

**IN SITU ULTRASONOGRAPHIC REPRODUCTIVE  
EVALUATION OF THE FEMALE BLACK RHINOCEROS (*Diceros  
bicornis*) AND WHITE RHINOCEROS (*Ceratotherium simum*) IN  
SOUTH AFRICA**



**Interim Report: USFWS RTCF GRANT No. 98210-2-G354**

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Project Closing Date: June 1, 2004  
Interim Report Date: September 15, 2002  
Reporting Period: June – September, 2002

Project Title:  
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EVALUATION OF THE FEMALE BLACK RHINOCEROS (*Diceros  
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SOUTH AFRICA  
YEAR 2**

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## STATEMENT of NEED

The black rhinoceros (*Diceros bicornis*) is endangered throughout Africa following decades of poaching for its horn. Just over 2,700 survive in the wild. Today, poaching remains the single greatest threat to this species' long-term survival. The control of poaching in South Africa and other African nations can be attributed, in part, to intensive protection and monitoring of isolated rhino populations.

As black rhino populations expand, this management scheme involving intensive protection and monitoring through translocation, radio-telemetry techniques, etc. will be critical to control of poaching pressure. An important factor that may threaten ongoing management of these mammals in some African range states is the concern, to date unsubstantiated by any scientific data, that intensive management practices may be a source of fetal loss and/or early embryonic death, and thus limit expansion of wild rhino populations. The African Rhino Specialist Group recently evaluated the problem and supports research efforts that would provide insights into the effects (or the lack thereof) of the capture process on rhino fertility. The information that this project would produce may ultimately affect management decisions for *in situ* rhino populations by answering this question. In addition, this project would provide two additional benefits to black rhino survival. First, the knowledge accumulated would aid management decisions regarding safe movement and overall handling of pregnant animals and would help provide an indication of reproductive health of a population. Second, this project would involve training of local scientists in ultrasonographic techniques in the rhinoceros to facilitate ongoing studies, provided benefits justify purchase of necessary equipment.

The application of this work to the field situation has great potential. As the various rhinoceros species become further isolated into smaller and smaller geographic areas, an opportunistic reproductive monitoring program of females immobilized for radio-collaring studies or translocation purposes could be implemented. An understanding of the reproductive health of wild rhino groups would prove valuable in formulating management plans for these fragmented populations. Opportunistic ultrasonography at the time of capture could provide insights into the effects of the translocation process on embryo/fetal viability during different stages of gestation. For an animal having such a long interbirth interval and producing a single offspring, this information may prove valuable as rhinos are by necessity becoming more painstakingly managed in parks, reserves, conservancies, sanctuaries, and IPZ's throughout Africa and Asia.

We are not suggesting that wild rhinos be subjected to immobilization simply to be scanned ultrasonographically. This would be an inappropriate use of financial and technological resources in most contexts. It may, however, be worth integrating a 10 - 15 minute scanning procedure into capture and translocation protocols already in place for a variety of reasons. By scanning rhinos opportunistically, managers of free-ranging rhinos may obtain practical information and simultaneously enhance understanding of the causes of infertility in captive specimens, the type of two-way information exchange that benefits both wild and captive rhino populations.

## Acknowledgements

This project was funded primarily by the United States Fish and Wildlife Service's Rhino and Tiger Conservation Fund with additional support from the International Rhino Foundation, the Tapeats Fund, the Fossil Rim Wildlife Center, and Priscilla and Gary Schmidt. This conservation mission would not have been possible without the long-term commitment and contributions of the International Rhino Foundation. Dr. Thomas Foose and John Lucas of the IRF have been instrumental in providing support for my involvement in international rhino conservation efforts. Dr. Steve Osofsky has provided invaluable advice and support of our rhinoceros research and *in situ* conservation objectives. Dr. Richard Emslie of the IUCN AfRSG has provided technical and scientific guidance. Generous support for the helicopter expenditures associated with this work was made possible by the Tapeats Foundation.

The success of this project has been made possible by the generous contributions of the Tswalu Kalahari Desert Reserve and the Oppenheimer family. We would also like to thank the entire Tswalu ranger staff as well as the Specialist Game Capture team for their efforts to facilitate this research. In particular, we thank Jaco Loots, Kester Vickery, and Pete Morkel for their commitment to this project and the critical follow-up monitoring that remains integral to our success. The Fossil Rim Wildlife Center has provided both financial and technical resources and support in many ways to the IRF and rhino conservation efforts; we thank Jerry Millhon, Bruce Williams and Kelley Snodgrass for their efforts to make field conservation a reality at our organization. Invaluable field assistance has been provided by Dr. Rolfe Radcliffe, Dr. Chris Foggin, Dr. Donald Paglia, and Laura Stokes-Greene. Finally, I would like to personally thank Annie Graham for her continued enthusiasm and support for our efforts to improve conservation and health of these endangered rhinoceros species.

## 2002 Interim Report Summary

Dates of field data collection: July 20, 2002 through August 24, 2002

### 1) *Progress made toward achieving the project's objectives and measureables*

**Objective One:** Identification of pregnant females to facilitate follow-up monitoring for the purpose of studying the effects of immobilization (if any) on rhinoceros female fertility and fetal health. A second proposed benefit was the use of this tool for enhancement of field decision-making.

- A total of 23 rhinos were immobilized during the five-week 2002 project, thirteen of which were females (11 white rhino and 2 black rhino females were examined; see Appendices A and C). This project was conducted in an opportunistic manner by combining field ultrasonography with immobilization of rhinoceros for the purpose of field identification via ear-notching and transponder placement.
- The total number of subject females examined for this project over the 2-year period comes to 29, twenty of which were documented to be pregnant via field ultrasonography.
- Initial evaluation of the outcomes for the 2001 data demonstrate the following preliminary findings (Appendix B):
  - a) 7 of 12 pregnant females have given birth without complications and are doing well in the neonatal period after completion of Year One of the study.
  - b) 4 of 12 pregnant females await documentation of the outcomes as follow-up data is still in the process of being collected.
  - c) Only one of the twelve pregnant females was lost to follow-up as she died 8 months after data sampling. The cause of death was not determined, but this female was suspected to be one of the oldest females in the herd.
  - d) No expected or confirmed fetal or neonatal losses have been documented to date during Year One of this project.
  - e) Due to the preliminary nature of this data, no conclusions can be drawn at this time.
  - f) Although this data is still preliminary, the information gained will be valuable for making appropriate field management decisions regarding immobilization and/or translocation of pregnant rhinoceros.

- All data was recorded on standardized forms to allow ease of use in the field setting. These forms (see Appendix C) contain all data pertinent to each rhino including the ultrasonographic findings as well as the predicted calving date, if applicable.

*Objective Two:* Training of local scientists in the use and interpretation of ultrasonography and the transfer of ultrasound technology to the field.

- This objective was met, in part, with the introduction of the technique and transfer of knowledge and use of this technology to field rhino conservation programs. Drs. Pete Morkel, Markus Hofmeyr and Chap Mavterson are eager to learn the actual techniques for transfer of this tool to the field setting. This objective will be accomplished during future field seasons.
- Dr. Markus Hofmeyr of Kruger National Park already has the necessary equipment for sustainability of this project long-term once the transfer of training is complete.
- Year Three of this project will focus on capacity building through technology transfer and implementation of hands-on training of local scientists. This will facilitate long-term sustainability of the techniques developed in order to aid managed rhino conservation efforts in both Africa and Asia.

*Objective Three:* Identify cycling female rhinos to assess fertility of individual animals and fecundity of populations. The documentation of normal ultrasonographic events in wild female rhinos for comparison to captive animals may benefit both programs.

- This objective will require analysis of data from multiple seasons and comparison to established rhino data fertility numbers.

*Objective Four:* Correlate observed ultrasound data with fecal hormone assays to facilitate development of inexpensive and less intensive monitoring methods based on fecal hormone analysis.

- This objective was not achieved in Year 1 or 2 due to the difficulty in sample collection and storage in remote field locations. This objective may not be a realistic goal of this project, but was not necessary to achieve the project goals.

## *2) Problems encountered which threaten to limit the success of the project*

There were no problems encountered which threaten to limit the success of the project, although there were certainly challenges faced. First and foremost, the success of this project will lie with the follow-up monitoring that will support this initial fieldwork. The team of wildlife rangers at Tswalu and Kruger are among the most talented and well-equipped in Southern Africa. In addition, the field site at Tswalu chosen for this study has proven to be ideal as it provides wide-open terrain to facilitate the intensive monitoring essential to this work. I do not foresee any problems with the proposed schedule of follow-up monitoring for this project in either the Tswalu or Kruger study sites.

## *3) Expenditures of grant funds, matching funds and in-kind support*

A detailed summary of budget items and accounting for this project is outlined in a separate document. The Fossil Rim match was met in full with in-kind use of the Fossil Rim ultrasound equipment and full coverage of Dr. Radcliffe's salary, benefits and film expenses. The South Africa match was also met with one exception. The actual helicopter expenses were estimated at only \$10,000 USD since the majority of the work was done in a Robinson R22. One-half of the helicopter expenses (\$5000 USD) were matched for the 2002 field season through the generous support of Annie Graham and the Tapeats Fund. The partial field support of helicopter expenses for this project was considered essential to success of this project.

# APPENDIX A-2001 Data

## SUMMARY OF RHINO PREGNANCY TESTING

August 2001						
Exam Date	RSA Location	Animal ID	Pregnant	Gestation Age	Calving Date	Fetal Sex
30 July 2001	Thaba Tholo	Estelle (Dbm)	No	N/A	N/A	
3 August 2001	Kruger	Matjulwna	Yes	~10 months	~February 2002	
7 August 2001	Kruger	Akura (Dbm)	No	N/A	N/A	
10 August 2001	Kruger	Female No. 1	Yes	5 months	August 2002	
10 August 2001	Kruger	Female No. 3	Yes	7 months	May 2002	
18 August 2001	Tswalu	Tswalu #8	Unknown	Late term Pregnant?	Unknown	
19 August 2001	Tswalu	Tswalu #9	Unknown	Late term Pregnant?	Unknown	
19 August 2001	Tswalu	Tswalu #4	Yes	~10 months	~March 2002	
19 August 2001	Tswalu	Tswalu #18	Yes	5 months	August 2002 Female	
19 August 2001	Tswalu	Tswalu #6	Yes	~10 months	~March 2002	
19 August 2001	Tswalu	Tswalu #7	No	N/A	N/A	
20 August 2001	Tswalu	Tswalu #12	Unknown	Late term Pregnant?	Unknown	
20 August 2001	Tswalu	Tswalu #13	No	N/A	N/A	
23 August 2001	Tswalu	Tswalu #21	Unknown	Late term Pregnant?	Unknown	
23 August 2001	Tswalu	Tswalu #22	Yes	4 months	September 2002 Female	
24 August 2001	Tswalu	Tswalu #23	Yes	6 months	July 2002 Female	

Note: Dbm = *Diceros bicornis minor* (all other animals are *Ceratotherium simum simum*)



## APPENDIX A-2002 Data

### SUMMARY OF RHINO PREGNANCY TESTING

August 2002

<u>Exam Date</u>	<u>RSA Location</u>	<u>Animal ID</u>	<u>Pregnant</u>	<u>Gestation Age</u>	<u>Calving Date</u>	<u>Fetal Sex</u>
28 July 2002	Tswalu	Tswalu #17	Yes	~10 months	~February 2003	
28 July 2002	Tswalu	Tswalu #26	Yes	~10 months	~February 2003	
29 July 2002	Tswalu	Tswalu #33	Yes	6 months	June-July 2003	Female
31 July 2002	Tswalu	"Bogale" (Dbb)	Yes	5 months	June-July 2003	
31 July 2002	Tswalu	"Nantoni" (Dbb)	Yes	5 months	June-July 2003	Female
17 August 2002	Kruger Veldt	Kruger #65 (T#43260F6605)	Yes	7 months	June 2003	
17 August 2002	Kruger Boma	Kruger #64 (T#43262D305C; SGS#2)	No	NA	NA	
17 August 2002	Kruger Boma	Kruger #43 (T#4327412471; SGS#3)	Yes	5 months	August 2003	Female
17 August 2002	Kruger Boma	Kruger #26 (T#432648342C8; SGS#4)	No	NA	NA	
20 August 2002	Kruger/ Marakele NP	Kruger #29 (T#432A4F7141)	No	NA	NA	
20 August 2002	Kruger/ Marakele NP	Kruger #57 (T#4327091C7C)	No	NA	NA	
20 August 2002	Kruger/ Marakele NP	Kruger #58 (T#4327587926)	Yes	90 days	October 2003	Male
20 August 2002	Kruger/ Marakele NP	Kruger #21 (T#4328382E1F)	Yes	~10 months	~March 2003	

Note: Dbb = *Diceros bicornis bicornis* (all other animals are *Ceratotherium simum simum*)

## APPENDIX B

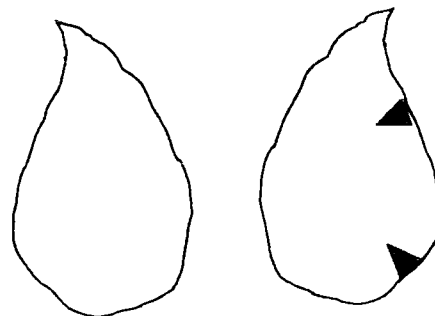
### PREGNANCY OUTCOMES; YEAR 1

Animal ID	PREDICTION		OUTCOMES	
	Estimated GA (Gestational Age)	Estimated CD (Calving Date)	Actual GA	Actual CD
Tswalu #8	Late-term Pregnant	None	NA; This cow was found dead in July 2002 (NOTE: the estimated date of the cow's death was April 2002 or 8 months after immobilization for ear-notching. The outcome of this cow and any possible calf was not possible as a post-mortem exam could not be completed)	
Tswalu #9	Late-term Pregnant	None	8 months	25 May 2002
Tswalu #4	~10 months	~March 2002	11 months	5 February 2002
Tswalu #18	5 months	August 2002	6 months	July 2002
Tswalu #6	~10 months	~March 2002	Calved PENDING DATA	
Tswalu #12	Late-term Pregnant	None	~15 months	~October 2001
Tswalu #21	Late-term Pregnant	None	10 months	March 2002
Tswalu #22	4 months	September 2002	PENDING OUTCOME	
Tswalu #23	6 months	July 2002	6 months	1 July 2002
<b>Kruger #1</b>	<b>5 months</b>	<b>August 2002</b>	<b>PENDING OUTCOME</b>	
<b>Kruger #3</b>	<b>7 months</b>	<b>May-June 2002</b>	<b>PENDING OUTCOME</b>	
<b>Matjulwna</b>	<b>~10 months</b>	<b>~February 2002</b>	<b>PENDING OUTCOME</b>	

Note: All Kruger animals (**In bold**) underwent an immobilization procedure as well as a translocation event to a new area. Therefore these animals experienced additional factors (other than the immobilization procedure) that may influence the outcomes of a pregnancy.

# **APPENDIX C-2001 Data** **THABA THOLO RESERVE RHINO DATA SHEET 2001**

Subject No. 1      Species: *Diceros bicornis minor*  
 Date: 30 July, 2001  
 Location: Thaba Tholo  
 Identification: Estelle  
 Estimated age: 5 years based on size  
 Calf: No  
 Pregnant: No  
 Estimated calving date: N/A



## **Anesthesia summary**

### **Dart:**

3.0 mg etorphine  
 40 mg azaperone  
 2500 IU hyalase

### **IM at arrival:**

1.5 mg etorphine

### **IV at arrival:**

20 mg nalorphine  
 15 mg midazolam

### **Reversal:**

12 mg diprenorphine  
 plus 100 mg naltrexone mixed IV

**Reproductive status:** normal  
 nonpregnant young female, ovaries not  
 examined. Good candidate for  
 translocation to Tanzania.

## KRUGER RESERVE RHINO DATA SHEET 2001

Subject No. 2      Species: *Ceratotherium simum simum*

Date: 3 August, 2001

Location: Kruger National Park, Malelane

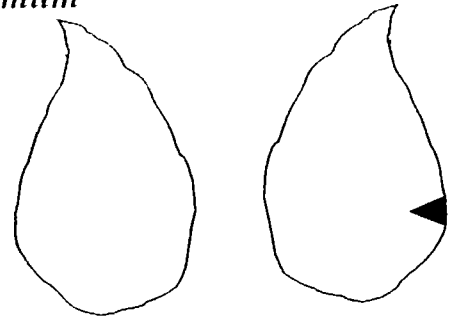
Identification: Matjulwna

Estimated age: ~10 years based on size

Calf: ~5 year-old calf at foot

Pregnant: Estimated ~10 months pregnant; fetus not  
Observed

Estimated calving date: February 2002



### Anesthesia summary

#### Dart:

4 mg etorphine  
40 mg azaperone  
2500 IU hyalase

#### IV at arrival:

20 mg nalorphine  
1 mg Diprenorphine

#### Crate loading:

12 mg Diprenorphine IV

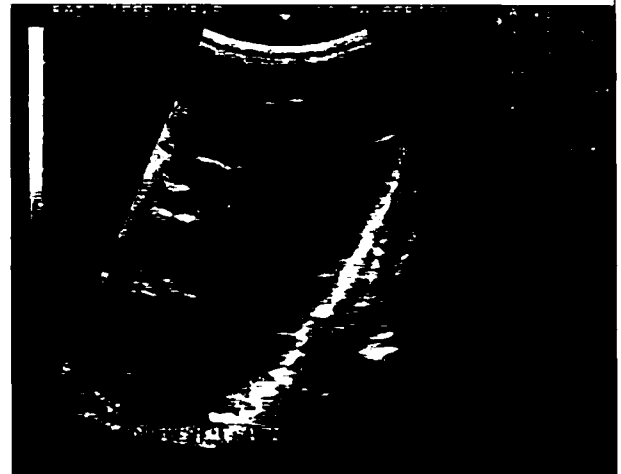
#### Off-loading into boma:

100 mg Naltrexone IM  
80 mg Azaperone IV

#### Capture:

Markus darted rhinos from Eurocopter with  
Martin as pilot

Reproductive status: Late term  
pregnancy. Fetus not observed, estimate  
gestational age to be approximately 10  
months based on deep fetal positioning.



# KRUGER RESERVE RHINO DATA SHEET 2001

Subject No. 3 Species: *Diceros bicornis minor*

Date: 7 August, 2001

Location: Kruger National Park, Malelane

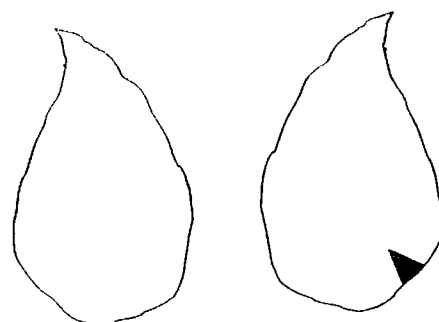
Identification: Akura

Estimated age: ~10 years based on size

Calf: 5 year-old calf at foot

Pregnant: No

Estimated calving date: NA



## Anesthesia summary

Dart 1:

2.5 mg etorphine

40 mg azaperone

2500 IU hyalase

Dart 2:

1.5 mg etorphine

IV at arrival:

20 mg nalorphine

SpO2: 76% to 90%

Reversal:

100 mg Naltrexone

Reproductive status: normal nonpregnant young female with evidence of follicular activity but no evidence of recent ovulation



# KRUGER RESERVE RHINO DATA SHEET 2001

Subject No. 4      Species: *Ceratotherium simum simum*

Date: 10 August, 2001

Location: Kruger National Park, Malelane

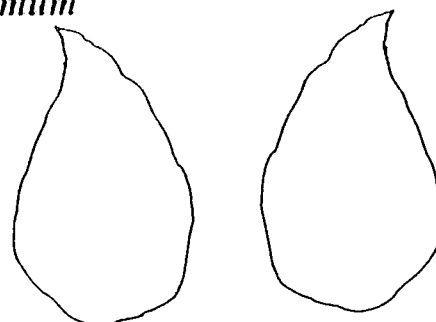
Identification: No. 1

Estimated age: Adult female

Calf: ~3 year-old calf at foot

Pregnant: 5 months pregnant; fetal eye and skull measured

Estimated calving date: August 2002



## Anesthesia summary

Dart: 4 mg etorphine  
40 mg azaperone  
2500 IU hyalase

## IV at arrival:

20 mg nalorphine  
1 mg Diprenorphine

## Crate loading:

12 mg Diprenorphine IV

## Off-loading into boma:

100 mg Naltrexone IM  
80 mg Azaperone IV

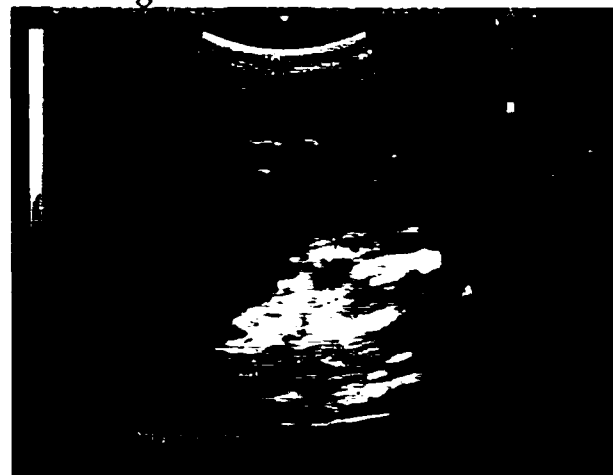
## Capture:

Markus darted rhinos from Eurocopter with Martin as pilot

## Reproductive status: Pregnant 5 months

Fetal eye = 11 mm

Skull length = 70 mm



# **KRUGER RESERVE RHINO DATA SHEET 2001**

Subject No. 5      Species: *Ceratotherium simum simum*

Date: 10 August, 2001

Location: Kruger National Park, Malelane

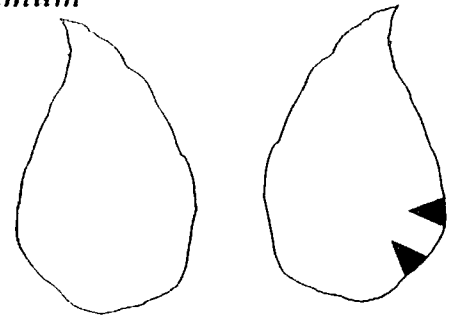
Identification: No. 3

Estimated age: Adult female

Calf: ~3 year-old calf at foot

Pregnant: 7 months pregnant; fetal heart observed and foot measured

Estimated calving date: May 2002



**Anesthesia summary**

**Dart:**

4 mg etorphine

40 mg azaperone

2500 IU hyalase

**IV at arrival:**

20 mg nalorphine

1 mg Diprenorphine

**Crate loading:**

12 mg Diprenorphine IV

**Off-loading into boma:**

100 mg Naltrexone IM

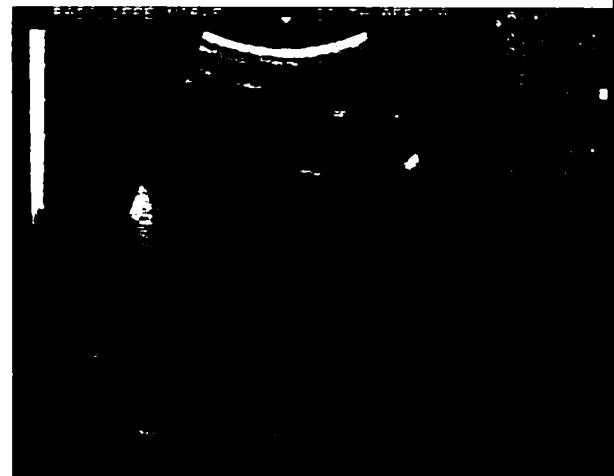
80 mg Azaperone IV

**Capture:**

Markus darted rhinos from Eurocopter with Pharney as pilot

**Reproductive status:** Pregnant 7 months  
Fetal heart and liver

**Fetal foot = 32 mm**



# TSWALU KALAHARI RESERVE RHINO DATA SHEET 2001

Subject No. 6 Species: *Ceratotherium simum simum*

Date: 18 August, 2001

Location: Kalkpan, southern section of Tswalu

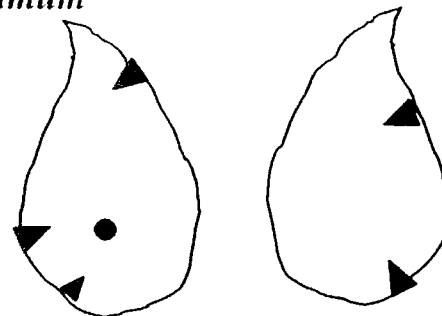
Ear Identification: No. 8

Estimated age: 25-30 years based on  
tooth and horn wear

Calf: ~2 year old male calf

Pregnant: Possible late pregnancy – No fetus observed

Estimated calving date: ?



## Anesthesia summary

### Dart:

3.5 mg etorphine  
40 mg azaperone  
2500 IU hyalase

### IM at arrival:

1.5 mg etorphine

### IV at arrival:

20 mg nalorphine  
15 mg midazolam

### Reversal:

12 mg diprenorphine  
plus 100 mg naltrexone mixed IV

Reproductive status: Unknown, suspect  
possible late-term pregnancy.





# TSWALU KALAHARI RESERVE RHINO DATA SHEET 2001

Subject No. 7 Species: *Ceratotherium simum simum*

Date: 19 August, 2001

Location: Kalkpan (Roggella Pan), N of white road

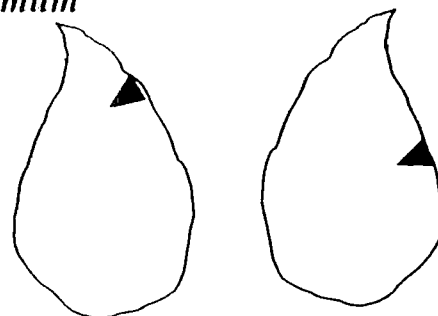
Ear Identification: No. 9

Estimated age: ~15 years based on  
tooth and horn wear

Calf: ~2.5 year old female calf

Pregnant: Possible late pregnancy

Estimated calving date: ?



## Anesthesia summary

### Dart:

3.8 mg etorphine  
40 mg azaperone  
2500 IU hyalase

### IM at arrival:

1.5 mg etorphine

### IV at arrival:

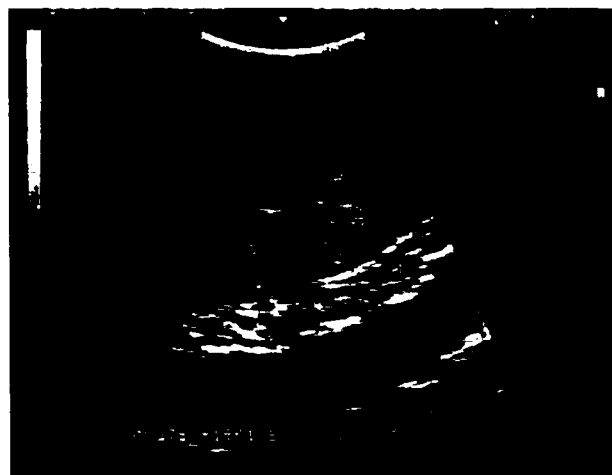
20 mg nalorphine

### Reversal:

12 mg diprenorphine  
plus 100 mg naltrexone mixed IV

Total down time = 38 min

Reproductive status: Unknown, suspect  
possible late-term pregnancy.



# TSWALU KALAHARI RESERVE RHINO DATA SHEET 2001

Subject No. 8 Species: *Ceratotherium simum simum*

Date: 19 August, 2001

Location: Kalkpan (Roggella Pan), N of white road

Ear Identification: No. 4

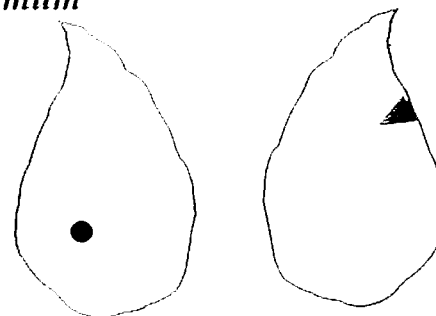
Estimated age: ~6 years based on

size

Calf: No

Pregnant: ~ 10 months pregnant; fetus not observed

Estimated calving date: ~March 2002



## Anesthesia summary

Dart:

2.8 mg etorphine

30 mg azaperone

2500 IU hyalase

IV at arrival:

15 mg nalorphine

plus 10 mg nalorphine

Reversal:

8 mg diprenorphine

plus 75 mg naltrexone mixed IV

Total down time = 30 min

Reproductive status: ~ 10 months pregnant



# TSWALU KALAHARI RESERVE RHINO DATA SHEET 2001

Subject No. 9 Species: *Ceratotherium simum simum*

Date: 19 August, 2001

Location: Tsamma, Tswalu south, near white road

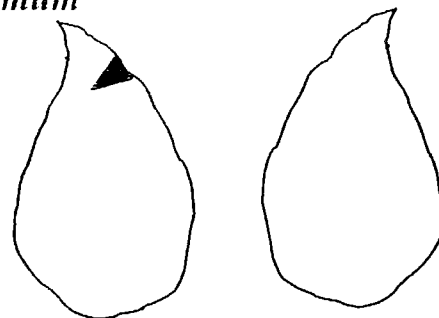
Ear Identification: No. 18

Estimated age: 15-20 years based on size

Calf: 1.5 year old calf at foot

Pregnant: 5 months pregnant; fetal eye and foot measured

Estimated calving date: August 2002



## Anesthesia summary

### Dart:

4 mg etorphine  
40 mg azaperone  
2500 IU hyalase

### IM at arrival:

1.5 mg etorphine

### IV at arrival:

20 mg nalorphine  
15 mg midazolam

### Reversal:

12 mg diprenorphine  
plus 75 mg naltrexone mixed IV

### Sternal position

Reproductive status: 5 months pregnant

Fetal eye = 11 mm

Fetal foot = 27 mm

Skull length = 70 mm

Trunk diameter = 80 mm



Fetal head



Fetal heart



Fetal foot



Fetal head



Umbilicus



# TSWALU KALAHARI RESERVE RHINO DATA SHEET 2001

Subject No. 10

Date: 19 August, 2001

Location: Tsamma, Tswalu south camp

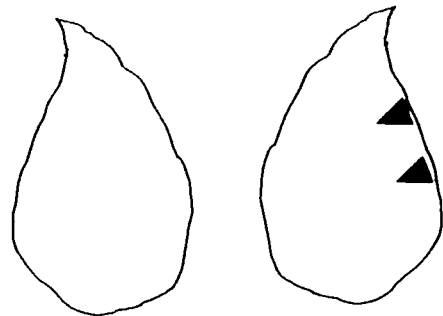
Ear Identification: No. 6

Estimated age: ~6 years based on size

Calf: No

Pregnant: ~ 10 months pregnant; fetus not observed

Estimated calving date: ~March 2002



## Anesthesia summary

### Dart:

3 mg etorphine  
30 mg azaperone  
2500 IU hyalase

### IM at arrival:

1.5 mg etorphine

### IV at arrival:

20 mg nalorphine

### Reversal:

12 mg diprenorphine  
plus 75 mg naltrexone mixed IV

Sternal position

Reproductive status: ~10 months pregnant



# TSWALU KALAHARI RESERVE RHINO DATA SHEET 2001

Subject No. 11 Species: *Ceratotherium simum simum*

Date: 19 August, 2001

Location: Tsamma, Tswalu south, S of gravel road near W fence

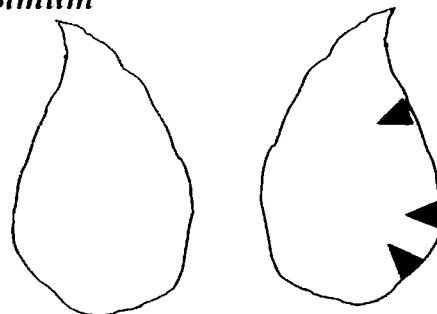
Ear Identification: No. 7

Estimated age: ~4.5 to 5 years based on size

Calf: No

Pregnant: Not pregnant; both ovaries imaged

Estimated calving date: N/A



## Anesthesia summary

### Dart:

3 mg etorphine  
30 mg azaperone  
2500 IU hyalase

### IV at arrival:

20 mg nalorphine  
5 mg midazolam

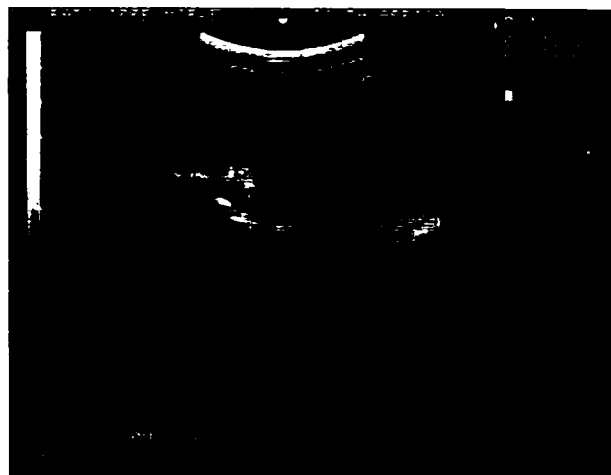
### Reversal:

8 mg diprenorphine  
plus 75 mg naltrexone mixed IV

### Sternal position

Total down time = 25 min

Reproductive status: normal  
nonpregnant young female with evidence  
of follicular activity but no evidence of  
recent ovulation



Left ovary:  
Multiple small follicles with no evidence of recent ovulation



Right ovary:  
Multiple small follicles with small luteal structure – breeding age female



# TSWALU KALAHARI RESERVE RHINO DATA SHEET 2001

Subject No. 12 Species: *Ceratotherium simum simum*

Date: 20 August, 2001

Location: Kalkpan, Tswalu south

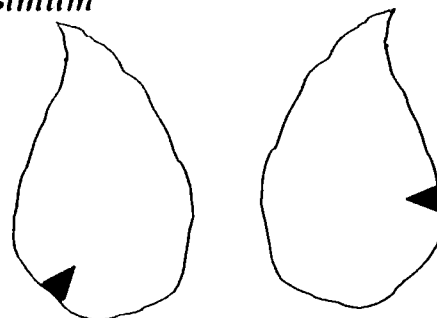
Ear Identification: No. 12

Estimated age: ~20 years based on size

Calf: Yes

Pregnant: Possible pregnant – fetus not observed

Estimated calving date: ?



## Anesthesia summary

### Dart:

3 mg etorphine

30 mg azaperone

2500 IU hyalase

### IV at arrival:

20 mg nalorphine

5 mg midazolam

### Reversal:

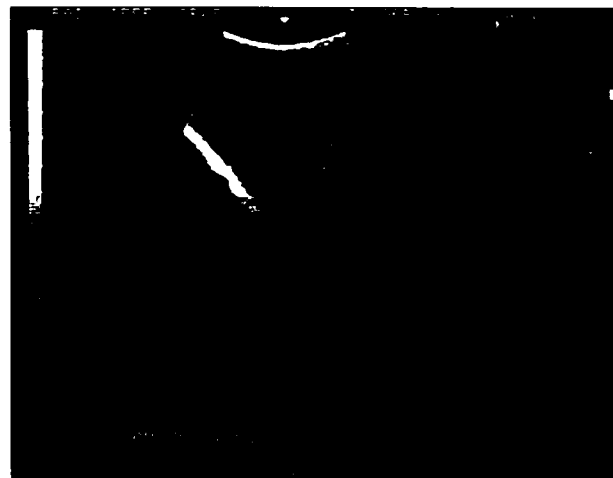
8 mg diprenorphine

plus 75 mg naltrexone mixed IV

### Sternal position

Total down time = 25 min

Reproductive status: Suspect late term pregnancy, but fetus not visualized so will need to monitor in field





# TSWALU KALAHARI RESERVE RHINO DATA SHEET 2001

Subject No. 13 Species: *Ceratotherium simum simum*

Date: 20 August, 2001

Location: Kalkpan, Tswalu south

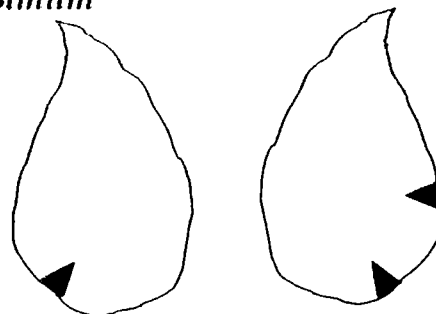
Ear Identification: No. 13

Estimated age: ~3.5 years based on size

Calf: Yes

Pregnant: Not pregnant; left ovary imaged

Estimated calving date: N/A



## Anesthesia summary

### Dart:

3 mg etorphine  
30 mg azaperone  
2500 IU hyalase

### IV at arrival:

20 mg nalorphine  
15 mg midazolam

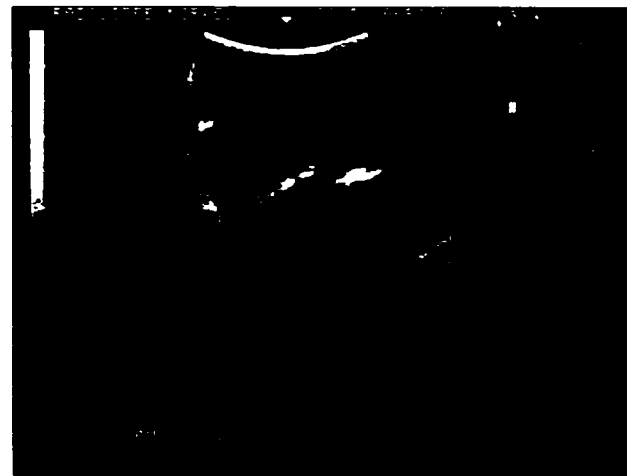
### Reversal:

8 mg diprenorphine  
plus 75 mg naltrexone mixed IV

### Sternal position

Total down time = 25 min

Reproductive status: normal nonpregnant young female with evidence of follicular activity, but no evidence of recent ovulation



Left ovary:  
Small follicle with no evidence of recent  
ovulation



# TSWALU KALAHARI RESERVE RHINO DATA SHEET 2001

Subject No. 14 Species: *Ceratotherium simum simum*

Date: 23 August, 2001

Location: Koranna, Tswalu north

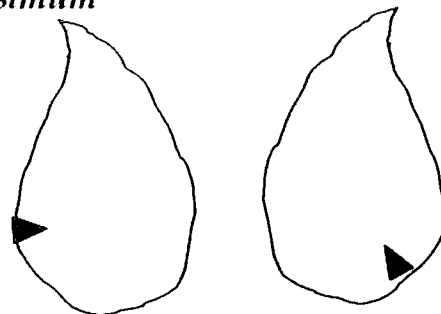
Ear Identification: No. 21

Estimated age: ~15 years based on size

Calf: Yes, ~2 year old calf at foot

Pregnant: Unknown – possible late term pregnancy

Estimated calving date: Unknown



## Anesthesia summary

### Dart:

3 mg etorphine  
30 mg azaperone  
2500 IU hyalase

### IV at arrival:

20 mg nalorphine  
15 mg midazolam

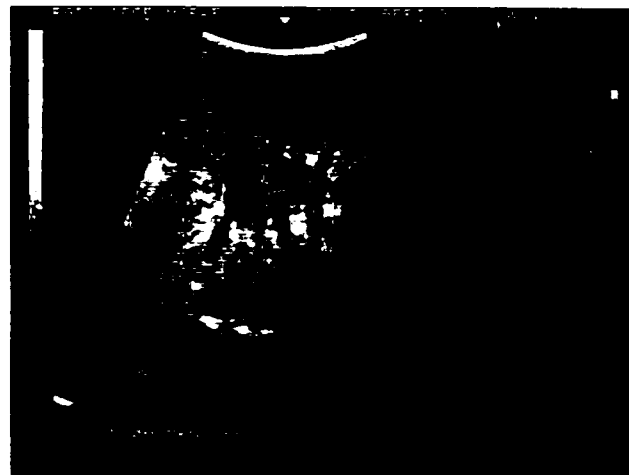
### Reversal:

8 mg diprenorphine  
plus 75 mg naltrexone mixed IV

### Sternal position

Total down time = 25 min

Reproductive status: Unknown – suspect possible late-term pregnancy based on intrauterine fluid observed without fetus



Uterine horn with fluid consistent with pregnancy, but no fetus observed



# TSWALU KALAHARI RESERVE RHINO DATA SHEET 2001

Subject No. 15 Species: *Ceratotherium simum simum*

Date: 23 August, 2001

Location: Koranna, Tswalu north

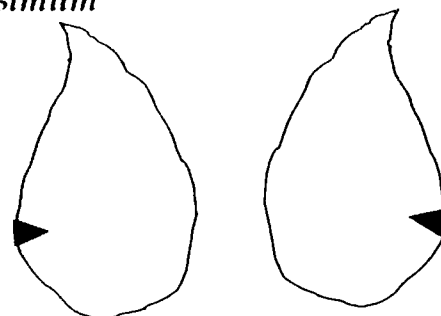
Ear Identification: No. 22

Estimated age: ~20 years based on size

Calf: Yes, ~1.5 year old calf at foot

Pregnant: 4 months pregnant

Estimated calving date: September 2002



## Anesthesia summary

### Dart:

3 mg etorphine

30 mg azaperone

2500 IU hyalase

### IV at arrival:

20 mg nalorphine

15 mg midazolam

### Reversal:

8 mg diprenorphine

plus 75 mg naltrexone mixed IV

### Sternal position

Total down time = 25 min

Mean SpO2 = 85%

Reproductive status: Pregnant; 4 months based on fetal foot measurement and fetal size

Fetal foot = 15 mm

Fetal trunk diameter = 60 mm



Fetal rear legs and female sex

Fetal foot and umbilicus



Fetal rear end with legs



Female fetus with vulva



# TSWALU KALAHARI RESERVE RHINO DATA SHEET 2001

Subject No. 16 Species: *Ceratotherium simum simum*

Date: 24 August, 2001

Location: Koranna, Tswalu north

Ear Identification: No. 23

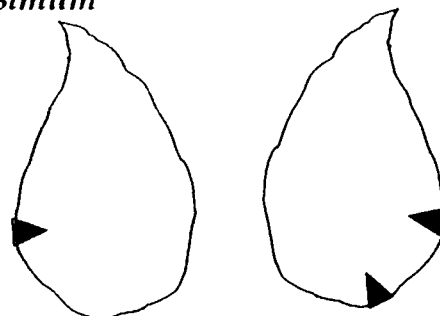
Estimated age: ~15 years based on size

Calf: Yes, ~1.5 year old calf at foot

Pregnant: 6 months pregnant

Estimated calving date: July 2002

Fetal sex: Female



## Anesthesia summary

### Dart:

4 mg etorphine

40 mg azaperone

2500 IU hyalase

### IV at arrival:

20 mg naltorphine

15 mg midazolam

### Reversal:

8 mg diprenorphine

plus 75 mg naltrexone mixed IV

### Sternal position

Total down time = 25 min

Mean SpO2 = 85%

Reproductive status: Pregnant; 6 months based on fetal foot measurement and fetal size

Fetal foot = 35 mm

Fetal trunk diameter = 110 mm



Fetal feet



Fetal foot with digits



Female fetus with mammary gland



Female fetus with mammary gland



Fetal heart



Fetal tail and vertebrae





# **APPENDIX C-2002 Data** **TSWALU KALAHARI RESERVE RHINO DATA SHEET 2002**

Subject No. 17      Species: *Ceratotherium simum simum*

Date: 28 July, 2002

Location: Legaba, predator section of Tswalu

Ear Identification: No. 17

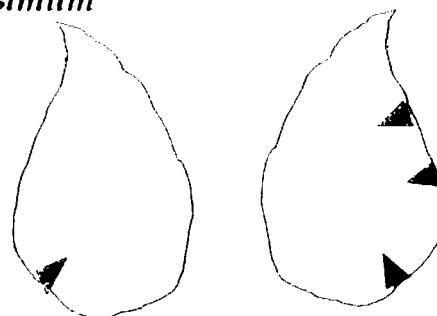
Estimated age: 25-30 years based on  
tooth and horn wear

Calf: ~3 year old male calf

Pregnant: Late pregnancy; estimate 10 months.

No fetus observed.

Estimated calving date: February 2003



## **Anesthesia summary**

Dart:

3.5 mg etorphine  
40 mg azaperone  
2500 IU hyalase

IV at arrival:

20 mg nalorphine  
15 mg midazolam

Reversal:

100 mg naltrexone IV

Reproductive status: Late-term pregnancy. Fetus not observed.



# TSWALU KALAHARI RESERVE RHINO DATA SHEET 2002

Subject No. 18 Species: *Ceratotherium simum simum*

Date: 28 July, 2002

Location: Legaba, predator section of Tswalu

Ear Identification: No. 26

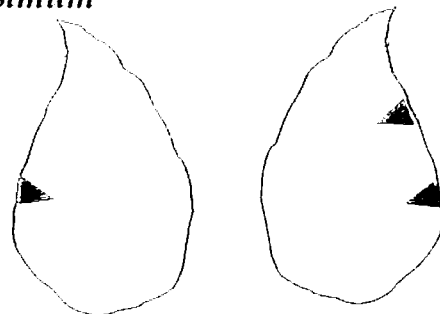
Estimated age: ~20 years

Calf: ~3 year old male calf

Pregnant: Late pregnancy; estimate 10 months.

No fetus observed.

Estimated calving date: February 2003



## Anesthesia summary

### Dart:

3.5 mg etorphine

40 mg azaperone

2500 IU hyalase

### IV at arrival:

20 mg nalorphine

15 mg midazolam

### Reversal:

100 mg naltrexone IV

Reproductive status: Late-term pregnancy. Fetus not observed.



# TSWALU KALAHARI RESERVE RHINO DATA SHEET 2002

Subject No. ~~18~~ 19 Species: *Ceratotherium simum simum*

Date: 29 July, 2002

Location: Legaba, predator section of Tswalu

Ear Identification: No. 33

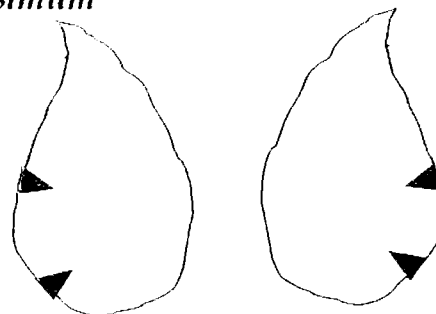
Estimated age: ~10 years

Calf: None

Pregnant: 6 months.

Fetal sex: female.

Estimated calving date: Late June-early July 2003



## Anesthesia summary

### Dart:

3.5 mg etorphine  
40 mg azaperone  
2500 IU hyalase

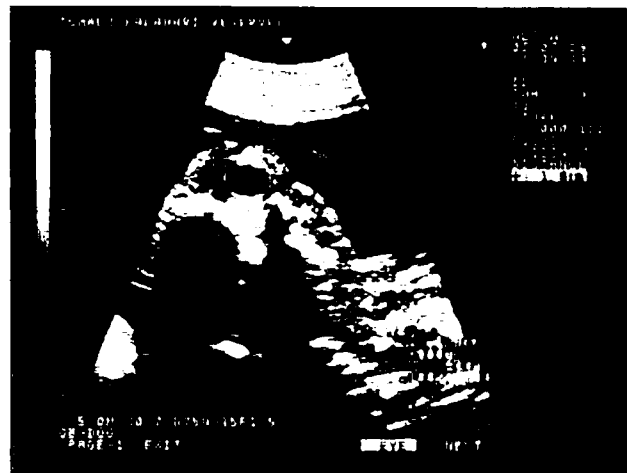
### IV at arrival:

20 mg nalorphine  
15 mg midazolam

### Reversal:

100 mg naltrexone IV

Reproductive status: Fetal eye diameter measured 15 mm consistent with a 180-day gestational age.



Fetal foot showing 3 digits characteristic of this odd-toed ungulate.



Fetal foot diameter of 38 mm, consistent with a 180-day fetal gestational age.



Female fetal sex determined by observation of fetal mammary gland.



Characteristic wide lips of the white rhino fetus.



# TSWALU KALAHARI RESERVE RHINO DATA SHEET 2002

Subject No. 20 Species: *Diceros bicornis bicornis*

Date: 31 July, 2002

Location: Korannaberg, northwestern Tswalu

Tswalu Identification: Bogale

Estimated age: 20 years

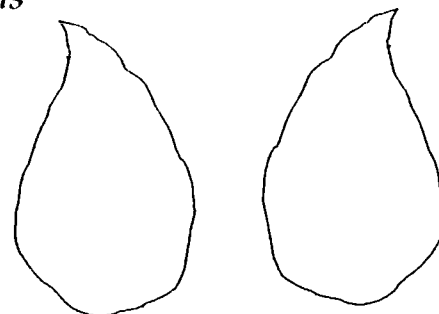
Calf: 13 month calf at side

Pregnant: Pregnant ~ 5 month fetal age.

Gestational age: 160 days.

Fetal sex: not determined.

Estimated calving date: late June – early July 2003



## Anesthesia summary

Dart:

2.5 mg etorphine

40 mg azaperone

2500 IU hyalase

IV at arrival:

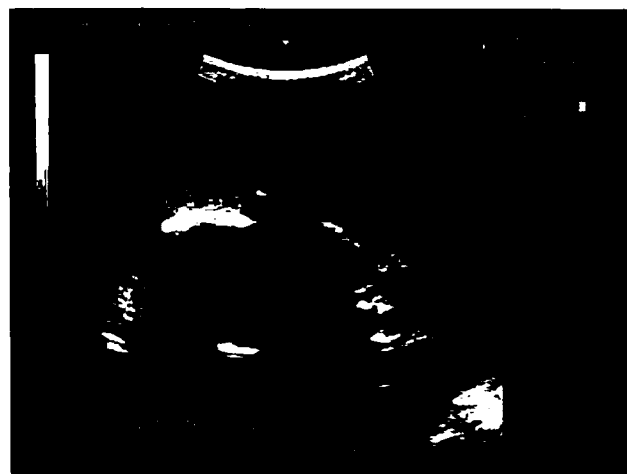
10 mg nalorphine

5 - 10 mg midazolam

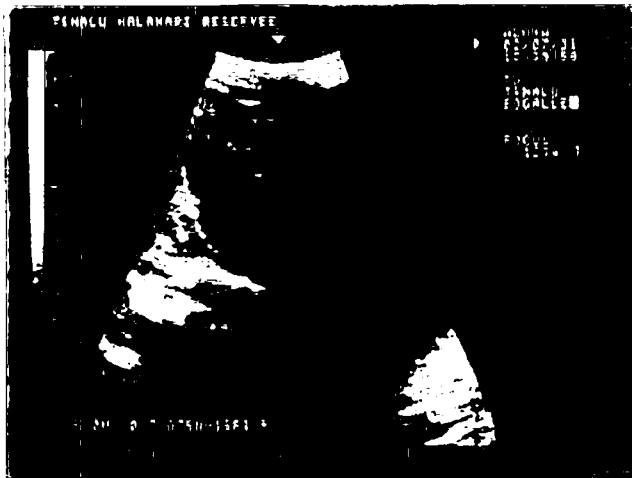
Reversal:

100 mg naltrexone IV

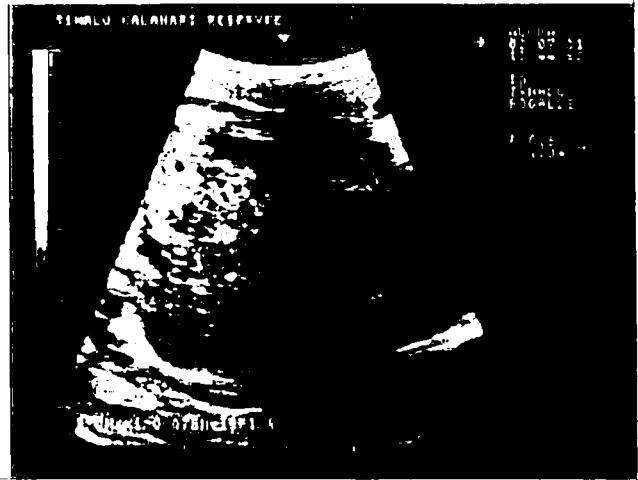
Reproductive status: Pregnant. Fetal eye measurement of 12 mm consistent with a 160 - day fetal age.



Fetal foot in cross-section.



Fetal trunk diameter of 93 mm consistent with a 150 day fetus.



### **Fetal measurements:**

Fetal eye diameter: 12 mm

Fetal foot diameter: 25 mm

Fetal head diameter: 100 mm

Fetal trunk diameter: 93 mm

Fetal sex: Not determined.

## TSWALU KALAHARI RESERVE RHINO DATA SHEET 2002

Subject No. 21      Species: *Diceros bicornis bicornis*

Date: 31 July, 2002

Location: Korannaberg, northwestern Tswalu

Tswalu Identification: Nantoni

Estimated age: 15 years

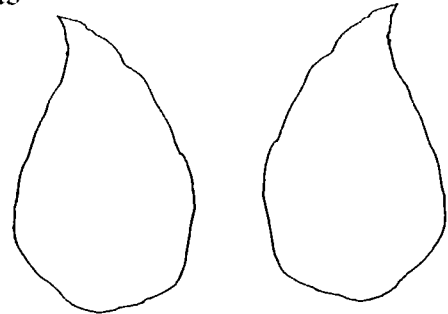
Calf: 13 month calf at side

Pregnant: Pregnant ~ 5 month fetal age.

Gestational age: 160 days.

Fetal sex: female.

Estimated calving date: late June – early July 2003



### Anesthesia summary

#### Dart:

2.5 mg etorphine  
40 mg azaperone  
2500 IU hyalase

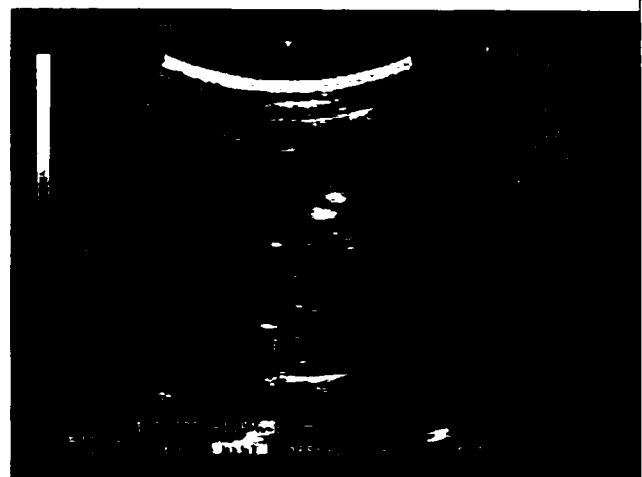
#### IV at arrival:

10 mg nalorphine  
5 - 10 mg midazolam

#### Reversal:

100 mg naltrexone IV

Reproductive status: Pregnant. Fetal foot measurement of 17 mm.



Fetal eye diameter of 12 mm consistent with a fetal age of 160 days.



Fetal eye and head image enlarged.



### Fetal measurements:

Fetal eye diameter: 12 mm  
Fetal foot diameter: 17 mm  
Fetal head diameter: 90 mm

Fetal sex: Female.



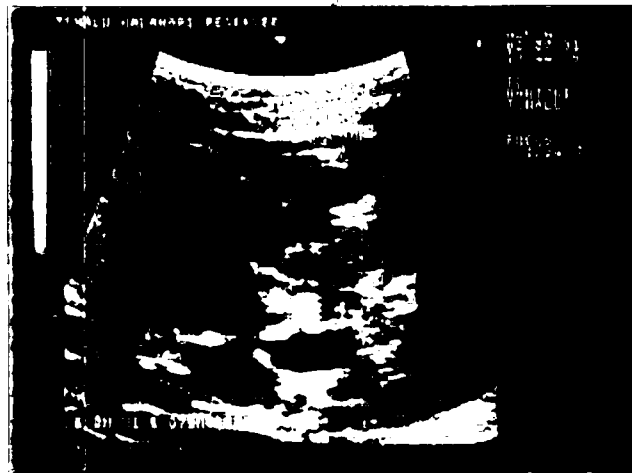
Fetal heart, ribs and liver.



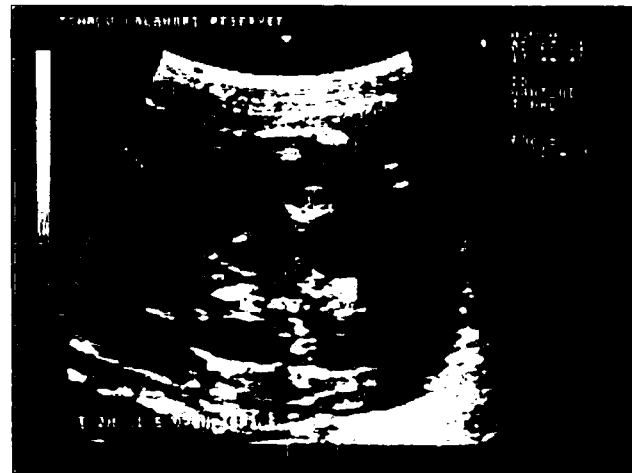
Fetal mammary gland and foot.



Female fetal sex confirmation via identification of vulva and observed connection with urinary bladder.



Female fetal sex.



## KRUGER RESERVE RHINO DATA SHEET 2002

Subject No. 22 Species: *Ceratotherium simum simum*

Date: 17 August, 2002

Location: Kruger National Park, Crocodile Bridge

Identification: Kruger ID#65

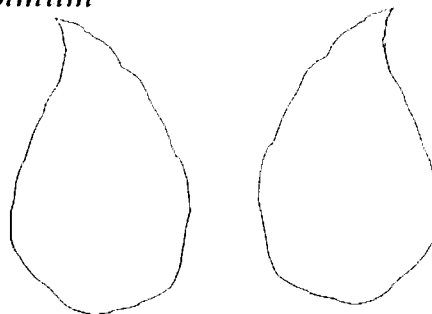
Estimated age: ~10 - 15 years based on size

Calf: ~14 month-old calf at foot

Pregnant: Estimated ~7 months pregnant (210 days)

Fetal sex: Unknown

Estimated calving date: June 2002



### Anesthesia summary

#### Dart:

4 mg etorphine  
40 mg azaperone  
2200 IU hyalase

#### IV at arrival:

15 mg nalorphine  
1 mg Diprenorphine

#### Crate loading:

12 mg Diprenorphine IV

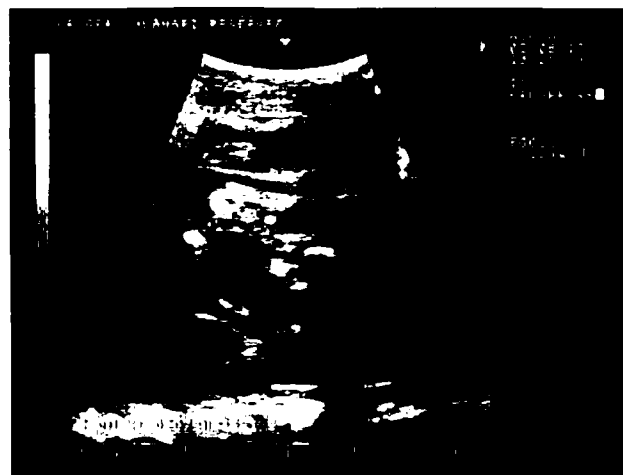
#### Off-loading into boma:

100 mg Naltrexone IM  
80 mg Azaperone IV

#### Capture:

Markus darted rhinos from Eurocopter with  
Martin as pilot

Reproductive status: Pregnant ~7 months,  
estimate gestational age to be 210 days  
based on fetal eye diameter of 16mm and  
rib diameter of 10 mm.



Fetal rib diameter of 10 mm is consistent with a fetal age of approximately 7 months.



### **Fetal Measurements:**

Fetal Eye = ~ 16 mm

Fetal Rib diameter = 10 mm

Fetal sex: Unknown

## KRUGER RESERVE RHINO DATA SHEET 2002

Subject No. 23      Species: *Ceratotherium simum simum*

Date: 17 August, 2002

Location: Kruger National Park, Skukuza boma

Identification: Kruger ID#64

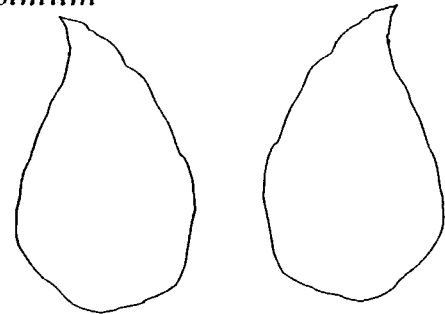
Estimated age: ~5 years based on size

Calf: None

Pregnant: Non-pregnant

Fetal sex: NA

Estimated calving date: NA



### Anesthesia summary

Dart:

1 mg etorphine

IV at arrival:

15 mg nalorphine

Crate loading:

1 mg Diprenorphine IV

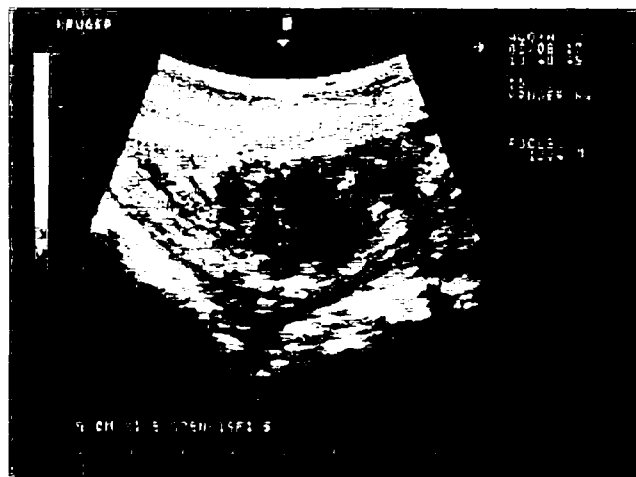
### Capture:

Markus darted rhino in Skukuza boma for translocation to Specialist Game Services for sale in South Africa.

Reproductive status: Non-pregnant uterus.



Cervix of nonpregnant rhino.



## KRUGER RESERVE RHINO DATA SHEET 2002

Subject No. 24      Species: *Ceratotherium simum simum*

Date: 17 August, 2002

Location: Kruger National Park, Skukuza boma

Identification: Kruger ID #43 (SGS# 3)

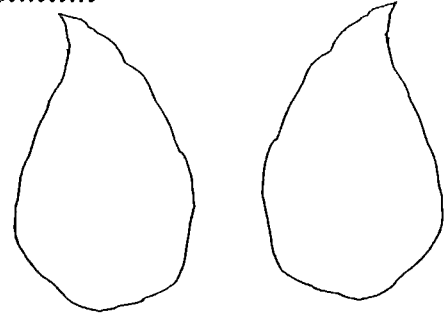
Estimated age: ~10 years based on size

Calf: None

Pregnant: Pregnant; Gestational age = 5 months

Fetal sex: Female

Estimated calving date: August 2003



### Anesthesia summary

Dart:

1 mg etorphine  
5 mg Midazolam

IV at arrival:

5 mg Nalorphine

Crate loading:

1 mg Diprenorphine IV

Capture:

Markus darted rhino in Skukuza boma for translocation to Specialist Game Services for sale in South Africa.

Reproductive status: Pregnant with an estimated gestational age of 5 months based on fetal eye measurement of 11mm and fetal foot diameter of 22 mm.



Rear feet of rhino fetus in cross-section.



Female fetus based on visualization of mammary gland.



### Fetal Measurements:

Fetal eye diameter: 11 mm

Fetal foot diameter: 22 mm

Fetal sex: Female

## KRUGER RESERVE RHINO DATA SHEET 2002

Subject No. 25      Species: *Ceratotherium simum simum*

Date: 17 August, 2002

Location: Kruger National Park, Skukuza boma

Identification: Kruger ID#26 (SGS# 4)

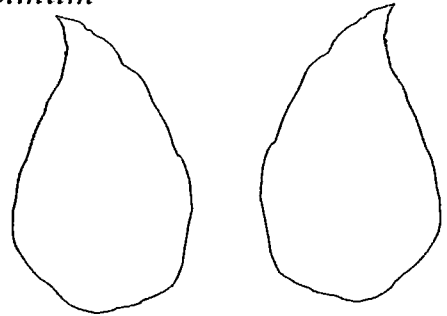
Estimated age: ~15 years based on size

Calf: None

Pregnant: Not Pregnant

Fetal sex: NA

Estimated calving date: NA



### Anesthesia summary

Dart:

1.2 mg etorphine

5 mg Midazolam

IV at arrival:

5 mg Nalorphine

Crate loading:

1 mg Diprenorphine IV

Capture:

Markus darted rhino in Skukuza boma for translocation to Specialist Game Services for sale in South Africa.

Reproductive status: Non-pregnant uterus.





Multiple small follicles on right ovary.



## KRUGER RESERVE RHINO DATA SHEET 2002

Subject No. 26      Species: *Ceratotherium simum simum*

Date: 20 August, 2002

Location: Kruger National Park, Skukuza boma

Identification: Kruger ID#29

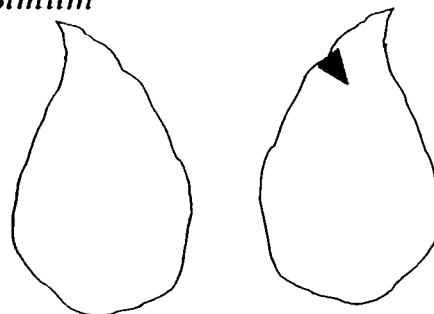
Estimated age: ~8 to 10 years based on size

Calf: None

Pregnant: Not Pregnant

Fetal sex: NA

Estimated calving date: NA



### Anesthesia summary

#### Dart:

2 mg etorphine

5 mg Midazolam

#### IV at arrival:

10 mg Nalorphine

#### Crate loading:

1 mg Diprenorphine IV

#### Capture:

Peter Buss darted rhino in Skukuza boma for translocation to Marakele National Park.

Reproductive status: Non-pregnant uterus; Estrus female or possible evidence of uterine pathology characterized by intrauterine fluid collection (IFC). These collections may be normal during estrous, but are considered abnormal during diestrous. A 30 mm POF correlates with a female in estrus rather than pathology, but this female should be monitored for future infertility.



Preovulatory follicle on right ovary  
indicative of cyclic activity and possible  
estrous period of cycle.



## KRUGER RESERVE RHINO DATA SHEET 2002

Subject No. 28 Species: *Ceratotherium simum simum*

Date: 20 August, 2002

Location: Kruger National Park translocation to Marakele

Identification: Kruger ID#58

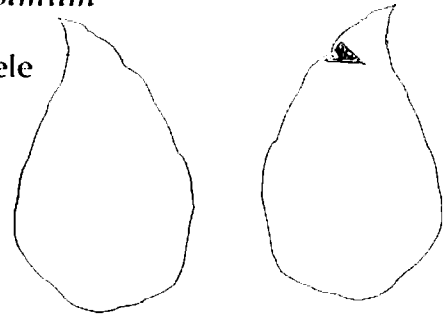
Estimated age: ~8 to 10 years based on size

Calf: None

Pregnant: Pregnant 90 days

Fetal sex: Male

Estimated calving date: October 2003



### Anesthesia summary

#### Dart:

1 mg etorphine

1.5 mg etorphine supplement

#### IV at arrival:

5 mg Midazolam

#### Crate loading:

10 mg Nalorphine IV

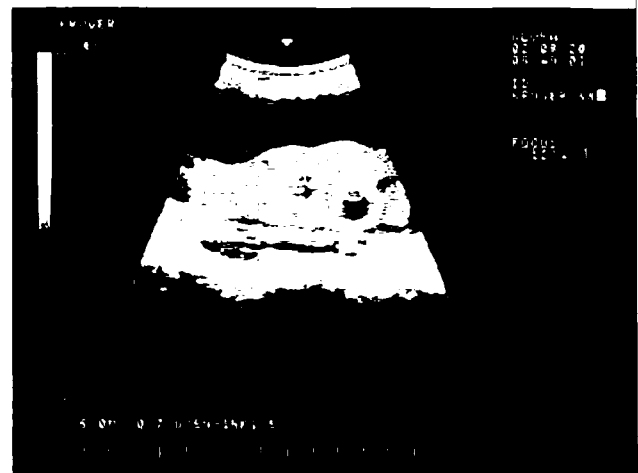
0.6 mg Diprenorphine IV

plus 4.8 mg Diprenorphine IV

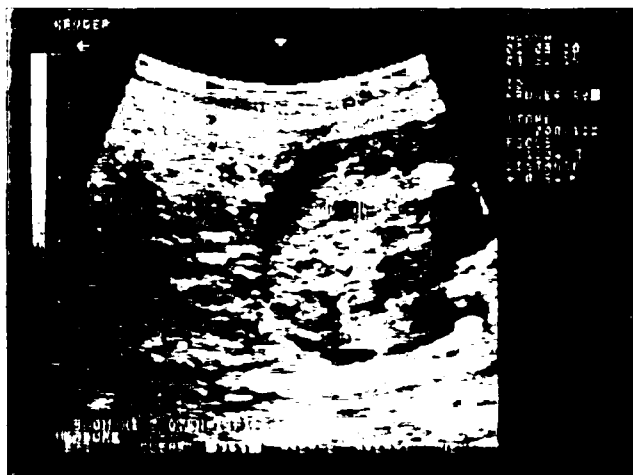
Reproductive status: Pregnant; 90 day-old fetus.

### Capture:

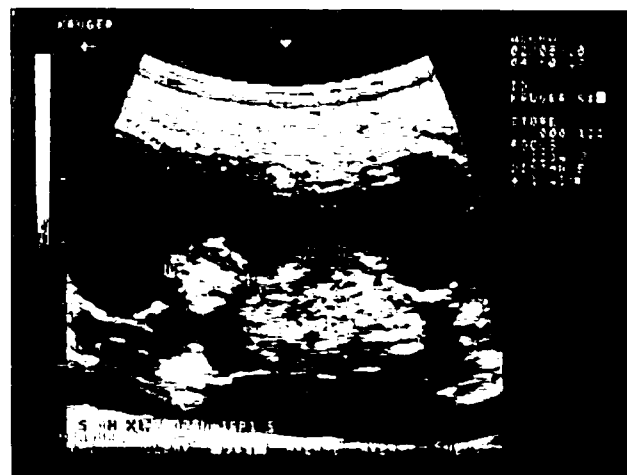
Peter Buss darted rhino in Skukuza boma for translocation to Marakele National Park.



Fetal eye measurement of 5 mm consistent with a 90 day fetus.



Fetal foot measurement of 24 mm consistent with a 90 day gestational age.

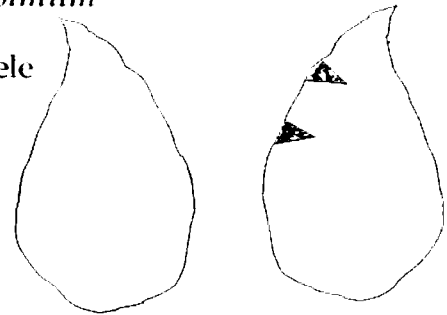


Male fetus with visible prepuce located between rear legs adjacent to the umbilicus.



## KRUGER RESERVE RHINO DATA SHEET 2002

Subject No. 29      Species: *Ceratotherium simum simum*  
 Date: 20 August, 2002  
 Location: Kruger National Park translocation to Marakele  
 Identification: Kruger ID#21  
 Estimated age: Adult female  
 Calf: Subadult calf aged ~5 years at side  
 Pregnant: Pregnant > 10 months  
 Fetal sex: Unknown  
 Estimated calving date: ~March 2003



### Anesthesia summary

Dart:

1.5 mg etorphine

IV at arrival:

5 mg Midazolam

Crate loading:

20 mg Nalorphine IV  
 1.2 mg Diprenorphine IV  
 plus 3.6 mg Diprenorphine IV

Capture:

Peter Buss darted rhino in Skukuza boma for translocation to Marakele National Park.

Reproductive status: Late-term pregnancy; estimated GA to be greater than 10 months. Fetus not observed.

