PRESENTATIONS
SESSION XII
EX SITU MANAGEMENT
Management of a breeding herd of African elephants (*Loxodonta africana*) on a predominately forage diet.

Ray L Ball, DVM, Maura Middleton, BA
Tampa’s Lowry Park Zoo
Obligate forage feeding
Health and nutritional evaluation of gorillas on diets without commercial biscuits
Primates

Salad Days  Heart disease doesn’t just hit humans. It’s the leading killer among male zoo gorillas, and scientists want to know why. Obesity? Perhaps, but the term has yet to be defined for the primates. Diet? Likely, and Elana Hahn-Deaser of Cleveland Metroparks Zoo is trying to prove it. As part of a multi-year study, she’s been feeding her two gorillas, Brubec and Mikota (below), a diet meant to mimic the largely vegetarian one eaten in the wild. Heavy on leafy greens, the new diet is also modeled after a heart-healthy human one, says Less. Judging by the 65 pounds each of her charges has shed so far, it’s nothing to take lightly. —Graham Zuckerman
Behavioral response of captive gorillas to the introduction of a biscuit-free, high fiber, low fruit diet

Richard A. Bergl¹, Ray Ball², Kristin Owen³, Sam Young³, Aaron Jesue¹, Courtni Bean¹, Barbara L. Sherman³, and Shana R. Lavin⁴

¹North Carolina Zoological Park
²Busch Gardens, Tampa Bay
³College of Veterinary Medicine, North Carolina State University
⁴Lincoln Park Zoo
White rhinoceroses

- Rotterdam 2011
- Serum electrolytes, minerals, vitamins
  - Zn deficiency in pregnancy
  - 9/10 births female
- Two facilities
Manatees

- Wild manatee rehabilitation
- Maintained on romaine lettuce
  - Small portion of native sea grasses
- 4 months to 2 years
African Elephants

• Landscape-scale feeding patterns of African elephant inferred from carbon isotope analysis of feces.

• Predominately grazers
• Opportunistic browsers
• Tolerant of foods with relatively low nutritional value
Concerns with concentrates

- Low fiber
  - peNDF
- High starch
  - CHO metabolism
  - Obesity
  - Inflammatory?
- Reduced feeding times
  - Stereotypy
  - Altered mineral physiology
Can elephants in managed care be fed predominately forages?

**Current Concerns**
- Obesity
- Foot concerns
- Reproduction limitations
- Inflammatory conditions
- Secondary infectious Dz
  - Tuberculosis
  - Salmonella
  - EEHV

**Objectives**
- Leaner animals
- Improve foot health
- Improve reproduction
- Reduce inflammatory stress
- Reduce secondary infections
Can elephants in managed care be fed predominately forages?

- Safe
- Provides adequate nutrients
- Palatable
- Promotes health
- Supports reproduction
Diet Comparison

Concentrate based
• 30kgs grass hay
• 4.5kg elephant supplement
• 2kg oats
• 4kg sweet feed
• Bread enrichment
• Produce training
• Browse enrichment

Forage based
• Grass hay ad libitum
  – Coastal
• 2kgs alfalfa hay
• 3kgs produce training
• Browse daily
Browse
Laurel oak (*Quercus hemisphaerica*)
Live oak (*Quercus virginiana*)
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Comparisons on diets

• 1.3 African elephants
  – Imported
  – 1.2 Swaziland
  – Clinically healthy
  – Trunk wash negative

• Body weights/condition

• Reproduction

• Bloods

• Blood
  – Hematology
  – Serum biochemistry
  – Vitamin E
  – Vitamin D
  – Micro minerals
Hematology

Concentrate
• WBC 11.79 *10^3/ul
  • SD 2.799, N=25
• Monocytes 4.599*10^3/ul
  – SD 2.456, N=25

Forage
• WBC 14.17*10^3/ul
  – SD 2.484  N=54
• Monocytes 2.569*10^3/ul
  – SD 2.067, N=54
Hematology

Concentrate

- Hematocrit 36.02 % SD2.783, N= 24
- Hemoglobin 12.72 g/dl SD 1.512, N= 25
- RBC 2.882 *10^6/ul SD 0.416, N=25
- Platelets 514 *10^3/ul SD 223.7, N=24

Forage

- Hematocrit 33.63 % SD 4.016, N= 56
- Hemoglobin 11.46 g/dl SD 1.138, N= 53
- RBC 2.724 *10^6/ul SD 0.255, N=53
- Platelets 200.5*10^3/ul SD 188, N=41
Hematology Differences

• Monocytes
  – Antigen stimulus
  – Careful not to over interpret

• Hct
  – Hydration status

• Platelets
  – Chronic inflammation

• Lower Hct seen in white rhinos fed forage only
  – Ball et al IEF/IRF Rotterdam 2011

• Concentrate fed elephants hemoconcentrating??
  • Pairs with serum protein
Serum Biochemistry

Concentrate
- Total protein 7.632 g/dl
  - SD 0.34, N=25
- Albumin 3.242 g/dl
  - SD 0.262, N=24
- Globulin 4.388 g/dl
  - SD 0.37, N=24

Forage
- Total protein 6.894 g/dl
  - SD 0.83, N=16
- Albumin 2.85 g/dl
  - SD 0.434, N=16
- Globulin 3.929 g/dl
  - SD 0.658, N=17
Serum Biochemistry

**Concentrate**
- Creatinine 1.356 mg/dl
  - SD 0.25, N=24
- BUN 8.44 mg/dl
  - SD 3.097, N=25
- Amylase 9924 SU
  - SD 2707, N=23
- Triglyceride 27.83 mg/dl
  - SD 11.05, N=23

**Forage**
- Creatinine 1.1 mg/dl
  - SD 0.181, N=16
- BUN 6.5 mg/dl
  - SD 2.875, N=16
- Amylase 7225 SU
  - SD 4076, N=16
- Triglyceride 22.38 mg/dl
  - SD 3.204, N=54
Serum Biochemistry

- BUN, Cr lower in forage fed animals
  - Lower protein intake
  - Improvement in renal function?
    - Subclinical renal insufficiency
- Amylase
  - Renal disease may prolong clearance
- Lower protein intake still appears adequate
  - Reproduction
  - Lactation
  - Calf growth
- Concentrate fed elephants under some “renal stress”??
  - Contribute to low Vit D?
Vitamin D (25-OH, MSU)

- No values before diet change
- MSU mean on 86 individuals 14mmol/L
- Forage fed ranged from 20 to 27 mmol/L
  - N=4
Descriptive epidemiology using serology in an outbreak of *Mycobacterium tuberculosis* in managed Asian elephants (*Elephas maximus*) at a single facility.

Ray L. Ball, DVM, Lowry Park Zoo, Tampa, Florida, USA,
Sumeet Gupta, Vet Student Scholar, Ohio State University

Vitamin D Levels in Captive U.S. Elephants

Asian elephants from different zoos in the United States.

compared across geographic location to diet and blood vitamin D values of elephants from Thailand

Asian elephants in northern latitudes of the United States exhibit lower concentrations of blood vitamin D than those in southern latitudes and those living in their natural habitat of southeast Asia.
• Suggest abnormal handling of this vitamin

• Renal pathology
• Vitamin mal-absorption
• Granulomatous disease
Decreased synthesis of 1,25-dihydroxyvitamin D

Chronic kidney disease

Stages 2 and 3 (estimated glomerular filtration rate, 31 to 89 ml/min/1.73 m²)
Hyperphosphatemia increases fibroblast growth factor 23, which decreases 25-hydroxyvitamin D-1α-hydroxylase activity5,6,91-94

Stages 4 and 5 (estimated glomerular filtration rate <30 ml/min/1.73 m²)
Inability to produce adequate amounts of 1,25-dihydroxyvitamin D2,3,6,91-96

Causes decreased fractional excretion of phosphorus and decreased serum levels of 1,25-dihydroxyvitamin D
Causes hypocalcemia, secondary hyperparathyroidism, and renal bone disease

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Low serum vitamin D levels and tuberculosis: a systematic review and meta-analysis

Kelechi E Nnoaham1* and Aileen Clarke2
What is the most important nutrient?

- Water
  - Water comprises 99% of all molecules within the animal’s body
    - Neonate bird or mammal (71-88% of BW)
    - Decreases as they grow
  - Decreased in obese animals (50-65%)
    - Muscle 72%
    - Fat 3–7%
Vitamin E (MSU)

Concentrates
- Mean 0.35 ug/ml
  - N=2

Forage
- Mean 1.39 ug/ml
  - N=4

- Free ranging values reported 0.41 to 0.61 ug/ml
- Same imported group at another facility
- 0.41ug/ml to 0.13ug/ml in 4 years
  - Schlegel et al 2008
- 307 samples from two other Florida facilities
  - Mean 0.618 ug/ml
Vitamin E antioxidant

• More fresh browse
  – Better Vit E intake
• Less inflammation
  – Lower platelets
  – Lower globulins
  – Lower monocytes
• Less oxidative stress = higher levels of Vit E??
Minerals
all statistically same

- Cobalt ng/ml
- Copper ug/ml
- Iron ug/dl
- Mang ng/ml
- Molyb ng/ml
- Zinc ug/ml
- Selenium ng/ml

- P=0.06
- 78 Conc; 75 Forage
- 1.25 Conc; 1.172 Forage
- 67 Conc; 54.8 Forage
Weight/Body Condition

SDUDLA

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Reproduction

Ellie Progesterone
Matjeka Progesterone

Mbali

old P4 Assay
different poly p4 assay
Forage feeding

• Appears to be safe
• Sustainable
• Meets basic needs
• Meets needs for reproduction
  – Lactation
  – Calf development

• Trivers-Willard hypothesis, maternal condition at or around conception affects the secondary sex ratio in mammals
• White rhinos
• African elephants
  – Swaziland imports
Forage feeding

- May alter hydration status
- May improve renal health
- May be less inflammatory

- Improve hydration
- Improve renal health
  - Improves Vit D
Further analysis

- Fatty acids
  - Strengthened digital cushion
  - Data in cattle
  - The fatty acid content of the bovine digital pad can be influenced by lipid intake (Raber, M., M., 2006)
  - Fatty acids have been compared in African elephants between wild animals and managed ones fed concentrates (Clauss 2006).
Further analysis

• Heat stress and diet
  – Forages produce more heat
• Obesity
• Sex selection in offspring
  – Trivers-Willard hypothesis
Acknowledgements

- TLPZ Elephant Staff
- TLPZ Veterinary Staff
- City of Tampa
- Oscar Nurse Landscaping
Asian Elephant Support (AES) is a U.S. non-profit foundation dedicated to the care and conservation of elephants in Asian range countries, and to the people whose lives are intertwined with this magnificent and endangered species.

www.asianelephantsupport.org
Mission of Asian Elephant Support

- Provide financial support for elephant projects in Asian range countries that meet our criteria for care of captive elephants and for conservation of the species.
- Increase awareness of the needs and future of the Asian elephant.
- Increase awareness of the humane treatment of elephants living in captivity.
- Provide educational opportunities to those persons who care for elephants in Asian range countries.
AES Projects 2012–2013
Hoof knives for Mahouts–India

• Collaboration with EMA Conservation Committee

• Raised $1755.52 for mahouts in Assam, India
ElefantAsia
Laos PDR

Portable scales donated by AES
Field Course in Emerging Diseases of Asian Elephants

- Follow up field course to Regional Asian Elephant Veterinary Workshop
- Funded by a grant from the USFWS’s Asian Elephant Conservation Fund
- Kerala, India – November 2012

- Hosted by the Kerala Veterinary and Animal Sciences University
Elephant Endotheliotropic Herpesvirus (EEHV)

- In conjunction with a grant from USFWS’s Asian Elephant Conservation Fund
- Confirmed first two cases of EEHV in Sumatra, Indonesia
Facilitated a visit by veterinarians – hosted by Myanmar Timber Enterprise

Provided funding for elephant medicine
AES provides emergency funding for rescued orphans and other individual elephants needing immediate assistance.
AGAM

- Found in an abandoned well in Aceh, Sumatra
- Villagers contacted VESSWIC
- Unable to locate herd so relocated to EEC in Saree, Sumatra.
RAJU

- Orphaned possibly due to HEC issue
- Weak and dehydrated
- Under one month old
Documenting Indigenous Traditional Knowledge of the Asian Elephant in Captivity

Asian Nature Conservation Foundation
Centre for Ecological Sciences
Indian Institute of Science
Bangalore, India

- Record the relationship between the elephant and its keeper
- Provide valuable insight into the mitigation of human–elephant conflict issues
2\textsuperscript{nd} Regional Asian Elephant Veterinary Workshop, Myanmar 2014

Funded by a grant from the USFWS Asian Elephant Conservation Fund
AES Activities
Fundraisers

California Pizza Kitchen
3rd Annual Fundraiser
E-cards

Happy Holidays

Father’s Day

Happy Birthday

Mother’s Day
Elephant Education

1st Grade Presentation
Asian Festival – May 2013

Earth Day at the Virginia Zoo – April 2013
Ways to Help

- Donations
  Mail or PayPal on line

- Good Search

- Good Dining

- Fundraisers
  California Pizza Kitchen
  Buffalo Exchange
For More Information

Website
www.asianelephantsupport.org

E-mail
info@asianelephantsupport.org

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