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FOOD PREFERENCES OF THE ONE HORNED INDIAN RHINOCEROS, *RHINOCEROS UNICORNIS*, IN KAZIRANGA NATIONAL PARK, INDIA

By

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ABSTRACT

FOOD PREFERENCES OF THE ONE HORNED INDIAN RHINOCEROS, RHINOCEROS UNICORNIS, IN KAZIRANGA NATIONAL PARK, INDIA

By

Kamal Chandra Patar

The food preferences of the one horned Indian rhinoceros (Rhinoceros unicornis) were determined in the Kaziranga National Park, Assam, India during the dry season of 1975-1976.

Square-meter vegetation plots were located over 120ha of a short-grass rhino habitat. Grasses made up 77%, and forbs 23%, of the rhino's diet during the November to April dry season. Highly preferred species were Arundo donax, Hemarthria compressa, Carex rubrobrunnea, Eleochoris fistulosa, and Lippia geminata. Thirteen grass and forb species were eaten by rhinos but not to the extent warranted by their abundance. Three forbs were avoided as foods.

H. compressa, C. rubrobrunnea, and A. donax together comprised 71.5% of the available forage and 91.1% of the rhino's diet. They seemed to typify the ideal dry-season habitat of the rhino. In some areas, however,

these species seemed to be overgrazed. There was thus some indication that maximum ungulate populations had been achieved.

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INTRODUCTION

The one-horned Indian rhinoceros (Rhinoceros unicornis) is one of the world's five living species of rhinoceros (Hvass, 1970). Formerly extensively distributed, the Indian rhino is today limited to parts of Nepal and to portions of West Bengal and Assam in India (Prater, 1965). In Assam, the rhino occurs in Kaziranga National Park, Manas Wildlife Sanctuary and Pobitora, Orang Pava and Lackhowa Game Sanctuaries. It occurs and is also protected on some islands in the Brahmaputra River, but must compete with livestock there.

The 1972 census of Kaziranga National Park (Lahan and Sonowal, 1973), revealed that the rhino population had increased to 658, whereas only 366 animals were counted in 1966. The 1972 population consisted of 203 adult males, 188 adult females, 44 sub-adult males, 37 sub-adult females, 67 calves plus 119 individuals which were neither sexed nor aged.

In Assam the rhino's primary mating season is from February to June, but mating occurs during all months (Kakati and Rajkonwar, 1972) and (Mukherjee, 1966). Kakati and Rajkonwar (1972) further state that

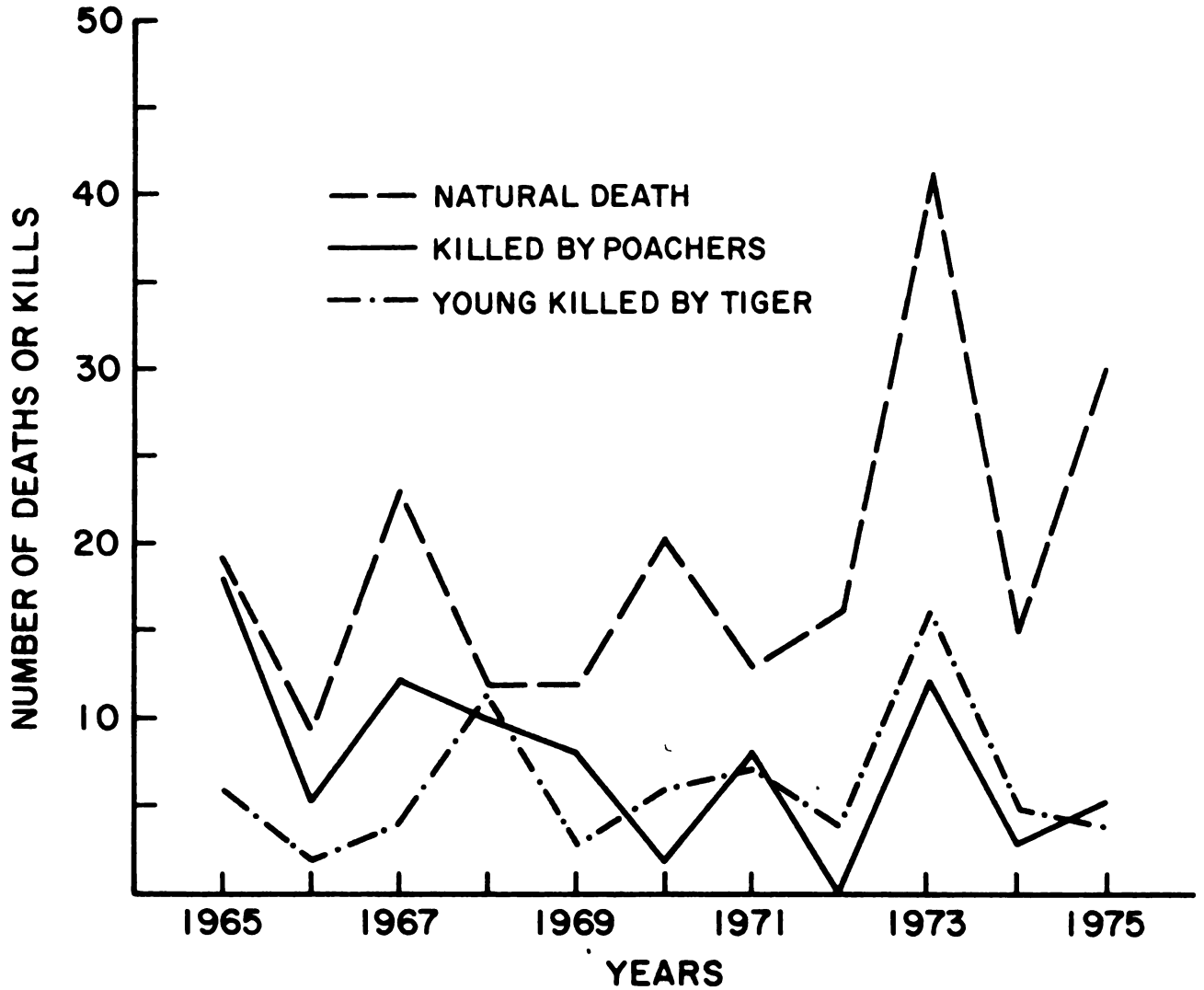

Figure 1. Mortality of Rhinoceros unicornis in Kaziranga National Park

a female rhino at the Gauhati Zoo first accepted a mate at 5 years and 11 months of age. The interval between her calving and the next service was approximately 28 months. The gestation period is 18-19 months and the period between births is 3-4 years (Mukherjee, 1966). Single births are the rule.

In some parts of Asia, powdered rhino horn is considered to have magical powers and is so highly priced that poaching of rhinos is a continuous threat even at Kaziranga despite rigid measures undertaken to control it. Prior to 1966, rhino poaching in the present Kaziranga National Park area reduced the population to a low level. Before Kaziranga attained National Park status, losses of rhinos probably also were caused by the transmission of rinderpest and anthrax from domestic water buffalo (Bubalus bubalis) brought into the area by herdsmen. In addition, tigers (Panthera tigris) killed some rhino calves. Since the park was placed under management controls, poaching has been largely eliminated and all livestocks have been excluded. Since 1965, increases in natural mortality including flood-caused deaths and predator-induced kills have paralleled the recorded growth in rhino numbers (Figure 1).

Kaziranga National Park (see Figure 2) is situated in the eastern part of Assam on the south bank of the Brahmaputra River in Sibsagar and Nowgong Districts

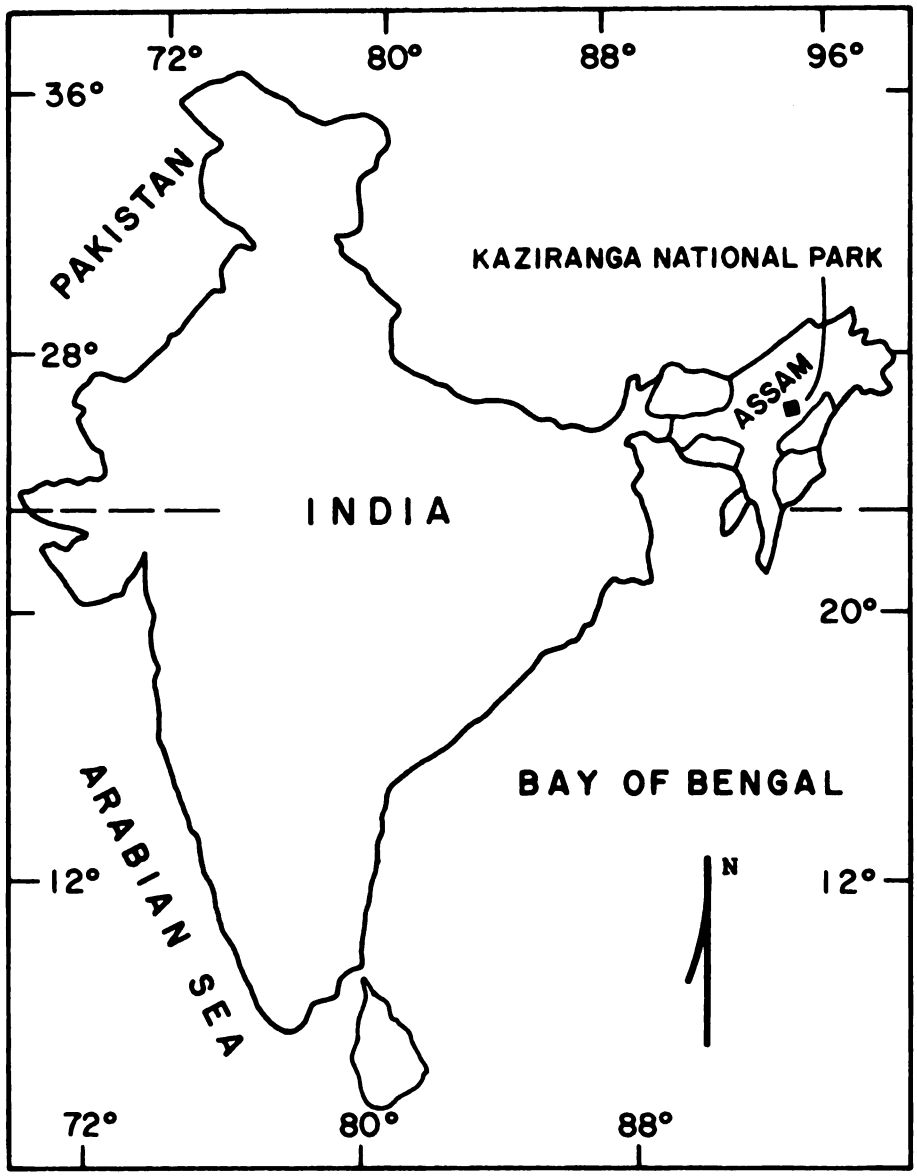

Figure 2. Map of India showing the location of Kaziranga National Park

from longitude 90°5/W to 90°40/E and from latitude 26°30/S to 26°45/N. The area is nearly flat.

In 1908, an area of 22,892ha was established as the Kaziranga Reserved Forest. This reserve was declared a Game Sanctuary in 1916 and later was enlarged to become the Kaziranga Wildlife Sanctuary with an area of 430km^2. In 1974, this tract was declared the Kaziranga National Park (Figure 3).

The large Brahmaputra River flows westward along the northern boundary of the national park and is fed by streams that originate from the Mikir Hills. Water courses criss-cross through the national park before joining the Brahmaputra. The Mordaiffolu River follows the southern boundary and the Diffolu and Bhengra Rivers flow through the national park from east to west.

In addition to these streams, the national park is dotted with numerous beels (lakes or ponds which contain water throughout the year). Beels and marshes are the principal places in which rhinos wallow. These are evenly scattered throughout the park and it is near water that rhinos concentrate in the dry season, when only 5.6% of the national park is wet. Rhinos are most numerous in and around the wet areas of the southern and western part of the park where the water table is highest.

The soils of Kaziranga National Park are deep alluvial deposits. In the south-western portion, loams

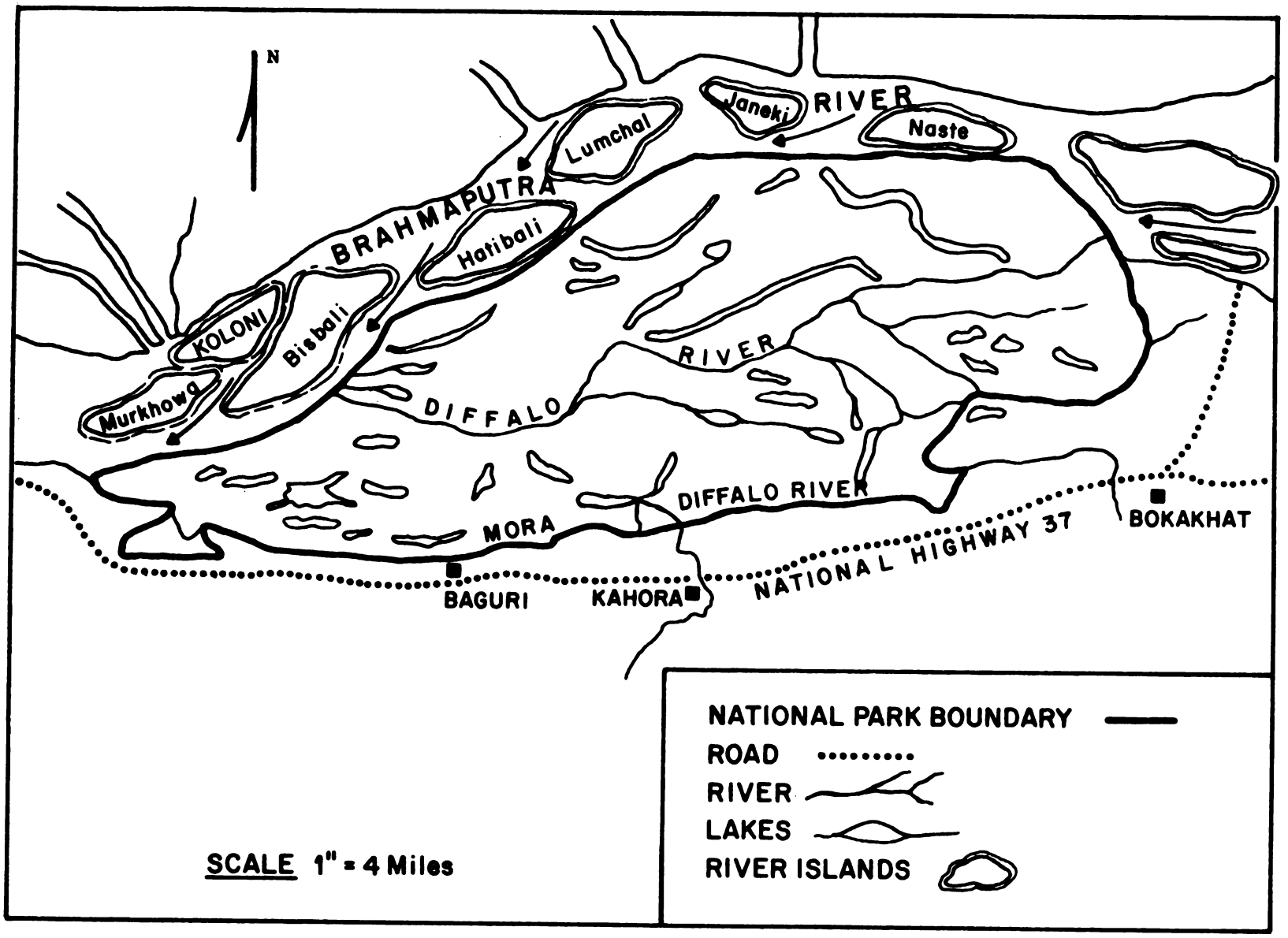

Figure 3. Map of Kaziranga National Park showing rivers, beels, islands

are characteristic, while the north-eastern portion is sandy. The most fertile soils occur in the southern half of the park where the rhinos are most numerous during the dry months.

Climatically, the area is tropical. The mean annual temperature is 23.4°C with mean annual maximum and minimum temperatures of 27.8°C and 18.9°C respectively. Temperatures have been recorded as low as 8.9°C and as high as 34.7°C.

A dry season prevails from November to March. During the dry or winter months, the nights are cold, fog is common, and dew-fall is heavy, frost and snow are absent.

Pre-monsoon showers start in March and April and heavy monsoon rains occur from May through September. The average annual rainfall is 1827 mm; 76% of which falls from May to September. Monthly precipitation is usually highest in June (320 mm) and lowest in December (11 mm) (Figure 4).

At Kaziranga, four major vegetative types occur: forests, tall-grass, short-grass, and aquatic areas. The relative habitat composition of the park is 27.9% forests, 66.5% tall and short grass and 5.6% water areas. Numerous plant species occur in each habitat (Appendix 1).

Approximately 290 square kilometres in the park are burnt annually. An effort is made to burn all the

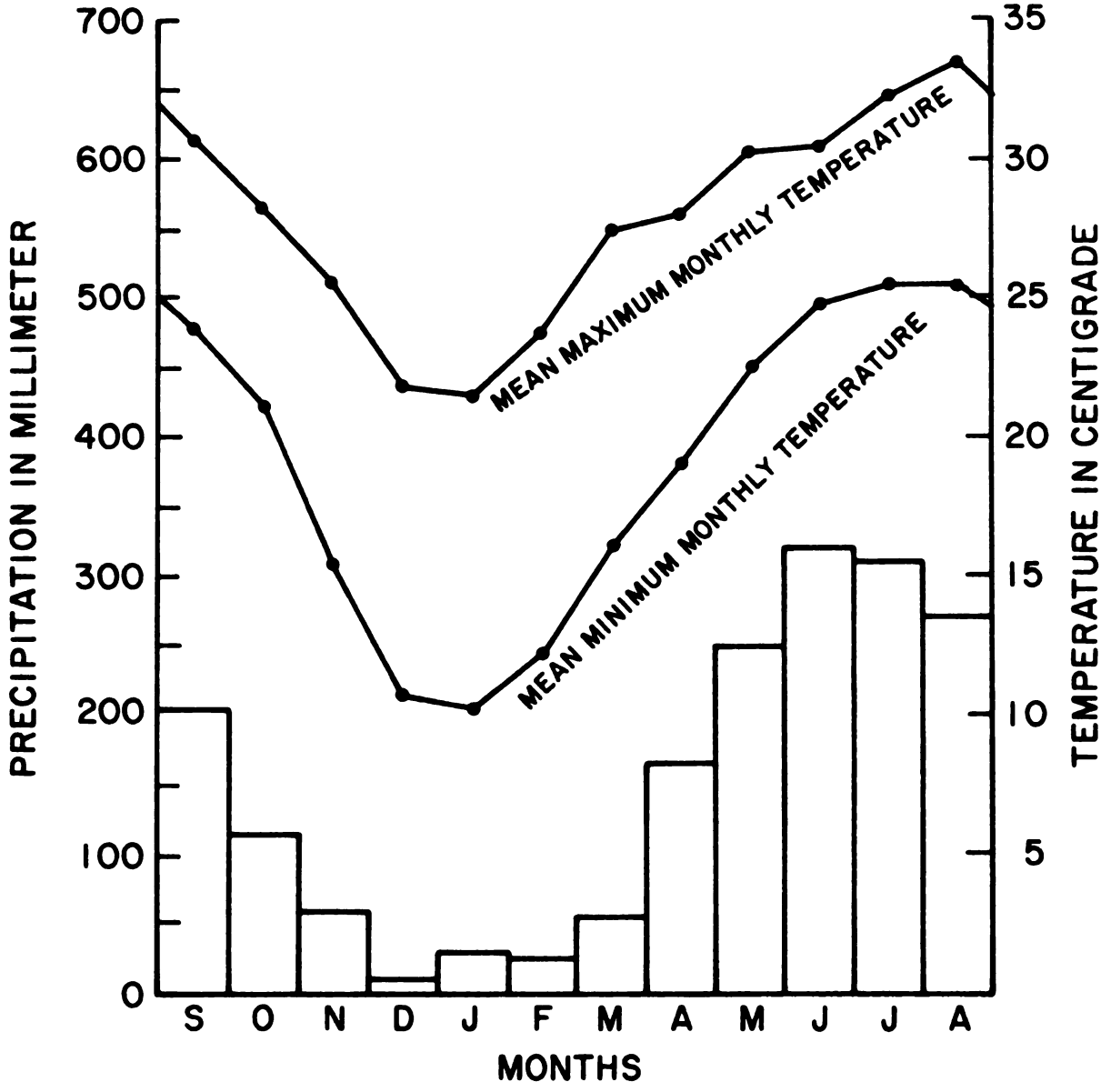

Figure 4. Mean monthly distribution of precipitation, and maximum and minimum temperature during 1965-74, Kaziranga National Park

tall-grass area, mainly in February and March to increase the availability of forage and its utilization by wildlife. Vegetative compartments are bordered by patrol-paths and roads which tend to act as fire lines. This practice is conducted also to control invading shrubs and various diseases such as brown-spot on grasses and ungulate liver fluke.

In addition to rhinos, several other species of large wild mammals are common in the national park: water buffalo, swamp deer (Cervus duvauceli), hog deer (Axis porcinus), sambhar (Cervus unicolor), barking deer (Muntiacus muntjak), boar (Sus scrofa), gaur (bos gaurus), Indian elephant (Elephas maximus), Sloth bear (Melursus ursinus), tiger and leopard (Panthera pardus).

Figure 5. A rhino grazing with buffalos and deer in short grass area of Kaziranga National Park

OBJECTIVES OF THE STUDY

Range condition and vegetative trends are affected by foraging herbivores. In order to determine these factors, it is essential to know the order in which forage plants are selected by various ungulate species.

Rhinos are important grazers in Kaziranga National Partk. This study was undertaken to learn the food preferences and principal foods of the Indian rhinoceros in its short-grass dry-season habitat. Notes on range condition and trend also were to be made.

Figure 6. Different habitat types in Kaziranga National Park

METHODS

All portions of the short grass vegetative type in the park were visited. Direct observations of rhinos were made and the plant species which occurred there were collected. Unknown plants were identified by the personnel of the Botanical Survey of India at Shillong.

Study plots were located in those sections of the short-grass habitat which were not utilized by other large herbivores. These places were mainly near roads, patrol paths and camps where patrol staff mounted on elephants could drive away competitive ungulates such as buffalos, barasingha deer and hog deer. Though these species were easily seen from the elevated patrol stations (situated on 10'-15' stilts) they were not often present in the study area because of the constant movement of the patrol staff.

On three areas totalling about 120 hectares, other grazers were mainly lacking and 15-20 rhinos were seen to feed regularly. These portions of the short-grass habitat were sampled systematically using a one square-meter frame. Fifty such one sq. m. plots were marked by pegs and spaced at 250 m. intervals along

parallel north-south transects 100 m. apart. The distance between plots was measured using a metal tape and lines were kept equidistant using a hand compass. Vegetative plots were sampled between 0900 and 1500 hours, when rhinos usually moved away to their wallows or to wooded and tall-grass areas.

Both Cain (1938) and Braun-Blanquet (1932) have stated that the number of plots needed to sample vegetative compositions is adequate when, after increasing the number of plots, the slope of the species-area curve becomes approximately horizontal. On this basis, it was determined (Figure 7) that on these 120 ha, only 40 plots were necessary. Fifty plots, nevertheless, were studied.

In each plot the number of individual shrubs, forbs, and grasses present, were tallied by species. Each plot was visited two to four times per month from December through March. Forage availability and utilization were measured during each visit if grazing had occurred during the interval. The several observations at each plot were averaged (Table 1). Plots completely eaten were not revisited since the lack of moisture prevented further plant growth.

After collecting inventory data on each visit to the 50 plots, 20-50 specimens of uneaten plants near the plots were clipped at the mean minimum grazing height

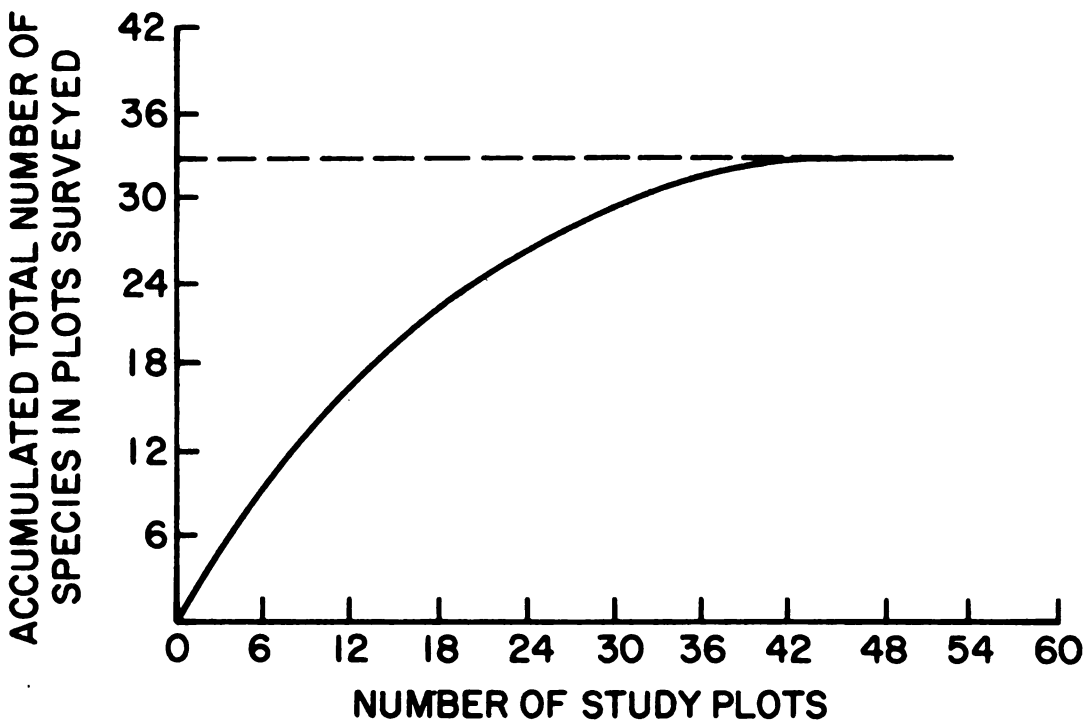

Figure 7. Species area curve for the vegetation in Kaziranga National Park

measured on the study plot. Clipped plants were separated by species and placed in paper bags. All plants were dried to a constant weight in an oven at 80°C. The weights of the plant parts clipped were considered to be equal to the weights of plant parts consumed.

Preference values were determined for each forage species by dividing the percentage weight which that species comprised among foods consumed by the percentage weight of that species among foods available (Petrides, 1975). Species with preference values above 1.00 were those which were sought out as preferred foods. Species with a preference rating of 1.00 would be neither preferred nor neglected, but eaten in proportion to their abundance in the field. Ratings below 1.00 represented forage species which tended to be neglected. Species which were totally avoided were given a zero preference rating. This method enables the quantitative determination of relative rhino preference levels for each plant species. In contrast to the calculated dry season preference ratings, wet season food habits were merely recorded from general observations. Direct observations of feeding rhinos were usually made from elephant-back at a distance of 10-15 m. Binoculars were frequently used. Occasional observations were made at patrol camps or from a jeep. Rhinos were observed during their feeding periods which usually extended from 0600 to 0900 hours and 1500 to 1800 hours.

Figure 8. A solitary rhino in the short grass area, Kaziranga National Park

RESULTS

Food Preferences

While 47 plant species were eaten by rhinos in all habitats (Appendix 1), only 18 were consumed on the 120 ha short-grass study area. Nearly 77% of the rhino's diet consisted of four grass species, i.e. Arundo donax, Hemarthria compressa, Erianthus elephantinus and Cynodon dactylon. The remaining food plants taken consisted of 14 forbs. Three forbs found on the study area were avoided as foods by rhinos (Table 1).

During the dry season, rhinos primarily ate non-woody vegetation. In order of preference (Table 1), Arundo donax, Hemarthria compressa, Carex rubrobrunnea, Eleochoris fistulosa and Lippia geminata were consumed to a greater degree than their abundance alone would warrant.

Thirteen non-preferred plants were eaten. In order of choice these were: Nasturtium indica, Polygonum chinense, Centella asiatica, Ficus scandens, Cyperus auricomus, Amaranthus viridis, Polygonum barbatum, Oxalis corniculata, Kyllinga brevifolia, Pteridium aquilinum, Fragaria indica, Cynodon dactylon and

Table 1. Dry season winter food preference ratings for forage plants eaten by the rhinoceros, Kaziranga National Park, Assam, India, November to April, 1975-1976.

Forage species	Average Dry Weights		
	Edible Portions per Plant (g)	Available/ha (kg) = A	Consumed/ha (kg) = C
Arundo donax	1.195	91.78	74.09
Hemarthria compressa	.215	683.57	502.84
Carex rubrobrunnea	.239	190.53	131.55
Eleochoris fistulosa	.127	8.00	5.33
Lippia geminata	1.182	10.40	6.15
Nasturtium indica	.982	3.54	1.96
Polygonum chinense	.505	13.03	6.87
Centella asiatica	.316	5.31	2.78
Ficus scandens	.741	14.82	7.41
Cyperus auricomus	.473	9.93	4.92
Amaranthus viridis	.388	7.14	3.03
Polygonum barbatum	.810	22.68	8.91
Oxalis corniculata	.117	5.03	1.22

Table 1 (continued)

Forage species	Average Dry Weights		
	Edible Portions per Plant (g)	Available/ha (kg) = A	Consumed/ha (kg) = C
Kyllinga brevifolia	.086	.76	.17
Pteridium aquilinum	.425	1.11	.17
Fragaria indica	.120	7.01	.86
Cynodon dactylon	.081	12.49	1.39
Erianthus elephantinus	.475	175.37	17.67
Solanum torvum	3.35	8.71	0.00
Xanthium strumarium	9.97	35.89	0.00
Polygonum hydropiper	6.01	43.27	0.00
Totals		1350.37	777.32

Table 1 (continued)

	Percentages		
Available forage (%)	Consumed (%)	Removed (%)	Preference ratings
$a = \frac{A}{\Sigma A} \times 100$	$c = \frac{C}{\Sigma C} \times 100$	$R = \frac{C}{A} \times 100$	$p = \frac{c}{a}$
6.80	9.53	80.73	1.40
50.62	64.69	73.56	1.28
14.11	16.92	69.04	1.20
.59	.69	66.63	1.17
.77	.79	59.13	1.03
.26	.25	55.37	.96
.96	.89	52.72	.93
.39	.36	52.35	.92
1.10	.95	50.00	.86
.74	.63	49.55	.85
.53	.39	42.44	.74
1.68	1.15	39.39	.68
.37	.16	24.25	.43

Table 1 (continued)

Available forage (%) $a = \frac{A}{\Sigma A} \times 100$	Consumed (%) $c = \frac{C}{\Sigma C} \times 100$	Removed (%) $R = \frac{C}{A} \times 100$	Preference ratings $p = \frac{c}{a}$
.06	.02	22.37	.33
.08	.02	15.32	.25
.52	.11	12.27	.21
.92	.18	11.13	.20
12.99	2.27	10.08	.17
.65	0.00	0.00	0.00
2.66	0.00	0.00	0.00
3.20	0.00	0.00	0.00
100.00	100.00	1.	1.74

Erianthus elephantinus. Forty-nine to 55% of the N. indica, P. chinense, C. asiatica, F. scandens and C. auricomus was eaten, whereas 10-42% of the remaining eight species was consumed.

Solanum torvum, Xanthium strumarium and Polygonum hydropiper were avoided entirely.

During the dry season, rhinos were seen eating the following plants in the forest area: Amaranthus viridis, Centella asiatica, Fragaria indica and Pteridium aquilinum. Shrubs and trees were not utilized there or elsewhere by rhinos during the dry season study period. Preference ratings were not determined.

Important Foods

The most valuable species, in terms of the bulk contribution to the rhino's diet in the short-grass area (Table 1) were H. compressa, C. rubrobrunnea and A. donax. Together, Hemarthria, Carex and Arundo seemed to provide an ideal habitat for the rhino. They comprised 71.5% of the available forage and 91.1% of the total food eaten.

A. donax, the most preferred species, is a grass 2-6 m. high, growing from a creeping rhizome. Known regionally as nal, it occurs near beels in the wet portion on the short-gress habitat. Comprising 6.8% of the available forage, it accounted for 9.5% of the rhino's

diet during the dry season. Due to heavy utilization by rhinos, buffalos and elephants it was being depleted throughout the park.

H. compressa, the second favorite dry-season food, comprised 50.6% of the available forage and made up 64.7% of the rhino's diet. Known locally as lokosa, it appeared to be the most important dry season food of the rhino within the park. As is true for all species in the short-grass habitat, this plant becomes unavailable during the wet season due to flooding.

E. elephantinus a tall, clumped, reed-like grass, locally called ekra, is a 4 m. high perennial. It comprised 13% of the available forage and 10% of the rhino's diet. E. elephantinus also occurs in the tall-grass area with Saccharum sp. and Imperata cylindrica. All of these grasses were eaten there for one to eight weeks after burning. E. elephantinus is increasing in the dry portion of the short-grass area as this non-preferred grass spreads from the tall-grass habitat.

From the middle of June to September, when about 60% of the national park is under water, rhinos seek the higher ground of the forest area. At this time, plants which are eaten heavily during the dry period, notably H. compressa and C. rubrobrunnea, are submerged elsewhere and thus unavailable. Forbs and grasses which are little eaten during the dry season become more important

in the diets during the monsoon. Some shrubs are eaten under these conditions as Laurie (1974) also observed. Detailed study on these points is needed.

As the floods recede, the somewhat-submerged grasses in aquatic areas, Leersia hexandra and Andropogon sp., are heavily grazed by rhinos. Other aquatic plants eaten there are: Monochoria hastaefolia, Cypersus diffusus, Eleochoris fistulosa, Sagittara sagitifolia, Eichornia speciosa, Potamogeton crispus, Cyperus iria, Jussaea suffruticosa, and Najas major (Appendix 1). These plants occur in both the short-grass and aquatic habitats, but most show no green above-ground parts during the dry season and do not seem to be eaten then.

In the tall-grass areas, the leaves and inflorescences of the grasses Vetiveria zizanioides, Saccharum sp. and E. elephantinus were seen to be eaten somewhat but no detailed data are available.

Range Condition and Trend

Very heavy utilization by rhinos of their preferred food grasses was seen on the short-grass habitat around Sohola Beel, in the eastern portion of the park. It appears that the preferred dry season food species A. donax, H. compressa, C. rubrobrunnea and E. fistulosa were being replaced there by P. hydropiper, X. strumarium and S. torvum. The latter three species were avoided as foods by the rhinos (Table 1). P. hydropiper

was increasing in the wetter portions of the short-grass habitat and X. strumarium and S. torvum increased in the drier sections.

Over the study area, 15-20 adult rhinos grazed regularly during the dry season study period. Approximately 777 kg per ha of vegetation was removed by rhinos from the 120 ha study area then (Table 1). About fifty percent of the forage available from the nine most preferred species (Table 1) was eaten. Though it seems possible that overgrazing of these species may be occurring, further study of their productivity under rhino grazing pressure is desirable.

RECOMMENDATIONS FOR MANAGEMENT

In considering a program for the management of rhinos in the park ecosystem, it is suggested that:

1. Assessment of the rhino population and range conditions be conducted annually.
2. Permanent plots be established to help evaluate habitat trends within the park.
3. Studies on the food preferences of other large herbivores be carried out to determine the availability of the plants occurring in the park, their utilization and preferred herbivore stocking density.
4. Changes in range composition should be assessed periodically to determine whether overuse is occurring. If the preferred and important forages H. compressa, C. rubrobrunnea and A. donax became depleted or if the neglected and avoided plant species show evidence of increasing over considerable areas or in places preferred by ungulates, then animal populations may require management.

SUMMARY

Food preferences of the Indian rhinoceros (Rhinoceros unicornis) were studied in the Kaziranga National Park, Assam, India, from November 1975 through April 1976. Studies were made of the forages available and consumed by means of vegetation plots. Of the 47 plant species eaten, only 21 occurred on the 120-hectare short grass study area. In the latter group, 18 were eaten. Feeding rhinos also were directly observed.

Preferred dry season food plants were Arundo donax, Hemarthria compressa, Carex rubrobrunnea, Eleochoris fistulosa and Lippia geminata. The species eaten but not preferred were: Nasturtium indica, Polygonum chinense, Centella asiatica, Ficus scandens, Cyperus auricomus, Amaranthus viridis, Polygonum barbatum, Oxalis corniculata, Kyllinga brevifolia, Pteridium aquilinum, Fragaria indica, Cynodon dactylon and Erianthus elephantinus. Common, but totally avoided species were Solanum torvum, Xanthium strumarium, and Polygonum hydropiper.

Plants contributing most to the rhino's diet were: H. compressa, C. rubrobrunnea, A. donax, E. elephantinus and P. barbatum.

More than 50% of the available A. donax, H. compressa, C. rubrobrunnea, E. fistulosa, L. geminata, N. indica, P. chinense, C. asiatica and F. scandens forages was consumed.

The three grasses H. compressa, C. rubrobrunnea, and A. donax comprised 71.5% of the available forage and 91.1% of the rhino's diet. These grasses typify the ideal dry-season habitat of the rhino. In some areas, however, these grasses appear to be overgrazed. There is thus some indication that maximum ungulate populations have been achieved or possibly even exceeded.

A. donax was the most preferred dry season food, comprising 9.53% of the diet and 6.8% of the food available. H. compressa, the second most preferred food, comprised 64.69% of the diet and 50.62% of the available food. Fifty-nine to 81% of the available forage of the five most preferred food plants was consumed.

During the dry season in the short grass habitat, A. donax, H. compressa, C. rubrobrunnea, and L. geminata are reduced. In this important habitat, P. hydropiper, X. strumarium, and S. torvum tended to increase. It appeared that the biomass of large herbivores may be at or near the carrying capacity of the park.

Rhinos move to forest habitats when the short grass area is flooded, usually between July and September. Here some shrubs are eaten in addition to somewhat-aquatic grasses and forbs.

It is recommended that the rhino population and condition of the range be evaluated annually; that food preference studies be undertaken on the other large herbivores in the park; and that permanent plots be established to help assess habitat trends.

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APPENDIX

APPENDIX 1

List of principal plant species occurring (x) in Kaziranga National Park (India) habitats. The average length of plant parts eaten by rhinos is given in centimeters for those plants eaten.

Name of the species	Wooded forest habitat			Tall-grass habitat	Short-grass habitat	Aquatic habitat	Plant parts eaten
	T C[1]	M C	B C				
Anacardiaceae							
Spondias magnifera	x						
Lanea grandis	x						
Apocynaceae							
Alstonia scholaris	x						
Wrightia tomentosa		x					
Rauwolfia serpentina			x				
Anonaceae							
Polyalthia jenkinsii		x					
Amaranthaceae							
Amaranthus viridis			16		16		SLI
Amaranthus spinosus			x		x		
Alismaceae							
Sagittaria sagittifolia						10	SL
Asteraceae							
Grangea maderspatana			x		x		

[1] T C - Top canopy; M C - Middle canopy; B C - Bottom canopy; X - Plant present; S = stems; L = leaves; I = inflorescene; T = tender shoots.

Appendix 1 (continued)

Name of Species	Wooded forest habitat			Tall-grass habitat	Short-grass habitat	Aquatic habitat	Plant parts eaten
	T C	M C	B C				
Acanthaceae							
Lepidagathis sp.							
Bignoniaceae							
Oroxylum indicum	x						
Convolvulaceae							
Ipomaea			16		16		SLI
Ipomaea aquatica						15	SLI
Combretaceae							
Terminalia belerica	x						
Terminalia chebula	x						
Compositae							
Eupatorium odoratum			x				
Mikania scandens			x	x			
Ageratum conyzoides			x	x	x		
Sphaeranthus indicus			x	x	x		
Blumea laciniata			x	x	x		
Gnaphalium indicum			x	x	x		
Eclipta alba			x	x	x		
Xanthium strumarium					x		

Appendix 1 (continued)

Name of Species	Wooded forest habitat			Tall-grass habitat	Short-grass habitat	Aquatic habitat	Plant parts eaten
	T C	M C	B C				
Cyperaceae							
Cyperus pilosus			25		25		SL
Carex rubrobrunnea			30		30		SL
Kyllinga brevifolia			15		15		SL
Eleocharis fistulosa			15		10		SL
Cyperus auricomus			15		15		SL
Cyperus iria					x		
Scirpus articulatus					x		
Cruciferae							
Capsella bursa-pestoris			15		15		SLI
Brassica campestris				15	15		SLI
Nasturtium indicum				15	15		SL
Chenopodiaceae							
Chenopodium album			x		x		
Commelinaceae							
Floscopa scandens			15		15		SL
Commelina bengalensis			20		20		SL
Caryphyllaceae							
Drymaria cordata			10		10		SL
Dilleniaceae							
Dillenia indica	x						
Dillenia pentagyna		x					

Appendix 1 (continued)

Name of Species	Wooded forest habitat			Tall-grass habitat	Short-grass habitat	Aquatic habitat	Plant parts eaten
	T C	M C	B C				
Datiscaceae							
Tetrameles nudiflora	x						
Dioscoreaceae							
Dioscorea pentaphylla			x				
Euphorbiaceae							
Bridelia retusa	x						
Bischofia javanica	x						
Trewia nudiflora	x						
Gramineae							
Saccharum arundinaceum				30			LIT
Arundo donax				35	35	35	LIT
Erianthus elephantinus (Ravanae)				35	35		LIT
Saccharum spontaneum				30			LIT
Saccharum elephatinus				x			
Imperata cylindrica				20	20		
Vetiveria zizanioides				15	15		T
Hamarthria compressa					16		SLI
Cynodon dactylon			10		10		SLI
Eleusina indica			10		10		SLI
Seteria glauca			10		10		SLI
Chrysopogon aciculatus				8	8		LT

Appendix 1 (continued)

Name of Species	Wooded forest habitat				Tall-grass habitat	Short-grass habitat	Aquatic habitat	Plant parts eaten
	T	C	M C	B C				
Eragrostis unioloides					x	x		
Leersia hexandra							35	SLI
Andropogon sp.							35	SLI
Lauraceae								
Litsaea ployantha			x					
Baccaurea sapida	x							
Liliaceae								
Smilax latifolia				x				
Leguminosae								
Albizzia procera	x							
Albizzia lebek	x							
Bauhinia variegata			x					
Cassia fistula			x					
Flemingia chappar				x				
Cassia tora				x				
Mimosa pudica				8				SLI
Desmodium cephalotes				x				
Spatholobus roxburghi				x				
Bauhinia vahlii				x				
Milletia auriculata				x				
Abrus precatorius				x				
Labiatae								
Leucas linifolia				x		x		
Lythraceae								
Lagerstremia parviflora	x							
Lagerstremia flos-reginae	x							

Appendix 1 (continued)

Name of Species	Wooded forest habitat						Tall-grass habitat	Short-grass habitat	Aquatic habitat	Plant parts eaten
	T	C	M	C	B	C				
Malvaceae										
Bombax malabaricum	x									
Kydia calycina	x									
Meliaceae										
Amoora walichii	x									
Cedrela toona	x									
Myrtaceae										
Eugenia jambolana	x									
Careya arborea			x							
Myrsinaceae										
Ardisia humilis										
Naiadaceae										
Potamogeton crispus									10	SLI
Najas minor									8	SLI
Najas graminea									10	SLI
Onagraceae										
Trapa bispinosa									x	
Fussiaea repens									10	SLI
Fussiaea suffruticosa									8	SLI
Oxalidaceae										
Oxalis corniculata					10			10		SLI
Oxalis acetosella					10			10		SLI

Appendix 1 (continued)

Name of Species	Wooded forest habitat			Tall-grass habitat	Short-grass habitat	Aquatic habitat	Plant parts eaten
	T C	M C	B C				
Palmae							
Calamus tenuis			x				
Polygonaceae							
Polygonum hydropiper			x		x		
Polygonum chinense			30		30		SLI
Polygonum barbatum			30		30		SLI
Polypodaceae							
Pteridium aquilinum			17	17	17		LT
Ponteriaceae							
Eichhornia crassipes						15	SL
Monochoria hastaefolia						12	SLI
Monochoria vaginalis						x	
Eichhornia speciosa						10	SLI
Rhamnaceae							
Zizyphus jujuba		x					
Rubiaceae							
Anthocephalus cadamba	x						
Morinda angustifolia			x				
Randia fasciculata			x				
Paederia foetida			15				SL
Rutaceae							
Murraya koenigii			x		x		

Appendix 1 (continued)

Name of Species	Wooded forest habitat			Tall-grass habitat	Short-grass habitat	Aquatic habitat	Plant parts eaten
	T C	M C	B C				
Rosaceae							
Rosa moschata			x				
Rosa macraphylla			x		x		
Fragaria indica			10		10		SLI
Solanaceae							
Solanum indicum			x				
Solanum torvum			x		x		
Solanum khasianum			x		x		
Sterculiaceae							
Sterculia alata		x					
Tiliaceae							
Grewia sapida			x				
Umbeliferae							
Eryngium foetidum			x		x		
Hydrocotyle javanica			x		x		
Hydrocotyle rotundifolia			5		5		SL
Oenanthe stolonifera			x		x		
Centella asiatica			8		8		SL
Urticaceae							
Randia dumetorium		x					
Girardinia zeylanica			x				
Leportia crenulata			x	x	x		

Appendix 1 (continued)

Name of Species	Wooded forest habitat			Tall-grass habitat	Short-grass habitat	Aquatic habitat	Plant parts eaten
	T C	M C	B C				
Ficus bengalensis			x	x	x		
Ficus religiosa	x						
Ficus scandens			20		20		SL
Verbenaceae							
Premna latifolia	x						
Vitex peduncularis	x						
Gmelina arborea	x						
Clerodendron infortunatum			x				
Lippia geminata			15		15		SLT
Zingiberaceae ·							
Alpinia allughas			x				