Population Analysis and Breeding and Transfer Recommendations

Grey-winged Trumpeter (*Psophia crepitans*)
AZA Population Management Plan Program

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PMC
American Zoo and Aquarium Association
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Executive Summary
Grey-winged Trumpeter (*Psophia crepitans*) PMP

The Gruiformes Taxon Advisory Group has designated grey-winged trumpeters to be managed as a PMP with a target size of 80 specimens (2008 RCP). The population is currently 45 distributed among 18 institutions.

When gene diversity falls below 90% of that in the founding population, it is expected that reproduction will be increasingly compromised by, among other factors, lower hatch weights, smaller clutch sizes, and greater neonatal mortality. Gene diversity is currently 89%; GD is expected to be 29% at 100 years from present. Increases in population effective size (to 0.3) result in projections as high as 65% GD at 100 years.

Demography	
Current size of population (N) - Total (Males, Females, Unknown)	45 (19.25.1)
# animals excluded from management	0
Population size following exclusions	45
Target population size	80
Mean generation time (yrs)	6.99
Historic/Projected population growth rate (lambda)	1.04/1.04

Genetics (Genetic statistics calculated from the analytical studbook)	***Current***	***Potential***
Founders	13	9
Founder genome equivalents (FGE)	4.82	18.24
Gene diversity (GD%)	89.62	97.26
Population mean kinship (MK)	0.1038	
Mean inbreeding (F)	0.00	
Percentage of pedigree known before assumptions and exclusions	72	
Percentage of pedigree known after assumptions and exclusions	87	
Effective population size/census size ratio (Ne / N)	0.0936	
Years To 90% Gene Diversity	N/A	
Years to 10% Loss of Gene Diversity	6	
Gene Diversity at 100 Years From Present (%) Assuming λ = 1.04, Target size = 80	29	

Special Concerns: Breeding success in this population is very low. In spite of recommending 16 breeding pairs in the 2008 Breeding and Transfer Plan, only two pairs have produced offspring. At that time every male (the limiting sex in this population) in the population, with the exception of one housed in a sibling pair, was recommended to breed. While the growth facilitated by 2 successful pairings was sufficient to maintain the population size, the resulting offspring they do not represent a genetically diverse sample and recruitment of additional breeding pairs is necessary for the long-term management of this population. Institutions receiving breeding recommendations are strongly encouraged to prioritize the successful propagation of this species.

As with SSP populations, pairings recommended for this population are prioritized to maintain or increase gene diversity through considerations of mean kinship, avoidance of inbreeding and differences in sire and dam mean kinships. In the interest of demographic stability some over-represented proven breeders continue to receive breeding recommendations. As in 2008, every male that can receive a breeding recommendation will be recommended to breed.

Summary Actions: The PMP recommends 7 transfers and 17 breeding pairs. The PMP also recommends that all paired birds, including those not recommended for current breeding, be maintained under conditions conducive to breeding. Pairs should be encouraged to engage in courtship, nesting and incubating behaviors. Low rates of pairing success presents a significant challenge to the maintenance of this population; it is hoped that encouraging these behaviors will facilitate breeding if/when these animals can be placed in more genetically suitable pairings in the future.

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The planning meeting for the grey-winged trumpeter was held via email the week of June 21, 2010.

This plan was prepared and distributed with the assistance of the AZA Population Management Center.
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Description of Population Status
Grey-winged Trumpeter (*Psophia crepitans*) PMP

Introduction: The Gruiformes Taxon Advisory Group has designated grey-winged trumpeters to be managed as a PMP with a target size of 80 specimens (2008 RCP). Genetic and demographic analyses of the population were performed in June 2010 resulting in the current Breeding and Transfer Plan. Analyses were performed on the analytical (XX) version of the North American Regional Grey-winged Trumpeter Studbook (current to 1 June 2010) using POPLINK 1.25 and PM2000 1.213. The goal of these recommendations is to insure the genetic and demographic health of the population. Recommendations proposed in a Population Management Plan are non-binding; participation is voluntary.

Managed Population: The current population is 45 distributed among 18 institutions.

Special Concerns: Breeding success in this population is very low. In spite of recommending 16 breeding pairs in the 2008 Breeding and Transfer Plan, only two pairs have produced offspring. At that time every male (the limiting sex in this population) in the population, with the exception of one housed in a sibling pair, was recommended to breed. While the growth facilitated by 2 successful pairings was sufficient to maintain the population size, the resulting offspring they do not represent a genetically diverse sample and recruitment of additional breeding pairs is necessary for the long-term management of this population. Institutions receiving breeding recommendations are strongly encouraged to prioritize the successful propagation of this species.

As with SSP populations, pairings recommended for this population are prioritized to maintain or increase gene diversity through considerations of mean kinship, avoidance of inbreeding and differences in sire and dam mean kinships. In the interest of demographic stability some over-represented proven breeders continue to receive breeding recommendations. As in 2008, every male that can receive a breeding recommendation will be recommended to breed.

Demography: The grey-winged trumpeters were first exhibited in North America in 1905 but were held only sporadically until 1980; it was not until the mid 1980s that captive hatches occurred in any significant numbers Figure 1). The population's failure to maintain consistent hatch rates over the past decade is of some concern. It is unknown at this time whether the failure of this population to maintain its size is due to an inability to propagate the species or simply due to the species not being the focus of propagation efforts. Institutions receiving breeding recommendations are asked to make serious attempts to achieve successful reproduction; it is hoped that such efforts will result in consistent growth rates and the population will begin to move toward the recommended target size and the large number of requests for additional specimens can be filled.

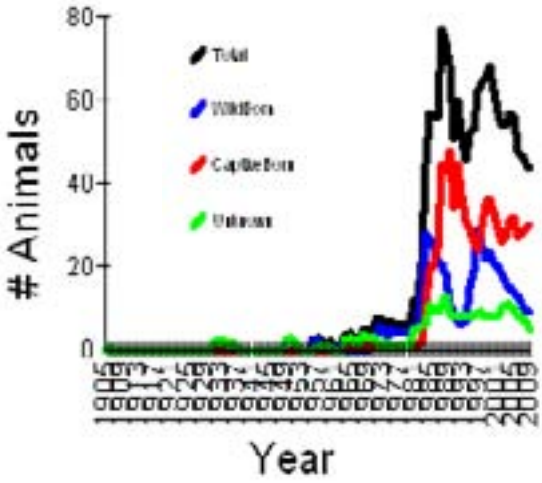

Figure 1. Population census.

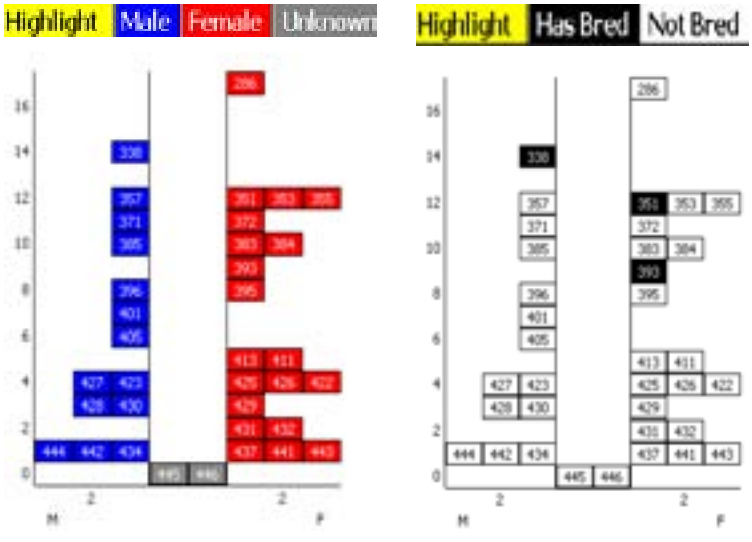

Figure 2. Age structure in the PMP by sex and by breeding success UNK age animals do not appear.

Demographic data for this population is lacking as a result of small population size combined with a short history of breeding in captivity. Captive trumpeter populations in general lack data regarding life span, reproductive span, and vital rates. Model data sets for similar species are also unavailable or limited. Lifespan may be greater than 30 years. The oldest living grey-winged trumpeter is currently 23 years old but historic records include animals as old as 28 years. Chick mortality is moderate with less than 36% of chicks failing to survive their first year.

The age distribution (Figure 2) deviates from a stable one with several empty age classes and a disproportionate number of individuals in the middle age classes relative to younger ones. This distribution illustrates a decrease in population growth rates as importations have slowed, attrition of the aging wild caught specimens has increased, and captive propagation has not increased at a compensatory rate. The sex ratio is female biased (17.26.2). Reproduction has been recorded in known-aged animals from the ages of 1 to 15 years in males and 1 to 10 years in females; some animals of unknown age may have bred at older ages. Some reproduction in the earliest age classes may be an artifact of data entry conventions assuming wild caught birds to be one year of age at time of capture. There is some concern that the proven breeders may soon become post-reproductive.

Genetics: The population is descended from 13 founders, with 9 potential founders remaining in the living population. However, all of these potential founders are currently over the age of nine years and may be unlikely to be recruited as breeders.

GENETICS	***Current***	***Potential***
Number of Founders	13	9
Founder Genome Equivalents	4.82	18.24
Gene Diversity Retained (%)	89.62	97.26
Population Mean Kinship	0.1038	
Mean Inbreeding (F)	0	
% Known Pedigree before assumptions/exclusions	72	
% Known Pedigree after assumptions/exclusions	15	
N_e/N	0.09	
Years To 90% Gene Diversity	n/a	
Years To 10% Gene Diversity loss	6	
Gene Diversity at 100 Years From Present (%)	29	

*projections are calculated using the analytical studbook

Gene diversity (GD) in the population (89%) is low relative to the average SSP (93%); potential gene diversity is very high at 97%. Long-term projections indicate that given current population parameters and a target population size of 100, GD is likely to be as low as 29% in 100 years. Potential founder recruitment could lessen rates of GD loss but the remaining potential founders are all greater than nine years of age.

Perhaps more likely and productive than potential founder recruitment to gene diversity retention in grey-winged trumpeters is the population effective size. Currently N_e/N in this population is 0.09, much lower than values close to 0.3 typically seen in monogamous breeders. Increasing the proportion of breeders in the population to 0.3, even in the absence of further potential founder recruitment, increases projected GD at 100 years to 64%.

Figure 3 Founder representation in the pmp illustrating the large number of potential founders..

Management Strategy: Eight hatches are required in the coming year to maintain the current population size. An annual growth rate of 4% (lambda = 1.04) is projected to result in the population target size (80) in approximately 15 years and requires approximately 14 hatches per annum in the coming years. Unfortunately, given skewed sex ratio, only 17 pairs could be recommended.

Parent rearing is considered to be an important factor in the future breeding success of grey-winged trumpeters. Double-clutching is encouraged in cases where multiple clutches can be obtained without excluding parent rearing. In the event that hand-rearing is necessitated, ghost, isolation, or puppet rearing is recommended.

Recommended pairings include some over-represented specimens in the interest of demographic stability. The only animals not recommended to breed are individuals in sibling pairs, and females for which males are unavailable due to the sex ratio bias.

1. Recommend 17 pairings in the coming year. Double clutches should be attempted where possible without sacrificing parent rearing.

2. Recommend 7 transfers to create breeding pairs and to fill exhibit requests.

3. Recommend that all paired birds, including those not recommended for current breeding, be maintained under conditions conducive to breeding. Pairs should be encouraged to engage in courtship, nesting and incubating behaviors. Low rates of pairing success presents a significant challenge to the maintenance of this population; it is hoped that encouraging these behaviors will facilitate breeding if/when these animals can be placed in more genetically suitable pairings in the future.

Summary of Breeding and Transfer Recommendations

ID	Location	Local ID	Sex	Disposition	Location	Breeding	With	Notes
423	BIODOME	2519	M	HOLD	BIODOME	BREED WITH	441	
441	BIODOME	2715	F	HOLD	BIODOME	BREED WITH	423	
371	BIRMINGHM	B01001	M	HOLD	BIRMINGHM	BREED WITH	372	
372	BIRMINGHM	B01003	F	HOLD	BIRMINGHM	BREED WITH	371	
~~149~~	~~BROWNSVIL~~	~~3913~~	~~F~~	~~SEND TO~~	~~CALDWELL~~	~~DO NOT BREED~~		Reported following analysis as dead
~~351~~	~~BROWNSVIL~~	~~6842~~	~~F~~	~~HOLD~~	~~BROWNSVIL~~	~~BREED WITH~~	~~357~~	Reported following analysis as dead
357	BROWNSVIL	6785	M	HOLD	BROWNSVIL	BREED WITH	413	
413	BROWNSVIL	8793	F	HOLD	BROWNSVIL	BREED WITH	357	
447	DALLAS WA	9A077	F	HOLD	DALLAS WA	BREED WITH	448	
448	DALLAS WA	9A076	M	HOLD	DALLAS WA	BREED WITH	447	
449	DALLAS WA	9A231	F	HOLD	DALLAS WA	DO NOT BREED		
343	HONOLULU	970054	F	HOLD	HONOLULU	BREED WITH	349	
349	HONOLULU	970228	M	HOLD	HONOLULU	BREED WITH	343	
286	HOUSTON	24641	F	HOLD	HOUSTON	BREED WITH	430	
430	HOUSTON	24320	M	HOLD	HOUSTON	BREED WITH	286	
405	JACKSONVL	604401	M	HOLD	JACKSONVL	BREED WITH	411	
411	JACKSONVL	605378	F	HOLD	JACKSONVL	BREED WITH	405	
428	METROZOO	B70327	M	HOLD	METROZOO	DO NOT BREED		sibling pair
429	METROZOO	B70328	F	HOLD	METROZOO	DO NOT BREED		sibling pair
312	ORLANDO	GV2500	M	HOLD	ORLANDO	BREED WITH	383	
383	ORLANDO	GV2501	F	HOLD	ORLANDO	BREED WITH	312	
370	PITTS CA	5113	F	HOLD	PITTS CA	BREED WITH	442	
391	RIO GRAND	B01003	F	SEND TO	MILWAUKEE	BREED WITH	396	
425	SCOT NECK	UNK	F	HOLD	SCOT NECK	DO NOT BREED		no male available for this female at this time
426	SCOT NECK	UNK	F	HOLD	SCOT NECK	DO NOT BREED		no male available for this female at this time
422	SD-WAP	806034	F	SEND TO	RIO GRAND	DO NOT BREED		no male available for this female at this time

ID	Location	Local ID	Sex	Disposition	Location	Breeding	With	Notes
432	SD-WAP	808253	F	SEND TO	RIO GRAND	DO NOT BREED		no male available for this female at this time
346	SEATTLE	970075	M	HOLD	SEATTLE	BREED WITH	347	
347	SEATTLE	970076	F	HOLD	SEATTLE	BREED WITH	346	
353	SEATTLE	202921	F	HOLD	SEATTLE	BREED WITH	401	
395	SEATTLE	200561	F	HOLD	SEATTLE	DO NOT BREED		
401	SEATTLE	201052	M	HOLD	SEATTLE	BREED WITH	353	
431	SEATTLE	202496	F	HOLD	SEATTLE	DO NOT BREED		
445	SEATTLE	203416	M	HOLD	SEATTLE	DO NOT BREED		maintain in sibling pair until mate becomes available
427	SEDGWICK	12326	M	HOLD	SEDGWICK	BREED WITH	443	
355	ST LOUIS	980905	F	HOLD	ST LOUIS	BREED WITH	434	
434	ST LOUIS	106934	M	HOLD	ST LOUIS	BREED WITH	355	
384	TOLEDO	1690	F	HOLD	TOLEDO	BREED WITH	385	
385	TOLEDO	1869	M	HOLD	TOLEDO	BREED WITH	384	
338	TORONTO	36778	M	HOLD	TORONTO	BREED WITH	393	
393	TORONTO	40995	F	HOLD	TORONTO	BREED WITH	338	
442	TORONTO	43233	M	SEND TO	PITTS CA	BREED WITH	370	
443	TORONTO	43271	F	SEND TO	SEDGWICK	BREED WITH	427	
444	TORONTO	43272	M	SEND TO	TRACY AV	BREED WITH	437	
446	TORONTO	44213	U	HOLD	TORONTO	DO NOT BREED		DETERMINE AND REPORT SEX
437	TRACY	202833	F	HOLD	TRACY	BREED WITH	444	
146	WINNIPEG	001007	F	~~HOLD~~	~~WINNIPEG~~	~~BREED WITH~~	~~396~~	REPORTED FOLLOWING ANALYSIS AS DEAD
396	WINNIPEG	E00336	M	SEND TO	MILWAUKEE	BREED WITH	391	

Recommendations by Institution

BIODOME

Biodome de Montreal
Montreal, Quebec

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
423	2519	M	HOLD	BIODOME	BREED WITH	441	
441	2715	F	HOLD	BIODOME	BREED WITH	423	

BIRMINGHM

Birmingham Zoo
Birmingham, AL

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
371	B01001	M	HOLD	BIRMINGHM	BREED WITH	372	
372	B01003	F	HOLD	BIRMINGHM	BREED WITH	371	

BROWNSVIL

Gladys Porter Zoo
Brownsville, TX

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
149	3913	F	~~SEND TO~~	~~CALDWELL~~	~~DO NOT BREED~~		Reported following analysis as dead
351	6842	F	~~HOLD~~	~~BROWNSVIL~~	~~BREED WITH~~	~~357~~	Reported following analysis as dead
357	6785	M	HOLD	BROWNSVIL	BREED WITH	413	
413	8793	F	HOLD	BROWNSVIL	BREED WITH	357	

DALLAS

Dallas World Aquarium
Dallas, TX

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
447	9A077	F	HOLD	DALLAS WA	BREED WITH	448	
448	9A076	M	HOLD	DALLAS WA	BREED WITH	449	
449	9A231	F	HOLD	DALLAS WA	DO NOT BREED		

HONOLULU

Honolulu Zoo
Honolulu, HI

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
343	970054	F	HOLD	HONOLULU	BREED WITH	349	
349	970228	M	HOLD	HONOLULU	BREED WITH	343	

HOUSTON

Houston Zoo, Inc.
Houston, TX

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
286	24641	F	HOLD	HOUSTON	BREED WITH	430	
430	24320	M	HOLD	HOUSTON	BREED WITH	286	

JACKSONVL

Jacksonville Zoo and Gardens
Jacksonville, FL

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
405	604401	M	HOLD	JACKSONVL	BREED WITH	411	
411	605378	F	HOLD	JACKSONVL	BREED WITH	405	

METROZOO

Miami Metrozoo
Miami, FL

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
428	B70327	M	HOLD	METROZOO	DO NOT BREED		sibling pair
429	B70328	F	HOLD	METROZOO	DO NOT BREED		sibling pair

MILWAUKEE

Milwaukee County Zoo
Milwaukee, WI

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
391	B01003	F	RECEIVE FROM	RIO GRAND	BREED WITH	396	
396	E00336	M	RECEIVE FROM	WINNIPEG	BREED WITH	391	

ORLANDO

Sea World Orlando
Orlando, FL

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
312	GV2500	M	HOLD	ORLANDO	BREED WITH	383	
383	GV2501	F	HOLD	ORLANDO	BREED WITH	312	

PITTS CA

National Aviary in Pittsburgh
Pittsburgh, PA

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
370	5113	F	HOLD	PITTS CA	BREED WITH	442	
442	43233	M	RECEIVE FROM	TORONTO	BREED WITH	370	

RIO GRAND

Albuquerque Biological Park
Albuquerque, NM

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
391	B01003	F	SEND TO	MILWAUKEE	BREED WITH	396	
422	806034	F	RECEIVE FROM	SD-WAP	DO NOT BREED		no male available for this female at this time
432	808253	F	RECEIVE FROM	SD-WAP	DO NOT BREED		no male available for this female at this time

SCOT NECK

Sylvan Heights Waterfowl
Scotland Neck, NC

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
425	UNK	F	HOLD	SCOT NECK	DO NOT BREED		no male available for this female at this time
426	UNK	F	HOLD	SCOT NECK	DO NOT BREED		no male available for this female at this time

SD-WAP

San Diego Wild Animal Park
Escondido, CA

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
422	806034	F	SEND TO	RIO GRAND	DO NOT BREED		no male available for this female at this time
432	808253	F	SEND TO	RIO GRAND	DO NOT BREED		no male available for this female at this time

SEATTLE

Woodland Park Zoological Gardens
Seattle, WA

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
346	970075	M	HOLD	SEATTLE	BREED WITH	347	
347	970076	F	HOLD	SEATTLE	BREED WITH	346	
395	200561	F	HOLD	SEATTLE	DO NOT BREED		no male available for this female at this time
401	201052	M	HOLD	SEATTLE	BREED WITH	353	
353	202921	F	HOLD	SEATTLE	BREED WITH	401	
431	202496	F	HOLD	SEATTLE	DO NOT BREED		no male available for this female at this time
445	203416	M	HOLD	SEATTLE	DO NOT BREED		maintain in sibling pair until mate becomes available

SEDGWICK

Sedgwick County Zoo
Wichita, KS

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
443	43271	F	RECEIVE FROM	TORONTO	BREED WITH	427	Demographic pairing – poor MK match
427	12326	M	HOLD	SEDGWICK	BREED WITH	443	Demographic pairing – poor MK match

ST LOUIS

Saint Louis Zoological Park
St. Louis, MO

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
355	980905	F	HOLD	ST LOUIS	BREED WITH	434	
434	106934	M	HOLD	ST LOUIS	BREED WITH	355	

TRACY AV

Tracy Aviary
Salt Lake City, UT

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
437	202833	F	HOLD	TRACY AV	BREED WITH	444	Demographic pairing – poor MK match
444	43272	M	RECEIVE FROM	TORONTO	BREED WITH	437	Demographic pairing – poor MK match

TOLEDO

Toledo Zoological Gardens
Toledo, OH

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
384	1690	F	HOLD	TOLEDO	BREED WITH	385	
385	1869	M	HOLD	TOLEDO	BREED WITH	384	

TORONTO

Toronto Zoo
Scarborough, Ontario

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
338	36778	M	HOLD	TORONTO	BREED WITH	393	
393	40995	F	HOLD	TORONTO	BREED WITH	338	
442	43233	M	SEND TO	PITTS CA	BREED WITH	370	
443	43271	F	SEND TO	SEDGWICK	BREED WITH	427	
444	43272	M	SEND TO	TRACY AV	BREED WITH	437	
446	44213	U	HOLD	TORONTO	DO NOT BREED		DETERMINE AND REPORT SEX

WINNIPEG

Assiniboine Park Zoo
Winnipeg, Manitoba

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
146	001007	F	~~HOLD~~	~~WINNIPEG~~	~~BREED WITH~~	~~396~~	Reported following analysis as dead
396	E00336	M	SEND TO	MILWAUKEE	BREED WITH	391	

Appendix A
Assumptions

SPECIMENS WITH UNKNOWN PARENTAGE

Studbook ID	Current Status	Sire	Dam	XX SIRE	XX DAM	Birth Date	First Location	Second Location	Current Location	# AZA Living Descendants	% AZA Living Population	# Total Living Descendants	Living Descendants' Studbook ID
61	Dead	UNK	UNK	WILD	WILD	1/1/1983	GUYANAZOO	CHASE B	FORTWORTH	7	16.28%	7	351, 413, 430, 411, 412, 408, 414
192	Dead	UNK	33	34	33	11/16/1988	SANDIEGOZ	SEATTLE	SEATTLE	7	16.28%	7	351, 413, 430, 411, 412, 408, 414
144	Living	UNK	UNK	34	33	11/1/1987	UNKNOWN	CHISHOLM	SEDGWICK	1	2.33%	1	144
149	Living	UNK	UNK	34	33	1/12/1988	UNKNOWN	CHISHOLM	BROWNSVIL	1	2.33%	1	149
196	Living	UNK	UNK	34	33	11/25/1988	UNKNOWN	CHISHOLM	TORONTO	1	2.33%	1	196
206	Living	UNK	33	34	33	3/31/1989	SANDIEGOZ	PROVIDNCE	MILWAUKEE	1	2.33%	1	206
312	Living	UNK	UNK	WILD	WILD	10/13/1993	UNKNOWN	CYPRESS	BUSCH TAM	1	2.33%	1	312
382	Living	UNK	UNK	WILD	WILD	1/1/2000	UNKNOWN	MOHILEF D	LOSANGELE	1	2.33%	1	382
383	Living	UNK	UNK	WILD	WILD	1/1/2000	UNKNOWN	MOHILEF D	LOSANGELE	1	2.33%	1	383
391	Living	UNK	UNK	WILD	WILD	3/8/2001	UNKNOWN	FALLBROOK	RIO GRAND	1	2.33%	1	391
393	Living	UNK	UNK	--	--	6/1/2001	UNKNOWN	QUEBEC	TORONTO	1	2.33%	1	393
146	Living	UNK	33	34	33	11/2/1987	SANDIEGOZ	CHISHOLM	WINNIPEG	0	0%	1	146

Appendix B
Life Tables

	Males					Females				
Age	**Qx**	**Px**	**Lx**	**Mx**	**Vx**	**Qx**	**Px**	**Lx**	**Mx**	**Vx**
0	0.360	0.640	1.000	0.020	1.220	0.350	0.650	1.000	0.000	1.212
1	0.130	0.870	0.640	0.030	1.721	0.160	0.840	0.650	0.000	1.727
2	0.150	0.850	0.557	0.150	2.056	0.090	0.910	0.546	0.010	2.045
3	0.130	0.870	0.473	0.330	2.322	0.140	0.860	0.497	0.210	2.372
4	0.110	0.890	0.412	0.270	2.371	0.150	0.850	0.427	0.290	2.610
5	0.130	0.870	0.366	0.500	2.498	0.070	0.930	0.363	0.280	2.701
6	0.110	0.890	0.319	0.250	2.378	0.090	0.910	0.338	0.870	2.717
7	0.150	0.850	0.284	0.320	2.557	0.110	0.890	0.307	1.400	2.118
8	0.060	0.940	0.241	0.240	2.627	0.100	0.900	0.274	0.680	0.829
9	0.170	0.830	0.227	0.090	2.818	0.140	0.860	0.246	0.140	0.174
10	0.160	0.840	0.188	0.580	3.421	0.080	0.920	0.212	0.040	0.040
11	0.130	0.870	0.158	1.300	3.483	0.190	0.810	0.195	0.000	0.000
12	0.230	0.770	0.138	1.730	2.775	0.130	0.870	0.158	0.000	0.000
13	0.160	0.840	0.106	0.920	1.367	0.040	0.960	0.137	0.000	0.000
14	0.410	0.590	0.089	0.400	0.645	0.170	0.830	0.132	0.000	0.000
15	0.500	0.500	0.052	0.460	0.460	0.100	0.900	0.109	0.000	0.000
16	0.000	1.000	0.026	0.000	0.000	0.100	0.900	0.098	0.000	0.000
17	0.000	1.000	0.026	0.000	0.000	0.000	1.000	0.089	0.000	0.000
18	0.000	1.000	0.026	0.000	0.000	0.120	0.880	0.089	0.000	0.000
19	0.000	1.000	0.026	0.000	0.000	0.000	1.000	0.078	0.000	0.000
20	0.000	1.000	0.026	0.000	0.000	0.430	0.570	0.078	0.000	0.000
21	0.000	1.000	0.026	0.000	0.000	0.000	1.000	0.044	0.000	0.000
22	0.000	1.000	0.026	0.000	0.000	0.330	0.670	0.044	0.000	0.000
23	0.000	1.000	0.026	0.000	0.000	0.000	1.000	0.030	0.000	0.000
24	0.000	1.000	0.026	0.000	0.000	0.000	1.000	0.030	0.000	0.000
25	0.500	0.500	0.026	0.000	0.000	0.000	1.000	0.030	0.000	0.000
26	0.000	1.000	0.013	0.000	0.000	0.000	1.000	0.030	0.000	0.000
27	1.000	0.000	0.013	0.000	0.000	0.000	1.000	0.030	0.000	0.000
28	1.000	0.000	0.000	0.000	0.000	0.000	1.000	0.030	0.000	0.000
29	1.000	0.000	0.000	0.000	0.000	0.000	1.000	0.030	0.000	0.000
30	1.000	0.000	0.000	0.000	0.000	1.000	0.000	0.030	0.000	0.000
31	1.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000

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

Projected population growth rates

Males: r = 0.0457; lambda = 1.0467; R0 = 1.406; T = 7.46

Females: r = 0.0322; lambda = 1.0327; R0 = 1.233; T = 6.52

Appendix C
Ordered Mean Kinships

Males

SB#	MK	%Known	Age	Location
312	0.000	100.0	0	ORLANDO
349	0.000	100.0	0	HONOLULU
371	0.000	100.0	11	BIRMINGHM
401	0.018	100.0	8	SEATTLE
357	0.027	100.0	12	BROWNSVIL
430	0.044	87.5	4	HOUSTON
338	0.045	100.0	14	TORONTO
442	0.054	50.0	1	TORONTO
444	0.054	50.0	1	TORONTO
446	0.054	50.0	U0	TORONTO
346	0.143	100.0	0	SEATTLE
385	0.152	100.0	10	TOLEDO
396	0.152	100.0	9	WINNIPEG
405	0.152	100.0	6	JACKSONVL
423	0.152	100.0	5	BIODOME
427	0.152	100.0	4	SEDGWICK
428	0.152	100.0	4	METROZOO
434	0.152	100.0	2	ST LOUIS
445	0.152	100.0	U0	SEATTLE

Females

SB#	MK	%Known	Age	Location
391	0.000	100.0	0	RIO GRAND
384	0.000	100.0	10	TOLEDO
383	0.000	100.0	10	ORLANDO
372	0.000	100.0	11	BIRMINGHM
370	0.000	100.0	0	PITTS CA
343	0.000	100.0	0	HONOLULU
286	0.018	100.0	18	HOUSTON
355	0.027	100.0	12	ST LOUIS
149	0.038	100.0	22	BROWNSVIL
146	0.038	100.0	23	WINNIPEG
413	0.044	87.5	6	BROWNSVIL
411	0.044	87.5	6	JACKSONVL
351	0.049	75.0	13	BROWNSVIL
446	0.054	50.0	U0	TORONTO
443	0.054	50.0	1	TORONTO
441	0.054	50.0	1	BIODOME
347	0.143	100.0	0	SEATTLE
445	0.152	100.0	U0	SEATTLE
437	0.152	100.0	2	SEATTLE
432	0.152	100.0	3	SD-WAP
431	0.152	100.0	3	SEATTLE
429	0.152	100.0	4	METROZOO
426	0.152	100.0	4	SCOT NECK
425	0.152	100.0	4	SCOT NECK
422	0.152	100.0	5	SD-WAP
395	0.152	100.0	9	SEATTLE

Appendix D
Summary of Data Exports

Report compiled under POPLINK V. 1.25 & Population Management 2000, V. 1.213

Data exported on: 17 June 2010
Data compiled by: Shawn Pedersen
Data current thru: 1 JUNE 2010
Plan: email

Filter Conditions in Effect:

Genetics: N.AM., Dates: As of End of date 17 June 2010/ Status: Living
Demography : N.AM, Dates: During 01/01/1980 <= date .and. date <= 17 June 2010

Appendix E
Exclusions

No birds were excluded from the breeding population.

Appendix F
Definitions

Management Terms

SSP Master Plan – A document that provides complete breeding and transfer recommendations for a Species Survival Plan (SSP®) population. The document is based on genetic and demographic analyses with consideration of behavioral, social, and institutional wants and needs. A draft of the Master Plan must be published in the Members Only section of the AZA Web site for a 30-day comment period. After the Coordinator incorporates/responds to institutional comments, a final version of the Master Plan must be published in the Members Only section of the AZA Web site. SSP Participation by AZA institutions is required.

Full Participation – AZA policy stating that all AZA accredited institutions and certified related facilities having an SSP animal in their collection are required to participate in the SSP partnership process and abide by the recommendations of the SSP.

Population Management Plan (PMP)– A document that provides complete breeding and transfer recommendations for a PMP population. The document is based on genetic and demographic analyses with consideration of behavioral, social, and institutional wants and needs. A draft of the PMP must be published in the Members Only section of the AZA Web site for a 30-day comment period. After the PMP Manager incorporates/responds to institutional comments, a final version of the PMP must be published in the Members Only section of the AZA Web site. PMP Participation by AZA institutions is voluntary.

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

Institution	IR	IR Email	IR Phone #
Assiniboine Park Zoo	Phil King	pking@winnipeg.ca	
Biodome de Montreal	Chantal Routhier	crouthier@ville.montreal.qc.ca	514-868-3001
Birmingham Zoo	Cindy Pinger	cpinger@birminghamzoo.com	205-879-0409
Brookfield Zoo	Tim Snyder	tim.snyder@czs.org	708-688-8401
Caldwell Zoo	Yvonne Stainback	ystainback@caldwellzoo.org	903-593-2121 x223
Fresno Chaffee Zoo	Andy Snider	asnider@fresnochaffeezoo.com	559-498-5914
Dallas World Aquarium	Josef Lindholm	josef@dwazoo.com	214-720-2224 x401
El Paso Zoo	John Kiseda	KisedaJJ@elpasotexas.gov	915-521-1850 x1860
Gladys Porter Zoo	Colette Adams	cadams@gpz.org	956-546-9431
Honolulu Zoo	Linda Santos	lsantos1@honolulu.gov	808-971-7169
Houston Zoo	Hannah Bailey	hbailey@houstonzoo.org	713-533-6565
Jacksonville Zoo	Robin B. Lentz	lentzr@JaxZoo.org	(904) 757-4462 x166
Miami Metrozoo	James Dunster	JDUN@miamidade.gov	305-251-0400 x251
Milwaukee County Zoo	Alex Waier	Alex.Waier@Milwcnty.com	414-256-5449
Nashville Zoo	Joe deGraauw	jdegraauw@nashvillezoo.org	615-833-1534 x155
National Aviary	Steven Sarro	steve.sarro@aviary.org	(412) 323-7235 x211
National Zoo	Dan Boritt	borittd@si.edu	202-633-3097
Rio Grand Zoo	Peter Shannon	pshannon@cabq.gov	505-764-6258
San Diego WAP	Mike Mace	MMace@sandiegozoo.org	760-738-5077
Sea World Orlando	Sherry Branch	sherry.branch@seaworld.com	407-363-2361
Sedgwick County Zoo	Joe Barkowski	jbarkowski@scz.org	316-266-8235
St. Louis Zoo	Michael Macek	Macek@stlzoo.org	314-781-0900 x362
Sylvan Heights Waterfowl	Ali Lubbock	ali@shwpark.com	
Toledo Zoo	Robert Webster	robert.webster@Toledozoo.org	419-385-5721 x2008
Toronto Zoo	Tom Mason	tmason@torontozoo.ca	416-392-5972
Tracy Aviary	Roger Sweeney	RogerS@tracyaviary.org	801-596-8500 x15
Woodland Park Zoo	Shawn Pedersen	shawn.pedersen@zoo.org	206-548-2516
Zoo Atlanta	James Balance	jballance@zooatlanta.org	404-624-5841