Institutional Representative Draft – Comments due by 22 Nov 2013

Population Analysis & Breeding and Transfer Plan

Nubian Ibex (*Capra nubiana*)
AZA Species Survival Plan®
Yellow Program

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PMC Population Management Center

Lincoln Park Zoo   Association of Zoos & Aquariums

CAZA

Executive Summary

Nubian Ibex (*Capra nubiana*)

The current population of Nubian ibex includes 74 animals (34 males, 40 females) held by 7 AZA institutions and 1 non-AZA institution. The Caprinae Taxon Advisory Group has set the target size for this population to be 100 animals (2011 Regional Collection Plan). At present, the Nubian Ibex Program qualifies as a Yellow Program. This is a two-year plan, and the first breeding and transfer plan for this species.

Genetic and demographic analyses of the Nubian Ibex North American Studbook (current to 1 June 2013) were performed using PopLink 2.4 and PMx 1.2, resulting in the current breeding and transfer plan for this species. The current gene diversity in the population is 70.30% of that present in the founding population. Gene diversity at 100 years from present is projected to be ~ 30% if the population can maintain a growth rate of 19% per year to reach the target size of 100 individuals. At present, the best management strategy for the population is to breed animals with the lowest mean kinships. However, given the small number of breeding individuals, it will be necessary to import additional unrelated animals in the future to improve long-term genetic viability.

Demography

Current population size (males.females.unknown)	74 (34. 40.0)
# Animals excluded from management	17
Population size following exclusions	57 (25. 32.0)
Target population size	100
Mean generation time (T; in years)	4.7
Projected Population Growth Rate (λ)	1.191
Historic Population Growth Rate (average λ 2007-2012)	1.017

Genetics

	2013	**Current Potential**
Founders	19	0 additional
Founder genome equivalents (FGE)	1.68	4.20
Current gene diversity (GD %)	70.30	88.11
Population mean kinship (MK)	0.2970	-----
Mean inbreeding (F)	0.3411	-----
% pedigree known before assumptions and exclusions	15	-----
% pedigree known after assumptions and exclusions	100	-----
% pedigree certain after assumptions and exclusions	45	-----
Effective population size/census size ratio (Ne / N)	0.127	-----
Years To 90% Gene Diversity	currently <90%	-----
Years To 10% Loss of GD	13*	-----
Gene Diversity at 100 Years From Present (%)	29.8 *	-----

*projections based on the analytical breeding population growing to 100 animals over ~ 3 years (λ = 1.190)

Analyses suggest that ~24 births are needed over the next two years (12 per year) to maintain the current population size, while ~58 births are needed over the next two years (~29 per year) to maintain a growth rate of 19%. The number of pairs recommended is intended to produce sufficient offspring to grow the population size, fill new institutions if recruited, and replace individuals as needed. As with most managed AZA populations, pairings are prioritized to maintain or increase gene diversity through considerations of mean kinship, avoidance of inbreeding, differences in sire and dam mean kinships, and the degree of uncertainty within a pedigree.

Summary Actions: The Program recommends 23 females to breed and 13 transfers.

This Animal Program is currently a Yellow Program and recommendations proposed are non-binding – Participation is voluntary. Dispositions to non-AZA institutions should comply with each institution's acquisition/disposition policy.

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Report and Analyses prepared by:
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Planning occurred on October 2nd, 2013 via an online meeting at the San Diego Zoo Safari Park, and was attended by Alison Mott (Sacramento Zoo), Harrison Edell (Sacramento Zoo), and Andrea Putnam (San Diego Zoo Global).

This plan was reviewed and distributed with the assistance of the Population Management Center.
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This Animal Program is currently a Yellow Program and recommendations proposed are non-binding – Participation is voluntary. Dispositions to non-AZA institutions should comply with each institution's acquisition/disposition policy.

Description of Population Status

Introduction: The current population of Nubian ibex includes 74 animals (34 males, 40 females) held by 7 AZA institutions and 1 non-AZA institution. The Caprinae Taxon Advisory Group has set the target size for this population to be 100 animals (2011 Regional Collection Plan). At present, the Nubian Ibex Program qualifies as a Yellow Program. This is a two-year plan, and the first breeding and transfer plan for this species.

Genetic and demographic analyses of the Nubian Ibex North American Studbook (current to 1 June 2013) were performed using PopLink 2.4 and PMx 1.2, resulting in the current breeding and transfer plan for this species.

Analytical Population: Only 15% of the pedigree of the current, living population can be traced to documented founders. Thus, an analytic dataset was created for the genetic analyses reported here (Appendix A). After incorporating assumptions, 100% of the pedigree is known, 45% of which is certain. Seventeen animals were excluded from genetic analyses due to castration or unknown pedigree. Pedigree assumptions could not be made for 14 currently living animals that originated from the private sector. Because of hybridization concerns, these animals were excluded from analyses. A total of 57 animals (25 males, 32 females) were included in the breeding population.

Demography: Studbook records indicate that Nubian ibex have been exhibited in North American zoos since the 1920's, with the first birth occurring in 1928 at the Philadelphia Zoo. The population began to grow rapidly during the 1980's, peaking at its largest size of 148 animals in 1994 (Figures 1 and 2). The N. American population has remained below a population size of 100 individuals since 2001. Based on the current life tables (Appendix C) and age structure (Figure 3), the population has a projected growth rate of 19% per year (projected $\lambda = 1.190$).

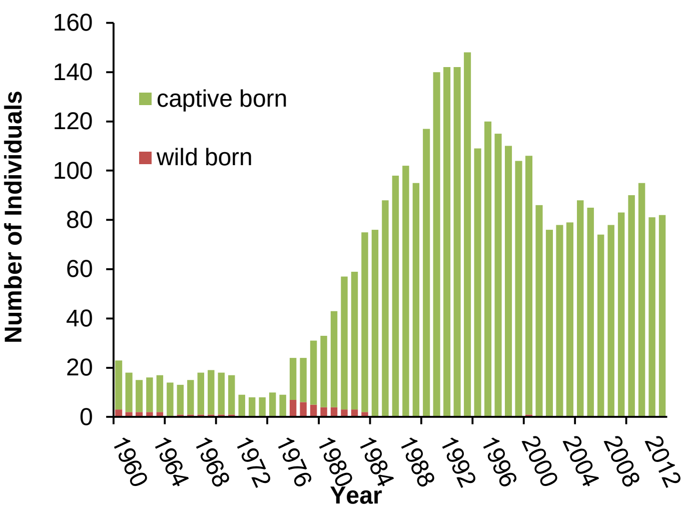

Figure 1. Census of Nubian ibex in North America from 1960 to 2013, by birth type.

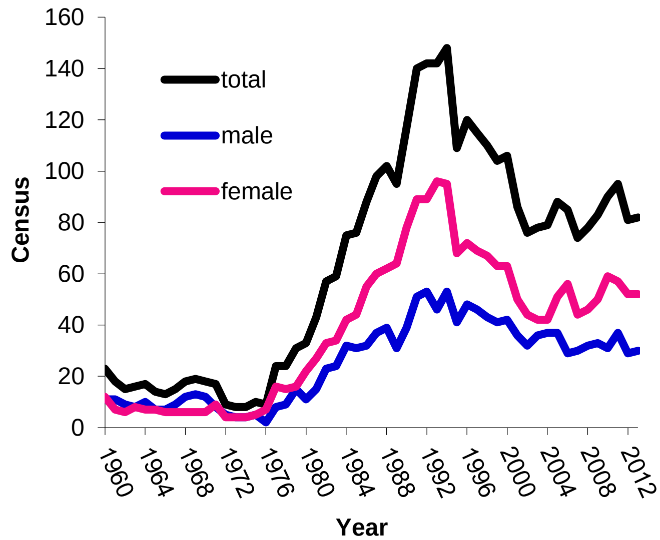

Figure 2. Census of Nubian ibex in North America from 1960 to 2013, by sex.

The age structure of the genetically managed Nubian ibex population has gaps in a number of the young male age classes (Figure 3), although there were 13 male births in 2013. The Program should attempt to maintain consistent reproduction from year to year to prevent 'boom and bust' cycles. The current sex ratio is skewed toward more females. Nubian ibex can live into their late teens and early twenties; the oldest male to have lived in North America was 19 years old and the oldest female was 22 years old. Median life expectancy is 9.9 years for males and 11.1 years for females (50% of males and females die before these ages and 50% die after). Both sexes are reproductive by the time they're 1 year old.

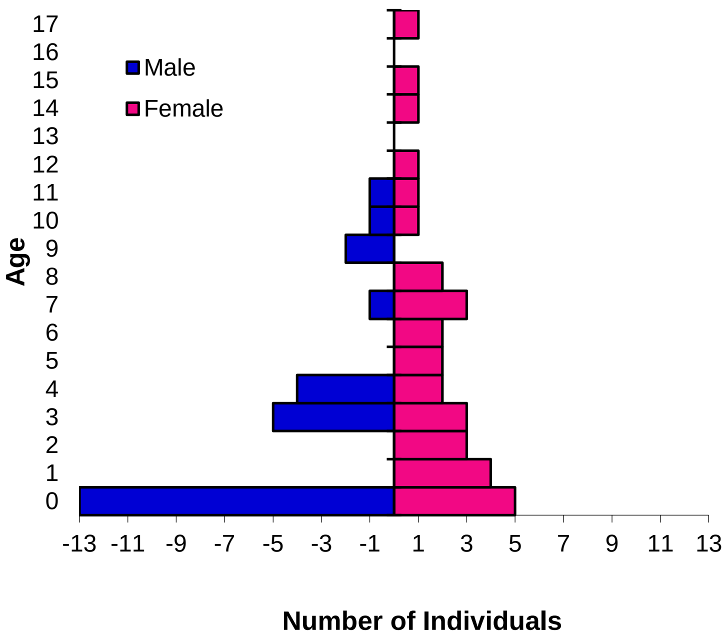

Figure 3. Age distribution of the genetically managed population of Nubian ibex.

Current demographic analyses indicate that mortality for the first year of life is 34% for males and 32% for females (Appendix C). Analyses suggest that ~24 births are needed over the next two years (12 per year) to maintain the current population size, while ~58 births are needed over the next two years (~29 per year) to maintain a growth rate of 19%. The genetically managed population has been averaging ~35 births per year for the last 5 years, which is sufficient reproduction to grow the population slowly.

Genetics: The studbook pedigree indicates that the genetically managed Nubian ibex population is descended from 19 founders with no potential founders remaining (Figure 4). Founder representation in the population is highly skewed; more equal representation would retain more gene diversity. The gene diversity of the population is 70.30%, which is equivalent to that found in ~2 unrelated animals (FGE = 1.68).

Typical AZA program goals include thresholds for tolerance of gene diversity loss over time; 90% gene diversity retention for 100 years is not an uncommon management goal. Decreases in gene diversity below 90% of that in the founding population have been associated with increasingly compromised reproduction by, among other factors, lower birth weights, smaller litter sizes, and greater neonatal mortality. The Nubian ibex pedigree yields a current gene diversity of ~70%, which is projected to decline to ~30% over the next 100 years if the current population can maintain a 19% growth rate and reach its target size of 100 animals in ~3 years.

The current mean kinship in the population is ~0.30. Full-siblings have a kinship of 0.25, which means that the average relationship in the population is slightly higher than that of full-siblings. Thus, additional imports of unrelated animals will be necessary for this population to be genetically viable over the long-term.

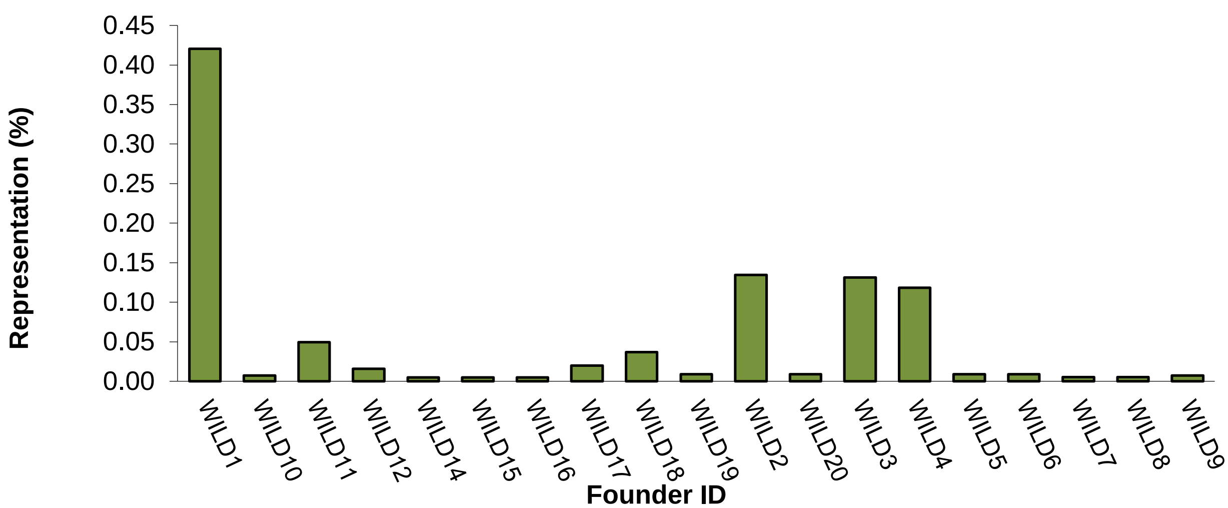

Figure 4: Founder representation graph based on the analytical studbook illustrating the unequal distribution of various founder lines in the Nubian ibex population.

Genetics Summary

	2013	Current Potential
Number of Founders	19	0 additional
Founder Genome Equivalents (FGE)	1.68	4.20
Gene Diversity (%)	70.30	88.11
Population Mean Kinship	0.2970	-----
Mean Inbreeding (F)	0.3411	-----
% Known Pedigree Before Assumptions/Exclusions	15	-----
% Known Pedigree After Assumptions/Exclusions	100	-----
% Pedigree Certain After Assumptions/Exclusions	45	-----
N_e/N	0.127	-----
Years To 90% Gene Diversity	currently <90%	-----
Years To 10% Loss of GD	13*	-----
Gene Diversity at 100 Years From Present (%)	29.8 *	-----

*projections based on the analytical breeding population growing to 100 animals over the next ~3 years (λ = 1.190)

Management Strategy: The current population of Nubian ibex is 74 animals (34 males, 40 females) held by 7 AZA institutions and one non-AZA institution. Demographic analyses suggest that ~24 births are needed over the next two years (12 per year) to maintain the current population size.

This is a 2-year plan (2013-2015). Interim recommendations will continue to be made as needed.

At this time, the program:

1. **Recommends 23 females to breed.**
2. **Recommends 13 transfers to meet institutional needs and establish new breeding groups.**
3. **Recommends equalizing founder distributions by breeding underrepresented animals and transferring breeding individuals among institutions. Overrepresented animals may be selected for breeding to meet demographic needs of the institutions.**

This Animal Program is currently a Yellow Program and recommendations proposed are non-binding – Participation is voluntary. Dispositions to non-AZA institutions should comply with each institution's acquisition/disposition policy.

Summary of Breeding and Transfer Recommendations

SB ID	Location	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
992	GUADALJR	M01328	F	17	HOLD	GUADALJR	BREED WITH	1480, 1490	
1031	GUADALJR	M01619	F	15	HOLD	GUADALJR	BREED WITH	1480, 1490	
1057	SD-WAP	699126	F	14	HOLD	SD-WAP	BREED WITH	1242, 1478, 1308	
1105	BATONROUG	9174	F	12	SEND TO	LOSANGELE	BREED WITH	1135	
1106	BATONROUG	9175	M	12	HOLD	BATONROUG	DO NOT BREED		Excluded
1107	BATONROUG	9176	M	12	HOLD	BATONROUG	DO NOT BREED		Excluded
1131	SAN ANTON	A02005	F	11	HOLD	SAN ANTON	BREED WITH	1384	
1135	LOSANGELE	990972	M	11	HOLD	LOSANGELE	BREED WITH	1105, 1241, 1385	
1149	SAN ANTON	A03002	F	10	HOLD	SAN ANTON	BREED WITH	1384	
1159	SD-WAP	603113	M	10	SEE NOTES	SD-WAP	DO NOT BREED		Available
1200	SD-WAP	605080	F	8	HOLD	SD-WAP	BREED WITH	1242, 1478, 1308	
1201	SD-WAP	605081	F	8	HOLD	SD-WAP	BREED WITH	1242, 1478, 1308	
1224	SD-WAP	606065	F	7	HOLD	SD-WAP	BREED WITH	1242, 1478, 1308	
1236	NY BRONX	M08034	M	7	HOLD	NY BRONX	DO NOT BREED		Excluded
1237	SAN ANTON	A06078	F	7	HOLD	SAN ANTON	BREED WITH	1384	
1241	SAN ANTON	Y06076	F	7	SEND TO	LOSANGELE	BREED WITH	1135	
1242	GUADALJR	M02903	M	7	SEND TO	SD-WAP	BREED WITH	1057, 1200, 1201, 1224, 1268, 1404, 1301, 1499, 1317, 1259	See Notes
1259	SD-WAP	607079	F	6	HOLD	SD-WAP	BREED WITH	1242, 1478, 1308	
1260	SD-WAP	607081	F	6	SEND TO	PUEBLA	DO NOT BREED		See Notes
1268	SD-WAP	608052	F	5	HOLD	SD-WAP	BREED WITH	1242, 1478, 1308	
1270	SD-WAP	608058	F	5	HOLD	SD-WAP	SEE NOTES		
1296	NY BRONX	M09048	M	4	HOLD	NY BRONX	DO NOT BREED		
1301	SD-WAP	609064	F	4	HOLD	SD-WAP	BREED WITH	1242, 1478, 1308	
1304	SD-WAP	609069	M	4	SEND TO	NY BRONX	DO NOT BREED		
1308	NY BRONX	M09049	M	4	SEND TO	SD-WAP	BREED WITH	1057, 1200, 1201, 1224, 1268, 1404, 1301, 1499, 1317, 1259	See Notes
1317	SD-WAP	609082	F	4	HOLD	SD-WAP	BREED WITH	1242, 1478, 1308	
1321	NY BRONX	M09100	M	4	HOLD	NY BRONX	DO NOT BREED		
1332	DALLAS	09J971	F	9	HOLD	DALLAS	SEE NOTES		Excluded
1333	DALLAS	09J972	F	9	HOLD	DALLAS	SEE NOTES		Excluded
1334	DALLAS	09J974	M	9	HOLD	DALLAS	SEE NOTES		Excluded
1335	DALLAS	09J967	M	9	HOLD	DALLAS	SEE NOTES		Excluded
1336	DALLAS	09J970	F	8	HOLD	DALLAS	SEE NOTES		Excluded
1338	DALLAS	09J975	F	5	HOLD	DALLAS	SEE NOTES		Excluded
1339	DALLAS	09J976	F	5	HOLD	DALLAS	SEE NOTES		Excluded
1360	SD-WAP	610069	M	3	SEND TO	NY BRONX	DO NOT BREED		
1384	NY BRONX	M10088	M	3	SEND TO	SAN ANTON	BREED WITH	1149, 1131, 1237, 1387, 1394	See Notes

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SB ID	Location	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
1385	SAN ANTON	A10043	F	3	HOLD	SAN ANTON	BREED WITH	1384	
1386	NY BRONX	M10089	M	3	HOLD	NY BRONX	DO NOT BREED		
1387	SAN ANTON	A10060	F	3	HOLD	SAN ANTON	BREED WITH	1384	
1388	NY BRONX	M10090	M	3	HOLD	NY BRONX	DO NOT BREED		
1393	NY BRONX	M10113	M	3	HOLD	NY BRONX	DO NOT BREED		
1394	SAN ANTON	Y10046	F	3	HOLD	SAN ANTON	BREED WITH	1384	
1397	GUADALJR	M03667	F	2	HOLD	GUADALJR	BREED WITH	1480, 1490	
1398	DALLAS	11L005	F	2	HOLD	DALLAS	SEE NOTES		Excluded
1399	DALLAS	11L006	F	2	HOLD	DALLAS	SEE NOTES		Excluded
1404	SD-WAP	611091	F	2	HOLD	SD-WAP	BREED WITH	1242, 1478, 1308	
1410	SD-WAP	611099	F	2	HOLD	SD-WAP	SEE NOTES		
1425	FORTWORTH	206772	M	2	HOLD	FORTWORTH	SEE NOTES		Excluded
1426	FORTWORTH	206773	M	2	HOLD	FORTWORTH	SEE NOTES		Excluded
1427	DALLAS	11L030	M	2	HOLD	DALLAS	SEE NOTES		Excluded
1428	DALLAS	11L051	M	2	HOLD	DALLAS	SEE NOTES		Excluded
1429	DALLAS	11L052	F	2	HOLD	DALLAS	SEE NOTES		Excluded
1447	SD-WAP	612089	F	1	SEND TO	BATONROUG	DO NOT BREED		
1462	SD-WAP	612143	F	1	SEND TO	BATONROUG	DO NOT BREED		
1464	SD-WAP	612149	F	1	HOLD	SD-WAP	SEE NOTES		
1477	GUADALJR	M03796	F	1	HOLD	GUADALJR	BREED WITH	1480, 1490	
1478	GUADALJR	M03913	M	0	SEND TO	SD-WAP	BREED WITH	1057, 1200, 1201, 1224, 1268, 1404, 1301, 1499, 1317, 1259	See Notes
1479	GUADALJR	M03914	F	0	HOLD	GUADALJR	BREED WITH	1480, 1490	
1480	SD-WAP	613072	M	0	SEND TO	GUADALJR	BREED WITH	992, 1031, 1397, 1477, 1479	
1481	SD-WAP	613073	M	0	HOLD	SD-WAP	DO NOT BREED		
1482	SD-WAP	613081	M	0	HOLD	SD-WAP	DO NOT BREED		
1487	SD-WAP	613089	F	0	SEND TO	PUEBLA	DO NOT BREED		See Notes
1488	SD-WAP	613095	M	0	HOLD	SD-WAP	DO NOT BREED		
1489	SD-WAP	613096	M	0	HOLD	SD-WAP	DO NOT BREED		
1490	SD-WAP	613097	M	0	SEND TO	GUADALJR	BREED WITH	992, 1031, 1397, 1477, 1479	
1491	SD-WAP	613098	F	0	HOLD	SD-WAP	SEE NOTES		
1492	SD-WAP	613102	M	0	HOLD	SD-WAP	DO NOT BREED		
1493	SD-WAP	613103	M	0	HOLD	SD-WAP	DO NOT BREED		
1494	SD-WAP	613104	M	0	HOLD	SD-WAP	DO NOT BREED		
1495	SD-WAP	613125	M	0	HOLD	SD-WAP	DO NOT BREED		
1496	SD-WAP	613126	M	0	HOLD	SD-WAP	DO NOT BREED		
1497	SD-WAP	613138	F	0	SEND TO	PUEBLA	DO NOT BREED		See Notes
1499	SD-WAP	613212	F	0	HOLD	SD-WAP	BREED WITH	1242, 1478, 1308	
1500	SD-WAP	613219	M	0	HOLD	SD-WAP	DO NOT BREED		

Recommendations By Institution

BATONROUG
BREC's Baton Rouge Zoo
Baton Rouge, LA

Institutional Note: Female 1105 is currently the most genetically valuable female in the United States. Please consider transferring her to LOSANGELE for a breeding recommendation.

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
1105	9174	F	12	SEND TO	LOSANGELE	BREED WITH	1135	
1106	9175	M	12	HOLD	BATONROUG	DO NOT BREED		Excluded
1107	9176	M	12	HOLD	BATONROUG	DO NOT BREED		Excluded
1447	612089	F	1	RECEIVE FROM	SD-WAP	DO NOT BREED		
1462	612143	F	1	RECEIVE FROM	SD-WAP	DO NOT BREED		

DALLAS
Dallas Zoo
Dallas, TX

Institutional Note: Because of uncertain pedigrees, your institution's animals were not given specific breeding recommendations. Please breed to meet your institutional needs.

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
1332	09J971	F	9	HOLD	DALLAS	SEE NOTES		Excluded
1333	09J972	F	9	HOLD	DALLAS	SEE NOTES		Excluded
1334	09J974	M	9	HOLD	DALLAS	SEE NOTES		Excluded
1335	09J967	M	9	HOLD	DALLAS	SEE NOTES		Excluded
1336	09J970	F	8	HOLD	DALLAS	SEE NOTES		Excluded
1338	09J975	F	5	HOLD	DALLAS	SEE NOTES		Excluded
1339	09J976	F	5	HOLD	DALLAS	SEE NOTES		Excluded
1398	11L005	F	2	HOLD	DALLAS	SEE NOTES		Excluded
1399	11L006	F	2	HOLD	DALLAS	SEE NOTES		Excluded
1427	11L030	M	2	HOLD	DALLAS	SEE NOTES		Excluded
1428	11L051	M	2	HOLD	DALLAS	SEE NOTES		Excluded
1429	11L052	F	2	HOLD	DALLAS	SEE NOTES		Excluded

FORTWORTH
Fort Worth Zoo
Fort Worth, TX

Institutional Note: Because of uncertain pedigrees, your institution's animals were not given specific breeding recommendations. If your institution would like to hold a breeding group of pedigreed animals, please contact the Program Coordinator.

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
1425	206772	M	2	HOLD	FORTWORTH	SEE NOTES		Excluded
1426	206773	M	2	HOLD	FORTWORTH	SEE NOTES		Excluded

GUADALJR

Guadalajara Zoo

Guadalajara, Jalisco, Mexico

Institutional Note: Your institution's Nubian ibex are the most genetically valuable in the managed population as they represent founder lineages no longer present in the United States. However, they are very closely related to one another. An exchange of animals between SD-WAP and GUADALJR could significantly improve the genetic diversity of the population, and reduce inbreeding. After this initial international exchange of Nubian ibex, GUADALJR and PUEBLA are likely to receive breeding recommendations between institutions in the next plan.

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
992	M01328	F	17	HOLD	GUADALJR	BREED WITH	1480, 1490	
1031	M01619	F	15	HOLD	GUADALJR	BREED WITH	1480, 1490	
1242	M02903	M	7	SEND TO	SD-WAP	BREED WITH	1057, 1200, 1201, 1224, 1268, 1404, 1301, 1499, 1317, 1259	
1397	M03667	F	2	HOLD	GUADALJR	BREED WITH	1480, 1490	
1477	M03796	F	1	HOLD	GUADALJR	BREED WITH	1480, 1490	
1478	M03913	M	0	SEND TO	SD-WAP	BREED WITH	1057, 1200, 1201, 1224, 1268, 1404, 1301, 1499, 1317, 1259	
1479	M03914	F	0	HOLD	GUADALJR	BREED WITH	1480, 1490	
1480	613072	M	0	RECEIVE FROM	SD-WAP	BREED WITH	992, 1031, 1397, 1477, 1479	
1490	613097	M	0	RECEIVE FROM	SD-WAP	BREED WITH	992, 1031, 1397, 1477, 1479	

LOSANGELE

Los Angeles Zoo

Los Angeles, CA

Institutional Note: This is a high-priority breeding group, as these females are some of the most genetically valuable animals in the United States.

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
1135	990972	M	11	HOLD	LOSANGELE	BREED WITH	1105, 1241, 1385	
1105	9174	F	12	RECEIVE FROM	BATONROUG	BREED WITH	1135	
1241	Y06076	F	7	RECEIVE FROM	SAN ANTON	BREED WITH	1135	
1385	A10043	F	3	RECEIVE FROM	SAN ANTON	BREED WITH	1135	

NY BRONX
Bronx Zoo
Bronx, NY

Institutional Note: Your institution's Nubian ibex are the most genetically valuable males in the United States. Please consider transferring 2 males for breeding recommendations. Placing these males in breeding situations could significantly increase the genetic diversity of the population. Please contact the Program Coordinator if you would prefer not to receive 2 replacement males.

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
1236	M08034	M	7	HOLD	NY BRONX	DO NOT BREED		Excluded
1296	M09048	M	4	HOLD	NY BRONX	DO NOT BREED		
1308	M09049	M	4	SEND TO	SD-WAP	BREED WITH	1057, 1200, 1201, 1224, 1268, 1404, 1301, 1499, 1317, 1259	See Notes
1321	M09100	M	4	HOLD	NY BRONX	DO NOT BREED		
1384	M10088	M	3	SEND TO	SAN ANTON	BREED WITH	1131, 1149, 1237, 1387, 1394	See Notes
1386	M10089	M	3	HOLD	NY BRONX	DO NOT BREED		
1388	M10090	M	3	HOLD	NY BRONX	DO NOT BREED		
1393	M10113	M	3	HOLD	NY BRONX	DO NOT BREED		
1304	609069	M	4	RECEIVE FROM	SD-WAP	DO NOT BREED		
1360	610069	M	3	RECEIVE FROM	SD-WAP	DO NOT BREED		

PUEBLA
Africam Safari
Puebla, Mexico

Institutional Note: Females transferred from SD-WAP will receive breeding recommendations with a male from GUADALJR, if one becomes available, in the next plan.

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
1260	607081	F	6	RECEIVE FROM	SD-WAP	DO NOT BREED		
1487	613089	F	0	RECEIVE FROM	SD-WAP	DO NOT BREED		
1497	613138	F	0	RECEIVE FROM	SD-WAP	DO NOT BREED		

SAN ANTON
San Antonio Zoo and Aquarium
San Antonio, TX

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
1131	A02005	F	11	HOLD	SAN ANTON	BREED WITH	1384	
1149	A03002	F	10	HOLD	SAN ANTON	BREED WITH	1384	
1237	A06078	F	7	HOLD	SAN ANTON	BREED WITH	1384	
1241	Y06076	F	7	SEND TO	LOSANGELE	BREED WITH	1135	
1385	A10043	F	3	SEND TO	LOSANGELE	BREED WITH	1135	
1387	A10060	F	3	HOLD	SAN ANTON	BREED WITH	1384	
1394	Y10046	F	3	HOLD	SAN ANTON	BREED WITH	1384	
1384	M10088	M	3	RECEIVE FROM	NY BRONX	BREED WITH	1131, 1149, 1237, 1387, 1394	

SD-WAP
San Diego Zoo Safari Park
Escondido, CA

Institutional Note: Please consider an exchange of Nubian ibex between your institution and GUADALJR, as they

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
1057	699126	F	14	HOLD	SD-WAP	BREED WITH	1242, 1478, 1308	
1159	603113	M	10	SEE NOTES	SD-WAP	DO NOT BREED		Available
1200	605080	F	8	HOLD	SD-WAP	BREED WITH	1242, 1478, 1308	
1201	605081	F	8	HOLD	SD-WAP	BREED WITH	1242, 1478, 1308	
1224	606065	F	7	HOLD	SD-WAP	BREED WITH	1242, 1478, 1308	
1259	607079	F	6	HOLD	SD-WAP	BREED WITH	1242, 1478, 1308	
1260	607081	F	6	SEND TO	PUEBLA	DO NOT BREED		Future breeder
1268	608052	F	5	HOLD	SD-WAP	BREED WITH	1242, 1478, 1308	
1270	608058	F	5	HOLD	SD-WAP	SEE NOTES		
1301	609064	F	4	HOLD	SD-WAP	BREED WITH	1242, 1478, 1308	
1304	609069	M	4	SEND TO	NY BRONX	DO NOT BREED		
1317	609082	F	4	HOLD	SD-WAP	BREED WITH	1242, 1478, 1308	
1360	610069	M	3	SEND TO	NY BRONX	DO NOT BREED		
1404	611091	F	2	HOLD	SD-WAP	BREED WITH	1242, 1478, 1308	
1410	611099	F	2	HOLD	SD-WAP	SEE NOTES		
1447	612089	F	1	SEND TO	BATONROUG	DO NOT BREED		
1462	612143	F	1	SEND TO	BATONROUG	DO NOT BREED		
1464	612149	F	1	HOLD	SD-WAP	SEE NOTES		
1480	613072	M	0	SEND TO	GUADALJR	BREED WITH	992, 1031, 1397, 1477, 1479	
1481	613073	M	0	HOLD	SD-WAP	DO NOT BREED		
1482	613081	M	0	HOLD	SD-WAP	DO NOT BREED		
1487	613089	F	0	SEND TO	PUEBLA	DO NOT BREED		Future breeder
1488	613095	M	0	HOLD	SD-WAP	DO NOT BREED		
1489	613096	M	0	HOLD	SD-WAP	DO NOT BREED		
1490	613097	M	0	SEND TO	GUADALJR	BREED WITH	992, 1031, 1397, 1477, 1479	
1491	613098	F	0	HOLD	SD-WAP	SEE NOTES		
1492	613102	M	0	HOLD	SD-WAP	DO NOT BREED		
1493	613103	M	0	HOLD	SD-WAP	DO NOT BREED		
1494	613104	M	0	HOLD	SD-WAP	DO NOT BREED		
1495	613125	M	0	HOLD	SD-WAP	DO NOT BREED		
1496	613126	M	0	HOLD	SD-WAP	DO NOT BREED		
1497	613138	F	0	SEND TO	PUEBLA	DO NOT BREED		Future breeder
1499	613212	F	0	HOLD	SD-WAP	BREED WITH	1242, 1478, 1308	
1500	613219	M	0	HOLD	SD-WAP	DO NOT BREED		
1242	M02903	M	7	RECEIVE FROM	GUADALJR	BREED WITH	1057, 1200, 1201, 1224, 1268, 1404, 1301, 1499, 1317, 1259	
1478	M03913	M	0	RECEIVE FROM	GUADALJR	BREED WITH	1057, 1200, 1201, 1224, 1268, 1404, 1301, 1499, 1317, 1259	
1308	M09049	M	4	SEND TO	SD-WAP	BREED WITH	1057, 1200, 1201, 1224, 1268, 1404, 1301, 1499, 1317, 1259	

have the most genetically valuable males in the managed population. Your institution is recommended to receive a genetically valuable breeding male from NY BRONX in the interim. Females listed with no breeding recommendation may be bred with males 1242, 1478, and 1308 to meet institutional needs.

Appendix A
Analytical Assumptions

Assumptions to resolve unknown pedigree for living animals.

SB#	Sire	New Sire	Dam	New Dam	Notes
15	MULT14	42	MULT15	44	These potential sires and dams all trace back to the early CLEVELAND imports, 42 and 44.
19	UNK	WILD7	UNK	WILD8	This animals was imported from HAI BAR to OKLAHOMA in 1964, assume unrelated to the rest of the population.
31	UNK	WILD9	UNK	WILD10	This animal was transferred from BERLIN TP to OKLAHOMA in 1969, assume unrelated to the rest of the population.
130	UNK	WILD11	UNK	WILD12	Individuals 130-135 were imported to LOSANGELE from HAI BAR in 1976. Assume half-sibs and unrelated to the rest of the population.
131	UNK	WILD11	UNK	WILD13	
132	UNK	WILD11	UNK	WILD14	
133	UNK	WILD11	UNK	WILD15	
134	UNK	WILD11	UNK	WILD16	
135	UNK	WILD11	UNK	WILD17	
240	UNK	WILD1	UNK	WILD18	Assume 240, 244, 243 and 242 are all half sibs from HAI BAR and unrelated to the rest of the population.
242	UNK	WILD1	UNK	WILD2	
243	UNK	WILD1	UNK	WILD3	
244	UNK	WILD1	UNK	WILD4	
529	UNK	MULT999	UNK	MULT998	Phoenix did not keep Nubian ibex records prior to 1989. Their animals could be related to those from institutions breeding in the early and mid-1980's (SANDIEGOZ, OKLAHOMA, LOSANGELE). Sire and dam MULTs were created to represent all of these lineages that descend from HAI BAR and BERLIN TP transfers into N. America during the 1950's through 1981.
593	UNK	MULT999	UNK	MULT998	The parents of this individual at GUADALAJR are related to unknown PHOENIX animals from the 1980's.
665	UNK	MULT999	UNK	MULT998	Phoenix did not keep Nubian ibex records prior to 1989. Their animals could be related to those from institutions breeding in the early and mid-1980's (SANDIEGOZ, OKLAHOMA, LOSANGELE). Sire and dam MULTs were created to represent all of these lineages that descend from HAI BAR and BERLIN TP transfers into N. America during the 1950's through 1981.
666	UNK	MULT999	UNK	MULT998	
671	UNK	MULT999	UNK	MULT998	
672	UNK	MULT999	UNK	MULT998	
984	UNK	242	UNK	MULT996	HOLIDAY received animals from SANDIEGOZ and SD-WAP. Assume related to their lineages.
986	UNK	242	UNK	MULT996	
987	UNK	242	UNK	MULT996	
42	UNK	WILD5	UNK	WILD6	Individuals 42 and 44 were transferred to CLEVELAND from L RUHE in 1955, making them the first imports to N. America since the 1930's. Assume unrelated to earlier 1920's and 1930's imports.
44	UNK	WILD19	UNK	WILD20	
992	MULT109	MULT999	520		Related to unknown PHOENIX animals from the 1980's.

Appendix B
Summary of Data Exports

Report compiled under PopLink V. 2.4 and Population Management x, V. 1.2.
PMx Project: Nubian_ibex_2013
Report compiled under Population Management x, version 1.2
10/1/2013 Comments: for 2013 breeding and transfer plan

Studbook information:
Data compiled by: Alison Mott
Data current thru: 6/1/2013
Scope of data: North America

Demographic data from:
Demographic data from: C:\Documents and Settings\asputnam\My Documents\PMx\PMx_Projects\ Nubian_ibex 2013\PMx Export\ Nubian_ibex _2013.csv
Demographic filter conditions:
Locations = N.AMERICA, MEXICO, During 1/1/1960 – 10/1/2013, Status = Living

Birth flow was set to 'Pulse' because of a statistically significant ($P < 0.05$) non-random distribution of births across months using a Chi-squared test.

Genetic data from:
C:\Documents and Settings\asputnam\My Documents\PMx\PMx_Projects\ Nubian_ibex _2013\PMx Export\ Nubian_ibex _2013.ped
Genetic filter conditions:
Locations = N.AMERICA, MEXICO, During 1/1/1960 – 10/1/2013, Status = Living

Appendix C
Life Tables

MALES								
Age	**Qx**	**Px**	**lx**	**Mx**	**Vx**	**Ex**	**Risk (Qx)**	**Risk (Mx)**
0	0.34	0.66	1.00	0.004	1.20	6.87	422.7	422.7
1	0.11	0.89	0.66	0.119	1.95	7.78	224.6	224.6
2	0.07	0.93	0.59	0.297	2.48	7.44	150.5	150.5
3	0.07	0.93	0.55	0.450	2.87	6.91	123.8	123.8
4	0.10	0.90	0.51	0.775	3.26	6.46	103.2	103.2
5	0.10	0.90	0.46	0.708	3.40	6.07	87.6	87.6
6	0.11	0.89	0.42	1.237	3.70	5.67	75.2	75.2
7	0.18	0.82	0.37	1.218	3.54	5.46	62.2	62.2
8	0.02	0.98	0.30	0.999	3.19	5.00	52.2	52.2
9	0.18	0.82	0.30	1.588	2.99	4.43	46.4	46.4
10	0.18	0.82	0.24	1.209	2.11	4.18	36.5	36.5
11	0.20	0.80	0.20	0.600	1.36	3.92	26.5	26.5
12	0.28	0.72	0.16	0.213	1.22	3.81	19.0	19.0
13	0.07	0.93	0.12	0.754	1.53	3.47	14.4	14.4
14	0.23	0.77	0.11	0.690	1.12	2.89	12.0	12.0
15	0.20	0.80	0.08	0.435	0.67	2.42	9.6	9.6
16	0.50	0.50	0.07	0.437	0.44	2.13	6.0	6.0
17	0.00	1.00	0.03	0.000	0.00	1.70	4.0	4.0
18	0.80	0.20	0.03	0.000	0.00	1.16	3.3	3.3
19	1.00	0.00	0.01	0.000	0.00	1.00	0.1	0.1

Qx = mortality; Px = survival; lx = cumulative survivorship; Mx = fecundity; Vx = reproductive value; Ex = life expectancy
At Risk (Qx and Mx) = number of animals corresponding values are estimated from
r = 21; lambda = 1.230; T = 5.1

FEMALES								
Age	**Qx**	**Px**	**lx**	**Mx**	**Vx**	**Ex**	**Risk (Qx)**	**Risk (Mx)**
0	0.32	0.68	1.00	0.007	1.19	7.62	462.3	462.3
1	0.10	0.90	0.68	0.252	1.76	8.57	298.6	298.6
2	0.08	0.92	0.62	0.415	1.92	8.32	230.7	230.7
3	0.08	0.92	0.57	0.481	1.88	7.95	194.4	194.4
4	0.08	0.92	0.52	0.461	1.75	7.54	165.6	165.6
5	0.09	0.91	0.48	0.432	1.62	7.11	145.0	145.0
6	0.12	0.88	0.44	0.435	1.53	6.81	119.8	119.8
7	0.08	0.92	0.39	0.419	1.40	6.44	102.7	102.7
8	0.05	0.95	0.36	0.335	1.21	5.82	90.9	90.9
9	0.12	0.88	0.34	0.425	1.10	5.26	79.8	79.8
10	0.16	0.84	0.30	0.204	0.90	4.93	67.6	67.6
11	0.12	0.88	0.25	0.198	0.93	4.58	53.8	53.8
12	0.10	0.90	0.22	0.216	0.95	4.04	43.3	43.3
13	0.19	0.81	0.20	0.440	0.99	3.55	35.4	35.4
14	0.13	0.87	0.16	0.142	0.76	3.05	28.9	28.9
15	0.36	0.64	0.14	0.173	0.94	2.68	22.6	22.6
16	0.44	0.56	0.09	0.066	1.45	2.75	14.1	14.1
17	0.16	0.84	0.05	0.197	2.40	2.64	7.9	7.9
18	0.28	0.72	0.04	0.176	3.24	2.09	6.3	6.3
19	0.62	0.38	0.03	0.394	6.11	1.88	3.5	3.5
20	0.44	0.56	0.01	0.514	15.51	2.07	1.6	1.6
21	0.00	1.00	0.01	1.029	24.20	1.50	1.0	1.0
22	1.00	0.00	0.01	53.451	53.45	1.00	0.7	0.7

Qx = mortality; Px = survival; lx = cumulative survivorship; Mx = fecundity; Vx = reproductive value; Ex = life expectancy
At Risk (Qx and Mx) = number of animals corresponding values are estimated from
r = 0.143; lambda = 1.154; T = 4.3

Appendix D
Individuals Excluded from Genetic Analyses

Studbook ID	Sex	Age	Location	Reason for Exclusion
1106	M	12	BATONROUG	Neutered
1107	M	12	BATONROUG	Neutered
1236	M	7	NY BRONX	Neutered
1332	F	9	DALLAS	Unknown pedigree
1333	F	9	DALLAS	Unknown pedigree
1334	M	9	DALLAS	Unknown pedigree
1335	M	9	DALLAS	Unknown pedigree
1336	F	8	DALLAS	Unknown pedigree
1338	F	5	DALLAS	Unknown pedigree
1339	F	5	DALLAS	Unknown pedigree
1398	F	2	DALLAS	Unknown pedigree
1399	F	2	DALLAS	Unknown pedigree
1425	M	2	FORTWORTH	Unknown pedigree
1426	M	2	FORTWORTH	Unknown pedigree
1427	M	2	DALLAS	Unknown pedigree
1428	M	2	DALLAS	Unknown pedigree
1429	F	2	DALLAS	Unknown pedigree

Appendix E
Ordered Mean Kinships

Note: This list is current to June 1st, 2013. Values are subject to change with any birth, death, import, export, inclusion, or exclusion. **Average Population MK = 0.2970.**

MALES

SB#	MK	% Known	Age	Location
1478	0.1095	100	0	GUADALJR
1242	0.1103	100	7	GUADALJR
1308	0.2709	100	4	NY BRONX
1384	0.2756	100	3	NY BRONX
1386	0.2796	100	3	NY BRONX
1296	0.2796	100	4	NY BRONX
1393	0.2796	100	3	NY BRONX
1388	0.2814	100	3	NY BRONX
1321	0.2814	100	4	NY BRONX
1135	0.297	100	11	LOSANGELE
1492	0.3466	100	0	SD-WAP
1480	0.3473	100	0	SD-WAP
1481	0.3473	100	0	SD-WAP
1495	0.3489	100	0	SD-WAP
1496	0.3489	100	0	SD-WAP
1304	0.3638	100	4	SD-WAP
1482	0.3695	100	0	SD-WAP
1490	0.3723	100	0	SD-WAP
1360	0.3725	100	3	SD-WAP
1493	0.3725	100	0	SD-WAP
1494	0.3725	100	0	SD-WAP
1488	0.3811	100	0	SD-WAP
1489	0.3811	100	0	SD-WAP
1500	0.3871	100	0	SD-WAP
1159	0.3891	100	10	SD-WAP

FEMALES

SB#	MK	% Known	Age	Location
1031	0.0915	100	15	GUADALJR
992	0.1017	100	17	GUADALJR
1477	0.1045	100	1	GUADALJR
1397	0.1095	100	2	GUADALJR
1479	0.1095	100	0	GUADALJR
1105	0.1794	100	12	BATONROUG
1149	0.2025	100	10	SAN ANTON
1131	0.2105	100	11	SAN ANTON
1237	0.2111	100	7	SAN ANTON
1241	0.2151	100	7	SAN ANTON
1385	0.2756	100	3	SAN ANTON
1387	0.2796	100	3	SAN ANTON
1394	0.2796	100	3	SAN ANTON
1057	0.2983	100	14	SD-WAP
1200	0.2983	100	8	SD-WAP
1201	0.2998	100	8	SD-WAP
1224	0.303	100	7	SD-WAP
1268	0.3245	100	5	SD-WAP
1404	0.3388	100	2	SD-WAP
1301	0.3438	100	4	SD-WAP
1499	0.3465	100	0	SD-WAP
1317	0.3494	100	4	SD-WAP
1259	0.3498	100	6	SD-WAP
1410	0.3598	100	2	SD-WAP
1487	0.3598	100	0	SD-WAP
1260	0.3653	100	6	SD-WAP
1497	0.367	100	0	SD-WAP
1270	0.3676	100	5	SD-WAP
1491	0.3723	100	0	SD-WAP
1464	0.3799	100	1	SD-WAP
1447	0.3801	100	1	SD-WAP
1462	0.3869	100	1	SD-WAP

Appendix F
Definitions

Management Terms

Green Species Survival Plan® (Green SSP) Program– A Green SSP Program has a population size of 50 or more animals and is projected to retain 90% gene diversity for a minimum of 100 years or 10 generations. Green SSP Programs are subject to AZA's Full Participation and Non–Member Participation Policies.

Yellow Species Survival Plan® (Yellow SSP) Program – A Yellow SSP Program has a population size of 50 or more animals but cannot retain 90% gene diversity for 100 years or 10 generations. Yellow SSP participation by AZA institutions is voluntary.

Red Program – A Red Program has a population size of fewer than 50 animals. If the Taxon Advisory Group (TAG) recommends this species in their Regional Collection Plan (RCP), a Red Program will have an official AZA Regional Studbook but will not be required to produce a formal Breeding and Transfer Plan on a regular basis. Red Program participation by AZA institutions is voluntary.

Full Participation – AZA policy stating that all AZA accredited institutions and certified related facilities having a Green SSP animal in their collection are required to participate in the collaborative SSP planning process (e.g., provide relevant animal data to the AZA Studbook Keeper, assign an Institutional Representative who will communicate institutional wants and needs to the SSP Coordinator and comment on the draft plan during the 30-day review period, and abide by the recommendations agreed upon in the final plan).

All AZA member institutions and Animal Programs, regardless of management designation, must adhere to the AZA Acquisition and Disposition Policy, and well as the AZA Code of Professional Ethics. For more information on AZA policies, see http://www.aza.org/board-policies/.

Demographic Terms

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

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

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

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

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

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

Qx, Mortality – Probability that an individual of age *x* dies during time period. Qx = 1-Px

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.
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").

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

Genetic Terms

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

Current Gene Diversity (GD) -- The proportional gene diversity (as a proportion of the source population) is the probability that two alleles from the same locus sampled at random from the population will not be identical by descent. Gene diversity is calculated from allele frequencies, and is the heterozygosity expected in progeny produced by random mating, and if the population were in Hardy-Weinberg equilibrium.

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

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

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

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

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

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

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

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

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

Kinship Value (KV) – 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.

Appendix G
Directory of Institutional Representatives

Contact Name (IR)	Institution	Email Address	Phone
Sam Winslow	BATONROUG - BREC's Baton Rouge Zoo, Baker, LA	swinslow@brzoo.org	
Randy Barker	COLO SPRG - Cheyenne Mtn Zoological Park, Colorado Springs, CO	rbarker@cmzoo.org	(719) 633-9925 x118
Todd Bowsher	DALLAS - Dallas Zoo, Dallas, TX	todd.bowsher@dallaszoo.com	(469) 554-7210
Kurt Giesler	FORTWORTH - Fort Worth Zoological Park, Ft Worth, TX	KGiesler@fortworthzoo.org	(817) 759-7165
Liliana Bascal	GUDALJR- Guadalajara Zoo, Guadalajara, Mexico	labascal@zooguadalajara.com.mx	
Jeff Holland	LOSANGELE - Los Angeles Zoo & Botanical Gardens, Los Angeles, CA	jeff.holland@lacity.org	(323) 644-4220
Dr. David Powell	NY BRONX - Bronx Zoo/Wildlife Conservation Societ, Bronx, NY	dpowell@wcs.org	(718) 220-5162
Patrick Roux	OBTERRE -- Parc de la Haute-Touche, Obterre, France	roux@mnhn.fr	
Frank Carlos Camacho	PUEBLA - Africam Safari, Puebla, Mexico	fcamacho@africamsafari.com.mx	222 2817000 x239
John Gramieri	SAN ANTON - San Antonio Zoological Gardens & Aqua, San Antonio, TX	mammalcurator@sazoo.org	(210) 734-7184 x1330
Randy Reiches	SD-WAP - San Diego Zoo Safari Park, Escondido, CA	rrieches@sandiegozoo.org	(760) 738-5015

Appendix H

DESCRIPTIVE SURVIVAL STATISTICS REPORT

Nubian ibex Studbook

Capra nubiana

Studbook

Studbook data current as of 6/1/2013

Compiled by

Alison Mott

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PopLink Studbook filename: Ibex_Nubian_5Sept2013

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Data Filtered by: Locations = N.AMERICA, MEXICO AND

StartDate = 1/1/1960 AND EndDate = 9/30/2013

PopLink Version: 2.4

REPORT OVERVIEW:

Based on this analysis, if a Nubian ibex survives to its first birthday, its median life expectancy is 7.8 years. Please see the body of the report for more details.

BACKGROUND ON ANALYSES:

These analyses were conducted using animals that lived during the period 1 January 1960 to 30 September 2013 at institutions within N.AMERICA, MEXICO. The analyses mainly focus on survival statistics from 1 year (e.g. excluding any individuals that did not survive past their first birthday). These statistics most accurately reflect typical survival for animals, which can be seen on exhibit in zoos and aquariums.

This report summarizes survival records of individuals housed at zoological facilities for a specific geographic range and time period; these records trace an individual's history from birth or entry into the population to death, exit out of the population, or the end of the time period. As such, this history only reflects standard practices - including management, husbandry, and acquisition/disposition practices - for the specified time period and geographic range. Thus, the report contents should be viewed with some caution as they may not fully reflect current and newly emerging zoo and aquarium management techniques or practices. For example, if the population has not been maintained in zoos and aquariums long enough to have many adults living into old age, median life expectancy will likely be an underestimate until more data accrue in older age classes. Thus, users of these reports should recognize that the results produced will likely vary over time or depending on the subset of data selected.

Although for many species, including humans, survival statistics often differ for males and females, for these analyses male and female statistics were not statistically different[1]; these results therefore include pooled data from males, females, and unknown sex individuals.

SUMMARY OF ANALYSES:

SURVIVAL STATISTICS

The dataset used for analysis includes partial or full lifespans of 678 individuals, 329 (48.5%) of which had died by 30 September 2013.

If a Nubian ibex survives to its first birthday, its **median life expectancy**[2] is **7.8 years of age**. Given the quality of the data

- how many animals are in the database and how many have died - there is a 95% chance that the true median falls between 7.2 and 9.2 years of age (i.e., these are the 95% confidence limits). Only 25% of Nubian ibex can be expected to survive to be 12.5 years or older.

First-year (infant) survival[3] for Nubian ibex is 67%. The year after birth/hatching is a period of relatively low survival for many species and life histories.

The **maximum longevity**[4] observed for Nubian ibex is **22.4 years**; this longevity record is based on an individual which was DEAD as of the analysis end date (studbook number 671, sex = Female, origin = Captive Born, birth date estimate = None).[5]

The correct interpretation of these statistics is that, if it survives the first year of life, the 'typical' Nubian ibex will live 7.8 years; that half of all Nubian ibex can be expected to die before they reach 7.8 and half will live longer than 7.8; that only 25% of all Nubian ibex can be expected to live 12.5 years; and that it is rare but possible for Nubian ibex to live 22.4 years.

The median life expectancy, confidence interval, first-year survival, and maximum longevity may change as more data are accumulated, the population's age structure changes, or management practices improve.

While both median life expectancy and maximum longevity are discussed in this report, it is more appropriate to rely on median life expectancy to place the age of any one individual in context. To put these statistics in perspective, median life expectancy from age one for people in the United States is 77.5 years and the maximum longevity (documented worldwide) is 122 years[6]. Therefore, if a person lived to be 85 years old, the appropriate context is that they lived well beyond the median life expectancy (77.5), not that they fell short of the maximum longevity (122).

DATA QUALITY

The PopLink Survival Tool uses five data quality measures to determine whether data are robust enough to make reliable estimates of key survival parameters. **This population passed all of the following data quality tests:**

1. Can the median life expectancy be calculated? **PASS**
2. Is the sample size (number of individuals at risk) greater than 20 individuals at the median? **PASS**
3. Is the 95% Confidence Interval (CI) bounded? **PASS**
4. Is the sample size in the first age class of analysis (e.g. the first day of analysis) greater than 30 individuals? **PASS**
5. Is the length of the 95% CI < 33% of the maximum longevity? **PASS**

PopLink data validation has never been run; if errors are present in this studbook, they may affect the data in this analysis.

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[1] Statistical significance was determined by comparing 84% confidence intervals around median life expectancy for males and females, with 2 unknown sex individuals proportionally incorporated into the analysis. For this population, overlapping confidence intervals indicated that data could be pooled. See the PopLink manual for more details.

[2] The statistics analyzed for this report (median life expectancy, 95% confidence limits, and age to which 25% of individuals survive) exclude any individuals who did not survive to their first birthday; these individuals are excluded because this Report is focused on providing median survival estimates for the typical individual that survives the vulnerable infant stage. In other words, this report answers the question, 'how long is this species expected to live once it has reached its first birthday?' For this studbook, 449 individuals died before their first birthday and were excluded from these analyses.

For all animals that survive to their first birthday, 50% will die before the median life expectancy in this report and 50% die after. Note that the median life expectancy obtained from population management software (PM2000, PMx, ZooRisk) or from life tables in Breeding and Transfer Plans (e.g. where Lx = 0.5) will be lower because it includes these individuals that did not survive to their first birthday in order to project the correct number of births needed. See the PopLink manual for more details.

[3]For reference, first-year survival is provided. For this studbook and the selected demographic window, 449 individuals did not survive to their first birthday and were excluded from the estimates provided above (median life expectancy, 95% confidence limits, and age to which 25% of individuals survive).

[4] Maximum longevity is the age of the oldest known individual for this species, living or dead. It is not necessarily the biological maximum age, but only reflects the individuals included in the dataset.

[5] Censored individuals are individuals whose deaths have not been observed as of the end of the analysis window, including individuals who 1) are still alive as of the end date, 2) exited the geographic window before the end date (through transfer or release), or 3) were lost-to-follow up before the end date.

[6] Median life expectancy for people is estimated from: Xu, Jiaquan, Kochanek KD, Murphy SL, and Tejada-Vera B. 2007. Deaths: Final Data for 2007. National vital statistics reports; vol 58 no 19. Hyattsville, MD: National Center for Health Statistics. Jeanne Calment of France was the oldest documented and fully validated human and died at 122 years and 164 days; from: http://www.grg.org/Adams/Tables.htm. Accessed August 9, 2007.