

# Complete Analysis and Breeding Plan

## Guam Rail

*Rallus owstoni*

## Species Survival Plan®



**SSP Coordinator/Regional Studbook Keeper**

**Megan R. Ross Ph.D., Lincoln Park Zoo**

[mross@lpzoo.org](mailto:mross@lpzoo.org)

**Guam DAWR Liaison**

**Suzanne Medina**

**SPMAG ADVISOR**

**Colleen Lynch, AZA Population Management Center**

**19 March 2008**

This report prepared with assistance from the

**PMC**

Population Management Center

Lincoln Park  
Zoo

ASSOCIATION  
OF ZOOS &  
AQUARIUMS

## Executive Summary

### Guam Rail (*Rallus owstoni*) Species Survival Plan<sup>®</sup>

The Gruiformes TAG Regional Collection Plan has recommended Guam rails be managed as a SSP. AZA institutions hold 54 individuals at this time in 14 institutions; Guam Division of Aquatic and Wildlife Resources (DAWR) holds 138 specimens.

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. The North American population serves as a support population for the Guam population providing a genetic reservoir as well as a source of individuals for release. Therefore, these breeding recommendations are meant to balance the genetic representation between the mainland and Guam populations, as well as to breed individuals for release to be sent back to Guam. **Previous masterplans have excluded data for the Guam DAWR facility but the studbook is currently updated for both DAWR and N. American facilities. Both populations are included in the current master plans. Population statistics are presented for the the North American and DAWR population.**

	DEMOGRAPHY		
	North America	DAWR	Total
Current Population Size	54	138	192
Target Population Size	50	150	200
Mean Generation Time (years)	3.44	2.37	2.65
Projected Population Growth Rate ( $\lambda$ )	1.15	1.67	1.48

	GENETICS					
	North America		DAWR		Total	
	<i>Current</i>	<i>Potential</i>	<i>Current</i>	<i>Potential</i>	<i>Current</i>	<i>Potential</i>
Current Gene Diversity (% of Wild)	84.35	91.12	88.64	92.88	88.65	93.09
Founder Genome Equivalents	3.19	5.63	4.40	7.02	4.41	7.24
Number of Founders	10	0	10	0	10	0
Years To 90% Gene Diversity	n/a		n/a		n/a	
Gene Diversity at 100 (%)	26		50		63	
Ne/N	0.2637		0.2536		0.2848	

At this time, the population should be maintained to grow at a rate that does not exceed the limits of the release program or the ability of designated quarantine facilities to export birds. In most SSPs, pairings recommended for populations 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. However, for this population genetic considerations for pairs have been relaxed to meet demographic goals of the release program. The number of pairings recommended is intended to grow the population in order to supplement the reintroduction population.

**Summary Actions:** The SSP will have 7 exportations to the Guam population, 0 importations from the Guam population, 7 North American transfers, 18 breeding pairs in North America, 18 breeding pairs at Guam DAWR, and 50 releases.

# Table of Contents

<b>Executive Summary</b>	1
<b>I. Description of Population Status</b>	3
Demography	3
Genetics	5
Management Strategy	7
<b>II. Recommendations</b>	
Summary Recommendations – N. America	8
Summary Recommendations – DAWR	11
CHICAGOLP, CINCINNAT, GAINSVLL,	12
FRESNO, GAINSVLL,	13
GUAM DAWR	14
LOUISVILL, MILWAUKEE, NZP-CRC, NZP-WASH,	19
OKLAHOMA, PHILADELP, PITTS CA, RACINE,	20
SAN ANTON, SANDIEGOZ,	21
SD-WAP, SEDGWICK	22
<b>III. Appendices</b>	
A. Life Table	23
B. Ordered Mean Kinship	24
C. Summary of Data Exports	26
D. Definitions	27
E. Directory or Institutional Representatives	29

## **Species Coordinator**

**Megan R. Ross Ph.D.**

Lincoln Park Zoo

2001 North Clark Street, Chicago, Illinois 60614

Ph 312-742-7925 Fax 312-742-7220 [mross@lpzoo.org](mailto:mross@lpzoo.org)

Report and Analyses prepared by:

Colleen Lynch, Consulting Population Biologist, AZA Population Management Center

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

[pmc@lpzoo.org](mailto:pmc@lpzoo.org)

# Description of Population Status

**Introduction:** In 1984, as the wild population of the ko'ko', or Guam rail had already been eliminated from southern Guam, biologists from the Division of Aquatic and Wildlife Resources (DAWR) at Guam's Department of Agriculture began a captive breeding program with 21 wild caught ko'ko's. By the end of 1986, the last sighting of the ko'ko' occurred in northern Guam and the species was declared extinct in the wild. Focus was now on maintaining the birds in captivity with the hopes of releasing them back into the wild as soon as possible. Breeding began on Guam with the first successful hatching of a Guam rail chick in August 1984. Also, that same year ten rails were transferred to zoological facilities in the mainland United States to assist in captive breeding.

Since that time Guam rails have been managed as an SSP in AZA institutions. Several management plans have been produced and distributed since that time, most recently in 2007. Comprehensive genetic and demographic analyses of the Guam Rail International Studbook (current to 1 January 2008) were performed in January 2008, resulting in the current master plan for this species. Recommendations contained in this master plan supercede those made by earlier plans. **Previous masterplans have excluded data for the Guam DAWR facility but the studbook is currently updated for both DAWR and N. American facilities. Both populations are included in the current master plan. Population statistics are presented for the the North American and DAWR population. DAWR has requested pairing recommendations and release recommendations for 50 individuals at this time.**

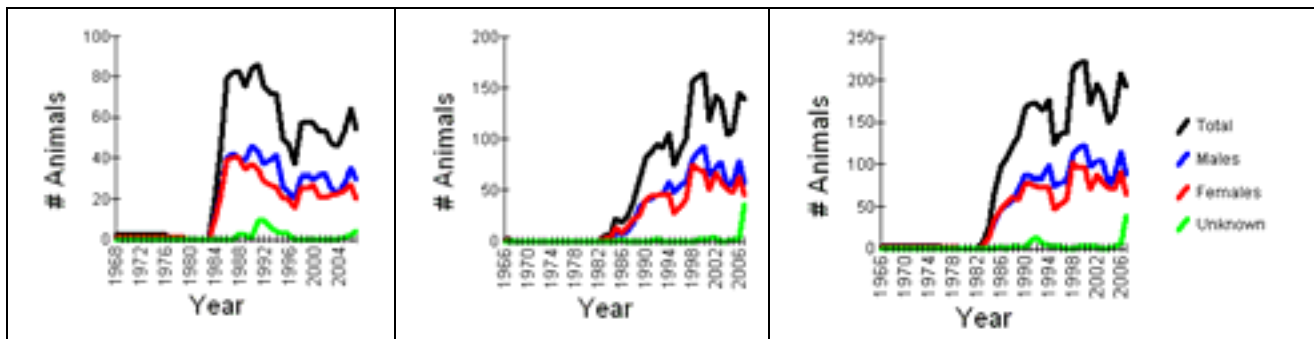
**Managed Population:** The total Guam rail population is currently 192 individuals (54 in North America, 138 at DAWR) distributed among 15 institutions (14 in North America, 1 in Guam). Seven individuals were removed from the N .American potential breeding population due to advanced age/apparent senescence (SB#s 393, 414, 266, 372, 489, 380, 383). One specimen participates in education programs (# 841). Fifteen specimens were excluded from the DAWR population for age, medical, or education reasons. These exclusions are noted in the recommendations table for DAWR.

**Demography:** The North American Regional population grew quickly following its appearance in 1984. Since the population's inception annual growth rates attributed to captive propagation have varied ( $\lambda = 0.90 - 2.83$ ) Periods of growth have been interspersed with periods of decline demonstrating the need for continued and consistent management of the program. Following a resurgence of interest in the program in 1997-2000 annual growth rates have averaged 1.13 in North American Institutions.

N. America

DAWR

Total



**Figure 1.** Census of Guam rails in N. America, Guam, and Total.

Current spaces available for this population in North America number approximately 50, however, current rates of population growth rates are typically planned to exceed available space as portions of the population in North America are frequently exported to Guam for release and to supplement the Guam captive population. If these exports, however, are not carefully planned to maintain a stable age distribution, higher growth rates exhibited earlier in the program may not be sustainable.

N. America

DAWR

Total

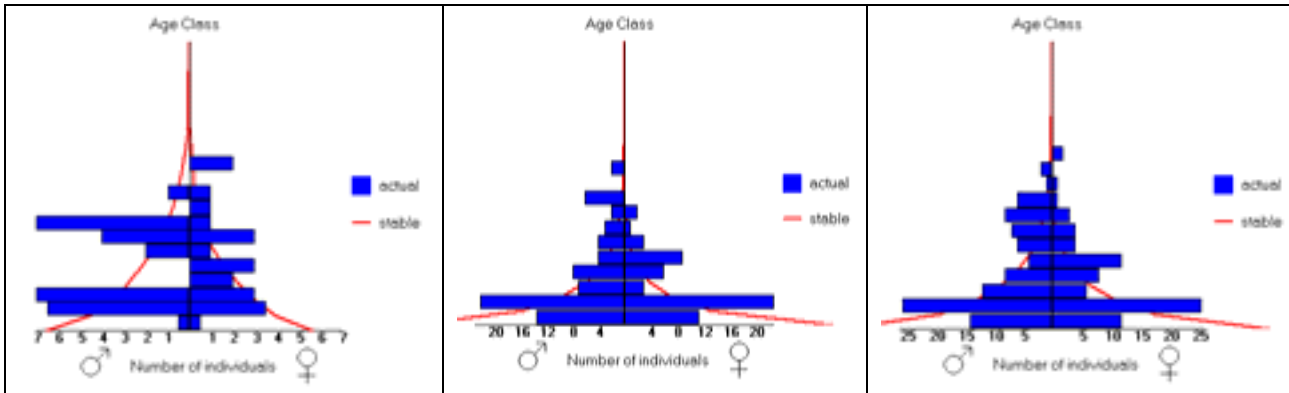


Figure 2. Age distribution of N. America, Guam, and Total.

The age structure of the N. American population deviates from a stable distribution as periods of high production are interspersed by short periods of low production (Figure 2). Such inconsistencies in annual growth rates often result in difficulty predicting future population growth rates as the number of individuals entering and leaving reproductive age classes vary from year to year. The DAWR population exhibits similar instabilities in the age structure though not as extreme due to its greater population size. The overall population exhibits a fairly stable age distribution.

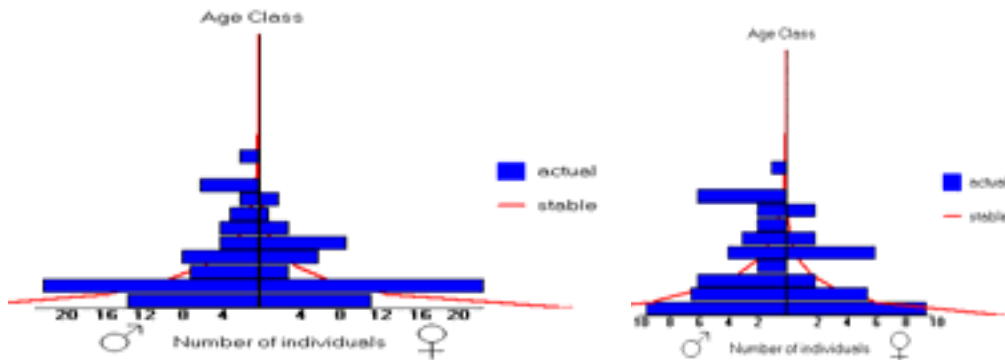
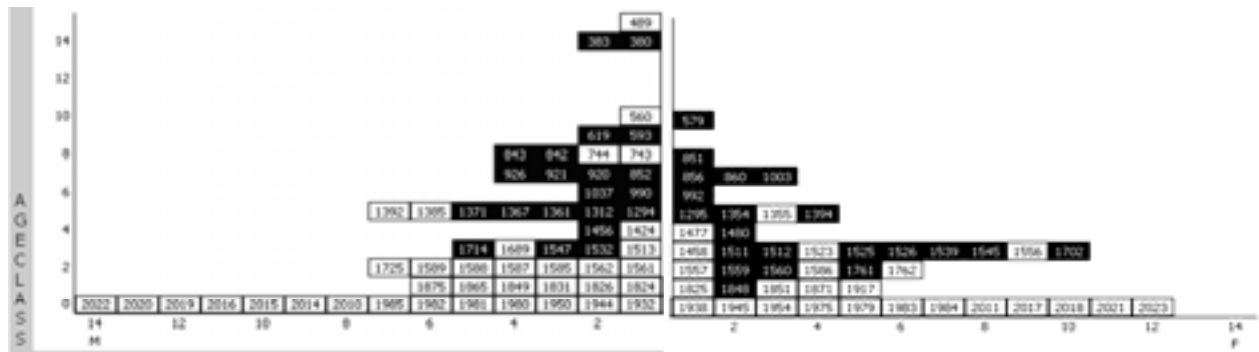


Figure 3. Age distribution DAWR population before (left) and after (right) recommended releases.

The age structure of the DAWR population approximates a stable distribution but is male-biased in sex ratio. This poses a programmatic challenge as the DAWR facility hopes to manage a female-biased flock. It is recommended that the DAWR facility, shift to an even sex-ratio to maximize Ne/N ratio (which in turn will maximize GD retention). The DAWR facility is also planning a release of 50 individuals in the coming months and has stated that an even sex ratio of release cohorts is a priority over even sex ratio of the captive flock at this time. The formation of DAWR breeding pairs in the coming year, therefore, will be limited by the number of females remaining in the captive flock after releases (Figure 3).



Also of concern is the distribution of breeders among age classes in the DAWR facility. The breeders (in black above) are found mostly in the oldest age classes. It is important that younger breeders be recruited and proven before older breeders are lost to attrition to avoid interruptions in production for releases. Recruiting younger breeders has proven challenging in the North American population and efforts to recruit younger breeders should continue in that population as well.

Demographic data suggests the lifespan of Guam rails is as great as 18 years. Males and females can reproduce at ages as young as three months old and have not been observed to breed beyond the age of 11 years. Breeding in captivity is complex, as the males can be extremely aggressive and have at times injured or killed females. Once a pair bond has formed, however, pairs can produce up to ten clutches a year. Clutches range from 1-4 eggs, averaging 2.125, with an incubation period of 19 days. Within two to three weeks after hatching a clutch, the adults begin nesting again while still caring for the young chicks from the previous clutch. Infant mortality is under 27%.

**Genetics:** The managed population is descended from 10 founders and no potential founders remain. Gene diversity in the population (84%) is low relative to the average SSP (93%), but the potential gene diversity is 91%. The population gene diversity could fall below 80% in less than 3 years. Projections of gene diversity indicate 26% at 100 years from present. 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 and greater neonatal mortality. The potential gene diversity is high and gene diversity retention could be extended through management. Strategies to do so would include equalizing founder representation and further increasing the population's effective size.

### **Genetic Summary - N. America Only**

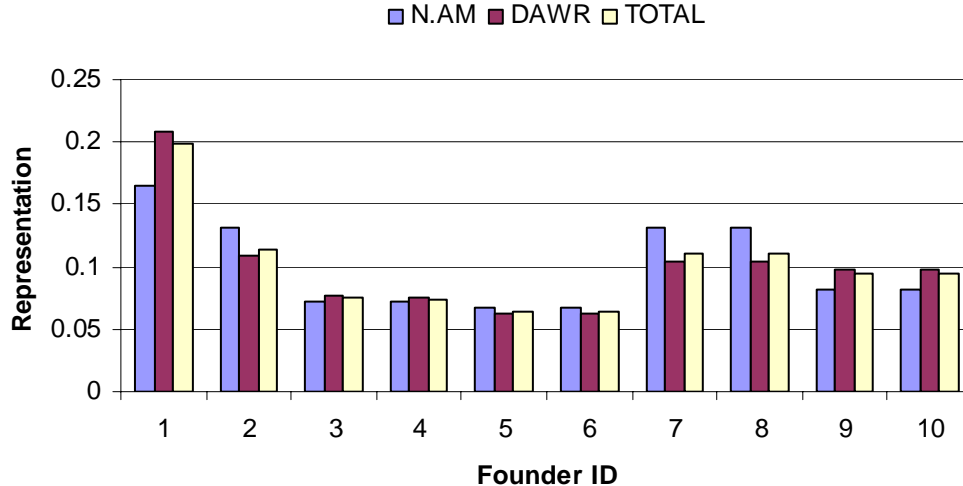
	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	
	<b>Actual</b>	<b>Actual</b>	<b>Actual</b>	<b>Actual</b>	<b>Potential</b>
Founders	10	10	10	10	0
Founder Genome Equivalent	3.77	3.52	3.17	3.19	5.63
Gene Diversity Retained (%)	86.75	85.78	84.24	84.35	91.12
Population Mean Kinship	0.1343	0.1422	0.1576	0.1565	
Mean Inbreeding	0.0607	0.0702	0.0830	0.0806	
% Pedigree Known	100	100	100	100	
Years to 90%	0	0	0	n/a	
Diversity at 100 Years (%)	27	26	25	26	
$N_e/N$	0.28	0.30	0.2585	0.2637	

## Genetic Summary - N. America + DAWR

	N. America		DAWR		Total	
	Actual	Potential	Actual	Potential	Actual	Potential
Founders	10	0	10	0	10	0
Founder Genome Equivalents	3.19	5.63	4.40	7.02	4.41	7.24
Gene Diversity Retained (%)	84.35	91.12	88.64	92.88	88.65	93.09
Population Mean Kinship	0.1565		0.1136		0.1135	
Mean Inbreeding	0.0806		0.0762		0.0762	
% Pedigree Known	100		100		100	
Years to 90%	n/a		n/a		n/a	
Diversity at 100 Years (%)	26		50		63	
$N_e/N$	0.2637		0.2536		0.2848	

Gene diversity in the DAWR population is higher than that in North America. While both populations share the same founder base and founder representation among the two populations is similar, higher target population size and more rapid population growth at the DAWR facility results in greater GD retention. GD in this population could drop below 80% in as few as 15 years. Increasing effective population size by recruiting a greater proportion of the captive flock as breeders is the most likely strategy to reduce the rate of further GD loss. In population managed for rapid reproduction is not uncommon for  $N_e/N$  to equal 0.4. Such an increase in  $N_e/N$  results in a GD projection for this population of 63% at 100 years and 28 years to 90%.

### Founder Representation



**Management Strategy North America:** Demographic analyses indicate that the current population size will be maintained with the addition of 8-9 hatches. Twelve pairs are recommended to produce up to one clutch per pair to maintain the mainland population. An additional six pairings are recommended to supply exports to Guam DAWR; export pairs are requested to produce one clutch and then consult the species coordinator prior to production of a possible second clutch. The number of export pairs has been determined by the expressed capacity of the export facilities for the next year.

1. Recommend 12 pairings – to be single-clutched – for the mainland population. Prior to production of a second clutch please contact the Species Coordinator. A large number of pairings are recommended relative to production goals and second clutches may or may not be desired depending on overall pairing success.
2. Recommend 6 pairings – to be single-clutched for exportation of offspring. Facilities producing for quarantine may produce multiple clutches at the discretion of the species coordinator and designated quarantine facility to insure space for all individuals in export shipments.
3. Recommend 8 transfers within North America.
4. Recommend 7 transfers to Guam from current population
5. Immediately upon hatch of individuals recommended for export, contact your designated quarantine station to facilitate availability of quarantine space at time of shipment.

**Management Strategy DAWR:** Demographic analyses indicate that the current population size will be maintained with the addition of approximately 18 hatches. Any production in excess of this should be available for release.

1. Recommend 18 pairings to rotate through 22 breeding enclosures. Pairs may be given “time off” and replaced by alternate pairs as needed. Additional pairings may be formed as unsexed animals remaining following planned releases are sexed.
2. Recommend 50 release individuals as requested by Guam DAWR. Several “extra” or alternate release individuals have been recommended in the event that priority release specimens can not be released.
3. Recommend 7 imports from North America of existing specimens.
4. Recommend continued importation of N. American chicks from designated breeding pairs.

## Summary of Breeding and Transfer Recommendations – N. America

ID	Location	Local ID	Sex	Disposition	Location	Breeding	With	Notes
871	CHICAGOLP	20513	F	HOLD	CHICAGOLP	BREED WITH	986	Breed for Guam - export via SDZ
986	CHICAGOLP	21998	M	HOLD	CHICAGOLP	BREED WITH	871	
1573	CINCINNAT	206004	F	HOLD	CINCINNAT	DO NOT BREED		reported as dead following analysis
1565	CINCINNAT	205068	M	HOLD	CINCINNAT	DO NOT BREED		reported as dead following analysis
414	CINCINNAT		F	HOLD	CINCINNAT	DO NOT BREED		excluded age
393	CINCINNAT		M	HOLD	CINCINNAT	DO NOT BREED		excluded age
853	CINCINNAT	200043	F	HOLD	CINCINNAT	BREED WITH	1593	Breed for N AM
1410	CINCINNAT	203097	F	HOLD	CINCINNAT	BREED WITH	1321	Breed for Guam - export via DAK
1577	CINCINNAT	207022	U			SEE NOTES		a female offspring from this clutch is to be sent to LOUISVILL, remaining clutchmates to GUAM via DAK
1576	CINCINNAT	207021	U			SEE NOTES		a female offspring from this clutch is to be sent to LOUISVILL, remaining clutchmates to GUAM via DAK
1575	CINCINNAT	206286	U			SEE NOTES		a female offspring from this clutch is to be sent to LOUISVILL, remaining clutchmates to GUAM via DAK
1593	CINCINNAT	_____	M	HOLD	CINCINNAT	BREED WITH	853	
1578	CINCINNAT	_____	M	HOLD	CINCINNAT	DO NOT BREED		
1574	CINCINNAT	206292	F	SEND TO	FRESNO	DO NOT BREED		
1572	CINCINNAT	206291	M	SEND TO	FRESNO	DO NOT BREED		
1321	CINCINNAT	204002	M	HOLD	CINCINNAT	BREED WITH	1410	
2040	GAINSVLL	26808	U	SEND TO	PHILADELP	BREED WITH	985	Breed for N AM IF FEMALE SEND TO PHILLY
1459	GAINSVLL	26803	F	HOLD	GAINSVLL	BREED WITH	1322	Breed for N AM
1322	GAINSVLL	26804	M	HOLD	GAINSVLL	BREED WITH	1459	
994	LOUISVILL	201869	M	HOLD	LOUISVILL	BREED WITH		FEMALE FROM CINCI, 1575, 1576, or 1577
1460	LOUISVILL	_____	F	SEND TO	SANDIEGOZ	BREED WITH	988	Breed for N AM

ID	Location	Local ID	Sex	Disposition	Location	Breeding	With	Notes
372	NZP-CRC		M	HOLD	NZP-CRC	DO NOT BREED		excluded age
266	NZP-CRC		M	HOLD	NZP-CRC	DO NOT BREED		excluded age
727	NZP-CRC	214314	F	HOLD	NZP-CRC	BREED WITH	1292	Breed for N AM
1292	NZP-CRC	215020	M	HOLD	NZP-CRC	BREED WITH	727	
508	NZP-CRC	215532	F	HOLD	NZP-CRC	DO NOT BREED		
1412	NZP-WASH	215283	F	HOLD	NZP-WASH	BREED WITH	1318	Breed for N AM
1318	NZP-WASH	215019	M	HOLD	NZP-WASH	BREED WITH	1412	
1595	OKLAHOMA	780802	F	HOLD	OKLAHOMA	BREED WITH	872	Breed for N AM – reported as dead during draft period
872	OKLAHOMA	780801	M	HOLD	OKLAHOMA	BREED WITH	1595	
985	PHILADELP	205350	M	HOLD	PHILADELP	BREED WITH	2040	
1580	PITTS CA	7409	F	SEND TO	SAN ANTON	BREED WITH	1579	Breed for Guam - export via SDZ
993	PITTS CA	6081	F	HOLD	PITTS CA	BREED WITH	981	Breed for Guam - export via DAK
981	PITTS CA	5597	M	HOLD	PITTS CA	BREED WITH	993	
1319	RACINE	M0435	F	HOLD	RACINE	BREED WITH	1314	Breed for N AM
1314	RACINE	M0614	M	HOLD	RACINE	BREED WITH	1319	
1584	SAN ANTON	A06073	F	SEND TO	MILWAUKEE	BREED WITH	1594	Breed for N AM
1579	SAN ANTON	A06071	M	HOLD	SAN ANTON	BREED WITH	1580	Breed for Guam - export via SDZ
995	SAN ANTON	Y04017	F	HOLD	SAN ANTON	BREED WITH	1313	Breed for Guam - export via SDZ
1313	SAN ANTON	N02016	M	HOLD	SAN ANTON	BREED WITH	995	
988	SANDIEGOZ	801077	M	HOLD	SANDIEGOZ	BREED WITH	1460	
1583	SANDIEGOZ	307419	M	EXPORT TO	GUAM	NO REC.		
1582	SANDIEGOZ	307418	M	EXPORT TO	GUAM	NO REC.		
1581	SANDIEGOZ	307421	M	EXPORT TO	GUAM	NO REC.		
1569	SANDIEGOZ	307420	M	EXPORT TO	GUAM	NO REC.		
1293	SANDIEGOZ	307424	M	EXPORT TO	GUAM	SEE NOTES		FOR RELEASE - Kills females in captivity
1564	SD-WAP	807251	F	HOLD	SD-WAP	BREED WITH	1591	Breed for N AM
1315	SD-WAP	807257	F	HOLD	SD-WAP	BREED WITH	1596	Breed for N AM

ID	Location	Local ID	Sex	Disposition	Location	Breeding	With	Notes
1596	SD-WAP	806190	M	HOLD	SD-WAP	BREED WITH	1315	
1594	SD-WAP	806182	M	SEND TO	MILWAUKEE	BREED WITH	1584	
1591	SD-WAP	806139	M	HOLD	SD-WAP	BREED WITH	1564	
841	SEDGWICK		M	HOLD	SEDGWICK	DO NOT BREED		excluded ed
543	SEDGWICK	11908	F	HOLD	SEDGWICK	BREED WITH	636	Breed for N AM
636	SEDGWICK	11907	M	HOLD	SEDGWICK	BREED WITH	543	

## Summary of Breeding and Release Recommendations – DAWR

**Breeding pairs** – Pairs are prioritized based upon genetic value from the top to the bottom of the list.

Pairs containing females needing “time off” can be replaced by pairs further down the list as needed (the full pair should be rotated out of breeding and replaced by another full pair to maximize Ne/N ratio as the use of a male with multiple females will reduce this value and compromise GD retention).

(926 & 1458;  $F = 0.074$ )  
(920 & 1354);  $F = 0.078$   
(852 & 1954);  $F = 0.077$   
(843 & 1539);  $F = 0.083$   
(921 & 1917);  $F = 0.080$   
(1547 & 1762;  $F = 0.078$ )  
(1714 & 992;  $F = 0.076$ )  
(1037 & 1512);  $F = 0.087$   
(593 & 1003;  $F = 0.055$ )  
(990 & 1523;  $F = 0.084$ )  
(1367 & 1355;  $F = 0.070$ )  
(1312 & 2018;  $F = 0.084$ )  
(1293 & 1526;  $F = 0.069$ )  
(1725 & 1983;  $F = 0.086$ )  
(1849 & 1825;  $F = 0.079$ )  
(1569 & 2021;  $F = 0.081$ )  
(1424 & 2023;  $F = 0.084$ )  
(1456 & 1480;  $F = 0.081$ )

**Release individuals** – Releases are prioritized based upon genetic metrics. Animals at the beginning of the list are the most over-represented in the population. The first fifty birds on the list are recommended as priority releases. Historic breeders are noted in BOLD. Should a historic breeder or other individual not be released it should be replaced by the next same or UNK sex individual on the list. Current breeding recommendations assume that extra release specimens will not be required (only the top 50 specimens will be released. Any release designated specimens remaining following releases may be paired using maximum avoidance of inbreeding (as other pairings have recently been made at DAWR).

### Release 1

**1560; 1559; 1545; 1294;** 1556; 1958; 2014; 1961; 1557; 1969; 1962; **1295;** 1979; 1950; **1394;** 1585; 1973; 1980; 1586; 1963; 1964; **1511; 1371;** 1561; 1974;

### Release 2

1587; 1977; 1984; 1965; **1848;** 1562; 1932; 1960; 1588; 1975; 1985; 1978; 2010; 1932; 1589; **1525; 1761;** 1945; 1938; 1981; 1970; 2011; 2015; 1871; **619;**

### Release Extras

2037; 1826; **1917; 1354; 852;** 1956; 1575; 2016; **1456;** 1982; 1971; **1512;** 1702; 1957; **1539;** 1851; 2038; **1954;** 2017

**CHICAGOLP****Lincoln Park Zoological Gardens**

Chicago, IL

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
871	20513	F	HOLD	CHICAGOLP	BREED WITH	986	Breed for Guam - export via SDZ
986	21998	M	HOLD	CHICAGOLP	BREED WITH	871	

**CINCINNAT****Cincinnati Zoo & Botanical Garden**

Cincinnati, OH

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
393		M	HOLD	CINCINNAT	DO NOT BREED		excluded age
414		F	HOLD	CINCINNAT	DO NOT BREED		excluded age
853	200043	F	HOLD	CINCINNAT	BREED WITH	1593	Breed for N AM
1321	204002	M	HOLD	CINCINNAT	BREED WITH	1410	
1410	203097	F	HOLD	CINCINNAT	BREED WITH	1321	Breed for Guam - export via DAK
1565	205068	M	HOLD	CINCINNAT	DO NOT BREED		reported as dead following analysis
1572	206291	M	SEND TO	FRESNO	DO NOT BREED		
1573	206004	F	HOLD	CINCINNAT	DO NOT BREED		reported as dead following analysis
1574	206292	F	SEND TO	FRESNO	DO NOT BREED		
1575	206286	U			SEE NOTES		a female offspring from this clutch is to be sent to LOUISVILL, remaining clutchmates to GUAM via DAK
1576	207021	U			SEE NOTES		a female offspring from this clutch is to be sent to LOUISVILL, remaining clutchmates to GUAM via DAK
1577	207022	U			SEE NOTES		a female offspring from this clutch is to be sent to LOUISVILL, remaining clutchmates to GUAM via DAK
1578	_____	M	HOLD	CINCINNAT	DO NOT BREED		
1593	_____	M	HOLD	CINCINNAT	BREED WITH	853	

**FRESNO****Chaffee Zoo**

Fresno, CA

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
1572	206291	M	RECEIVE FROM	CINCINNAT	DO NOT BREED		
1574	206292	F	RECEIVE FROM	CINCINNAT	DO NOT BREED		

**GAINSVLL****Santa Fe Teaching Zoo**

Gainesville, FL

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
1322	26804	M	HOLD	GAINSVLL	BREED WITH	1459	
1459	26803	F	HOLD	GAINSVLL	BREED WITH	1322	Breed for N AM
2040	26808	U	SEND TO	PHILADELP	BREED WITH	985	Breed for N AM IF FEMALE SEND TO PHILLY

**GUAM DAWR**  
**GUAM (U.S.)**  
MALAY ARCHIPELAGO, Asian Region

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
380		M	HOLD	GUAM	DO NOT BREED		excluded as per SM
383		M	HOLD	GUAM	DO NOT BREED		excluded as per SM
489		M	HOLD	GUAM	DO NOT BREED		excluded as per SM
560		M	HOLD	GUAM	DO NOT BREED		excluded - education bird
579		F	HOLD	GUAM	DO NOT BREED		excluded - education bird
743		M	HOLD	GUAM	DO NOT BREED		excluded - education bird
744		M	HOLD	GUAM	DO NOT BREED		excluded - education bird
851		F	HOLD	GUAM	DO NOT BREED		excluded as per SM
856		F	HOLD	GUAM	DO NOT BREED		excluded as per SM
860		F	HOLD	GUAM	DO NOT BREED		excluded as per SM
1385		M	HOLD	GUAM	DO NOT BREED		excluded as per SM
1392		M	HOLD	GUAM	DO NOT BREED		excluded - education bird
1477		F	HOLD	GUAM	DO NOT BREED		excluded as per SM
1689		M	HOLD	GUAM	DO NOT BREED		excluded - education bird
1966		U	HOLD	GUAM	DO NOT BREED		excluded as per SM
593	682	M	HOLD	GUAM	BREED WITH	1003	
619	2004	M	RELEASE	GUAM	DO NOT BREED		Release group # 2
842	2192	M	HOLD	GUAM	DO NOT BREED		
843	2193	M	HOLD	GUAM	BREED WITH	1539	
852	436	M	HOLD	GUAM	BREED WITH	1954	
920	2348	M	HOLD	GUAM	BREED WITH	1354	
921	2349	M	HOLD	GUAM	BREED WITH	1917	
926	2354	M	HOLD	GUAM	BREED WITH	1458	
990	12121	M	HOLD	GUAM	BREED WITH	1523	
992	12-153	F	HOLD	GUAM	BREED WITH	1714	
1003	2411	F	HOLD	GUAM	BREED WITH	593	
1037	2447	M	HOLD	GUAM	BREED WITH	1512	
1294	2913	M	RELEASE	GUAM	DO NOT BREED		Release group # 1
1295	2911	F	RELEASE	GUAM	DO NOT BREED		Release group # 1
1312	2910	M	HOLD	GUAM	BREED WITH	2018	
1354	2628	F	HOLD	GUAM	BREED WITH	920	
1355	2629	F	HOLD	GUAM	BREED WITH	1367	
1361	2635	M	HOLD	GUAM	DO NOT BREED		

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
1367	2641	M	HOLD	GUAM	BREED WITH	1355	
1371	2645	M	RELEASE	GUAM	DO NOT BREED		Release group # 1
1394	2668	F	RELEASE	GUAM	DO NOT BREED		Release group # 1
1424	2696	M	HOLD	GUAM	BREED WITH	2023	
1456	2729	M	HOLD	GUAM	BREED WITH	1480	
1458	18	F	HOLD	GUAM	BREED WITH	926	
1480	2740	F	HOLD	GUAM	BREED WITH	1956	non-releasable
1511	2776	F	RELEASE	GUAM	DO NOT BREED		Release group # 1
1512	2777	F	HOLD	GUAM	BREED WITH	1037	
1513	2778	M	HOLD	GUAM	DO NOT BREED		
1523	2788	F	HOLD	GUAM	BREED WITH	990	
1525	2790	F	RELEASE	GUAM	DO NOT BREED		Release group # 2
1526	2791	F	HOLD	GUAM	BREED WITH	1293	
1532	2797	M	HOLD	GUAM	DO NOT BREED		
1539	2804	F	HOLD	GUAM	BREED WITH	843	
1545	2810	F	RELEASE	GUAM	DO NOT BREED		Release group # 1
1547	2812	M	HOLD	GUAM	BREED WITH	1762	
1556	10-50	F	RELEASE	GUAM	DO NOT BREED		Release group # 1
1557	10-49	F	RELEASE	GUAM	DO NOT BREED		Release group # 1
1559	10-46	F	RELEASE	GUAM	DO NOT BREED		Release group # 1
1560	000	F	RELEASE	GUAM	DO NOT BREED		Release group # 1
1561	001	M	RELEASE	GUAM	DO NOT BREED		Release group # 1
1562	002	M	RELEASE	GUAM	DO NOT BREED		Release group # 2
1585	004	M	RELEASE	GUAM	DO NOT BREED		Release group # 1
1586	007	F	RELEASE	GUAM	DO NOT BREED		Release group # 1
1587	006	M	RELEASE	GUAM	DO NOT BREED		Release group # 2
1588	003	M	RELEASE	GUAM	DO NOT BREED		Release group # 2
1589	005	M	RELEASE	GUAM	DO NOT BREED		Release group # 2
1702	2827	F	AVAILABLE	GUAM	DO NOT BREED		Release extra
1714	2833	M	HOLD	GUAM	BREED WITH	992	
1725	2839	M	HOLD	GUAM	BREED WITH	1983	
1761	2865	F	RELEASE	GUAM	DO NOT BREED		Release group # 2
1762	2866	F	HOLD	GUAM	BREED WITH	1547	
1824	2921	M	HOLD	GUAM	DO NOT BREED		
1825	2922	F	HOLD	GUAM	BREED WITH	1849	

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
1826	2923	M	AVAILABLE	GUAM	DO NOT BREED		Release extra
1831	2925	M	HOLD	GUAM	DO NOT BREED		
1848	2941	F	RELEASE	GUAM	DO NOT BREED		Release group # 2
1849	2942	M	HOLD	GUAM	BREED WITH	1825	
1851	2944	F	AVAILABLE	GUAM	DO NOT BREED		Release extra
1865	2956	M	HOLD	GUAM	DO NOT BREED		
1871	2960	F	RELEASE	GUAM	DO NOT BREED		Release group # 2
1875	2959	M	HOLD	GUAM	DO NOT BREED		
1917	2985	F	HOLD	GUAM	BREED WITH	921	
1932	3000	M	RELEASE	GUAM	DO NOT BREED		Release group # 2
1938	107	F	RELEASE	GUAM	DO NOT BREED		Release group # 2
1944	113	M	HOLD	GUAM	DO NOT BREED		
1945	114	F	RELEASE	GUAM	DO NOT BREED		Release group # 2
1950	119	M	RELEASE	GUAM	DO NOT BREED		Release group # 1
1954	123	F	HOLD	GUAM	BREED WITH	852	
1956	127	U	AVAILABLE	GUAM	DO NOT BREED		Release extra
1957	128	U	AVAILABLE	GUAM	DO NOT BREED		Release extra
1958	125	U	RELEASE	GUAM	DO NOT BREED		Release group # 1
1960	129	U	RELEASE	GUAM	DO NOT BREED		Release group # 2
1961	130	U	RELEASE	GUAM	DO NOT BREED		Release group # 1
1962	131	U	RELEASE	GUAM	DO NOT BREED		Release group # 1
1963	132	U	RELEASE	GUAM	DO NOT BREED		Release group # 1
1964	137	U	RELEASE	GUAM	DO NOT BREED		Release group # 1
1965	138	U	RELEASE	GUAM	DO NOT BREED		Release group # 2
1967	134	U	HOLD	GUAM	DO NOT BREED		report sex for July Mid-year Master Plan
1968	135	U	HOLD	GUAM	DO NOT BREED		report sex for July Mid-year Master Plan
1969	136	U	RELEASE	GUAM	DO NOT BREED		Release group # 1
1970	139	U	RELEASE	GUAM	DO NOT BREED		Release group # 2
1971	140	U	AVAILABLE	GUAM	DO NOT BREED		Release extra
1972	141	U	HOLD	GUAM	DO NOT BREED		report sex for July Mid-year Master Plan

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
1973	142	U	RELEASE	GUAM	DO NOT BREED		Release group # 1
1974	143	U	RELEASE	GUAM	DO NOT BREED		Release group # 1
1975	149	F	RELEASE	GUAM	DO NOT BREED		Release group # 2
1976	144	U	HOLD	GUAM	DO NOT BREED		report sex for July Mid-year Master Plan
1977	145	U	RELEASE	GUAM	DO NOT BREED		Release group # 2
1978	146	U	RELEASE	GUAM	DO NOT BREED		Release group # 2
1979	147	F	RELEASE	GUAM	DO NOT BREED		Release group # 1
1980	148	M	RELEASE	GUAM	DO NOT BREED		Release group # 1
1981	150	M	RELEASE	GUAM	DO NOT BREED		Release group # 2
1982	151	M	AVAILABLE	GUAM	DO NOT BREED		Release extra
1983	152	F	HOLD	GUAM	BREED WITH	1725	
1984	153	F	RELEASE	GUAM	DO NOT BREED		Release group # 2
1985	154	M	RELEASE	GUAM	DO NOT BREED		Release group # 2
2010	155	M	RELEASE	GUAM	DO NOT BREED		Release group # 2
2011	156	F	RELEASE	GUAM	DO NOT BREED		Release group # 2
2014	159	M	RELEASE	GUAM	DO NOT BREED		Release group # 1
2015	160	M	RELEASE	GUAM	DO NOT BREED		Release group # 2
2016	161	M	AVAILABLE	GUAM	DO NOT BREED		Release extra
2017	162	F	AVAILABLE	GUAM	DO NOT BREED		Release extra
2018	163	F	HOLD	GUAM	BREED WITH	1312	
2019	164	M	HOLD	GUAM	DO NOT BREED		
2020	165	M	HOLD	GUAM	DO NOT BREED		
2021	166	F	HOLD	GUAM	BREED WITH	1569	
2022	167	M	HOLD	GUAM	DO NOT BREED		
2023	168	F	HOLD	GUAM	BREED WITH	1424	
2024	169	U	HOLD	GUAM	DO NOT BREED		report sex for July Mid-year Master Plan
2025	170	U	HOLD	GUAM	DO NOT BREED		report sex for July Mid-year Master Plan
2026	171	U	HOLD	GUAM	DO NOT BREED		report sex for July Mid-year Master Plan
2027	172	U	HOLD	GUAM	DO NOT BREED		report sex for July Mid-year Master Plan
2028	173	U	HOLD	GUAM	DO NOT BREED		report sex for July Mid-year Master Plan

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
2029	174	U	HOLD	GUAM	DO NOT BREED		report sex for July Mid-year Master Plan
2030	175	U	HOLD	GUAM	DO NOT BREED		report sex for July Mid-year Master Plan
2031	176	U	HOLD	GUAM	DO NOT BREED		report sex for July Mid-year Master Plan
2032	177	U	HOLD	GUAM	DO NOT BREED		report sex for July Mid-year Master Plan
2033	178	U	HOLD	GUAM	DO NOT BREED		report sex for July Mid-year Master Plan
2034	179	U	HOLD	GUAM	DO NOT BREED		report sex for July Mid-year Master Plan
2035	180	U	HOLD	GUAM	DO NOT BREED		report sex for July Mid-year Master Plan
2036	181	U	HOLD	GUAM	DO NOT BREED		report sex for July Mid-year Master Plan
2037	009	U	RELEASE	GUAM	DO NOT BREED		Release group # 2
2038	008	U	AVAILABLE	GUAM	DO NOT BREED		Release extra

**LOUISVILL**

**Louisville Zoological Garden**  
Louisville, KY

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
994	201869	M	HOLD	LOUISVILL	BREED WITH		FEMALE FROM CINCI, 1575. 1576, or 1577
1460	_____	F	SEND TO	SANDIEGOZ	BREED WITH	988	Breed for N AM

**MILWAUKEE**

**Milwaukee County Zoological Gardens**  
Milwaukee, WI

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
1584	A06073	F	RECEIVE FROM	SAN ANTON	BREED WITH	1594	Breed for N AM
1594	806182	M	RECEIVE FROM	SD-WAP	BREED WITH	1584	

**NZP-CRC**

**NZP-Conservation & Research Center**  
Front Royal, VA

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
508	215532	F	HOLD	NZP-CRC	DO NOT BREED		
727	214314	F	HOLD	NZP-CRC	BREED WITH	1292	Breed for N AM
1292	215020	M	HOLD	NZP-CRC	BREED WITH	727	

266	M	HOLD	NZP-CRC	DO NOT BREED		excluded age
372	M	HOLD	NZP-CRC	DO NOT BREED		excluded age

**NZP-WASH**

**Smithsonian National Zoological Park**  
Washington, DC

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
1318	215019	M	HOLD	NZP-WASH	BREED WITH	1412	
1412	215283	F	HOLD	NZP-WASH	BREED WITH	1318	Breed for N AM

**OKLAHOMA**

**Oklahoma City Zoological Park**  
Oklahoma City, OK

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
872	780801	M	HOLD	OKLAHOMA	BREED WITH	1595	
1595	780802	F	HOLD	OKLAHOMA	BREED WITH	872	Reported as dead during draft period - Breed for N AM

**PHILADELPHIA**

**The Philadelphia Zoo**  
Philadelphia, PA

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
2040	26808	U	RECEIVE FROM	GAINSVLL	BREED WITH	985	Breed for N AM IF FEMALE SEND TO PHILLY
985	205350	M	HOLD	PHILADELPHIA	BREED WITH	2040	

**PITTSBURGH**

**National Aviary in Pittsburgh**  
Pittsburgh, PA

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
981	5597	M	HOLD	PITTSBURGH	BREED WITH	993	
993	6081	F	HOLD	PITTSBURGH	BREED WITH	981	Breed for Guam - export via DAK
1580	7409	F	SEND TO	SAN ANTON	BREED WITH	1579	Breed for guam - export via SDZ

**RACINE**

**Racine Zoological Gardens**  
Racine, WI

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
1314	M0614	M	HOLD	RACINE	BREED WITH	1319	
1319	M0435	F	HOLD	RACINE	BREED WITH	1314	Breed for N AM

**SAN ANTON**

**San Antonio Zoological Gardens & Aqua**  
San Antonio, TX

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
1580	7409	F	RECEIVE FROM	PITTS CA	BREED WITH	1579	Breed for guam - export via SDZ
995	Y04017	F	HOLD	SAN ANTON	BREED WITH	1313	Breed for Guam - export via SDZ
1313	N02016	M	HOLD	SAN ANTON	BREED WITH	995	
1579	A06071	M	HOLD	SAN ANTON	BREED WITH	1580	Breed for Guam - export via SDZ
1584	A06073	F	SEND TO	MILWAUKEE	BREED WITH	1594	Breed for N AM

**SANDIEGOZ**

**Zoological Society of San Diego**  
San Diego, CA

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
1460	_____	F	RECEIVE FROM	LOUISVILL	BREED WITH	988	Breed for N AM
988	801077	M	HOLD	SANDIEGOZ	BREED WITH	1460	
1293	307424	M	EXPORT TO	GUAM	SEE NOTES		FOR RELEASE - Kills females in captivity
1569	307420	M	EXPORT TO	GUAM	NO REC.		
1581	307421	M	EXPORT TO	GUAM	NO REC.		
1582	307418	M	EXPORT TO	GUAM	NO REC.		
1583	307419	M	EXPORT TO	GUAM	NO REC.		

**SD-WAP**

**San Diego Wild Animal Park**  
Escondido, CA

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
1315	807257	F	HOLD	SD-WAP	BREED WITH	1596	Breed for N AM
1564	807251	F	HOLD	SD-WAP	BREED WITH	1591	Breed for N AM
1591	806139	M	HOLD	SD-WAP	BREED WITH	1564	
1594	806182	M	SEND TO	MILWAUKEE	BREED WITH	1584	
1596	806190	M	HOLD	SD-WAP	BREED WITH	1315	

**SEDGWICK**

**Sedgwick County Zoo**  
Wichita, KS

ID	Local ID	Sex	Disposition	Location	Breeding	With	Notes
543	11908	F	HOLD	SEDGWICK	BREED WITH	636	Breed for N AM
636	11907	M	HOLD	SEDGWICK	BREED WITH	543	

841		M	HOLD	SEDGWICK	DO NOT BREED		excluded ed
-----	--	---	------	----------	--------------	--	-------------

## Appendix A Life Table

### North America

Age	Males					Females				
	Qx	Px	Lx	Mx	Vx	Qx	Px	Lx	Mx	Vx
0	0.280	0.720	1.000	0.050	1.163	0.270	0.730	1.000	0.010	1.156
1	0.070	0.930	0.720	0.270	1.598	0.130	0.870	0.730	0.290	1.652
2	0.070	0.930	0.670	0.520	1.656	0.060	0.940	0.635	0.470	1.717
3	0.040	0.960	0.623	0.430	1.396	0.160	0.840	0.597	0.610	1.592
4	0.050	0.950	0.598	0.440	1.173	0.130	0.870	0.501	0.800	1.308
5	0.080	0.920	0.568	0.230	0.909	0.200	0.800	0.436	0.210	0.691
6	0.080	0.920	0.522	0.340	0.856	0.190	0.810	0.349	0.200	0.680
7	0.100	0.900	0.481	0.340	0.657	0.220	0.780	0.283	0.560	0.685
8	0.180	0.820	0.433	0.240	0.427	0.330	0.670	0.221	0.170	0.195
9	0.110	0.890	0.355	0.170	0.254	0.230	0.770	0.148	0.040	0.040
10	0.130	0.870	0.316	0.090	0.111	0.210	0.790	0.114	0.000	0.000
11	0.240	0.760	0.275	0.030	0.030	0.160	0.840	0.090	0.000	0.000
12	0.060	0.940	0.209	0.000	0.000	0.400	0.600	0.075	0.000	0.000
13	0.390	0.610	0.196	0.000	0.000	0.360	0.640	0.045	0.000	0.000
14	0.500	0.500	0.120	0.000	0.000	0.000	1.000	0.029	0.000	0.000
15	0.000	1.000	0.060	0.000	0.000	0.500	0.500	0.029	0.000	0.000
16	0.000	1.000	0.060	0.000	0.000	1.000	0.000	0.014	0.000	0.000
17	0.000	1.000	0.060	0.000	0.000	1.000	0.000	0.000	0.000	0.000
18	1.000	0.000	0.060	0.000	0.000	1.000	0.000	0.000	0.000	0.000
19	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:  $r = 0.1484$ ;  $\lambda = 1.1600$ ;  $R_0 = 1.684$ ;  $T = 3.51$

Females:  $r = 0.1290$ ;  $\lambda = 1.1377$ ;  $R_0 = 1.545$ ;  $T = 3.37$

### DAWR

Age	Males					Females				
	Qx	Px	Lx	Mx	Vx	Qx	Px	Lx	Mx	Vx
0	0.400	0.600	1.000	0.050	1.250	0.420	0.580	1.000	0.050	1.266
1	0.050	0.950	0.600	0.670	2.571	0.050	0.950	0.580	1.200	3.020
2	0.060	0.940	0.570	0.940	3.151	0.080	0.920	0.551	1.850	3.460
3	0.060	0.940	0.536	1.150	3.685	0.080	0.920	0.507	1.450	3.111
4	0.030	0.970	0.504	1.320	4.161	0.100	0.900	0.466	1.600	3.244
5	0.040	0.960	0.489	1.720	4.612	0.080	0.920	0.420	1.960	3.214
6	0.000	1.000	0.469	2.000	4.626	0.190	0.810	0.386	1.630	2.571
7	0.000	1.000	0.469	2.080	4.114	0.170	0.830	0.313	1.640	2.042
8	0.030	0.970	0.469	2.320	3.235	0.220	0.780	0.260	0.680	0.886
9	0.000	1.000	0.455	0.740	1.456	0.100	0.900	0.202	0.440	0.440
10	0.090	0.910	0.455	1.040	1.174	0.140	0.860	0.182	0.000	0.000
11	0.100	0.900	0.414	0.200	0.232	0.170	0.830	0.157	0.000	0.000
12	0.210	0.790	0.373	0.060	0.060	0.400	0.600	0.130	0.000	0.000
13	0.200	0.800	0.294	0.000	0.000	0.000	1.000	0.078	0.000	0.000
14	0.300	0.700	0.235	0.000	0.000	0.670	0.330	0.078	0.000	0.000
15	0.180	0.820	0.165	0.000	0.000	0.000	1.000	0.026	0.000	0.000
16	0.500	0.500	0.135	0.000	0.000	0.000	1.000	0.026	0.000	0.000
17	1.220	-0.220	0.068	0.000	0.000	0.000	1.000	0.026	0.000	0.000
18	1.000	0.000	-0.015	0.000	0.000	1.000	0.000	0.026	0.000	0.000

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

### Projected population growth rates

Males:  $r = 0.4490$ ;  $\lambda = 1.5667$ ;  $R_0 = 3.547$ ;  $T = 2.82$

Females:  $r = 0.5755$ ;  $\lambda = 1.7781$ ;  $R_0 = 3.019$ ;  $T = 1.92$

## Appendix B Ordered Mean Kinship

### North America

#### Males

SB#	MK	%Known	Age	Location
1292	0.105	100.0	7	NZP-CRC
1293	0.105	100.0	7	SANDIEGOZ
636	0.111	100.0	9	SEDGWICK
1314	0.141	100.0	6	RACINE
1591	0.142	100.0	2	SD-WAP
1593	0.142	100.0	1	CINCINNAT
1594	0.142	100.0	1	SD-WAP
1596	0.142	100.0	1	SD-WAP
988	0.144	100.0	7	SANDIEGOZ
985	0.146	100.0	7	PHILADELP
872	0.151	100.0	7	OKLAHOMA
1313	0.151	100.0	6	SAN ANTON
986	0.156	100.0	7	CHICAGOLP
981	0.161	100.0	7	PITTS CA
2040	0.167	100.0	U0	GAINSVLL
994	0.169	100.0	6	LOUISVILL
1318	0.169	100.0	6	NZP-WASH
1579	0.170	100.0	2	SAN ANTON
1582	0.170	100.0	1	SANDIEGOZ
1583	0.170	100.0	2	SANDIEGOZ
1322	0.171	100.0	5	GAINSVLL
1569	0.175	100.0	2	SANDIEGOZ
1578	0.175	100.0	2	CINCINNAT
1581	0.175	100.0	2	SANDIEGOZ
1565	0.181	100.0	2	CINCINNAT
1572	0.181	100.0	1	CINCINNAT
1575	0.181	100.0	U1	CINCINNAT
1576	0.181	100.0	U1	CINCINNAT
1577	0.181	100.0	U1	CINCINNAT
1321	0.186	100.0	5	CINCINNAT

#### Females

SB#	MK	%Known	Age	Location
853	0.080	100.0	8	CINCINNAT
727	0.103	100.0	9	NZP-CRC
508	0.114	100.0	11	NZP-CRC
1460	0.132	100.0	4	LOUISVILL
1595	0.142	100.0	1	OKLAHOMA
1412	0.150	100.0	4	NZP-WASH
1564	0.150	100.0	3	SD-WAP
1459	0.152	100.0	3	GAINSVLL
543	0.164	100.0	11	SEDGWICK
1410	0.167	100.0	4	CINCINNAT
2040	0.167	100.0	U0	GAINSVLL
1315	0.169	100.0	6	SD-WAP
1319	0.169	100.0	5	RACINE
1584	0.170	100.0	2	SAN ANTON
871	0.171	100.0	7	CHICAGOLP
1580	0.175	100.0	2	PITTS CA
993	0.179	100.0	6	PITTS CA
995	0.179	100.0	6	SAN ANTON
1573	0.181	100.0	2	CINCINNAT
1574	0.181	100.0	1	CINCINNAT
1575	0.181	100.0	U1	CINCINNAT
1576	0.181	100.0	U1	CINCINNAT
1577	0.181	100.0	U1	CINCINNAT

### DAWR – Pre-release

#### Males

SB#	MK	%Known	Age	Location
920	0.094	100.0	8	GUAM
921	0.097	100.0	8	GUAM
1714	0.102	100.0	3	GUAM
926	0.102	100.0	8	GUAM
842	0.103	100.0	8	GUAM
1725	0.104	100.0	3	GUAM
1037	0.104	100.0	6	GUAM
1424	0.105	100.0	5	GUAM
1976	0.106	100.0	U1	GUAM
1865	0.106	100.0	1	GUAM
1831	0.106	100.0	2	GUAM
1547	0.106	100.0	4	GUAM
843	0.106	100.0	8	GUAM
1957	0.107	100.0	U1	GUAM
1956	0.107	100.0	U1	GUAM
1849	0.107	100.0	1	GUAM
1826	0.107	100.0	2	GUAM
1532	0.107	100.0	4	GUAM
593	0.107	100.0	10	GUAM
2029	0.108	100.0	U0	GUAM
1824	0.108	100.0	2	GUAM
1312	0.108	100.0	6	GUAM
1968	0.109	100.0	U1	GUAM
1967	0.109	100.0	U1	GUAM
1944	0.109	100.0	1	GUAM
990	0.109	100.0	7	GUAM
1513	0.110	100.0	4	GUAM
1293	0.110	100.0	7	SANDIEGOZ

#### Females

SB#	MK	%Known	Age	Location
1539	0.103	100.0	4	GUAM
1003	0.105	100.0	7	GUAM
1976	0.106	100.0	U1	GUAM
1954	0.106	100.0	1	GUAM
1458	0.106	100.0	4	GUAM
1355	0.106	100.0	5	GUAM
1957	0.107	100.0	U1	GUAM
1956	0.107	100.0	U1	GUAM
1945	0.107	100.0	1	GUAM
1851	0.107	100.0	1	GUAM
1762	0.107	100.0	2	GUAM
2029	0.108	100.0	U0	GUAM
1825	0.108	100.0	2	GUAM
1354	0.108	100.0	5	GUAM
992	0.108	100.0	7	GUAM
1968	0.109	100.0	U1	GUAM
1967	0.109	100.0	U1	GUAM
1917	0.109	100.0	1	GUAM
1761	0.109	100.0	2	GUAM
1871	0.111	100.0	1	GUAM
1848	0.111	100.0	1	GUAM
1525	0.111	100.0	4	GUAM
1512	0.111	100.0	4	GUAM
1972	0.112	100.0	U1	GUAM
1971	0.112	100.0	U1	GUAM
1970	0.112	100.0	U1	GUAM
1960	0.112	100.0	U1	GUAM
1511	0.112	100.0	4	GUAM

## Males

SB#	MK	%Known	Age	Location
852	0.110	100.0	8	GUAM
619	0.110	100.0	10	GUAM
1361	0.111	100.0	5	GUAM
1972	0.112	100.0	U1	GUAM
1971	0.112	100.0	U1	GUAM
1970	0.112	100.0	U1	GUAM
1960	0.112	100.0	U1	GUAM
1932	0.112	100.0	1	GUAM
1875	0.112	100.0	1	GUAM
1583	0.112	100.0	2	SANDIEGOZ
1582	0.112	100.0	2	SANDIEGOZ
1581	0.112	100.0	2	SANDIEGOZ
1569	0.112	100.0	2	SANDIEGOZ
2022	0.113	100.0	0	GUAM
2038	0.114	100.0	U1	GUAM
2037	0.114	100.0	U1	GUAM
1576	0.114	100.0	U1	CINCINNAT
1575	0.114	100.0	U1	CINCINNAT
1371	0.114	100.0	5	GUAM
2033	0.115	100.0	U0	GUAM
1367	0.115	100.0	5	GUAM
2027	0.116	100.0	U0	GUAM
2010	0.116	100.0	0	GUAM
1965	0.116	100.0	U1	GUAM
1964	0.116	100.0	U1	GUAM
1456	0.116	100.0	4	GUAM
2020	0.118	100.0	0	GUAM
2019	0.118	100.0	0	GUAM
1985	0.118	100.0	1	GUAM
1982	0.118	100.0	1	GUAM
1981	0.118	100.0	1	GUAM
1974	0.118	100.0	U1	GUAM
1973	0.118	100.0	U1	GUAM
1963	0.118	100.0	U1	GUAM
1962	0.118	100.0	U1	GUAM
1961	0.118	100.0	U1	GUAM
1950	0.118	100.0	1	GUAM
1562	0.118	100.0	3	GUAM
1561	0.118	100.0	3	GUAM
2032	0.120	100.0	U0	GUAM
2031	0.120	100.0	U0	GUAM
2030	0.120	100.0	U0	GUAM
2028	0.120	100.0	U0	GUAM
2036	0.121	100.0	U0	GUAM
2035	0.121	100.0	U0	GUAM
2034	0.121	100.0	U0	GUAM
2026	0.121	100.0	U0	GUAM
2026	0.121	100.0	U0	GUAM
2025	0.121	100.0	U0	GUAM
2024	0.121	100.0	U0	GUAM
2016	0.121	100.0	0	GUAM
2015	0.121	100.0	0	GUAM
2014	0.121	100.0	0	GUAM
1980	0.121	100.0	1	GUAM
1978	0.121	100.0	U1	GUAM
1977	0.121	100.0	U1	GUAM
1969	0.121	100.0	U1	GUAM
1958	0.121	100.0	U1	GUAM
1589	0.122	100.0	3	GUAM
1588	0.122	100.0	3	GUAM
1587	0.122	100.0	3	GUAM
1585	0.122	100.0	3	GUAM
1294	0.122	100.0	6	GUAM

## Females

SB#	MK	%Known	Age	Location
1480	0.112	100.0	4	GUAM
2023	0.113	100.0	0	GUAM
2021	0.113	100.0	0	GUAM
2038	0.114	100.0	U1	GUAM
2037	0.114	100.0	U1	GUAM
1938	0.114	100.0	1	GUAM
1576	0.114	100.0	U1	CINCINNAT
1575	0.114	100.0	U1	CINCINNAT
1523	0.114	100.0	4	GUAM
2033	0.115	100.0	U0	GUAM
1526	0.115	100.0	4	GUAM
2027	0.116	100.0	U0	GUAM
2011	0.116	100.0	0	GUAM
1965	0.116	100.0	U1	GUAM
1964	0.116	100.0	U1	GUAM
1702	0.117	100.0	3	GUAM
1394	0.117	100.0	5	GUAM
1984	0.118	100.0	1	GUAM
1983	0.118	100.0	1	GUAM
1975	0.118	100.0	1	GUAM
1974	0.118	100.0	U1	GUAM
1973	0.118	100.0	U1	GUAM
1963	0.118	100.0	U1	GUAM
1962	0.118	100.0	U1	GUAM
1961	0.118	100.0	U1	GUAM
2032	0.120	100.0	U0	GUAM
2031	0.120	100.0	U0	GUAM
2030	0.120	100.0	U0	GUAM
2028	0.120	100.0	U0	GUAM
2036	0.121	100.0	U0	GUAM
2035	0.121	100.0	U0	GUAM
2034	0.121	100.0	U0	GUAM
2026	0.121	100.0	U0	GUAM
2025	0.121	100.0	U0	GUAM
2024	0.121	100.0	U0	GUAM
2018	0.121	100.0	0	GUAM
2017	0.121	100.0	0	GUAM
1979	0.121	100.0	1	GUAM
1978	0.121	100.0	U1	GUAM
1977	0.121	100.0	U1	GUAM
1969	0.121	100.0	U1	GUAM
1958	0.121	100.0	U1	GUAM
1295	0.121	100.0	6	GUAM
1586	0.122	100.0	3	GUAM
1557	0.122	100.0	3	GUAM
1556	0.122	100.0	3	GUAM
1545	0.123	100.0	4	GUAM
1560	0.125	100.0	3	GUAM
1559	0.125	100.0	3	GUAM

## DAWR – Post-release

### Males

SB#	MK	%Known	Age	Location
920	0.102	100.0	8	GUAM
990	0.104	100.0	7	GUAM
1037	0.105	100.0	6	GUAM

### Females

SB#	MK	%Known	Age	Location
992	0.104	100.0	7	GUAM
1458	0.104	100.0	4	GUAM
1523	0.106	100.0	4	GUAM

## Males

SB#	MK	%Known	Age	Location
1367	0.105	100.0	5	GUAM
1312	0.106	100.0	6	GUAM
1547	0.106	100.0	4	GUAM
1714	0.106	100.0	3	GUAM
926	0.107	100.0	8	GUAM
1424	0.107	100.0	5	GUAM
1293	0.108	100.0	7	SANDIEGOZ
1725	0.108	100.0	3	GUAM
1849	0.108	100.0	1	GUAM
1972	0.108	100.0	U1	GUAM
842	0.109	100.0	8	GUAM
1569	0.109	100.0	2	SANDIEGOZ
1581	0.109	100.0	2	SANDIEGOZ
1532	0.110	100.0	4	GUAM
1583	0.110	100.0	2	SANDIEGOZ
1582	0.110	100.0	2	SANDIEGOZ
1576	0.110	100.0	U1	CINCINNAT
1361	0.111	100.0	5	GUAM
1831	0.111	100.0	2	GUAM
1976	0.111	100.0	U1	GUAM
593	0.112	100.0	10	GUAM
2027	0.112	100.0	U0	GUAM
843	0.113	100.0	8	GUAM
1865	0.113	100.0	1	GUAM
2029	0.113	100.0	U0	GUAM
1456	0.114	100.0	4	GUAM
1824	0.114	100.0	2	GUAM
1967	0.114	100.0	U1	GUAM
1968	0.114	100.0	U1	GUAM
1875	0.115	100.0	1	GUAM
2028	0.115	100.0	U0	GUAM
2030	0.115	100.0	U0	GUAM
2031	0.115	100.0	U0	GUAM
2033	0.115	100.0	U0	GUAM
2032	0.115	100.0	U0	GUAM
1944	0.116	100.0	1	GUAM
1513	0.118	100.0	4	GUAM
852	0.119	100.0	8	GUAM
2019	0.120	100.0	0	GUAM
2020	0.120	100.0	0	GUAM
2022	0.120	100.0	0	GUAM
2024	0.124	100.0	U0	GUAM
2025	0.124	100.0	U0	GUAM
2026	0.124	100.0	U0	GUAM
2034	0.124	100.0	U0	GUAM
2035	0.124	100.0	U0	GUAM
2036	0.124	100.0	U0	GUAM

## Females

SB#	MK	%Known	Age	Location
1355	0.107	100.0	5	GUAM
1972	0.108	100.0	U1	GUAM
2018	0.108	100.0	0	GUAM
1526	0.110	100.0	4	GUAM
1576	0.110	100.0	U1	CINCINNAT
1983	0.110	100.0	1	GUAM
1539	0.111	100.0	4	GUAM
1762	0.111	100.0	2	GUAM
1954	0.111	100.0	1	GUAM
1976	0.111	100.0	U1	GUAM
2027	0.112	100.0	U0	GUAM
2029	0.113	100.0	U0	GUAM
1825	0.114	100.0	2	GUAM
1917	0.114	100.0	1	GUAM
1967	0.114	100.0	U1	GUAM
1968	0.114	100.0	U1	GUAM
1354	0.115	100.0	5	GUAM
2028	0.115	100.0	U0	GUAM
2030	0.115	100.0	U0	GUAM
2031	0.115	100.0	U0	GUAM
2033	0.115	100.0	U0	GUAM
2032	0.115	100.0	U0	GUAM
1512	0.118	100.0	4	GUAM
2021	0.120	100.0	0	GUAM
2023	0.120	100.0	0	GUAM
1480	0.121	100.0	4	GUAM
2024	0.124	100.0	U0	GUAM
2025	0.124	100.0	U0	GUAM
2026	0.124	100.0	U0	GUAM
2034	0.124	100.0	U0	GUAM
2035	0.124	100.0	U0	GUAM
2036	0.124	100.0	U0	GUAM

## Appendix C Summary of Data Exports

**Report compiled under SPARKS V. 1.5& Population Management 2000, V. 1.2131**

Data exported on: 3 JAN 2008  
 Data compiled by: Megan Ross  
 Data current thru: 1 JAN 2008  
 Scope of data: Regional

### Filter Conditions In Effect:

**Genetics:** Dates: As of End of date <=1/02/2008 Status: Living by 1/02/2008  
**Demography :** Dates: During 01/01/1980<= date .and. date <= 1/02/2008

# 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 ( $\lambda$ ) 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

First Name	Last Name	Institution	Phone	E-mail
Jim	Metzinger	Akron Zoological Park		jmetzinger@akronzoo.org
Lee	Shoen	Audubon Zoo	504-861-5124	lschoen@AudubonInstitute.org
Tracy	Leeds	Cheyenne Mountain Zoo		tleeds@cmzoo.org
Dave	Oehler	Cincinnati Zoo	513-475-6153	david.oehler@cincinnati.org
John	Azua	Denver Zoo		jazua@denverzoo.org
Deidre	Fontenot	Disney Animal Kingdom	407-939-6238	Deidre.K.Fontenot@disney.com
Lori	Grady	Disney Animal Kingdom		Lori.Grady@disney.com
John	Kiseda	El Paso Zoo		kisedajj@elpasotexas.gov
Andy	Snider	Fresno Chaffee Zoo		asnider@fresnochaffeezoo.com
Suzanne	Medina	Guam DAWR	671-735-3995	medinas@guam.net
Caplan	Anderson	Guam DAWR	671-735-3995	caplananderson@yahoo.com
Leslie	Santos	Honolulu Zoo		lsantos1@honolulu.gov
Amy	Roberts	Kansas City Zoo		amyroberts@fotzkc.org
Megan	Ross	Lincoln Park Zoo	312-742-7925	mross@lpzoo.org
Elizabeth	Bruccoleri	Lincoln Park Zoo	312-742-0539	ebruccoleri@lpzoo.org
Gary	Michael	Louisville Zoo	502-459-2181 x 346	gary.michael@loukymetro.org
Alex	Waier	Milwaukee County Zoo		Alex.Waier@Milwcnty.com
Steve	Sarro	National Aviary	412-323-7235 ext 216	steve.sarro@aviary.org
Darcy	Henthorn	Oklahoma Zoo		Dhenthorn@okczoo.com
Aliza	Baltz	Philadelphia Zoo	215-243-5368	Baltz.Aliza@phillyzoo.org
Steve	Ruscko	Racine Zoo	262-636-9423	sruscko@racinezoo.org
Josep	San Miguel	San Antonio Zoo	210-734-7184 ex120	curbirds@sazoo-aq.org
Mike	Mace	San Diego Wild Animal Park	760-738-5077	mmace@sandiegozoo.org
Dave	Rimlinger	San Diego Zoo	619-557-3978	drimlinger@sandiegozoo.org
Kathy	Russell	Santa Fe Community College Teaching Zoo	352-395-5601	Kathy.Russell@sfcc.edu
Joe	Barkowski	Sedgwick County Zoo	316-942-2212 x235	jbbski@aol.com
Paul	Tomassoni	Smithsonian National Zoological Park	202-673-4808	tomassonip@si.edu
Scott	Derrickson	Smithsonian National Zoological Park-- CRC	202-636-1488	derricksons@si.edu
Chris	Sheppard	Wildlife Conservation Society/Bronx Zoo	718-220-5154	bigbird@westnet.com