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Please acknowledge. I'd be pleased to have your comments.

Andrew

TAXATION EDUCATION STUDY

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INTRODUCTION

Work was started in the Chitawan National Park on 20th December, 1972. The first six weeks were spent exploring the park, becoming acquainted with the rhinos and deciding upon the best areas in which to concentrate studies. Between 4th February, 1973, and 8th March, 1973, a visit was made to the Kaziranga and Manas Wildlife Reserves in Assam. During 20 days at Kaziranga and 3 days at Manas, data was collected on the state of the vegetation and the movements, behaviour and feeding habits of the rhinos. Data was also collected on numbers, group compositions and behaviour of elephants, buffalo, swamp deer and hog deer. Apart from a five day visit to a Bihar Wildlife Sanctuary in April, work has continued in Chitawan to the present moment concentrating on three general lines.

1. Survey of distribution and numbers of rhino within and outside the park boundaries.
   Individual identification wherever possible, the classification of all individuals as to sex and age and the compilation of a photographic file of recognizable individuals.
   Compilation of a photographic age series by taking monthly photographs of cows with their calves.

2. Assessment of the vegetation types in different areas of the park and seasonal changes in abundance of rhino food species and others.

3. Observation of rhino behaviour and movements concentrating on social interactions, daily activity patterns and feeding habits.

One major and four comparative study areas have been chosen :

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a) Sauraha in the extreme east of the park will be the main study area. This includes Itarni Island and the area to the west bordered by the World Wildlife Fund rhino fence around the Jaimangala salient. It was chosen because of its high rhino population of at least 37 in 5 square miles (7.5 per square mile) and the existence of some relatively open areas with convenient trees for siting machans. There is also no regular disturbance by tourists on elephants and the area is thus ideal for behavioural observations. Patches of scrubby Trewia, Simul forest alternate with stretches of elephant grass the most common stands being mixed of "ghans", "jucka" and "borrua". Wallows are plentiful.

b) The immediate area around Tiger Tops, Bhimly Island and the Surang Valley. 23 different rhinos have been identified and are normally resident within an area of 6 square miles. The population density is almost certainly less than 5 per square mile. The area includes a variety of habitats. Bhimly is mainly covered in sparse simul woodland with low "ghans" and "borrua" growth grazed heavily by domestic stock in the dry season. The area east of Bhimly has been reduced to an open plain of short colonizers with no cover at all where rhinos are very rarely seen. South along the Reu and Surang Rivers the grass growth is lush and tall. Stands of "borrua", "jucka" and "narcut" predominate and house many rhinos though they are hard to see. The Someswar woodlands further to the south are used by rhinos along the borders with the grasslands and a considerable amount of browsing activity has been observed. Wallows again are plentiful in all but the eastern part.

c) Khoria Mohan and Chumka area consists of very tall "borrua", "jucka" and "dumi" grasslands so thick that an elephant is the only practicable mode of travel in most places. Only 9 rhino have been identified but there are probably at least 20 in the area. Sal forest on the lower slopes

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of the Someswar reaches the Naryani River at Chunka in the west. To the east the hills form an amphitheatre of grasslands between themselves and the Naryani and there are four sizeable tals or lakes in the area.

d) Bangariola - The islands in the Naryani River west and north of the Rapti confluence are covered mainly with the Khair-sissoo forest type (Acacia catechu and Dalbergia sissoo). A two day boat trip through the area starting from Narangarh revealed very little sign of rhino until almost due west of the Rapti confluence. Here from one island 4 rhino were seen and the tracks of a mother and calf spotted. The area, though difficult to work and orientate oneself in, warrants further investigation. The small twigs of sissoo (Dalbergia sissoo) were being eaten in large quantities by the rhinos. They may be confined to single islands during the monsoon as the Naryani flows so fast. One seen on 9th March turned back after having difficulty in crossing a swiftflowing channel.

e) Sukhibar - Jarnilli - This is an area of low rhino density. It consists mainly of Sal forest in which the only rhinos are found at two big tals when they have water in them. Jarnilli on the edge of the forest has a slightly higher concentration but most of the rhinos are found in the tall "dudi", "jucka" and "narcut" (Arundo donax) thickets around the Doomry and Majur Tal. Numbers are difficult to estimate but there are probably only 20 rhinos in 20 square miles.

Kaziranga

The habitat in Kaziranga is more uniform. Tall stands of Erianthus ravanae predominate. Simul trees in the grasslands are scattered and suffer from fires lit by the sanctuary guards to encourage the fresh green regrowth for the rhinos' grazing. The rhino population is very large. A census

undertaken in March 1972 gave 653 rhinos in 190 square miles. This is a density of 4.3 per square mile but almost half of this total are confined to a 27 square mile area of tall grass and lakes in the extreme west of the sanctuary. Here there is a density of 11 per square mile. From a machan in this area it was common to see 20 rhinos simultaneously grazing or wallowing within an area of 1.5 square miles.

RESULTS

1. The Population

A total of 80 rhinos have been individually tallied and classified as to sex and age. 71 of these are recognizable again with the aid of sketches and photographs showing characteristic folds and scars in the skin, cuts in the ears and shapes of horns. Sexing of rhinos in the field is easy by the external genitalia with adults but difficult with calves and subadults. Sexing of the calves continues slowly as chance encounters provide the opportunity. Ageing of calves by estimation of height and reference to 200 records (Lang 1966) has been relatively easy. Using Lang's records of lengths and shoulder heights for rhinos born in Basel Zoo the following table has been prepared by which an estimate of the relative area of calf to cow in side view silhouette can be related to age.

Age Class	Age	Calf side view area as fraction of Cow's	Height cms.
I	0	1/9	62
II	1 yr	1/3	123
III	2 yrs	2/3	144
	3 yrs (Subadult)	3/4	157
	Adult		170)

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At the 3yr or subadult stage many rhinos have left their mothers.

The classification of the 80 rhinos tallied is as below :

TOTAL		Saurah	Tiger Tops	Khorienchan	Bangariola	Farail
25	Adult males	11	9	1	2	2
25	Adult females	12	7	3	1	2
5	Subadult males	3	2			
3	Subadult females	2	1			
1	Unsexed adult	. . . . .			1	
2	Unsexed Subadults	. . . . .		1		
7	Calves I	3	2	1	1	0
8	Calves II	4	1	1	0	2
4	Calves III	3	1	0	0	0
19	Total	10	4	2	1	2
80	TOTAL	38	23	7	5	7

The sex ratio is 30 males to 28 females.

62.5 % of the population is adult.

23.8 % of the population are calves accompanying cows.

8.8 % of the population are calves less than one year old.

28.0 % of adult females have calves of less than one year old.

76.0 % of adult females have accompanying calves.

The yearly recruitment to this sample of 80 is 7 or 8.8 %. 12 deaths of rhino were recorded last year, 9 of which were due to poaching. This represents a loss of 9.2 % per year from the estimated 130 rhinos in the population last year (Pelink and Upretti, 1972). The 3 natural deaths account for 2.3 % of the population. Thus natural deaths and poaching

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deaths account almost exactly for the yearly recruitment of rhinos to the population. The situation is similar this year.

	1972 (Jan - Dec)	1973 (Jan - May)
Poached rhinos	9	3
Natural deaths	3	1

Thus at the present rate of recruitment and deaths the population is static. If poaching can be brought totally under control there should be a 6.5 % increase in the population peryear subject to secondary effects on the rhino and the habitat. The last case of poaching was in February when a pregnant female was killed.

These figures for population composition are very similar to those reported for Kaziranga in the 1972 census :

	1972 Kaziranga	1973 Chitawan
% Population adult	59.4	62.5
% Population calves less than 1 year old	10.2	8.8
% Adult females with calves less than 1 year old	35.6	28.0

There is a slightly lower recruitment rate in Chitawan and a higher percentage of the population is adult.

The ratios of Calves I : Adult females ; (II + III + SA) in Chitawan and Kaziranga are 28 : 100 : 83 and 36 : 100 : 100 .

The theoretical maximum numbers of juveniles possible aged 1 - 4 years is 3 x 28 = 84 in Chitawan and 3 x 36 = 108 in Kaziranga. Comparing these figures with the actual ones it can be seen that they correspond pretty

nearly. The Kaziranga actual figure is a little low and this may be due to predation by tiger. 39 calves have been recorded killed by tiger in the last 7 years whereas in Chitawan I can only find records of 3 in the same period. The tiger population of Kaziranga is twice that of Chitawan and contained in a smaller area.

An estimate of calving interval can be made from -

$$\frac{\text{No. mature females}}{\text{No. calves less than 1 year old}}$$

In Chitawan this is $\frac{25}{7}$ = 3.6 years.

Skulls are now being collected in Chitawan and in Kaziranga in my absence and it is hoped to define age classes on the basis of tooth wear. Of the 5 rhinos poached in Chitawan since December 4 had adult dentition, and one was a class II calf. Of the 2 natural deaths both had adult dentition and one had teeth worn smooth with no cusps at all.

Chitawan Rhino Deaths

Dec 1972	1 Adult female + Class II calf	poached
	1 Adult female	drowned in lake
Feb 1973	1 Adult female	shot & died 10 days later of bullet wounds.
	1 Adult male	poached
	1 Adult female - pregnant	poached
	1 Acult female	died natural death

Population Estimate

Pelink and Uproti (1972) estimated 121 - 149 rhinos in the Chitawan after conducting a census from helicopter and elephants. I have individually classified 80 rhinos within the park and had fleeting glimpses of others.

Tracks have been seen in very thickly vegetated parts of the park where observation is very difficult and also outside the park on the other side of the Naryani River in Nawalpur. A motorist chased a rhino along the Hetaura road 20 miles from the park boundary. At this stage I think that the 1972 census gives a reasonably accurate estimate.

2. Habitat Requirements

Rhinos are only found in Chitawan in places where there is a) adequate cover for sheltering from the sun and hiding from humans, b) water for drinking and wallowing, (the latter must be away from human disturbance in most cases though a few old males prove exceptions), and c) an adequate food supply.

a) Cover

Rhinos are seen regularly over Bhimly Island up until February but after the destruction of the long grass by fire they become restricted to one area of thick "ghans" on Bhimly which remained to a large extent unburnt. Tracks and nocturnal observations showed that though the burnt areas were spurned during the day because of human disturbance, cattle and buffalo grazing and lack of shelter, they grazed on the lush regrowth at night. However, the domestic stock grazing pressure grew so much that in April the rhinos were grazing more in the Surang Valley "narcut" and "borrua" stands. There are also abundant sheltered wallows in the Surang area.

The domestic stock grazing pressure at Bhimly is much higher than at Saurah. Several hundred head grazed simultaneously on Bhimly in April but rarely more than 3 - 400 graze simultaneously in the Saurah study area if one excludes a badly overgrazed piece of land on the east of Itarni island. In a similar situation at Saurah where the long "borrua", "jucka" and "ghans" cover had been burnt off, rhinos were often found grazing in the

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daylight hours and this can be ascribed to less human and domestic stock disturbance.

b) Water

In undisturbed areas like Gurung, rhinos can be observed drinking on exposed riverbanks during the middle of the day. In most other areas where human disturbance is greater they avoid exposing themselves and keep to thick cover and sheltered water supplies. They have no need to drink during daylight hours. A lactating female followed from dawn onwards drank first at 23.15 hours and she left her 6 month old calf 100 yards from the river in thick cover while she drank.

Water is needed not only for drinking but also for wallowing. It also provides waterplants which are fed upon in large quantities by the rhinos. Lack of wallows may explain the relatively high concentrations of rhino at Gaurah and Tiger Tops and the low numbers in the tall grasslands between Jarnili and Bocmry and further east to Jaimungala. This could limit distribution in the dry season.

The table below shows the % of observations of rhinos on which the initial encounter the animals were wallowing - normally in a small lake, stream or pool with some degree of vegetation cover surrounding it :

	% Observations Wallowing
December	0
January	2.3
March	13.0
April	21.8
May	37.1

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The Reu and Rapti Rivers are not used except in early evening and a large expanse of grasslands east of Saurah is devoid of suitable wallows in the dry season. Perhaps during the monsoon these areas will be used more. Upreti (pers. comm.) reports 17 rhino counted in one tal 5 miles west of Saurah in May 1972 after a prolonged dry period during which the Saurah tals dried up or were too exposed to cattle grazing for the rhinos to make use of them. Some of the rhinos using the tal were recognizable as ones seen previously at Saurah.

So far this year there has been regular rainfall and the population level at Saurah has remained pretty constant. Even after the most recent rains there are large numbers of rhino in the small area near Jaimungala village and over 14 have been seen during a 2 hour elephant ride. The special conditions of the habitat and the proximity of the village I suspect have something to do with this. Although a fence has been built along the edge of the Jaimungala salient I twice saw rhinos pushing their way through the fence at night time and making their way across the fields. The people on the north bank all build rhino ditches and fences around their crops and claim that during the rice and maize season they suffer enormous losses from rhinos. This liking of cropraiding may be one reason for the rhino's concentration near the agricultural land and away from the wilder forest areas.

It is also noticeable that rhinos use the short grass areas for grazing such as the airstrip and areas beside the Rapti River heavily grazed by domestic stock. Here also the rhinos make use of secondary colonizers unpalatable to cattle or elephants such as Artemisia, Zanthoxylum, and Solanum for browsing. Their growth here is probably a result of extensive stock grazing but it has had the indirect effect of providing different food for the rhinos. Goddard (1967) reports black rhinos (Diceros bicornis) making use of overgrazed areas in Ngorongoro Crater where Solanum and

Indigofera occur and surmises that overgrazing in this case results on a wider herbivore fauna.

c) Feeding Observations

Seasonal feeding observations in different areas are being collected. Goddard's method of feeding stations (Goddard 1967) is being tried but it is difficult to stay with an individual for long periods close enough to identify every species eaten without affecting the behaviour of the rhinos. One method which has been used in a single area is to record species eaten by rhinos passing near to a machan and to relate those eaten to those available on the route taken. On a larger scale, positions of rhinos are plotted every five minutes on a map of a ½ square mile expanse of mixed grasslands visible from a machan. A rough vegetation map of the area is made to show the relative abundances of different species in different areas which may then be correlated with the time spent by the rhinos in the different areas.

So far identification of plants in Kathmandu has not proceeded very fast as the grass specialist is away on leave. Nepali names taught to me by the local people are used in this recording.

The pattern of grazing and its change throughout the year has been as follows at Baurah :

December : Main grazing done on short anthropogenous grasses, Cynodon dactylon and short "ghans" by night. A lot of browsing on shrubs such as Artemisia, "daygun", Solanum and Zizyphus. Tuffy "ghans" grazed among the milkweed thickets.

The Artemisia and "ghans" show a different growth form which may be due to rhino grazing. Rhinos usually eat long fronds by laying them sideways in their mouths and then jerking the head up or sideways to break the fronds or to pass it through the mouth

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tearing off leaves. This behaviour is also shown with charred stems which rhinos pull through their mouths to scrape off the ashes.

The Artemisia and "ghans" are growing woody stems with short tufty outgrowths all the way up them.

The following table gives the percentages of observations of grazing rhinos made in each of 4 areas at Gaurah each month :

	Tufty "Ghans", short creeping grasses & colonizing shrubs	"Barrua", "Judka", "Ghans" flats	Water weed in tal	Forest Browsing
December	67	26	0	7
January	75	8	0	17
March	13	55	26	6
April	13	50	31	1
May	46	23	26	5

All the data was gathered on a standard elephant tour taking in all four areas on each occasion.

January : As for December but more browsing in the forests. No grazing in the tall elephant grass stands.

March : After fire had swept through a mixed stand of "judka", "barrua" and "ghans" the new regrowth proved the main grazing attraction to the rhinos and remained so until early May.

April : As March. Charred stems were eaten or pulled through the mouth. A large proportion of the rhino's time was spent feeding on under water vegetation in the tal s.

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(19 grass species and 23 shrubs have been collected as rhino food plants and are at present awaiting identification in Kathmandu).

In the Khaurah study area about 82% of the wild large herbivore biomass is made up by rhino. If cattle and buffalo are also included the figure drops to 50% of the biomass made up by rhinos.

The picture is very different in the Bhimly, Harrbass, Sukibar area where 1,500 cattle were counted in the area from the top of the Someswar ridge one day in April. Here the rhino has little more than 30% of the biomass if these stocks are included. Although a certain amount of cattle grazing does not do much harm on this scale it is very destructive.

Observations have been made on plants eaten by cattle and buffalo and more detailed work is being done in different areas to discover the exact overlap of food species between cattle and rhinos. Chital, hog deer and wild pig occupy the same grazing grounds and share the same resources though no doubt they exploit them differently.

Kaziranga

In Kaziranga in March most of the rhinos were feeding on Eriantus ravennae regrowth after a fire. They also fed on "mal" Arundo donax, Cynodon dactyl and other short creeping grasses. One individual in particular fed heavily on the water vegetation including the water hyacinth Eichhornia crassipes.

Using the 1972 census figures the rhinos make up 28 % of the biomass of the park but in the Bagori Beat they make up 50% of the biomass.

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3. Individual Behaviour

a) Space Time Utilisation of Habitat

A lot of data has been collected on activity patterns and could be subjected to detailed analysis in an effort to correlate activity with age, sex, location, temperature and weather conditions. Most feeding activity takes place in the early morning or late evening. In winter grazing usually continues until 10.00 a.m. at which time the heavy river mist which covered the valley from 4 or 5 a.m. onwards was usually clearing. This was followed by a period of rest, not necessarily in the shade and a further period of grazing in the afternoon. Animals often rested for a short time around dusk and then grazed until midnight or later when a 2 - 4 hour rest period before dawn was normal. The pattern is similar in the summer but animals wallow as early as 6 a.m. and the main grazing period is usually from 3 p.m. onwards despite the fact that the sun is still high and hot at this time.

Rhinos have been watched for 406 hours since December. One calf and cow were followed for 24 hours in January and almost 24 hours in April. The following shows their activity on both occasions.

20th January, 1973 — Cow + 6 month old Calf

1715 - 1910	Lying, sleeping
1910 - 2315	Grazing, browsing
2315 - 0005	Adult female goes to the river to drink leaving the calf in thick cover.
0005 - 0130	Grazing, browsing
0130 - 0410	Lying
0410 - 0955	Grazing
0955 - 1430	Lying
1430 - 1645	Grazing
1645 - 1700	Lying

1700 I leave

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Total time	: Lying	:	9.40 hours
	Feeding	:	13.30 hours
	Walking & drinking	:	0.50 hours

In April attempts to follow animals for 24 hours were unsuccessful but observations from machans day and night indicated the following general activity pattern, for this particular cow and calf.

April

15.00	Start grazing and head slowly towards a big tal.
17.30	Reach tal and feed on waterweed under water.
19.00	Leave tal to graze.
23.00	Lie down
00.10	Graze
-	
05.00	Grazing still
09.00	To cover - tal or wood.
09.00 - 15.00	Lying

Time :	Lying	: 7.30 hours
	Grazing	: 14.30 hours

Wallowing in the midday period is usually in water in thick cover where the rhino cannot be seen, but the rhinos also wallow regularly in the evenings in open pools and combine this activity with a considerable amount of feeding on the waterweeds. The times of wallowing observations mean little because so much wallowing is done hidden in thick cover such as Arundo donax. In Kaziranga midday wallowing in the open lakes is common behaviour.

Movements

All movements observed so far have been local i.e. less than 3 miles, but some animals may roam more widely as is indicated by the low number of resightings of subadults and some adults in 2 square miles of the Saurah area. The male "1" left the area for most of May but was resighted again at the end of May. The male "IV" disappeared completely and has not been seen all May while others have come in e.g. VII and XIII. A,a, B and b are the most permanent residents in the relatively open area around Saurah where observation and identification is easiest.

Females + Calves

March	10	11	5	5	2	1	4		1			1		2
April	17	13	2	1	5		4	5	4		10	1	2	1
May	15	12	2		2	7	8		6	2				3
	42	41	9	6	9	8	16	5	11	2	10	2	2	6

Males

	1													
March	13	7		14	6	5						1		
April	13	5	2	14	7	1		1	1	3	2			2
May	4	3	1		13		6			2	1	1	4	
	30	16	3	28	26	6	6	1	1	5	3	2	4	2

A B C D E F G H I M are adult cows with calves a b c d e f g h i m

J and K are adult

L is subadult

1, II, III, IV, V, VIII, IX, X, XI, XIIX, XIV are adult males

VI, VII, and XII are subadult males

b) Reactions to Other Animals and Man

Reactions to human disturbance or other animals are extremely variable and depend on the medium of stimulation, the time of day, the cover available and the individual concerned. A typical sequence following a rhino's detection of human smell might be as follows :

A cow rhino stands slowly rotating her ears and flapping them occasionally to rid her head of jungle mynahs or flies. An accompanying calf does the same and stands at an angle to its mother. The cow snorts and makes a mock charge head held low to the ground in the direction of origin of the smell. A mock charge is brought to a stop after a few steps and the cow wheels around in a half circle and then a full circle taking tiny steps and swinging the head round fast as if undecided about where to go. Two or three mock charges may be made and then the pair run away with the calf normally leading. Snorting and honking may continue for several minutes from a couple of hundred yards away.

Alternatively the cow may push home her charge a bit further. I have turned one charging female by shouting and escaped two others by falling to one side and climbing a tree.

Rhinos in Kaziranga graze peacefully with buffalo, swamp deer and hog deer and I have watched them in Chitawan walk through herds of Chital with no disturbing effects. Also in Chitawan a rhino was seen to chase a sloth bear 200 yards across a sandy beach into the forest, honking loudly on the way. On another occasion a male rhino charged a hog deer which grazed too near to him.

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Smell is the rhinos' best sense. They are immediately alerted if downwind of a human observer. Their sight is very poor and is only really effective in perception of moving silhouettes or at very close range. Sounds such as crackling in grass and bushes are often ignored when the rhino itself is in thick vegetation but when it is exposed on a wallow or open area any unusual sound immediately alerts it. At night they are slightly less wary and come out more into the open areas to graze. Some old males become almost oblivious to human observers at this time and may be approached in the open to within a few yards while they continue to graze.

An observer can sit up a tree only 6 feet off the ground and a rhino underneath though perfectly aware of the smell of humans, will often walk by sniffing and investigating yet unable to detect the origin of the smell.

Birds Associating with Rhinos

In Kaziranga the following birds were often seen on the backs of rhinos or around its feet and head picking up morsels of food as the rhinos grazed :

Cattle egret - Bubulcus ibis
Common mynah - Acridotheres tristis
Black drongo - Dicrurus macrocercus albirictus

In Chitawan cattle egrets are not seen in association with rhinos. The most common avian follower is the Jungle Mynah Aethiopsar fuscus which picks up morsels from the ground or picks from open wounds on the rhino's body. The common kingfisher Alcedo atthis uses rhinos as perches when they wallow in the tals and the Indian pipit Anthus rufulus has been observed picking up morsels from around a grazing rhino's mouth. The black drongo is also found in association with the rhinos in Chitawan.

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4. Social Behaviour

a) Social Organisation

The following table shows the classification of group compositions and the numbers of each type seen. Groups means animals which are found moving toget and staying together for an hour or more. Many groups are very temporary in nature and those larger than two in size have never remained together for mor than 2 days. The data does not include groups found wallowing together. Up to 9 rhinos have been seen wallowing together but in no sense of the word are they a group under these circumstances. There can be a lot of agression displayed if the rhinos venture too near each other.

		Chitawan		Kaziranga	
1	Adult male	122	(28.0%)	90	(33.7%)
	Adult female	23	(5.3%)	23	(8.6%)
	Subadult	31	(7.1%)	51	(19.1%)
2	Adult female + calf	235	(54.0%)	61	(22.8%)
	Adult female + Adult male	8	(1.8%)	13	(4.9%)
	Two adult males	4	(0.9%)	3	(1.1%)
	Two adult females	2	(0.5%)	0	(0.0%)
	Two subadults	0	(0.0%)	16	(6.0%)
	Adult female + subadult	0	(0.0%)	4	(1.5%)
3	Two adult females + 1 calf	2	(0.5%)	0	(0.0%)
	Adult female + calf and subadult	8	(1.8%)	4	(6.0%)

Kaziranga and Chitawan are compared in this table. The main differences betw the two localities are that the number of single subadults is considerably higher in Kaziranga and the number of cow-calf pairs is lower in Kaziranga. This indicates that the calves are leaving their mothers earlier in Kaziranga than in Chitawan.

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b) Vocalization

The following vocalisations have been noted which function as communication signals :

1. Snort

A sound made by expelling air in a succession of quick bursts through the lips and nostrils. It is used as a warning sound to man, elephant or rhino when they approach too near. Another rhino may answer a snort with the same noise.

2. Honk

After the snort the animal either stands its ground, runs away or charges. The honk may be made in any of these situations though it is not always used. It is a loud guttural noise reminiscent of honking geese, and often two tone in nature. Two rhinos may answer each other's honks.

3. Huffh

On fleeing expulsion of air in the throat makes a wheezing noise which is in time with the trotting pace usually used in these circumstances.

4. Bleat

A noise made by cows with head low and held forward in submissive posture when faced by an adult male. A low pitched one tone vocalization made with an open mouth.

5. Bellow

This is made as a threat noise by rhinos approaching another or standing facing another. It is similar to the bleat but louder and more forcible and made with the head raised and mouth open.

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6. Grunt

A noise made by calves as a contact noise with their mothers. Its frequency is increased when the calf is out of sight of its mother or a long way away. It is a short simple grunt made deep inside the throat and can be made with the mouth shut or open and even while grazing. It is repeated regularly at rates of up to 1 per 2 seconds. Cows also make this noise but usually make no reply to a calves grunts. It has a curious ventriloquistic property and can be very misleading as to the direction of origin.

7. Squeak Pant

A sharp squeaking intake of breath followed immediately by a panting outflow similar to a mild honk. It is repeated many times in succession by males running in pursuit of females and has also been recorded by a male in persuit of another male. After a female has escaped the male may stop and continue to squeak pant gradually reducing the frequency. In this stage the pant noise is sometimes omitted or becomes too faint to be heard.

8. Roar

This is made in a serious fight. It is a higher intensity honk longer drawn out and louder.

9. Pig Grunt

A noise which has only been heard once by two males fighting.

c) Cow - Calf Relationship

Adult females and calves have been treated as a unit for data recording. They are almost always seen together even when the calves are subadults (¾ the size of the adults).

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On 3 occasions on which suckling was observed the calf suckled from behind the cow with its head between her back legs. On another occasion it suckled from the side facing backwards.

Babies feed on plants from an early age. Food selection is slightly different. One 6 month old calf ate a large quantity of a small leaved creeper while her mother grazed on lush grass regrowth.

Wallows are visited by both mother and calf together and they usually wallow in physical contact with each other. However, two very small calves at Kaziranga always stayed on the side while their mothers wallowed. In some cases the calf puts its forelegs up on the cow's back from the side and sleeps with its forequarters resting on its mother's back.

Cow and calf greet each other by rubbing noses and necks and this greeting is also seen between two calves on occasions. Greeting and close physical contact during wallowing and lying down on land is characteristic of all age classes of calves.

It is often the calf who notices the presence of an observer first and may walk towards a suspicious object or smell. The cow is in her turn alarmed and may follow or overtake the calf. If they take fright either may run off, sometimes honking, but the calf usually takes the lead with the cow covering its retreat.

Leader		Leader	
No. of Occasions		No. of Occasions	
Cow	Calf	Cow	Calf
23	38	70	35
Disturbed		Undisturbed	

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In an undisturbed situation it is normal for the cow to lead. Calves sometimes romp and play around the cow running as much as 150 yards ahead of her and back and then rubbing noses or necks on returning. A 2 month old calf in Kaziranga was seen to run ahead and behind its mother as she approached a wallow and then to gambol on the side as the cow wallowed.

When grazing it is not uncommon for two calf - cow pairs to graze close together but they always move as separate units and though they move in roughly the same direction they are not following each other and they give the impression of being together by chance. They seldom stay together for more than 2 hours.

Often two or more cow - calf pairs wallow in one tal. They coexist quietly if they stay apart but there is often antagonism if one approaches another or just after a new rhino enters the wallow.

e.g. 13th May, 1973 1810 hours

B + b enter pool at west end. B leads and after drinking they walk steadily east. B lifts tail, urinates and lies down. b overtakes B and walks on towards E and e lying together in the water 10 yards away. E snorts. b approaches with head held high. E snorts, rises to her feet and snorts again. b runs back to B. E gives the open mouth threat display and followed closely by e approaches b. b retreats further towards B. E attacks again with open mouth, lips turned back and lunges at b's face. b honks and runs towards B who also runs away. E + e lie down again together. B + b pass 8 yards to the left of lying F + f. B walks past but b approaches f who gets up. They rub noses with a circular motion. b blows bubbles. F snorts. f returns to her side. F snorts. b walks off to lie beside B who has lain down 20 yards away in the water.

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1820 hours

3 pairs lying at 20 yards intervals. All the calves blow bubbles with heads under water and then come up for air before submerging the head again and blowing more bubbles. All roll in the mud occasionally. They roll onto one flank first and rock back again before turning to the other flank. I have never seen an adult rhino roll right over its spine.

d) Adult male Interaction

On two occasions adult bulls have been observed grazing together but separated within 30 minutes. Aggression between bulls has also been recorded. One bull chased another while squeak panting. 2 bulls faced each other heads low, parrying with their horns and noses and making pig like grunts. They stood for 5 minutes before one suddenly turned and ran. The victor had no wounds but the loser had a 12 inch long fresh wound on the right of the neck.

Two bulls wallowing together sometimes come into close contact and stand facing each other snorting. Normally one will turn and run before any fighting occurs but on some occasions charges have been observed in which a sideways lunge of the head is made with the incisor tusks bared.

Adult females have been seen to attack adult males who flee from their charge. Records of all aggressive interactions are being collected and so far in the Saurah area there are two males which have never been defeated by another male. An interaction between these two males has not been observed but they use the same grazing grounds and wallows.

There are two adult females, both with calves, who are dominant in an encounter with either of the two dominant males and initiate interactions with them. The other females in the area do not initiate interactions with any males and are submissive if an encounter does take place.

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c) Marking

Dungpiles

Dungpiles in Chitawan are scarcer and smaller than those in Kaziranga. They are used by more than one individual and I have seen 5 rhinos use the same dungpile in one morning in Kaziranga. Only twice have I seen rhinos backing up to a dungpile before defecating. More often they walk over it or walk up to it and turn slightly outwards. Sometimes they smell it closely beforehand. Adult males, subadults, adult females and very small calves have all been seen using the same dungpiles. On one occasion a rhino scraped its hind leg in its dung after defecation. I saw signs that another rhino had done the same elsewhere. Normally the rhino, having defecated, moves on.

Dungpiles are found throughout the rhino areas but more frequently by wallow or in open short grass areas. Holes in the ground, natural or man made, attract rhinos as places to defecate.

Urination

Bull rhinos spray urine in up to 8 backward directed squirts when confronted by man, elephant or another rhino or when approaching the same himself. The tail is always curled over the back before urination. Only adult males have been observed to spray their urine.

Fleshmen

Both males and females use the "fleshmen" posture after sniffing the ground where other rhinos have passed or urinated. Unlike the African rhinos the Indian rhino has very good neck articulation and lifts its nose above shoulder level, curls back the front and sides of the lips, more especially the upper one, and keeps the stance for a few seconds.

Two parallel furrows about 16 inches apart and up to 50 yards long are often found and especially in the vicinity of dungpiles. On two occasions a male was seen making a pair of these furrows. An extract from the field notes is:-

8th April, 1973

"V" has just chased a female who escaped him.

15.33 Adult male V smells ground and fleshmans, head turned up sharply with his lips curled right back. He walks on slowly south grazing. He spray urinates twice and walks with a stiff legged gait dragging his back legs one after the other so that the middle toes gouge furrows behind. He continues for 50 yards squirting more urine behind and on to his legs.

17.10 M + m (cow + calf) walk south along roughly the same route. M smells the ground and fleshmans. She overtakes m and reaches V's route. She fleshmans again at this point and moves on across his path.

17.45 III (bull) walks south grazing. He fleshmans on V's route of this morning.

Conclusion

It is hard to see how these marking behaviour patterns could be in defence of a territory as reported by Ullrich (1961). The ranges of the four males seen most frequently at Kaurah overlap considerably. Three of them have been seen grazing together 50 yards apart without any antagonism. Three of them also courted the same female over a period of 2 days and she was left unaccompanied during some of this time. All the rhinos, both males and females move according to the state of the vegetation to take advantage of the nutritious regrowing grass after fires and the new grass shooting up with the start of the rains. The same was seen in Kaziranga with up to 25 rhinos - adult males, females, calves and subadults - grazing on an area of regrowth Eriauthus.

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So far it appears that there may be a dominance hierarchy which includes both sexes. It is complicated however and is probably affected by the circumstances in which the encounter takes place. One of the females who is dominant over the dominant males is submissive to a female who is submissive to a dominant male. All the interactions on which this example is based took place in a single wallow but similar encounters have been observed on land.

With the collection of more data in different locations a clearer picture should emerge. So far there is no evidence for any "territory" or defence of same.

f) Sexual Behaviour

i) Approach by the Bull

The bull follows the cow wherever she goes in an attempt to come face to face with her but without frightening her. Sometimes the cow takes fright and runs before they even come face to face in which case the bull gives chase uttering the squeak pants described earlier. They both run with their tails up behind them. She honks occasionally. One such pair ran half a mile in the open. The male caught up with the female from 200 yards behind at the start and as he came up to her lunged at her rear flank with his head - possibly with the incisors bared. She continued to run and he to lunge until she began to draw ahead and they entered the forest again. On another occasion in which the cow escaped, the bull stopped, squeak panted with decreasing frequency and then charged a small Trewia tree hitting it 4½ feet from the ground with the base of his horn and taking off a piece of bark 6 inches square stuck in his horn. He squirted urine twice and walked away.

The sequence of events if the female doesnot run away or if the male catches up with her again varies but there are two basic postures which are accepted

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during the premating stage.

a) Male and female stand facing each other with heads low, chins almost on the ground and noses or horns touching. They normally move their horns from side to side like two hockey players at a "bully off". Caressing of foreheads and cheeks of partner with open lips may occur.

b) Male stands behind female with his chin resting on her rump. He may follow her for long periods like this. This position is sometimes reversed so that the female has her chin on the male's rump.

Both these behaviour patterns combined with much chasing, grunting and honking have been observed many times in Kaziranga but on most occasions the courtship went no further than (b). On one occasion a bull attempted to mount a cow in the water, pushing his forefeet forwards towards her neck. He dismounted as she walked out of the water, smelt her anus, "flehmened", and put his chin on her rump. Soon afterwards they grazed together among 3 other rhinos - 1 male and 2 females. No interest was taken in the female by the other male. However, one female in Chitawan was chased by three different adult males in 2 days.

ii) Approach by Cow

The same female on the third day was seen to approach a grazing male head on. She snorted twice and advanced. The male walked forward grazing to 4 yards away when the female snorted and ran.

Courtship behaviour has been observed or heard in every moth since December. There seems to be no obvious seasonal peak in births. Of accurately known age calves one was born in January, one in February, and one in May last year.

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Plans for the Next 6 Months

1. Further behaviour observations to try and discover more about social organization.

2. Observations of changes in feeding behaviour and distribution of rhinos during the monsoon and especially to check on cropraiding in the paddies.

3. Further survey work outside the park to discover the size of the outlying populations in Nawalpur and Kathar and the Mahenera National Park.

4. Vegetation Analysis : setting up a series of permanent transects through a variety of grassland types for recording monthly changes in abundance + growth form of different grasses and forbs.

5. Habitat - the habitat favoured by rhinos in different areas of the park and the use made of it.

6. Completion of a photographic file on all the rhinos encountered and an age series on the young calves.

7. A further visit to Kaziranga Reserve for more comparative work.

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