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The Taxonomic Status of the Black Rhinoceros (*Diceros bicornis* Linn. 1758) in South West Africa

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CONTENTS

I. INTRODUCTION

The question as to whether the black rhinoceros occurring in South West Africa should have subspecific status or not, is still a debatable point. This uncertainly is mainly due to a lack of sufficient material available to workers. During 1966 and 1967 however, 18 black rhino skulls were collected throughout the north-western sector of South West Africa lying to the north of the Ugab River.

As the black rhinoceros occurring in Zululand are regarded by most recent workers as *Diceros bicornis bicornis*, viz. Shortridge (1934), Allen (1939), Roberts (1951), Ellerman (1953), Meester *et al* (1964), and Ansell (1967), it was decided to compare the abovementioned skulls to a sample from the Natal population.

No evidence could be found of sexual dimorphism in the skulls of the black rhinoceros. Foster (1965), did extensive work on this aspect and was equally unsuccessful. Sexual dimorphism in the skulls does not seem to exist and was therefore disregarded as a factor which might have an influence on any statistical conclusions regarding the study.

II. TAXONOMY

Rhinoceroses belong to the family Rhinocerotidae and is grouped into the order Perissodactyla. The black rhinoceros falls into the genus Diceros Gray, 1821.

DICEROS BICORNIS Linnaeus, 1758.

1758 *Rhinoceros bicornis* Linnaeus, Syst. Nat. 10th ed. 1:56. "India", but Cape of Good Hope according to Thomas (1911:144).

1803 *Rhinoceros africanus* Blumenbach, Man. Hist. Nat. 1:156, Cape of Good Hope.

1836 *Rhinoceros keitloa* A. Smith, Rept. Exped. Expl. Central Afr., 44 "Country north and south of Kurrichaine" (Marico district, western Transvaal).

1837 *Rhinoceros ketloa* A. Smith, Cat. S. Afr. Mus. 7 "180 miles N.E. of Lattakoo".

1842 *Rhinoceros bicornis* Var. B. *Rhinoceros gordoni* Lesson, Nouv. Tabl. Règne Anim. Mamm. 159, nom. nud.

1845* *Rhinoceros niger* Schinz, Synops. Mamm. 2:335. Chuntop near Mt. Mitchell, Kuiseb district, South West Africa (Shortridge, 1934, Mamm. S.W.Africa, 1:412 Footnote).

1845 *Rhinoceros camperi* Schinz, loc. cit. Cape of Good Hope.

1898 *Rhinoceros bicornis capensis* Trouessart, Cat. Mamm. Viv. Foss. 757. Cape of Good Hope.

1922* *Opiceros occidentalis* Zukowsky, Arch. Naturgesch. 88A, 7:162. Kaokoveld-Cunene region, northern South West Africa.

1934 *Diceros bicornis* Shortridge, Mamm. S.W. Africa, 1:412 South West Africa.

1947 *Diceros bicornis punyana* Potter & Mitchell, Field, 190:385. Hluhluwe Game Reserve, Zululand, Natal.

* Described forms from or possibly from South West Africa.

III. COMMENTS ON TAXONOMY

Captain Alexander travelled through South West Africa during 1836 and 1837. In his 'Travels in the Interior of South Africa' he published a description of a black rhinoceros he came across at Chuntop near Mount Mitchell. According to Alexander these animals were well over six foot tall. Their horns were mounted loosely on the forehead and while browsing the animals would strike the horns against each other causing a clacking noise. Whenever the animal became alarmed the two horns would stiffen, and the animal would be ready to defend himself. Schinz (1845) in his monograph, 'Synopsis Mammalium' named a species *Rhinoceros niger* after Capt. Alexander's description, which is also listed in Gray (1867).

In his publication 'On some Cranial and Dental Characteristics of the existing Species of rhinoceros' Flower (1876) omitted the species *Rhinoceros niger* probably due to a lack of material.

In 1922 Zukowsky described a species, *Opsiceros occidentalis* from northern Kaokoveld. The general

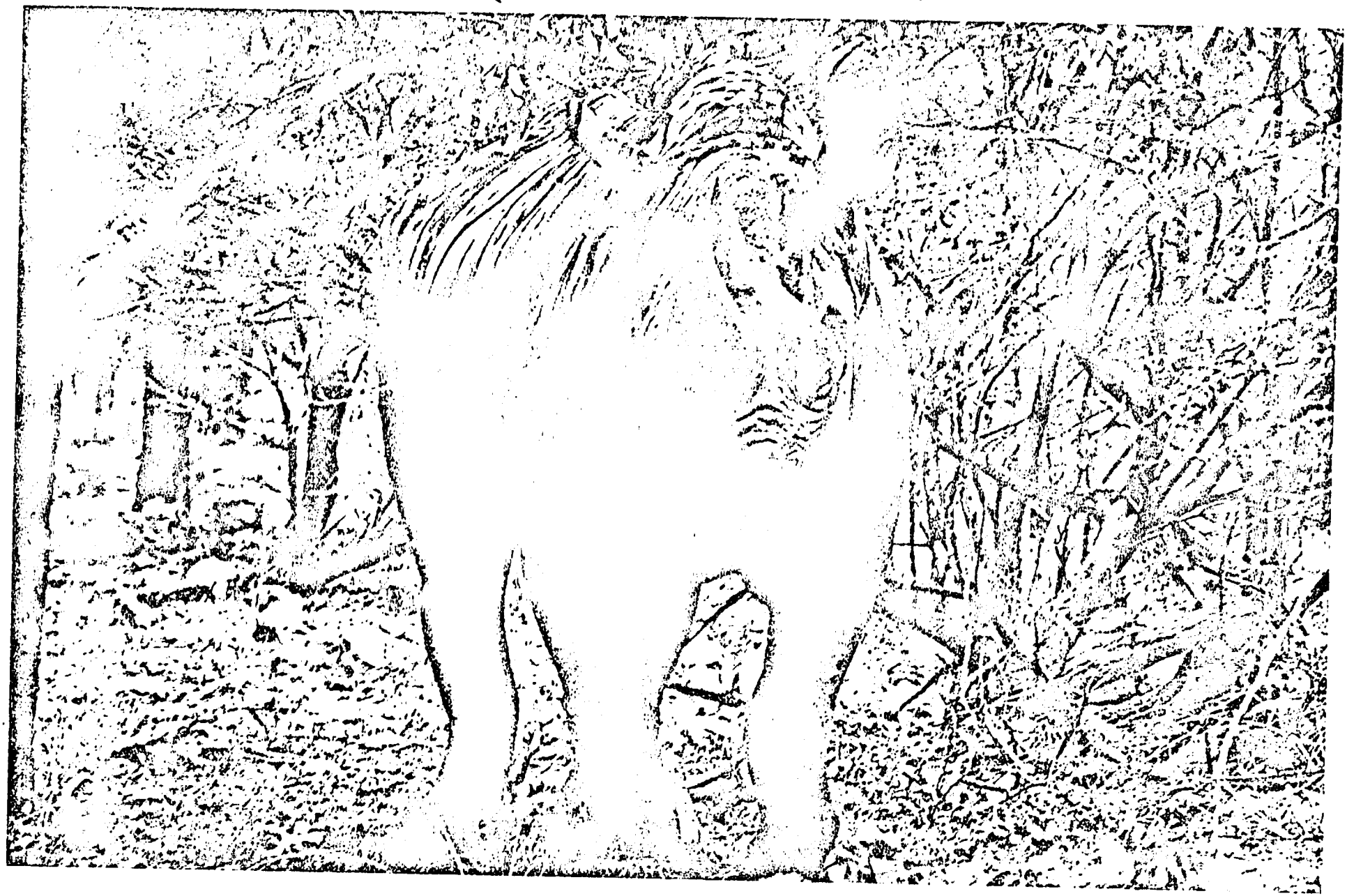

Plate 1. Black rhinoceros in a typical stance.

Plate 2. Female black rhinoceros in the Etosha National Park showing the two horns of nearly equal length.

distribution of this animal was published in 1924. According to Zukowsky they occurred in isolated localities as far south as the lower Ugab River.

According to the distribution pattern of the black rhinoceros in South West Africa before 1900 they occurred along the western side of South West Africa mainly in the escarpment zone. Alexander's map show Mt. Mitchell to be situated at the present-day Naukluft Mountains. Zoogeographically Mt. Mitchell and the Kaokoveld belongs to the same entity. No ecological barriers eg. mountain ranges or perennial rivers, exist between these two localities to stop any gene flow. If it is further taken into consideration that *Rhinoceros niger* was only based on a description in a travelogue and not on any actual measurements the existence of two species of black rhinoceros in South West Africa seems to be a very remote possibility.

Shortridge (1934) regarded it as unlikely that *Opsiceros occidentalis* Zukowsky 1922, would be distinguishable from the typical *Diceros bicornis*. Even if this would be the case it still would be a synonym of *Rhinoceros niger* Schinz 1845, which would antedate it.

Roberts (1951), and Allen (1939), both regarded *Rhinoceros niger* and *Opsiceros occidentalis* as synonyms of *Diceros bicornis bicornis*.

In 1965 Zukowsky published his revision on the genus Diceros. In this he recognises both *Diceros bicornis niger* Schinz 1845, and *Diceros bicornis occidentalis* Zukowsky 1922. In this work he also acknowledged the existence of *Diceros bicornis keitloa* A. Smith 1836. The latter form has first been shown by Selous (1881) to be a synonym of *Diceros bicornis*, a view held by most workers thereafter. Smith described this species from north of the present day Kuruman and the map published by Zukowsky shows the locality to be in the upper reaches of the Limpopo drainage system. In the Kaokoveld however, at least three animals are known to exist (Plate 2) which would satisfy some of the external characteristics described by Smith (1836) page 2 for *Rhinoceros keitloa* viz. ". . . the two horns are of equal, or nearly equal length".

Hopwood (1939), and Ansell (1967), both accepted the possibility of the existence of a separate subspecies in Angola based on skull characteristics which would then also include the South West African form. Hopwood however did not name the subspecies due to insufficient material. Ansell suggested the name *Diceros bicornis niger* Schinz 1845.

The validity of a subspecies in South West Africa (and Southern Angola) is therefore still in question.

IV. ANALYSIS OF CRANIAL MEASUREMENTS

As already mentioned eighteen skulls were found in South West Africa. Twenty skulls were obtained from the collection at the Hluhluwe Game Reserve, Natal. From all these skulls the following measurements were taken (See fig. 1).

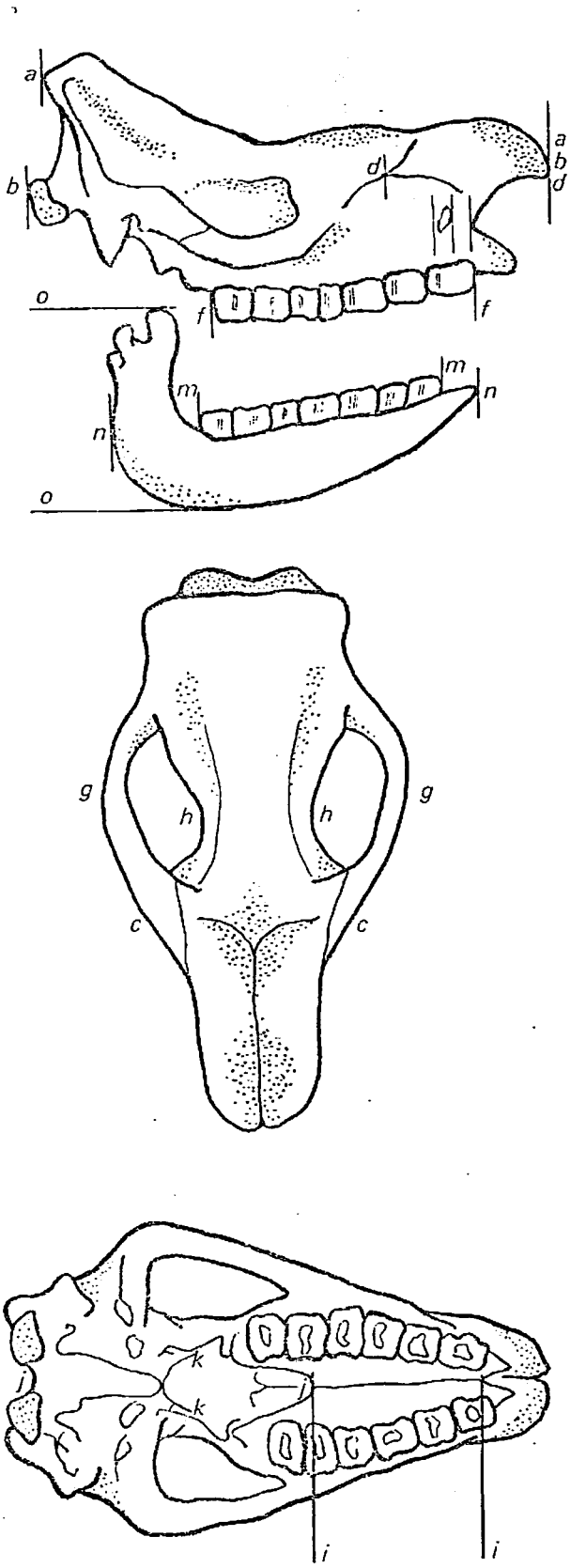

Figure 1. Lateral, dorsal and ventral views of a rhino skull, showing points between which measurements were taken.

TABLE 1. *Diceros bicornis* skull measurements from a South West African sample

Skull	a/a	b/b	c/c	d/d	e/e	f/f	g/g	h/h	i/i	j/j	k/k	l/l post	l/l ant	m/m	n/n	o/o
1	—	57.5	22.9	—	—	27.3	34.2	12.2	20.7	—	6.2	4.9	2.4	26.9	45.5	23.5
2	—	—	22.3	—	18.2	28.3	33.7	12.0	19.3	29.5	7.2	4.1	1.5	27.5	45.3	25.2
3	55.7	50.2	21.6	—	—	25.7	32.6	10.8	19.6	26.8	6.5	3.9	1.4	—	—	—
4	63.0	56.1	21.6	—	—	27.1	34.1	11.4	21.2	31.9	6.3	3.4	1.4	24.8	46.0	24.2
5	56.5	46.7	20.8	18.5	15.9	39.9	31.1	11.9	18.8	30.3	—	4.1	1.8	—	—	—
6	63.3	57.8	21.8	20.9	16.3	27.9	34.8	12.1	20.3	31.8	6.4	4.7	1.7	—	—	—
7	59.4	54.2	24.2	—	—	27.4	35.4	12.1	19.8	29.1	6.5	4.4	1.6	27.3	47.3	24.6
8	57.0	52.8	22.3	18.6	17.2	27.5	33.5	10.8	19.6	26.8	5.8	4.3	1.9	—	—	—
9	56.5	51.2	19.9	17.9	14.3	26.4	30.4	10.3	18.6	27.9	6.1	3.5	1.5	—	—	—
10	59.0	53.7	23.1	—	—	26.5	33.3	11.7	22.2	30.8	6.9	4.4	1.6	26.2	44.5	22.6
11	58.4	54.8	21.9	18.7	16.3	26.3	32.9	12.0	18.6	29.6	7.8	4.6	1.8	26.7	46.4	24.1
12	58.2	52.3	19.3	19.5	17.7	27.6	33.1	12.0	17.7	29.9	7.5	4.6	1.7	26.5	45.8	24.3
13	61.2	57.3	21.8	—	—	27.1	32.7	11.6	19.9	30.9	6.7	4.0	1.8	25.7	45.6	26.5
14	59.8		20.0	19.8	16.4	27.6	31.0	10.8	19.4	30.2		3.8	1.3	27.8	45.6	25.8
15	60.5	51.0	22.5	—	—	—	33.4	11.9	—	28.9	—	4.0	1.9	—	—	—
16	55.2	46.8	20.3	18.2	16.5	26.7	32.4	11.8	—	29.1	—	3.7	1.6	—	—	—
17	59.8	53.8	23.3	—	—	28.3	33.6	11.5	20.1	30.5	7.2	3.8	1.8	—	—	—
18	55.5	53.1	20.7	18.3	—	—	—	10.7	—	—	—	—	1.8	—	—	—

a/a: Greatest length i.e. condylo-nasal

b/b: Greatest length i.e. occipito-nasal

c/c: Anterior orbital width

d/d: Nasal length

e/e: Nasal width

f/f: Length of upper tooth row

g/g: Zygomatic width

h/h: Post. orbital constriction

i/i: Palatine length

j/j: Post. edge palatine-basilar length

k/k: Interperygoid width

l/l post: Lacrimal length from post. edge of foramen

l/l ant: Lacrimal length from anterior edge of foramen

m/m: Length of lower tooth row

n/n: Greatest length of lower jaw

o/o: Greatest height of lower jaw

TABLE 2. *Diceros bicornis* skull measurements from a Natal sample

Skull	a/a	b/b	c/c	d/d	e/e	f/f	g/g	h/h	i/i	j/j	k/k	l/l post	l/l ant	m/m	n/n	o/o
1	56.9	54.5	21.7	19.2	16.0	26.7	32.3	11.1	20.0	29.5	7.4	4.3	1.8	24.4	44.0	23.7
2	56.7	53.0	21.5	18.9	16.0	29.1	33.1	11.6	20.5	28.2	9.2	4.4	1.8	26.5	43.7	23.4
3	59.6	57.2	24.0	16.2	13.9	28.3	34.3	11.9	20.6	28.9	7.8	4.4	2.1	23.1	44.3	22.5
4	51.7	49.1	21.0	17.3	15.1	24.7	31.1	10.2	18.3	27.5	6.5	3.8	1.7	26.5	41.1	21.2
5	51.2	47.6	22.3	18.4	15.7	26.9	34.3	10.6	18.7	29.2	6.5	4.6	2.1	26.2	43.7	22.2
6	52.5	47.5	20.0	17.1	14.7	25.7	30.7	10.3	18.5	27.7	6.9	4.4	2.0	26.2	43.3	23.9
7	51.2	48.3	21.3	17.7	16.2	24.0	32.1	10.2	16.6	27.1	6.6	4.1	1.8	25.2	42.4	22.7
8	44.3	41.5	16.8	14.7	12.1	19.4	25.9	9.3	15.6	25.1	6.6	3.3	1.5	22.0	37.7	18.9
9	52.5	48.8	19.9	16.1	14.6	24.6	31.1	10.9	18.5	27.1	6.9	4.1	2.0	23.6	43.1	23.1
10	49.4	46.5	19.4	16.1	14.6	23.8	30.0	10.0	17.3	28.5	7.1	4/1	1.9	28.8	41.6	21.0
11	54.0	50.7	19.1	18.0	11.3	19.5	26.5	9.2	16.0	30.4	6.5	5.4	2.9	22.9	41.3	24.1
12	48.4	44.9	19.2	16.9	15.0	24.4	29.4	10.2	17.1	27.1	7.3	3.4	1.6	23.6	40.2	21.1
13	43.9	38.5	18.0	15.5	12.6	19.4	26.7	9.6	14.9	23.8	7.1	3.3	1.8	20.2	34.7	18.4
14	48.3	44.3	19.1	16.9	15.0	24.6	29.3	10.1	17.1	27.1	7.1	3.6	1.5	24.0	39.9	21.1
15	50.4	48.9	20.7	18.0	16.1	24.9	30.8	10.1	17.9	26.7	6.1	3.9	1.8	24.4	41.7	21.8
16	51.7	48.2	18.7	17.2	13.9	23.9	30.4	9.4	18.1	24.3	6.7	3.6	1.7	27.5	43.8	23.3
17	54.1	47.1	20.0	18.4	16.8	27.6	30.9	10.1	16.3	29.3	6.3	4.6	2.3	24.7	44.6	24.3
18	52.0	47.7	21.9	18.0	15.6	25.4	30.1	10.4	18.7	26.1	7.3	3.8	1.6	24.8	41.3	21.1
19	55.2	53.3	22.3	18.5	16.5	27.8	32.5	11.7	19.9	27.3	8.0	4.8	2.0	26.8	43.5	23.1
20	51.1	48.9	19.5	17.5	15.1	25.1	30.7	10.8	17.9	28.3	6.2	3.9	1.5	26.9	43.7	22.3

a/a: Greatest length i.e. condylo-nasal

b/b: Greatest length i.e. occipito-nasal

c/c: Anterior orbital width

d/d: Nasal length

e/e: Nasal width

f/f: Length of upper tooth row

g/g: Zygomatic width

h/h: Post. orbital constriction

i/i: Palatine length

j/j: Post. edge palatine-basilar length

k/k: Interperygoid width

l/l post: Lacrimal length from post. edge of foramen

l/l ant: Lacrimal length from anterior edge of foramen

m/m: Length of lower tooth row

n/n: Greatest length of lower jaw

o/o: Greatest height of lower jaw

TABLE 3. A comparative analysis of *Diceros bicornis* skull measurements obtained from a South West African and a Natal sample.

		a/a	b/b	c/c	d/d	e/e	f/f	g/g	h/h	i/i	j/j	k/k	l/l post	l/l ant	m/m	n/n	o/o
Sample size n	S.W.A.	16	17	20	9	0 9	16	17	20	15	16	14	17	18	9	9	9
	NATAL	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Mean	S.W.A.	58.6	52.9	21.6	18.9	16.4	17.0	33.0	11.5	19.7	29.6	6.7	4.1	1.6	26.6	45.8	24.5
	NATAL	51.7	48.3	20.3	17.3	14.8	24.8	30.6	10.3	17.9	27.4	7.0	4.0	1.8	24.9	41.9	22.1
Variance	S.W.A.	6.43	10.82	1.72	0.91	1.23	1.18	1.62	0.35	1.25	2.30	0.16	0.18	0.06	0.88	0.66	1.38
	NATAL	14.99	18.32	2.90	1.376	2.16	7.68	5.31	0.58	2.54	2.92	0.051	0.29	0.10	4.22	6.03	2.59
Standard deviation (SD)	S.W.A.	2.537	3.289	1.31	0.953	1.109	1.08	1.27	0.59	1.118	1.516	0.028	0.424	0.2449	0.938	0.812	1.174
	NATAL	3.871	4.28	1.702	1.117	1.469	2.771	2.304	0.761	1.593	1.708	0.084	0.1702	0.100	2.05	2.455	1.609
Difference of means		6.9	4.6	1.3	1.6	1.6	2.2	2.4	1.2	1.8	2.2	0.358	0.1	0.2	1.7	3.9	2.4
Standard error (SE)	S.W.A.	0.634	0.798	0.308	0.317	0.350	0.263	0.300	0.139	0.288	0.379	0.37	0.102	0.057	0.31	0.27	0.391
	NATAL	0.27	0.95	0.380	0.762	0.328	0.619	0.515	0.170	0.344	0.382	0.52	0.038	0.022	0.459	0.549	9.359
Standard error of the difference (SEd)		0.687	1.24	0.487	0.409	0.467	0.672	0.595	0.107	0.448	0.538	0.608	0.0014	0.0032	0.553	0.609	0.530
SEdx3		2.061	3.72	1.461	1.227	1.401	2.016	1.785	0.327	1.344	1.614	0.228	0.0042	0.0096	1.659	1.827	1.590
Coefficient of difference (Mayr *et al.*, 1953) (CD)		1.064	0.606	0.431	0.772	0.620	0.597	0.671	0.888	0.663	0.682	0.3	0.168	0.581	0.568	0.193	0.862

a/a: Greatest length i.e. condylo-nasal

b/b: Greatest length i.e. occipito-nasal

c/c: Anterior orbital width

d/d: Nasal length

e/e: Nasal width

f/f: Length of upper tooth row

g/g: Zygomatic width

h/h: Post. orbital constriction

i/i: Palatine length

j/j: Post. edge palatine-basilar length

k/k: Interpterygoid width

l/l post: Lacrimal length from post. edge of foramen

l/l ant: Lacrimal length from anterior edge of foramen

m/m: Length of lower tooth row

n/n: Greatest length of lower jaw

o/o: Greatest height of lower jaw

a/a: length of the skull between the premaxilla to the posterior extention of the occipital bone.

b/b: Length of the skull between the premaxilla to the posterior edge of the condylus.

c/c: Width at the anterior edge of the orbital.

d/d: Length of the nasals medially from the posterior to the anterior edges.

e/e: Extreme width of nasals.

f/f: Length of upper toothrow from anterior edge of the first premolar to posterior edge of the last molar.

g/g: Greatest zygomatic width.

h/h: Narrowest width of the post orbital constriction.

i/i: Palatine length between foramen palatinum and choane.

j/j: Length from the posterior edge of the palatines at choane to the basioccipital at foramen magnum.

k/k: Interpterygoid width.

l/l: Distance between the anterior orbital foramen and the sub-nasal immargination when measured from:

l/l ant: anterior edge of the anterior orbital foramen and

l/l post: posterior edge of the anterior orbital foramen.

m/m: Length of lower toothrow from the anterior edge of the premolar to the posterior edge of the last molar.

n/n: Greatest length of the lower jaw from the anterior edge of the symphysis to the posterior edge of the angular process.

o/o: The greatest height of the lower jaw.

These measurements were taken with a steel slide-caliper and a calibrated steel tape. All these measurements are given in tables 1 and 2. The measurements are given in centimetres.

The measurements taken from Natal and South West Africa were then analysed statistically.

Measurements taken from the South West African skulls are on the average larger than measurements taken from the Natal skulls, with two exceptions viz. mean interptergoid width and lacrimal length from the anterior edge of the foramen. The latter two means are smaller in the South West African black rhinoceros' skulls.

The determine whether the difference in measurements between the two rhino samples were statistically significant the standard error of the difference between the two groups of means was calculated. The following formula was used (Mayr, Linsley and Usinger, 1953).

$$SE_d = \sqrt{(SE_{m1})^2 + (SE_{m2})^2}$$

where SE_d = Standard error of the difference

SE_{m1} = Standard error of means of first group of measurements (South West Africa).

SE_{m2} = Standard error of means of second group of measurements (Natal).

The results obtained can be seen in table 3. The difference between the different arithmetic means is over three times the SE_d in almost all the measurements — thus statistically significant. Only the anterior orbital widths show no significant difference.

The various skull measurements were then subjected to Mayr, Linsley and Usinger's (1953), interpretation of the "75 per cent rule" parameter. They suggest the acceptance as a standard of subspecific separation that 75 per cent of population A be different from 97 per cent of population B. This would then mean that about 90 per cent of the individuals of A are different from about 90 per cent of the individuals of B.

In calculating the coefficient of difference (C.D.) the following formula was used (Mayer *et al*, 1953):

$$C.D. = \frac{M_B - M_A}{SD_A + SD_B}$$

The value which corresponds to the standard of subspecific difference (75 per cent A from 97 per cent B) = 2.56/2 = 1.28. Then, if the C.D. exceeds 1.28, it seems probable that it will be advisable to separate the two populations subspecifically. At this value about 90 per cent of A is different from about 90 per cent of B.

The following results were obtained using this procedure. (Table 4). Only seven of the measurements show a magnitude of joint nonoverlap of more than 75 per cent; greatest skull length has a joint nonoverlap of more than 85 per cent and greatest length of the lower jaw has a joint nonoverlap of more than 88 per cent. This indicates that no subspecies difference exist.

TABLE 4. Percentage joint nonoverlap of partially overlapping skull measurements of black rhino populations in South West Africa and Natal associated with values for coefficient of difference (C.D.)

Measurement	C.D.	Joint nonoverlap per cent
(Conventional level of subspecific difference)	1.28	90%
Greatest length of lower jaw	1.193	more than 88
Greatest skull length (condylo nasal)	1.064	more than 85
Post. orbital constriction	.888	more than 80
Height of lower jaw	.862	more than 80
Nasal length	.772	more than 75
Length from post. palatine to basilar	.682	more than 75
Zygomatic width	.671	nearly 75

All the other measurements were below this level.

To determine the correlation between greatest skull length and palatine length the following formula was used:

$$r = \frac{y - \frac{xy}{n}}{\sqrt{\left(x^2 - \frac{(x)^2}{n}\right)\left(y^2 - \frac{(xy)^2}{n}\right)}}$$

The following r values were found for the two populations

S.W.A. r = 0.544 and NATAL r = 0.788.

These values show that there does exist a correlation between the total length of the skull and the length of the palatine. This correlation seems to be more marked in the South West Africa population. To determine whether the statistical r values differ significantly they were then subjected to the t test.

S.W.A. $r = 0.544$ $n = 13$ NATAL $r = 0.788$ $n = 20$

	n	r	z	$\frac{1}{n-3}$
S.W.A. (n_1)	13	0.544	0.61	0.1
NATAL (n_2)	20	0.788	$\frac{1.065}{0.455}$	$\frac{0.05}{\frac{1}{n-3}} = 0.15$

$$S_{z1} - z2 = \frac{n_1 - 3}{1} + \frac{1}{n_2 - 3}$$

$$= 0.378$$

$$t = \frac{z_1 - z_2}{S_{z1} - z_2}$$

$$= \frac{.455}{.387}$$

$$= 1.18$$

$$t^{\infty}_{.05} = 1.96 > 1.18$$

This shows that the values of r do not differ significantly.

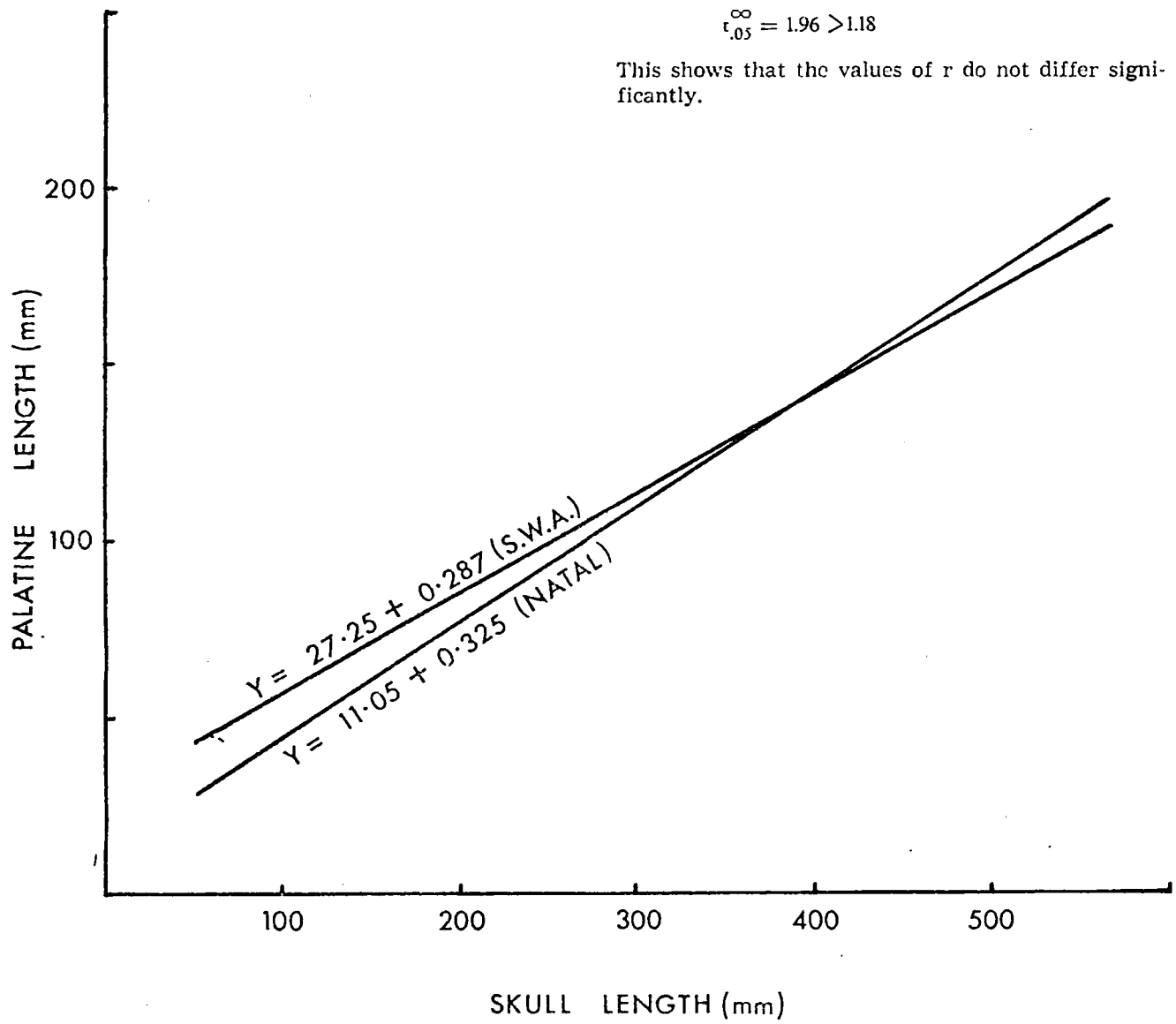

Figure 2. Regression lines of greatest skull length to palatine length for a South West African sample and a Natal sample of black rhinoceros.

The coefficients of regression between greatest skull length and the length of the palatine were also determined. This method is discused by Bailey (1959). The basic observation are in pairs of assiciated observations, represented by x and y (For x and y values see a/a and i/i in tables 1 and 2). The following factors are determined for each sample: n, x, y, x^2, y^2, and xy.

The following quantities are now calculated to give the estimated variances and estimated co-variance.

$$Sx^2 = x^2 - \frac{(x)^2}{n}$$

$$Sy^2 = y^2 - \frac{(y)^2}{n}$$

$$c = xy - \frac{xy}{n}$$

where Sx^2 = estimated variance
Sx^2 = estimated varience
c = estimated co-variance

The true regression line for the regression of y on x is given by:

$$y = a + bx$$

where a = observed frequency
b = estimated regression coefficient.

The true regression coefficient b is determined by:

$$b = \frac{c}{Sx^2}$$

and the constant a by:

$$a = y - bx$$

The regression lines of greatest skull length to the length of the palatine are shown in figure 2. These represent both the black rhinoceros population in South West Africa and that occurring in Natal.

V. DISCUSSION AND CONCLUSIONS

As shown earlier only the description of *occidentalis* Zukowsky 1922, is edequate enough for further consideration although it is antedated by *niger* Schinz 1845. In his original discription Zukowsky describes the skull of *Opsiceros occidentalis* as follows:

> "Schädel: Verhältnismäßig breiter und kürzer als bei *O. bicornis*"

As seen under the previous heading, the mean of the greatest skull length of the South West African specimens exceeds that of Natal with 6.9 cms. However this characteristic also shows a joint nonoverlap of more than 85 per cent, close to the conventional level of subspecific difference. The mean width of the skull at the zygomatic arch is also larger (2.4 cm) in the South West African population. Taking the skull measurements as base it can be reasoned that in the South West African specimens the animals should on the average be larger than those animals occurring in the Natal population. In his description of *Opsiceros occidentalis* Zukowsky 1922, however, describes the animal as follows:

> "Allgemeine Kennzeichen: Viel kleiner als *O. bicornis* und verwandte Formen".

According then to the abovementioned it seem that Zukowsky's claim for a separate species and even a distinct subspecies for South West Africa is groundless.

That the tendency exists in the South West African black rhinoceros population to differ from the Natal population is clearly illustrated in figure 2. This tendency, however, is shown by the 75 per cent parameter to be still below the conventional level of subspecific difference. The black rhinoceros population in South West Africa and that occurring in Natal are thus below the conventional level of subspecific distinctness. *Diceros bicornis niger* Schinz 1845, and *Diceros bicornis occidentalis* Zukowsky 1922 are therefore synonymous to *Diceros bicornis bicornis* Linn 1758.

VI. SUMMARY

Sixteen measurements were taken of each of the 18 black rhinoceros skulls collected in South West Africa. Similar measurements were then taken of each of the 20 skulls collected in Natal. These measurements were then analysed statistically. Mayr, Linsley and Usinger's (1953), interpretation of the 75 per cent rule parameter was used. The coefficients of regression between greatest skull length and the length of the palatine were also determined. The statistical analysis of these measurements showed that a tendency exists in the South West African black rhinoceros to differ from the Natal population. This tendency is still below the conventional level of subspecific difference.

VII. ACKNOWLEDGEMENTS

I wish to express my sincere gratitude to Mr. B. de la Bat, Director of Nature Concervation and Tourism, for his advice and criticism and under whose direction the work took place. To the Administration of South West Africa I wish to express my greatest appreciation for having arranged a study visit to the Natal Game Parks. Also to Dr. R. Bigalke and Messrs. J. Vincent and P. Hitchens for their informative talks as well as the hospitality extended to me.

I am also very much indebted to Mr. C. G. Coetzee for his guidance and for critically reading through the manuscript.

I am very much obliged to the Administration of South West Africa for permission to include the inforation gathered during this study as a part of a M.Sc. (Wildlife management) thesis.

VIII. REFERENCES

ALEXANDER, J. E.
1838 *Expedition into Southern Africa.* vol I and II. Henry Colburn. London.

ALLEN, G. M.
1939 Checklist of African Mammals. *Bull. Mus. comp. Zool. Harv.* 83: 1-763.

ANDERSON, C. J.
1892 *Lake Ngami or, Explorations and Discoveries during four year's wanderings in the wilds of South West Africa.* Hurst and Blackett. London.

ANDERSON, J. L.
1966 Tooth Replacement and Dentition of the Black Rhinoceros (*Diceros bicornis* Linn.) *The Lammergeyer.* 6: 41-46.

ANSELL, W. F. H.
1959 The possibility of the former occurrance of white [and black] rhinoceros in the Barotse Protectorate. *Afr. Wild Life* 13: 336.
1967 *Preliminary identification Manual for African Mammals.* Edited J. Meester. Smithsonian Institution, United States National Museum.

BAILEY, N. T. J.
1959 *Statistical methods in Biology.* The English Universities Press Ltd. London.

BLUMENBACH,
1803 *Rhinoceros africanus* Blumenbach 1803. *Man. Hist. Nat.* 1: 156.

BRAND, D. J.
1964 Die verspreiding en getalsterkte van die witrenoster (*Ceratotherium simum Burch.*) en swartrenoster (*Diceros bicornis* Linn.) in Suidelike Afrika. *Zoön* 2.

CAVE, A. J. B.
1959 The foramen ovale in the Rhinocerotidae. *Proc. int. Congr. Zool.* 15: 419-421.
1962 Burchell's original specimens of *Rhinoceros simum.* (Tax. history of recent Rhinocerotidae disc. Original specimans reviewed. Lectotype selected, tax., diagnostic characters disc.. compared with *Diceros bicornis*). *Proc. zool. Soc.* Lond. 139: 691-700.

DERANIYAGALA, P. E. P.
1953 The extinct and living subfamilies of African Rhinocerotidae. *Spolia Seylan* 27 (1): 13-14.

DRUMMOND, W. H.
1867 On the African Rhinoceroses. *Proc. zool. Soc.* Lond.: 109-114.
1875 *The Large Game and Natural history of South and South East Africa.* Edmonston and Douglas. Edenburg.

FISCHER, A.
1914 *"Menschen und Tiere in Deutsch-Südwestafrika".* Stuttgar'.

FLOWER, W. H.
1867 On some Cranial and Dental Characters of the existing Species of Rhinoceros. *Proc. zool. Soc.* Lond. 443-457.

FLOWER, W. H. & LYDEKKER, R.
1891 *An introduction to the study of Mammals living and extint.* Adam and Charles Black. London.

FOSTER, J. B.
1965 Mortality and ageing of black rhinoceros in East Tsavo Park, Kenya. *E. Afr. Wild. J.* 3: 116-119.

GALTON, F.
1889 *Narrative of an explorer in tropical South Africa.* Ward, Lock and Co., London.

GRAY, J. E.
1867 Observations on the preserved specimens and skeletons of the Rhinoceratidae in the collection of the British Museum and the Royal College of Surgeons, including the description of three new species. *Proc. zool. Soc.* Lond.: 1003-1032.
1873 On the Dentition of Rhinoceroses (Rhinocerotes) and on the characters offered by their skulls. *Ann. Mag. nat. Hist.* Lond. Ser 4, Vol. II (65): 356-361.

MAYR, LINSLEY & USINGER
1953 *Methods and Principles of Systematic Zoology.* McGraw-Hill Book Co. London.

MEESTER J., DAVIS, D. H. S. & COETZEE, C. G.
1964 *An interim classification of Southern African Mammals* (Roneod).

POCOCK, R. I.
1946 A sexual difference in the skulls of Asiatic Rhinoceroses. *Proc. zool. Soc.* Lond. 115: 319-322.

ROBERTS, A.
1951 *The Mammals of South Africa.* Trustees, "The Mammals of South Africa". Book Fund.

SCHINZ, L.
1845 *"Synopsis Mammalium"* Synops. Mamm., 2: 335.

SCLATER, W. L.
1900 *The Mammals of South Africa.* Vol. 1 pp 303-308 Porter. London.

SELOUS, F. I.
1881 On the South African Rhinoceroses. *Proc. zool. Soc.* Lond. 725. - 734

SHORTRIDGE, G. L.
1934 *The Mammals of South West Africa.* Vol. 1 pp. 412-424. William Heinemann Ltd. Lond.

SMITH, A.
1836 Report of the Expedition for Exploring Central Africa from the Cape of Good Hope, June 23, 1834 under the Superintendence of Dr. A. Smith. *Rept. Exped. Expl. Central Afr.*, 44 8 vo. Cape Town.
1837 Rhinoceros ketloa A. Smith (1837). *Cat. S. Afr. Mus.* 7.

TINDALL HOPWOOD, A.
1937 Contributions to the study of some African Mammals — II The subspecies of the Black Rhinoceros, *Diceros bicornis* (Linn.) defined by the proportions of the skull. *J. Linn. Soc. — Zoology.* Vol. XL: 447-457.

TROUESSART, A.
1898 *Catalogue of living and extinct animals.* Cat. Mamm. Viv. Foss. 757.

ZUKOWSKY, L.
1922 Vorläufige Mitteilung über eine neue Art des Spitzschnaus-Nashorns aus Südwest-Afrika. *Archiv. für Naturgeschichte.* 88a, 7-12: 162-163. 163.
1924 *"Opsiceros occidentalis* Zukowsky. *Archiv. für Naturgeschichte,* 90A, 1-6: 80-82.
1965 Die Systematik der Gattung *Diceros* Gray, 1821 *Der Zoologische Garten* 3 Band 30 Heft 3/4.