

Population Management

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North Carolina Zoo



Population Management Overview

Jodi Neely Wiley
North Carolina Zoo
Hamadryas Baboon
Studbook Keeper
and SSP Coordinator



What is a studbook?

- Studbooks include the pedigree and location history of the population in a database that provides the basis for the detailed genetic and demographic analyses used for management of captive animal populations.
- Studbooks may either be regional (e.g., North American) or international in scope.
- Studbook taxa are selected through the regional collection planning process of AZA's TAGs.



New Studbook Program Designations

Green SSP Studbook Program

- Population is currently sustainable for the long term
- Able to maintain >90% gene diversity for 100 years

Yellow SSP Studbook Program

- Population unable to maintain >90% gene diversity for 100 years

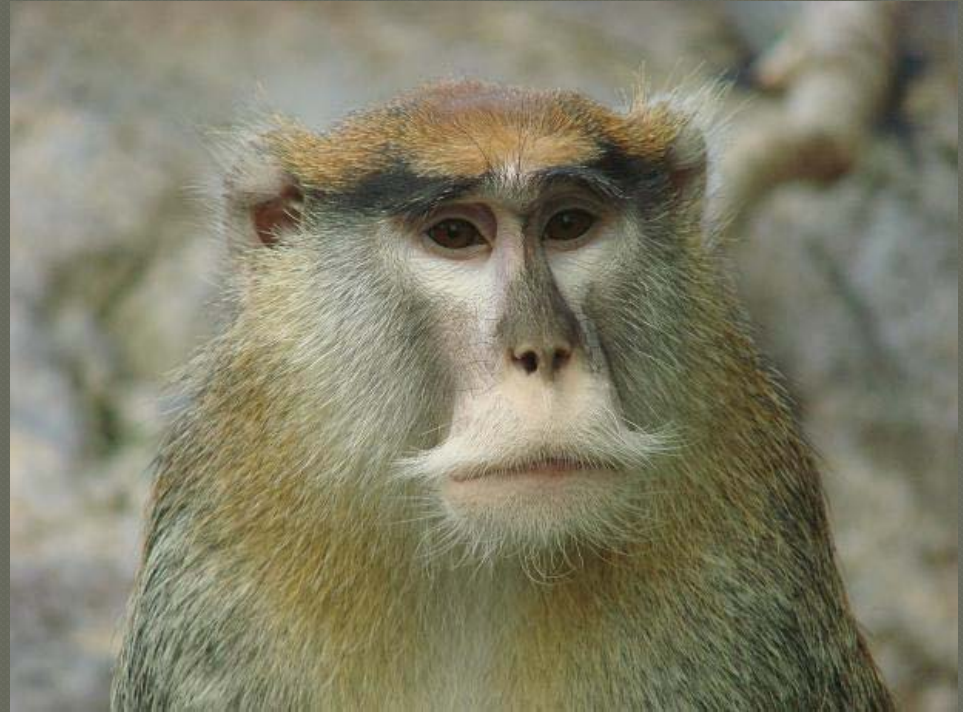
Red SSP Studbook Program

- The population is not currently sustainable
- Fewer than 50 individuals
- Adherence to SSP is voluntary



How do you become a studbook keeper?

- ◉ Studbook Position must be vacant
- ◉ Must be an AZA member
- ◉ Needs to be an “expert” on the specific species



How do you become a studbook keeper?

- ◉ Institutional support
- ◉ Participate in TAG (Taxon Advisory Group) meetings
- ◉ Must take Population Management I course
- ◉ Apply



used for keeping studbooks

Sparks- DOS format

- The 1st program used for studbooks and can be used for international studbooks

The screenshot shows a DOS window titled "SPARKS16.EXE" with a blue background and white text. The main title is "SPARKS Data Edit". The interface is divided into four quadrants by a central vertical line and a horizontal line. The top-left quadrant is titled "Master Record" and contains the following data: Studbook N°: 926, Sex: Male, Birth Date: 21 May 2013, Sire: 782 NEGELLI, and Dam: 797 SUDI. The top-right quadrant is titled "Event Records" and contains: Birth ASHEBORO 1983, 21 May 2013. The bottom-left quadrant is titled "Special Data" and contains: House Name Wiley, 21 May 2013. The bottom-right quadrant is titled "User Defined Fields" and is currently empty. At the bottom of the window, a prompt asks "Print specimen worksheet (Immediately/File)?" with the instruction "<Esc> key to Return".

SPARKS16.EXE

SPARKS Data Edit

Master Record

Studbook N°: 926

Sex: Male

Birth Date: 21 May 2013

Sire: 782 NEGELLI

Dam: 797 SUDI

Captive birth ->

Parent reared

Event Records

Birth ASHEBORO 1983

21 May 2013

Special Data

House Name Wiley

21 May 2013

User Defined Fields

Print specimen worksheet (Immediately/File)?

<Esc> key to Return

used for keeping studbooks

PopLink- the newer program

- More user friendly

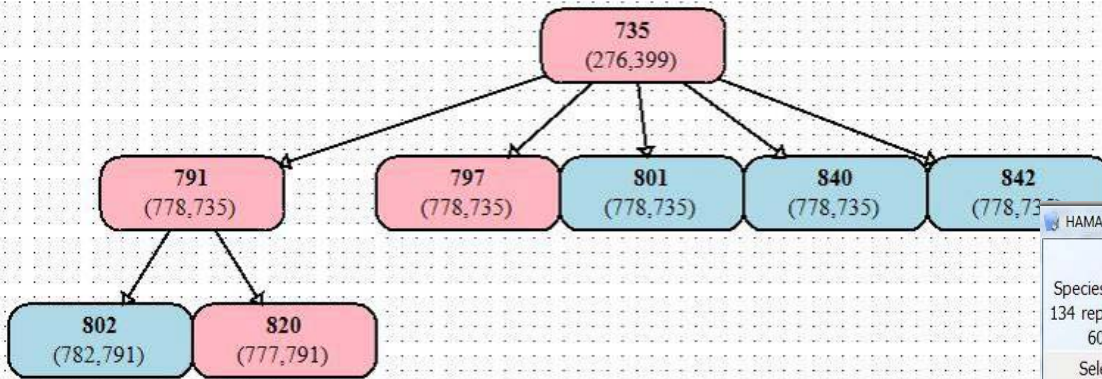
The screenshot displays the PopLink software interface. At the top, there is a menu bar with options: File, Edit, View, Overlay, Validate, Reports, Export, Help. Below the menu bar is a toolbar with icons for home, search, edit, print, and star. The main window shows a filter bar with 'Select Filters' and 'As of 7/13/2013 AND Status = Living'. Below the filter bar, there are statistics: 'Totals: 30.47.2 (79) at 9 Institutions', 'Currentness Date: 3/19/2013', and 'No Sort Order Applied'. The main data area is a table with columns: Studbook ID, Edit, Current Sex, Current Location, Current Local ID, Sire, Dam, Birth Date, Birth Date Est., Current Age, Current Age Est., Current Status, and Current Reproduct. The table contains 20 rows of data, each representing a studbook entry.

Studbook ID	Edit	Current Sex	Current Location	Current Local ID	Sire	Dam	Birth Date	Birth Date Est.	Current Age	Current Age Est.	Current Status	Current Reproduct
379	...	Female	PROSPECTP	938024	159	117	2/14/1976	None	37.41	None	Living	Not Contract
494	...	Female	OAKLAND	113	356	315	8/30/1980	None	32.868	None	Living	Not Contract
539	...	Female	COLUMBIA	SJ1367	276	MULT2	4/5/1982	None	31.272	None	Living	Not Contract
561	...	Female	PHOENIX	5772	374	199	2/11/1983	None	30.418	None	Living	Neutered/St
614	...	Female	ASHEBORO	833	482	494	10/3/1984	None	28.775	None	Living	Neutered/St
646	...	Female	PHOENIX	5773	116	424	10/14/1985	None	27.745	None	Living	Neutered/St
662	...	Female	SEDGWICK	9291	UNK	376	6/23/1986	None	27.055	None	Living	Not Contract
664	...	Female	PHOENIX	11085	79	428	7/18/1986	None	26.987	None	Living	Not Contract
665	...	Female	SEDGWICK	9288	UNK	316	7/27/1986	None	26.962	None	Living	Not Contract
690	...	Female	OAKLAND	574	482	494	6/3/1987	None	26.111	None	Living	Not Contract
707	...	Female	ASHEBORO	955	276	399	5/9/1988	None	25.177	None	Living	Neutered/St
732	...	Female	OAKLAND	691	611	494	1/16/1990	None	23.488	None	Living	Not Contract
735	...	Female	ASHEBORO	1088	276	399	2/10/1990	None	23.42	None	Living	Not Contract
737	...	Male	OAKLAND	750	611	576	2/28/1990	None	23.37	None	Living	Neutered/St
740	...	Female	PHOENIX	5879	598	424	5/14/1990	None	23.165	None	Living	Neutered/St
745	...	Female	SEDGWICK	9290	631	662	8/11/1990	None	22.921	None	Living	Not Contract
747	...	Male	COLUMBIA	11048	185	460	10/26/1990	None	22.713	None	Living	Not Contract
750	...	Female	ASHEBORO	1144	276	399	12/30/1990	None	22.535	None	Living	Neutered/St
755	...	Female	SEDGWICK	10282	631	665	10/12/1991	None	21.752	None	Living	Not Contract

Reports Generated from PopLink

Descendants For:

Select Highlight No Highlights Selected



HAMADRYAS - Reproductive Report

REPRODUCTIVE REPORT

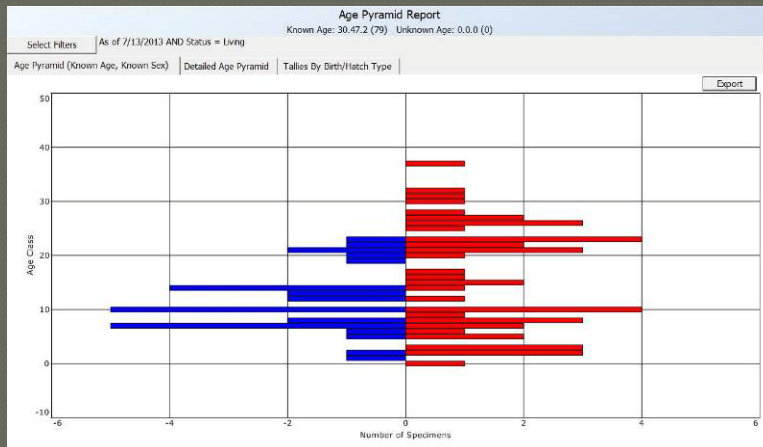
Species Type: Live Bearing Gestation Period: 2 Days Maximum Birth Date Range For Litter
134 reported dams, with 230.240.35 (505) offspring (not including 271 offspring of UNK/MU
60 reported sires, with 248.230.35 (513) offspring (All ages are at dam conception)

Select Filters Filters applied to parents: No Filters Applied

Sire Age At All Estimated Conceptions | Number Of Offspring Per Sire |
Dam Age At First Birth | Dam Age At All Births | Number Of Offspring Per Dam |
Interbirth Intervals | Birth Seasonality | Sire Age At First Estimated Conception | Litter Size |

Median age: 6.615 Mean age: 7.814

Studbook ID	Age At Estimated Conception	Sire's Birth Date	Estimate	First Offspring's ID
228	4.014	5/9/1970	None	325
778	4.205	8/1/1998	None	789
482	4.408	4/12/1980	None	611
249	4.476	6/26/1971	None	373
418	4.537	9/25/1977	None	540
505	4.602	11/25/1980	None	637
185	4.613	11/4/1968	Day	293
278	4.726	1/1/1973	Year	418
487	4.734	5/25/1980	None	628
362	4.772	7/3/1975	None	482
356	5.092	4/10/1975	None	485
162	5.254	4/20/1967	None	265
87	5.273	1/1/1962	Year	161
611	5.344	9/10/1984	None	732



Publish Studbook

- Studbooks must be published every 3 years

**North American Regional
Hamadryas Baboon Studbook**
(*Papio hamadryas*)



4th edition
Studbook data current through May 2009

Jodi Neely Wiley
North Carolina Zoological Park
Asheboro, NC 27205
(336) 879-7672
<jodi.wiley@nczoo.org>




**ASSOCIATION
OF ZOOS &
AQUARIUMS**

Preparing for Master Planning Session

Create/Update Studbook

- Information gathered from Taxon reports and specimen reports
 - Registrars
 - Institutional Representatives
 - Isis

Report Start Date Jun 12, 2013		Taxon Report <i>Papio hamadryas</i>				Report End Date Jun 12, 2013			
MIG12-28386560 Local ID: 33638									
Individual		Hamadryas baboon				Least Concern (LC)		Papio hamadryas	
<u>Date in</u>	<u>Acquisition - Vendor/Local Id</u>	<u>Phy</u>	<u>Own</u>	<u>Reported By</u>	<u>Disposition - Recipient/Local Id</u>	<u>Phy</u>	<u>Own</u>	<u>Date out</u>	
Jul 01, 1981	Birth/Hatch	In	In	FRANKFURT / 33638	-	-	-	-	
<u>Sex/Contraception</u>	Female / Medical method- hormonal(Active)			<u>Birth Type</u>	Captive Born				
<u>Hybrid Status</u>	Not a hybrid			<u>Birth Location</u>	Zoologischer Garten Frankfurt				
<u>Enclosure</u>	A11			<u>Birth Date/Age</u>	Jul 01, 1981 / 31Y,11M,11D				
<u>Rearing</u>	Parent			<u>Local ID</u>	[33638/FRANKFURT]				
<u>Dam</u>	[UNK / FRANKFURT]			<u>Tattoo</u>	[F 15/FRANKFURT]				
<u>Sire</u>	[UNK / FRANKFURT]			<u>Transponder</u>	[00-0126-BC9C/FRANKFURT]				
MIG12-28386562 Local ID: 34254									
Individual		Hamadryas baboon				Least Concern (LC)		Papio hamadryas	
<u>Date in</u>	<u>Acquisition - Vendor/Local Id</u>	<u>Phy</u>	<u>Own</u>	<u>Reported By</u>	<u>Disposition - Recipient/Local Id</u>	<u>Phy</u>	<u>Own</u>	<u>Date out</u>	
Dec 06, 1991	Birth/Hatch	In	In	FRANKFURT / 34254	-	-	-	-	
<u>Sex/Contraception</u>	Female / Medical method- hormonal(Active)			<u>Birth Type</u>	Captive Born				
<u>Hybrid Status</u>	Not a hybrid			<u>Birth Location</u>	Zoologischer Garten Frankfurt				
<u>Enclosure</u>	A11			<u>Birth Date/Age</u>	Dec 06, 1991 / 21Y,6M,6D				
<u>Rearing</u>	Parent			<u>Local ID</u>	[34254/FRANKFURT]				
<u>Dam</u>	[UNK / FRANKFURT]			<u>Tattoo</u>	[2/FRANKFURT] [F 35/FRANKFURT]				
<u>Sire</u>	[UNK / FRANKFURT]			<u>Transponder</u>	[00-01D3-2D4E/FRANKFURT]				
MIG12-28386563 Local ID: 35956									

Surveys

- Send out surveys to holding institutions annually
- Ask for specimen reports
- Any special concerns or requests?

Hamadryas Baboon Questionnaire

November 2009

Institution Name _____

Institutional Representative for:

Hamadryas Baboon _____

Phone Number _____

E-mail Address _____

Fax Number _____

Number of animals currently housed at your location: _____

Please list Studbook ID Numbers of individuals housed at your facility|

We are currently housing (non-breeding) _____

We are currently breeding _____ Hamadryas Baboons.

We would like to place _____ Hamadryas Baboons. Please give ID number of individuals

We would like to acquire _____ Hamadryas Baboons.

Would you like to participate in the breeding of this species? _____

Would you be willing to hold single-sex groups? _____

Maximum number of Hamadryas Baboons that you can house _____

Any special concerns or considerations?

Return completed form by 15 November 2009:

Jodi Neely Wiley · North Carolina Zoo · 4401 Zoo Parkway · Asheboro, North Carolina 27205

or

jodi.wiley@nczoo.org

Master Planning for the Species

- Typically try to Master plan every 2-3 years
- Meet with PMC (Population Management Center)
- Run data base to determine best possible pairings to keep genetic diversity in the species.

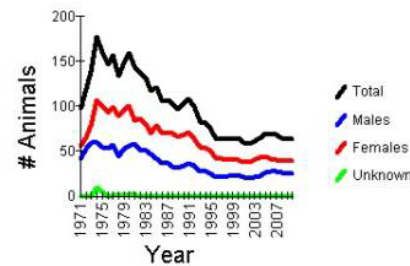


Figure 1. Census of hamadryas baboons in North America.

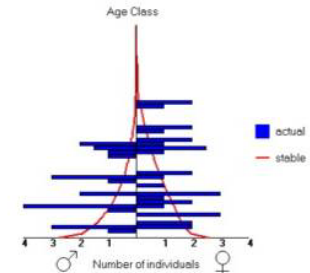
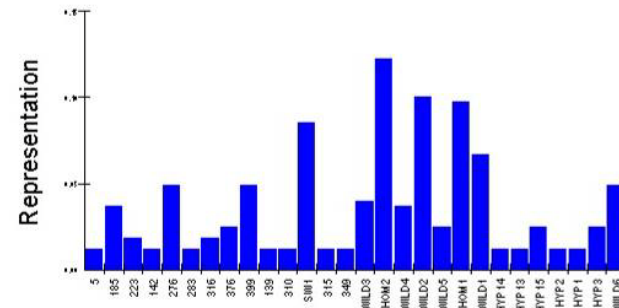


Figure 2. Age structure of hamadryas baboons in SSP genetically managed population.

Both males and females reach sexual maturity by the age of four years and most have not been observed to reproduce beyond their mid-20s (with the exception of two females that bred regularly past 40). Hamadryas can live in captivity to be more than 30 years old. Infant mortality is 35% and 33% for males and females respectively in the first year of life, with 26.5% mortality in the first 30 days.

Genetics: The managed population is descended from 28 founders and 0 additional potential founders remain (Figure 3). Twenty three animals were removed from the analytical population at the time the genetic analyses were conducted.

Founder Representation



Master Planning for the Species

Recommendations made for:

- Breeding
- Transfers
- Companionship

PROSPECTP

Prospect Park Wildlife Center, 450 Flatbush Ave., Brooklyn, NY USA 11225
 Contact: Terry Webb, Phone: (718) 399-7313 Fax: (718)399-7337, e-mail: twebb@wcs.org

ID	Local ID	Sex	Age	Additional Info	Disposition	Location	Breeding	With	Notes
379	938024	F	37	Kobo	HOLD	PROSPECTP	DO NOT BREED		
757	938065	M	21	Simen	HOLD	PROSPECTP	DO NOT BREED		
763	938066	M	20	Bole	HOLD	PROSPECTP	BREED	812, 813	
775	978015	F	17	Matara	HOLD	PROSPECTP	DO NOT BREED		Sterile, Hybrid
793	P04001	F	9	Binti	HOLD	PROSPECTP	DO NOT BREED		Sterile, Dam is a Hybrid
812	P09023	F	10	Kaia	HOLD	PROSPECTP	BREED	763	
813	P09024	F	9	Rebecca RB	HOLD	PROSPECTP	BREED	763	
818	P10039	M	2		SEND TO	MELBOURNE	DO NOT BREED		
819	P10040	M	2		SEND TO	MELBOURNE	DO NOT BREED		

Summary:

Before transfers: 4 males, 5 females
 After transfers: 2 males, 5 females

PUEBLA

Africam Safari, 11 Oriente 2407, Col. Azcárate , 72007 Puebla, Puebla Mexico
 Contact : Frank Carlos Camacho, PH: (+52-222) 281 70 00 ext 240, FX: (+52-222) 281 70 00 ext 257, Email: fcamacho@africansafari.com.mx, cholguin@africansafari.com.mx

ID	Local ID	Sex	Age	Additional Info	Disposition	Location	Breeding	With	Notes
821	1638	F	23	AFR 01	HOLD	PUEBLA	DO NOT BREED		
822	1646	M	19	24	HOLD	PUEBLA	BREED	825	
824	3416	m	14	29	HOLD	PUEBLA	DO NOT BREED		Excluded from analyses
825	3853	F	12	35	HOLD	PUEBLA	BREED	822	
826	4278	F	14	30	HOLD	PUEBLA	BREED	828	
827	4279	m	12	32	HOLD	PUEBLA	DO NOT BREED		Excluded

Keepers as Population Managers

- Good Communicator
- Must be an “expert” on the species you manage and able to answer questions from other institutions on husbandry, introduction methods, behavioral issues, etc.
- Can be time consuming and may have to use personal time (on average ~5 hours per week answering emails, phone conferences, updating studbook, etc)

Population Managers working with Keepers

- ◉ Keepers are experts on their specific animals and are a great resource
 - Husbandry
 - Behavior
 - Conservation



A Crash Course in Masterplanning

Presented by: Randy Fulk- Education Curator NC Zoo

Material Provided by:

The Population
Management Center
&
North Carolina Zoo



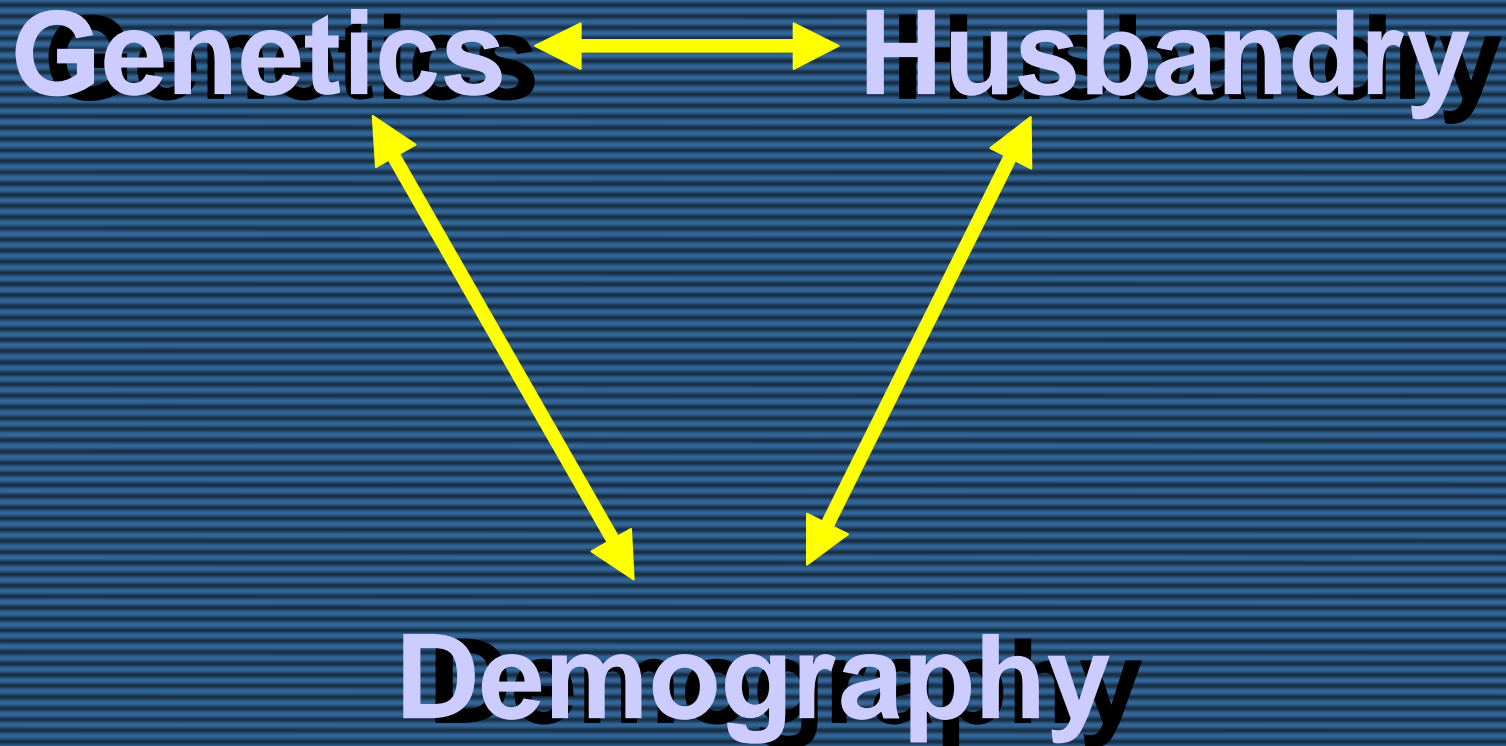
Small Populations

Vulnerable to Stochastic Events

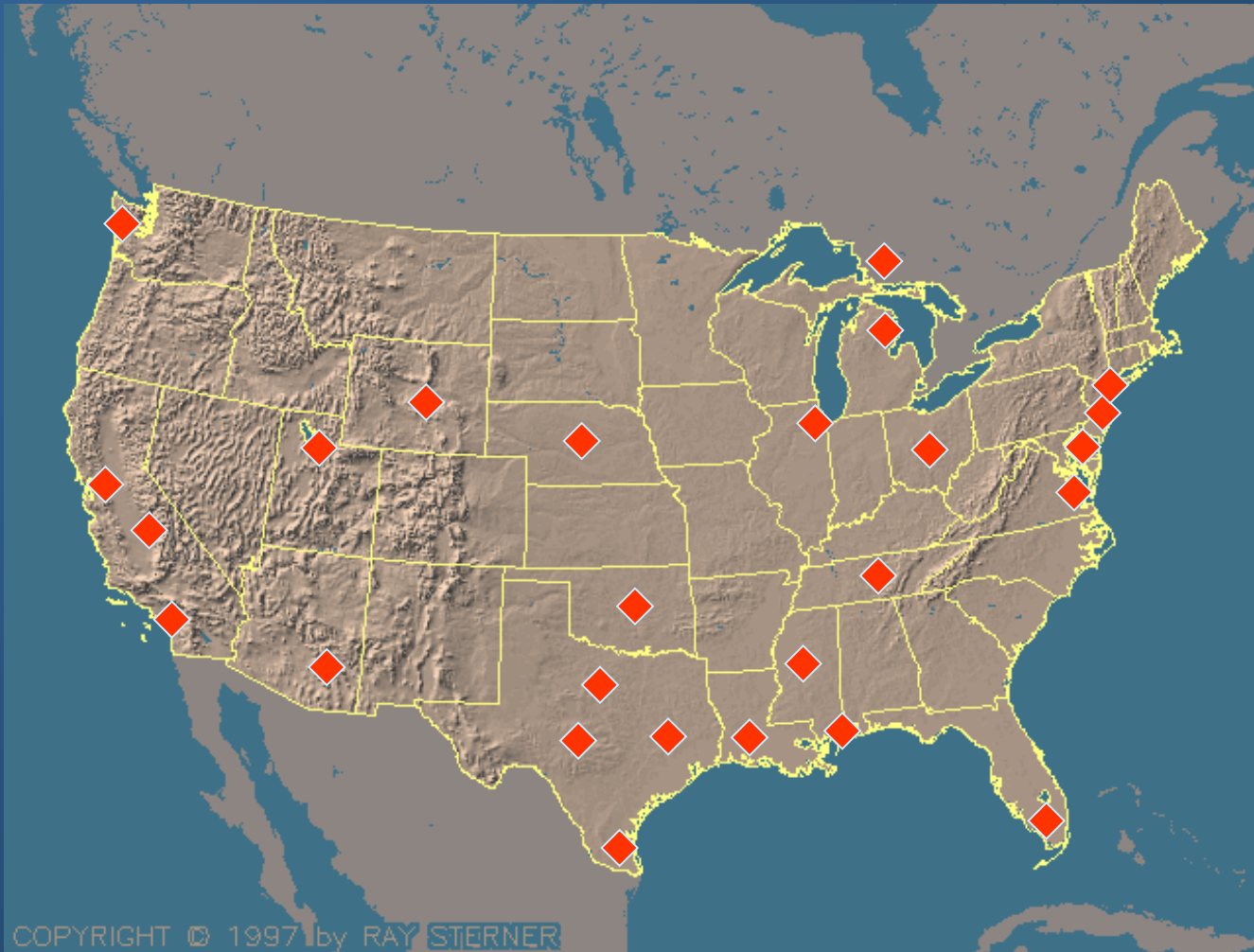
Demographically Unstable

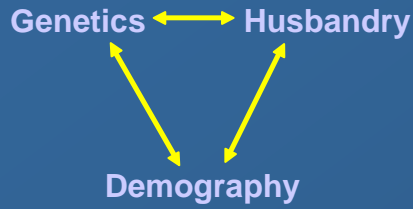
Loss of Genetic Diversity

MASTERPLAN



Potential mates can be few and far between





Genetics

Population Genetics – study of genetic traits in a population and how the frequencies of traits change from one generation to the next.



Genetics

Genetic Diversity

keep as much genetic variety as possible
by managing mean kinship and inbreeding

$$GD = 1 - \sum (p_i^2)$$

Mean Kinship

= average relatedness to everyone else in the population
⇒ breed animals with lowest mean kinships

$$mk_i = \sum_{j=1}^N f_{ij} / N$$

Inbreeding

avoid breeding close relatives

$$F = 1 - \sum (1/2)^{n-1}$$

Gene Diversity

Our goal is to keep gene diversity at or above 90%

the average mammal SSP has 93% GD

(in other words, the captive population has 93% of the genetic variation of the wild population from which they came)

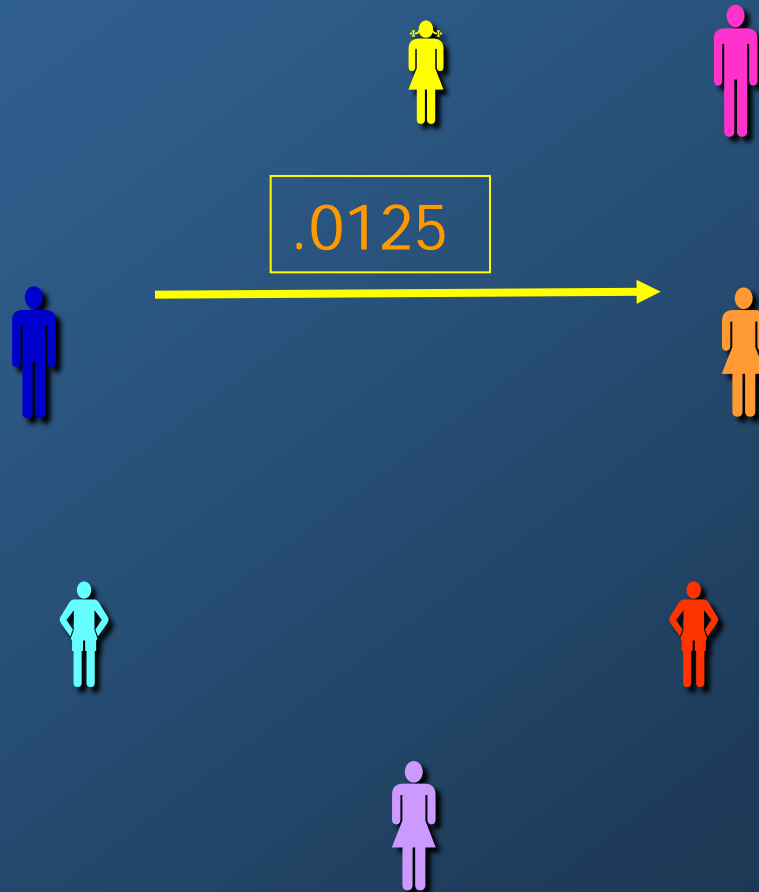
Gene diversity is lost from one generation to the next

An individual cannot pass on all of its traits to its offspring;
some traits will be lost

Our job is to slow this loss...

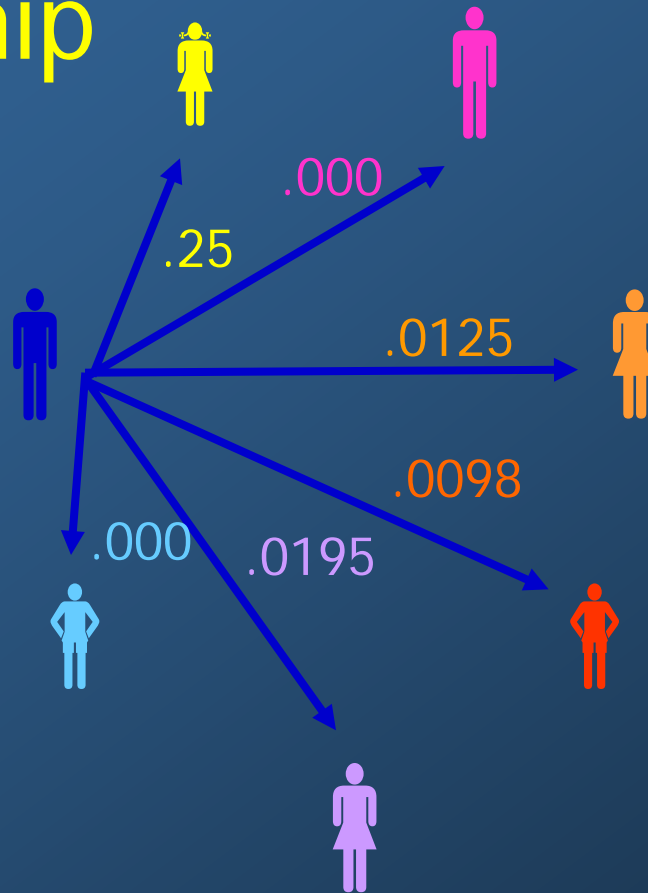
GENETICS 101

Kinship



GENETICS 101

Mean Kinship



$$\text{Mean kinship} = \frac{.000 + .0195 + .0098 + .0125 + .000 + .25}{6} = .049$$

GENETICS 101

Descendant Mean Kinship

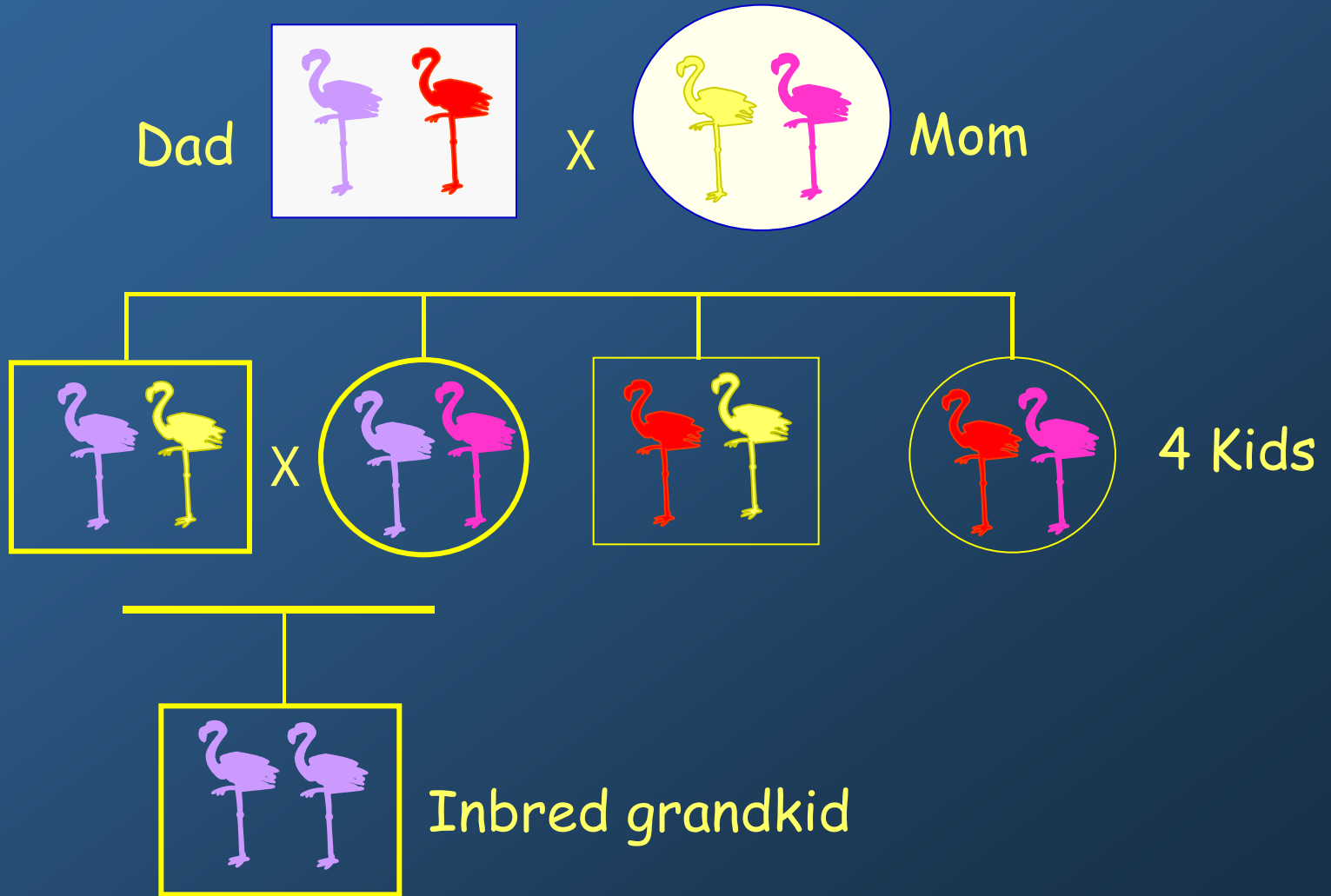


GENETICS 101

How do we use Mean Kinship?

We choose individuals with low mean kinships to make the most desirable breeding pairs.

Inbreeding Reduces Diversity



GENETICS 101

Inbreeding can be *Depressing*

Juvenile survival

Adult survival

Mate acquisition

Social dominance

Fertility and Fecundity

Growth

USHER'S  SYNDROME

BAADD!!!

hydrocephaly

albinism

Wilson's Disease

PKU

hemophilia



microcephaly

polydactaly

Basic Truths About Genetics

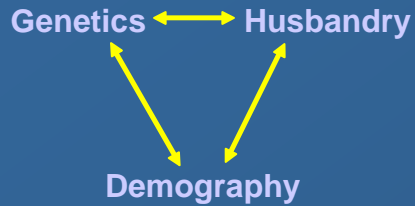
Genetically diverse populations survive longer

Small populations always lose genetic diversity
(GD) over generations

Rare alleles are lost first

Shorter generation times lead to more rapid loss
of GD

Unequal family sizes reduce GD



Demography

The study of population statistics
– births and deaths and
everything in
between.

Demography

Numbers, numbers, numbers...

number of animals

number of males

number of females

number of young animals

number of old animals

number of reproducing animals

number of non-reproducing animals

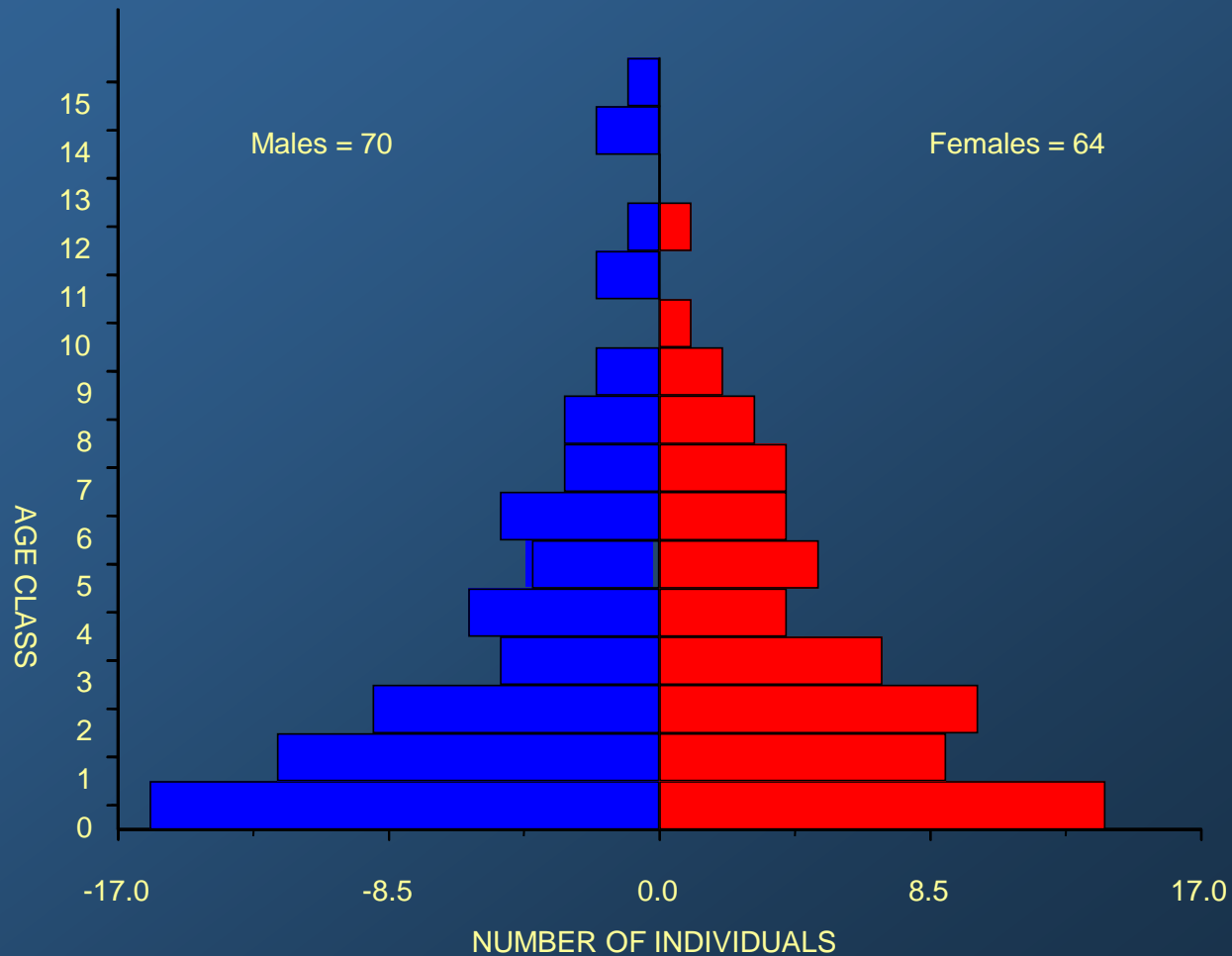
number of births

number of

deaths

DEMOGRAPHY 101

Age Distribution



Life Tables

Demographic Analysis for CALLITHRIX GEOFFROYI

- Male Life Table
- Female Life Table
- Age Distribution
- Male Projections
- Female Projections
- Total Projections
- Reproductive Planning
- Other Info.

Males: Actual Data

Life Table:

Age (x)	Px	lx	Mx	Ri
0	0.61	1.00	0.00	
1	0.91	0.61	0.00	
2	0.91	0.56	0.20	
3	0.93	0.51	0.35	
4	0.90	0.47	0.52	
5	0.88	0.42	0.67	
6	0.87	0.37	0.63	
7	0.84	0.32	0.35	
8	0.91	0.27	0.36	
9	0.78	0.25	0.54	
10	0.60	0.19	0.52	
11	1.00	0.12	0.35	
12	1.00	0.12	1.26	
13	1.00	0.12	0.00	
14	1.00	0.12	0.00	
15	1.00	0.12	0.00	
16	0.00	0.12	0.00	
17	0.00	0.00	0.00	

Estimates:

$r = 0.0769$

$\lambda = 1.0799$

$T = 5.90$

$N = 43.00$

$N_{20\text{ yrs}} = 200.12$

Males: Model Data

Life Table:

Age (x)	Px	lx	Mx
0	0.61	1.00	0.00
1	0.91	0.61	0.00
2	0.91	0.56	0.20
3	0.93	0.51	0.35
4	0.90	0.47	0.52
5	0.88	0.42	0.67
6	0.87	0.37	0.63
7	0.84	0.32	0.35
8	0.91	0.27	0.36
9	0.78	0.25	0.54
10	0.60	0.19	0.52
11	1.00	0.12	0.35
12	1.00	0.12	1.26
13	1.00	0.12	0.00
14	1.00	0.12	0.00
15	1.00	0.12	0.00
16	0.00	0.12	0.00

Estimates:

$r = 0.0769$

$\lambda = 1.0799$

$T = 5.90$

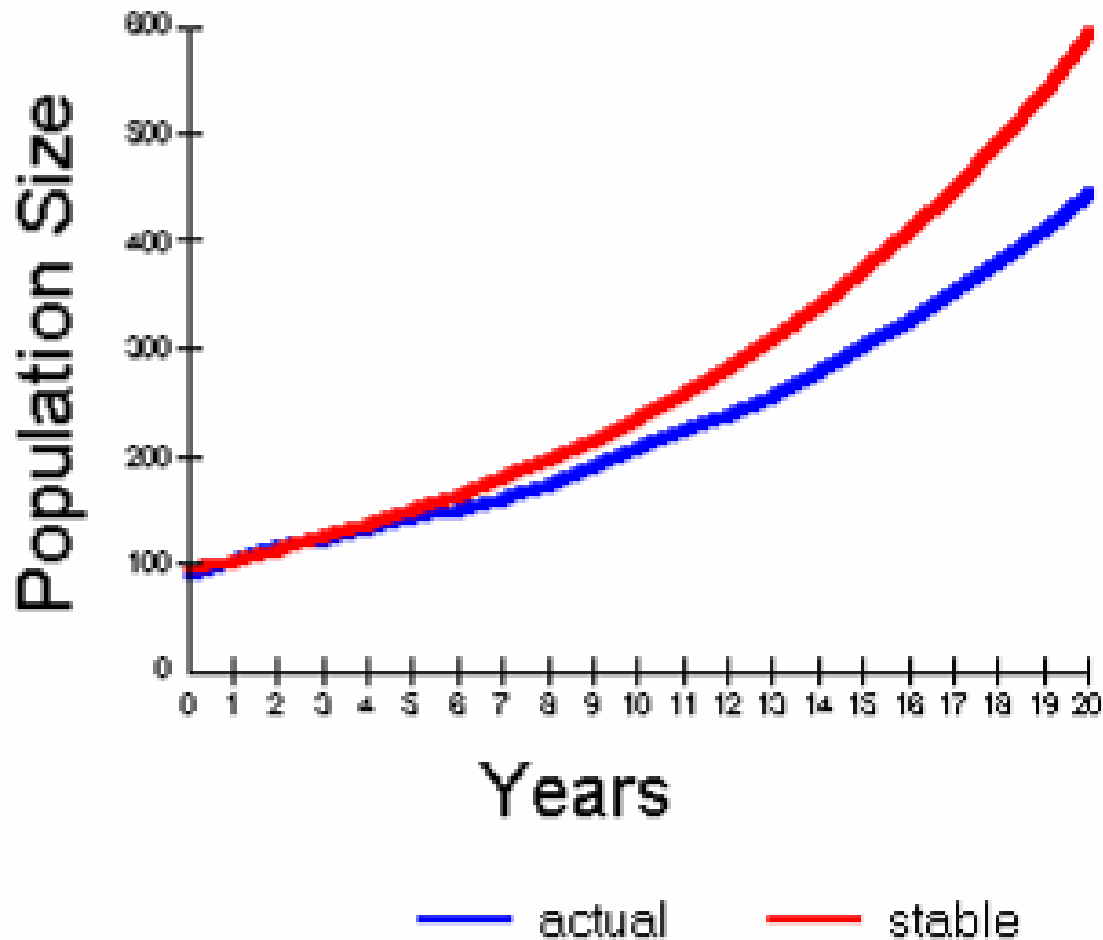
$N = 43.00$

$N_{20\text{ yrs}} = 200.12$

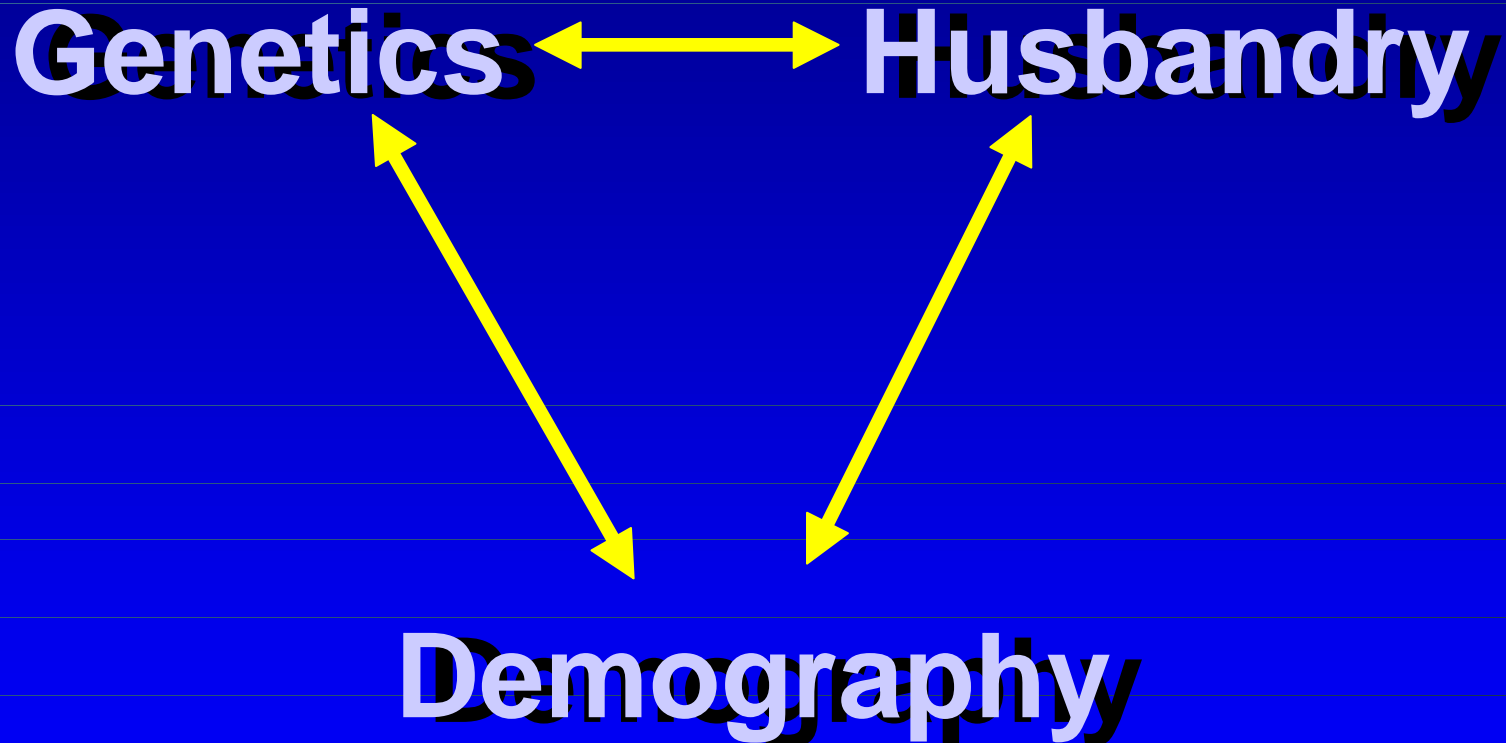
These data have been smoothed 0x
[Click here](#) to smooth the data once more

DEMOGRAPHY 103

Population Growth Projections



MASTERPLAN



Basic Strategies

Start with sufficient numbers of founders

Expand the population as quickly as possible to its carrying capacity

Stabilize the population at its carrying capacity

Basic Strategies

Equalize family sizes/founder representation

Extend generation time as much as possible

Subdivide the population

Use available repro technology to best
advantage

SSP Central Dogma

1st Priority:

Breed individuals with lowest MK

Most underrepresented

Possess the rarest alleles

SSP Central Dogma

2nd Priority

Breed individuals whose alleles may be lost soon

Age

Health

Reproductive Condition

You need to...

Receive clean studbook from RSDMC

Export data and create PM2000 project

Review demographic information

Plan the number of pairs

Select the animals in the breeding population

Review genetic results

Make your breeding pairs

Write a draft and distribute for comment

Incorporate comments into final report

Copy, collate, bind, stuff envelopes, mail, and
post on the internet

Repeat next year!