Population Analysis & Breeding and Transfer Plan

Pygmy Slow Loris (*Nycticebus pygmaeus*)
AZA Species Survival Plan®
Red Program

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08 February 2022

PMC Population Management Center

LINCOLN PARK ZOO.

ASSOCIATION OF ZOOS & AQUARIUMS

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Acknowledgments

The Pygmy Slow Loris SSP planning meeting was held via online conferencing on 9 December 2021, attended by the following:

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Christie Eddie, Omaha's Henry Doorly Zoo & Aquarium
Rachel Bladow, AZA Population Management Center at Lincoln Park Zoo

Cover photo courtesy of David Haring, Duke Lemur Center

This plan was prepared and distributed with the assistance of the Planning Coordinator and Research Assistant at the AZA Population Management Center (pmc@lpzoo.org).

Description of Population Status

Species Survival Plan® for the Pygmy Slow Loris (*Nycticebus pygmaeus*)

Introduction: The current SSP population consists of 40 animals (21 males and 19 females) distributed among 18 facilities. The Prosimian Taxon Advisory Group has set the target population size for this population to be 55 animals (2019 Regional Collection Plan). Under AZA's current sustainability designations, this Program qualifies as a Red SSP (<50 formally managed animals). The pygmy slow loris (*Nycticebus pygmaeus*) is a nocturnal, arboreal species of slow loris endemic to Vietnam, Laos, eastern Cambodia, and China. In the wild, pygmy slow loris are largely threatened by habitat loss and the species has been afforded the highest level of protection by CITES (Appendix I) to combat overexploitation.

Analytical Assumptions and Exclusions: The pedigree of this population is 98.6% known before assumptions and exclusions. Following assumptions and exclusions, the pedigree is 100% known and 100% certain (Appendix A). One animal has been excluded from the potentially breeding population (Appendix C).

Demography: This SSP species first appeared in AZA facilities in 1986 when a single male was confiscated and transferred to the Honolulu Zoo. From 1968 – 1986, the population size remained quite low, never exceeding four individuals, and the Honolulu Zoo remained the only holding institution. The current SSP population was founded in 1987 when the San Diego Zoo, Duke Lemur Center, and Cincinnati Zoo imported 29 individuals from Sweden. The first recorded births occurred in 1988 at all three facilities that worked to import animals. The population steadily grew to a peak of 76 individuals by 2011 (average λ 1989 – 2011 = 1.04; Figure 1). This growth can largely be attributed to successful breeding (zoo born λ from 1989 – 2011 ranged from 0.86 to 1.50) and secondly to a small number of continued imports. Since 2012, however, the population has experienced a notable decline in size primarily due to insufficient reproduction. The reasons for this low, inconsistent reproduction in recent years are currently unclear, but may be associated with husbandry, particularly diet. The population has declined on average over the past five years by 4% (λ=0.96).

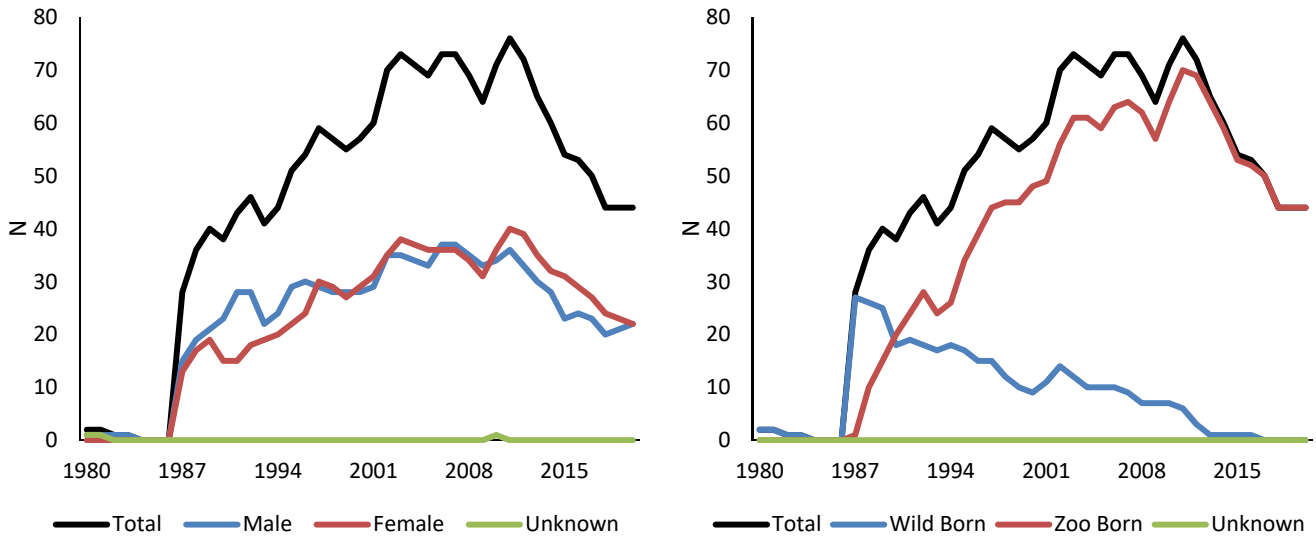


Figure 1. *Census of Pygmy Slow Loris SSP from 1980 to 2020 by sex (left) and birth type (right).*

The age structure illustrates the number of males and females in each age class (Figure 2). Based on its current age structure and growth rate, if the population continues on its current trajectory, this population is expected to decrease over time (Table 1).

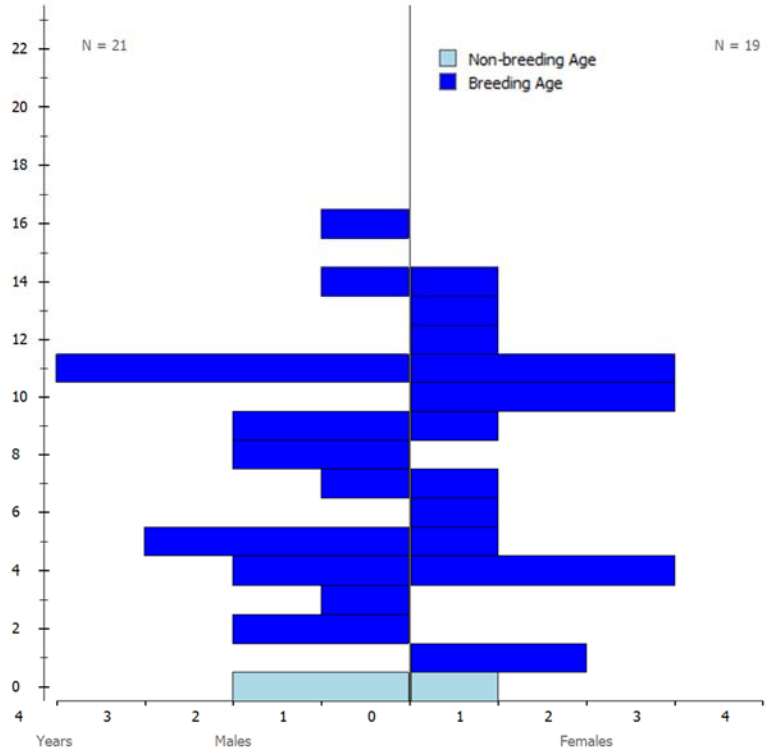


Figure 2. *Age distribution of the entire population, N= 40 (21.19.0) in the Pygmy Slow Loris SSP.*

Table 1: *Demographic status of SSP population, according to studbook.*

Demography Summary		
Current size of SSP population (N) – Total (Males.Females.Unknown Sex)	40 (21.19.0)	
Number of individuals excluded from genetic analyses	1 (0.1.0)	
Population size following exclusions	39 (21.18.0)	
Target population size (Kt) from *Prosimian* TAG *2019* RCP	55	
Mean generation time (T, years)	7.0	
Population growth rates (λ; lambda)*: Life Table / 5-year / Projected	0.998 / 0.964 / 0.891 <> 0.961 <> 1.010	
Survival/Mortality	**Males**	**Females**
Observed first year mortality rate (Q_x)	0.447	0.411
Median life expectancy (MLE), excluding first year mortalities (years) (from PopLink Survival Statistics Report (https://www.aza.org/species-survival-statistics))	12.3	
Observed maximum longevity (L_x)	21	20
Reproduction		
Observed reproductive age range	1–16	1–14
Gestation time	182 days	
Median litter size born	2	
Percent of the living population that is zoo-born	100%	

* Life table (N.AMERICA: 1 Jan 1987 – 23 Nov 2021); 5-year from studbook census; Projected from PMx stochastic 20-year projections

Genetics: Based on pedigree assumptions and exclusions, the studbook pedigree indicates that this SSP is descended from 28 founders with no potential founders remaining. The gene diversity of the population is 93%, which is equivalent to that found in approximately seven founders (FGE = 6.80). Founder representation in the population is currently highly skewed (Figure 3). Equalizing founder contributions through breeding unrepresented lineages will increase gene diversity within the SSP. The current mean kinship in the population is 0.0735. First-cousins have a kinship of 0.0625, which means that the average relationship in the population is slightly closer than that of non-inbred first-cousins.

Typical AZA program goals include thresholds for tolerance of gene diversity loss over time; 90% gene diversity retention for 100 years is a common management goal. Decreases in gene diversity below 90% of that in the founding population have been associated with reproduction increasingly compromised by, among other factors, lower birth weights, smaller litter sizes, and greater neonatal mortality in some species. Based on current population parameters and recent growth rate trends, gene diversity is projected to decline to 61% over the next 100 years if the current population grows to the RCP target size of 55 at a stable rate (λ = 1.00).

Table 2: *Genetic status and projections for the Pygmy Slow Loris SSP population.*

Genetics Summary*						
	2013	***2015***	***2017***	***2019***	**2021****	**Potential**
Founders	*32*	*32*	*30*	*28*	28	0
Founder genome equivalents (FGE)	*12.33*	*10.94*	*8.44*	*6.99*	6.80	10.23
Gene diversity (GD %)	*95.94*	*95.43*	*94.08*	*92.85*	92.65	95.11
Population mean kinship (MK)	*0.0409*	*0.0457*	*0.0592*	*0.0715*	0.0735	--
Mean inbreeding (F)	*0.0038*	*0.0000*	*0.0000*	*0.0015*	0.0048	--
Effective population size (N_e/N)	*0.41*	*0.32*	*0.40*	*0.4678*	0.4344	--
Percentage of pedigree known before / after assumptions and exclusions	*98 / 100*	*98 / 100*	*98 / 100*	*98.6 / 100*	98.6 / 100	--
Projections						
Years to 90% gene diversity	*31*	*13*	*13*	*7*	6	7
Years to 10% loss of gene diversity	*67*	*27*	*37*	*34*	27	35
Gene diversity at 100 Years (%)	*81*	*70*	*72*	*73.2*	60.9	68.9
Gene diversity in 10 generations (%)	*NA*	*NA*	*NA*	*77.2*	69.1	75.0
	Assuming λ = 1.01, Target size = 110, Generation length = 7.0, Starting population size = 66	*Assuming λ = 1.01, Target size = 90, Generation length = 7.0, Starting population size = 49*	*Assuming λ = 1.005, Target size = 90, Generation length = 7.0, Starting population size = 47*	*Assuming λ = 1.014, Target size = 90, Generation length = 6.9, Starting population size = 38*	Assuming λ = 1.00, Target size = 55, Generation length = 7.0, Starting population size = 40 Ne/N = 0.434	Assuming λ = 1.01, Target size = 55, Generation length = 7.0, Starting population size = 44 Ne/N = 0.47

*Genetic statistics may not be comparable across years due to changes in software and parameters used for projections from year to year.
**Pedigree assumptions were created for this population and may over- or under-estimate genetic statistics shown in this table.

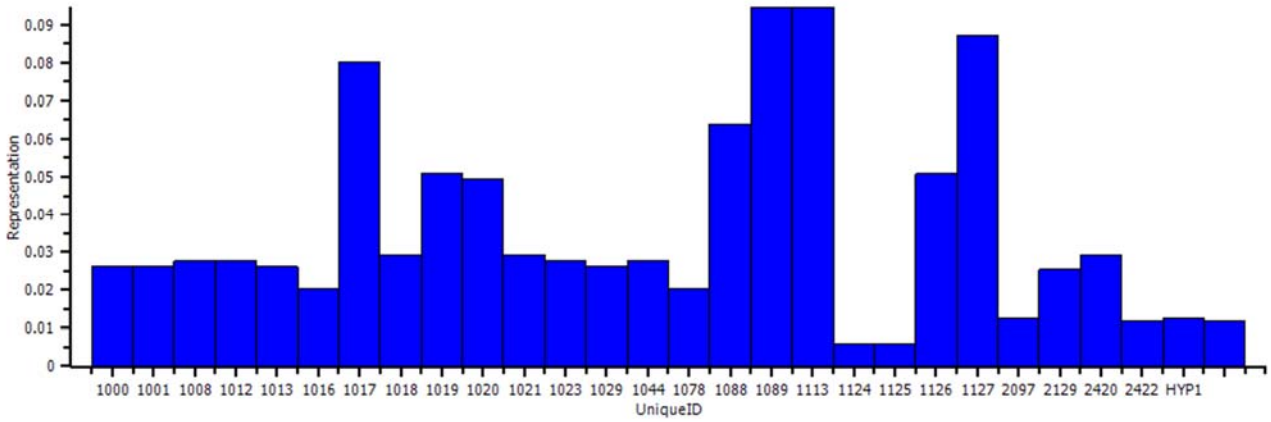


Figure 3. *Founder representation distribution of the analytical Pygmy Slow Loris SSP population.*

Recommendation Outcomes: The website PMCTrack calculates the outcomes of SSP recommendations by comparing Breeding and Transfer Plan recommendations to births and transfers recorded in the studbook (Figure 4). There are many reasons that recommendations might not be fulfilled, including interim recommendations issued by the SSP Coordinator; these reasons can be captured using PMCTrack Outcomes Surveys. SSP participants are always encouraged to attempt to fulfill recommendations and to communicate successes and failures to the SSP Coordinator.

Of the recommendations proprosed in the 2019 Breeding and Transfer Plan, 32% of the BREED WITH recommendations were fulfilled, and 78% of SEND TO recommendations were fulfilled as requested by October 2021. Interim recommendations were created over the last three years, which is not currently represented in the percent fulfillment rate.

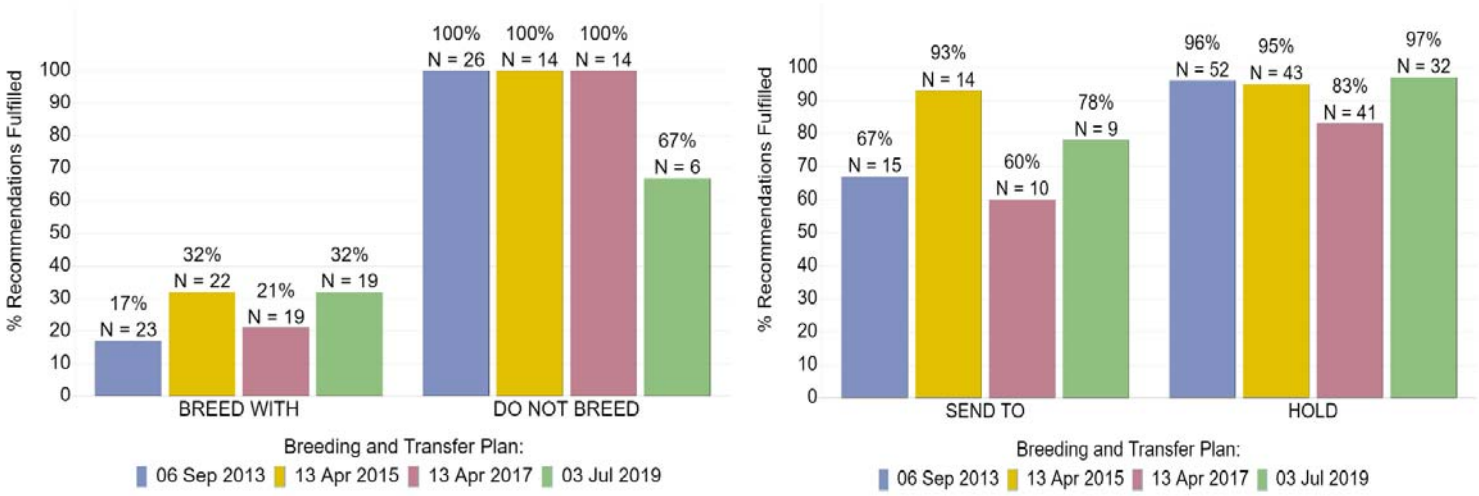


Figure 4. Recommendation outcomes by breeding (left) and transfers (right) for the past Pygmy Slow Loris SSP Breeding and Transfer Plans. *N* represents the number of recommendations scored for each recommendation type, per plan, and the number represents the percentage recommendations fulfilled. Please visit PMCTrack.org or contact pmctrack@lpzoo.org for more information or with any questions.

Management Strategies: This is a 2-year plan (2022-2024). Interim recommendations will continue to be made as needed until another full set of recommendations are produced. Recommendations contained in this plan supersede all previous recommendations.

Table 3: Historic reproduction and future population goals.

Current Reproductive Goals Summary		
	Number of Births Needed per Year over the next 3 Years	**Target Population Size**
To maintain current population size (λ = 1.00)	5–6	40
To grow to the TAG's recommended target population size in 5 years (λ = 1.0658)	9–11	55
**This model was examined as an option for a slower growth rate due to the current low reproductive success rates. Any births past this number will contribute to the SSP reaching the 5-year target size.* To grow to the TAG's recommended target population size in 10 years (λ = 1.0324)	7–9	55
Reproductive Goals Summary from the Last BTP (2019)		
Number of females recommended to breed	19	
Number of births since then	12	
Recent Trends in the SSP Population (2016 – 2021)		
Average number of births / deaths per year, from the past five years	6.4 / 8.4	
Average number of imports / exports per year, from the past five years	0 / 0	

At this time, the SSP:

1. **Recommends 16 females to breed at 15 facilities.**
    - **a.** Five of these females are recommended to breed with previous mates as part of established breeding pairs that have successfully produced offspring.
    - b. Breeding facilities are excepted to hold offspring for at least two years when needed.

2. **Recommends nine transfers to establish new pairs and meet facility requests.**
    - a. Four new breeding pairs will be established through these transfer recommendations.

3. **Requests that all breeding facilities closely monitor breeding** and contact the SSP Coordinator to discuss ideas to aid in successful pregnancies and births.
    - a. Over the last five years, the reproductive rate has not been high enough to offset deaths. There is growing concern that reproductive success has decreased, possibly due to husbandry, specifically weight and diet.
    - b. **No recorded female has bred for the first time after the age of 10**. Any females approaching that age that have not yet bred should be a focus for that facility.

4. **Recommends diet and weight be closely tracked**. **The recommended weight range for pygmy slow lorises in captivity is 300 – 500g** (Appendix G; The Little Fireface Project, www.nocturama.org). In the temperature-controlled environments in which these individuals live, there is no reason they should exceed 500g.

5. **Requests that facilities report all occurrences of stillbirths and/or miscarriage to the SSP Coordinator.**

Breeding and Transfer Recommendations by Facility

AKRON

Akron Zoological Park

Akron, OH

Facility Note: Male #2667 will remain at your facility at least until June 2022 since the female he will be paired with does not turn one until then and therefore cannot leave her group.

SB ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2605	101471	F	13	HOLD	AKRON	DO NOT BREED		Excluded - Behavior
2667	101772	M	5	SEND TO	CLEVELAND	BREED WITH	2714	
2689	200616	M	2	RECEIVE FROM	CLEVELAND	DO NOT BREED		
2690	200617	M	2	RECEIVE FROM	CLEVELAND	DO NOT BREED		

BLOOMINGT

Miller Park Zoo

Bloomington, IL

Facility Note: Female #2661 has not reproduced yet at the age of six; no female has reproduced for the first time past the age of 10. Please contact the SSP Coordinator to discuss strategies to improve the chances of reproduction.

SB ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2661	M17002	F	6	HOLD	BLOOMINGT	BREED WITH	2682	
2682	M19007	M	4	HOLD	BLOOMINGT	BREED WITH	2661	

CHICAGOBR

Chicago Zoological Park / Brookfield Zoo

Brookfield, IL

Facility Note: Both females can be sent out around August 2022, as close as possible to the same time.

SB ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2626	4920	F	10	HOLD	CHICAGOBR	BREED WITH	2631	
2631	4919	M	11	HOLD	CHICAGOBR	BREED WITH	2626	
2707	9545	F	1	SEND TO	NY BRONX	BREED WITH	2713	
2708	9546	F	1	SEND TO	NZP-WASH	BREED WITH	2715	

CHICAGOLP

Lincoln Park Zoological Gardens

Chicago, IL

SB ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2637	23548	F	10	HOLD	CHICAGOLP	DO NOT BREED		
2646	23550	M	8	HOLD	CHICAGOLP	DO NOT BREED		

CINCINNAT

Cincinnati Zoo & Botanical Garden

Cincinnati, OH

SB ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2622	119021	M	11	HOLD	CINCINNAT	BREED WITH	2630	
2630	UNK	F	11	HOLD	CINCINNAT	BREED WITH	2622	

CLEVELAND

Cleveland Metroparks Zoo

Cleveland, OH

Facility Note: Transfers will not occur until June 2022 at the earliest.

SB ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2667	101772	M	5	RECEIVE FROM	AKRON	BREED WITH	2714	
2689	200616	M	2	SEND TO	AKRON	DO NOT BREED		
2690	200617	M	2	SEND TO	AKRON	DO NOT BREED		
2714	7878	F	0	RECEIVE FROM	LITTLEROC	BREED WITH	2667	

DRAPER

The Loveland Living Planet Aquarium

Draper, UT

Facility Note: Please contact the SSP Coordinator when you are ready to receive animals.

DULUTH

Lake Superior Zoological Gardens

Duluth, MN

SB ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2679	100503	F	4	HOLD	DULUTH	BREED WITH	2685	
2685	100504	M	3	HOLD	DULUTH	BREED WITH	2679	

EL PASO

El Paso Zoo

El Paso, TX

Facility Note: This pair has a low likelihood of success due to the male's age, however, please do not limit breeding. No recorded male has reproduced past the age of 16.

SB ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2450	202198	M	16	HOLD	EL PASO	BREED WITH	2632	
2632	201291	F	11	HOLD	EL PASO	BREED WITH	2450	

EVANSVLLE

Mesker Park Zoo

Evansville, IN

Facility Note: This pair has a low likelihood of success due to the female's age, however, please do not limit breeding. No recorded female has reproduced past the age of 14.

SB ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2502	119021	F	14	HOLD	EVANSVLLE	BREED WITH	2641	
2641	118015	M	9	HOLD	EVANSVLLE	BREED WITH	2502	

GARDENCTY

Lee Richardson Zoo

Garden City, KS

SB ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2666	117017	F	5	HOLD	GARDENCTY	BREED WITH	2671	
2671	117022	M	5	HOLD	GARDENCTY	BREED WITH	2666	

LITTLEROC

Little Rock Zoological Gardens

Little Rock, AK

Facility Note: Juveniles will be sent out no earlier than June 2022.

SB ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2634	7403	M	11	HOLD	LITTLEROC	BREED WITH	2654	
2654	7508	F	7	HOLD	LITTLEROC	BREED WITH	2634	
2714	7878	F	0	SEND TO	CLEVELAND	BREED WITH	2667	
2715	7879	M	0	SEND TO	NZP-WASH	BREED WITH	2708	

MEMPHIS

Memphis Zoological Garden & Aquarium

Memphis, TN

SB ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2673	19M042	M	4	HOLD	MEMPHIS	BREED WITH	2683	
2683	10M021	F	4	HOLD	MEMPHIS	BREED WITH	2673	

MOODY

Aquarium & Rainforest at Moody Gardens

Galveston, TX

SB ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2638	6379	F	10	HOLD	MOODY	BREED WITH	2649	
2649	7832	M	9	HOLD	MOODY	BREED WITH	2638	

NY BRONX

Bronx Zoo/Wildlife Conservation Society

Bronx, NY

Facility Note: Will receive female from CHCIAGOBR no earlier than August 2022.

SB ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2623	M14052	M	11	HOLD	NY BRONX	BREED WITH	2640	
2640	M14053	F	9	HOLD	NY BRONX	BREED WITH	2623	
2707	9545	F	1	RECEIVE FROM	CHICAGOBR	BREED WITH	2713	
2713	M21015	M	0	HOLD	NY BRONX	BREED WITH	2707	

NZP-WASH

Smithsonian National Zoological Park

Washington, DC

Facility Note: Welcome to the SSP! The female from CHICAGOBR will arrive no earlier than August 2022 and the male from LITTLEROC no earlier than June 2022. If possible, the male transfer could be delayed until August to coincide with the female.

SB ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2708	9546	F	1	RECEIVE FROM	CHICAGOBR	BREED WITH	2715	
2715	7879	M	0	RECEIVE FROM	LITTLEROC	BREED WITH	2708	

OMAHA

Omaha's Henry Doorly Zoo

Omaha, NE

SB ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2652	24485	M	8	HOLD	OMAHA	BREED WITH	2677	
2677	24709	F	4	HOLD	OMAHA	BREED WITH	2652	

PHILADELP

Philadelphia Zoo

Philadelphia, PA

Facility Note: Please talk to the SSP Coordinator for details regarding the transfer of male #2676.

SB ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2504	P09015	M	14	RECEIVE FROM	PROSPECTP	BREED WITH	2617	
2617	104733	F	11	HOLD	PHILADELP	BREED WITH	2504	
2676	105322	M	5	SEND TO	TBD	SEE NOTES		Breed With 2659

PROSPECTP

Prospect Park Zoo

Brooklyn, NY

SB ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2504	P09015	M	14	SEND TO	PHILADELP	BREED WITH	2617	

PUEBLO

Pueblo Zoo

Pueblo, CO

Facility Note: This pair has a low likelihood of success due to the female's age and lack of prior reproduction, however, please do not limit breeding. No recorded female has bred for the first time past the age of 10.

SB ID	Local ID	Sex	Age	Disposition	Location	Breeding	With	Notes
2614	M39021	F	12	HOLD	PUEBLO	SEE NOTES		
2653	M39022	M	7	HOLD	PUEBLO	SEE NOTES		

Appendices

A. Analytical Assumptions

HYPOTHETICAL INDIVIDUALS

Studbook ID	Sire	Dam	Notes
HYP1	WILD	WILD	To represent likely wild caught sire of SB# 2108, which was born at IRCHEL in Switzerland on 4/10/1989.

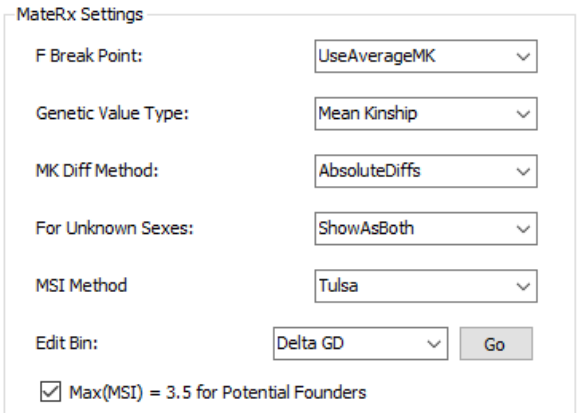
ANALYTICAL DATA FOR TRUE INDIVIDUALS

Studbook ID	Field	TRUE	Overlay	Notes
2108	Sire	UNK	HYP1	No individuals in the SB are recorded as having been at institution at which 2108 was born (IRCHEL) other than SB#s 2108 and 2097. Therefore, created and assigned a wild-origin hypothetical sire, which seems reasonable given the birth date of SB# 2108 and the origins of the recorded mother.

B. Summary of Data Exports

Studbook Name	Loris, Pygmy Slow (Nycticebus pygmaeus)
Studbook Currentness Date	4 July 2021
Studbook Software and version #	ZIMS for Studbooks 3.0 – 8 November 2021
Overlay Name	Parental_Assumptions_2020
PMx version #	1.6.2.20200804
Descriptive Survival Statistics Report	Report is archived with PMC/AZA and Median Life Expectancy can be viewed here: https://www.aza.org/species-survival-statistics

PMx Project: Loris_PygmySlow_Dec2021
Created: 2021-11-23 by PMx version 1.6.2.20200804
File: C:\PMxProjects\Loris_PygmySlow_Dec2021.pmxproj
Description: Made for planning meeting



Primary data file
Data File Name: zims.zims
Common Name: Pygmy slow loris
Scientific Name: Nycticebus pygmaeus
Data Source: ZIMS for Studbooks
Studbook Name: Loris, Pygmy Slow (Nycticebus pygmaeus)
Exported On: 2021-11-23
Software version: ZIMS for Studbooks 3.0
Current Through: 2021-07-14
Compiled By: ELENA A LESS
Scope: AZA

Demographic Filter:
Dates: 1987-01-01 to 2021-11-23
Location: North America

Census & Genetic Filter:
Dates: 1987-01-01 to 2021-11-23
Association: AZA / Association of Zoos & Aquariums (AZA)

77 births to parents with unknown ages have been added in proportion to known aged parents.
This is 28% of TOTAL births (N=272)

Selected population was changed from the originally imported data.

C. Animals Excluded from Genetic Analyses

ID	Location	Sex	Age	Reason for Exclusion
2605	AKRON	F	13	Behavior

D. Life Tables

Px = survival; Qx = mortality; Lx = cumulative survivorship; Mx = fecundity; Ex = life expectancy; Vx = expected future reproduction,
At Risk (Qx and Mx) = number of animals corresponding values are estimated from.

MALES

Age	Px	Qx	Risk Qx	Lx	Mx	Risk Mx	Ex	Vx
0	0.55	0.45	81.23	1.00	0.00	81.23	8.73	1.29
1	0.96	0.04	80.44	0.55	0.00	80.44	11.10	1.84
2	0.96	0.04	82.25	0.53	0.04	82.27	10.47	1.89
3	0.97	0.03	80.17	0.51	0.15	80.20	9.80	1.91
4	0.97	0.03	77.23	0.50	0.22	77.30	9.06	1.80
5	0.99	0.01	72.21	0.48	0.17	72.26	8.22	1.60
6	0.99	0.01	70.80	0.48	0.26	70.87	7.32	1.44
7	0.94	0.06	67.54	0.47	0.25	67.62	6.56	1.21
8	0.95	0.05	62.58	0.44	0.19	62.65	5.87	1.01
9	0.90	0.10	56.41	0.42	0.16	56.44	5.25	0.88
10	0.92	0.08	48.61	0.38	0.28	48.69	4.67	0.79
11	0.84	0.16	39.91	0.35	0.20	39.94	4.17	0.58
12	0.77	0.24	29.60	0.29	0.15	29.66	3.94	0.47
13	0.89	0.12	23.40	0.22	0.17	23.44	3.60	0.38
14	0.78	0.22	20.44	0.20	0.05	20.47	3.11	0.25
15	0.82	0.18	15.67	0.16	0.07	15.68	2.63	0.24
16	0.62	0.39	11.35	0.13	0.23	11.39	2.24	0.23
17	0.63	0.38	7.02	0.08	0.00	7.02	2.00	0.00
18	0.40	0.60	3.82	0.05	0.00	3.82	1.86	0.00
19	0.50	0.50	1.30	0.02	0.00	1.30	2.00	0.00
20	1.00	0.00	1.00	0.01	0.00	1.00	1.50	0.00
21	0.00	1.00	0.00	0.01	0.00	0.00	1.00	0.00
22	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00

r = -0.007, λ = 0.993, Ro = 0.948, T = 7.6, N@20 = 19

FEMALES

Age	Px	Qx	Risk Qx	Lx	Mx	Risk Mx	Ex	Vx
0	0.59	0.41	76.26	1.00	0.00	76.26	9.08	1.26
1	0.97	0.03	73.26	0.59	0.04	73.29	11.01	1.72
2	0.95	0.05	75.23	0.58	0.09	75.29	10.43	1.76
3	0.95	0.05	75.06	0.55	0.20	75.23	9.91	1.76
4	0.96	0.04	71.84	0.52	0.22	71.91	9.31	1.63
5	0.96	0.04	67.58	0.50	0.30	67.76	8.68	1.48
6	0.94	0.06	63.76	0.48	0.28	63.86	8.10	1.25
7	0.97	0.03	57.60	0.45	0.38	57.70	7.46	1.02
8	0.98	0.02	56.14	0.43	0.11	56.19	6.63	0.67
9	0.89	0.11	51.83	0.43	0.23	51.98	6.00	0.60
10	0.94	0.06	46.27	0.38	0.15	46.33	5.48	0.41
11	0.93	0.07	39.39	0.36	0.14	39.42	4.81	0.28
12	0.86	0.14	33.02	0.33	0.08	33.16	4.26	0.16
13	0.80	0.20	25.83	0.28	0.07	25.88	3.92	0.10
14	0.87	0.13	21.01	0.23	0.03	21.04	3.52	0.03
15	0.74	0.26	15.67	0.20	0.00	15.67	3.12	0.00
16	0.93	0.07	13.64	0.15	0.00	13.64	2.59	0.00
17	0.62	0.39	9.44	0.13	0.00	9.44	2.05	0.00
18	0.75	0.25	6.45	0.08	0.00	6.45	1.57	0.00
19	0.17	0.83	3.26	0.06	0.00	3.26	1.14	0.00
20	0.00	1.00	0.83	0.01	0.00	0.83	1.00	0.00
21	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00

r = 0.003, λ = 1.003, Ro = 1.020, T = 6.3, N@20 = 19

E. Ordered Mean Kinship List

These lists are current to December 2021 and values are subject to change with any birth, death, import, export, inclusion, exclusion, or changes in pedigree or pedigree assumptions.

Population MK = 0.0735
(as indicated by the black line)

MALES

SB ID	MK	Known	Age	Location
2652	0.0341	1.0000	8	OMAHA
2641	0.0506	1.0000	9	EVANSVLLE
2622	0.0544	1.0000	11	CINCINNAT
2623	0.0576	1.0000	11	NY BRONX
2649	0.0576	1.0000	9	MOODY
2713	0.0621	1.0000	0	NY BRONX
2450	0.0643	1.0000	16	EL PASO
2504	0.0660	1.0000	14	PROSPECTP
2673	0.0742	1.0000	4	MEMPHIS
2634	0.0788	1.0000	11	LITTLEROC
2653	0.0799	1.0000	7	PUEBLO
2671	0.0799	1.0000	5	GARDENCTY
2685	0.0801	1.0000	3	DULUTH
2667	0.0820	1.0000	5	AKRON
2676	0.0820	1.0000	5	PHILADELP
2646	0.0831	1.0000	8	CHICAGOLP
2631	0.0844	1.0000	11	CHICAGOBR
2689	0.0845	1.0000	2	CLEVELAND
2690	0.0845	1.0000	2	CLEVELAND
2682	0.0922	1.0000	4	BLOOMINGT
2715	0.0922	1.0000	0	LITTLEROC

FEMALES

SB ID	MK	Known	Age	Location
2617	0.0507	1.0000	11	PHILADELP
2640	0.0538	1.0000	9	NY BRONX
2502	0.0583	1.0000	14	EVANSVLLE
2637	0.0643	1.0000	10	CHICAGOLP
2614	0.0660	1.0000	12	PUEBLO
2626	0.0668	1.0000	10	CHICAGOBR
2677	0.0714	1.0000	4	OMAHA
2632	0.0715	1.0000	11	EL PASO
2630	0.0748	1.0000	11	CINCINNAT
2638	0.0780	1.0000	10	MOODY
2661	0.0820	1.0000	6	BLOOMINGT
2666	0.0820	1.0000	5	GARDENCTY
2679	0.0820	1.0000	4	DULUTH
2707	0.0820	1.0000	1	CHICAGOBR
2708	0.0820	1.0000	1	CHICAGOBR
2683	0.0922	1.0000	4	MEMPHIS
2714	0.0922	1.0000	0	LITTLEROC
2654	0.0927	1.0000	7	LITTLEROC

F. Definitions

Management Terms (as of January 2019)

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

Yellow Species Survival Plan® (Yellow SSP) Program – A Yellow SSP Program has a population size of 50 or more animals but cannot retain 90% gene diversity for 100 years or 10 generations. Yellow SSP participation by AZA facilities is voluntary. Yellow SSP Programs are subject to AZA's Sustainability Partner Policy.

Red Species Survival Plan® (Red SSP) Program – A Red SSP Program has a population size of twenty or more animals managed among three or more participating AZA facilities. If a population does not meet these minimum criteria, but has an IUCN designation of Critically Endangered, Endangered, or Extinct in the Wild, and the TAG has developed three goals to sustain this population, then the population will be considered a Red SSP Program. Red SSPs cannot retain 90% gene diversity for 100 years or 10 generations and participation by AZA facilities is voluntary. Red SSP Programs are subject to AZA's Sustainability Partner Policy.

Sustainability Partners – AZA Animal Population Management (APM) Committee approved wildlife facilities that regularly exchange animals with AZA-accredited facilities and certified related facilities, typically as part of the Species Survival Plan® (SSP) Program Breeding and Transfer Plan or other SSP Program management process.

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

All AZA member facilities and Animal Programs, regardless of management designation, must adhere to the AZA Policy on Responsible Population Management and the AZA Code of Professional Ethics. For more information on AZA policies, see https://www.aza.org/board-approved-policies-and-position-statements.

Demographic Terms

Age Distribution – A visual representation of the numbers or percentages of individuals in various age and sex classes.

Ex, Life Expectancy – The 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. A lambda of 1.11 means an 11% per year increase; a lambda of 0.97 means a 3% decline in size per year. The three lambdas highlighted in this BTP are: 1) Life Table, from the PMx life tables, the change in the population based on the demographic regional and date window exported from the studbook, the life table lambda is the rate at which the population would be expected to grow (in the future) given the birth and death rates reported in the life tables and assuming a stable age distribution (does NOT factor in imports or exports); 2) 5-year, from the studbook census, the 5-year lambda is calculated from observed changes in population size over the last 5 years and includes births, deaths, imports and exports; and 3) Projected, from the PMx stochastic 20-year projections (includes confidence intervals), models how the population is predicted to grow or decline over the next 20 years given the birth and death rates from the life tables and the age structure of the current population.

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.

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.

Median Life Expectancy (MLE) – The 'typical' age at which an average animal is expected to live, excluding those that were born and died on the same day. This is the age at which Lx = 0.5, meaning that 50% are expected to die before that age and 50% after that age. A Survival Statistics Library is maintained for most AZA Animal Programs on the AZA website: https://www.aza.org/species-survival-statistics

Maximum Longevity – The maximum age at which we have observed a species to live. If the oldest observed animal is currently living, we do not yet know the maximum longevity.

Mx, Fecundity – The average number of same-sexed offspring born to animals in that age class. Because studbooks typically have relatively small sample sizes, studbook software calculates Mx as 1/2 the average number of offspring 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 an age class; is conditional on an individual being alive at the beginning of the age class. Alternatively, the proportion of individuals that survive from the beginning of one age class to the next.

Qx, Mortality – The probability that an individual of age *x* dies during an age class (Qx = 1-Px). Alternatively, 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").

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.

Target Population Size (TPS) – The desired number of SSP animals to be held across AZA and approved partner facilities over a specific, stated timeframe. This number is determined with consideration for program roles and goals (genetic, demographic, and others), logistical constraints, spatial competition with other TAG-managed species, and other population-specific concerns. Target Population Size is determined by the Taxon Advisory Group (TAG) and published in their Regional Collection Plan (RCP).

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

Genetic Terms

Allele – Alternate forms of DNA at a particular position in a genome (genetic locus). Alleles represent the most basic form of genetic diversity.

Gene Diversity (GD) – The probability that two alleles randomly sampled from the same genetic locus across a population are not identical by descent. Gene diversity is calculated relative to a population’s founders, which are assumed to be unrelated and not inbred, and is the proportional diversity retained by the current, descendant population.

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 allele 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 allele frequency drift is measured in the current generation).

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

Founder Representation – The proportion of the alleles in the living, descendant population that are derived from that founder.

Inbreeding Coefficient (F) – The probability that the two alleles present at an individual’s genetic locus are identical by descent (i.e., both alleles originated from an ancestor common to both the individual’s parents).

Mean Kinship (MK) – The mean (or average) kinship coefficient between an animal and all animals (including itself) in the living, captive-born population. An individual’s mean kinship is a measure of how well its alleles are represented within a population. Animals with low mean kinships have few relatives, are from under-represented founder lineages, and have transmitted few of their alleles to the next generation; these individual should be prioritized for breeding to slow a population’s gene diversity loss.

Percent Known – The percentage of an animal's genome that is traceable to known founders. Thus, if an animal has an UNK sire, its % Known = 50. If it has an UNK grandparent, its % Known = 75.

Percent Certain – The percentage of the living individuals’ pedigree that can be completely identified as *certain:* (exact identity of both parents is known) and traceable back to known founders. Individuals that are 100% *certain* do not have any MULTs or UNKs in their pedigree. *Certainty* represents a higher degree of knowledge than *Known* and therefore is always less than or equal to *Known.*

G. AZA Animal Population Management (APM) Committee Disclaimers

as of June 2019

This Animal Program is currently a Red SSP and recommendations proposed are non-binding – participation is voluntary. Transfers to non-AZA facilities must comply with each facility's acquisition/transfer policy, in accordance with the AZA Policy on Responsible Population Management. APM Committee-approved Sustainability Partners are expected to agree and abide by AZA's Code of Professional Ethics, SSP Full Participation Policy, Policy on Responsible Population Management, and Accreditation Standards related to animal care and welfare.

H. Directory of Institutional Representatives

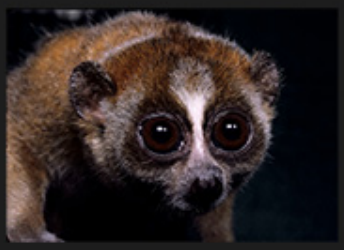
Contact Name (IR)	Institution	Email
Lauren McKenna	AKRON – Akron Zoological Park	l.mckenna@akronzoo.org
Nancee Hutchinson	BLOOMINGT – Miller Park Zoo	nhutchinson@cityblm.org
Joan Daniels Tantillo	CHICAGOBR – Chicago Zoological Society - Brookfield Zoo	joan.daniels-tantillo@czs.org
Dan Boehm	CHICAGOLP – Lincoln Park Zoo	dboehm@lpzoo.org
Jon Kiefer	CINCINNAT – Cincinnati Zoo & Botanical Garden	Jonathan.Kiefer@cincinnatizoo.org
Elena Less	CLEVELAND – Cleveland Metroparks Zoo	eah@clevelandmetroparks.com
Rebecca Westover	DRAPER – The Loveland Living Planet Aquarium	Rebecca.w@thelivingplanet.com
Bethany Wright	DULUTH – Lake Superior Zoo	Bwright@lszoo.org
Mary Alvarez	EL PASO – El Paso Zoo	alvarezmr@elpasotexas.gov
Leigh Ramon	EVANSVLLE – Mesker Park Zoo & Botanic Garden	lramon@meskerparkzoo.com
Joe Knobbe	GARDENCTY – Lee Richardson Zoo	joe.knobbe@gardencityks.us
Robbie Elsner	LITTLEROC – Little Rock Zoo	relsner@littlerock.gov
Lauren Caskey	MEMPHIS - Memphis Zoo	lcaskey@memphiszoo.org
Paula Kolvig	MOODY – Rainforest & Aquarium at Moody Gardens, Inc.	pkolvig@moodygardens.org
Jessica Moody	NY BRONX – Bronx Zoo	jmoody@wcs.org
Kenton Kerns	NZP-WASH – Smithsonian National Zoological Park	kernsk@si.edu
Christie Eddie	OMAHA – Omaha's Henry Doorly Zoo & Aquarium	christiee@omahazoo.com
Michael Stern	PHILADELP – Philadelphia Zoo	stern.michael@phillyzoo.org
Nichole Shelmidine	PROSPECTP – Prospect Park Zoo	nshelmidine@wcs.org
Ashley Bowen	PUEBLO – Pueblo Zoo	abowen@pueblozoo.org

Little Fireface Project
Saving the slow loris via ecology, education, empowerment

Captive Loris Diet Fact Sheet

Behaviour in Captivity

These species all require complex climbing structures with vertical, horizontal and diagonal angles within their enclosures. Reversed lighting enclosures can work well if the light used is red and NOT blue as our research has shown that blue light impacts circadian rhythms, increases stress, and reduces fertility. The pygmy slow loris and greater slow loris naturally seek shelter between bamboo strands and would benefit from dense strands of bamboo in lieu of a sleeping box. Meanwhile the Bengal slow loris requires neither but will instead sleep curled in a ball, ideally on a network of branches where it can still feel hidden if necessary.



Pygmy Slow Loris
(Nycticebus pygmaeus)
Daily Diet

- **10 g** Gum Arabic (with mineral supplement)
- **4 g** insects
- **50 ml** diluted lory bird nectar
- **20 g** non-leafy vegetables
- **One** tree branch (with variation in leaves and blossoms)

Bengal Slow Loris
(Nycticebus bengalensis)
Daily Diet

- **15 g** Gum Arabic (with mineral supplement)
- **5 g** insects
- **50 ml** diluted lory bird nectar
- **40 g** non leafy vegetables
- **Two** tree branches (with variation in leaves and blossoms)

Greater slow loris
(Nycticebus coucang)
Daily Diet

- **10 g** Gum Arabic (with mineral supplement)
- **5 g** of insects
- **50 ml** diluted lory bird nectar
- **25 g** non-leafy vegetables
- **One** tree branch (with variation in leaves and blossoms)

Slow lorises eat insects & small animals regularly. Boiled eggs, cooked chicken, and cooked shrimp are good protein sources. Crickets, locusts and other insects should be fed daily. Mealworms, and wax worms can be fed periodically but may cause transient diarrhea.

Slow lorises eat minimal fruit; excessive fruit causes diabetes, obesity and tooth decay. Feed daily more vegetables than cultivated fruits, such as: broccoli, carrot, cucumber, cooked yams, sweetcorn, aubergine, cooked or raw beans.

The most commonly eaten food of slow lorises, gum and nectar can be replicated with commercially available gum crystals and nectar powder, fed in feeders.

Little Fireface Project