ROUND THE HORN

REPORT ON THE IMMOBILISATION OF NORTHERN WHITE RHINOS

(Ceratotherium simum cottoni)

FOR RADIO-TELEMETRY

AT GARAMBA NATIONAL PARK, ZAIRE

WWF PROJECT 1954.01/ZR0009.02

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by Kes Smith, Mbayma Atalia, Peter Morkel and Fraser Smith

1 SUMMARY

From 1st to 6th June 1992 four northern white rhinos (Ceratotherium simum cottoni) were immobilised and radio collars were fitted to three of them. At the same time they were measured, ear notched for long term identification, all identification marks noted, medicated and samples of blood were taken for genetic and disease analysis, and ticks for identification.

No major problems were encountered and the animals have shown no sign of ill-effects.

2 INTRODUCTION

2.1 Background

The northern white rhinos (Ceratotherium simum cottoni) at Garamba National Park in north eastern Zaire represent the last known wild population of this sub-species. When the Garamba National Park Project (GNPP) first started in 1984 there were only 15 remaining. Now there are 31, but they are at a density of only 0.003/km2. This makes them very difficult to find for protection and study.

Radio-telemetry of the rhinos was first proposed in 1983 to improve the chances for protecting and monitoring them. It was decided at the time that the possible risks to so valuable a population from the immobilisation were not justified, and it has proved possible to give them a reasonable degree of protection through general improvements to anti-poaching. However, as the population expands, and poaching pressure resulting from the Sudanese war increases, the protection and monitoring is becoming more difficult and more detailed studies also suffer from the time it takes to locate rhinos.

The sub-adults cause particular problems of location and identification. When young they are identified relative to their mothers. When they leave the mother only sex, estimated age, nose wrinkle patterns and ear hair serve to identify the individuals. The latter two are no use for aerial monitoring. The former can often only bring the choice down to one of two or three different individuals. The sub-adult males also disperse to peripheral areas, where they are particularly difficult to find. Some individuals are not seen for a year or more at a time and during that period one cannot be sure of their continued survival. In order to make more detailed

studies of feeding behaviour, communication and diurnal activity there was also a need to be able to find the rhinos more easilly.

In early 1992 the Président Délégue Géneral of the Institut Zaïrois pour la Conservation de la Nature agreed to the radio-collaring of a sample of the rhinos provided that it was carried out by a suitably qualified and experienced veterinarian and that all possible precautions were taken to ensure the safety of the rhinos.

Dr Peter Morkel of International Wildlife Veterinery Services (IWVS), and Dr Luis Geldenhuys of Etosha Institute of Ecology were chosen do do the immobilisations and, thanks to their efforts, IWVS organised and purchased the transmitters and receivers, and the Elephant and Rhino Foundation paid for their travel. Due to problems of timing, Dr Geldenhuys was, in the end, unable to participate.

2.2 Objectives

The objectives of the immobilisations and the use of radio-telemetry were as follows:

1) To improve the protection of the rhinos, both directly by knowing their locations and having feed-back on problems, and indirectly by gaining a better undestanding of their ranges , habitat use and social interactions.
2) To facilitate more detailed studies, specifically those of feeding behaviour in relation to the use of termitaria, communication, sub-adult behaviour and social behaviour in relation to known inter-individual relations.
3) To profit from the immobilisations enable sampling of blood and tissue for genetic analysis of this small population, for pathological investigations. They of diseases

3 METHODS

3.1 Personnel

Dr Peter Morkel	-	Veterinarian: immobilisation, medication, blood sampling, ear notching.
Dr Kes Smith	-	Identifications,measurements, tooth impressions, photography, radio-telemetry
Dr Mbayma Atalia	-	Identifications, measurements, tooth impressions, veterinary assistance, radio-telemetry
Fraser Smith	-	Pilot: locating rhinos,guiding ground teams, keeping track of rhinos post-darting, flying to test radio telemetry;
Brian Clarke	-	Collar attachment
C.P.Muhindo	-	Observer, radio communication
Eza Kobode & Atama-to	-	General assistance
Tandu	-	Aerial observation
Bruce Davidson	-	Filming
Annette Lanjouw	-	Photography, radio communication

3.2 Equipment

Palmer CapChur Powder Projector - GNPP
Darts, drugs etc - Dr P.Morkel
Radio collars: MOD 505 with antennae TA-5HT/Int/Dip and receivers: TR-4, frequency 172 MHz, by Telonics - IWVS
Liquid nitrogen flasks manufactured by Taylor Wharton - Dr W.B.Karesh and Dr R.Aman
Centrifuge, 12 volt 'Mobilespin' by Vulcan Technologies - GNPP
Aircraft - PA 12 - Smiths and Wildlife Conservation Fund, and C-206 - GNPP; fuel and maintenance by WWF and FZS
Vehicles - GNPP
Radios by Motorola - GNPP

3.3 Rhino location

The method of locating and darting the rhinos was basically as described for biopsy darting (Smith et al 1992, internal report). In this case, however, since specific animals were required, the first flight was accompanied by K. Smith and Mbayma to identify and choose the rhino. The ground team, including Smith and Mbayma then went by vehicle and by foot to the approximate location of the rhinos. F.Smith in the aircraft directed the ground team to the rhinos, staying high to avoid disturbance. He kept the rhinos in sight post-darting and guided the ground team to them when they went down. This was vital to ensure the safety of the operation and minimise the time the rhinos were down. The grass was too long for good visibility on the ground.

Flying time necessary was up to 8 hours a day. The totals up to 7th June were:

5Y-KEZ	16.9 hrs
9Q-CBR	7.4 hrs

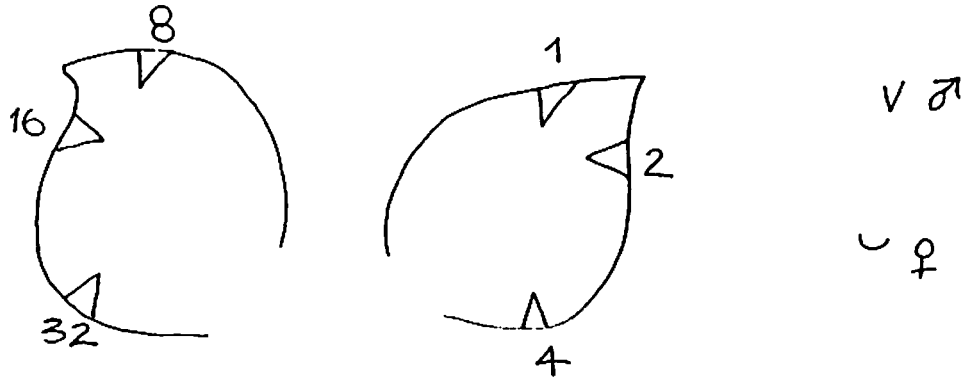
3.4 Immobilisations

Immobilisation was carried out with a mixture of M99, Domosedan and Hyaluronidase, reversal with M 50-50. Details of individual dosages and responses are given in Annexe I. Rate of breathing was monitored throughout and the animals were kept in sternal recumbancy during the period of immobilisation except for a brief period of lateral recumbancy to allow for tooth impressions and blood sampling. Dart wounds were treated with anti-biotics and in the case of the male bearing the wounds from fighting, his other wounds were also treated.

3.5 Measurements and samples

The rhinos were measured according to the enclosed data sheet and nose wrinkle patterns were drawn. Blood samples were taken and later separated by centrifuging into serum, buffy coat and red blood cell fractions before freezing in liquid nitrogen. The piece of ear removed by ear notching was kept as a skin sample for genetic analysis. Part was kept whole and refrigerated. Part was frozen in culture medium

The ear notching system was as follows:



An attempt was made to take tooth impressions using dental acrylic on a plastic support. The mouth was held open with an adjustable scissor-like wedge. It was made of two long pieces of wood hinged together at one end and covered at that end with plastic to protect the gums.

3.6 Radio-collaring

Radio collars were chosen as the mounting for the transmitters rather than horn or ear tag mounts because:

- Collars have been used successfully on rhinos in the past, eg on both black (Diceros bicornis) and white rhino (C.s.simum) in Pilanbesberg National Park and on the greater one-horned rhino (Rhinoceros unicornis) in Royal Chitwan National Park (Hillman 1982, Dinerstein pers.comm.)
- They are tried and tested pieces of equipment manufactured by a good company, which should therefore be reliable.
- Collars generally have a good range and long battery life, both important factors in Garamba, where the rhino range is over 1000 km2 and long term follow up is forseen.
- Collars are quick and easy to attach where infrastructure is minimal and it is difficult to get personnel and equipment quickly to an immobilized rhino. In addition the first author has had unsatisfactory results with horn mounts.
- Collars could serve as a visual deterrent to poachers and can help guards in rhino monitoring.

However Leader-Williams working in Luangwa Valley found problems with wide collars rubbing the ears of black rhinos, (pers.comm.) and white rhinos have a narrow space in which the collar can fit between ears and neck humps. Morkel and others working in Namibia have avoided this problem by modifying the collars, and this proceedure was followed here.

The radio collars were basically the standard MOD 505 manufactured by Telonics, where the transmitter hangs below

the neck and the two ends of the dipole antenna pass up on either side of the animal's neck, sandwiched in the collar. The collar was cut off at the ends of the antennae, whose tips were pulled through a hole to the outside of the collar to extend the range. Heavy duty upholstry elastic in a loose canvas sleeve was then sandwiched between the two layers of one end of the collar and rivetted in place. On the rhino this part then went over the head behind the ears and was rivetted into the opposite side of the collar with the canvas concertina-ed to allow for expansion. This modification has the dual advantages of protecting the rhino from any abrasive damage and allowing for expansion due to growth of young rhinos. It has the disadvantage that it would not last as long on the rhino as a standard collar.

Reception of transmission and searching for the collared rhinos were carried out both on the ground with the hand held antennae and from the air with the two antennae mounted on the wing struts of the aircraft, pointing at an angle outwards and joined to a single receiver with a right/left switch box.

4 RESULTS

4.1 Rhinos

Three sub-adult female and one young male rhino were immobilized. They were provisionally identified as 4dF 'Minzoto', 4cF 'Noel', 5bF 'Grizmek' and either M7 'Moitier' or 1aM 'Moke' or 4aM 'Bolete Moke', but confirmation of these identifications awaits the results of genetic analysis.

Collars were placed on all except 4c. 4c and 4d were in a group together. 4c was the first one darted but she did not go down. The dart remained in her neck but it had penetrated the skin at an angle and it appeared that little or no drug entered the muscle. The second time she was darted, 4d was lying down in front of her. As the dart was fired she got up and it hit 4d at the base of the horn. She responded to the drug and so she was measured, sampled and collared instead. 4c was successfully darted a following day and the dart was removed, the wound treated and all other measurements and samples were taken. She was not collared since the dart wound was on her neck and the presence of the collar might have stimulated an abscess to develop.

All other immobilizations were straight-forward. Induction times varied from 3.45 to 11 minutes and the rhinos moved between 250 and 800 metres before going down. Details of the responses to the drugs are given in Annexe I. Individual measurements and other records are given in Annexe II

The peripheral young male was found to have horn wounds from fighting. His right eye was closed up and slightly clouded, the left eye had a wound just behind it. He had other wounds on his neck and rump. All were treated withy anti-biotic.

As provisional permission had only been received in February and funds had to be found, equipment purchased and full permission cleared within the confines of the dry season when the grass is short enough for effective field work, the immobilisations were carried out well into the wet season, with little time available. It was therefore decided to collar only three rhinos at this stage, to follow up the effect on them and, if there were no problems, to collar more at the start of the next dry season.

4.2 Samples

Details of the blood and skin samples collected are given in Annexe III. The ticks were taken by Dr Morkel to Dr J.Walker at the Veterinary Research Institute, Onderstepoort.

The tissue samples taken to Professor Harley have been successfully cultured. The main genetic analyses are still to be carried out by Dr R.Aman at the Dept. of Molecular Genetics, National Museums of Kenya. All results are to be returned to the Park and to the IZCN.

The purposes of the genetic analysis of this and the material collected by biopsy darting are:

- Establish genetic variability within the population
- Establish parental lines and degrees of inter-relationship
- Establish juvenile paternities and the contribution to breeding by all the adult males
- Compare the genetics of the northern and southern sub-species of white rhinos.

Some problems were encountered with the tooth impressions. We have previously done many successful impressions of elephants using plasticene. However, the recent batch of plasticene had been of poor quality and it was decided to use the best materials for the rhinos. The use of dental acrylic and the design of bases had been successfully tested on a rhino skull in the museum. However, the tooth row of a white rhino only begins some 15 to 20 cm into the mouth and ends about 40 cm (a forearm length) in. The mouth is not designed to open very wide and there are 5 to 6 cm of tough grass plucking lips to penetrate. The dental acrylic sets so fast that there is very little time to manouver. In addition the rhinos needed to be kept in sternal recumbancy most of the time, in which position the mouth is resting firmly on the ground.

In one case, to ensure the safety of the rhino, it was not turned on its side at all. In all other cases the time spent laterally was kept to a minimum and little time was possible to try the impressions. On the second rhino the period on its side was kept to the last to finish all other work first. By this time the rhino was beginning to come round and rebelled against opening its mouth. For the latter two, therefore, the period of time spent laterally to allow for tooth impressions and blood sampling was carried out earlier. We suceededin

getting incomplete impressions from two of the rhinos and feeling out wear of other teeth with fingers. The wedge will be re-designed and good quality plasticene used in future.

4.3 Telemetry

The Telonics equipment is very functional and well made.The transmitters were all working when tested and the receivers are small, light and compact and ideal for field work on foot.

Range of reception of signals was at first disappointing. Even from the air at the normal rhino search height of 300 feet a.g.l. range of reception with line of sight, on initial tests, was only 2km.

The terrain is gently undulating, with no points of elevation close to the rhino area for tracking from the ground. The grass was about a metre high at the time of immobilization and has been growing rapidly ever since. The terrain and the length of, often damp, grass may therefore reduce the range of transmission. When consulted, Telonics suspected cables, headsets and insufficient electrical screening on the aircraft and offered much useful advice.

However, subsequent work has yielded better results. By increasing aircraft height to 1,500 feet a.g.l. we have received signals at 15 km. On the ground with line of sight we have received signals at 6 km. The body of the rhino attenuates the signal to a certain extent, particularly depending which way it is facing and the strongest signals even at 5 km from the ground, have been received from a detached collar, lying on the ground. We have also found that the signal is stronger when the receiving antenna is in the same line as the transmitting antenna, i.e. vertical when the rhino is standing, horizontal when it is lying down. However, this has the advantage that one can use these factors to obtain limited information on activity before seeing the rhino.

5 FOLLOW UP

5.1 Rhino Observations

Follow up has been both from the air by K. and F.Smith and Mbayma, and from the ground by K.Smith and Mbayma with the guards Eza and Atama. The idea of having continual monitoring on the ground by the above guards has not proved very feasible during the long grass season. With reduced reception and visibility due to grass height and with the extent of the rhino movements, it is necessary to have a vehicle available to search the area and to provide a high platform. Dr Mbayma, with his vehicle, has not been able to spend as much time on the terrain as he had planned.

Results so far have been extremely interesting. We have found more change in the composition of the sub-adult groups than we had previously been able to guage. We have been able to observe the moves to attempted territorial take-over by the young male and we have been able to investigate further the question of inter-individual communication. We have also been able to direct patrols to cover areas not previously considered high priority for rhino protection.

The locations of the collared rhinos until mid-August are shown on the accompanying map (Fig.1).

The two sub-adult females did not move great distances. The areas of the extended polygons surrounding their locations to date are 34 and 43 km2 respectively. The first sub-adult female immobilised, referred to for tracking npurposes as Channel 1, was with and older sub-adult female at the time. They were believed to be 4d and 4c, aged 3yrs 10 months and 5yrs 8 months. 4c had remained with her mother F4 after the birth of 4d, and they had occasionally been joined by another sub-adult female, believed to be the next oldest sister, 4b. They were thus a close knit family. When 4eF , 'Sifa' was born these two sisters left, possibly chased out from, F4's immediate family group. However they could often be seen from the air following her at a distance. We were therefore particularly keen to collar one to get more chance to investigate communication and to increase the possibilities of finding the mother calf pair. We were surprised therefore when, subsequent to the immobilisations the two did not rejoin each other. The older female remained close by when the younger was immobilised, but as she was the one with the dart in her neck, she was then immediately stalked herself as soon as 4d had recovered. She therefore moved off. On many subsequent occasions, however they were within a few kilometres of each other, but channel 1 (4d?) remained alone on all our observations except for a temporary association with F4 and 4e. On one occasion when we were tracking her from the ground, she became aware of us and approached very close. This is a phenomenon two of the authors have noted before with lone sub-adults. They appear to be seeking company. The older sub-adult (4c?) subsequently joined up with the other collared female, Channel 3, who is believed to be 5b 'Grizmek'.

This second collared female, Channel 3, was with a young male sub-adult when darted. We identified them as 5b and 5c. He stayed close by the whole time she was immobilised and after she was revived they called to each other with the 'mewing' call and 'huff-panting' and rejoined. We then saw them together until the female apparentely came into oestrus. The young male was chased away by M9 'Notch' and the female joined up with 4c.

The peripheral young male who was located several kilometres west of the core rhino area was found to have horn wounds and had almost certainly been trying to take over a territory or mate with females in another male's area. He is fully grown

and well muscled, but his horns are still relatively short. He remained in the western area, along the Willibadi I river for two weeks and was invariably hidden in patches of long grass. On 20th June we found that he had moved east and south to the Willibadi II and on 8th July he was found north of there close to the edge of M9's territory. We remarked that he appeared to be moving back for another try. On 3rd August we found him between Eleti I and II, well within M9's area and in a region currently frequently used by females and sub-adults. We failed to get a signal from himion 4th but on 5th we received a strong signal from 5km away. It took time to get round to that region down-wind, and as we approached we saw M9 feeding in the direction of the signal and Channel 2, the young male walking rapidly south out of M9's home range. We followed him but as he was moving too fast for any sound recording, which was the purpose of the day's work, we left him to follow M9, who went to drink and then to rest beneath a tree. We later found Channel 2's collar in an area of well trampled grass where the two males had obviously been fighting.

5.2 Collar longevity

Signal strength of the transmitter is still as good as when the collars were first attached. Two of the collars have, however come off after two months.

The first was the first collar fitted, channel 1 on 4d. It was attached on 3rd June and came off shortly before 3rd August. We found it close to a fallen dead tree, a chip of which was broken off. It appeared that the rhino had caught the collar in a projection of the tree and broken it. If the chipped part of the tree was indeed where she had broken the collar, it appeared to be a relatively focused action rather than the passing result of general rubbing, since the chip was at one end of the tree. It broke at the point of attachment of the elastic to the collar material.

The young male's collar, Channel 2 was fitted on 6th June. It came off in the early morning of 5th August in the process of a fight between two males. It also broke at the point of attachment of elastic to collar.

In mid September the third collar was still on a rhino.

Collars with a modified elastic insert have stayed over four months on rhinos in Namibia and are still on. However the environment is much dryer there. Average annual rainfall in Garamba is 1300 mm. and these collars were on during the wet season. The main body of the elastic is still in good condition, but the canvas had rotted and torn exposing the vulnerable point of entry into the stiff material of the collar.

We feel that the elastic-modified collars are well worth while for the safety and comfort of the rhino, but that at least two

layers of elastic are needed, stronger canvas and possibly reinforcement at the point of attachment.

6 PROPOSED FUTURE ACTION

We propose to continue radio-collaring as early as possible in the forth-coming dry season to allow maximum time for intensive follow up. The unused collars would be put on and those that have come off would be replaced, that from the male onto the same animal, the others onto different sub-adults. Double elastic and reinforcing will be used.

We propose to attach to a sample of the collars a solid state digital sound recorder (Gulick S. pers. comm.) in order:

a) To make good recordings of all rhino communication by sound,

b) To investigate communication by infrasound

c) To study rhino sound communication at low density and within known inter-relationships.

To maximise the safety of the rhinos it is important that Dr Morkel carries out the immobilisation. Funds are required to cover his travel. We are also seeking development funds for the sound recorder.

7 REFERENCES

Hillman K (1982) Follow up to the Introduction of Black rhinos (Diceros bicornis) to Pilanesberg National Park. Bophutatswana National Parks, Internal report.

8 ACKNOWLEDGEMENTS

We are very grateful to WWF and FZS in collaboration with the IZCN for assuring the conservation of the rhinos and supporting aspects of this work through the Garamba National Park Project. We are extremely grateful to International Wildlife Veterinary Services for ordering, purchasing and sending the telemetry equipment and to the Rhino and Elephant Foundation for supporting the travel expenses of Dr Morkel and Dr Geldenhuys and for contributing to the costs of the equipment. We thank the IZCN for allowing the work to be carried out.

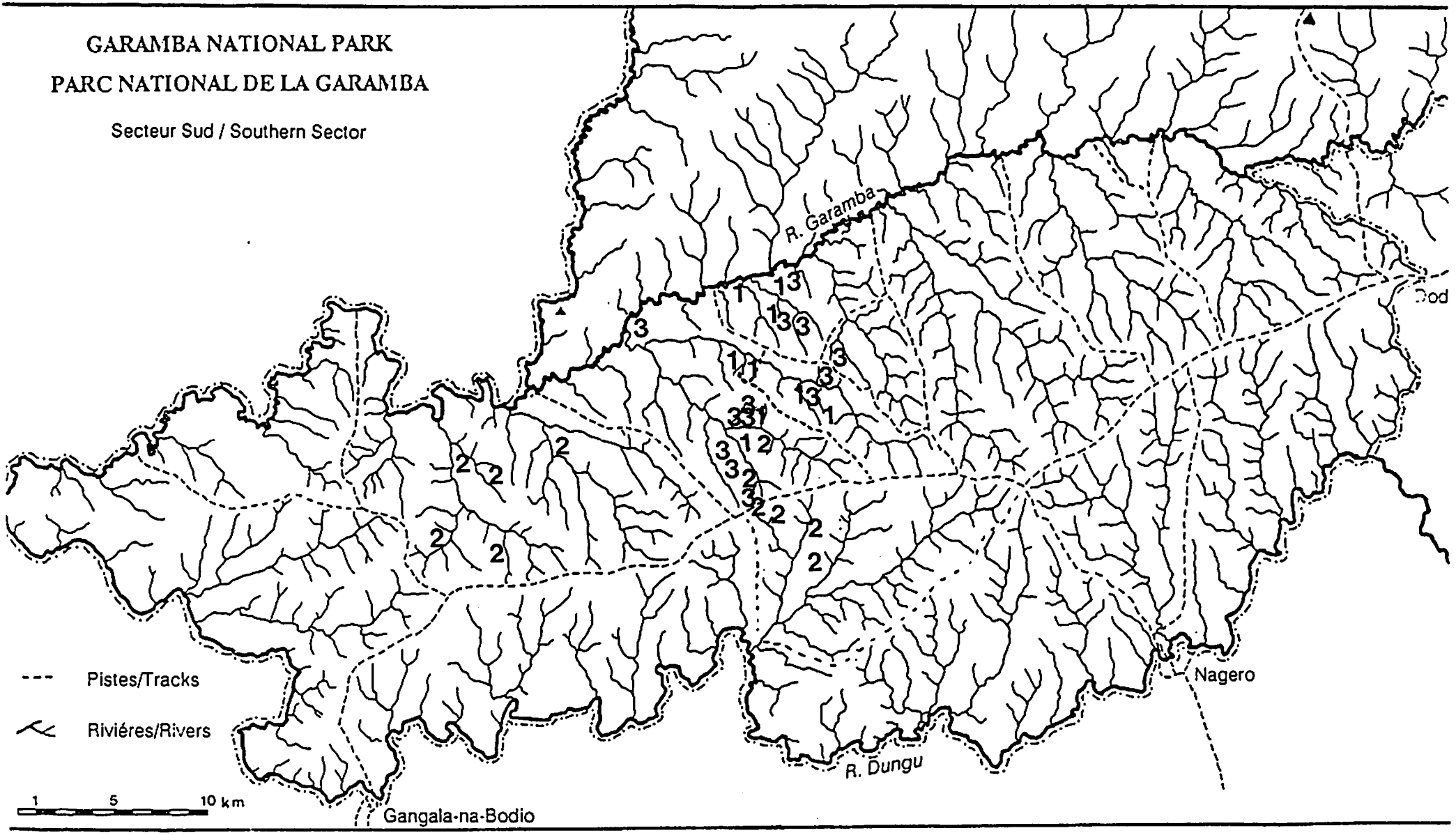


Fig 1.
LOCATIONS OF RADIO COLLARED RHINOS, June-August 1992
LOCALISATIONS DES RHINOS PAR RADIO-TELEMETRIE, Juin-Aout 1992
(1:Channel 1,4d; 2:Channel 2,M7/1a/4a; 3:Channel 3, 5b)

Parc National de la Garamba

NORTHERN WHITE RHINOCEROS (Ceratotherium simum cottoni)

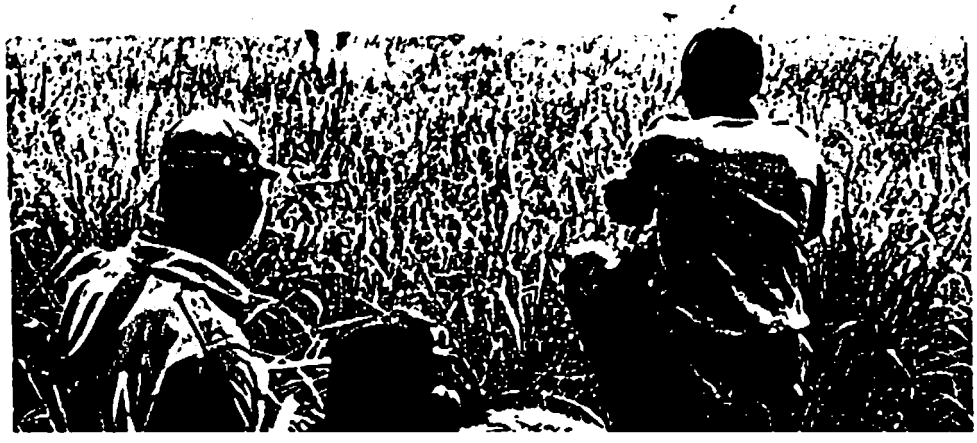
POPULATION STRUCTURE, APRIL 1992

ADULT MALES		STATUS
M2	`Eleti'	dominant, territory changed in 09.88.
M3	`Kondo akatani'	prior to 09.88 classed as old sub-adult, took over territory of M2
M4	`Bac'	probably dominant.
M5	`Bawesi'	dominant
M6	`Longuecorne'	dominant
M7	`Moitier'	young male
M9	`Notch'	dominant
ADULT FEMALES		
F1	`Mama Moke`	with JF
F3	`Kunalina'	with JM
F4	`Boletina'	with IF
F5	`Mama Giningamba'	with JM
F6	`Pacque'	with JM and SF
3aF	`Kuni'	born c.9-10/83, with JM
SUB-ADULTS		
1aM	`Moke'	S2, male, born mid 1983
4aM	`Bolete moke'	S2, male, born c. 08-09.1983
5aM	`Giningamba'	S2, male, born 02.85
4bF	`Mai'	S2, female, born 05.85
3bF	`Juillet'	S2, female, born 07.85,
6aF	`Oeuf de Pacque'	S1, female, born 03.86
4cF	`Noel'	S1, female, born 10-11.87 (M2 sire?)
5bF	`Grizmek'	S1, female, born 10.87 (M4 sire?)
6bM	`Elikya'	S1, male, born 06.88
1bM	`Mpiko'	S1, male, born 03-04.89
4dF	`Minzoto'	S1, female, born 08-09.89
5cM	`Molende'	S1, male, born 08.89 (M3 sire?)
3cM	`Solo'	J3, male, born 12.89,partially independent
JUVENILES		
3aaM	`Bonne Annee'	J2, male, born 12.90 (M6 sire?)
1cF	`Nawango'	J2, female, born 02.91
5dF	`Jengatu'	J1, female, born 07.91 (M3 sire?)
3dM	`Mamu'	J1, male, born 09.91
4eF	`Sifa'	I2, female, born 01.92

TOTAL KNOWN INDIVIDUALS	
Male adults (MA)	7
Female adults (FA)	6
Male sub-adults (SM)	7
Female sub-adults(SF)	6
Male juveniles (JM)	2
Female juveniles (JF)	2
Female infant (IF)	1
TOTAL	31
SEX RATIO	16M : 15F
ADULT:SUBAD.+ JUV.RATIO	1 : 1.4

5Y-KEZ above young male, channel 2, with Pete Morkel, Mbayma Atalia and guards

Collar attachment and measurements, Channel 1 Brian Clarke,Kes Smith, Mbayma Atalia and guards



Radio tracking Channel 1, Atama, Clarke,Mbayma

Annexe 1

NOTES ON IMMOBILISATIONS OF NORTHERN WHITE RHINOS, June 1992

1. 3.6.92, 4dF, Female 2 yr 10 mths, good condition
   Darted with 2,8mg M99 + 10mg Domosedan + 1500 IU Hyaluronidase
   Dart site: Head, posterior to rostral horn.
   Induction time: 3.45 mins. Moved +- 400 m. post darting
   Breathing: 12 - 5
   Pulse rate: 66 - 60
   Temperature: 38,8 - 38,1 °C
   Quality of immobilisation: Good. Slightly "twitchy" but adequate muscle relaxation and regular deep breathing
   Dose: Correct

2. 5.6.92, 4cF, Female 4 yrs 8 mths, good condition
   Darted with 3mg M99 + 10mg Domosedan + 1500 IU Hyaluronidase
   Dart site: right shoulder
   Induction time: 11 min, Moved +- 500m. post darting.
   Breathing 14 - 8
   Pulse rate: 72 - 60
   Temperature 38,2 - 38,9°C
   Quality of immobilisation: Good. Good muscle relaxation and deep regular respiration.
   Dose: Good. Perhaps slightly low ie 3,2 mg M99 may have been better.

3. 5.6.92 5bF, Female 4 yrs 8 mths, good condition
   Darted with: 3mg M((+ 10mg Domosedan + 1500 IU Hyaluronidase
   Dart site: Right shoulder, skin fold.
   Induction time: +- 9 mins. Moved +- 800m. post darting.
   Breathing 8 - 6 deep.
   Temperature: 38,8°C.
   Quality of immobilisation: Good, possibly slightly light.
   Dose: Bit low, 3.2mg M99 better.

4. 6.5.92. M7/1a/4a Male, +-9yrs. Good condition, but number of horn wounds.
   Darted with: 3.3mg M99 + 12 mg Domosedan + 1500 IU Hyalase.
   Dart site: Left shoulder
   Induction time: 7.59 mins. Moved +-250m. post darting
   Breathing: 8 - 8
   Temperature: 37,0 - 38,0°C
   Gave 45 mg Midazol IV to improve muscle relaxation.
   Dose: Bit low, 3,5 M99 + 14 mg Domosedan better.

PARC NATIONAL DE LA GARAMBA

RADIO FREQ.
.172.1.....
.Channel 1.

DES DIMENSIONS DE RHINO (cm)
RHINO MEASUREMENTS (cm)

DATE..3/6/92.....LOC....445205.....GRP..2 SAF (SA1&SA2) U5 & U3....
NO. NAME AGE/SEXE
NO..U5 (4d ?).....NOM....Minzoto ?.....CLASSE...SAF1, 2yr 9-10mths ?.
TOOTH MEASUREMENTS Impression taken...-...(Too awake towards end, could not
DIMENSIONS DES DENTS (Impression.....Direct.....) open mouth)

Ht.	pm1	pm2	pm3	pm4	PM2	PM3	PM4	M1	M2	M3
Width										
Wear										

SHOULDER HT (lying) (standing)
HAUTEUR A L'EPAULE (couche).....142.....(debout).....
BACK LENGTH (straight) (curved)
LONGEUR DU DOS (droit).....197.....(courbe).....200.....
GIRTH (1/2 X 2) NECK CIRC.
AU TOUR DU CORPS A SANGLE.....230.....CIRC.DE COU..141.....
HEAD LENGTH DORSAL POST-ORB.WIDTH
LONG.DU TETE.....91.....CONCAVITY....3,2.....LARG.POST-ORB.....34.....
EAR (Length) (Width) (Curve)
OREILLE(Longeur)..a).33.....(Largeur).c) 17.....(Courbe).b)26,5 d)26,5.....
HORN (straight) (Curved) (Bas.circ.)
CORNE Ant.(droite)...25.....(Courbe)....27.....(Bas.circ.).41.....

Post. "	....9..."...	...10..."...	..38.....	
FOREFOOT Length	mid-length	Width	Circ.	
PIED ANT.Longeur.	....27..	Mi-longeur	....25....	Largeur..19.....	Circ...71.....
HINDFOOT "	"	"	"	
PIED POST "	...28..	"	.....	"	..20.....	"	..73.....

FOOTNOTES

at immobilization

NOSE WRINKLES

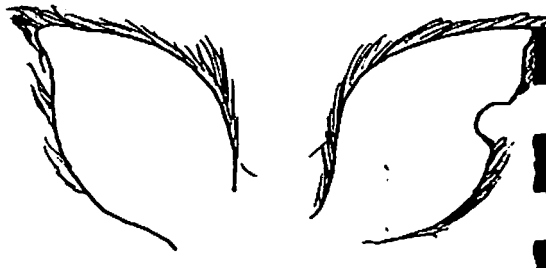
RIDES DE NEZ

from photo rhino standing.

HORNS & EARS

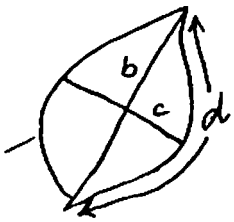
CORNES ET OREILLES

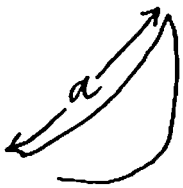
3/4



SAMPLES/ ECHANTILLONS SENT TO/ENVOYES A
Ear skin: in medium, frozen R.Aman
no medium, frozen R.Aman
" " , cool R.Aman & E.Harley
Blood: plasma,buffy coat,RBC R.Aman
Plasma, serum P.Morkel

NOTES
Time darted.11.29Time down.1 hr...Time up.....





Tail - hair 67
+hair 71

PARC NATIONAL DE LA GARAMBA

RADIO FREQ.
.172.2.....
.Channel 2...

DES DIMENSIONS DE RHINO (cm)
RHINO MEASUREMENTS (cm)

DATE.6.6.92.....LOC..270141.....GRP..1 Ad Male.....
NO. NAME AGE/SEXE
NO.M7/1a/4a.?.....NOM.Moitier/Moke/Bolete moke...CLASSE..Young adult male.....
TOOTH MEASUREMENTS Impression taken:1st 2 teeth
DIMENSIONS DES DENTS (Impression../..Direct.....)

Ht. pm1....pm2....pm3....pm4....PM2....PM3....PM4....M1.....M2....M3....

Width.....4.3x2.8..4.86x3.4+(not full width on imp.)

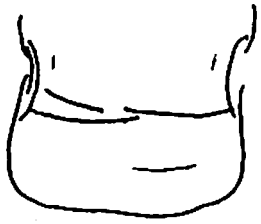
Wear.....5-6.....4 v.unworn Age Class IX.(7-9yr)..

SHOULDER HT (lying) (standing)
HAUTEUR A L'EPAULE (couche).....161.1.....(debout).....
BACK LENGTH (straight) (curved)
LONGEUR DU DOS (droit).....250.....(courbe)....264.....
GIRTH (1/2 X 2) NECK CIRC.
AU TOUR DU CORPS A SANGLE...136x2...272.....CIRC.DE COU.182.....
HEAD LENGTH DORSAL POST-ORB.WIDTH
LONG.DU TETE.....86 (102).CONCAVITY..7,5.....LARG.POST-ORB...40.....
EAR (Length) (Width) (Curve)
OREILLE(Longeur).a)34.b)35,5(Largeur).c)19.....(Courbe).d)32.....
HORN (straight) (Curved) (Bas.circ.)
CORNE Ant.(droite)..50.....(Courbe)..55,7.....(Bas.circ.).70.....

Post. " ..23,5....."...."....21....."....."....60.....
FOREFOOT Length mid-length Width Circ.
PIED ANT.Longeur.....28,5mi-longeur..27,6....Largeur.23,9.....Circ..78.....
HINDFOOT " " " "
PIED POST "....27,5...."...26,5..."....21....."....73.....
FOOTNOTES

NOSE WRINKLES

RIDES DE NEZ

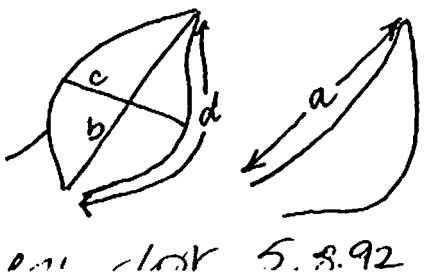


HORNS&EARS

CORNES&OREILLES

SAMPLES/ ECHANTILLONS SENT TO/ENVOYES A
Ear sample in medium LN R.Aman
" no " LN "
" " " " & E.Harley
Blood: Plasma, RBC, WBC (unwashed) R.Aman
Plasma & Serum P.Morkel

NOTES
Time darted.....Time down.....Time up.....
Right eye cloudy, sight prob. diminished or lost. Horn wound left neck & rump.
Neck well dev'd, fully grown.



5.8.92

PARC NATIONAL DE LA GARAMBA

RADIO FREQ.
.172.3....
.Channel 3

DES DIMENSIONS DE RHINO (cm)
RHINO MEASUREMENTS (cm)

DATE..5.6.....LOC..393184 Nakofo.....GRP.4:SA2F,SA1M,(5b&5c?)F5,5d...
NO. NAME AGE/SEXE
NO...U6 5b?.....NOM...Grizmek.....CLASSE.....SA1F.....
TOOTH MEASUREMENTS Impression taken...-...
DIMENSIONS DES DENTS (Impression.....Direct.....)

Ht. pm1....pm2....pm3....pm4....PM2....PM3....PM4....M1.....M2....M3....

Width.....

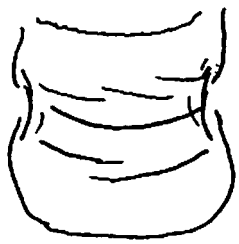
Wear.....

SHOULDER HT (lying) (standing)
HAUTEUR A L'EPAULE (couche)..Not poss.on sternum(debout).....
BACK LENGTH (straight) (curved)
LONGEUR DU DOS (droit).....214.....(courbe)...222.....
GIRTH (1/2 X 2) NECK CIRC.
AU TOUR DU CORPS A SANGLE..124x2: 248.....CIRC.DE COU..166.5.....
HEAD LENGTH 93 base horn DORSAL POST-ORB.WIDTH
LONG.DU TETE.108 to mouth.CONCAVITY.3,5.....LARG.POST-ORB..34.....
EAR (Length) (Width) (Curve)
OREILLE(Longeur).a)35 b)27,5(Largeur)...17.....(Courbe)...31.....
HORN (straight) (Curved) (Bas.circ.)
CORNE Ant.(droite)...36.....(Courbe)..40,7.....(Bas.circ.).57.....

Post. " ...15.....".....14.....".....47,5.....
FOREFOOT Length mid-length Width Circ.
PIED ANT.Longeur...30,5..Mi-longeur..29,5....Largeur.....Circ...78.....
HINDFOOT " " " "
PIED POST "...28,5. " ..... " ..20,5.... "..78.....
FOOTNOTES

NOSE WRINKLES

RIDES DE NEZ



HORNS

CORNES

SAMPLES/ ECHANTILLONS SENT TO/ENVOYES A
Ear sample a) in medium LN R.Aman
b) no " LN R.Aman
c) no " R.Aman & E.Harley
Blood: Plasma, WBC, RBC unwashed in LN R.Aman
Plasma & serum P.Morkel

NOTES
Time darted.....Time down.....Time up.....
Tail 73. Double bump on back of neck.

ears not v. hairy.

PARC NATIONAL DE LA GARAMBA

NO RADIO COLLAR

DES DIMENSIONS DE RHINO (cm)
RHINO MEASUREMENTS (cm)

DATE..5.6.92.....LOC.Nalokenge...368205.....GRP.3.6.92 wi.Ch1 4d/5.6alone...
NO. NAME AGE/SEXE
NO.U3 4c?.....NOM.Noel? Wavy Ears.....CLASSE....SA2F..4yr7-8mth?....
TOOTH MEASUREMENTS Impression taken.../.upper..
DIMENSIONS DES DENTS (Impression.....Direct.....)

Ht. pm1....pm2....pm3....pm4....PM2....PM3....PM4....M1.....M2....M3....

Width.....3,4x2,7.3,6x3,2.....

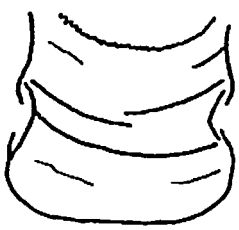
Wear.....9.....7-8.....Age class VII-VIII (3,5-7yr).....

SHOULDER HT (lying) (standing)
HAUTEUR A L'EPAULE (couche).....158,5.....(debout)..depth on sternum 105.
BACK LENGTH (straight) (curved)
LONGEUR DU DOS (droit).....214.....(courbe)....227.....
GIRTH (1/2 X 2) NECK CIRC.
AU TOUR DU CORPS A SANGLE..121x2: 242.....CIRC.DE COU..151.....
HEAD LENGTH DORSAL POST-ORB.WIDTH
LONG.DU TETE..88.....CONCAVITY....4.....LARG.POST-ORB.....
EAR (Length) (Width) (Curve)
OREILLE(Longeur)a)33 b)27...(Largeur).c)18.....(Courbe)..d)32,5.....
HORN (straight) (Curved) (Bas.circ.)
CORNE Ant.(droite).33.....(Courbe).....34,4.....(Bas.circ.)56,5.....

Post. " .14,3.....".....14.....".....49,5.....
FOREFOOT Length mid-length Width Circ.
PIED ANT.Longeur.....Mi-longeur.....Largeur.....Circ.....
HINDFOOT " 29,5 " 28,5 " 22,5 " 78,5
PIED POST "..28,5. "..29,5.... ".21,5..... "..72,3.....
FOOTNOTES

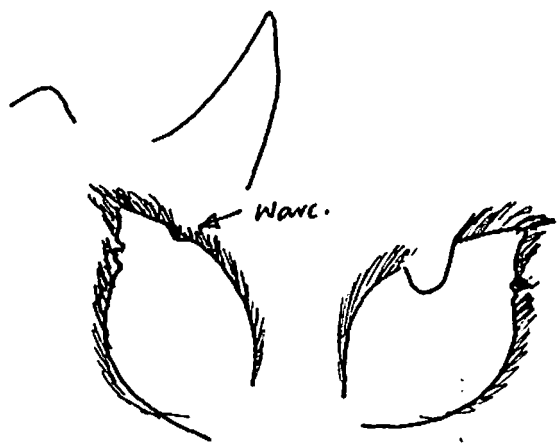
NOSE WRINKLES

RIDES DE NEZ



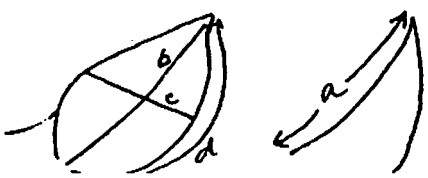
HORNS

CORNES



SAMPLES/ ECHANTILLONS SENT TO/ENVOYES A
Ear sample : in medium LN R.Aman
no " LN "
no " " & E.Harley
Blood: Plasma, WBC, RBC unwashed R.Aman
Plasma & Serum P.Morkel

NOTES
Time darted.....Time down.....Time up.....
Tail 151. Long dark hairs (2cm) on ears, wave in top inner.



SAMPLES OF NORTHERN WHITE RHINO (Ceratotherium simum cottoni) GIVEN TO DR RASHID AMAN FOR GENETIC ANALYSIS BY DR KES SMITH, DR MBAYMA ATALIA & DR PETER MORKEL, JUNE & JULY 1992

SAMPLE	RHINO	CLASS	SAMPLE	MEDIUM	LN	COLD
3.6.92	U5(4D?)	SAF1	a)EAR,Derm,epiderm,cartilage		/	
			b)" " " "	/	/	
			c)" " "	/	/	
			d)" " " "			/
			PLASMA		/	
			WBC		/	
			RBC		/	
5.6.92	U6(5B?)	SAF2	b)EAR, d,e,c	2	/	
			a) " " " "		/	
			d) " " " "			/
			PLASMA		/	
			WBC		/	
			RBC		/	
5.6.92	U3(4C?)	SAF2	a)EAR,e,d,c,		/	
			b)" " " "	2	/	
			d)" " " "			/
			PLASMA		/	
			WBC		/	
			RBC		/	
6.6.92	1A/4A/M7		a)EAR,e,d,c		/	
			b)" " " "	/	/	
			d)" " " "			/
			PLASMA		/	
			WBC		/	
			RBC		/	

Samples of unfrozen ear tissue from above animals also taken by Dr Morkel for Dr Harley.
Serum and plasma from above taken by Dr Morkel for pathology.

2.2.92 Rhino urine 1 pure, 1 + sand included for Dr R.Eley

SAMPLE OF Loxodonta africana cyclotis

23.5.92	PNG 18	Adult male, wild, poached			
			Epidermis, dermis	/	
			Muscle	/	