

Population Analysis and Breeding and Transfer Plan

Guam Rail (*Rallus owstoni*) AZA Species Survival Plan® Program



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PMC

Population Management Center

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Executive Summary

Guam Rail (*Rallus owstoni*) Species Survival Plan®

The Gruiformes TAG Regional Collection Plan has recommended Guam rails be managed as an SSP and have set the target size as 70 for the AZA population. At the time of analysis, AZA institutions hold 41 birds (24 males and 17 females) across 15 institutions. One bird (0.1) died during the draft period.

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 current gene diversity is 83.5%, however the potential gene diversity is high (91%). Careful breeding practices are important to maintain the genetic variation within the population. 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. These statistics represent the AZA / North American population excluding all birds currently housed on Guam.

DEMOGRAPHY	
AZA Population Size at the time of analysis	41 (24.17)
Birds excluded from genetics (one of which died during the comment period)	4 (2.2)
Population size after exclusions	37 (22.15)
Target Population Size	70
Mean Generation Time (years)	3.5
Historic / Projected Population Growth Rate (λ)	1.136 / 1.05

GENETICS		
	Current	Potential
Founders	10	0
Founder Genome Equivalents (FGE)	2.99	5.32
Gene Diversity Retained (%GD)	83.29	90.61
Population Mean Kinship (MK)	0.1671	--
Mean Inbreeding (F)	0.0832	--
% Pedigree Known before assumptions/exclusions	100	--
% Pedigree Known after assumptions/exclusions	100	--
Effective population size/census size ratio (N_e / N)	0.2211	--
Years to 90% Gene Diversity	N/A*	--
Years to 10% Loss in GD	8*	--
Diversity at 100 Years (%)	31*	--

* 2010 projections are based on a target size of 70 and a growth rate of 5% ($\lambda=1.05$).

Lower than expected productivity in pairs recommended to breed was observed in the last 1-2 years. It is thus important that institutions contact the Species Coordinator as eggs are produced so that a balance can be achieved between the demographic needs of the AZA population and the number of offspring exported. The population should also 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 3 exportations to the Guam population, 0 importations from the Guam population, 13 North American transfers and 14 breeding pairs in North America.

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Description of Population Status

Guam Rail (*Rallus owstoni*) Species Survival Plan[®]

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 zoo 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 2008. Comprehensive genetic and demographic analyses of the Guam Rail International Studbook (current to 1 April 2010) were performed in April 2010, resulting in the current breeding and transfer plan for this species. Recommendations contained in this master plan supersede those made by earlier plans. The Gruiformes Taxon Advisory Group has set a target size of 70 for the AZA population in their 2008 Regional Collection Plan.

Analytical Population: Data on birds currently in Guam have been excluded from the current analysis; population statistics and recommendations are presented for the AZA population only. The AZA Guam rail population at the time of analysis was 41 birds (24 males and 17 females) distributed among 15 institutions. Four of these birds were excluded from the genetic analysis (see Appendix C for details), resulting in a potentially breeding population of 37 (22.15) birds. One of the excluded birds (female, #993) died during the draft period.

Demography: The North American Regional population grew quickly following its appearance in 1984. Since the population's inception, annual growth rates attributed to zoo 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.

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 zoo population. So while the mean growth rate for the AZA population over the last 10 years has declined slightly ($\lambda=0.977$) (Figure 1), the total numbers of hatches has been high (Figure 2). Figure 1 displays census records taken on the 31st of December each year; thus chicks hatched and exported the same year are not shown in the graph. If exports are not carefully planned to maintain a stable age distribution, higher growth rates exhibited earlier in the program may not be sustainable.

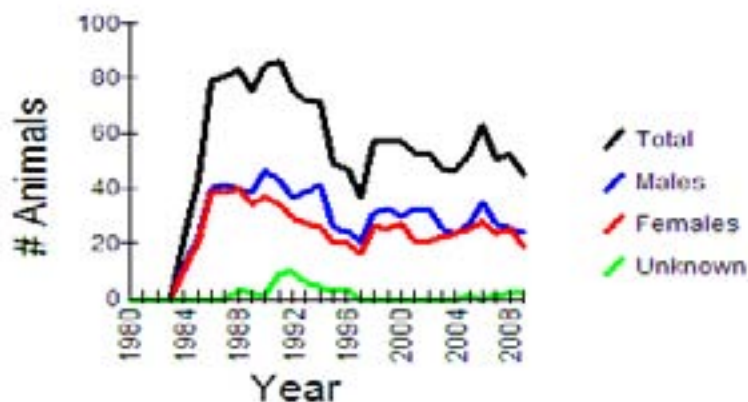


Figure 1. Census of Guam rails in AZA by sex. Census taken on 31st December each year.

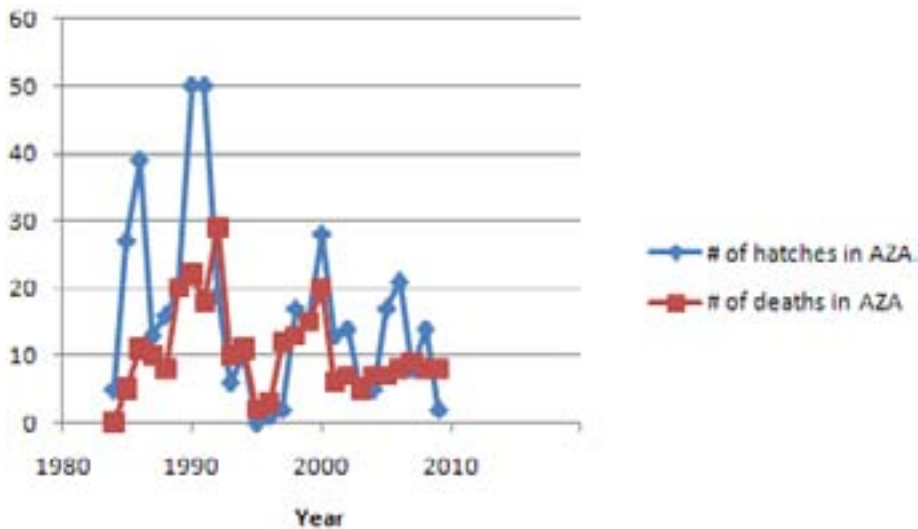


Figure 2. Number of Guam rail hatches and deaths in AZA each year since 1984.

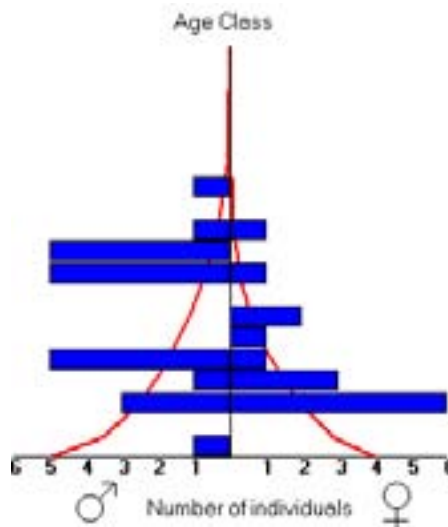


Figure 3. Age distribution of the current AZA potentially breeding population.

The age structure of the AZA population deviates from a stable distribution as periods of high production are interspersed by short periods of low production (Figure 3). 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 overall population exhibits a fairly stable age distribution.

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 1-6 eggs, averaging 2.2, 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. Male first year mortality is 29%, for females it is 27%.

Genetics: The managed population is descended from 10 founders and no potential founders remain. Gene diversity in the population is low at 83.55%, but has the potential to be higher (90.6%). The population gene diversity could fall by a further 10% in about 8 years. Projections of gene diversity (based on current statistics, a target size of 70 and a growth rate of 5%) indicate 31% 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 (Figure 4) and further increasing the population's effective size.

Genetic Summary						
	2005	2006	2007	2008	2010	
	Actual	Actual	Actual	Actual	Actual	Potential
Founders	10	10	10	10	10	0
Founder Genome Equivalent (FGE)	3.77	3.52	3.17	3.19	2.99	5.32
Gene Diversity Retained (%GD)	86.75	85.78	84.24	84.35	83.29	90.61
Population Mean Kinship (MK)	0.1343	0.1422	0.1576	0.1565	0.1671	--
Mean Inbreeding (F)	0.0607	0.0702	0.0830	0.0806	0.0832	--
% Pedigree Known before assumptions/exclusions	100	100	100	100	100	--
% Pedigree Known after assumptions/exclusions	100	100	100	100	100	--
Effective population size/census size ratio (N_e / N)	0.28	0.30	0.2585	0.2637	0.2211	--
Years to 90% Gene Diversity	0	0	0	n/a	N/A*	--
Years to 10% Loss in GD	--	--	--	--	8*	--
Diversity at 100 Years (%)	27	26	25	26	31*	--

* 2010 projections are based on a target size of 70 and a growth rate of 5% ($\lambda=1.05$).

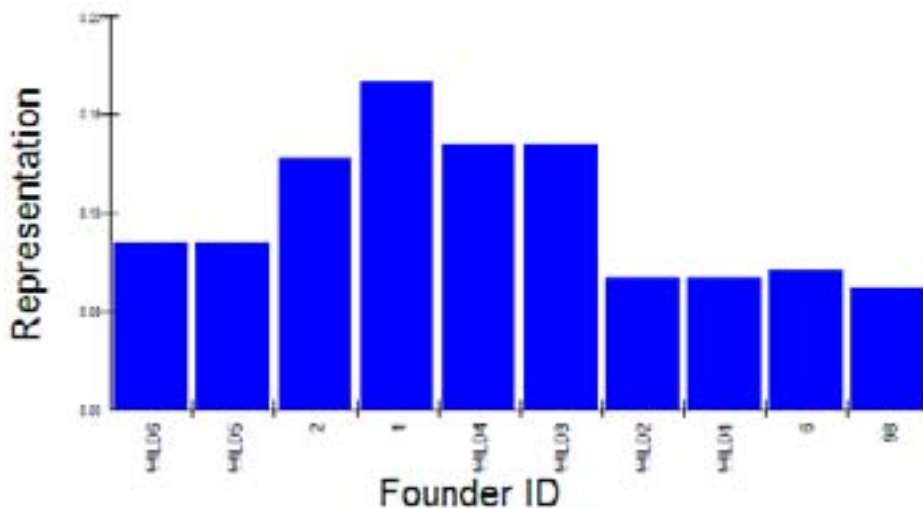


Figure 4. Founder representation graph illustrating the unequal distribution of various founder lines in the living Guam Rail AZA population.

Management Strategy: Demographic analyses indicate that the current population size will be maintained with the addition of 6-7 hatches. To grow to 50 in 5-6 years, between 8 and 10 hatches are required this year ($\lambda=1.05$). A total of fifteen pairs have been recommended to breed. Of these pairs, eight are recommended to breed for the AZA population. The other 7 pairs are recommended to breed for exportation to Guam, unless the demographic needs of the AZA population are not met. For this reason the SSP highly encourages institutions to inform the Species Coordinator when eggs are produced. Second clutches may or may not be desired depending on overall pairing success.

1. Recommend 8 females to breed – to be single-clutched – for the AZA population. Contact the Species Coordinator as eggs are produced. 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. Contact Species Coordinator as eggs are produced - if the demographic needs of the AZA population are not met, offspring from these pairs may be held in AZA. Second clutches may or may not be desired depending on overall pairing success.
3. Recommend 13 transfers within North America.
4. Recommend 3 transfers to Guam from current population
5. Disney Animal Kingdom and San Diego Zoo have been designated as U.S. quarantine stations for Guam rails being exported to Guam. To ensure quarantine space, please contact both the Species Coordinator and these stations upon hatch of individuals recommended for export.

Summary of Breeding and Transfer Recommendations

ID	Location	Sex	Age	Disposition	Location	Breeding	With	Notes
1321	CINCINNAT	M	8	SEND TO	PITTS CA	BREED WITH	2220	Breed for Guam
1574	CINCINNAT	F	3	HOLD	CINCINNAT	BREED WITH	2074	Breed for AZA
1578	CINCINNAT	M	4	HOLD	CINCINNAT	DO NOT BREED		
1593	CINCINNAT	M	4	HOLD	CINCINNAT	DO NOT BREED		
2072	CINCINNAT	F	3	SEND TO	PHILADELP	BREED WITH	985	Breed for AZA
2074	CINCINNAT	M	2	HOLD	CINCINNAT	BREED WITH	1574	Breed for AZA
1572	FRESNO	M	3	HOLD	FRESNO	BREED WITH	2218	Breed for Guam
2071	FRESNO	F	3	SEND TO	SEDGWICK	BREED WITH	636 OR 1314	Breed for AZA. #636 is the priority breeder, #1314 is the back-up
1322	GAINSVLL	M	8	HOLD	GAINSVLL	BREED WITH	1459	Breed for AZA
1459	GAINSVLL	F	6	HOLD	GAINSVLL	BREED WITH	1322	Breed for AZA
994	LOUISVILL	M	9	HOLD	LOUISVILL	BREED WITH	871	Breed for AZA
1460	LOUISVILL	F	6	SEND TO	NZP-CRC	BREED WITH	1292	SSP priority pairing. Breed for AZA
871	LOUISVILL	F	10	HOLD	LOUISVILL	BREED WITH	994	Breed for AZA
1594	MILWAUKEE	M	4	SEND TO	CHICAGOLP	DO NOT BREED		
508	NZP-CRC	F	14	HOLD	NZP-CRC	DO NOT BREED		Excluded - age
1292	NZP-CRC	M	9	HOLD	NZP-CRC	BREED WITH	1460	SSP priority pairing. Breed for AZA
1318	NZP-WASH	M	8	HOLD	NZP-WASH	BREED WITH	2216	Breed for Guam
872	OKLAHOMA	M	10	HOLD	OKLAHOMA	BREED WITH	2219	Breed for Guam
985	PHILADELP	M	9	HOLD	PHILADELP	BREED WITH	2072	Breed for AZA
2079	PHILADELP	M	2	HOLD	PHILADELP	DO NOT BREED		Excluded - education
993	PITTS-CA	F	9	HOLD	PITTS-CA	DO NOT BREED		Excluded - medical Died during draft period
981	PITTS CA	M	9	SEND TO	SAN ANTON	BREED WITH	2222	Breed for Guam
1314	RACINE	M	8	SEND TO	SEDGWICK	BREED WITH	2071	Back-up breeder. Breed for AZA.
1313	SAN ANTON	M	8	HOLD	SAN ANTON	BREED WITH	1580	Breed for AZA
1580	SAN ANTON	F	4	HOLD	SAN ANTON	BREED WITH	1313	Breed for AZA
988	SANDIEGOZ	M	9	HOLD	SANDIEGOZ	DO NOT BREED		
1315	SD-WAP	F	8	HOLD	SD-WAP	BREED WITH	1596	Breed for Guam
1564	SD-WAP	F	5	HOLD	SD-WAP	BREED WITH	1591	Breed for AZA
1591	SD-WAP	M	4	HOLD	SD-WAP	BREED WITH	1564	Breed for AZA
1596	SD-WAP	M	4	HOLD	SD-WAP	BREED WITH	1315	Breed for Guam
2216	SD-WAP	F	2	SEND TO	NZP-WASH	BREED WITH	1318	Breed for Guam
2217	SD-WAP	M	2	SEND TO	GUAM	NO REC.		
2218	SD-WAP	F	2	SEND TO	FRESNO	BREED WITH	1572	Breed for Guam
2219	SD-WAP	F	2	SEND TO	OKLAHOMA	BREED WITH	872	Breed for Guam
2220	SD-WAP	F	2	SEND TO	PITTS CA	BREED WITH	1321	Breed for Guam
2221	SD-WAP	F	2	SEND TO	RACINE (SEE NOTES)	DO NOT BREED		May be sent to Guam instead if Racine is unable to receive her
2222	SD-WAP	F	2	SEND TO	SAN ANTON	BREED WITH	981	Breed for Guam
2223	SD-WAP	M	2	SEND TO	GUAM	NO REC.		
2224	SD-WAP	M	0	SEND TO	GUAM	NO REC.		
841	SEDGWICK	M	10	HOLD	SEDGWICK	DO NOT BREED		Excluded - education
636	SEDGWICK	M	12	HOLD	SEDGWICK	BREED WITH	2071	Breed for AZA

CINCINNAT

Cincinnati Zoo & Botanical Garden
Cincinnati, OH

Institutional Notes:

- Please contact Species Coordinator on production of all eggs. Only double clutch if approval is given by the Species Coordinator.

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
1321	204002	M	8	SEND TO	PITTS CA	BREED WITH	2220	Breed for Guam
1578	207037	M	4	HOLD	CINCINNAT	DO NOT BREED		
1593	207083	M	4	HOLD	CINCINNAT	DO NOT BREED		
2072	207069	F	3	SEND TO	PHILADELP	BREED WITH	985	Breed for AZA
2074	208057	M	2	HOLD	CINCINNAT	BREED WITH	1574	Breed for AZA
1574	206292	F	3	HOLD	CINCINNAT	BREED WITH	2074	Breed for AZA

CHICAGOLP

Lincoln Park Zoo
Chicago, IL

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
1594	806182	M	4	RECEIVE FROM	MILWAUKEE	DO NOT BREED		

FRESNO

Fresno Chaffee Zoo
Fresno, CA

Institutional Notes:

- Please contact Species Coordinator on production of all eggs. Only double clutch if approval is given by the Species Coordinator.
- If needed for the AZA population, offspring designated for Guam may not be exported. Consult with Species Coordinator.
- Quarantine station for birds to be exported may either be Disney's Animal Kingdom or San Diego Zoo, depending on space availability and logistics. Consult with Species Coordinator.

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
1572	290205	M	3	HOLD	FRESNO	BREED WITH	2218	Breed for Guam
2071	290206	F	3	SEND TO	SEDGWICK	BREED WITH	636, 1314	#636 is the priority breeder, #1314 is the back-up. Breed for AZA.
2218	808159	F	2	RECEIVE FROM	SD-WAP	BREED WITH	1572	Breed for Guam

GAINSVLL

Santa Fe Teaching Zoo
Gainesville, FL

Institutional Notes:

- Please contact Species Coordinator on production of all eggs. Only double clutch if approval is given by the Species Coordinator.

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
1322	26804	M	8	HOLD	GAINSVLL	BREED WITH	1459	Breed for AZA
1459	26803	F	6	HOLD	GAINSVLL	BREED WITH	1322	Breed for AZA

LOUISVILL

Louisville Zoological Garden
Louisville, KY

Institutional Notes:

- Please contact Species Coordinator on production of all eggs. Only double clutch if approval is given by the Species Coordinator.

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
871	202333	F	10	HOLD	LOUISVILL	BREED WITH	994	Breed for AZA
994	201869	M	9	HOLD	LOUISVILL	BREED WITH	871	Breed for AZA
1460	202133	F	6	SEND TO	NZP-CRC	BREED WITH	1292	SSP priority pairing. Breed for AZA

MILWAUKEE

Milwaukee County Zoo
Milwaukee, WI

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
1594	806182	M	4	SEND TO	CHICAGOLP	DO NOT BREED		

NZP-CRC

NZP-Conservation & Research Center
Front Royal, VA

Institutional Notes:

- Please contact Species Coordinator on production of all eggs. Only double clutch if approval is given by the Species Coordinator.

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
1460	202133	F	6	RECEIVE FROM	LOUISVILL	BREED WITH	1292	SSP priority pairing. Breed for AZA
508	215532	F	14	HOLD	NZP-CRC	DO NOT BREED		Excluded - age
1292	215020	M	9	HOLD	NZP-CRC	BREED WITH	1460	SSP priority pairing. Breed for AZA

NZP-WASH

Smithsonian National Zoological Park
Washington, DC

Institutional Notes:

- Please contact Species Coordinator on production of all eggs. Only double clutch if approval is given by the Species Coordinator.
- If needed for the AZA population, offspring designated for Guam may not be exported. Consult with Species Coordinator.
- Quarantine station for birds to be exported may either be Disney's Animal Kingdom or San Diego Zoo, depending on space availability and logistics. Consult with Species Coordinator.

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
1318	215019	M	8	HOLD	NZP-WASH	BREED WITH	2216	Breed for Guam
2216	808084	F	2	RECEIVE FROM	SD-WAP	BREED WITH	1318	Breed for Guam

OKLAHOMA

Oklahoma City Zoological Park
Oklahoma City, OK

Institutional Notes:

- Please contact Species Coordinator on production of all eggs. Only double clutch if approval is given by the Species Coordinator.
- If needed for the AZA population, offspring designated for Guam may not be exported. Consult with Species Coordinator.
- Quarantine station for birds to be exported may either be Disney's Animal Kingdom or San Diego Zoo, depending on space availability and logistics. Consult with Species Coordinator.

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
872	780801	M	10	HOLD	OKLAHOMA	BREED WITH	2219	Breed for Guam
2219	808162	F	2	RECEIVE FROM	SD-WAP	BREED WITH	872	Breed for Guam

PHILADELPHIA

The Philadelphia Zoo
Philadelphia, PA

Institutional Notes:

- Please contact Species Coordinator on production of all eggs. Only double clutch if approval is given by the Species Coordinator.

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2079	205713	M	2	HOLD	PHILADELPHIA	DO NOT BREED		Excluded - education
985	205350	M	9	HOLD	PHILADELPHIA	BREED WITH	2072	Breed for AZA
2072	207069	F	3	RECEIVE FROM	CINCINNATI	BREED WITH	985	Breed for AZA

PITTSBURGH

National Aviary in Pittsburgh
Pittsburgh, PA

Institutional Notes:

- Please contact Species Coordinator on production of all eggs. Only double clutch if approval is given by the Species Coordinator.
- If needed for the AZA population, offspring designated for Guam may not be exported. Consult with Species Coordinator.
- Quarantine station for birds to be exported may either be Disney's Animal Kingdom or San Diego Zoo, depending on space availability and logistics. Consult with Species Coordinator.

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
1321	204002	M	8	RECEIVE FROM	CINCINNATI	BREED WITH	2220	Breed for Guam
2220	808201	F	2	RECEIVE FROM	SD-WAP	BREED WITH	1321	Breed for Guam
981	5597	M	9	SEND TO	SAN ANTONIO	BREED WITH	2222	Breed for Guam
993	6084	F	9	HOLD	PITTSBURGH	DO NOT BREED		Excluded - medical Died during draft period

RACINE

Racine Zoological Gardens
Racine, WI

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
1314	M0614	M	8	SEND TO	SEDGWICK	BREED WITH	2071	Back-up breeder. Breed for AZA.
2221	808213	F	2	RECEIVE FROM	SD-WAP	DO NOT BREED		Please inform the Species Coordinator if you are unable to receive this bird so alternative recommendations may be carried out

SAN ANTON

San Antonio Zoological Gardens & Aqua
San Antonio, TX

Institutional Notes:

- Please contact Species Coordinator on production of all eggs. Only double clutch if approval is given by the Species Coordinator.
- If needed for the AZA population, offspring designated for Guam may not be exported. Consult with Species Coordinator.
- Quarantine station for birds to be exported may either be Disney's Animal Kingdom or San Diego Zoo, depending on space availability and logistics. Consult with Species Coordinator.

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
981	5597	M	9	RECEIVE FROM	PITTS CA	BREED WITH	2222	Breed for Guam
1313	N02016	M	8	HOLD	SAN ANTON	BREED WITH	1580	Breed for AZA
1580	D07015	F	4	HOLD	SAN ANTON	BREED WITH	1313	Breed for AZA
2222	808214	F	2	RECEIVE FROM	SD-WAP	BREED WITH	981	Breed for Guam

SANDIEGOZ

Zoological Society of San Diego
San Diego, CA

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
988	801077	M	9	HOLD	SANDIEGOZ	DO NOT BREED		

SD-WAP

San Diego Wild Animal Park
Escondido, CA

Institutional Notes:

- Please contact Species Coordinator on production of all eggs. Only double clutch if approval is given by the Species Coordinator.
- If needed for the AZA population, offspring designated for Guam may not be exported. Consult with Species Coordinator.
- Quarantine station for SD-WAP birds to be exported will be San Diego Zoo.

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
1315	807257	F	8	HOLD	SD-WAP	BREED WITH	1596	Breed for Guam
1564	807251	F	5	HOLD	SD-WAP	BREED WITH	1591	Breed for AZA
1591	806139	M	4	HOLD	SD-WAP	BREED WITH	1564	Breed for AZA
1596	806190	M	4	HOLD	SD-WAP	BREED WITH	1315	Breed for Guam
2216	808084	F	2	SEND TO	NZP-WASH	BREED WITH	1318	Breed for Guam
2218	808159	F	2	SEND TO	FRESNO	BREED WITH	1572	Breed for Guam
2219	808162	F	2	SEND TO	OKLAHOMA	BREED WITH	872	Breed for Guam
2220	808201	F	2	SEND TO	PITTS CA	BREED WITH	1321	Breed for Guam
2221	808213	F	2	SEND TO	RACINE (SEE NOTES)	DO NOT BREED		If this bird cannot be accepted by Racine, it may be exported to Guam
2222	808214	F	2	SEND TO	SAN ANTON	BREED WITH	981	Breed for Guam
2223	808215	M	2	SEND TO	GUAM	NO REC.		
2224	809362	M	0	SEND TO	GUAM	NO REC.		
2217	808159	M	2	SEND TO	GUAM	NO REC.		

SEDGWICK

Sedgwick County Zoo
Wichita, KS

Institutional Notes:

- Please contact Species Coordinator on production of all eggs. Only double clutch if approval is given by the Species Coordinator.

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2071	290206	F	3	RECEIVE FROM	FRESNO	BREED WITH	636 OR 1314	#636 is the priority breeder, #1314 is the back-up. Breed for AZA
1314	M0614	M	8	RECEIVE FROM	RACINE	BREED WITH	2071	Back-up breeder. Breed for AZA.
636	11907	M	12	HOLD	SEDGWICK	BREED WITH	2071	
841	9550	M	10	HOLD	SEDGWICK	DO NOT BREED		Excluded - education

GUAM

ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2217	808159	M	2	RECEIVE FROM	SD-WAP	NO REC.		
2223	808215	M	2	RECEIVE FROM	SD-WAP	NO REC.		
2224	809362	M	0	RECEIVE FROM	SD-WAP	NO REC.		
2221	808213	F	2	RECEIVE FROM	SD-WAP	NO REC.		This recommendation is dependent on Racine's holding capabilities. This female will only be sent to Guam if Racine cannot accept her.

Appendix A Assumptions

The pedigree of the population is 100% known and no assumptions were created.

Appendix B Summary of Data Exports

Project: Guam Rail 2010
Report compiled under Population Management 2000, version 1.213
9:33:43 AM, 2 Apr 2010

Date to be used for calculations: 2 Apr 2010

Demographic data from: C:\Documents and Settings\cgroome\My Documents\PopLink 2.1\PopLink Databases\GuamRail2010\mGuamRail2010.prn and C:\Documents and Settings\cgroome\My Documents\PopLink 2.1\PopLink Databases\GuamRail2010\fGuamRail2010.prn

Genetic data from: C:\Documents and Settings\cgroome\My Documents\PopLink 2.1\PopLink Databases\GuamRail2010\GuamRail2010.ped

Studbook information:

Data exported on: 2 Apr 2010
Data compiled by: Megan R Ross, PhD
Contact info: Megan R Ross, PhD mross@lpzoo.org
Data current thru: 1 Apr 2010
Scope of data:

Demographic filter conditions:

Locations = N.AMERICA During 1/1/1980 – 2 Apr 2010 Status = Living

Genetic filter conditions:

Association = AZA.fed
As of 2 Apr 2010
Status = Living

Appendix C Birds excluded from the Genetic Analyses

SB ID#	Location	Sex	Age	Reason for Exclusion
841	SEDGWICK	M	10	Education bird
993	PITTS-CA	F	9	Medical <i>Died during draft period</i>
508	NZP-CRC	F	14	Age
2079	PHILADELP	M	2	Education bird

Appendix D Life Tables

Males

Age (x)	Qx	Px	lx	Mx	Vx	Ex	Risk (Qx)	Risk (Mx)
0	0.29	0.71	1	0.04	1.17	7.905	206.5	156.8
1	0.07	0.93	0.71	0.3	1.615	8.616	124.4	120
2	0.06	0.94	0.66	0.48	1.611	8.147	94.4	90.9
3	0.05	0.95	0.621	0.42	1.371	7.565	83.2	80.3
4	0.05	0.95	0.59	0.44	1.147	6.91	71.1	69.5
5	0.07	0.93	0.56	0.24	0.862	6.286	61.6	59.9
6	0.07	0.93	0.521	0.32	0.766	5.683	54.7	52.3
7	0.08	0.92	0.484	0.27	0.552	5.062	49.8	47
8	0.17	0.83	0.446	0.19	0.368	4.633	41.4	38.9
9	0.1	0.9	0.37	0.15	0.237	4.215	29.9	29.2
10	0.12	0.88	0.333	0.09	0.112	3.611	24.4	22.8
11	0.23	0.77	0.293	0.03	0.03	3.151	21.7	19.2
12	0.12	0.88	0.226	0	0	2.63	16	15.5
13	0.42	0.58	0.199	0	0	2.204	14.3	11
14	0.62	0.38	0.115	0	0	2.377	8	5.2
15	0	1	0.044	0	0	2.5	2.2	2.2
16	0	1	0.044	0	0	1.5	1.3	1.3
17	1	0	0.044	0	0	1	1	0.2
18	1	0	0	0	0	0	0	0

r = 0.1359
 lambda = 1.1455
 T = 3.53
 N = 24.00
 N(at 20 yrs) = 363.40

Females

Age (x)	Qx	Px	lx	Mx	Vx	Ex	Risk (Qx)	Risk (Mx)
0	0.27	0.73	1	0.01	1.156	5.481	209.9	161.5
1	0.13	0.87	0.73	0.26	1.637	5.678	128.5	117.8
2	0.07	0.93	0.635	0.45	1.729	5.21	99	96.3
3	0.15	0.85	0.591	0.61	1.617	4.723	85.9	79.3
4	0.13	0.87	0.502	0.78	1.32	4.333	63.5	60
5	0.2	0.8	0.437	0.2	0.727	3.98	51.5	45.6
6	0.2	0.8	0.349	0.27	0.743	3.725	39.9	35.5
7	0.23	0.77	0.28	0.53	0.678	3.464	31.1	27.6
8	0.3	0.7	0.215	0.2	0.225	3.332	23.6	19.9
9	0.26	0.74	0.151	0.04	0.04	3.254	15.6	13.4
10	0.27	0.73	0.111	0	0	3.064	11	10
11	0.12	0.88	0.081	0	0	2.602	8	7.9
12	0.43	0.57	0.072	0	0	2.18	7	4.6
13	0.55	0.45	0.041	0	0	2.241	3.6	2.6
14	0	1	0.018	0	0	2	1	1
15	0.5	0.5	0.018	0	0	1.333	2	2
16	1	0	0.009	0	0	1	1	0.9
17	1	0	0	0	0	0	0	0
18	1	0	0	0	0	0	0	0

r = 0.1197
 lambda = 1.1271
 T = 3.47
 N = 19.00
 N(at 20 yrs) = 208.05

Appendix E

Ordered Mean Kinship

Note: This list is based on data current to 1st April 2010. Values are subject to change with any hatch, death, import, export, inclusion, or exclusion.

Average Population MK = 0.1671

Males

<u>SB#</u>	<u>MK</u>	<u>%Known</u>	<u>Age</u>	<u>Location</u>
1292	0.111	100.0	9	NZP-CRC
636	0.128	100.0	12	SEDGWICK
2074	0.130	100.0	2	CINCINNAT
1313	0.135	100.0	8	SAN ANTON
1314	0.135	100.0	8	RACINE
872	0.151	100.0	10	OKLAHOMA
988	0.152	100.0	9	SANDIEGOZ
985	0.155	100.0	9	PHILADELP
981	0.157	100.0	9	PITTS CA
994	0.167	100.0	9	LOUISVILL
1318	0.167	100.0	8	NZP-WASH
1322	0.167	100.0	8	GAINSVLL
1578	0.168	100.0	4	CINCINNAT
1594	0.169	100.0	4	MILWAUKEE
1593	0.172	100.0	4	CINCINNAT
1572	0.172	100.0	3	FRESNO
1591	0.175	100.0	4	SD-WAP
1321	0.180	100.0	8	CINCINNAT
1596	0.191	100.0	4	SD-WAP
2217	0.196	100.0	2	SD-WAP
2223	0.196	100.0	2	SD-WAP
2224	0.196	100.0	0	SD-WAP

Females

<u>SB#</u>	<u>MK</u>	<u>%Known</u>	<u>Age</u>	<u>Location</u>
1460	0.146	100.0	6	LOUISVILL
1459	0.146	100.0	6	GAINSVLL
1564	0.152	100.0	5	SD-WAP
871	0.167	100.0	10	LOUISVILL
1580	0.168	100.0	4	SAN ANTON
2216	0.170	100.0	2	SD-WAP
2220	0.170	100.0	2	SD-WAP
1574	0.172	100.0	3	CINCINNAT
2071	0.172	100.0	3	FRESNO
2072	0.172	100.0	3	CINCINNAT
1315	0.189	100.0	8	SD-WAP
2219	0.196	100.0	2	SD-WAP
2218	0.196	100.0	2	SD-WAP
2221	0.196	100.0	2	SD-WAP
2222	0.196	100.0	2	SD-WAP

Appendix F

Definitions

Management Terms

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

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

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

Demographic Terms

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

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

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

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

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

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

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

Risk (Qx or Mx) – The number of individuals that have lived during an age class. The number at risk is used to calculate Mx and Qx by dividing the number of births and deaths that occurred during an age class by the number of animals at risk of dying and reproducing during that age class.

The proportion of individuals that die during an age class. It is calculated from the number of animals that die during an age class divided by the number of animals that were alive at the beginning of the age class (i.e. "at risk").

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

Genetic Terms

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

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

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

FOKE, First Order Kin Equivalents – The number of first-order kin (siblings or offspring) that would contain the number of copies of an individual's alleles (identical by descent) as are present in the zoo-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 zoo 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, zoo-born population. The mean kinship of a population is equal to the proportional loss of gene diversity of the descendant (zoo-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 G

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-zoo.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
Colleen	Lynch	Lincoln Park Zoo	312-742-8859	clynch@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
Dan	Borritt	Smithsonian National Zoological Park	202-673-4808	BorittD@si.edu
Lynch	Warren	Smithsonian National Zoological Park-- CRC	202-636-1488	LynchW@si.edu