Reproductive Management of Zoo Animals

Nancy Hawkes, PhD – General Curator

It's not always like it is in the movies …

Ex situ Propagation

- Absence of natural ranging, predators, resource fluctuations, seasonal changes
- Fragmentation of natural populations is similar to effect in managing zoo populations
- Led by our knowledge of domestics -- but goal is to *maximize* genetic diversity

Why Breed?

- Insurance policy for wild populations
- Ambassadors for education and fund-raising
- Minimize importations
- Stock for reintroductions

American Zoo & Aquarium Association

- 215 accredited institutions
- 106 Species Survival Programs

- Reproductive Assessment
- Natural Breeding
- Assisted Reproduction
- Handrearing
- Contraception
- Reintroduction

Species “rescued” by zoos:

- Arabian oryx
- Black-footed ferret
- California condor
- European bison
- Guam rail
- Pere David’s deer
- Red wolf

Golden lion tamarin

Reintroduction

Golden Lion Tamarin Reintroduction

- **one of first SSP species (445 animals @ 150 zoos)**
- **500 left in patches of Mata Atlantica**
- **42 founders/gene diversity 96.2%**
- **“pipeline zoos” serve as training camps**
- **first reintroduction in 1984**
- **reintroduction has added 359 animals**
- **95% of reintroduced population wild-born**
- **no reintroductions needed in 2002**

California Condor

©ZSSD

- Andean condor used as model
- Artificial incubation and rearing protocols

Black-footed Ferret

- NA most endangered mammal
- last 18 rescued in 1987
- natural breeding and laparoscopic intrauterine AI to increase population, overcome aggression
- 1991 - first reintroduction
- 2600 produced in captivity

How do they do it?

SOCIAL ORGANIZATION

- solitary
- family groups
- female kin groups
- single male groups
- multimale groups
- parental care
- communal care

MATING STRATEGY

- monogamy
- polygyny
- polyandry
- promiscuity

When do they do it?

ENVIRONMENTAL CUES

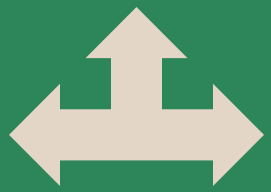
- seasonality/photoperiod
- temperature/humidity
- substrate/nesting resources
- food resources
- population size
- stress

INTERNAL PROCESSES

- puberty
- ovulatory cycle
- ovulatory process
- gestation/parturition

CONSERVATION BREEDING PROGRAM

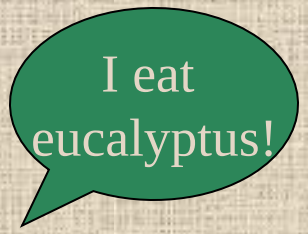
Animal Management



Assisted Reproduction Technology

- physical facilities/spatial configuration
- environmental parameters
- husbandry program
- record-keeping
- genetic context
- social context
- enrichment
- training
- diet

Nutrition



Genetics

All rhinos endangered

N/S White different subspecies

E/S Black not different subspecies

Sumatran/Bornean managed as one until 1982

karyotyping of subspecies confirmed by fieldwork

now moratorium on breeding hybrids

Sexing

Physical Environment

Golden-breasted Starling

Tree Kangaroo

Courtesy, WPZ

Cotton-top Tamarin

Social Environment

Flamingo Flock Size

Flock Size	N	% Display	% Nest Building	% Egg Laying	% Eggs Hatched	% Chicks Reared
1-5	8	50	25	25	25	13
6-10	10	40	40	20	20	20
11-20	13	69	69	38	38	38
21-40	8	100	100	75	75	75
40+	5	100	100	100	100	100

From Pickering et al., 1992

Breeding Success ≅ Group Size

AZA Rhinoceros Husbandry Resource Manual 1996

Editors • Michael Fouraker & Tarren Wagener • Fort Worth Zoological Park
Assistant Editor • Holly Emery • Fort Worth Zoological Park

Rhino species	Recommended minimum groupings for breeding[a]	Preferred optimal holding for a breeding institution
Black	1.1	2.2 (2 pairs)
White	1.2	2.4 (1 herd/ 1 back-up male)

Cheetah

Reproductive Technology

Tools

- Husbandry Training/Operant Conditioning
- Endocrinology
- Ultrasonography
- Endoscopy/Laparoscopy
- Gamete Collection & Analysis
- Gamete Cryopreservation
- Artificial Insemination
- In vitro Maturation & Fertilization

Exploring methods of estrus detection in sun bears (*Helarctos malayanus*)

Cheryl Frederick

GOALS

Adapt Giant Panda protocol to:

- Establish methods to study the reproductive biology of sun bears
- Characterize physiological and behavioral estrus (ovulation & sexual receptivity)
- Develop an assisted reproduction program for sun bears

Get Creative!

How do we collect gametes?

- manual semen collection
- conditioned masturbation
- electroejaculation
- laparoscopy
- uterine flushing
- at necropsy

Manual Collection

Training for Gametes

Conditioned Masturbation

Opportunistic Electroejaculation

Necropsy

Ultrasound-guided Laparoscopy

What do we do with gametes?

- Research/technique development
- Cryopreservation
- Artificial insemination
- *In vitro* maturation
- *In vitro* fertilization
- Embryo transfer/gamete intra-fallopian transfer (GIFT)
- Intra-cytoplasmic sperm injection (ICSI)
- Sex sorting

Cryopreservation

First Bengal tiger cubs by embryo transfer

Donoghue et al., 1990

Bongo calf from embryo transfer to eland

Dresser et al., 1984

Sex Selection

A word about training …

Training for Reproductive Assessments and ART

Maternal Care Training

Elephant ART

- husbandry training
- endocrinology
- ultrasonography
- endoscopy
- semen collection
- artificial insemination

Do the Math

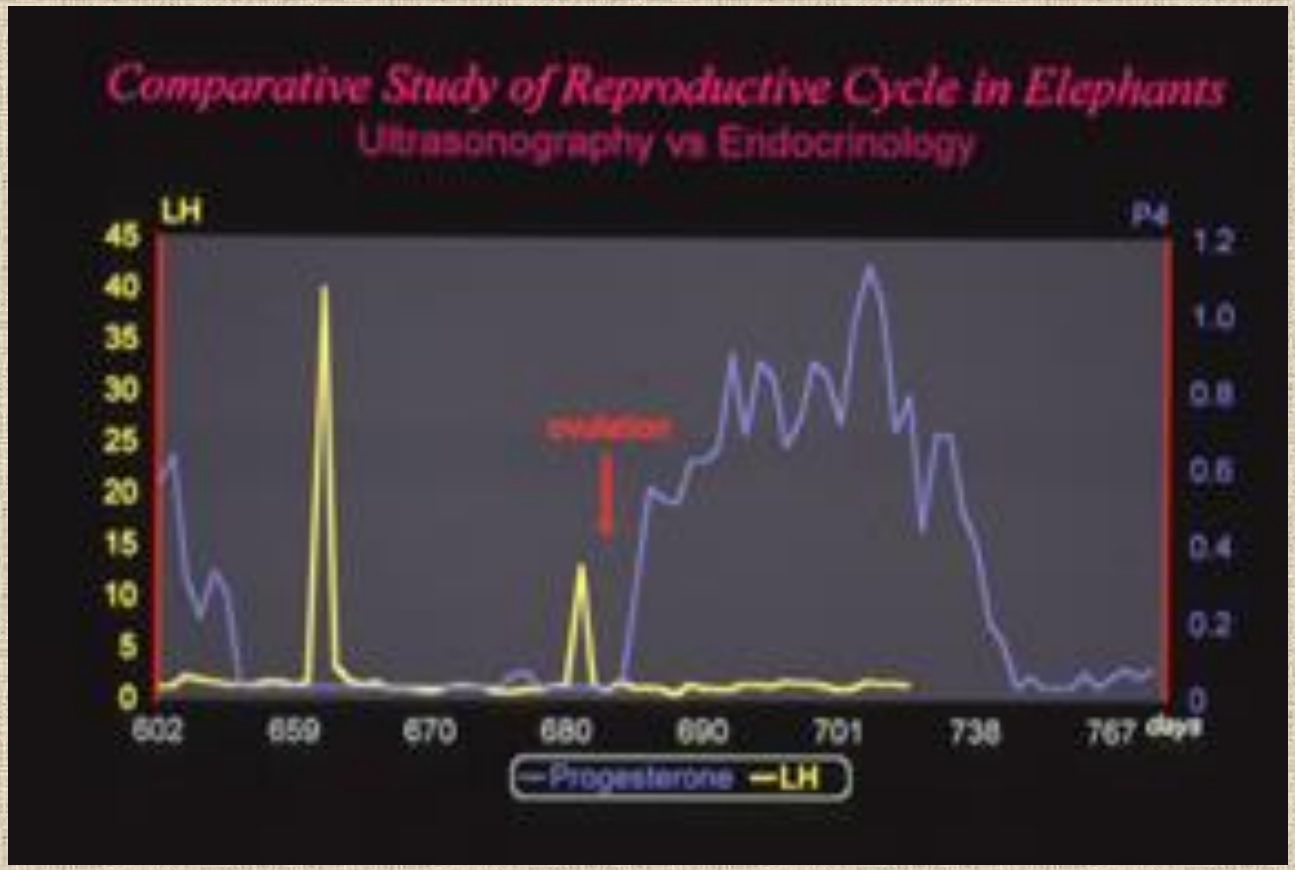
- Elephant SSP recommends an inter-birth interval of 4 years
- Hansa (Chai's first baby) is over 6 years old
- Gestation is 22 months

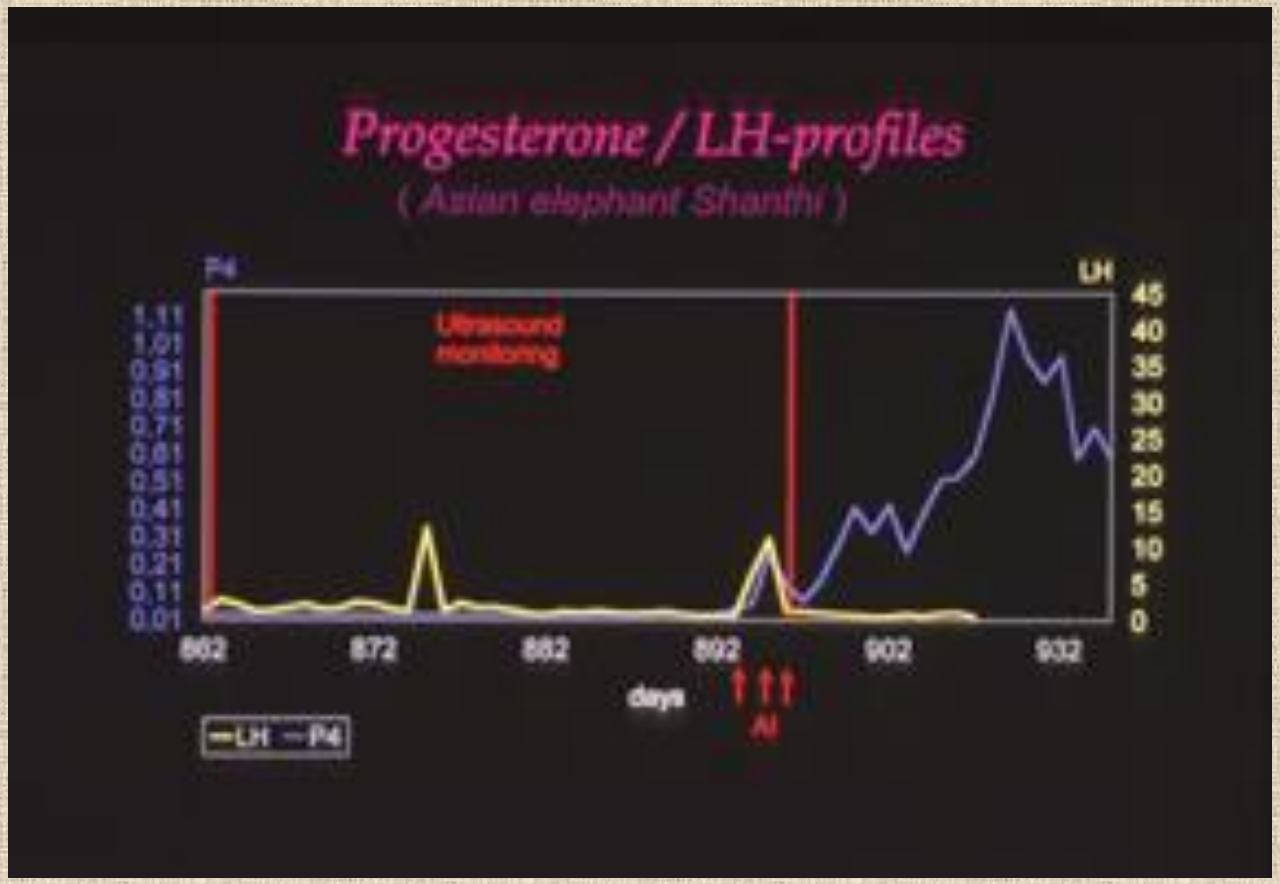
Plus, they only ovulate 3 times a year!

NZP: Kandula 2001

Thomas Hildebrandt & Frank Goeritz
Berlin Institute for Zoo Biology & Wildlife Research

Elephant Estrous Cycle




Progesterone / LH-profiles
(Asian elephant Shanthi)
P4
LH
Ultrasound monitoring
1.11
1.01
0.91
0.81
0.71
0.61
0.51
0.41
0.31
0.21
0.11
0.01
45
40
35
30
25
20
15
10
5
0
862
872
882
892
902
932
days
AI
LH
P4

Onyx

Balloon Catheter

Endoscope

Insemination Catheter

Endoscopic image

Ultrasonographic image