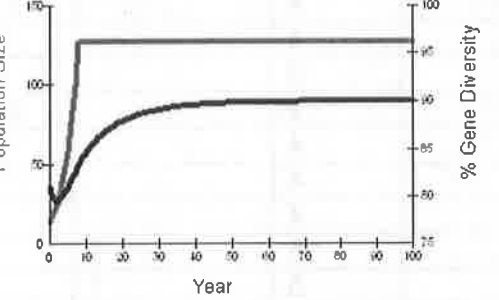| 25. | 00067 | 00070 | 0.250 |
26.	00069	00062	0.125
27.	00069	00063	0.250
28.	00069	00064	0.000
29.	00069	00068	0.188
30.	00069	00070	0.125

Current N = 41 % Known = 95.4   MK = 0.1568   GD = 0.8432
GV = 0.8320   fge = 3.19   # Pairs = 30

5.96 mean Ne over past 1.33 generations
3.000 current Ne estimated from 1.0 male and 3.0 female breeders
0.2857 Ne/N ratio

The goals report of PM2000 was generated for Indian Wild Ass. The objective of this was to achieve a population of a minimum 250 individuals in the next 10 years by the judicious addition of founder animals into the captive population in order to maintain a genetic diversity of 90% at the end of 50 years. Running the simulation with the current population provided a genetic diversity of only 65.31%. Various scenarios were generated by varying the numbers of founders to be added each year and changing the number of years for which founders may be added. Scenario 8 below in which 4 founders are to be added each year for the next 10 years allows the retention of maximum genetic diversity (85.7%) over the next 50 years.

Sl. No.	Scenario	Details
1		Goal Not Possible - Can Only Maintain 65.31% Program Objectives: 90% Gene Diversity at the end of 50 years Other variables: Generation Length = 3.3000 Maximum Potential Population Growth Rate = 1.2890 Current Population Size = 14.0000 Current Effective Size = 3.9000 Ratio of Ne/N = 0.2800 Current Gene Diversity = 0.8432 Maximum Allowable Population Size = 250.0000
2		Goal Not Possible - Can Only Maintain 72.55% Program Objectives: 90% Gene Diversity at the end of 50 years Other variables: Generation Length = 3.3000 Maximum Potential Population Growth Rate = 1.2890 Current Population Size = 14.0000 Current Effective Size = 3.9000 Ratio of Ne/N = 0.2800 Current Gene Diversity = 0.8432 Maximum Allowable Population Size = 250.0000 New Founders per Addition Event = 1.0000 Year to Start Adding Founders = 1.0000 Year to Stop Adding Founders = 5.0000 Years Between Addition Events = 1.0000 FGE Recruited per New Founder = 0.4000

3		Goal Not Possible - Can Only Maintain 77.77% Program Objectives: 90% Gene Diversity at the end of 50 years Other variables: Generation Length = 3.3000 Maximum Potential Population Growth Rate = 1.2890 Current Population Size = 14.0000 Current Effective Size = 3.9000 Ratio of Ne/N = 0.2800 Current Gene Diversity = 0.8432 Maximum Allowable Population Size = 250.0000 New Founders per Addition Event = 1.0000 Year to Start Adding Founders = 1.0000 Year to Stop Adding Founders = 10.0000 Years Between Addition Events = 1.0000 FGE Recruited per New Founder = 0.4000
4		Goal Not Possible - Can Only Maintain 76.56% Program Objectives: 90% Gene Diversity at the end of 50 years Other variables: Generation Length = 3.3000 Maximum Potential Population Growth Rate = 1.2890 Current Population Size = 14.0000 Current Effective Size = 3.9000 Ratio of Ne/N = 0.2800 Current Gene Diversity = 0.8432 Maximum Allowable Population Size = 250.0000 New Founders per Addition Event = 2.0000 Year to Start Adding Founders = 1.0000 Year to Stop Adding Founders = 5.0000 Years Between Addition Events = 1.0000 FGE Recruited per New Founder = 0.4000
5		Goal Not Possible - Can Only Maintain 82.13% Program Objectives: 90% Gene Diversity at the end of 50 years Other variables: Generation Length = 3.3000 Maximum Potential Population Growth Rate = 1.2890 Current Population Size = 14.0000 Current Effective Size = 3.9000 Ratio of Ne/N = 0.2800 Current Gene Diversity = 0.8432 Maximum Allowable Population Size = 250.0000 New Founders per Addition Event = 2.0000 Year to Start Adding Founders = 1.0000 Year to Stop Adding Founders = 10.0000 Years Between Addition Events = 1.0000 FGE Recruited per New Founder = 0.4000
6		Goal Not Possible - Can Only Maintain 84.35% Program Objectives: 90% Gene Diversity at the end of 50 years Other variables: Generation Length = 3.3000 Maximum Potential Population Growth Rate = 1.2890 Current Population Size = 14.0000 Current Effective Size = 3.9000 Ratio of Ne/N = 0.2800 Current Gene Diversity = 0.8432 Maximum Allowable Population Size = 250.0000 New Founders per Addition Event = 3.0000 Year to Start Adding Founders = 1.0000 Year to Stop Adding Founders = 10.0000 Years Between Addition Events = 1.0000

		FGE Recruited per New Founder = 0.4000
7		**Goal Not Possible - Can Only Maintain 80.91%** Program Objectives: 90% Gene Diversity at the end of 50 years Other variables: Generation Length = 3.3000 Maximum Potential Population Growth Rate = 1.2890 Current Population Size = 14.0000 Current Effective Size = 3.9000 Ratio of Ne/N = 0.2800 Current Gene Diversity = 0.8432 Maximum Allowable Population Size = 250.0000 New Founders per Addition Event = 4.0000 Year to Start Adding Founders = 1.0000 Year to Stop Adding Founders = 5.0000 Years Between Addition Events = 1.0000 FGE Recruited per New Founder = 0.4000
8		**Goal Not Possible - Can Only Maintain 85.7%** Program Objectives: 90% Gene Diversity at the end of 50 years Other variables: Generation Length = 3.3000 Maximum Potential Population Growth Rate = 1.2890 Current Population Size = 14.0000 Current Effective Size = 3.9000 Ratio of Ne/N = 0.2800 Current Gene Diversity = 0.8432 Maximum Allowable Population Size = 250.0000 New Founders per Addition Event = 4.0000 Year to Start Adding Founders = 1.0000 Year to Stop Adding Founders = 10.0000 Years Between Addition Events = 1.0000 FGE Recruited per New Founder = 0.4000
		Population Size Needed to Meet Goals Needed = 126 Program Objectives: 90% Gene Diversity at the end of 100 years Other variables: Generation Length = 3.3000 Maximum Potential Population Growth Rate = 1.2890 Current Population Size = 14.0000 Current Effective Size = 3.9000 Ratio of Ne/N = 0.2800 Current Gene Diversity = 0.8432 Maximum Allowable Population Size = 250.0000 New Founders per Addition Event = 1.0000 Year to Start Adding Founders = 1.0000 Year to Stop Adding Founders = 100.0000 Years Between Addition Events = 1.0000 FGE Recruited per New Founder = 0.4000

Demographic Analyses

Census

Table 6   Census

Year	Total	Females	Males	Unsexed	Wild	Captive Bred	Lambda
1958	1		1		1		
1959	1		1		1		1
1960	1		1		1		1
1961	1		1		1		1
1962	1		1		1		1
1963	1		1		1		1
1964	2	1	1		2		2
1965	2	1	1		2		1
1966	3	1	2		3		1.5
1967	3	1	2		3		1
1968	3	1	2		3		1
1969	2		2		2		0.667
1970	1		1		1		0.5
1971	2		2		2		2
1972	1		1		1		0.5
1973	1		1		1		1
1974	3	2	1		3		3
1975	3	1	2		3		1
1976	4	1	3		4		1.333
1977	3	1	2		3		0.75
1978	4	2	2		4		1.333
1979	4	2	2		4		1
1980	3	1	2		3		0.75
1981	2	1	1		2		0.667
1982	4	2	2		4		2
1983	4	1	3		4		1
1984	4	2	2		4		1
1985	6	3	3		5	1	1.5
1986	6	3	3		5	1	1
1987	7	4	3		5	2	1.167
1988	8	4	4		5	3	1.143
1989	7	4	3		4	3	0.875
1990	7	4	3		4	3	1
1991	6	4	2		4	2	0.857
1992	8	5	3		4	4	1.333
1993	8	5	3		4	4	1
1994	6	3	3		3	3	0.75
1995	8	3	5		3	5	1.333
1996	6	2	4		2	4	0.75
1997	6	1	5		2	4	1
1998	6	1	5		2	4	1
1999	6	1	5		2	4	1
2000	6	1	5		2	4	1
2001	9	4	5		5	4	1.5
2002	10	4	6		5	5	1.111

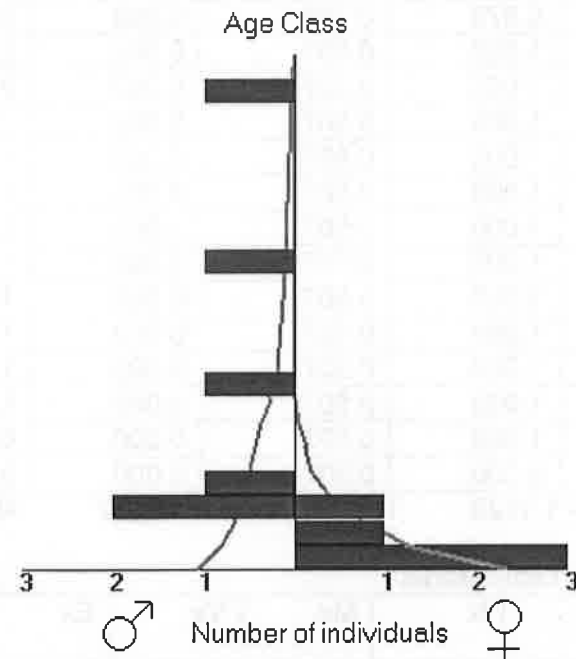| 2003	9	4	5		5	4	0.9
2004	8	3	5		4	4	0.889
2005	9	3	6		4	5	1.125
2006	12	4	8		4	8	1.333
2007	13	5	8		4	9	1.083

Figure 1   Age Pyramid of the Captive Indian Wild Population in India. (The blue boxes depict the actual age structure while the red line depicts a stable population)
Indian Wild Ass Total Males = 6.0   Total Females = 5.0   Unknown Age Males = 0.0
Unknown Age Females = 3.0

The age pyramid of the captive wild ass population is based on individuals of known ages which form a very small part of the total captive population of Indian wild ass. The age pyramid is therefore not a true reflection of the Captive population.

Life Table Analyses

An analysis of life tables for males suggests that a mortality peak is recorded in the first year, thereafter a peak is observed in the 7th year and then in the 20th year. The first mating by males was observed to occur between the third and fourth year of life and peaked in the fifth year. Thereafter it continuously shows a decline. The modeled data also shows similar trends. However, the life table is also based on individuals of known age (N = 6) which forms a small percentage of the total population and hence cannot be used for population predictions.

Table 7   Male life table Actual

Age (x)	Qx Mortality	Px Survival	Lx Survivorship	Mx Fecundity	Risk (Qx)	Risk (Mx)
0	0.160	0.840	1.000	0.000	12.900	10.900

1	0.100	0.900	0.840	0.000	10.000	9.100
2	0.000	1.000	0.756	0.000	7.300	7.300
3	0.000	1.000	0.756	0.430	4.500	4.500
4	0.000	1.000	0.756	1.420	4.000	4.000
5	0.000	1.000	0.756	0.480	4.000	4.000
6	0.000	1.000	0.756	0.000	3.800	3.800
7	0.330	0.670	0.756	0.000	3.000	2.900
8	0.000	1.000	0.507	0.000	2.000	2.000
9	0.000	1.000	0.507	0.000	2.000	2.000
10	0.000	1.000	0.507	0.000	2.000	2.000
11	0.000	1.000	0.507	0.000	1.900	1.900
12	0.000	1.000	0.507	0.000	1.000	1.000
13	0.000	1.000	0.507	0.000	1.000	1.000
14	0.000	1.000	0.507	0.000	1.000	1.000
15	0.000	1.000	0.507	0.000	1.000	1.000
16	0.000	1.000	0.507	0.000	1.000	1.000
17	0.000	1.000	0.507	0.000	1.000	1.000
18	0.000	1.000	0.507	0.000	1.000	1.000
19	0.000	1.000	0.507	0.000	0.400	0.400
20	1.000	0.000	0.507	0.000	0.000	0.000

r = 0.1418   lambda = 1.1523   T = 4.16   N = 6.00   N(at 20 yrs) = 102.20

Table 8   Male Life Table Model

Age (x)	Qx	Px	lx	Mx	Vx	Ex	Risk (Qx)	Risk (Mx)
0	0.160	0.840	1.000	0.000	1.087	13.820	12.900	10.900
1	0.100	0.900	0.840	0.000	1.444	14.779	10.000	9.100
2	0.000	1.000	0.756	0.000	1.756	14.545	7.300	7.300
3	0.000	1.000	0.756	0.430	2.024	13.545	4.500	4.500
4	0.000	1.000	0.756	1.420	1.837	12.545	4.000	4.000
5	0.000	1.000	0.756	0.480	0.480	11.545	4.000	4.000
6	0.000	1.000	0.756	0.000	0.000	10.545	3.800	3.800
7	0.330	0.670	0.756	0.000	0.000	11.431	3.000	2.900
8	0.000	1.000	0.507	0.000	0.000	13.000	2.000	2.000
9	0.000	1.000	0.507	0.000	0.000	12.000	2.000	2.000
10	0.000	1.000	0.507	0.000	0.000	11.000	2.000	2.000
11	0.000	1.000	0.507	0.000	0.000	10.000	1.900	1.900
12	0.000	1.000	0.507	0.000	0.000	9.000	1.000	1.000
13	0.000	1.000	0.507	0.000	0.000	8.000	1.000	1.000
14	0.000	1.000	0.507	0.000	0.000	7.000	1.000	1.000
15	0.000	1.000	0.507	0.000	0.000	6.000	1.000	1.000
16	0.000	1.000	0.507	0.000	0.000	5.000	1.000	1.000
17	0.000	1.000	0.507	0.000	0.000	4.000	1.000	1.000
18	0.000	1.000	0.507	0.000	0.000	3.000	1.000	1.000
19	0.000	1.000	0.507	0.000	0.000	2.000	0.400	0.400
20	1.000	0.000	0.507	0.000	0.000	1.000	0.000	0.000

r = 0.1418   lambda = 1.1523   T = 4.16   N = 6.00   N(at 20 yrs) = 102.20

The life tables for females suggests that mortality (Qx) is high in the first two years of life and thereafter shows a peak in the 3rd to 4th year and remains as a plateau after the 6th year. Fecundity peaks in the 7th year and then all breeding activity stops as is suggested by the life

table. Modeled data also shows similar trends. However the predictive use of the life table is limited due to the small sample size (N = 5).

Table 9   Female Life table Actual

Age (x)	Qx	Px	lx	Mx	Risk (Qx)	Risk (Mx)
0	0.250	0.750	1.000	0.000	7.900	6.400
1	0.230	0.770	0.750	0.930	4.400	3.400
2	0.000	1.000	0.578	0.000	2.300	2.300
3	0.500	0.500	0.578	2.950	2.000	1.100
4	0.000	1.000	0.289	0.000	1.000	1.000
5	0.000	1.000	0.289	3.170	1.000	1.000
6	1.000	0.000	0.289	0.000	1.000	0.700
7	1.000	0.000	0.000	0.000	0.000	0.000
8	1.000	0.000	0.000	0.000	0.000	0.000
9	1.000	0.000	0.000	0.000	0.000	0.000
10	1.000	0.000	0.000	0.000	0.000	0.000
11	1.000	0.000	0.000	0.000	0.000	0.000
12	1.000	0.000	0.000	0.000	0.000	0.000
13	1.000	0.000	0.000	0.000	0.000	0.000
14	1.000	0.000	0.000	0.000	0.000	0.000
15	1.000	0.000	0.000	0.000	0.000	0.000
16	1.000	0.000	0.000	0.000	0.000	0.000
17	1.000	0.000	0.000	0.000	0.000	0.000
18	1.000	0.000	0.000	0.000	0.000	0.000
19	1.000	0.000	0.000	0.000	0.000	0.000
20	1.000	0.000	0.000	0.000	0.000	0.000

r = 0.1418   lambda = 1.4426   T = 2.45   N = 5.00   N(at 20 yrs) = 7618.81

Table 10   Female Life Table Model

Age (x)	Qx	Px	lx	Mx	Vx	Ex	Risk (Qx)	Risk (Mx)
0	0.250	0.750	1.000	0.000	1.143	3.739	7.900	6.400
1	0.230	0.770	0.750	0.930	2.173	3.610	4.400	3.400
2	0.000	1.000	0.578	0.000	2.062	3.000	2.300	2.300
3	0.500	0.500	0.578	2.950	3.965	2.667	2.000	1.100
4	0.000	1.000	0.289	0.000	2.197	2.500	1.000	1.000
5	0.000	1.000	0.289	3.170	3.170	1.500	1.000	1.000
6	1.000	0.000	0.289	0.000	0.000	1.000	1.000	0.700
7	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

r = 0.3664   lambda = 1.4426   T = 2.45   N = 5.00   N(at 20 yrs) = 7618.81
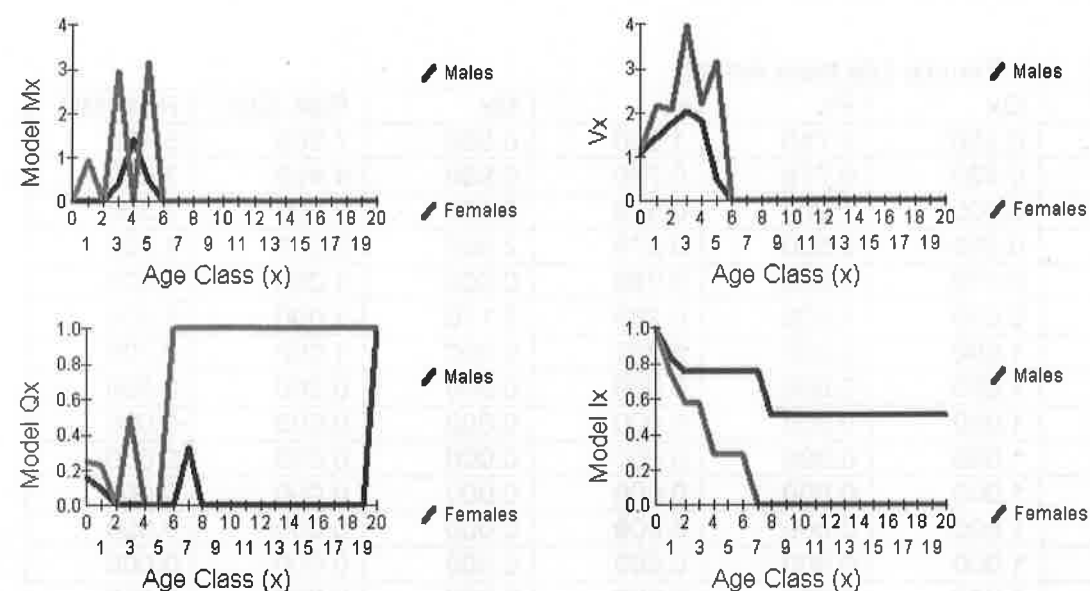
Figure 2   Modeled life table variables versus age class

Population Projections

The population projections for the next 20 years of captive Indian Wild Ass suggest that the population would continue to grow at steady rate of 1.3866 over the next twenty years to achieve a population of 250 individuals. However, in order to maintain stable populations the growth rate required is much higher as is indicated by the red lines in the figure 3below. Table 7 below depicts the number of births and pairs required each year till the tenth year to achieve a population of 250 individuals by the 10th year. A maximum size of 250 individuals was assumed as a minimum desired number of individuals in order to maintain a genetically viable and demographically stable, population as zoos outside India do not have the species in captivity.
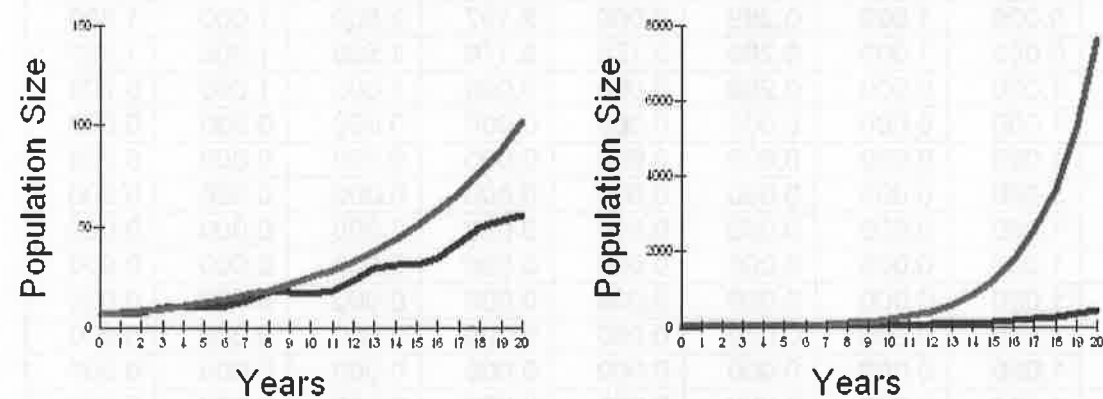
Population projection male

Population projection female
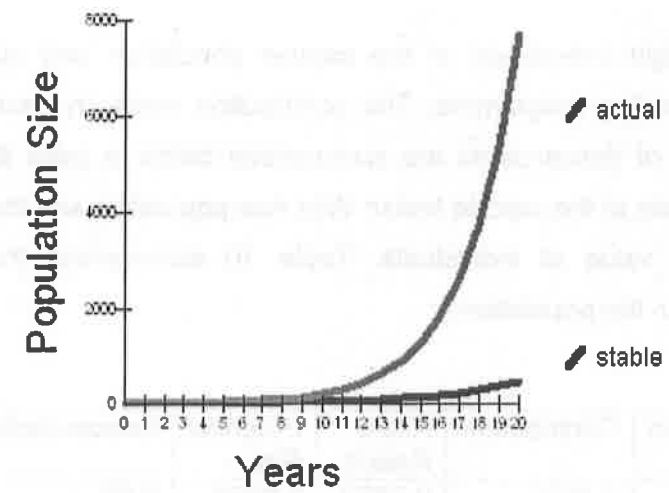
Population projection Total

Figure 3   Population Projections
Current Population Size: 11   New Population Size: 250   Growth Rate: 1.3666
Number of Years: 10   Sex Ratio at Birth: 50% Males and 50% Females

Table 11 Minimum number of births and pairs required to achieve target population.

Year	# Births	# Pairs
0	5.14267	10.3
1	8.724259	17.4
2	10.64389	21.3
3	14.97909	30.0
4	21.46071	42.9
5	28.72157	57.4
6	38.73435	77.5
7	53.82552	107.7
8	75.30574	150.6
9	101.6867	203.4
10	36.82732	73.7

Genetic analyses

Of the potential 51 founders (wild origin individuals) in the captive population only six individuals have been used in the breeding programme. The contribution made by each individual, allele retention and number of descendants are summarized below in table 8. Table 9 below lists all the living individuals of the captive Indian Wild Ass population and the various measures of current genetic value of individuals. Table 10 summarises the inbreeding coefficient of live individuals in the population.

Table 12   Founder Statistics

Studbook #	Sex	Age	Representation	Contribution	Allele Retent.	Potential Ret.	Descendants
00062	F	0	0.3000	2.2500	0.7590	1.0000	6.00
00063	F	0	0.1333	1.0000	0.7710	1.0000	2.00
00064	F	0	0.1333	1.0000	0.7395	1.0000	2.00
00032	F	D	0.1333	1.0000	0.7450	0.7450	2.00
00033	M	D	0.0667	0.5000	0.5000	0.5000	1.00
P00062	M	D	0.2333	1.7500	0.5000	0.5000	6.00

Current N = 11   % Known = 93.8   MK = 0.1844   GD = 0.8156
GV = 0.7538   fge = 2.71   # Pairs = 0

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Table 13   Individual statistics

Studbook #	Sex	Sire	Dam	Age	Location	Vx	% Known	F	MK	KV	GU - All	GU - Descend	Prob Lost	FOKE	# Offspring	Local ID
00051	M	00033	00032	19	Junagadh	0.00	100.0	0.0000	0.0833	0.0000	0.7450	0.7450	1.0000	2.50	0	John
00061	M	P00032	00032	12	Junagadh	0.00	50.0	0.0000	0.1000	0.0000	0.7450	0.7450	1.0000	3.00	0	Raudra
00062	F	Wild	Wild	0	Junagadh	1.14	100.0	0.0000	0.1500	0.1778	0.2410	-1.0000	0.0551	4.50	2	Begum
00063	F	Wild	Wild	0	Junagadh	1.14	100.0	0.0000	0.0667	0.0967	0.2290	-1.0000	0.0554	2.00	2	Aisha
00064	F	Wild	Wild	0	Junagadh	1.14	100.0	0.0000	0.0667	0.1005	0.2605	-1.0000	0.0604	2.00	2	Sita
00065	M	P00062	00062	7	Junagadh	0.00	100.0	0.0000	0.2500	0.2764	0.0190	0.0285	0.0280	7.50	5	Rustam
00066	M	00065	00063	3	Junagadh	2.02	100.0	0.0000	0.1917	0.2383	0.0000	0.2710	0.0051	5.75	0	Abhee
00067	M	00065	00064	2	Junagadh	1.76	100.0	0.0000	0.1917	0.2334	0.0000	0.2395	0.0068	5.75	0	67
00068	F	00065	00062	2	Junagadh	2.06	100.0	0.2500	0.2333	0.2798	0.0000	0.2590	0.0043	7.00	0	68
00069	M	00065	00063	2	Junagadh	1.76	100.0	0.0000	0.1917	0.2315	0.0000	0.2710	0.0071	5.75	0	69
00070	F	00065	00064	1	Junagadh	2.17	100.0	0.0000	0.1917	0.2441	0.0000	0.2395	0.0037	5.75	0	70

Current N = 11   % Known = 93.8   MK = 0.1844   GD = 0.8156   GV = 0.7538   fge = 2.71   # Pairs = 0

Table 14   Inbreeding Coefficients of Live Individuals

Studbook #	Sex	Age	Location	% Known	F Inbreeding Coefficient
00051	M	19	JUNAGADH	100.0	0.0000
00061	M	12	JUNAGADH	50.0	0.0000
00062	F	0	JUNAGADH	100.0	0.0000
00063	F	0	JUNAGADH	100.0	0.0000
00064	F	0	JUNAGADH	100.0	0.0000
00065	M	7	JUNAGADH	100.0	0.0000
00066	M	3	JUNAGADH	100.0	0.0000
00067	M	2	JUNAGADH	100.0	0.0000
00068	F	2	JUNAGADH	100.0	0.2500
00069	M	2	JUNAGADH	100.0	0.0000

Current N = 11   % Known = 93.8   MK = 0.1844   GD = 0.8156   GV = 0.7538

fge = 2.71   # Pairs = 0

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").

Ix, 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.