RHINOWATCH

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PILOT STUDY TO INVESTIGATE A SPOOR RECOGNITION SYSTEM FOR CENSUSING & MONITORING BLACK RHINO IN ETOSHA NATIONAL PARK, NAMIBIA

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Report to the Ministry of Environment and Tourism
Republic of Namibia
by

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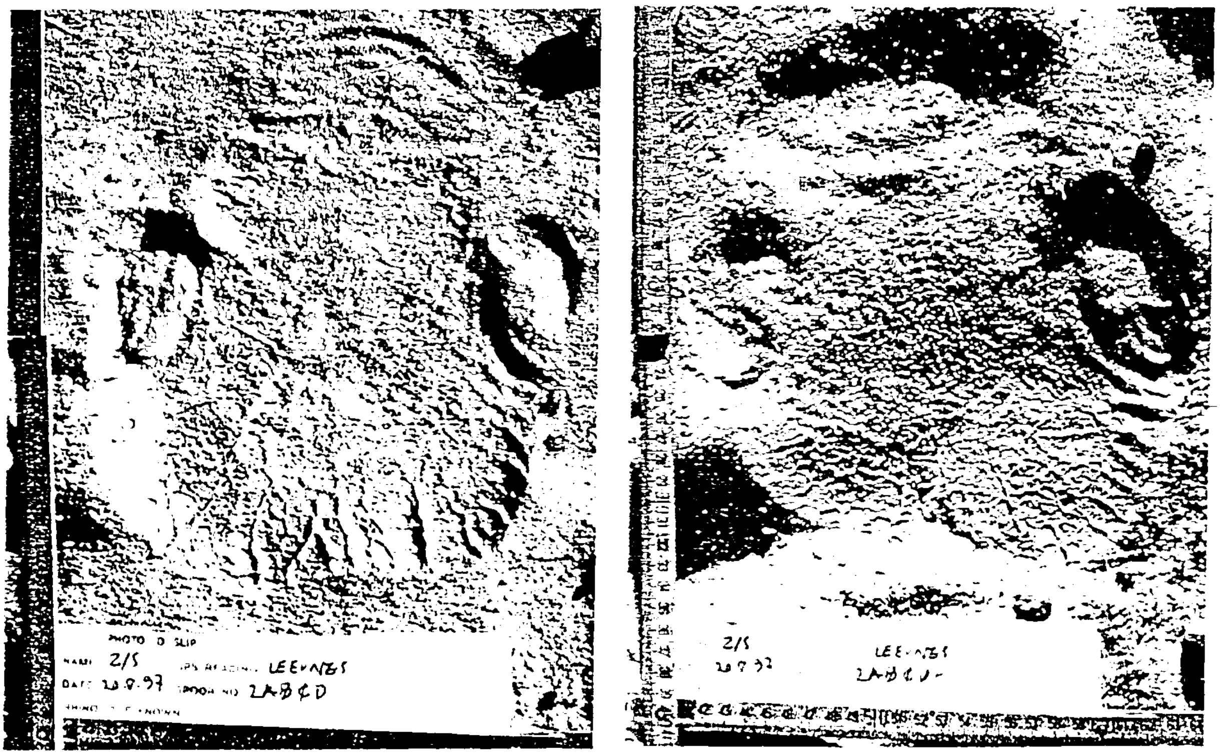

Spoor photographs taken at Leeunes waterhole, ENP, August 1997
Left and Right hind prints from one animal

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1 SUMMARY

Rhinowatch is a small non-governmental organisation based at the University of London. It is run by Dr S. Alibhai and Z. Jewell, and has been censusing and monitoring black rhino in Zimbabwe since 1992, in conjunction with the Department of National Parks and Wild Life Management. Rhinowatch is a research group dedicated to working closely with management to provide cost-effective, non-invasive and sustainable solutions to management problems relating to black rhino protection and monitoring (see Alibhai & Jewell, 1993; Alibhai, Jewell & Towindo, 1995; Alibhai, Jewell & Towindo, 1996; Alibhai & Jewell, 1997).

This pilot study in Etosha National Park (ENP) was commissioned by the Ministry of Environment and Tourism (MET) of the Republic of Namibia, and jointly undertaken in the field by the staff of MET and Rhinowatch. The main objective of the pilot study was to investigate the practicalities, through a full-scale field trial, of using a spoor recognition system (developed by Rhinowatch in Zimbabwe) in conjunction with existing methods used in ENP for the censusing and monitoring of black rhino. The pilot study was undertaken at the suggestion of Rhinowatch, after an initial feasiblity study by Rhinowatch in December 1996 (Alibhai & Jewell, 1997) had suggested that this technique could be productively integrated into the existing monitoring strategies employed in ENP. The pilot study was suggested as Level 1 of a development plan for an integrated role of this technique within the existing system (Alibhai & Jewell, 1997).

From 13 - 20 August 1997, MET staff and Rhinowatch carried out a joint study in two phases involving the use of whole animal photography and spoor photography respectively to establish the numbers of black rhinos visiting waterholes at Namutoni. At the time of writing this report, the results from the whole animal photography (MET staff) were not available. However, the results from the spoor identification technique revealed that the maximum and minimum estimates for eight waterholes, for which sufficient data was available, were 47 and 55 individuals respectively with Chudop (13) having the highest number of individual black rhinos visiting and Tsumcor (2) the lowest. The results from this pilot study illustrate clearly that this technique can be used effectively to monitor the black rhino in the ENP. Furthermore, for many animals, it is hoped (when the whole animal photography analysis has been completed) that it will enable the matching of the individual rhino to its spoor.

It is proposed that the development of this technique at ENP might be continued to Level 2 as

outlined by Alibhai & Jewell (1997). This level would require complete spoor coverage of all effective waterholes in the Namutoni section over a longer period to provide a reliable estimate of the black rhino population in that area. Once a complete spoor library of individual black rhino in the Namutoni area has been established it would be possible to start studying the ranging patterns of these animals. Since the spoor technique also enables the identification of calves, the study would also provide information about the birth rate for this area.

2 PILOT STUDY OBJECTIVES

For the present study, four objectives were recognised by Rhinowatch and the staff of the ENP:

2.1 To collect spoor photographs from waterholes in Blocks 9 and 10 of ENP over a period of 3 nights per Block and to estimate black rhino numbers drinking at these waterholes over this period from spoor alone.

2.2 To photograph, using flash photography in moonlit conditions, black rhino drinking at these waterholes over the same study period, and produce prints to enable identification of individuals and an estimation of numbers drinking at the waterholes.

2.3 To attempt to match spoor photographs with whole animal identifications made by ENP staff at the same waterholes over the same period.

2.4 To assess the practicalities and relative merits of taking spoor and whole black rhino photographs over the study period, and to make recommendations about how these techniques might be effectively integrated and used to benefit monitoring in ENP.

3 METHODS

3.1 Waterhole coverage

The pilot study was jointly undertaken by Rhinowatch and the staff of the MET from 13 - 20 August 1997. It was undertaken in two three-day phases to cover black rhino activity at waterholes in Blocks 9 and 10 of ENP. In Phase I (Block 10) waterholes at Aroe, Kameeldoring, Klein Namutoni, Mushara, Tsumcor and Twee Palms were targeted. In Phase II (Block 9) waterholes at Chudop, Groot Okevi, Klein Okevi, Kalkheuwel, Koinagas, Leeunes and Okerfontein were targeted. Global Positioning Systems were used to provide exact locstats for future reference work in this area.

3.2 Black rhino (whole animal) photography

ENP staff were positioned in vehicles at each designated waterhole. Observers attempted to take flash photographs of each rhino which was observed at the waterhole from frontal and lateral positions. The estimated optimum position from the rhino for photography was 15 metres. This was achieved either by leaving the vehicle or from within the vehicle, using 200mm lenses on SLR cameras with flash unit. Photographs are being processed at ENP at the time of writing this report, and results pending. Animals observed were recorded on a data sheet (Appendix 1) giving details of individual identification features. An attempt was made to record the position of entry, exit and path followed by each animal observed at the waterhole on a waterhole map (see Appendix 2) for matching with spoor identification.

3.3 Black rhino spoor photography

This involved the identification of individual black rhino from spoor photography.

Each morning Rhinowatch teams photographed spoor left by rhinos visiting waterholes which had been covered the previous night for whole animal photography by the MET staff. At each waterhole a Global Positioning System was used to map exact position should a UTM mapping system be adopted for future work. An initial 360° visual search over the substrate approximately 20m from the edge of the water at each waterhole revealed spoor tracks which were then systematically back-tracked as far as necessary to permit clear spoor to be seen. Each continuous spoor track was identified as one belonging to a single individual. Different spoor tracks were labelled as potentially belonging to different animals. The spoor photographs were then taken using a standardised procedure, with a Pentax K-1000 manual SLR camera carrying 400 ASA b/w print film. Both left and right hind spoor were photographed. A metric ruler was placed on the ground to the left and beneath the spoor for scale, and a photo identification slip (Appendix 3) completed and laid under the ruler for subsequent identification of each spoor photograph. The photograph was taken directly above the spoor to allow distortion-free analysis. From each spoor track identified, a maximum number of photographs were taken to allow interpretation from the widest possible base of information.

Prints were developed, and analysed at the Sinamatella Research base using the variety of methods being developed by Rhinowatch for individual recognition through spoor analysis, including pattern recognition, proportional measurement analysis after photographic optimisation and multivariate analysis including modal clustering and canonical analysis (Alibhai & Jewell, 1997). Using these techniques, the number of rhinos was estimated based on a minimum and maximum for each waterhole. Rhinos revisiting the same waterholes on different days or different waterholes were also identified using their spoor. Although 13 waterholes were included in the study, only eight produced enough reliable data for analysis, primarily due to the very limited amount of time available for the study.

3.4 Matching of spoor photographed at each waterhole to rhino identifications made at that waterhole by ENP staff over the same period.

This was done by attempting to match positions of spoor each morning with positions of black rhino arrival and departure at waterholes as made by ENP staff the previous night, and where no whole animal photographs were available, by matching observed descriptions as outlined on the form in Appendix 1. For example if a cow and one month old calf were observed at a waterhole, and spoor of cow with one month old calf found in exactly the same position the next morning, and there were no other similarly aged paired spoor found, it was assumed that the two were matched. It should be pointed out, however, that this did not take into account the possibility that another similar pair of animals might have visited the waterhole after the ENP staff had left - for example between 4am and 6am. Full confidence about matching could only be achieved with complete night coverage.

4 RESULTS

4.1 Waterhole coverage achieved

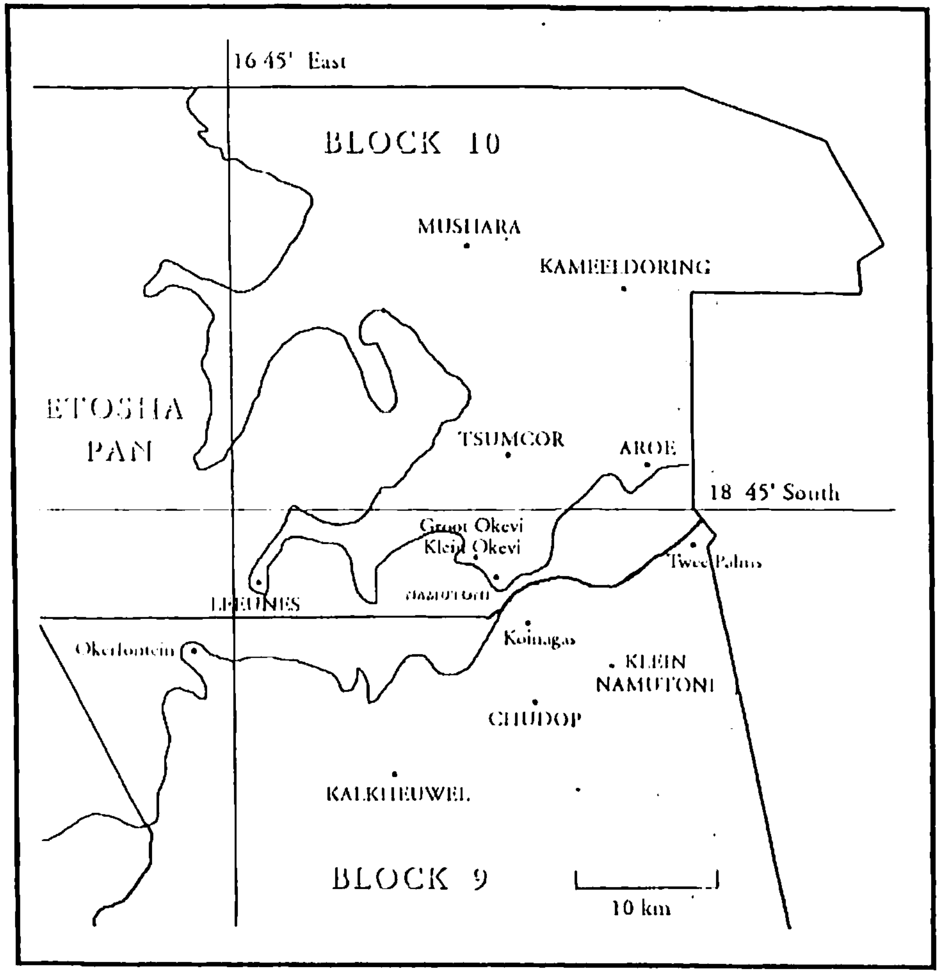
Tables 1 and 2 show the actual coverage, during phases I and II, of waterholes by both ENP staff and Rhinowatch. Figure 1 shows the coverage on a map of Blocks 9 and 10 in the Namutoni area of ENP. Good general coverage was achieved, the few omissions being due to continual presence of lions (e.g. Klein and Groot Okevi). Coverage by ENP staff was in most cases achieved from

WATER HOLE	DATE-AUG. 97	RW-SPOOR	ENP-WHOLE RHINO
AROE	13/14	+	+
	14/15	+	-
	15/16	+	-
KAMEELDORING	13/14	+	+
	14/15	+	+
	15/16	+	+
KLEIN NAMUTONI	13/14	-	-
	14/15	+	+
	15/16	+	-
MUSHARA	13/14	-	+
	14/15	-	+
	15/16	-	-
TSUMCOR	13/14	-	-
	14/15	+	-
	15/16	+	-
TWEE PALM	13/14	-	-
	14/15	-	+
	15/16	+	+

TABLE 1. Phase 1. Dates of six water holes covered in Block 10. ENP whole rhino photography carried out at night time and RW spoor photography carried out the following day. (+ = covered, - = not covered).

WATER HOLE	DATE-AUG. 97	RW-SPOOR	ENP-WHOLE RHINO
CHUDOP	17/18	-	-
	18/19	-	-
	19/20	-	-
GROOT OKEVI	17/18	-	-
	18/19	-	-
	19/20	-	-
KALKHEUWEL	17/18	-	-
	18/19	-	-
	19/20	-	-
KLEIN OKEVI	17/18	-	-
	18/19	-	-
	19/20	-	-
KOINAGAS	17/18	-	-
	18/19	-	-
	19/20	-	-
LEEUNES	17/18	-	+
	18/19	-	+
	19/20	-	-
OKERFONTEIN	17/18	-	-
	18/19	-	-
	19/20	-	-

TABLE 2. Phase 2. Dates of seven water holes covered in Block 9. ENP whole rhino photography carried out at night time and RW spoor photography carried out the following day. (+ = covered, - = not covered).



KEY

UPPER CASE eg MUSHARA	Waterhole contributing to final census figure
Lower Case eg Twee Palms	Waterhole covered, but not contributing to final census figure
NAMUTONI	Place/Area name

Fig. 1 Map of Study Area - Namutoni, ENP, Blocks 9 and 10.

1800 hrs until 0100 hours, and Rhinowatch coverage from 0600 hrs until all waterholes had been covered, which in most cases took until 1200 hrs each day. Table 3 shows the locstat at each waterhole and the substrate quality. The substrate quality at most waterholes was quite good for spoor work. Even at waterholes where a stony substrate predominated (e.g. Klein Namutoni), back-tracking the spoor usually led to areas where the spoor could be identified easily.

4.2 Black rhino spoor photography

The quality of black rhino spoor photographs taken at the waterholes is shown in Tables 4 and 5, for phases I and II (black rhino photographic prints taken by ENP staff were not available for analysis at the time of writing this report, and are therefore not included in a quality assessment in Tables 4 and 5). A simple scale from 1 (Good) to 3 (Poor) was used to classify the spoor quality. Photographic techniques were standardised, and the photographic results varied in quality depending on the quality of the spoor track only. The quality of the spoor track was found to be related to:

4.3.1 The age of the spoor. Spoor made early the previous evening was less clear than that made later during the night. Generally, the earlier the spoor was photographed in the morning the better the quality.

4.3.2 The light conditions. Spoor photographed very early in the morning when the sun was low benefited from better light contrast than spoor photographed when the sun was higher.

4.3.3 Wind conditions. Winds were unusually high during the study period and impacted directly on the lifespan of the spoor.

4.3.4 Activity of other animals at the waterhole. Heavy activity by other animals coming after the rhino affected spoor survival and quality. This was particularly important where elephant activity was high.

4.3.5 Substrate. The quality of the substrate for holding a spoor print was important. It was easier to find good spoor on sandy substrates than predominantly stony substrates.

The number of individual tracks photographed, and the estimated minimum and maximum number of rhino visiting the waterhole on the previous night are recorded in Tables 6 and 7 for

WATERHOLE	PHASE	LOCSTAT (MK33)	SUBSTRATE QUALITY
AROE	1	710529/7929125	SAND
KAMEELDORING	1	709895/7940556	SAND
KLEIN NAMUTONI	1	705623/7917417	STONE/SAND
MUSHARA	1	699218/7944125	SAND
TSUMCOR	1	700879/7929863	SAND
TWEE PALM	1	714037/7924251	STONE/ SAND
CHUDOP	2	702854/7913979	SAND
GROOT OKEVI	2	700136/7922719	STONE/SAND
KALKHEUWEL	2	692483/7909947	STONE/SAND
KLEIN OKEVI	2	701176/7921402	STONE/SAND
KOINAGAS	2	NA	STONE/SAND
LEEUNES	2	685735/7921293	SAND
OKERFONTEIN	2	681437/7914672	SAND

TABLE 3. The phases when the 13 waterholes at Namutoni were covered and the locstat (using GPS units) & substrate quality for each waterhole.

WATER HOLE	DATE-AUG. 97	RW-SPOOR QUALITY	ENP-PHOTO QUALITY
AROE	13/14	1	NA
	14/15	3	NA
	15/16	2	NA
KAMEELDORING	13/14	3	NA
	14/15	1	NA
	15/16	3	NA
KLEIN NAMUTONI	13/14	-	NA
	14/15	1-2	NA
	15/16	1	NA
MUSHARA	13/14	1	NA
	14/15	1	NA
	15/16	1	NA
TSUMCOR	13/14	3	NA
	14/15	-	NA
	15/16	3	NA
TWEE PALM	13/14	3	NA
	14/15	3	NA
	15/16	3	NA

TABLE 4. Phase 1. Spoor quality and rhino photo quality for six waterholes in Block 10. (Spoor quality scale: 1 = Good, 2 = Average, 3 = Poor. ENP rhino photo quality data not available).

WATER HOLE	DATE-AUG. 97	RW-SPOOR QUALITY	ENP-PHOTO QUALITY
CHUDOP	17/18	1-2	NA
	18/19	2	NA
	19/20	3	NA
GROOT OKEVI	17/18	-	NA
	18/19	-	NA
	19/20	-	NA
KALKHEUWEL	17/18	1-2	NA
	18/19	1	NA
	19/20	1-2	NA
KLEIN OKEVI	17/18	3	NA
	18/19	-	NA
	19/20	-	NA
KOINAGAS	17/18	-	NA
	18/19	-	NA
	19/20	-	NA
LEEUNES	17/18	1	NA
	18/19	1	NA
	19/20	1	NA
OKERFONTEIN	17/18	-	NA
	18/19	-	NA
	19/20	-	NA

TABLE 5. Spoor quality and rhino photo quality for seven waterholes in Block 9. (Spoor quality scale: 1 = Good, 2 = Average, 3 = Poor. ENP rhino photo quality data not available).

	DATE-AUG. 97	RW-NO. SPOOR TRACKS PHOTOGRAPHED	RW-ESTIMATED NO. OF RHINOS MIN	MAX	ENP-NO. OF SIGHTINGS OF RHINO	ENP-NO. OF SIGHTINGS PHOTOGRAPHED
AROE	13/14	8	2	2	3	1
	14/15	3	2	2	2	1
	15/16	9	1	2	1	1
KAMEELDORING	13/14	1	1	1	2	1
	14/15	9	7	7	7	5
	15/16	4	1	2	-	-
KLEIN NAMUTONI	13/14	-	-		-	-
	14/15	12	3	4	3	3
	15/16	16	6	6	6	5
MUSHARA	13/14	4	2	2	2	1
	14/15	1	1	1	4	1
	15/16	4	2	4	2	-
TSUMCOR	13/14	2	1	1	1	-
	14/15	0	0	0	0	-
	15/16	1	1	1	-	-
TWEE PALM	13/14	6	NA		3	-
	14/15	8	NA		2	0
	15/16	4	NA		2	1

TABLE 6. Phase 1. Numbers of spoor tracks photographed, RW-estimated number of rhinos, ENP numbers of rhinos photographed and ENP rhinos seen for six waterholes in Block 10.

	DATE-AUG. 97	RW-NO. SPOOR TRACKS PHOTOGRAPHED	RW-ESTIMATED NO. OF RHINOS MIN	MAX	ENP- NO. OF SIGHTINGS OF RHINO	ENP-NO. OF SIGHTINGS PHOTOGRAPHED
CHUDOP	17/18	14	3	3	2	2
	18/19	16	11	11	12	12
	19/20	8	3	3	3	2
GROOT OKEVI	17/18	-	-		-	-
	18/19	-	-		-	-
	19/20	-	-		-	-
KALKHEUWEL	17/18	8	3	4	3	3
	18/19	1	1	1	9	9
	19/20	11	5	5	10	10
KLEIN OKEVI	17/18	2	1	1	-	-
	18/19	-	-		-	-
	19/20	-	-		-	-
KOINAGAS	17/18	-	-		-	-
	18/19	-	-		-	-
	19/20	-	-		-	-
LEEUNES	17/18	13	4	4	4	3
	18/19	10	3	5	2	1
	19/20	17	3	3	3	3
OKERFONTEIN	17/18	-	-		-	-
	18/19	-	-		-	-
	19/20	-	-		-	-

TABLE 7. Phase 2. Numbers of spoor tracks photographed, RW-estimated number of rhinos, ENP numbers of rhinos photographed and ENP rhinos seen for seven waterholes in Block 9.

Phases I and II. Minimum and maximum numbers were estimated in order to account for variations in spoor quality where necessary. In the case of Twee Palms, spoor was in each case photographed in late morning and quality was not sufficiently good for estimations to be made.

The estimated minimum and maximum numbers of black rhino for each waterhole is shown in Table 8. The estimates are represented as minimum and maximum because in some instances it was not possible to determine the exact number of rhinos from their spoor. Of the eight waterholes for which sufficient data was available, Chudop appeared to be visited by the largest number of rhino (13 individual rhinos) and Tsumcor visited by the least number of rhinos (2) over the three day period. The TOTAL minimum and maximum for all eight waterholes is shown in Table 8 (this figure takes into account revists by the same animals to the same waterhole). This total was then corrected to allow for overlaps between waterholes and the CORRECTED TOTAL shows an estimated minimum of 47 and maximum of 55 black rhino for the eight waterholes (i.e. Rhino 1 was counted three times and Rhinos 2, 3 and 4 counted twice).

4.3 Black rhino (whole animal) photography

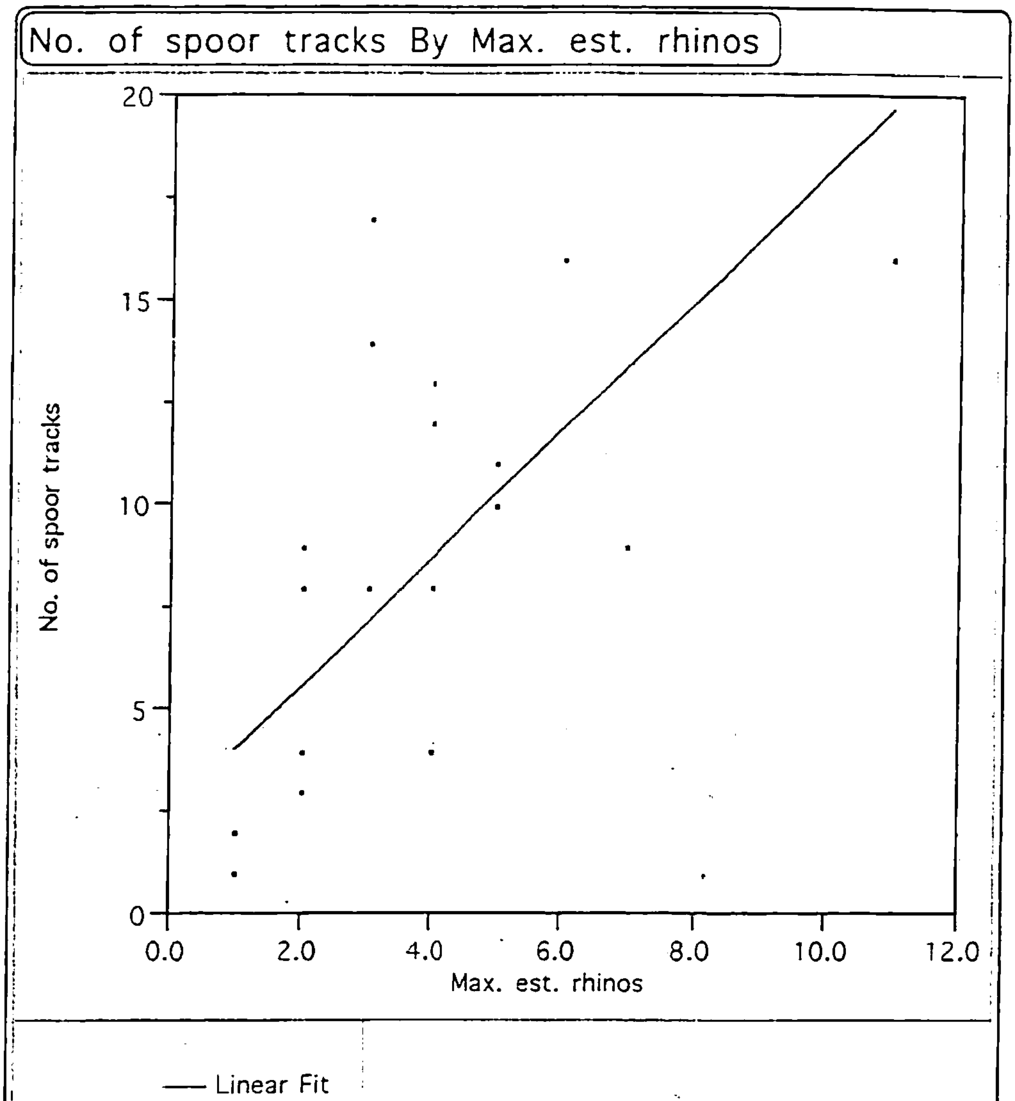
The number of black rhino sightings, and number of sightings photographed are shown in Tables 6 and 7 for Phases I and II. It was considered likely, from reports of visual sightings and individual animal features, that some animals were sighted on more than one occasion during the course of one night, and that this would be revealed by whole animal photography where photographs had been taken. The number of sightings were therefore not assumed to be the same as the number of animals visiting the waterhole, as it was possible that some animals returned more than once a night to visit the waterhole.

4.4 Relationship between number of spoor tracks and estimated number of rhinos

In order to see if the numbers of spoor tracks could be used as an indicator of the number of rhinos visiting waterholes, the two variables were plotted and the relationship tested statistically. Fig. 2. shows that although the correlation between the two variables was highly significant ($p = 0.0002$), the only safe conclusion that could be drawn from the analysis was that when there were few spoor tracks, there were fewer rhinos. However, the increase in the number of spoor tracks did not necessarilly indicate an increase in the number of rhinos.

WATERHOLE	MIN	MAX
CHUDOP	13	13
KALKHEUWEL	8	9
LEEUNES	8	10
KAMEELDORING	7	8
KLEIN NAMUTONI	7	8
MUSHARA	4	6
AROE	3	4
TSUMCOR	2	2
TOTAL	52	60
CORRECTED TOTAL	47	55

TABLE 8. The minimum and maximum numbers of rhinos estimated from spoor for eight individual waterholes and the total for the eight waterholes. The corrected total takes into account same rhinos which were seen at different waterholes.



Linear Fit

Summary of Fit

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	316.47242	316.472	20.6922
Error	21	321.17976	15.294	Prob>F
C Total	22	637.65217		0.0002

Parameter Estimates

FIG. 2. The number of spoor tracks identified each day at individual waterholes plotted against the maximum estimated rhinos (see Tables 6 & 7).

4.5 Revisits by rhinos to the same waterhole

Analysis of spoor photographs revealed that some rhino had visited a particular waterhole on more than one of the observed nights. Fig. 3 shows an analysis of revisits by individual rhino to each waterhole for seven waterholes for which sufficient data was available (Klein Namutoni was only covered for second and third nights). The first column for each waterhole indicates number of individual rhinos (based on the minimum estimate) visiting a waterhole on the first night. The second column shows the number of rhinos which had appeared the first night which reappeared at the same waterhole on the second night, and the third column represents the number of rhinos revisiting the same waterhole over all three nights. e.g. for Chudop, these figures were 3, 2 and 1 respectively. For all seven waterholes, of the total of 16 (based on the minimum estimate), 6 individuals (38%) which had visited a particular waterhole on the first night revisited on the second night and 2 (13%) visited the same waterhole over all three nights. Fig. 4 shows the numbers of rhinos appearing for the first time on the second night at eight waterholes. Of this section of the population (23), 4 (17%) appeared the following night. Taking into account all the rhinos, it was found that 27% visited the same waterhole on a consecutive night. However, it should be pointed out that the waterholes were covered over a period of three days only. To get a more reliable estimate of the percentage of revisits by rhinos to the same waterholes, the waterholes would have to be covered over a much greater period of time.

It should be noted that fresh spoor survived only a few hours under conditions prevailing during the study period, and there was no risk that spoor from a previous day might have been re-identified the following day.

Fig. 5 shows two spoor photographed on successive days at Leeunes waterhole, made by the same animal.

4.6 Movements between waterholes

Analysis of spoor photographs also revealed that four of the animals identified from spoor had visited more than one waterhole over the study period. Table 9 shows that rhino 1 visited Klein Namutoni on 15-8-97, Kalkheuwel on 18-8-97 and Chudop on 19-8-97. Rhino 2 visited Kalkheuwel on 18-8-97 and Chudop on 20-8-97. Rhinos 3 and 4 (a cow and calf) visited Chudop on 19-8-97 and Kalkheuwel on 20-8-97.

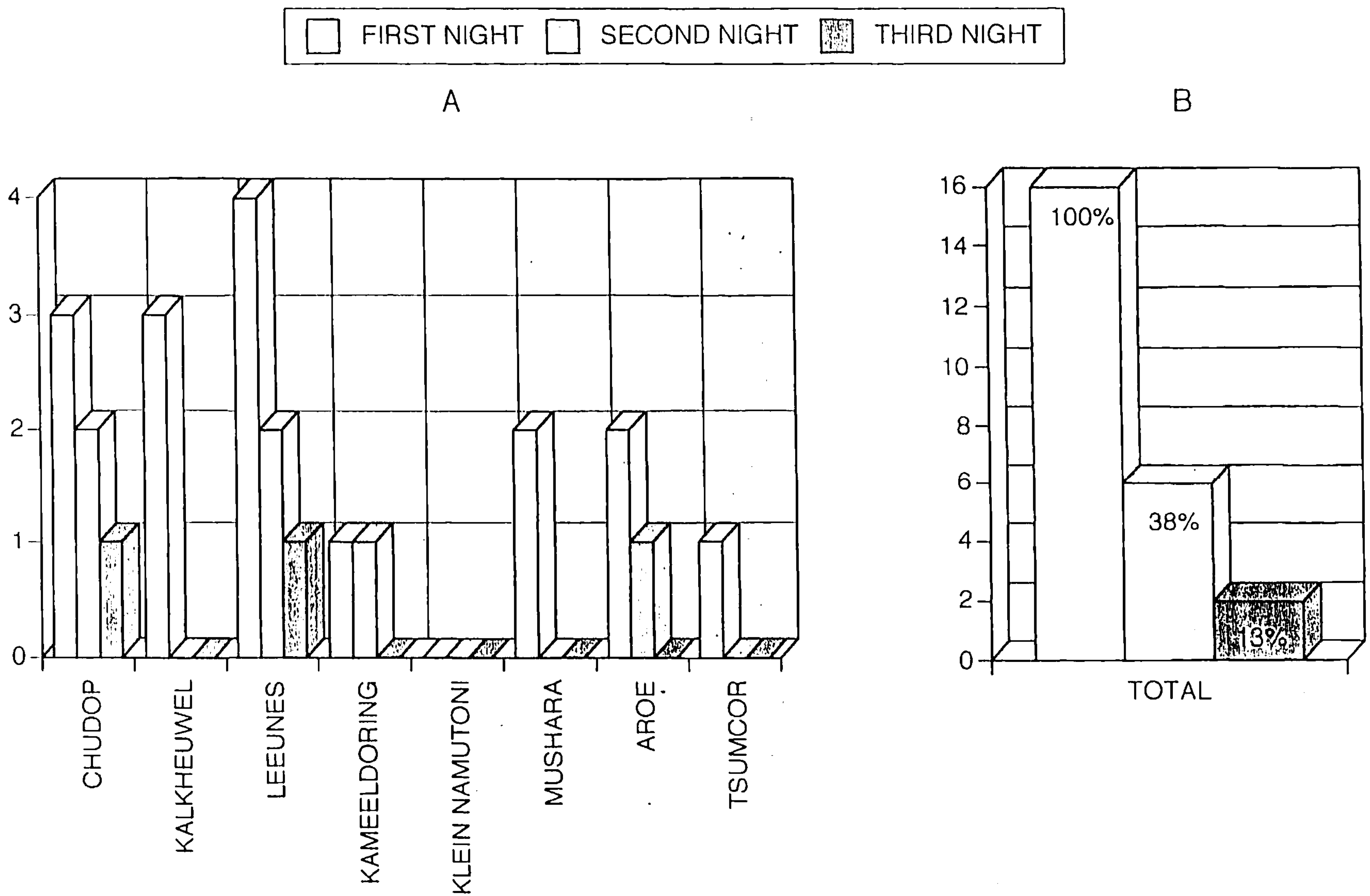


FIG. 3. Rhinos visiting waterholes on the first night which revisited the same waterhole on the second and third nights as determined by spoor analysis. (A) Number of rhinos estimated from spoor appearing at each waterhole (based on the minimum estimate) on the first night, second night and third night. (B) The totals and percentages for the seven waterholes (Klein Namutoni was only covered for second and third nights).

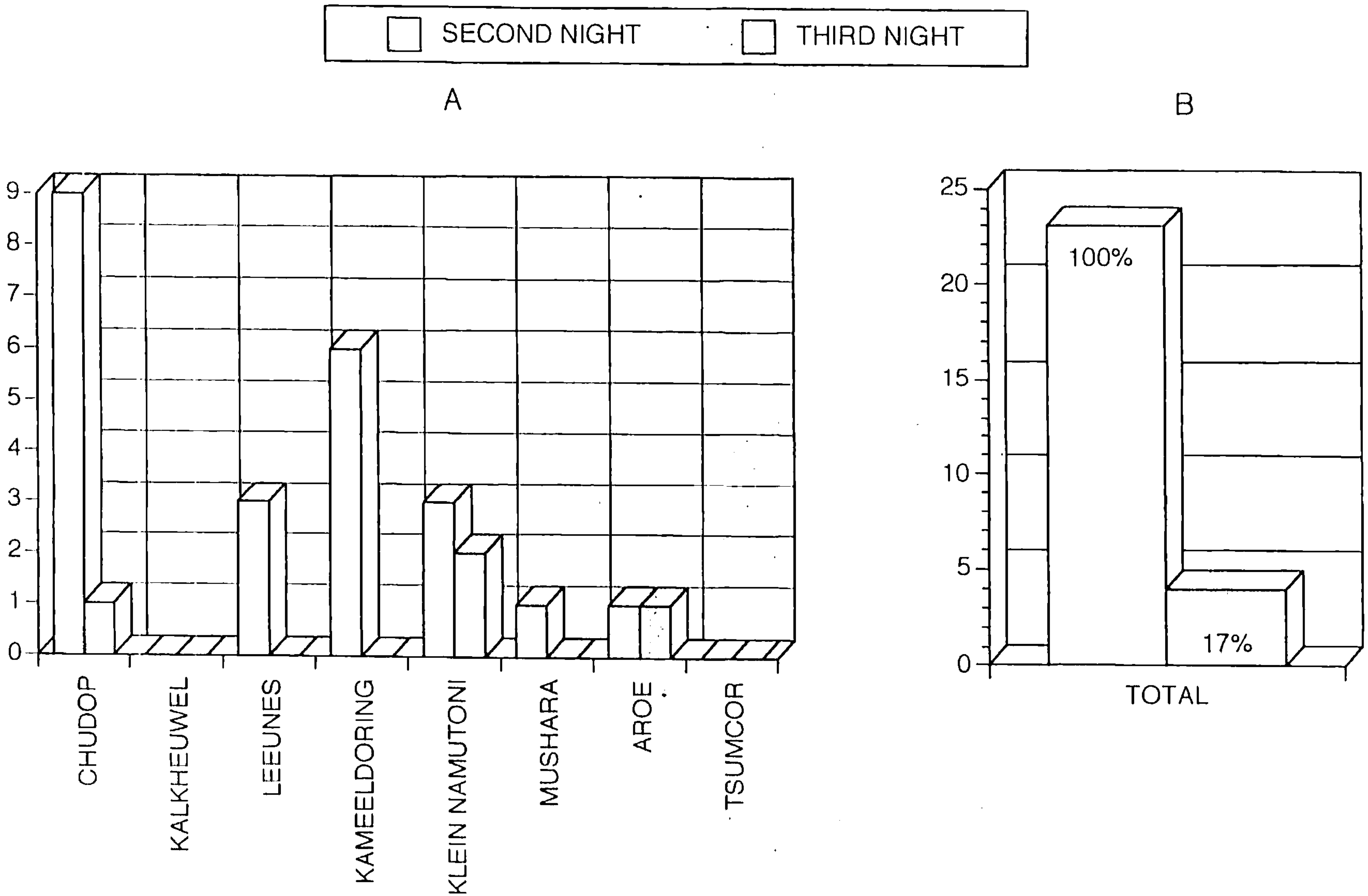
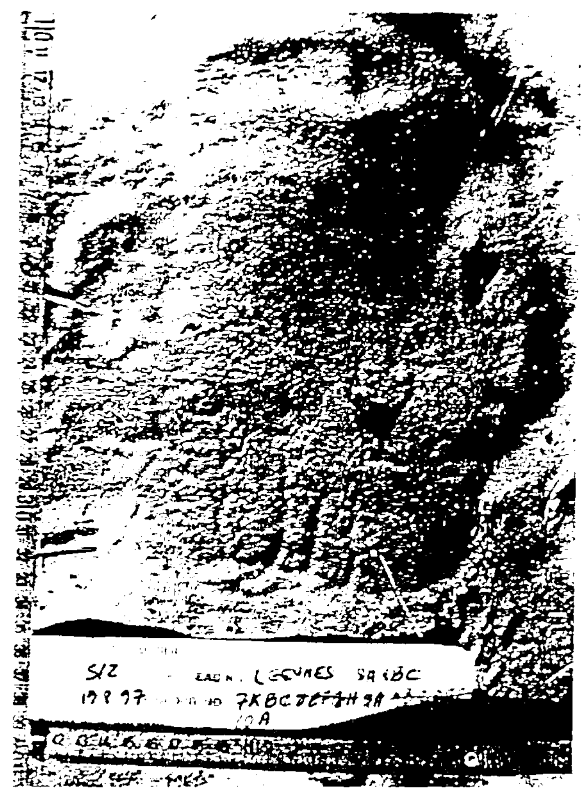


FIG. 4. Rhinos visiting waterholes on the second night which revisited the same waterhole on the third night as determined by spoor analysis (only rhinos appearing for the first time on the second night included). (A) Number of rhinos estimated from spoor appearing at each waterhole (based on the minimum estimate) on the second and third night. (B) The totals and percentages for the eight waterholes.

A



B

Fig. 5

A and B are photographs of right hind spoor, both taken at 8am, on 19-8-97 and 20-8-97 respectively, at Leeunes waterhole. A and B were shown by this study to have been made by the same animal, visiting the waterhole on successive days.

Photograph A spoor was estimated to be 8-12 hours old at the time of photography, and was therefore made early evening on 18-8-97

Photograph B spoor was estimated to be less than 4 hours old at the time of photography, and was therefore made early in the morining of 20-8-97.

	FIRST WATERHOLE	SECOND WATERHOLE	THIRD WATERHOLE
RHINO 1	KLEIN NAMUTONI	KALKHEUWEL	CHUDOP
	15-8-97	18-8-97	19-8-97
	RW 1	RW 3	RW 10
	ENP E8	ENP-NO MATCH AVAIL	ENP-NO MATCH AVAIL
RHINO 2	KALKHEUWEL	CHUDOP	
	18-8-97	20-8-97	
	RW 7	RW 7	
	ENP-NO MATCH AVAIL	ENP-NO MATCH AVAIL	
RHINOS 3 + 4	CHUDOP	KALKHEUWEL	
(COW + CALF)	19-8-97	20-8-97	
	RW 7 + 8	RW 1 + 2	
	ENP E4 + E4A	ENP-NO MATCH AVAIL	

TABLE 9. Rhino movements between waterholes as determined by spoor. Four rhinos, two individuals and one cow-calf pair, appeared to move between waterholes. The spoor of Rhino 1 was picked up at three waterholes and the others at two waterholes.

4.7 Matching black rhino identifications to spoor

Where possible, black rhino spoor were matched to animals sighted and photographed the previous night by ENP staff. Tables 10 and 11 show matches between Rhinowatch spoor tracks and ENP whole animal photographs for phases I and II, given in each case by the respective codes used by ENP and Rhinowatch. At least one animal per waterhole was matched for eight different waterholes and a total of 39 matches were made for all eight waterholes. This figure does not constitute the actual number of individual rhinos since there were several rhinos revisiting waterholes and, of course, a few individuals moving between waterholes. Since the actual estimate of rhino numbers from whole animal photography was not available, it was not possible to see if there was a statistically significant correlation between numbers as obtained by whole animal photography and those obtained by spoor analysis.

5 DISCUSSION

As outlined above, one of the objectives of this study was to assess the practicalities and relative merits of taking spoor and whole black rhino photographs over the study period, and to make recommendations about how these techniques might be effectively integrated and used to benefit monitoring in ENP.

5.1 Waterhole coverage (ENP and Rhinowatch) and data obtained

Good general coverage was made of the target waterholes, as outlined in Tables 1 and 2. However, not all of the data gathered at these waterholes was useable, and the final data used reflects coverage of eight waterholes for the reasons outlined above. It was thought that the initial target of coverage of thirteen waterholes was optimistic given the very short duration of the study period (6 days) and the number of teams operating. However, the black rhino population figures obtained for the eight waterholes covered can be considered reliable. A longer study period would have been more desirable, but this pilot was limited by the duration of viewing animals over the full moon period since the whole animal photography could only be carried out over this period.

Because of limited time available for this pilot study it was not possible to photograph spoor on

WATERHOLE	DATE-AUG. 97	RW-SPOOR TRACK NO.	ENP-WHOLE RHINO PHOTO NO.
AROE	13/14	8	E1
	14/15	1	E2
	15/16	-	-
KAMEELDORING	13/14	1	E3
	14/15	3	E4
		5 - 6	E7
		8	E5
	15/16	-	-
KLEIN NAMUTONI	13/14	-	-
	14/15	1	E8
		6 - 7	E7 + E7A
	15/16	1 - 2	9 + 9A
		3 - 8	E10 - E10A
		5.	E11
MUSHARA	13/14	1	E2
		2	E1
	14/15	-	-
	15/16	1	E2
		2	E3
TSUMCOR	13/14	1	E1
	14/15	-	-
	15/16	-	-
TWEE PALM	13/14	-	-
	14/15	-	-
	15/16	-	-

TABLE 10. Phase 1. RW spoor photos matched with ENP whole animal photos

WATER HOLE	DATE AUG. 97	RW-SPOOR TRACK NO.	ENP-WHOLE RHINO PHOTO NO
CHUDOP	17/18	2	E1
		9	E2
	18/19	1	E6
		7 + 8	E4 + E4A
		12 + 14	E7 + E7A
		13 + 16	E9 + E9A
		15	E5
	19/20	1	E11
		7	E12
		5	E13
GROOT OKEVI	17/18	-	-
	18/19	-	-
	19/20	-	-
KALKHEUWEL	17/18	1 + 2	E1
	18/19	-	-
	19/20	-	-
KLEIN OKEVI	17/18	-	-
	18/19	-	-
	19/20	-	-
KORNAGAS	17/18	-	-
	18/19	-	-
	19/20	-	-
LEEUNES	17/18	1	E FEM
		2 + 6	E COW + CALF
		13	E MAL
	18/19	1	E MAL
		[illegible]	E FEM ADULT
	19/20	-	-
OKERFONTEIN	17/18	-	
	18/19	-	
	19/20	-	

TABLE 11. Phase 2. RW spoor photos matched with ENP whole animal photos.

the northern boundary of Namutoni Block 10, as had been outlined in the original pilot study aims (see Alibhai & Jewell, 1997). However, this could easily be undertaken at a suitable time in the future.

5.2 Spoor condition summary

Much was learned from this pilot study about the factors governing the quality of spoor in ENP. During the short study period of 6 days the spoor quality varied enormously with conditions as outlined in section 4.3. Time was the single most important factor influencing decay of quality of fresh spoor, and particularly during this period when winds were higher than average. It was generally found that spoor photographed between 0600 and 0800 hours was in very good condition, and quality decreased thereafter. Lack of data from Twee Palms, the Okevis, Koinagas and Okerfontein waterholes was a consequence of late photography (due to the large number of waterholes to be covered), lion presence and/or high levels of other animal activity after the rhino had left. In retrospect, much of this could have been eliminated if the study had been conducted over a longer period of time or more teams had been available to cover the spoor photography. At no stage did substrate restrictions impact upon ability to find spoor, but they did affect the amount of time required to locate good spoor, for example at the Okevis and Koinagas. In summary the authors felt that ENP conditions were generally extremely favourable for a spoor study of this kind.

5.3 Whole rhino photo summary

It was apparent throughout the study period that attempting to photograph rhino coming to drink at waterholes over the full moon period was a difficult and potentially dangerous task requiring very skilled and dedicated staff. It was also noted that staff were required to perform the photography outside normal working hours and sacrifice sleep in many cases. It was found to be impractical for staff to sit up and observe the waterholes throughout the night and be expected to perform their normal duties the following day. This necessarily meant that most waterholes were not observed between 0100 and 0600 hours when some rhino might have been expected to drink. The practical difficulty of obtaining complete night coverage also impacted on the certainty with which spoor matches could be made - some rhino coming to drink may not have been observed/photographed. It was also the case that this technique could only be carried out during full moon periods when sufficient light was available to be able to see the rhino.

At the time of writing this report, data had not been available from the whole rhino photography for inclusion in this report.

5.4 Estimation of numbers of black rhino from spoor analysis and whole animal photography - relative merits.

A figure of 51±4 (±range) animals was estimated from spoor analysis at eight waterholes. The range of ±4 was due to the fact that some spoor photographs were taken late in the morning when spoor quality was beginning to deteriorate. This range could have been narrowed down considerably if all spoor photography had been carried out early in the morining. It is our recommendation that the minimum estimate (47) should be used as a reliable indicator of black rhino numbers. The clarity of spoor is obviously an important factor and if this method is used on a regular basis then any spoor or spoor track which is not clear should be excluded from population estimates. If it turns out that the unclear spoor does actually represent different individuals, then this will be picked up subsequently when the waterholes are revisited.

The figure obtained from whole rhino photography was not available. The authors are not able to comment on the estimated figures from the present study relative to current estimated figures for this area of ENP, and have, quite properly, not been given such data for reasons of security.

An estimated figure for black rhino numbers which is produced with spoor photography can be utilised in two ways. Firstly, it can, as is the case in this study, be compared with estimates from the ENP animal photography (currently not available) and a combined estimate be made with identification matches where possible. The advantage of this approach is that it will allow individuals to be identified as well as a census figure produced.

However, as a second option, the spoor technique can be used to create a library of prints from different animals, without having to photograph the whole animal, to produce a reliable estimate of population. The advantage of this method is that it can be used at any time of the month and is much less demanding of valuable staff time and effort. It will still allow individuals to be recognised, but the physical characteristics of the individual will not necessarily be known, unless the animal which made them was tracked and visually characterised during daylight at least on one occasion. However, as the technique is refined the authors hope that it will be possible to accurately age all calves and sub-adult animals and possibly also to sex animals. Another advantage of this method is that it can provide information about ranging and distribution of animals simply by spoor collection throughout ENP.

The ideal would perhaps be to combine the advantages of both techniques - to use moonlight photography where and when possible to get photographic records of individual animals, and to use spoor photography during the other times when this is not possible.

5.5 Possible extension of the spoor technique within ENP

This pilot study represented Level 1, as outlined in Alibhai & Jewell (1997), of the development of an integrated role for the spoor technique within the existing monitoring strategy employed within Etosha National Park. The authors consider that this study was very successful in meeting its objectives, and that, pending the final results of the whole animal photography from ENP, consideration might usefully be given to extending this study to Level 2.

Level 2 (Alibhai & Jewell, 1997) outlines the use of the spoor technique to give complete coverage of all waterholes in Namutoni Blocks 9 and 10 over a period of 4-6 weeks. This could also be undertaken in conjunction with the whole animal photography technique within the full moon period of that month. It would give a complete census figure for Namutoni, and frequency of overlap within and between waterholes, thus beginning to provide information about animal ranging patterns. Such a study would also undoubtedly benefit from experience and data obtained during this pilot.

In the interests of accurate mapping for gathering and plotting data on ranging and distribution, it is strongly recommended by the authors that consideration be given to the use of Global Positioning Systems and the adoption of standard UTM scale maps for this work within ENP.

Rhinowatch is currently working with systems engineers in the UK to refine the spoor technique and allow increased speed and accuracy of usage. Part of this process involves the design of specific software which will facilitate the use of the technique not only for black rhino but also for other endangered species.

6 PROPOSAL FOR EXTENSION OF PILOT STUDY TO LEVEL 2

The pilot study above was successfully undertaken at Level 1 of the proposed development schedule (Alibhai and Jewell 1997) for utilisation and incorporation of the spoor technique into the existing system of monitoring at ENP. Level 1 attempted to link moonlight photography of whole animals with spoor at waterhole over a short period. It is now proposed that this study be extended to Level 2 as proposed in the same document. Level 2 is designed to test the technique over a longer period of time to allow comprehensive testing of the spoor technique as a stand-alone for the days of the month when full moonlight is not present.

6.1. Aims of proposed pilot study at Level 2

6.1.1 To comprehensively photograph spoor at all waterholes in Namutoni Blocks 9 and 10 of ENP, and to produce a reliable estimate of the total black rhino population in this area.

6.1.2 If desired by ENP, local staff could be deployed to take whole animal photographs at some of these waterholes during full moon periods, in order for matches between spoor and whole animals to be made, although this would not be essential to meet the aim outlined in 6.1.1.

6.1.3 To assess the relative intensity of use of the different waterholes by the black rhino population and to investigate movements of animals between waterholes.

6.1.4 Using information collected above, to begin to assess animal ranging patterns within the Namutoni Area.

6.1.5 As a useful adjunct to the above work, Rhinowatch teams would use sophisticated night-viewing equipment outside full moon periods, to provide a complete night record of rhino activity at the waterholes covered. This would primarily involve viewing through binoculars or night-viewing equipment, with visual characterisation being noted on a form such as shown in Appendix 1.

6.2 Proposed methods

Rhinowatch would operate two full-time teams of Earthwatch volunteers to help fund and work the study. This system has been used by Rhinowatch at the Sinamatella IPZ since 1994. The volunteers would be fully trained to do night observations, and take spoor photographs the next morning under supervision. Every active waterhole in Blocks 9 and 10 would be covered over a period of 4-6 weeks. Each waterhole would be covered for a minimum of 3 and ideally 4 days.

Each team of volunteers would be divided into two groups and each group would be strategically placed in a small mobile viewing station (eg. combi vehicle, caravan etc) which would be left at the waterhole every night. Sub-groups of volunteers would alternate viewing duty to enable a comprehensive watch to be kept the entire night from dusk until dawn. The latest generation of night viewing equipment would be used to visualise and identify animals from the viewing station. Volunteers would not be required to leave the vehicles at anytime during the night. Volunteers would note the physical characteristics of rhino visiting the waterhole on a datasheet such as is currently used (Appendix 1), and draw a map of entry and exit points for each sighting. The study period would be undertaken at the peak of the dry season, when all animals were drinking at recognised water holes and comprehensive coverage was assured. The following morning, for each waterhole, accompanied by ENP scout, a fresh team would carry out the spoor photography. It is envisaged that, if desired by ENP, the whole exercise could be organised and run by the authors, with occasional logistical support and technical help from ENP staff.

6.3 Data analysis

Rhinowatch would analyse all data using the essential computer equipment at the Sinamatella Research base in Zimbabwe, and produce a fully-comprehensive report for the authorities in ENP (as has been done previously (see Alibhai & Jewell (1997)) and present report). Raw data gathered on observation sheets could of course be made available for ENP use as required.

6.4 Funding

If the proposal is acceptable to the MET, it is hoped that Rhinowatch would secure up to 50% of the funding required for the study. However, we recommend that Rhinowatch and MET might also be able to pursue joint funding applications to relevant organisations.

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Betsy Fox - Research Warden, Okaukuejo
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Willem Kubeb - Labourer
Peter Law - Rhinowatch field assistant
Walter Markel - Rhinowatch field assistant
Eben Naude - Senior Warden, Otjovasandu
Birgit Rusch - Pupil Warden
Fritz Schenk - Senior Warden, Namutoni
Trudy Stolz - Secretary, Namutoni
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AlexTsoni - Senior Scout, Namutoni
Jan Tsumib - Senior Scout, Namutoni
Kallie Venzke - Control Warden, Okaukuejo

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SINGLE
COW
BULL

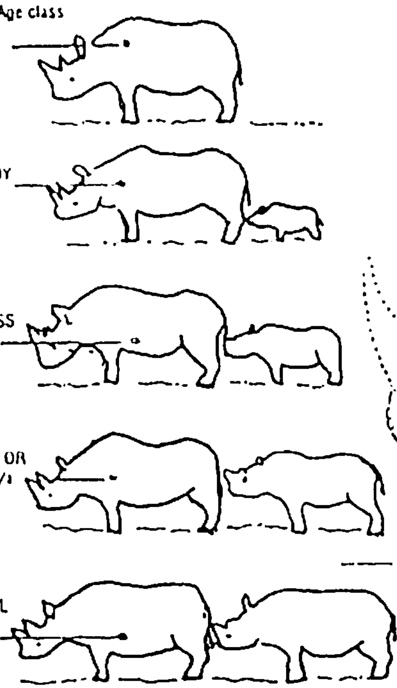
Age class

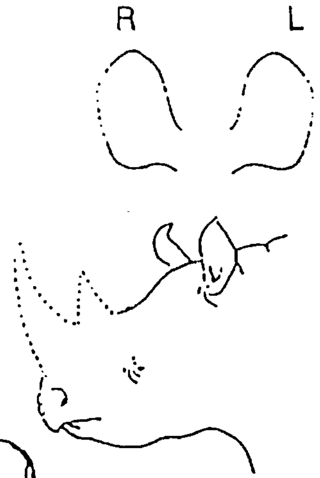
COW WITH BABY CALF

COW WITH LESS THAN ½ SIZE CALF

COW WITH ½ OR MORE THAN ½ SIZE CALF

COW OR BULL WITH SUB-ADULT





LOCALITY	
Rhino code no.	
Ear-notch no.	
Date identified	
Sex	

IDENTIFICATION	Ears		
	Horn		
	Sores / scar		
	Tail		
	Other		
	Photo No.		NAME:
	Spoor width (cm)	LF RF	
	Spoor width (cm)	LH RH	TIME:
	Photo File		
Behavior/Remarks			

SINGLE
COW
BULL

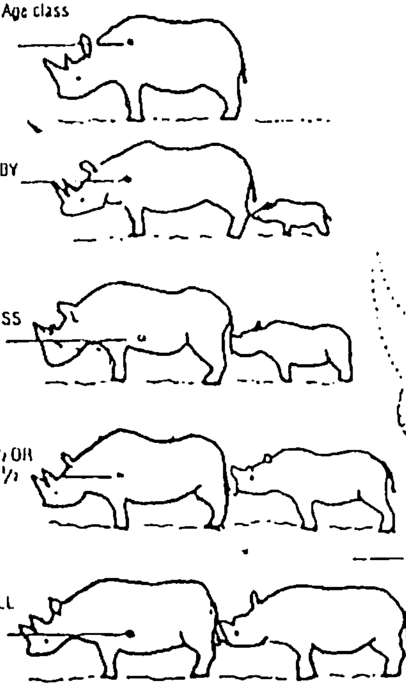
Age class

COW WITH BABY CALF

COW WITH LESS THAN ½ SIZE CALF

COW WITH ½ OR MORE THAN ½ SIZE CALF

COW OR BULL WITH SUB-ADULT



LOCALITY	
Rhino code no.	
Ear-notch no.	
Date identified	
Sex	

IDENTIFICATION	Ears		
	Horn		
	Sores / scar		
	Tail		
	Other		
	Photo No.		NAME:
	Spoor width (cm)	LF RF	
	Spoor width (cm)	LH RH	TIME:
	Photo File		
Behavior/Remarks			

Appendix 1

Date:
Waterhole name:
Rhino number:

DIAGRAM OF WATERHOLE:
Please draw incoming and outgoing path of rhino

N

W * E

S

Remarks:

Date:
Waterhole name:
Rhino number:

DIAGRAM OF WATERHOLE:
Please draw incoming and outgoing path of rhino

N

W * E

S

Remarks:

PHOTO ID SLIP

NAME: GPS READING:

DATE: SPOOR NO:

RHINO ID IF KNOWN:

PHOTO ID SLIP

NAME: GPS READING:

DATE: SPOOR NO:

RHINO ID IF KNOWN:

PHOTO ID SLIP

NAME: GPS READING:

DATE: SPOOR NO:

RHINO ID IF KNOWN:

PHOTO ID SLIP

NAME: GPS READING:

DATE: SPOOR NO:

RHINO ID IF KNOWN:

Appendix 3