

**PRELIMINARY REPORT ON THE POPULATION SIZE AND  
TREND (1973-1985) OF THE BLACK RHINOCEROS IN THE  
HLUHLUWE AND UMFOLOZI GAME RESERVES, 1985**

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## INTRODUCTION

The black rhinoceros Diceros bicornis is endangered throughout Africa. Its accelerated demise over the last 15 years, from an estimated 65000 to about 6000, due mainly to poaching for its horn, has been of great concern. The increased destruction of this species highlights the need for an improved and enlightened approach towards its conservation, more so now than ever before as the populations south of the Limpopo river may become the last strongholds in the world.

By the 1930's the black rhinoceros Diceros bicornis minor in the Republic of South Africa had been reduced to two relic populations (Hitchins 1975) : one in the Hluhluwe/Corridor/Umfolozzi Game Reserve complex and the other in Mkuzi Game Reserve. Under protection they increased in numbers and their distribution expanded through translocations to other reserves throughout South Africa (Hitchins 1984).

The Complex held, and still holds the largest population and it has been studied fairly intensively from 1961 to 1973 with the emphasis on Hluhluwe Game Reserve (Hitchins 1967, 1968, 1969, 1970a&b, 1971, 1975, 1976; Hitchins and Anderson 1983) and monitored infrequently up to 1980 (Brooks, Whateley and Anderson, 1980). Population studies revealed low recruitment rates in Hluhluwe and a more favourable rate in the Corridor and Umfolozzi Game Reserve. It had been suggested that the black rhinoceros in Hluhluwe were at ecological carrying capacity (Brooks et al 1980; Hitchins and Anderson 1983). The reason for the contrasting demography of these sub-populations is not clear; although it appears that the availability of browse (woody plants and forbs) has been reduced through various veld management practices (Hitchins 1976).

In 1980 a capital removal of about 10 % of the black rhinoceros population was undertaken, followed by annual removals equivalent to the annual rate of increase of a healthy population calculated at 4 %.

During 1984 field staff in the Complex expressed concern at the apparent low numbers of black rhino (H. Bentley and S. Pillinger pers. comm.) and the capture team had great difficulty in locating individuals in Hluhluwe Game Reserve during capture operations (R. Henwood pers. comm.).

As a result, a short-term one year project was initiated to determine the size of the black rhinoceros population in the Complex. Funding of this project was undertaken by the Endangered Wildlife Trust, the South African Nature Foundation, Natal Parks Board and the Mtubatuba Round Table 100.

This report presents the preliminary results of the survey and acts as an interim document pending completion of follow-up work planned for September 1986. Management recommendations will only appear in the final report.

### BRIEF HISTORY OF THE BLACK RHINOCEROS POPULATION IN THE COMPLEX

Little is known about the history of the black rhinoceros populations in the Complex prior to the first population estimate in 1935 when there were about 115 in Hluhluwe Game Reserve (Henkel 1937). Potter (1948) estimated the population in Hluhluwe to be 160 with no data for the Corridor or Umfolozzi Game Reserve.

It was not until 1961 that the black rhinoceros received any significant attention as far as numbers were concerned; although it had been accepted that the Hluhluwe population was the largest in Zululand and that the density of rhinos probably exceeded that anywhere else in Africa. After a ground count in February 1961, 300 animals were counted where previously it was estimated that the population numbered just over 200 (Deane 1961).

During the same year, 46 black rhinoceros died in the north-east section of the reserve over a four month period (Hitchins and Anderson 1983). Similar censuses were completed in 1967 and 1968 which gave estimates of 164 and 226, the mean being 195 (Hitchins 1967, 1968).

Between 1968 and 1973 a more accurate black rhinoceros population estimate was obtained based on recognisable individuals throughout the Complex (Hitchins 1976): 199 in Hluhluwe and 129 in the Corridor and Umfolozi. These results indicated that a marked decline of about 100 animals had occurred in Hluhluwe over the 12 year period from 1961 to 1973. During this period 36 black rhinos were removed (Appendix 1) for relocation to other suitable conservation areas (Hitchins 1984). Taking these remarks into account, the Hluhluwe population suffered a nett loss of some 65 animals, that is 22 % at a rate of 1,8 % per annum.

In 1973 the black rhinoceros recruitment rate was substantially higher in the Corridor and Umfolozi than in Hluhluwe. It was believed that the already lower rate in Hluhluwe had decreased even further to a point where the population was probably stable. Factors such as the relatively late attainment of female sexual maturity, a calving interval longer than that recorded in other known populations and high calf mortality, suggested that the Hluhluwe population was at or near its asymptote (Hitchins and Anderson 1983).

Between October 1975 and September 1977, Brooks (1979) found the structure of the population to be healthy with no indication that the mortality rate had increased; in fact a decrease in mortality rate was suggested. It was believed that the numerical status of the black rhinoceros in the Complex had remained unchanged since 1972.

During 1981 both black and square-lipped rhinoceros were poached in Hluhluwe Game Reserve and the Corridor. The official figure was 2 of each species, but an unofficial estimate was 15 black and 28 square-lipped rhinos (K. Meikeljohn pers.comm.).

## METHODS

The aim was to identify as many individual rhino as possible and to collect this information in a form that would allow analysis using mark-recapture techniques.

This was achieved through a series of ground and aerial surveys of the population conducted between February 1985 and January 1986. Every black rhinoceros encountered was identified by horn and other characteristics, sexed and aged after Hitchins 1969 & 1970.

### Field techniques

#### (i) Ground survey

Four surveys were completed in Umfolozi (2370 km walked), two in Hluhluwe (750 km) and two in the Corridor (470 km). The average distance walked per day was 24,6 km.

The Complex was divided into daily operational zones using the helicopter game census blocks as a guide. Each operational or daily patrol zone was in the order of 1470 ha in size so that in order to complete a survey Umfolozi would require 30 days, Corridor 13 days and Hluhluwe 18 days. The sequence in which the daily patrol zones were counted was determined using random numbers, while the route within each zone was varied on each occasion.

During the foot patrols all black rhinos sign : communal dung middens, isolated dung, spoor and other markings were recorded and related to the distances walked in each area.

(ii) Helicopter survey

Data on individual black rhinos were collected from a Hughes 300 C helicopter during 26 hours observation between 9 and 19 September 1985. Six flights were made over Hluhluwe (13,5h), four over the Corridor (7,5h) and one over Umfolozi (5h).

To optimise sampling efficiency, flights were restricted to between 06h45 to 12h30 on warm days when black rhinoceros favour exposed ridges. Black rhinos respond quickly to disturbance, so a rapid approach method was used resulting in a greater proportion of the population being located before disappearing into dense bush.

Analysis

(i) Square-lipped rhinos sightings as an index of black rhinoceros numbers.

All square-lipped rhinoceros encountered during the surveys were sexed and aged; and the number of sightings translated into a black rhinoceros estimate using the following formula:

$$\frac{\text{known s.l.rhino population size} \times \text{no. black rhino sightings}}{\text{no.s.l.rhino sightings}}$$

This method assumes that both species are equally visible to the observer.

(ii) Mark-recapture estimate.

The results of the four surveys in Umfolozi were analyzed using the Zuchini Model for mark-recapture data. The estimate is based on the pattern of resightings of individually recognisable rhinos recorded on successive surveys, and takes into account those individuals not actually encountered. Insufficient data were available from the Hluhluwe and Corridor surveys to provide firm estimates for these areas using the model. Black rhinoceros calves were not regarded as independent sightings and therefore were excluded from the initial analysis. The estimate given later in this report has been corrected to include the calf sector.

RESULTS AND DISCUSSION

Population size, trend and density

Preliminary population estimates of black rhinoceros for 1985 based on the number of individual animals (plus unsighted individuals), the mark-recapture analysis and using the square-lipped rhinoceros ratio method are presented in Table 1, along with the 1973 estimates.

The size of the black rhinoceros population in the complex is currently estimated at 191, comprising 69 in Hluhluwe, 37 in the Corridor and 85 in Umfolozi. Improved estimates, which will include expanded mark-recapture results, will only be available following the additional helicopter surveys planned for September 1986. Until then the population estimates given above, which were based simply on the numbers of rhinos individually identified plus those known to be present using sign, may be safely regarded as minimum figures and will be used in this report for discussion purposes.

Table 1. Preliminary estimates of the size of the black rhinoceros population in the Complex for 1985, with comparative figures for 1973.

Area	1973	1985				
	ident. animals	'known' animals			Zucchini mark-recapture	s.l. ratio ratio method
		ident	other	$\bar{n}$	$\bar{n}$ (95% conf. limits)	$\bar{n}$ (range)
Hluhluwe	199	49	20	69	n/a	50 (45-53)
Corridor	69	33	4	37	n/a	60 (51-74)
Umfolozi	60	75	10	85	93 (79-124)	106 (84-148)
Total	328	157	34	191	--	216 (180-275)

The results indicate a major decline in the Complex from 328 rhino to about 191 between 1973 and 1985. This is most marked in Hluhluwe where numbers have dropped from about 199 to 69 (65 % decrease), while the Umfolozi population has increased by 42 % from 60 to 85. Numbers in the Corridor have declined from about 69 to 37, a decrease of 46 %. It is interesting to note that from 1974-1985, 88 black rhinos were removed from the Complex for relocation purposes (Appendix 1), so if mortalities had been balanced by recruitment, the 1985 population would stand at about 240.

The changes in black rhino density from 1973 to 1985 presented in Figs 1 & 2 indicate that some areas experienced particularly marked declines, particularly the Manzimnyama and Nzimane valley areas in Hluhluwe and the Seme/Nthabayenthombi area in the Corridor. Also, the pattern of relative density within Umfolozi has remained unchanged since 1973, with the western area supporting the highest densities.

Although not actively investigated here, it is suggested that the decline from the high densities of 1961, and continued through 1973 to 1986, might be related to habitat change brought about, at least in part, by the controlled reduction of large grazers. The resultant increased grass cover would be expected to depress the abundance and availability of forbs, an important food item, and fire would have encroached further into the thicket communities to the detriment of some of the highly-palatable, but fire sensitive, woody plants. In 1973 it was predicted that the Hluhluwe population would decline should the practice of encouraging fire-maintained wooded grasslands continue. On the other hand the Corridor and Umfolozi black rhinoceros populations were expected to increase as they were below the carrying capacity of the vegetation (Hitchins 1976, Hitchins and Anderson 1983).

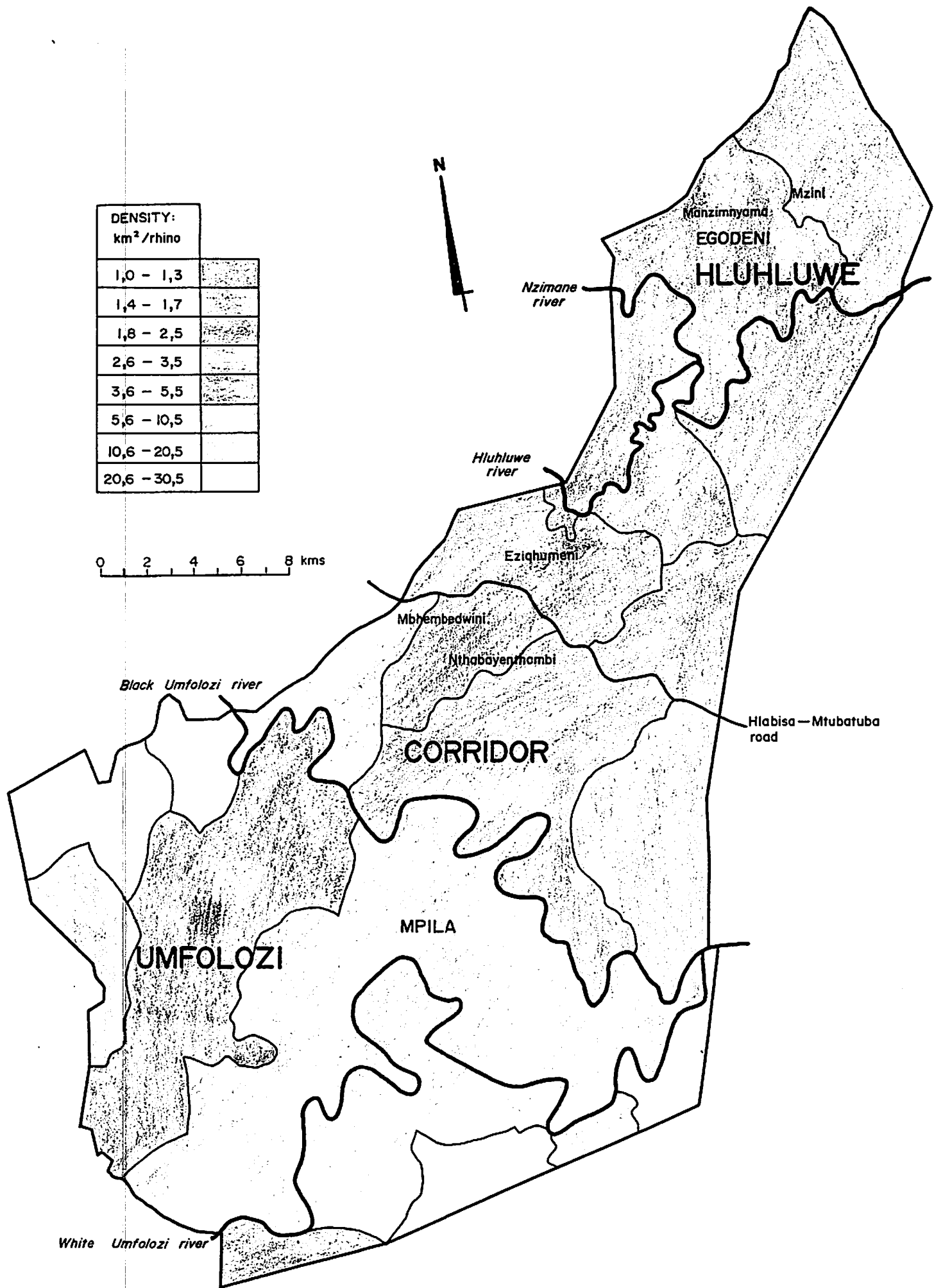


FIG. 1 BLACK RHINOCEROS DENSITY (km<sup>2</sup>/rhino) IN THE COMPLEX IN 1973

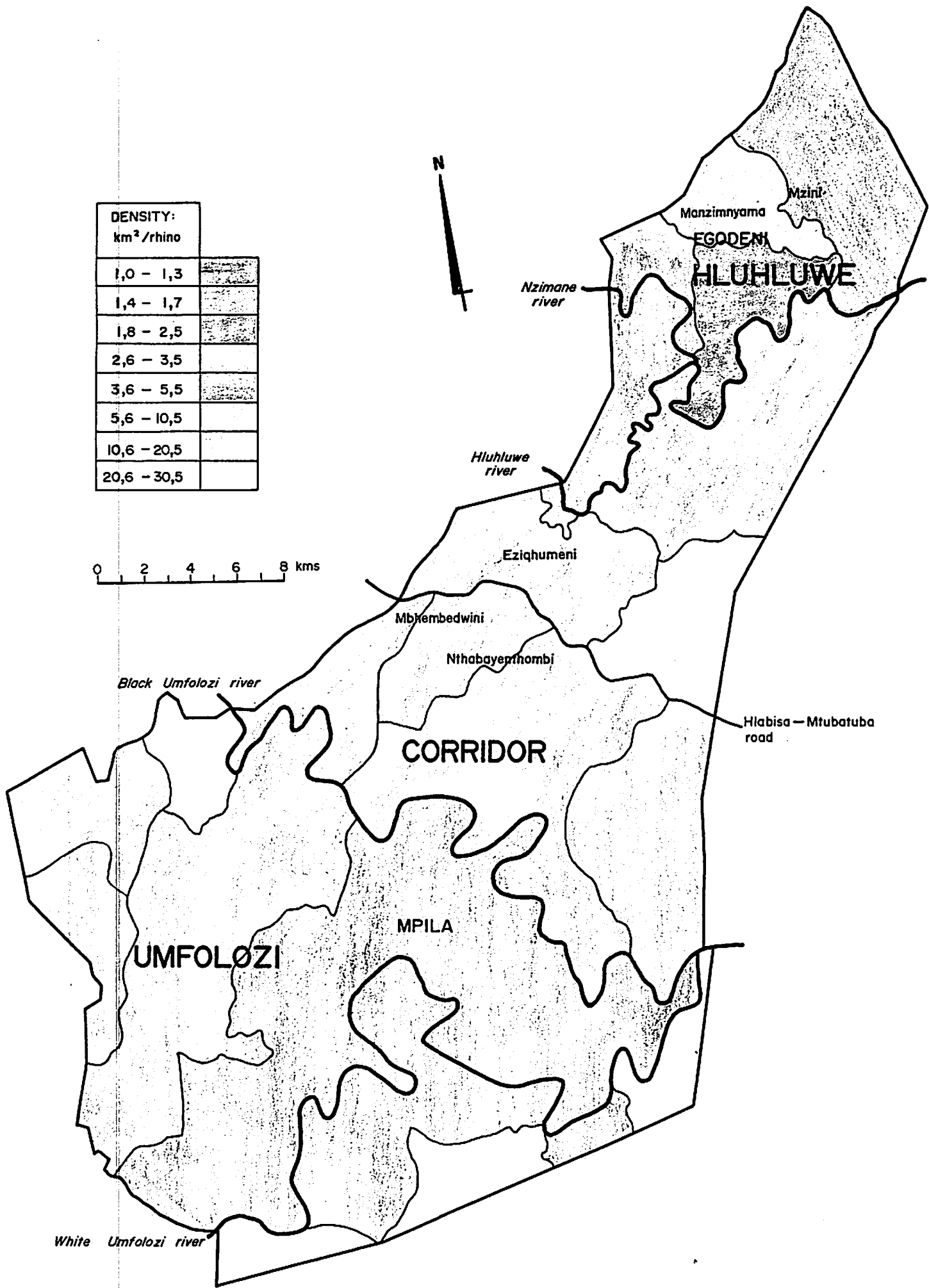


FIG. 2 BLACK RHINOCEROS DENSITY. (km<sup>2</sup> /rhino) IN THE COMPLEX IN 1985

### Population structure

The age and sex composition of the recognised individuals is given in Table 2.

Table 2. Sex and age composition of black rhinoceros in the central Complex in 1985.

Age class	Adult		Subadult		Immature						n	
	older than 8 years		5-8 years		3-5 years		1-3 years		birth-1 year			unsexed
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀		
Hluhluwe	22	18		1		1	1	3	2		1	49
Corridor	8	13		1			1	2	6	1	1	33
Umfolozi	23	26	1	3	2	2	1	6	5	5	1	75
Total:	53	57	1	5	2	3	3	11	13	6	3	157

The sex ratio of the adult component of the population in the Complex of 100 ♀: 93 ♂ was parity ( $p > 0,05$ ) based on the sample of 53 males and 57 females. This agrees with the findings in 1972 (Hitchins and Anderson 1983) and 1980 (Brooks et al 1980).

The sex ratio of the immature age class (1 to 5 years old) of 100 : 36, although based on a small sample, suggests a preponderance of females.

The sex ratio of the calf component (birth to 1 year old) of the population of 100 ♀: 216 ♂ is similar to previous studies: 1970, 100:150; 1971, 100:200; 1972, 100:267; 1973, 100:167. This preponderance of male calves born into the population has also been recorded in square-lipped rhino (Hitchins in litt., Owen-Smith 1973, Brooks 1980). These observations suggest a higher mortality among males than among females as by adulthood the age-specific sex ratio has become even.

The proportions of immatures and calves in the Complex from 1970 to 1985 are shown in Table 3. Of particular interest are the higher percentages of immatures plus calves in 1985 (HGR 16,3 %, Corridor 33,3 %, UGR 29,4 %) as compared with 1980 (13,6 %, 31,0 % and 8,0 % respectively) which might suggest a positive response to the heavy rhino removals in 1981 undertaken to ease suspected food limitations during the drought. However these trends might simply have resulted from the recovery of the vegetation as rainfall improved. The longer-term trend from 1973 to 1985 indicates that both the Umfolozi and Corridor populations are showing improved recruitment and have a very healthy proportion of young animals, while the Hluhluwe population remains in a depressed state.

### Black rhinoceros sign as an index of abundance

The frequency of occurrence of black rhino sign (dung, spoor, scrapes) is compared with actual rhino density within groups of patrol zones in Fig.3. These two parameters are highly correlated ( $r = 0,773$ ;  $P < 0,001$ ), which means that black rhino sign may be used as an index of relative abundance of the species between areas.



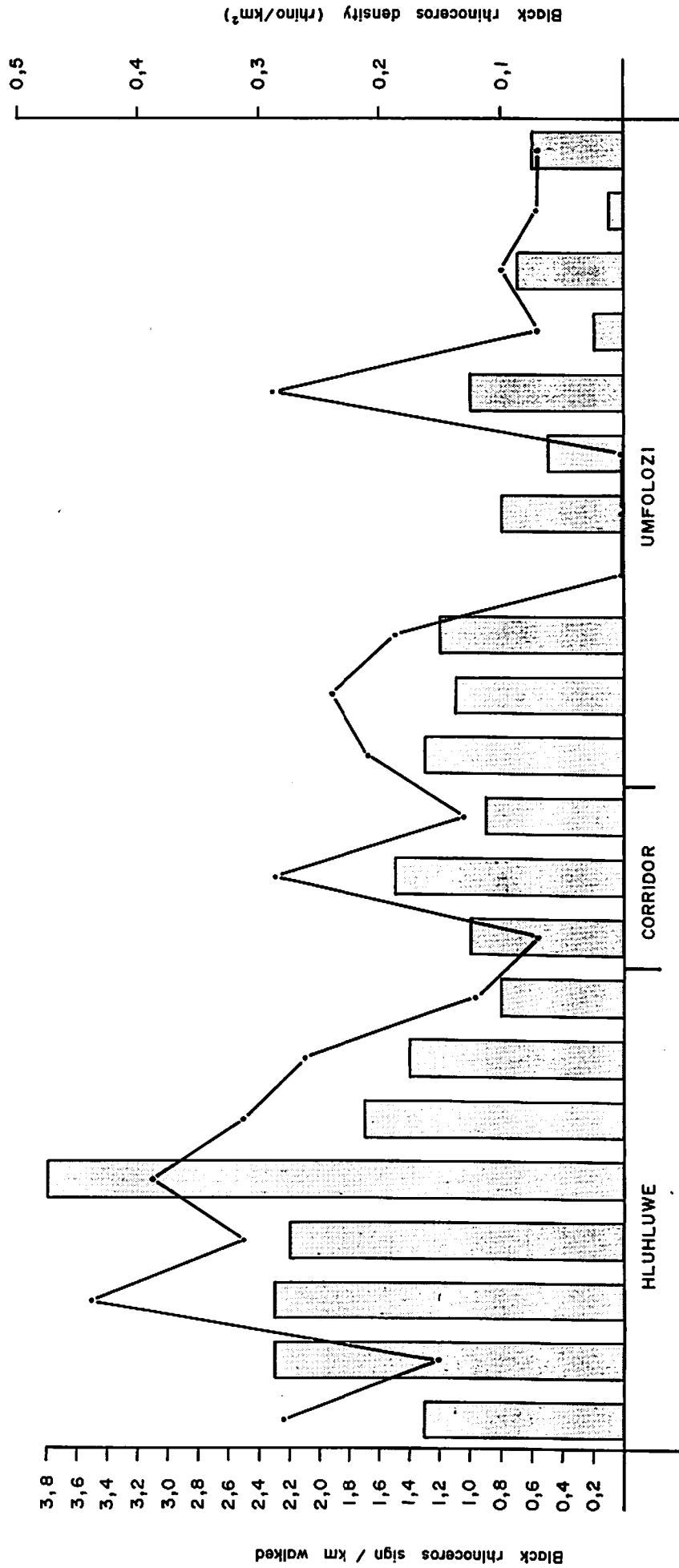


FIG. 3 BLACK RHINOCEROS SIGN AS AN INDEX OF ABUNDANCE (HISTOGRAM) COMPARED TO BLACK RHINOCEROS DENSITY (GRAPH) IN THE COMPLEX, 1985

Table 3. The proportions of immature black rhino and calves in the Complex from 1970 to 1985

Area	Year	% immature (1-4 yrs)	% calves (birth-1 yr)	% immature & calves combined
Hluhluwe	1970	18,4	6,4	24,8
	1971	13,6	6,1	19,7
	1972	13,9	8,9	22,8
	1973	12,1	7,1	19,2
	1976	6,6	8,0	14,6
	1980	9,5	4,1	13,6
	1985	10,2	6,1	16,3
Corridor	1970	11,1	5,5	16,6
	1971	11,5	7,7	19,2
	1972	7,1	14,3	21,4
	1973	21,4	3,6	25,0
	1976	5,7	16,1	21,8
	1980	20,7	10,3	31,0
	1985	9,1	24,2	33,3
Umfolozi	1970	12,0	12,0	24,0
	1971	16,1	6,4	22,5
	1972	9,7	9,7	19,3
	1973	19,0	2,4	21,4
	1976	6,3	11,3	17,6
	1980	8,0	0	8,0
	1985	14,7	14,7	29,4

Attachment to home range/territory

Previous studies of home range and territoriality (Anderson and Hitchins 1971, Hitchins 1971, Hitchins in litt.) have shown that the black rhinoceros is a sedentary species in Hluhluwe Game Reserve, with no records of movements out of their home ranges or territories, although slight increases in range size have been recorded in females apparently in response to the reduced availability of food. This is confirmed in the present study, as all 74 individuals that had been known from 1973 or before were still occupying the same areas (see Table 4). Some of these home ranges/territories had been occupied for 28 years.

Table 4. Tenure of home ranges or territories by known black rhinos

Area	Hluhluwe	Corridor	Umfolozi
No. adults positively identified from previous studies	27	18	29
No. known-age individuals	7	5	3
age range (years)	16-28	14-21	17-24
average age (years)	23	17	20
No. other known adults	20	13	26
period known : range (years)	15-23	14-19	13-19
average (years)	18	17	15

There is therefore no evidence to suggest that the decrease in numbers of the black rhinos in Hluhluwe and the Corridor can be attributed to movement into Umfolozi Game Reserve.

#### Physical condition

Of the 157 animals individually identified, 99 % were in good physical condition. Two males, both from the west of Umfolozi, were in fair condition; one of which was suffering from an injured fore-leg.

Prior to the survey in Hluhluwe Game Reserve an adult female was immobilised in the Sitezi area and moved to the bomas at Umfolozi to allow her severe horn wounds to be treated. Seven months later this animal was released back in Hluhluwe, but in the low black rhino density area of Seme.

#### Black rhinoceros mortality

During the 22 year period 1952 to 1973, 137 black rhinoceros were recorded as dying of natural causes in Hluhluwe Game Reserve (Table 5). Including the 1961 die-off, this represents an average of 6,2 animals per year or 4,1 animals per year when excluding the 1961 die-off. The 12 year period 1974 to 1985 has an average recorded mortality of 1,3 animals per year, perhaps suggesting a reduced mortality rate? Most of the data for the 1974 to 1985 period was obtained from NPB records at Hluhluwe Game Reserve. There were however some deaths that were not recorded in these records : animals poached at Ezizhumeni and Nthabayenthombi in 1981 and 2 animals burnt in a control fire in the Mzini valley in 1982. It is suggested that due to the abnormal field conditions of tall grass reducing visibility, only a small percentage of black rhino carcasses will be found, especially as they are rapidly disposed of by spotted hyaena.

Table 5. Causes of mortality of black rhinoceros in the Central Complex from 1952 to 1985.

Area Period	Hluhluwe		Corridor 1974-1985	Umfolozi 1974-1985
	1952-1973	1974-1985		
(i) <u>natural</u>				
1961 die-off	46			
unknown	54	12	1	12
horn wounds	23	1		
accidents	7	1		
poor condition	3			
other	1			
predation	3			
burnt by fire	-	2	1	
Sub-total	137	16	2	12
(ii) <u>unnatural</u>				
poaching	7	1	1	1
destroyed, endangered human life	1		1	2
immobilizing drugs	7			
Sub-total	15	1	2	3
Total:	152	17	4	15

The natural mortality rate per year in the Corridor and Umfolozi over the 12-year period 1974 to 1985 (Table 5) is 0,2 and 1,0 respectively.

The following mortality factors require special attention:

(i) Deaths resulting from control fires

As mentioned earlier, an adult female and immature were burnt in the Mzini valley in 1982 and a subadult female was also burnt in the Mbhembedwini area in the Corridor in 1985. These records are the first cases of black rhinos being killed by fires for some 30 years (since 1952) which is indicative of the present grassveld conditions prevailing in the Complex. It is possible that other black rhinos have suffered the same fate without being found.

(ii) Poaching

Of the 7 poaching cases involving black rhino in the Hluhluwe area between 1952-1973, three were unintentional as they were caught in snares set for antelope. Three cases involved the killing of black rhinos with spears outside the game reserve and there was a single case of a black rhino being shot inside the reserve in 1971.

In October 1979 a black rhino's death was recorded as 'cause of death unknown' in Umfolozi, but later investigation of the remains revealed a bullet hole through one of the ribs.

In 1981 both black and square-lipped rhinos were poached by a game guard in Hluhluwe and the Corridor. The accused admitted to shooting 2 black rhinos and showed staff the carcasses. The unofficial figure of black rhino poached was 15 and could be higher.

During the surveys in Hluhluwe and the north-western area of the Corridor it was obvious that some areas had suffered a greater decline in numbers of black rhino than others. These areas correspond to those in which this particular game guard was stationed and the circumstantial evidence suggests that the unofficial figure of 15 black rhinos poached is more realistic and is probably at the lower limit of what was actually removed.

(iii) Destroyed, endangered human life

In Hluhluwe Game Reserve between 1952 and 1973, when the black rhino density was the highest in Africa, a single black rhinoceros was shot in surrounding KwaZulu as it endangered human life while being driven back into the game reserve. This was in 1959. None were shot in self defence within the reserve during this period.

However such mortality has increased dramatically, with four females being shot by staff in Umfolozi in recent years (1-1982; 2-1983; 1-1986). This unnatural mortality factor is disturbing as black rhinoceros densities are still fairly low in Umfolozi and as they increase staff contacts with these animals will also increase.

### SUMMARY

- (i) There has been a marked decline in overall numbers of the black rhinoceros in the Complex from 328 in 1973 to a preliminary estimate of 191 in 1985. Final estimates will be available in the final report after completing the helicopter surveys in September 1986.
- (ii) The current preliminary estimate of 69 in Hluhluwe and 37 in the Corridor represents a decline of 65 % and 46 % respectively, while the figure of 85 for Umfolozi represents an increase of 42 %.
- (iii) The percentage of the population under 5 years old was 16 % in Hluhluwe, 33 % in the Corridor and 29 % in Umfolozi. The lower recruitment rate for Hluhluwe confirms findings from previous studies in this area since 1973.
- (iv) The long-term attachment of individuals to their home ranges/territories indicates that there had been no movement of adults from Hluhluwe and the Corridor into Umfolozi which could account for the observed increase in numbers in Umfolozi.
- (v) The loss of animals from translocations and recorded deaths, including poaching, since 1973 does not account for the observed overall decline in numbers.
- (vi) The precise causes of the decline in numbers has not been established, however, a number of possibilities exist:
  - (a) vegetation change resulting in reduced carrying capacity in certain areas, especially Hluhluwe.
  - (b) The level of poaching may have been significantly higher than recorded.
  - (c) The incidence of predation and the loss of animals through being burnt in veld fires might also be much higher than generally thought.
- (vii) The proposed major project on the ecological requirements of the black rhinos in Zululand planned to start in 1987 has been designed to provide answers to some of these concerns.
- (viii) Recommendations on the management of the black rhinoceros population in the Complex will appear in the final report, which should be completed by December 1986.

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Appendix 1: Black rhinoceros removals from the Central Complex for translocation purposes : 1961 to 1984.

Period	Hluhluwe			Corridor			Umfolozi			Total		
	total			total			total			total		
1961 to 1973	19	17	36	-	1	1	-	-	-	19	18	37
1974 to 1984	21	16	37	16	9	25	16	10	26	53	35	88
TOTAL:	40	33	73	16	10	26	16	10	26	72	53	125

Note: Data includes deaths during capture/translocation operations