

Feeding and drinking habits of the black rhinoceros in Masai Mara Game Reserve

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Summary

Feeding and drinking habits of the black rhinoceros (*Diceros bicornis* L.) population in Masai Mara Game Reserve, Kenya, were studied from May 1971 to August 1972. A total of 108 rhinoceros were recorded in the study area. Feeding rhinoceros were followed behind their feeding tracks until they stopped feeding (or changed to another activity) and the plants which they selected were identified. A technique was used which provided an indication of the relative importance of certain plants in the diet during May to September 1971 (wet–semi-dry), October 1971 to February 1972 (dry) and February to May 1972 (wet–semi-dry). A total of 240 h were spent actually watching feeding rhinoceros in thirteen distribution areas. During this period rhinoceros were observed eating seventy plant species from thirty botanical families. In all distribution areas rhinoceros were very selective for herbs and shrubs, and showed a marked preference for *Solanum incanum*, *Dichrostachys cinerea* and *Acacia* species. Rhinoceros were also observed to visit salt licks which contained sodium, magnesium, potassium and calcium.

Two feeding peaks, one in morning and the other in the afternoon were recorded.

Black rhinoceros drink water mainly at night. They spend most of the night time near the watering places for they were mostly located in the mornings walking to the feeding grounds.

Introduction

Masai Mara Game Reserve, the study area, covers 1530 km² (600 sq. miles). The region lies within the *Themeda–Hyparrhenia* zone (Heady, 1960), also called the scattered Tree Grassland or Open Grassland Zone (Edwards & Bogdan, 1951; Edwards, 1951). The Reserve is mostly plain land with a few isolated hills (Mukinya, 1973).

The vegetation of the study area varies greatly, particularly that of open grassland as pointed out by Taiti (1973). The plains are mainly dominated by *Themeda triandra*, *Pennisetum mezianum*, *Solanum incanum*, *Setaria sphacelata*, *Acacia hockii*, *Acacia drepanolobium*, *Dichrostachys cinerea*, *Becium* species, *Commelina* species, *Commiphora* species and *Maerua edulis*.

Within the plains there are thicket islands, each less than 5 km² in area. In these

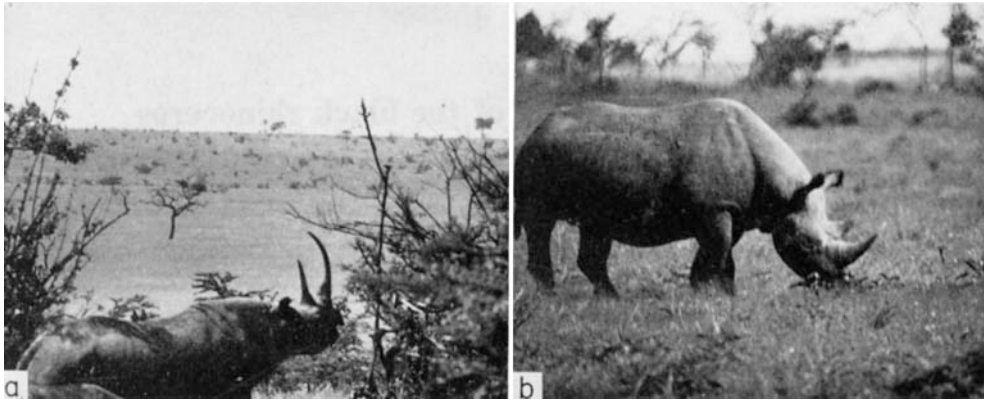


Fig. 1. (a) Rhino browsing on an *Acacia* bush about 2 m high. (b) Rhino browsing on *Solanum incanum* which is about 30 cm above the ground.

islands the dominant plant species are *Croton dichogamus*, *Acacia brevispica* and *Grewia* species.

There are numerous water courses with riparian strips of bushes. The main plant species are *Teclea nobilis*, *Grewia* species, *Dombeya* sp., *Olea africana*, *Croton dichogamus*, *Commelina* sp., *Phyllanthus* sp., *Indigofera* sp. and *Glycine* sp.

The vegetation of Mara is also described by Darling (1960) and Taiti (1973).

The rainfall varies from 980 mm (30 in.) per annum on the central plains area to 1680 mm on the eastern hills and the western area of the Game Reserve. Rain occurs in two seasons, namely March–May and December–January (Mukinya, 1973).

In this paper 'distribution area' means the total area which is occupied by a group of rhinos whose home ranges overlap but is separated by unoccupied country from other such groups of rhino (Mukinya, 1973).

Methods

The method used was based on direct observation of feeding rhinoceros (Fig. 1). Rhinoceros were searched for in a Land-Rover and, when found feeding, observations were made on foot following behind the feeding rhinoceros. With proper checking of wind direction, this method was quite feasible (Goddard, 1968, 1970). Throughout the study, observation times were more or less evenly scattered throughout the hours of day light (06.00–19.00 hours) so as to avoid observer bias in such matters as the diurnal pattern of feeding (Fig. 2).

Damage to plants made by a feeding rhino was easily noticeable along the track made by its feet. However, on hot days damaged portions dried out quickly (within an hour) and if doubt arose as to which animal species was responsible, the observation for that particular plant was ignored.

For each plant found broken off by the rhino for food, scientific name, height of remnant, height of uneaten plant of the same species within 30 cm from remnant, parts eaten, condition of remnant (whether uprooted or not), date and hour of observation were recorded. For plants which could not be identified on the spot, specimens were collected for later identification.

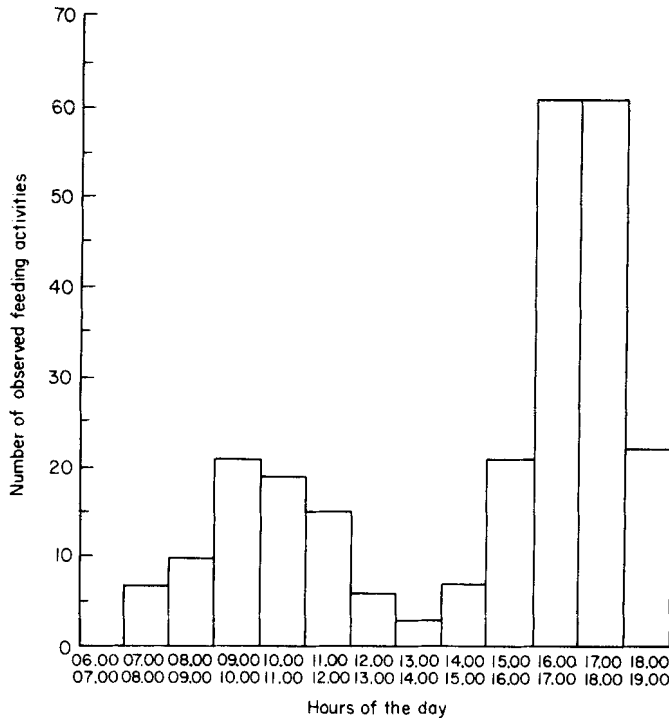


Fig. 2. Feeding activity.

The method used on drinking habits was also based on direct observation. Rhinos were observed from near the dam or water hole from 17.30 to 21.00 hours, and sometimes to 22.00 hours, four times a week from October to the end of November 1971 and from February to the end of March 1972. Observations were alternated between two drinking places. Each time an animal was heard drinking, it was spotted with the help of a spotlight during the absence of moonlight but in the presence of moonlight the spotlight was not used.

Results

Feeding hours

A total number of 253 observation periods to record feeding were made, each varying from $\frac{1}{2}$ h to 4 h, on different individual rhinoceros. In the early morning (06.00–07.30 hours) rhino were usually walking with little feeding activity. Serious feeding usually commenced shortly after 07.30 hours and continued up to around 12.00 hours (Fig. 2), making 24.5% of the total observations. This period covers a large part of the morning when the sun is not directly overhead. Records made between 12.00 and 14.00 hours made up 3.9% of the total observation. During this period rhinos were either wallowing or resting and out of total observations on wallowing 53.8% were recorded in this period. Another feeding peak was recorded between 14.00 and 19.00 hours, representing 71.6% of the total observations.

The two daily feeding peaks, one in the morning and another in the afternoon are

Table 1. List of food plants eaten by the black rhino in Masai Mara Game Reserve

Family and plant name	Growth form	Period from May to September 1971		Period from October 1971 to February 1972		Period from February to May 1972	
		No. eaten	% of total	No. eaten	% of total	No. eaten	% of total
ACANTHACEAE							
<i>Dyschoriste radicans</i> Nees	Creeping herb	8	0.32	0	0	7	0.42
<i>Barleria mucronata</i> Lindau	Spiny herb	5	0.20	0	0	0	0
AGAVACEAE							
<i>Sansevieria ehrenbergii</i> Bak	Herb	0	0	0	0	5	0.30
AMARANTHACEAE							
<i>Achyranthes aspera</i> L.	Herb	3	0.12	0	0	10	0.60
<i>Pupalia lappacea</i> (L.) Juss	Herb	7	0.28	0	0	0	0
<i>Lannea stuhlmannii</i> (Engl.) Engl.	Large tree	27	1.08	0	0	21	1.26
APOCYNACEAE							
<i>Carissa edulis</i> Vahl	Spiny bush	0	0	25	1.75	0	0
BORAGINACEAE							
<i>Cordia ovalis</i> DC.	Bush	45	1.80	45	3.15	35	2.10
BURSERACEAE							
<i>Commiphora africana</i> (A. Rich.) Engl.	Tree	70	2.80	0	0	65	3.90
<i>Commiphora trochae</i> Engl.	Tree	55	2.20	35	2.45	45	2.70
CAPPARIDACEAE							
<i>Boscia augustifolia</i> A. Rich.	Tree	10	0.44	0	0	5	0.30
<i>Capparis tomentosa</i> Lam.	Bush	0	0	18	1.26	29	1.74
<i>Maerua edulis</i> De Wolf	Geophytic herb	180	7.20	91	6.36	120	7.20
CELASTRACEAE							
<i>Maytenis senegalensis</i> (Lam.) Exell	Shrub	15	0.60	0	0	15	0.90
COMPOSITAE							
<i>Bidens pilosa</i> L.	Herb	0	0	2	0.14	0	0
<i>Erlangea cordifolia</i> (Oliv.) S. Moore	Herb	35	1.40	0	0	0	0
<i>Helichrysum glumaceum</i> DC.	Herb	9	0.36	0	0	31	1.86
COMMELINACEAE							
<i>Commelina benghalensis</i> L.	Herb	32	1.28	14	0.98	20	1.20
<i>Cyanotis foecunda</i> (C.B.Cl.) Hassk.	Herb	11	0.44	0	0	0	0
EBENACEAE							
<i>Euclea divinorum</i> Hiern	Tree	0	0	0	0	8	0.48

EUPHORBACEAE										
<i>Erythrococca bongensis</i> Pax	Shrub	7	0.28	0	0	0	0	48	2.88	
<i>Euphobia hirta</i> L.	Herb	18	0.72	0	0	0	0	0	0	
<i>Croton dichogamius</i> Pax	Shrub	98	3.92	137	9.59	80	4.80			
<i>Phyllanthus septialis</i> Muell. Arg.	Shrub	0	0	10	0.70	0	0			
GRAMINEAE										
<i>Cenchrus ciliaris</i> L.	Herb	14	0.56	0	0	0	0	0	0	
<i>Cymbopogon excavatus</i> (Hochst.) Staff	Herb	0	0	0	0	13	0.78			
<i>Bothriochloa insculpta</i> (A. Rich.) A. Camus	Medium height	0	0	0	0	17	1.02			
<i>Ischaemum afrum</i> (J. F. Gmel.) Dandy	Medium height	0	0	0	0	7	0.42			
<i>Pennisetum mezianum</i> Leake	Short	42	1.68	0	0	0	0			
<i>Sporobolus pyramidalis</i> Beauv	Medium height	33	1.32	0	0	0	0			
GRAMINEAE										
<i>Setaria sphacelata</i> (Schumach) Stapf & Hubb	Medium height	8	0.32	6	0.42	0	0			
<i>Themeda triandra</i> Forsk	Medium height	25	1.00	0	0	5	0.90			
LABIATAE										
<i>Leucas calostachys</i> Oliv.	Herb	17	0.68	15	1.05	0	0			
<i>Leucas martinicensis</i> Jacq. R. Br.	Herb	0	0	0	0	18	1.08			
<i>Coleus</i> sp.	Herb	15	0.60	0	0	3	0.18			
<i>Ocimum lamifolium</i> Beth	Woody herb	0	0	0	0	10	0.60			
<i>Orthosiphon parvifolius</i> Vatke	Herb	80	3.20	12	0.84	0	0			
<i>Plectranthus caninus</i> (Roth) Vatke	Herb	2	0.08	0	0	11	0.66			
LILIACEAE										
<i>Asparagus racemosus</i> Wild.	Herb	0	0	0	0	2	0.12			
MALVACEAE										
<i>Abutilon hirtum</i> (Lam.) Sweet	Shrub	0	0	2	0.14	0	0			
<i>Abutilon mauritianum</i> (Jacq.) Medic.	Bush	0	0	0	0	2	0.12			
<i>Hibiscus aethiopicus</i> L.	Herb	3	0.12	0	0	0	0			
<i>Sida rhombifolia</i> L.	Woody herb	5	0.20	0	0	0	0			
MIMOSACEAE										
<i>Acacia brevispica</i> Harms	Bush	172	6.88	29	2.03	50	3.00			
<i>Acacia drepanolobium</i> Sjoested	Small tree	14	0.56	78	5.46	0	0			
<i>Acacia gerrardii</i> Beth	Small tree	35	1.40	0	0	19	1.14			
<i>Acacia hockii</i> De Wild.	Small tree	355	13.40	157	10.99	178	10.68			

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Table 1—continued

Family and plant name	Growth form	Period from May to September 1971		Period from October 1971 to February 1972		Period from February to May 1972	
		No. eaten	% of total	No. eaten	% of total	No. eaten	% of total
<i>Acacia senegal</i> (L.) Willd.	Small tree	0	0	0	0	31	1.86
<i>Acacia seyal</i> Oliv.	Small tree	0	0	37	2.59	0	0
<i>Albizia petersiana</i> (Bolle) Oliv.	Tree	0	0	0	0	15	0.90
<i>Dichrostachys cinerea</i> (L.) Wight & Arn.	Small tree	259	10.36	238	16.66	167	10.02
OLEACEAE							
<i>Jasminum fluminense</i> Vell	Climber	11	0.44	15	1.05	13	0.78
<i>Olea africana</i> Mill.	Tree	0	0	0	0	8	0.48
PAPILIONACEAE							
<i>Crotalaria deserticola</i> Bak.	Herb	3	0.12	0	0	0	0
<i>Crotalaria spinosa</i> Beth	Herb	5	0.20	0	0	0	0
<i>Centrosema</i> sp.	—	9	0.36	0	0	0	0
<i>Glycine wightii</i> Verdc.	Climber	12	0.48	10	0.70	0	0
<i>Indigofera schimperi</i> Jaub. & Spach	Herb	75	3.00	22	1.54	37	2.22
<i>Ornocarpum trichocarpum</i> (Taub.) Harms	Shrub						
POLYGONACEAE							
<i>Oxygonum sinuatum</i> Dammer	Herb	43	1.72	0	0	23	1.38
RUTACEAE							
<i>Teclea nobilis</i> Del.	Shrub	3	0.12	0	0	0	0
SIMARUBACEAE							
<i>Balanites aegyptiaca</i> (L.) Del.	Tree	35	1.40	122	8.54	0	0
SOLANACEAE							
<i>Solanum incanum</i> L.	Herb	450	18.00	102	7.14	274	16.44
STERCULIACEAE							
<i>Dombeya burgenssi</i> Gerrard	Bush	5	0.20	0	0	0	0
<i>Melhania ovata</i> (cav.) Spreng	Herb	0	0	7	0.49	0	0
TILIACEAE							
<i>Grewia mollis</i> A. Juss	Bush	0	0	0	0	45	2.70
<i>Grewia similis</i> K. Schum	Bush	70	2.80	205	14.35	75	4.50
<i>Grewia trichocarpa</i> A. Rich	Bush	52	2.08	0	0	70	4.20
VERBENACEAE							
<i>Lippia javanica</i> (Burm. f. Spreng)	Bush	0	0	0	0	9	0.54
VITACEAE							
<i>Cyphostemma</i> sp.	Climber	0	0	0	0	11	0.66

Table 2. Summary of plant growth forms eaten by seasons (percentage of total observations)

Plant growth form	Season		
	May to September 1971	October 1971 to February 1972	February to May 1972
Trees	47.4%	69.2%	49.8%
Herbs	40.8	18.4	35.0
Shrubs	6.1	11.6	14.5
Others	5.2	2.2	3.9
Total	99.5	101.4	103.2

Note: Where total percentage adds up to more than 100 it is due to approximation in the individual species percentage calculations (Fig. 1) from which this summary was derived.

shown in Fig. 2. The afternoon period is generally preceded by wallowing and resting activities. During the wet seasons some rhinoceros were observed to wallow before 11.00 hours or to continue feeding even during the period between 12.00 and 14.00 hours. There is no doubt that rhinos can feed at any time during the day and probably also at night.

Plants eaten

Table 1 shows the details of food plants eaten in each of the three seasons, indicating the percentage contribution of each species to the total observations for that season.

Table 2 summarizes general seasonal trends according to plant growth forms. From May to September 1971 most of the vegetation was green and had grown to a height of over 30 cm after the previous burning and March–April rainfall. Burning was observed during the dry period from October 1971 to January 1972, although some areas were burnt again in March 1972. The period between February and May 1972 was regarded as a regeneration phase when previously burnt vegetation was sprouting green, soft shoots and branches with green leaves. The regenerating vegetation was fairly low in height.

During May to September 1971 rhinos were found to use a fairly large number of species (Table 1), probably because a variety of palatable trees, herbs and shrubs was readily available. As indicated (Table 2) approximately 47% were (young) trees and 41% were herbs. The remaining 12% were shrubs and other plant growth forms. Rhinoceros were most frequently observed feeding on the species *Solanum incanum*, *Acacia hockii*, *Dichrostachys cinerea*, *Acacia brevispica*, *Croton dichogamus* and *Maerua edulis* during this season. Grasses were not being taken separately but only together with herbs or shrubs in the same mouthful.

During the dry period (October–January), green herbs were not readily available since they were either dried up or destroyed by fire and they declined to only 18% of observations in this season (Table 2). Trees with semi-dried or dried leaves were frequently eaten, however, and represented approximately 69% of total observations. *Grewia similis*, *Solanum incanum*, *Dichrostachys cinerea*, *Acacia hockii*, *Acacia drepanolobium*, *Croton dichogamus* and *Maerua edulis* were the most frequently eaten species. Most were plants which were not seriously destroyed by fire on open grassland and over 1 m higher than the grass sward.

During February to May 1972, most plants had regenerated or were regenerating in all burnt areas. Again preferences were for trees (50% of observations) and herbs (35%). *Grewia trichocarpa*, *Grewia similis*, *Solanum incarum*, *Indigofera schimperi*, *Dichrostachys cinerea*, *Acacia hockii*, *Croton dichogamus*, *Erythrococca bongensis*, *Maerua edulis* and *Commiphora africana* were the most frequently eaten species.

Seasonal differences in species preferences were not very marked. Plants in the families Capparidaceae, Euphorbiaceae, Mimosaceae and Solanaceae, which include herbs and trees, were eaten year round. There was a marked increase in tree usage in the period October 1971 to February 1972 as compared to the other two periods. There was a corresponding decrease in herb usage for the same period. This decrease in the usage of herbs is attributed to their availability. For example *Maerua edulis*, *Croton dichogamus*, *Acacia hockii*, *Dichrostachys cinerea* and *Solanum incarum* were available and eaten throughout the year, whilst other species showed only seasonal availability.

Parts of plant eaten

Goddard (1968, 1970) noted that black rhinoceros ate the tips of shoots, stems, leaves



Fig. 3. (a) *Solanum incarum* plant which has not been browsed by a rhino. (b) *Solanum incarum* remnant after being browsed by a rhino. (c) An *Acacia hockii* branch bitten off by a rhino and another not eaten.

and inflorescences more than they ate inflorescences only, leaves only or stems only. In Mara, a similar pattern was observed. In most of the plants eaten, the bite was made below a clump of twigs bearing leaves and inflorescences. However, for some plants, bites were observed on undivided branches while other branches on the same main stem were not bitten (Fig. 3c). Remnants of the main stem of *Solanum incanum* indicated that side branches on the main stem had been eaten by rhinoceros. In some cases leafless main stems were found uprooted.

An estimate of the proportion of a plant eaten was obtained by comparing measurements of the height of the browsed remnant with the total height of an uneaten plant of the same species close to the remnant. Fig. 3a, b and c shows the condition of plants not eaten and eaten. Table 3 shows the size of portions of plants eaten which range from 7 to 26 cm. The mean proportion consumed of each species is about 40% of the uneaten height. The absolute heights of consumed regenerating plants range from 11 to 48 cm.

Table 3. Record of parts eaten and height of browsed remnant in comparison to uneaten plants

Plant	Sample size (plants)	Part eaten	Height of remnant in cm (mean)	Height of uneaten plant in cm (mean)	Portion of total plant eaten (mean) cm %	
<i>Dichrostachys cinerea</i>	405	S	22	48	26	54.2
<i>Commelina</i> sp.	66	S	13	29	16	55.2
<i>Ormocarpum</i> sp.	142	J	15	30	16	53.3
<i>Orthosiphon parvifolius</i>	92	J	6	11	7	63.6
<i>Acacia senegal</i>	31	S	12	20	8	40.0
<i>Maerua edulis</i>	391	J	23	33	10	30.3
<i>Acacia hockii</i>	670	S, J	20	38	18	44.4
<i>Solanum incanum</i>	626	S, J	21	40	19	47.5
<i>Acacia drepanolobium</i>	92	J	17	28	11	39.3
<i>Acacia brevispica</i>	201	J	27	40	13	32.5
<i>Balanites aegyptiaca</i>	157	J	20	30	10	33.3
<i>Commiphora</i> sp.	235	S	18	28	10	35.7

J = Leaves, stems, and inflorescence.

S = Stems and leaves of tips of shoots.

Influence of fire on browsing patterns

Temporary and permanent changes in habitat have considerable influence on the browsing patterns of the rhinoceros. It is traditional for Masai people to burn areas where domestic and wild animals live to encourage grazing for animals. This burning occurs once or twice a year.

Vegetation which is fire-sensitive is kept at a minimal height, as indicated by uneaten heights in Table 3, while plants which are fire-tolerant, after repeated burning dry up and eventually fall down. As a result in open grassland an animal like black rhinoceros is left to browse on herbs, shrubs and bushes which are less than 2 m high.

Standing remnants start regenerating soon after burning but within less than a year fire damage is observed again on regenerating portions. Thus, the burning cycle indirectly forces rhinoceros to browse mainly on regenerating vegetation and by doing so further reduce the rate of plant growth.

Significance of rhino's pattern of food selection

Rhino's pattern of food selection is mainly determined by habitat, availability and abundance of food. In all habitat types studied (Mukinya, 1973), rhinoceros were predominantly 'ground' feeders, concentrating on relatively small herbs, shrubs and trees. About 90% of total observations on feeding were recorded in habitats of open grassland or scrub with scattered trees. These two types of habitats as compared to riverine bush or bushes on slopes of hills and forests carry more of palatable, regenerating herbs, shrubs and trees which were preferred by rhinoceros.

During wet periods rhinoceros were found feeding close to wallowing areas. These were mainly on either less sloping open grassland or scrub with scattered tree habitats. Even during dry periods when rhinoceros were observed wallowing in water-pans along riverine bushes, they were found to leave bushes for more open areas to feed.

The pattern of food selection for some plants is related to their availability and abundance. In February 1972 when most plant regeneration after burning was observed, herbs, trees, and shrubs were sampled using a Point-Centred Quarter Method (Curtis, 1962) in all distribution areas (Mukinya, 1973) to determine their availability. Table 4 shows mean relative density and frequency of a few plants frequently found eaten by rhinoceros in the study area. As can be noted in Table 4, *Solanum incanum*, *Acacia hockii*, *Dichrostachys cinerea* and *Maerua edulis* each had high relative density and relative frequency for both open grassland and scrub with scattered trees. Table 1 shows that *Solanum incanum*, *Acacia hockii*, *Dichrostachys cinerea*, *Maerua edulis*, *Croton dichogamus* and *Acacia brevispica* were frequently selected by rhinoceros for food throughout the year. Table 4 suggests that on a broad comparison the more abundant species were also the ones eaten more frequently.

Table 4. The availability of some plant species eaten by rhino compared with the frequency with which they were eaten

Plant species	Transect	Mean % R.D.	Mean % R.F.	Mean % of total plants eaten (all seasons and habitats)
<i>Solanum incanum</i>	a	23.6	32.7	13.9
	b	15.2	24.6	
<i>Acacia hockii</i>	a	10.5	15.9	11.7
	b	10.7	21.0	
<i>Dichrostachys cinerea</i>	a	14.3	15.6	12.3
	b	11.8	16.5	
<i>Maerua edulis</i>	a	14.8	22.7	6.9
	b	7.3	15.1	
<i>Acacia drepanolobium</i>	a	25.8	38.3	3.0
	b	23.8	15.7	

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Table 4—continued

Plant species	Transect	Mean % R.D.	Mean % R.F.	Mean % of total plants eaten (all seasons and habitats)
<i>Croton dichogamus</i>	a	1.7	1.3	6.1
	b	1.3	1.9	
<i>Commiphora africana</i>	a	1.7	5.9	3.3
	b	15.3	23.2	
<i>Commiphora trothae</i>	a	3.7	8.7	2.7
	b	14.3	20.4	
<i>Acacia senegal</i>	a	2.7	8.2	1.8
	b	4.4	7.9	
<i>Acacia brevispica</i>	a	4.2	10.6	3.1
	b	4.3	7.5	

Abbreviations: R.D. = Relative density; R.F. = Relative frequency; a = Transect in open grassland; b = Transect in wooded grassland.

Salt licks

Two separate salt-licking places were noted in distribution area A (Mukinya, 1973) of the study area. Rhinoceros as well as other animal species particularly topi, *Damaliscus korrigum* Ogilby, were observed frequently visiting the salt licks between October 1971 and December 1971. On six occasions rhinos were observed during the day-time licking salt. In addition, during the month of December 1971, foot-prints were checked in the evenings, as well as the following morning for one continuous week, to find out whether rhinoceros had visited the licks during the night. Previous rhino foot marks were destroyed by sweeping the ground each evening. On two separate occasions of the week rhino foot-prints were noted on the swept ground which indicated that rhinoceros also visited the salt lick at night. This may be probably due to the fact that these salt licks were only 1 km from the streams where rhinoceros used to drink water.

To determine minerals in these salt holes soil samples were collected and taken to Kabete Soil Laboratory for analysis. The result of the tests is shown in Table 5.

Dietary constituents of food plants eaten or soluble and colloidal mineral in water drunk by the rhinoceros were not analysed so as to compare their concentration with the results of salt licks shown in Table 5. However, McCullagh (1969) found calcium, sodium and potassium as a part of mineral composition of the dry matter of elephant (*Loxodonta africana* Blumenbach) stomach contents from grass and woody plants. Rhinoceros do eat woody plants which contain the minerals mentioned above. The rhino's licking salts of magnesium, sodium, potassium and calcium from salt lick places may indicate their possible dietary importance. They may be obtained through food plants, water or dry soil containing them.

Table 5. Results of chemical test of salt licks (soil)

Soil samples	A ₁ SAL.	A ₂ SAL.
pH-H ₂ O	7.2	7.4
pH-KCl	5.5	6.0
E.C. (mmhos/cm ²)	0.09	1.6
Ca (m.e. %)	11.2	7.0
Mg (m.e. %)	2.9	3.2
K (m.e. %)	0.5	1.0
Na (m.e. %)	1.4	8.8

Abbreviations: E.C. =Electrical conductivity; (mmhos/cm²) =Milliohms; m.e. % = Milliequivalent percentage; A₁ SAL. =Salt lick 1; A₂ SAL. =Salt lick 2.

Drinking habits

In general, drinking habits of the rhinoceros vary from locality to locality and from season to season depending on water availability (Joubert & Eloff, 1971). In Mara, rhinoceros were observed drinking from sunset. Observations on rhinoceros drinking permanently from Mara and Sand rivers were not made because of thickets along the rivers which could not be penetrated on foot during the hours of darkness. Observations were only made on rhinoceros using a water hole and a dam close to the working camp.

The rhinoceros were waited for near the water hole from 17.30 to 21.00 hours and sometimes to 22.00 hours four times a week from first week of October 1971 to the end of November and from first week of February 1972 to the end of March 1972. It was observed that rhinoceros shows a preference for drinking at night as there was no drinking observation recorded between the period around 06.00 to about 18.00 hours Rhinoceros were observed to drink usually between 18.00 and 21.00 hours, but there is no reason to suggest that they cannot drink at any other time of the night because they were mostly located near the water places shortly after 06.00 hours walking to their feeding ground, as previously mentioned. Results of drinking observations are shown in Table 6.

Table 6. Record of rhino drinking hours

Months	Period	Number of observations recorded									
		Dam					Water hole				
		17.00	18.00	19.00	20.00	21.00	17.00	18.00	19.00	20.00	21.00
		18.00	19.00	20.00	21.00	22.00	18.00	19.00	20.00	21.00	22.00
October 1971	Dry	0	2	2	2	1	0	1	2	3	0
November 1971	Dry	0	1	3	3	0	0	2	3	2	0
February 1972	Wet	0	1	1	2	0	0	1	2	0	0
March 1972	Wet	0	0	2	0	0	0	2	1	1	0
Total		0	4	8	7	1	0	6	8	6	0

During the wet periods rhinoceros were not frequently observed drinking from the water holes and it was assumed that they depended mostly on water from shallow pans within their home ranges. However, during the dry period, when most of the streams and pans were dry they depended mainly on the water holes and dams.

Rhinoceros were not found drinking from wallowing holes during the wallowing periods. The holes used for wallowing contained mud (baked mud). However, if the hole holds more water than loose soil, it is not used for wallowing.

Discussion

Black rhinoceros probably eat more plant species than observed in this study. Goddard (1968, 1970) observed that rhinoceros in Ngorongoro and Olduvai Gorge ate 191 species from forty-nine botanical families, while in Tsavo they were observed eating 102 species from thirty-two botanical families.

It is interesting to note the preference for Cappariaceae, Sclanaceae, Euphorbiaceae and Mimosaceae in Mara.

In the two main habitat types studied black rhinoceros concentrated between 66% and 90% of their feeding on regenerating plants. A similar range of time use to that in the present study was noted by Goddard (1970): during the hours around mid-day, rhinos were rarely observed feeding but either wallowing or resting in the bushes.

Geographical location, in itself, particularly when considering different populations of the same species, does not cause much difference in habits of that species unless environmental and climatological parameters are different. The habitats studied by Goddard are similar to Mara with a wide variety of plant species eaten by the black rhinoceros. Thus very little difference would be expected with food preferences.

Joubert and Eloff (1971) noted that rhinoceros in South West Africa were observed eating 'whitish crust' with a salty taste formed at the water's edge of the water holes. When they analysed the chemicals in the water they found presence of Na^+ , K^+ and Ca^+ ions. In the Mara similar ions with an addition of Mg^+ were present in the salt licks frequently visited by the rhinoceros.

The preference for drinking at night is rather difficult to explain but may be influenced by the fact that rhinoceros are sedentary animals. Rhinos were observed resting under the shade trees from 08.00 to 17.00 hours with more observations between 12.00 and 15.30 hours. Most of the observations on wallowing were also recorded between 12.00 and 16.00 hours. The remaining daylight hours are spent on feeding. By wallowing and resting rhinoceros probably reduce loss of water from their bodies through sweat, thereby minimizing the need for drinking during the daytime.

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