

Analysis and Breeding Recommendations

Toco Toucan *Ramphastos toco* **Species Survival Plan®**



Species Coordinator
Ken Naugher, Montgomery Zoo

Regional Studbook Keeper
Martin Vince, Riverbanks Zoo

SPMAG ADVISOR
Colleen Lynch, AZA Population Management Center

13 JUNE 2006

This report was prepared with assistance from the

PMC

American Zoo and Aquarium Association
Population Management Center

Lincoln Park
Zoo

ASSOCIATION
OF ZOOS &
AQUARIUMS

Executive Summary

Population Management Plan for Toco Toucan

The Piciformes TAG has set a target population size for toco toucans at 75 (2003 RCP) specimens. The current population size is 93 specimens distributed among 40 institutions. This is the third management plan for this species, following the plans in 2001 and 2002.

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 birth weights, smaller litter sizes, and greater neonatal mortality. The current population structure allows maintenance of gene diversity above 90% for approximately 3 years. Careful breeding resulting in equalization of founder representation and recruitment of existing potential founders, increasing the population growth rate, and improving the N_e/N ratio all could extend the time to 90%. This population, given its current size, number of unrepresented founders, and availability of new founders, has the foundation for meeting standardized genetic goals for captive populations under population management. Without improved management, projections are grim, with less than 1% gene diversity expected at 100 years from present.

DEMOGRAPHY

Current Population Size	93
Target Population Size	75
Specimens Excluded from Genetic Analyses	13
Mean Generation Time (years)	8.6
Projected Population Growth Rate (λ)	0.9

GENETICS

	<i>Current</i>	<i>Potential</i>
Current Gene Diversity (% of Wild)	91.95	99.00
Founder Genome Equivalents	6.21	50.14
Number of Founders	15	38
% Pedigree Known prior to assumptions/exclusions	36.5	
% Pedigree Known following assumptions/exclusions	100	
Years To 90% Gene Diversity	3	
Gene Diversity at 100 Years From Present (%)	<1%	

Thirteen of the 93 living specimens have been excluded from the genetic analyses because they have partially or completely unknown pedigrees. Assumptions have been made to address unknown pedigrees where possible but a considerable degree of unknowns remain in the pedigree. It is the goal of the SSP the unknown pedigree specimens not be bred so that the unknown pedigree portion of the population be replaced over time with known pedigree specimens.

Since the last Breeding and Transfer Plan import events have brought 35 specimens into the population, illustrating the historic reliance of this population on recruitment from outside sources. Of great concern to this population are the large number of unrepresented potential founders some of which are aged, the low N_e/N ratio, and the lack of population growth attributed to captive propagation relative to that from private sector acquisitions and importations. It is crucial to the long-term management of this population that these concerns be addressed.

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, differences in sire and dam mean kinships, and the degree of uncertainty within a pedigree.

Summary Actions: The SSP recommends 18 breeding pairs and 8 transfers.

Table of Contents

Executive Summary

I.	Description of Population Status	3
	Demography	3
	Genetics	3
	Management Strategy	4
II.	Recommendations	
	Summary Recommendations	5
	ALEXANDRI, AUDUBON, BREVARD	10
	BUSCH TAM, CALDWELL, CAPE MAY	11
	CHICAGOBR, COLUMBIA	12
	DALLAS WA, DENVER	13
	DREHER PA, FORTWORTH, FT WAYNE	14
	GLEN OAK, GREENVISC, GULF BREZ	15
	HONOLULU, HOUSTON, KNOXVILLE	16
	LOWRY, LUFKIN, MEMPHIS	17
	MONTGOMRY	18
	NASHV ZOO, NY BRONX	19
	NZP-WASH, OMAHA, ORLANDO	20
	PHOENIX, PITTS CA, RIO GRAND	21
	S BARBARA, SEA WORLD, ST AUG GA	22
	ST LOUIS, TOPEKA, TULSA	23
	W PALM BE, WORLDBIRD	24
III.	Appendices	
	A. Exclusions And Assumptions	25
	B. Life Table	26
	C. Ordered Mean Kinship	27
	D. Summary of Data Export	27
	E. Definitions	28
	F. Directory of Institutional Representatives	30

Species Coordinator

Ken Naugher

Montgomery Zoo, knaugher@ci.montgomery.al.us

Report and Analyses prepared by:

Colleen Lynch

Population Biologist, AZA Population Management Center, clynch@lpzoo.org

**This plan was prepared and distributed with the assistance of the AZA
Population Management Center in Chicago.**

pmc@lpzoo.org

Description of Population Status

Introduction: Genetic and demographic analyses of the population were performed in April 2006 resulting in the current Population Management Plan for the AZA North American toco toucan population. Recommendations contained in this Population Management Plan represent the results of these analyses. Population Management Plan analyses were performed on the North American Regional Toco Toucan Studbook (current to 30 October 2005) using SPARKS 1.5 and PM2000 1.211. The goal of these recommendations is to help insure the genetic and demographic health of this population. Recommendations in the current plan supersede those in earlier plans

Managed Population: The current population is 93 distributed among 40 AZA institutions. Thirteen animals were excluded from the managed population due to unknown pedigrees of 50% or greater. Where possible, assumptions were incorporated into the pedigree to include a greater number of individuals. The managed population that remains after these exclusions is 80. The target population size for toco toucans is 75. No exclusions were made for health or behavioral reasons. Individuals excluded from the managed (known pedigree) population as well as assumptions are listed in Appendix A.

Demography: Records indicate toco toucans first appeared in North American zoos as early as 1902 but were not commonly held until the 1960's. It was not until the mid-1970s that captive breeding became a source of captive specimens. Captive propagation of this species is still uncommon, and importation has become much more difficult since it was listed on CITES Appendix II, though efforts to acquire new founders have resulted in the importation of 35 specimens in the last 4 years.

Population growth still relies heavily on acquisitions from the wild and the private sector. While occasional additions of wild caught specimens would benefit the population, those animals coming from private sources often have little documentation to support founder status. The captive population would derive greater benefit from successful propagation within the managed population than it would from a continued influx of unknown pedigree animals.

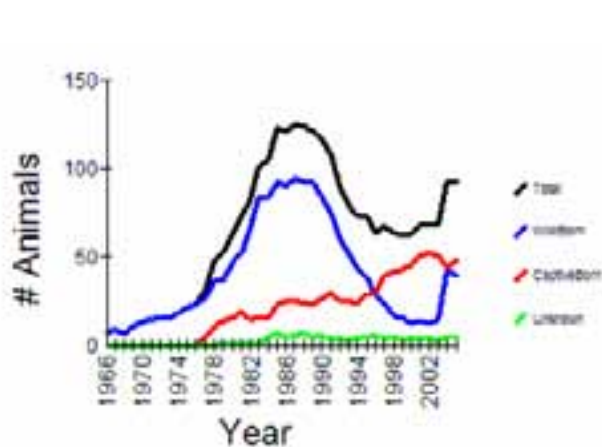


Figure 1. Population census of toco toucans in AZA zoos.

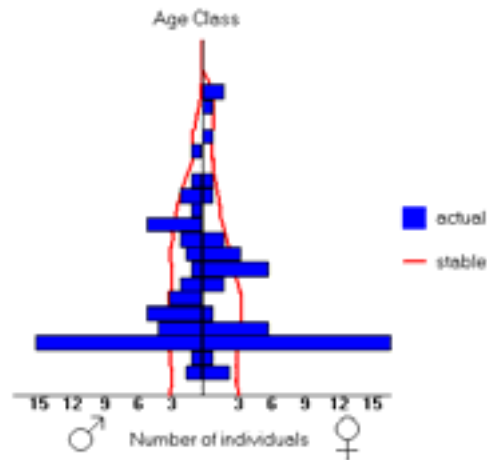


Figure 2. Age structure of known pedigree specimens in the SSP.

Population annual growth rates attributed to captive propagation within AZA institutions have varied greatly from year to year over the last decade (range of annual $\lambda = 0.76 - 1.21$) but the population has exhibited an overall trend of increase with a mean annual growth rate of 1.06 (Figure 1).

The age distribution is irregular, illustrating inconsistent population growth with bulges reflecting import events (Figure 2). Captive toco toucans have lived until the age of 21 years but have reproduced beyond the age of 17 years with the exception of a single male specimen that reproduced at 20 years of age. It is unknown whether other animals in the older age classes failed to reproduce due to reproductive senescence or lack of reproductive opportunity. Both males and females are reproductive at the age of about two years.

Genetics: The managed population is descended from 15 founders, with 35 potential founders remaining in the living population. Some of these potential founders are of advanced age and it is unlikely that they will be

recruited. Most are the results of recent imports and are estimated to be young birds of less than 5 years of age.

Genetic Summary

	Current	Potential
Founder Genome Equivalents	6.21	50.14
Gene Diversity Retained (%)	91.95	99.00
Population Mean Kinship	0.0726	
Mean Inbreeding	0.0542	
Ne/N	0.1322	
% Pedigree Known prior to assumptions/exclusions	36.5	
% Pedigree Known after assumptions/exclusions	98.7	

Gene diversity in the population is moderate relative to many other managed populations (91%), but the potential gene diversity remains high (99%). Gene diversity is likely to remain above 90% for less than 3 years given current population parameters. Long-term projections of gene diversity indicate less than 1% gene diversity at 100 years from present. Inadequate population growth and effective size ratio severely limit gene diversity retention in this population. Improving the N_e/N ratio (currently 0.13) of the population also could extend time to 90%. Presently, only 11 animals in the population have living offspring. A concerted effort to recruit breeders would likely improve the effective population size. Recruiting an additional 20 breeders would raise the N_e/N ratio to 0.30 (a value considered typical of managed populations) given the current population size. Careful breeding targeted at the equalization of founder representation and recruitment of potential founders (Figure 3) will extend the time to 90% gene diversity.

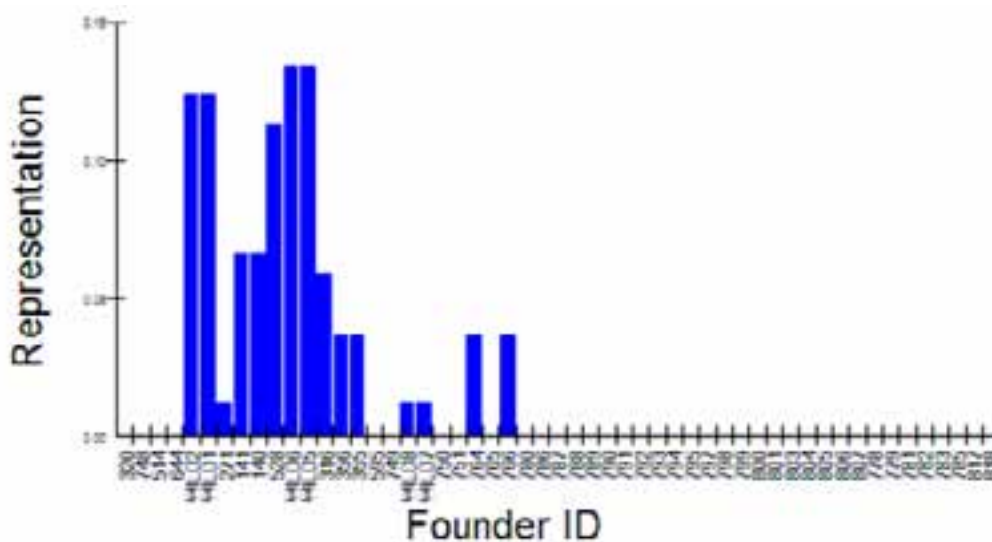


Figure 3. Founder representation in the SSP illustrating the large number of unrepresented founders and inequality of founder representation.

Management Strategy: It is recommended that the population be maintained at the target size of 75 specimens. Maintaining the current size will require 12 hatches in the coming year. Given a clutch size of 2-4 but a low likelihood of pairing success, 18 pairs are recommended for breeding. In an effort to increase the effective population size (N_e) it is recommended that a concerted effort be made to recruit existing potential founders. It is also recommended that institutions consider the impact of adding unknown origin specimens to the population when acquiring specimens.

1. Recommend 18 breeding pairs.
2. Recommend 8 transfers.

Summary of Breeding and Transfer Recommendations

ID	Location	Local ID	Sex	Disposition	Location	Breeding	With	Notes
637	ALEXANDRI	AV0002	F	SEND TO	GREENVISC	DO NOT BREED		Reported during draft as dead
644	ALEXANDRI	AV0124	M	HOLD	ALEXANDRI	BREED WITH	789	
793	AUDUBON	101492	F	HOLD	AUDUBON	BREED WITH	792	
792	AUDUBON	101491	M	HOLD	AUDUBON	BREED WITH	793	
779	BREVARD	24076	F	HOLD	BREVARD	BREED WITH	778	
778	BREVARD	24075	M	HOLD	BREVARD	BREED WITH	779	
788	BUSCH TAM	62676	F	SEND TO	DREHER PA	BREED WITH	803	
787	BUSCH TAM	62675	F	HOLD	BUSCH TAM	BREED WITH	786	
786	BUSCH TAM	62674	M	HOLD	BUSCH TAM	BREED WITH	787	
748	CALDWELL	105211	F	HOLD	CALDWELL	DO NOT BREED		advanced age, would need to be repaired to receive breeding rec
740	CALDWELL	104787	M	HOLD	CALDWELL	DO NOT BREED		over-rep'd
485	CAPE MAY	111	F	HOLD	CAPE MAY	DO NOT BREED		excluded - unknown pedigree
711	CAPE MAY	3027	M	HOLD	CAPE MAY	DO NOT BREED		MK not a priority for breeding at this time
514	CHICAGOBR	_____	F	HOLD	CHICAGOBR	DO NOT BREED		valuable female of advanced age
618	COLUMBIA	6719	F	HOLD	COLUMBIA	DO NOT BREED		over-rep'd
798	COLUMBIA	8741	F	HOLD	COLUMBIA	BREED WITH	799	
750	COLUMBIA	7439	F	HOLD	COLUMBIA	BREED WITH	797	
527	COLUMBIA	006447	M	HOLD	COLUMBIA	DO NOT BREED		over-rep'd
799	COLUMBIA	8740	M	HOLD	COLUMBIA	BREED WITH	798	
797	COLUMBIA	8739	M	HOLD	COLUMBIA	BREED WITH	750	
777	DALLAS WA	3A037	F	HOLD	DALLAS WA	DO NOT BREED		over-rep'd
652	DALLAS WA	99A017	F	HOLD	DALLAS WA	DO NOT BREED		MK not a priority for breeding at this time

ID	Location	Local ID	Sex	Disposition	Location	Breeding	With	Notes
695	DALLAS WA	1A0039	M	HOLD	DALLAS WA	DO NOT BREED		over-rep'd
651	DALLAS WA	97A010	M	HOLD	DALLAS WA	DO NOT BREED		over-rep'd
785	DENVER	A04462	F	HOLD	DENVER	BREED WITH	782	
783	DENVER	A04460	M	HOLD	DENVER	BREED WITH	790	
782	DENVER	A04459	M	HOLD	DENVER	BREED WITH	785	
803	DREHER PA	204177	M	HOLD	DREHER PA	BREED WITH	788	
742	FORTWORTH	201638	F	HOLD	FORTWORTH	DO NOT BREED		excluded - unknown pedigree
530	FORTWORTH	971004	M	HOLD	FORTWORTH	DO NOT BREED		over-rep'd
744	FT WAYNE	97024	F	HOLD	FT WAYNE	DO NOT BREED		excluded - unknown pedigree
743	FT WAYNE	97023	M	HOLD	FT WAYNE	DO NOT BREED		excluded - unknown pedigree
688	GLEN OAK	17715	F	HOLD	GLEN OAK	DO NOT BREED		pair for possible future breeding
661	GREENVISC	XXA014	M	HOLD	GREENVISC	DO NOT BREED		over-rep'd, companion only
808	GULF BREZ	A3959	F	HOLD	GULF BREZ	DO NOT BREED		excluded - unknown pedigree
809	GULF BREZ	A3958	M	HOLD	GULF BREZ	DO NOT BREED		excluded - unknown pedigree
706	HONOLULU	200061	F	HOLD	HONOLULU	DO NOT BREED		Valuable female – confirm pedigree of 706 to facilitate breeding rec
708	HONOLULU	200256	F	HOLD	HONOLULU	DO NOT BREED		excluded - unknown pedigree
622	HOUSTON	17835	F	HOLD	HOUSTON	DO NOT BREED		over-rep'd
587	HOUSTON	16814	M	HOLD	HOUSTON	DO NOT BREED		over-rep'd
726	KNOXVILLE	2343	M	HOLD	KNOXVILLE	DO NOT BREED		MK not a priority for breeding at this time
781	LOWRY	205248	F	HOLD	LOWRY	BREED WITH	780	
780	LOWRY	205247	M	HOLD	LOWRY	BREED WITH	781	

ID	Location	Local ID	Sex	Disposition	Location	Breeding	With	Notes
532	LUFKIN	08652	M	HOLD	LUFKIN	DO NOT BREED		814 dispositioned outside of SSP – receive next female offspring from 764/766 as a replacement and pair for possible future breeding
749	MEMPHIS	20252	F	HOLD	MEMPHIS	BREED WITH	791	
606	MEMPHIS	17956	M	SEND TO	NZP-WASH	DO NOT BREED		over-rep'd
807	MONTGOMRY	3349	F	HOLD	MONTGOMRY	BREED WITH	806	
805	MONTGOMRY	3348	F	HOLD	MONTGOMRY	BREED WITH	804	
529	MONTGOMRY	3369	M			DO NOT BREED		MK not a priority for breeding at this time, single - need companion?
806	MONTGOMRY	3347	M	HOLD	MONTGOMRY	BREED WITH	807	
804	MONTGOMRY	3346	M	HOLD	MONTGOMRY	BREED WITH	805	
815	NASHV ZOO	2352	F	HOLD	NASHV ZOO	DO NOT BREED		
814	NASHV ZOO	2350	F	SEND TO	LUFKIN	DO NOT BREED		Dispositioned out of SSP
790	NASHV ZOO	2282	F	SEND TO	DENVER	BREED WITH	783	
789	NASHV ZOO	2281	F	SEND TO	ALEXANDRI	BREED WITH	644	
766	NASHV ZOO	2000	F	HOLD	NASHV ZOO	BREED WITH	764	
765	NASHV ZOO	1999	F	HOLD	NASHV ZOO	BREED WITH	751	
729	NASHV ZOO	1862	M	HOLD	NASHV ZOO	DO NOT BREED		over-rep'd
816	NASHV ZOO	2351	M	SEND TO	S BARBARA	BREED WITH	794	
791	NASHV ZOO	2283	M	SEND TO	MEMPHIS	BREED WITH	749	
764	NASHV ZOO	1998	M	HOLD	NASHV ZOO	BREED WITH	766	send next female offspring from this pair to LUFKIN in place of 814
751	NASHV ZOO	2323	M	HOLD	NASHV ZOO	BREED WITH	765	

ID	Location	Local ID	Sex	Disposition	Location	Breeding	With	Notes
800	NY BRONX	S04076	F	HOLD	NY BRONX	BREED WITH	801	
801	NY BRONX	S04077	M	HOLD	NY BRONX	BREED WITH	800	
607	NZP-WASH	213972	F	HOLD	NZP-WASH	DO NOT BREED		over-rep'd
595	OMAHA	9455	F	HOLD	OMAHA	DO NOT BREED		
795	ORLANDO	TT2506	F	HOLD	ORLANDO	DO NOT BREED		valuable female, would need to be repaired to receive breeding rec
320	ORLANDO	TT2500	F	HOLD	ORLANDO	DO NOT BREED		advanced age, would need to be repaired to receive breeding rec
714	ORLANDO	TT2505	M	HOLD	ORLANDO	DO NOT BREED		over-rep'd
453	ORLANDO	TT2504	M	HOLD	ORLANDO	DO NOT BREED		excluded - unknown pedigree
696	PHOENIX	10121	M	HOLD	PHOENIX	DO NOT BREED		over-rep'd
741	PITTS CA	6166	F	HOLD	PITTS CA	DO NOT BREED		over-rep'd
609	RIO GRAND	B05025	F	HOLD	RIO GRAND	BREED WITH	713	
713	RIO GRAND	B00010	M	HOLD	RIO GRAND	BREED WITH	609	
794	S BARBARA	700061	F	HOLD	S BARBARA	BREED WITH	816	
473	S BARBARA	930063	M	SEND TO	GLEN OAK	DO NOT BREED		pair for possible future breeding
818	SEA WORLD	TT0002	F	HOLD	SEA WORLD	BREED WITH	817	
817	SEA WORLD	TT0001	M	HOLD	SEA WORLD	BREED WITH	818	
465	ST AUG GA	9733	F	HOLD	ST AUG GA	DO NOT BREED		excluded - unknown pedigree
467	ST AUG GA	A0406	M	HOLD	ST AUG GA	DO NOT BREED		MK not a priority for breeding at this time
755	ST LOUIS	103017	F	HOLD	ST LOUIS	DO NOT BREED		excluded - unknown pedigree
754	ST LOUIS	103018	F	HOLD	ST LOUIS	DO NOT BREED		excluded - unknown pedigree

ID	Location	Local ID	Sex	Disposition	Location	Breeding	With	Notes
528	TOPEKA	207405	F	HOLD	TOPEKA	DO NOT BREED		MK not a priority for breeding at this time
718	TOPEKA	005901	M	HOLD	TOPEKA	DO NOT BREED		over-rep'd reported during draft period as dead
526	TULSA	12075	F	HOLD	TULSA	DO NOT BREED		MK not a priority for breeding at this time
705	TULSA	13597	M	HOLD	TULSA	DO NOT BREED		over-rep'd
753	W PALM BE	D101	M	HOLD	W PALM BE	DO NOT BREED		excluded - unknown pedigree
752	W PALM BE	D100	M	HOLD	W PALM BE	DO NOT BREED		excluded - unknown pedigree
694	WORLDBIRD	000025	M	HOLD	WORLDBIRD	DO NOT BREED		excluded - unknown pedigree
692	WORLDBIRD	970019	U	HOLD	WORLDBIRD	DO NOT BREED		determine and report sex
691	WORLDBIRD	970018	U	HOLD	WORLDBIRD	DO NOT BREED		determine and report sex
690	WORLDBIRD	970017	U	HOLD	WORLDBIRD	DO NOT BREED		determine and report sex
813	WORLDBIRD	8887	U	HOLD	WORLDBIRD	DO NOT BREED		over-rep'd, determine and report sex

ALEXANDRI

Alexandria Zoological Park
Alexandria, LA

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
637	AV0002	F	SEND TO	GREENVISC	DO NOT BREED		Reported during draft as dead
644	AV0124	M	HOLD	ALEXANDRI	BREED WITH	789	
789	2281	F	RECEIVE FROM	NASHV ZOO	BREED WITH	644	

AUDUBON

Audubon Park Zoological Garden
New Orleans, LA

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
792	101491	M	HOLD	AUDUBON	BREED WITH	793	
793	101492	F	HOLD	AUDUBON	BREED WITH	792	

BREVARD

Brevard Zoo
Melbourne, FL

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
778	24075	M	HOLD	BREVARD	BREED WITH	779	
779	24076	F	HOLD	BREVARD	BREED WITH	778	

BUSCH TAM

Busch Gardens
Tampa, FL

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
786	62674	M	HOLD	BUSCH TAM	BREED WITH	787	
787	62675	F	HOLD	BUSCH TAM	BREED WITH	786	
788	62676	F	SEND TO	DREHER PA	BREED WITH	803	

CALDWELL

Caldwell Zoo
Tyler, TX

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
740	104787	M	HOLD	CALDWELL	DO NOT BREED		over-rep'd
748	105211	F	HOLD	CALDWELL	DO NOT BREED		advanced age, would need to be repaired to receive breeding rec

CAPE MAY

Cape May County Park Zoo
Cape May Court House, NJ

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
485	111	F	HOLD	CAPE MAY	DO NOT BREED		excluded - unknown pedigree
711	3027	M	HOLD	CAPE MAY	DO NOT BREED		MK not a priority for breeding at this time

CHICAGOBR

Chicago Zoological Park
Brookfield, IL

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
514	_____	F	HOLD	CHICAGOBR	DO NOT BREED		valuable female of advanced age

COLUMBIA

Riverbanks Zoo and Garden
Columbia, SC

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
527	006447	M	HOLD	COLUMBIA	DO NOT BREED		over-rep'd
618	6719	F	HOLD	COLUMBIA	DO NOT BREED		over-rep'd
750	7439	F	HOLD	COLUMBIA	BREED WITH	797	
797	8739	M	HOLD	COLUMBIA	BREED WITH	750	
798	8741	F	HOLD	COLUMBIA	BREED WITH	799	
799	8740	M	HOLD	COLUMBIA	BREED WITH	798	

DALLAS WA

Dallas World Aquarium
Dallas, TX

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
651	97A010	M	HOLD	DALLAS WA	DO NOT BREED		over-rep'd
652	99A017	F	HOLD	DALLAS WA	DO NOT BREED		MK not a priority for breeding at this time
695	1A0039	M	HOLD	DALLAS WA	DO NOT BREED		over-rep'd
777	3A037	F	HOLD	DALLAS WA	DO NOT BREED		over-rep'd

DENVER

Denver Zoological Gardens
Denver, CO

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
782	A04459	M	HOLD	DENVER	BREED WITH	785	
783	A04460	M	HOLD	DENVER	BREED WITH	790	
785	A04462	F	HOLD	DENVER	BREED WITH	782	
790	2282	F	RECEIVE FROM	NASHV ZOO	BREED WITH	783	

DREHER PA

Palm Beach Zoo at Dreher Park
West Palm Beach, FL

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
788	62676	F	RECEIVE FROM	BUSCH TAM	BREED WITH	803	
803	204177	M	HOLD	DREHER PA	BREED WITH	788	

FORTWORTH

Fort Worth Zoological Park
Ft Worth, TX

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
530	971004	M	HOLD	FORTWORTH	DO NOT BREED		over-rep'd
742	201638	F	HOLD	FORTWORTH	DO NOT BREED		excluded - unknown pedigree

FT WAYNE

Fort Wayne Children's Zool Garden
Fort Wayne, IN

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
743	97023	M	HOLD	FT WAYNE	DO NOT BREED		excluded - unknown pedigree
744	97024	F	HOLD	FT WAYNE	DO NOT BREED		excluded - unknown pedigree

GLEN OAK

Glen Oak Zoo

Peoria, IL

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
688	17715	F	HOLD	GLEN OAK	DO NOT BREED		pair for possible future breeding
473	930063	M	RECEIVE FROM	S BARBARA	DO NOT BREED		pair for possible future breeding

GREENVISC

Greenville Zoo

Greenville, SC

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
637	AV0002	F	RECEIVE FROM	ALEXANDRI	DO NOT BREED		Reported during draft as dead
661	XXA014	M	HOLD	GREENVISC	DO NOT BREED		over-rep'd, companion only

GULF BREZ

The ZOO

Gulf Breeze, FL

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
808	A3959	F	HOLD	GULF BREZ	DO NOT BREED		excluded - unknown pedigree
809	A3958	M	HOLD	GULF BREZ	DO NOT BREED		excluded - unknown pedigree

HONOLULU

Honolulu Zoo
Honolulu, HI

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
706	200061	F	HOLD	HONOLULU	DO NOT BREED		Valuable female – confirm pedigree of 706 to facilitate breeding rec
708	200256	F	HOLD	HONOLULU	DO NOT BREED		excluded - unknown pedigree – submit all pedigree data

HOUSTON

Houston Zoological Gardens
Houston, TX

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
587	16814	M	HOLD	HOUSTON	DO NOT BREED		over-rep'd
622	17835	F	HOLD	HOUSTON	DO NOT BREED		over-rep'd

KNOXVILLE

Knoxville Zoological Gardens
Knoxville, TN

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
726	2343	M	HOLD	KNOXVILLE	DO NOT BREED		MK not a priority for breeding at this time

LOWRY

Lowry Park Zoological Garden
Tampa, FL

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
780	205247	M	HOLD	LOWRY	BREED WITH	781	
781	205248	F	HOLD	LOWRY	BREED WITH	780	

LUFKIN

Ellen Trout Zoo
Lufkin, TX

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
532	08652	M	HOLD	LUFKIN	DO NOT BREED		pair for possible future breeding
814	2350	F	RECEIVE FROM	NASHV ZOO	DO NOT BREED		814 dispositioned outside of SSP – receive next female offspring from 764/766 as a replacement

MEMPHIS

Memphis Zoological Garden & Aquarium
Memphis, TN

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
606	17956	M	SEND TO	NZP-WASH	DO NOT BREED		over-rep'd
749	20252	F	HOLD	MEMPHIS	BREED WITH	791	
791	2283	M	RECEIVE FROM	NASHV ZOO	BREED WITH	749	

MONTGOMRY

Montgomery Zoo

Montgomery, AL

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
529	3369	M	HOLD	MONTGOMRY	DO NOT BREED		MK not a priority for breeding at this time
804	3346	M	HOLD	MONTGOMRY	BREED WITH	805	
805	3348	F	HOLD	MONTGOMRY	BREED WITH	804	
806	3347	M	HOLD	MONTGOMRY	BREED WITH	807	
807	3349	F	HOLD	MONTGOMRY	BREED WITH	806	

NASHV ZOO

Nashville Zoo at Grassmere
Nashville, TN

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
729	1862	M	HOLD	NASHV ZOO	DO NOT BREED		over-rep'd
751	2323	M	HOLD	NASHV ZOO	BREED WITH	765	
764	1998	M	HOLD	NASHV ZOO	BREED WITH	766	
765	1999	F	HOLD	NASHV ZOO	BREED WITH	751	
766	2000	F	HOLD	NASHV ZOO	BREED WITH	764	Send next female offspring from this pair to Lufkin in place of 814
789	2281	F	SEND TO	ALEXANDRI	BREED WITH	644	
790	2282	F	SEND TO	DENVER	BREED WITH	783	
791	2283	M	SEND TO	MEMPHIS	BREED WITH	749	
814	2350	F	SEND TO	LUFKIN	BREED WITH	532	Dispositioned outside of SSP
815	2352	F	HOLD	NASHV ZOO	DO NOT BREED		
816	2351	M	SEND TO	S BARABARA	BREED WITH	794	

NY BRONX

The Wildlife Conservation Society
Bronx, NY

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
800	S04076	F	HOLD	NY BRONX	BREED WITH	801	
801	S04077	M	HOLD	NY BRONX	BREED WITH	800	

NZP-WASH

National Zoological Park - Wash
Washington, DC

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
606	17956	M	RECEIVE FROM	MEMPHIS	DO NOT BREED		over-rep'd
607	213972	F	HOLD	NZP-WASH	DO NOT BREED		over-rep'd

OMAHA

Omaha's Henry Doorly Zoo
Omaha, NE

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
595	9455	F	HOLD	OMAHA	DO NOT BREED		

ORLANDO

Sea World Orlando
Orlando, FL

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
320	TT2500	F	HOLD	ORLANDO	DO NOT BREED		advanced age, would need to be repaired to receive breeding rec
453	TT2504	M	HOLD	ORLANDO	DO NOT BREED		excluded - unknown pedigree
714	TT2505	M	HOLD	ORLANDO	DO NOT BREED		over-rep'd
795	TT2506	F	HOLD	ORLANDO	DO NOT BREED		valuable female, would need to be repaired to receive breeding rec

PHOENIX

Phoenix Zoo

Phoenix, AZ

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
696	10121	M	HOLD	PHOENIX	DO NOT BREED		over-rep'd

PITTS CA

National Aviary in Pittsburgh

Pittsburgh, PA

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
741	6166	F	HOLD	PITTS CA	DO NOT BREED		over-rep'd

RIO GRAND

Albuquerque Biological Park

Albuquerque, NM

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
609	B05025	F	HOLD	RIO GRAND	BREED WITH	713	
713	B00010	M	HOLD	RIO GRAND	BREED WITH	609	

S BARBARA

Santa Barbara Zoological Gardens
Santa Barbara, CA

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
473	930063	M	SEND TO	GLEN OAK	DO NOT BREED		pair for possible future breeding
794	700061	F	HOLD	S BARBARA	BREED WITH	816	
816	2351	M	RECEIVE FROM	NASHV ZOO	BREED WITH	794	

SEA WORLD

Sea World San Diego
San Diego, CA

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
817	TT0001	M	HOLD	SEA WORLD	BREED WITH	818	
818	TT0002	F	HOLD	SEA WORLD	BREED WITH	817	

ST AUG GA

St. Augustine Alligator Farm
St Augustine, FL

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
465	9733	F	HOLD	ST AUG GA	DO NOT BREED		excluded - unknown pedigree
467	A0406	M	HOLD	ST AUG GA	DO NOT BREED		MK not a priority for breeding at this time

ST LOUIS

St. Louis Zoological Park
St. Louis, MO

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
754	103018	F	HOLD	ST LOUIS	DO NOT BREED		excluded - unknown pedigree
755	103017	F	HOLD	ST LOUIS	DO NOT BREED		excluded - unknown pedigree

TOPEKA

Topeka Zoological Park
Topeka, KS

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
528	207405	F	HOLD	TOPEKA	DO NOT BREED		MK not a priority for breeding at this time
718	005901	M	HOLD	TOPEKA	DO NOT BREED		over-rep'd

TULSA

Tulsa Zoo and Living Museum
Tulsa, OK

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
526	12075	F	HOLD	TULSA	DO NOT BREED		MK not a priority for breeding at this time
705	13597	M	HOLD	TULSA	DO NOT BREED		over-rep'd reported during draft period as dead

W PALM BE

Lion Country Safari Inc - Florida
Loxahatchee, FL

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
752	D100	M	HOLD	W PALM BE	DO NOT BREED		excluded - unknown pedigree
753	D101	M	HOLD	W PALM BE	DO NOT BREED		excluded - unknown pedigree

WORLDBIRD

Steve Martin Natural Encounters, Inc.
Lake Wales, FL

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
690	970017	U	HOLD	WORLDBIRD	DO NOT BREED		determine and report sex
691	970018	U	HOLD	WORLDBIRD	DO NOT BREED		determine and report sex
692	970019	U	HOLD	WORLDBIRD	DO NOT BREED		determine and report sex
694	000025	M	HOLD	WORLDBIRD	DO NOT BREED		excluded - unknown pedigree
813	8887	U	HOLD	WORLDBIRD	DO NOT BREED	over-rep'd,	determine and report sex

Appendix A Exclusions and Assumptions

Exclusions:

Pedigree $\geq 50\%$ Unknown: 453; 465; 485; 694; 708; 808; 809; 742; 743; 744; 752; 753; 754;

Assumptions:

OVERLAY REPORT		
TOCO TOUCAN	<i>Ramphastos toco</i>	
CHANGES MADE IN OVERLAY: "TOCO "		
STUD ID	CHANGES	NOTES
458	Change Sire ID from: UNK to: WILD1 Change Dam ID from: UNK to: WILD2	Sire Note: to denote the AVI BREED line
459	Change Sire ID from: UNK to: WILD1 Change Dam ID from: UNK to: WILD2	Sire Note: to denote the AVI BREED line
460	Change Sire ID from: UNK to: WILD1 Change Dam ID from: UNK to: WILD2	Sire Note: to denote the AVI BREED line
527	Change Sire ID from: UNK to: WILD5 Change Dam ID from: UNK to: WILD6	Sire Note: to denote FALLBROOK line
651	Change Sire ID from: UNK to: WILD5 Change Dam ID from: UNK to: WILD6	Sire Note: to denote FALLBROOK line
690	Change Sire ID from: UNK to: WILD5 Change Dam ID from: UNK to: WILD6	Sire Note: to denote FALLBROOK line
691	Change Sire ID from: UNK to: WILD5 Change Dam ID from: UNK to: WILD6	Sire Note: to denote FALLBROOK line
692	Change Sire ID from: UNK to: WILD5 Change Dam ID from: UNK to: WILD6	Sire Note: to denote FALLBROOK line
697	Change Sire ID from: UNK to: WILD3 Change Dam ID from: UNK to: WILD4	Sire Note: to denote BUENOSAIR line
698	Change Sire ID from: UNK to: WILD3 Change Dam ID from: UNK to: WILD4	Sire Note: to denote BUENOSAIR line
702	Change Sire ID from: UNK to: WILD3 Change Dam ID from: UNK to: WILD4	Sire Note: to denote BUENOSAIR line
703	Change Sire ID from: UNK to: WILD3 Change Dam ID from: UNK to: WILD4	Sire Note: to denote BUENOSAIR line
706	Change Sire ID from: UNK to: WILD7 Change Dam ID from: UNK to: WILD8	Sire Note: to denote CHENGCHOW line

NO BATCH EDITS ARE ENABLED

Number of Animals on this Report: 13

Appendix B Life Table

Age	Males					Females				
	Q _x	P _x	L _x	M _x	V _x	Q _x	P _x	L _x	M _x	V _x
0	0.280	0.720	1.000	0.000	1.163	0.320	0.680	1.000	0.000	1.190
1	0.080	0.920	0.720	0.010	1.267	0.070	0.930	0.680	0.010	1.311
2	0.080	0.920	0.662	0.060	1.197	0.140	0.860	0.632	0.060	1.248
3	0.110	0.890	0.609	0.070	1.100	0.070	0.930	0.544	0.070	1.145
4	0.090	0.910	0.542	0.110	1.003	0.120	0.880	0.506	0.080	1.021
5	0.160	0.840	0.494	0.080	0.892	0.130	0.870	0.445	0.090	0.924
6	0.110	0.890	0.415	0.130	0.825	0.110	0.890	0.387	0.150	0.816
7	0.180	0.820	0.369	0.200	0.710	0.230	0.770	0.345	0.160	0.687
8	0.120	0.880	0.303	0.180	0.527	0.260	0.740	0.265	0.170	0.599
9	0.060	0.940	0.266	0.120	0.335	0.170	0.830	0.196	0.130	0.474
10	0.190	0.810	0.250	0.100	0.215	0.270	0.730	0.163	0.110	0.377
11	0.200	0.800	0.203	0.020	0.125	0.300	0.700	0.119	0.110	0.320
12	0.200	0.800	0.162	0.000	0.115	0.290	0.710	0.083	0.020	0.257
13	0.240	0.760	0.130	0.000	0.129	0.140	0.860	0.059	0.110	0.264
14	0.290	0.710	0.099	0.000	0.152	0.430	0.570	0.051	0.120	0.182
15	0.480	0.520	0.070	0.000	0.212	0.150	0.850	0.029	0.080	0.080
16	0.310	0.690	0.036	0.000	0.321	0.160	0.840	0.025	0.000	0.000
17	0.000	1.000	0.025	0.150	0.344	0.220	0.780	0.021	0.000	0.000
18	0.290	0.710	0.025	0.000	0.199	0.000	1.000	0.016	0.000	0.000
19	0.640	0.360	0.018	0.000	0.308	0.210	0.790	0.016	0.000	0.000
20	0.000	1.000	0.006	0.510	0.510	0.000	1.000	0.013	0.000	0.000
21	1.000	0.000	0.006	0.000	0.000	1.000	0.000	0.013	0.000	0.000
22	1.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000
23	1.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000

Q_x = mortality; P_x = survival; L_x = cumulative survivorship; M_x = fecundity; V_x = expected future reproduction

Projected population growth rates

Males: $r = -0.1324$; $\lambda = 0.8760$; $R_0 = 0.320$; $T = 8.60$

Females: $r = -0.1508$; $\lambda = 0.8601$; $R_0 = 0.274$; $T = 8.60$

Appendix B Ordered Mean Kinship

Males

SB#	MK	%Known	Age	Location
644	0.000	100.0	14	ALEXANDRI
751	0.000	100.0	4	NASHV ZOO
778	0.000	100.0	3	BREVARD
780	0.000	100.0	3	LOWRY
782	0.000	100.0	3	DENVER
783	0.000	100.0	3	DENVER
786	0.000	100.0	3	BUSCH TAM
791	0.000	100.0	3	NASHV ZOO
792	0.000	100.0	3	AUDUBON
797	0.000	100.0	3	COLUMBIA
799	0.000	100.0	3	COLUMBIA
801	0.000	100.0	3	NY BRONX
803	0.000	100.0	3	DREHER PA
804	0.000	100.0	3	MONTGOMRY
806	0.000	100.0	3	MONTGOMRY
817	0.000	100.0	2	SEA WORLD
764	0.019	100.0	4	NASHV ZOO
532	0.026	100.0	11	LUFKIN
816	0.026	100.0	1	NASHV ZOO
467	0.040	100.0	13	ST AUG GA
529	0.048	100.0	11	MONTGOMRY
473	0.057	100.0	13	S BARBARA
711	0.060	100.0	6	CAPE MAY
713	0.060	100.0	7	RIO GRAND
726	0.060	100.0	5	KNOXVILLE
690	0.074	100.0	U9	WORLDBIRD
691	0.074	100.0	U9	WORLDBIRD
692	0.074	100.0	U9	WORLDBIRD
651	0.077	100.0	12	DALLAS WA
606	0.087	100.0	8	MEMPHIS
661	0.087	100.0	7	GREENVISC
714	0.087	100.0	5	ORLANDO
729	0.087	100.0	5	NASHV ZOO
530	0.090	100.0	10	FORTWORTH
705	0.090	100.0	11	TULSA
718	0.096	100.0	5	TOPEKA
587	0.105	100.0	10	HOUSTON
527	0.106	100.0	11	COLUMBIA
813	0.107	100.0	U1	COLUMBIA
695	0.109	100.0	6	DALLAS WA
740	0.109	100.0	5	CALDWELL
696	0.112	100.0	6	PHOENIX

Females

SB#	MK	%Known	Age	Location
320	0.000	100.0	20	ORLANDO
514	0.000	100.0	17	CHICAGOBR
595	0.000	100.0	10	OMAHA
748	0.000	100.0	20	CALDWELL
749	0.000	100.0	8	MEMPHIS
750	0.000	100.0	4	COLUMBIA
765	0.000	100.0	4	NASHV ZOO
779	0.000	100.0	3	BREVARD
781	0.000	100.0	3	LOWRY
785	0.000	100.0	3	DENVER
787	0.000	100.0	3	BUSCH TAM
788	0.000	100.0	3	BUSCH TAM
789	0.000	100.0	3	NASHV ZOO
790	0.000	100.0	3	NASHV ZOO
793	0.000	100.0	3	AUDUBON
794	0.000	100.0	3	S BARBARA
795	0.000	100.0	3	ORLANDO
798	0.000	100.0	3	COLUMBIA
800	0.000	100.0	3	NY BRONX
805	0.000	100.0	3	MONTGOMRY
807	0.000	100.0	3	MONTGOMRY
818	0.000	100.0	2	SEA WORLD
706	0.013	100.0	7	HONOLULU
766	0.019	100.0	4	NASHV ZOO
609	0.026	100.0	8	RIO GRAND
688	0.026	100.0	8	GLEN OAK
814	0.026	100.0	1	NASHV ZOO
815	0.026	100.0	1	NASHV ZOO
526	0.048	100.0	10	TULSA
528	0.056	100.0	13	TOPEKA
652	0.063	100.0	9	DALLAS WA
690	0.074	100.0	U9	WORLDBIRD
691	0.074	100.0	U9	WORLDBIRD
692	0.074	100.0	U9	WORLDBIRD
777	0.076	100.0	3	DALLAS WA
637	0.087	100.0	7	ALEXANDRI
607	0.090	100.0	9	NZP-WASH
618	0.097	100.0	8	COLUMBIA
622	0.101	100.0	8	HOUSTON
813	0.107	100.0	U1	COLUMBIA
741	0.109	100.0	5	PITTS CA
755	0.118	50.0	3	ST LOUIS

Appendix C Summary of Data Exports

Report compiled under SPARKS V. 1.5 & Population Management 2000, V. 1.211

Data exported on: 25 April 2006
Data compiled by: Martin Vince
Data current thru: 30 October 2005

ANALYTICAL STUDBOOK XX__TOCO

Filter Conditions In Effect:

Genetics: Locations: Association: AZA/Dates: As of End of date <= 24/04/2006 / Status: Living by 24/04/ 2006
Demography : Association: AZA/ Dates: During 01/01/1977 <= date .and. date <= 24/04/2006

Appendix D

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 individual's 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, V_x .

Appendix E

Directory of Institutional Representatives

Ken	Naugher	Montgomery Zoo	knaugher@montgomery.al.us
Gretchen	Bickert	Phoenix Zoo	gbickert@thephxzoo.com
Alan	Varsik	Santa Barbara Zoo	avarsik@santabarbarazoo.org
Wendy	Turner	Sea World San Diego	Wendy.turner@seaworld.com
Paul	Tomassoni	National Zoological Park	Ptomassoni@nzp.si.edu
Sherry	Branch	Sea World Orlando	Sherry.Branch@SeaWorld.com
Amanda	Whitaker	St. Augustine Alligator Farm	birdmamm@bellsouth.net
Steve	Martin	Steve Martin's Natural Encounters	natencount@aol.com
Ron	Cameron	Lion Country Safari	rcameron@lioncountrysafari.com
Michelle	Smurl	Brevard Zoo	mismurl@brevardzoo.org
Keith	Lovett	Palm Beach Zoo @ Dreher Park	k.lovett@lycos.com
Kelly	Rider	Lowry Park Zoo	kelly_r_33618@yahoo.com
Linda	Santos	Honolulu Zoo	zoolinda@hgea.org
Megan	Ross	Lincoln Park Zoo	meganr@lpzoo.org
Dawn	Petefish	Glen Oak Zoo	gozooreg@aol.com
Mark	Weldon	Ft. Wayne Children's Zoo	mark@kidszoo.com
Merle	Miller	Topeka Zoological Park	mmiller@topeka.org
Leslie	Whitt	Alexandria Zoological Park	les.whitt@cityofalex.com
Mark	Myers	Audubon Park Zoo	birds@auduboninstitute.org
Dan	Cassidy	Henry Doorly Zoo	cathym@omahazoo.com
Tracy	Carr	Cape May County Park Zoo	frogcarr@email.com
Bill	Aragon	Rio Grande Zoological Park	BAragon@cabg.gov
Diane	Fell	Tulsa Zoological Park	dianefell@ci.tulsa.ok.us
Jim	Dunster	National Aviary in Pittsburg	james.majeur@aviary.org
Bob	Wilson	Greenville Zoological Park	wilsonr@greenvillezoo.com
Martin	Vince	Riverbanks Zoo	mvince@riverbanks.org
Herb	Roberts	Memphis Zoo	hroberts@memphiszoo.org
Mark	Armstrong	Knoxville Zoological Gardens	marka@knoxville-zoo.org
Joe	DeGraauw	Nashville Zoo	jdegraauw@nashvillezoo.org
Lee	Schoen	Houston Zoological Gardens	schoen2@juno.com
Celia	Falzone	Ellen Trout Zoo	cfalzone@ci.lufkin.tx.us
Cindy	DiGesualdo	Dallas World Aquarium	vetcindy@dwazoo.com
Yvonne	Carbis	Caldwell Zoo	yvonneatzoo@aol.com
Brad	Hazelton	Fort Worth Zoo	CDBROWN@mail.ci.dallas.tx.us
John	Azua	Denver Zoo	jazua@denverzoo.org
Mike	Macek	Saint Louis Zoo	macek@stlzoo.org