

Use of Fecal Hormonal Analysis to Determine the Success of the Black Rhinoceros in Addo Elephant National Park, South Africa

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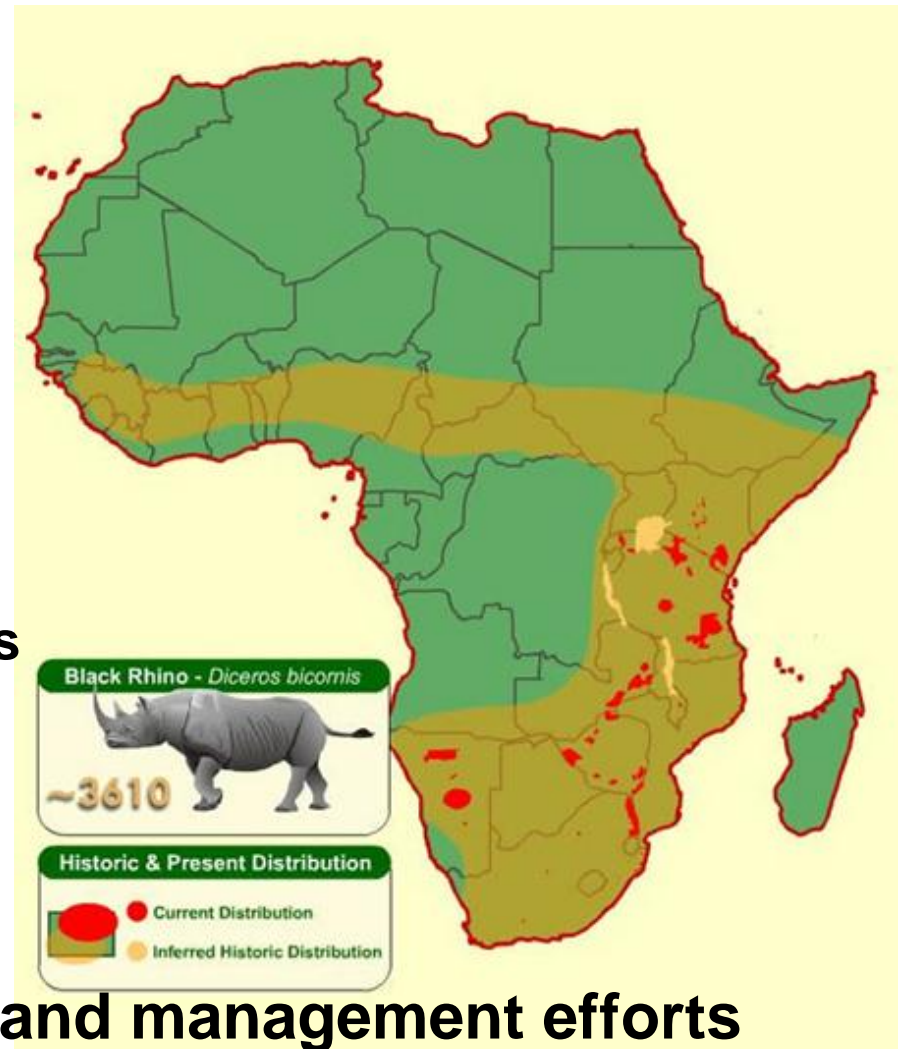
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~65,000



2,000 by 1992

- Due to poaching & habitat loss
- Now, ~3,610
- Highly endangered!
- The majority of research and management efforts are focused on recreating suitable habitat.



Hormonal analysis provides valuable information about factors influencing free-ranging wildlife population dynamics.

- **Gonadal hormones (for reproduction)**
- **Adrenocortical hormones (for stress physiology)**
- **Monitor the health status of wildlife**
- **Assist with management and conservation decision-making by providing information**



Addo Black Rhino Project



Our goal is to establish a health monitoring program that will investigate the relationship among black rhino hormonal activity and ecological factors that vary among two sections of Addo Elephant National Park (AENP).

Addo Elephant National Park



AENP Black Rhino Sub-populations

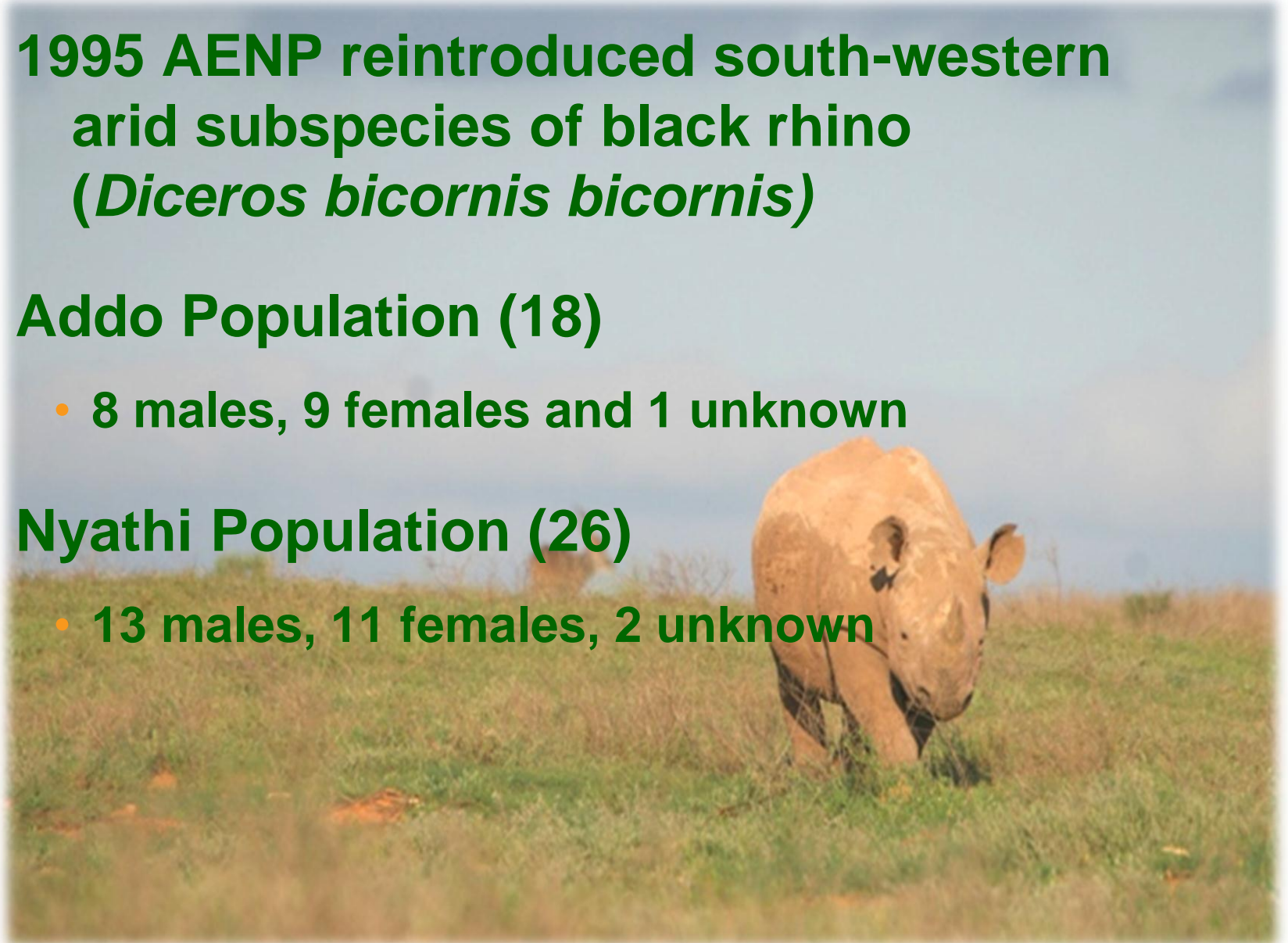
1995 AENP reintroduced south-western arid subspecies of black rhino (*Diceros bicornis bicornis*)

Addo Population (18)

- 8 males, 9 females and 1 unknown

Nyathi Population (26)

- 13 males, 11 females, 2 unknown



- **Our objectives are to investigate the impact of:**
 - **Resource availability (competition with elephants),**
 - **Predation pressures (lions and hyenas) and**
 - **Eco-tourism**
- on the rhinos' health and reproduction**



South African
NATIONAL PARKS

BLACK RHINO MONITORING

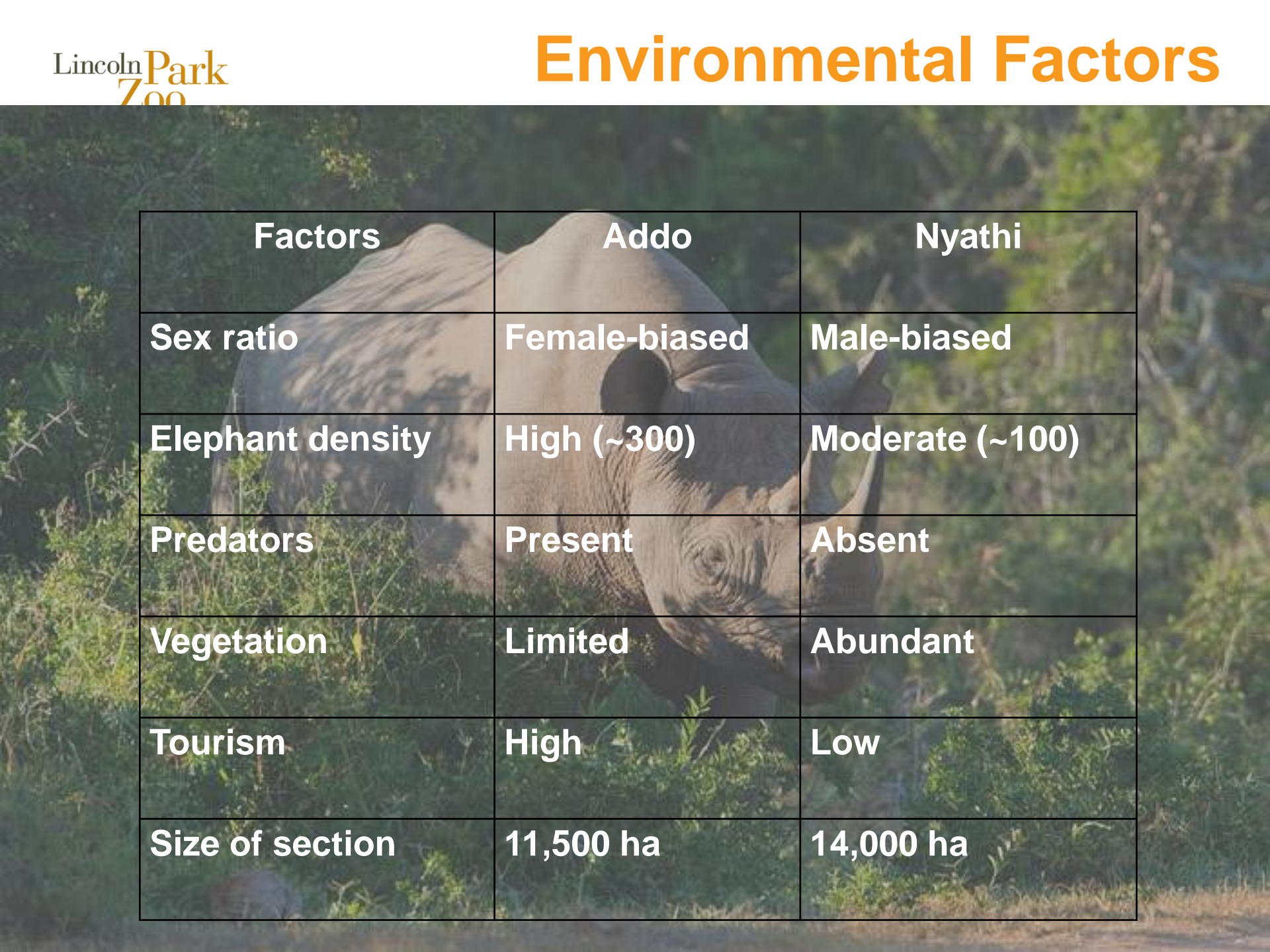


Our hypotheses are:

- 1. high densities of elephants, predators and tourists are associated with a suppression of gonadal activity in black rhino; and**
- 2. adrenocortical activity is positively associated with high anthropogenic activity and negatively affects reproduction in the black rhino.**



Environmental Factors



Factors	Addo	Nyathi
Sex ratio	Female-biased	Male-biased
Elephant density	High (~300)	Moderate (~100)
Predators	Present	Absent
Vegetation	Limited	Abundant
Tourism	High	Low
Size of section	11,500 ha	14,000 ha

Field Methods: Looking for Rhinos



Finding for rhinos in AENP





Camera traps Set Up on Middens



**Identify individuals by:
ear notch
horns**

Get sample date and time

Fecal Sample Collection



Sample collection

- Sample's age and identification
- Exposure to the environmental conditions

Sample storage

- Freezer are unreliable and/or unavailable
- Preservatives can negatively affect the hormone values
- Drying the sample, using solar or conventional ovens, cause degradation of the steroid hormones

Sample transportation to lab for analysis

- Use flammable preservatives
- Difficult to keep samples frozen
- Treatment for disease



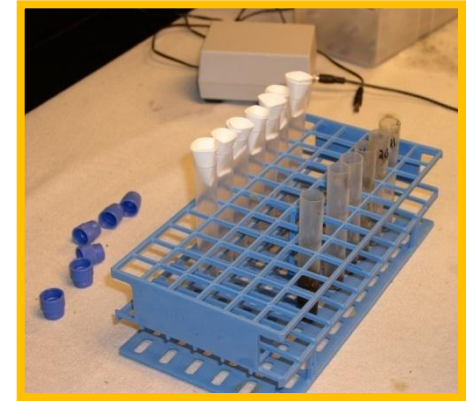
Fecal Hormone Extraction Protocols



Weigh
Add ethanol



Homogenize



Filter



Air-dry 1ml
No freezer needed

- All equipment is battery-powered
- Very cost effective
- Simplifies storage
- Simplifies transportation

(Santymire & Armstrong 2010 in Zoo Biology)

“Clear Blue Easy” Visual hormone identification

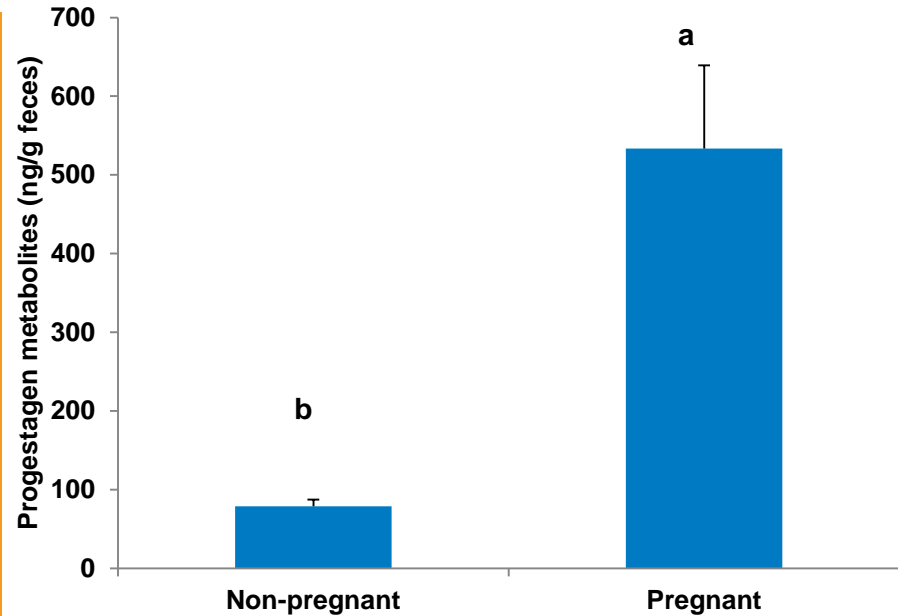


- **Dark = low hormone; Light = high hormones**
 - **Visual assessment of hormone activity**
- (Freeman et al., 2010 in Methods in Ecology and Evolution)

Preliminary Reproductive Results

Over 250 fecal samples from known individuals have been collected for over 3 years.

Seven (of seven) females have been correctly identified as pregnant via fecal hormone values.

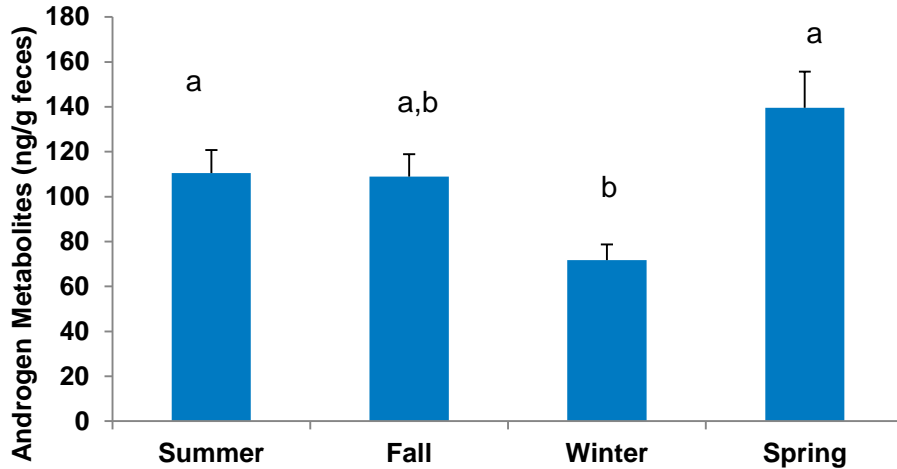


Mann-Whitney: $T_{12,33} = 461.0$, $P < 0.001$

Section	Age at First Calf (yrs)	Calving Interval (mo)
Addo	NA	33.5 ± 6.1 ; N=7
Nyathi	7.6 ± 0.4 ; N=6	25.5 ± 1.6 ; N=12

Preliminary Reproductive Results

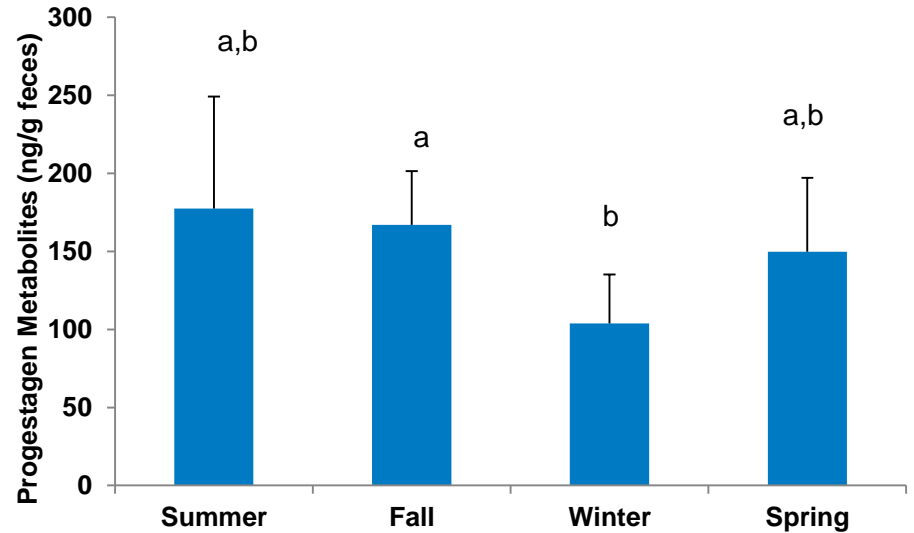
Male



(Kruskal-Wallis: $H_3 = 12.543$, $P = 0.006$)



Female



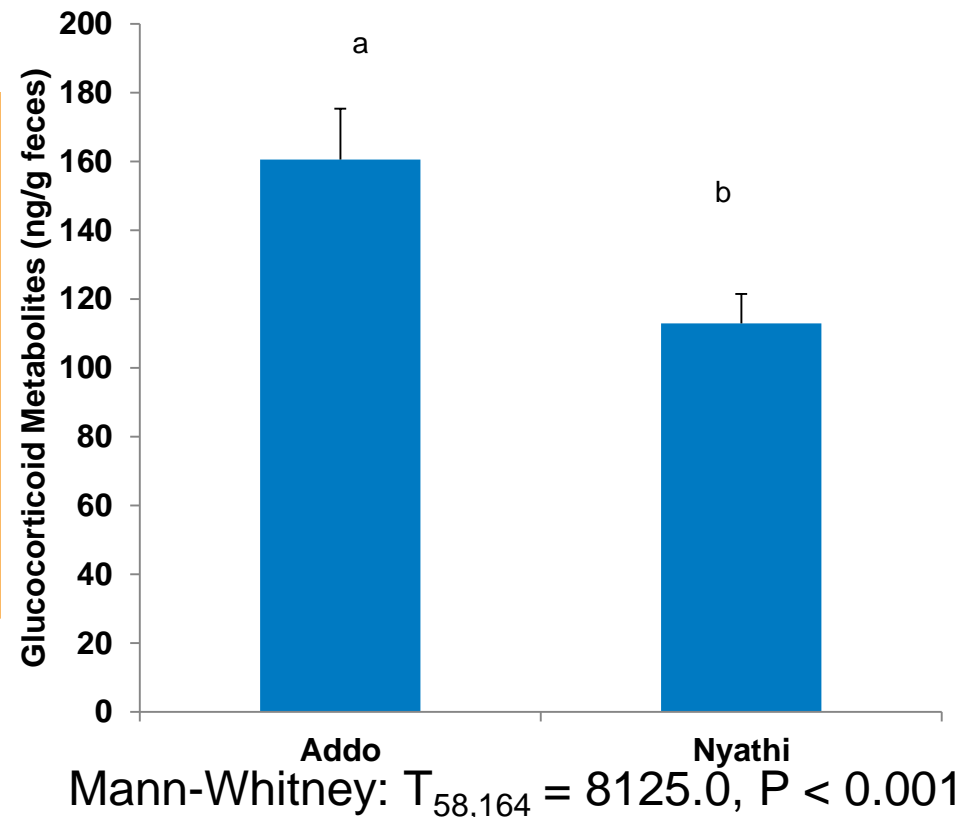
Kruskal-Wallis: $H_3 = 11.001$, $P = 0.012$



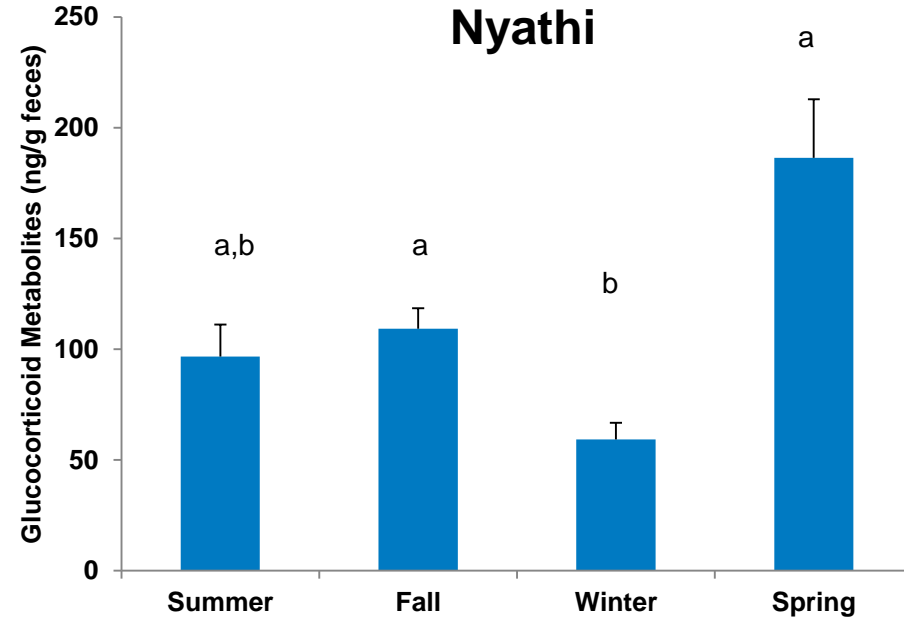
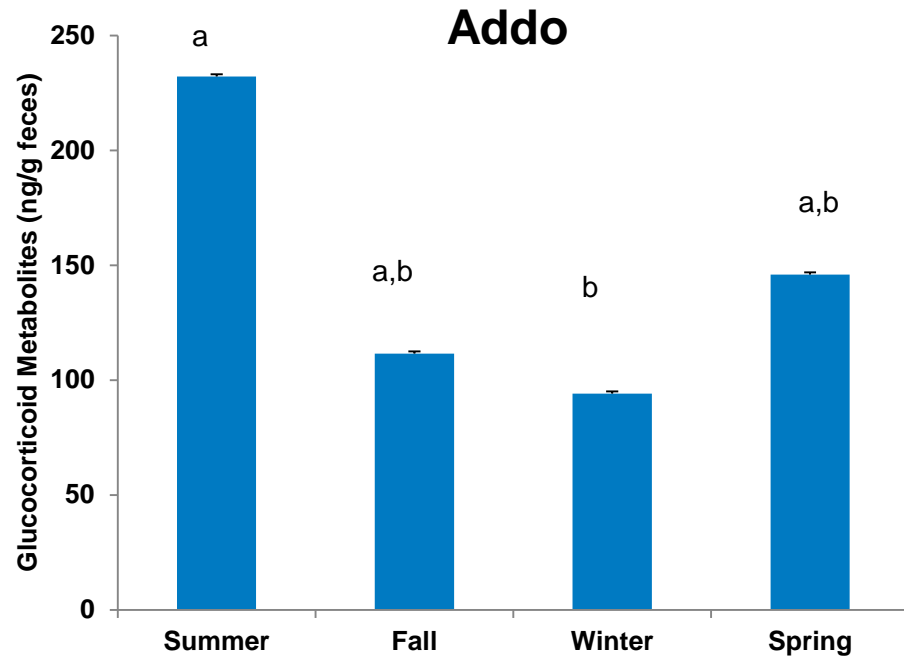
Winter & Spring= dry; Summer & Fall= wet

Preliminary Health Results

- Fecal glucocorticoid metabolites (FGM) were similar ($P > 0.05$) between sexes and age groups.
- However, the FGMs varied between the park sections.



Seasonal Effects on FGM



Kruskal-Wallis: $H_3 = 13.459$, $P = 0.004$

Kruskal-Wallis: $H_3 = 23.406$, $P < 0.001$



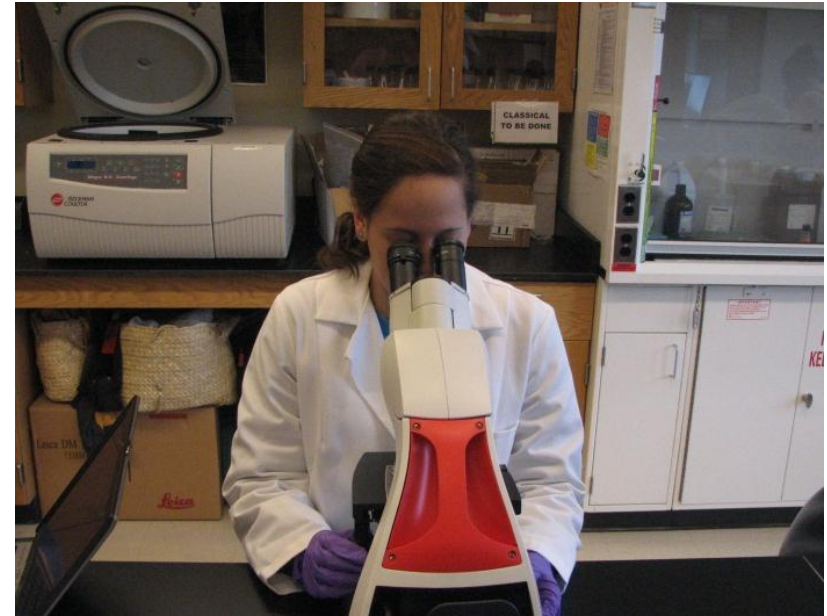
WILDVIEW 04-21-2010 18:28:55



WILDVIEW 08-15-2009 21:28:26

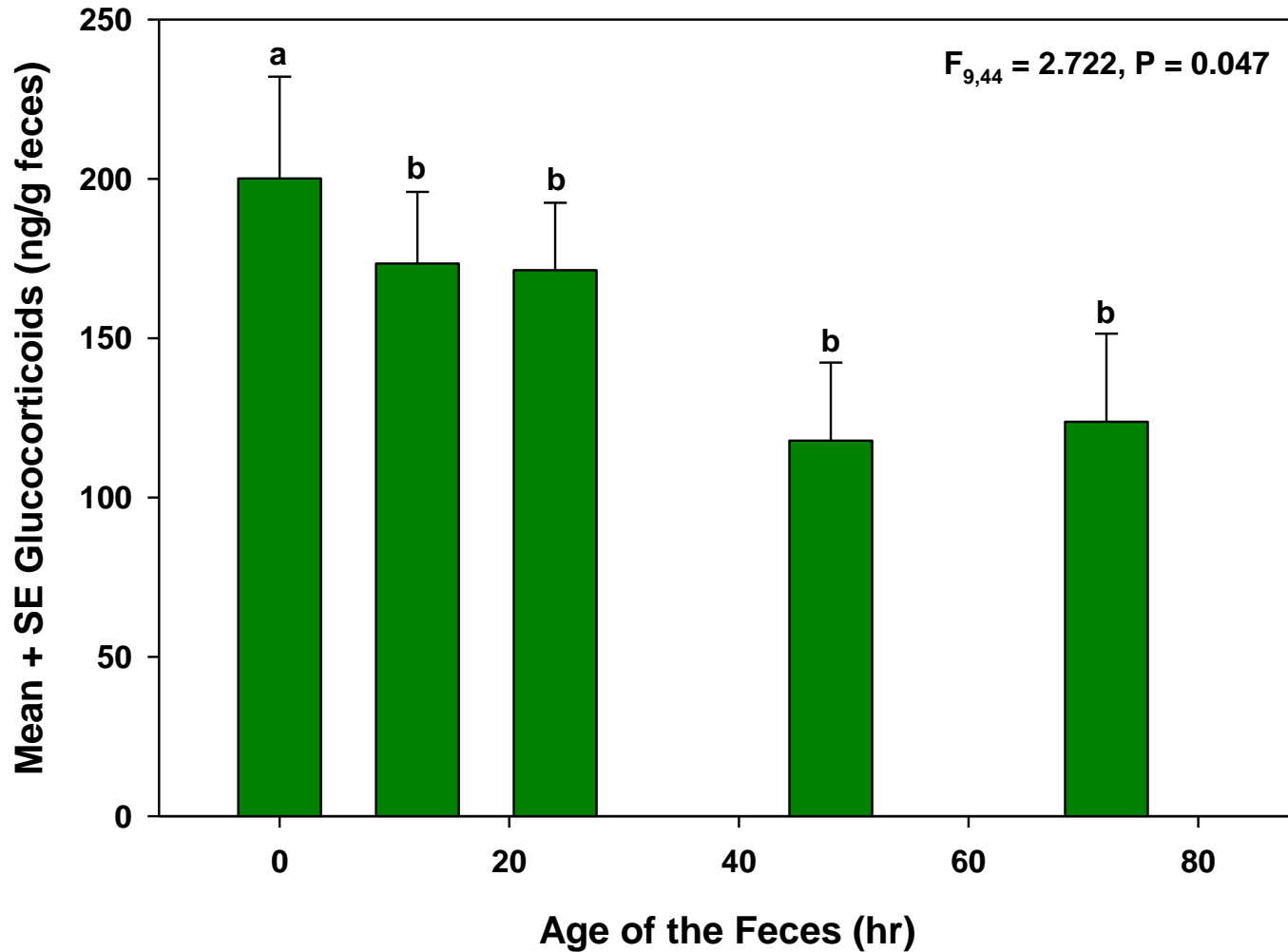
Patterns of Parasitism and Commensalism

**Preliminary results show:
A higher prevalence of
pathogenic parasite species
and lower prevalence of
symbiotic protozoa for Addo
compared to Nyathi rhinos**



**Jennifer Aronoff in Dr. Tom
Gillespie's lab at Emory University**

Environmental Degradation of Fecal Hormones

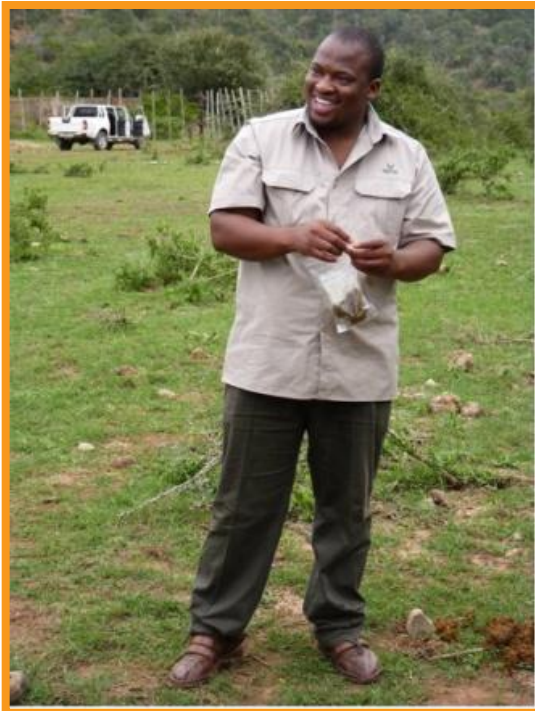


Due to a high degree of variation, it is best to collect only fecal samples that are <12 hr old.

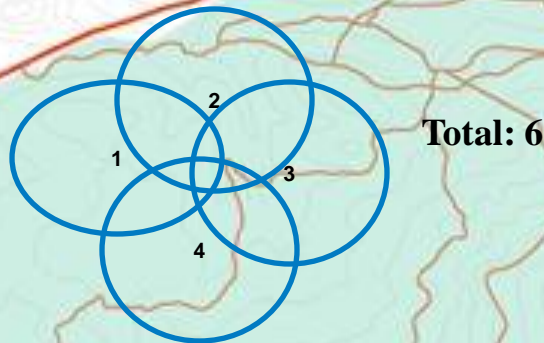
- **We have overcome challenges of field endocrinology by using c-traps on middens, field-fecal extraction methods and a field pregnancy detection assay.**
- **Calving interval: Addo's main camp > Nyathi**
- **FGM: Addo's main camp > Nyathi**
- **Parasites: Addo has fewer commensal and more pathogenic than Nyathi**
- **Density of elephants, tourist and predators:
Addo's main camp > Nyathi**
- **It is best to collect only fecal samples that are <12 hr old.**



- We will be extracting DNA from the fecal samples to identify “unknown” samples and possibility determine paternity.

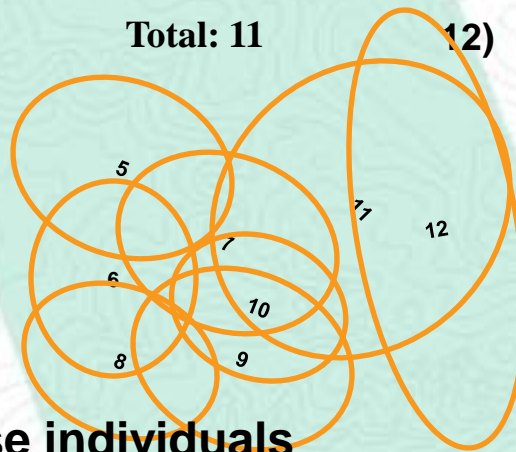


October 2009



- 1) Anke & Sandile (2008)
- 2) Nabap & Mel (2007)
- 3) Pete
- 4) Buntu (Anke's 2004)
- 5) Koranna & 2008 male calf
- 6) Ngara & 2008 female calf
- 7) Msilo (2002) & 2008 male calf
- 8) Ifele (Koranna's 2003)
- 9) Mosha (Koranna's 2005)
- 10) Jimmy (Ngara's 2004)
- 11) Ongava
- 12) Tswalu

Total: 11



- Approximate home ranges for these individuals
- How they are using the landscape

Acknowledgments

- John Addendorf, SANparks AENP Conservation Biologist
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- Diana Armstrong, LPZ



South African
NATIONAL PARKS

BLACK RHINO MONITORING



Lincoln Park
Zoo





Photo by Jed Bird