

JOURNAL  
OF THE  
BOMBAY NATURAL  
HISTORY SOCIETY

---

---

1973 AUGUST

Vol. 70

No. 2

---

---

Kaziranga Wild Life  
Sanctuary, Assam<sup>1</sup>

A BRIEF DESCRIPTION AND REPORT ON THE CENSUS OF  
LARGE ANIMALS (MARCH 1972)

BY

P. LAHAN<sup>2</sup> AND R. N. SONOWAL<sup>3</sup>

INTRODUCTION

In Kaziranga Wild Life Sanctuary the object and methods of management are to a large extent Rhino oriented in so far as the sanctuary holds the largest number of surviving great Indian one-horned rhinoceros. For sound scientific management of wild life basic data are required on the Ecology of the habitat, species living in the habitat, population dynamics of each species, inter and intra specific reaction of the various species of wild life and their influence on the habitat, carrying capacity of the area, and food habits. To collect such basic data considerable amount of field research is necessary.

As a part of this programme a census of the rhinoceros in Kaziranga was carried out in 1957, 1963 and 1966. However the first

---

<sup>1</sup> Accepted November 3, 1972.

<sup>2</sup> Divisional Forest Officer, Eastern Assam Wild Life Division, Bokakhat, Assam.

<sup>3</sup> Range Officer, Kaziranga Range, Kaziranga, Assam.

scientific and systematic census of larger mammals of Kaziranga including the rhinoceros was conducted in 1966 only by the Forest Department with the help of Mr. H. K. Nath and Dr. J. J. Spillett. Due to various reasons census of the wild animals in the Kaziranga Sanctuary could not be carried out during the subsequent years after 1966. A census of the larger mammals of the Kaziranga Wild Life Sanctuary was carried out during the year on the 24th and 25th of March 1972, after a lapse of six years.

A brief description of the Kaziranga Wild Life Sanctuary and the details of the census operation form the text of this report.

### KAZIRANGA WILD LIFE SANCTUARY

#### *Situation, Topography and Area:*

The Kaziranga Wild Life Sanctuary is situated partly in the civil district of Sibsagar and partly under Nowgong district in the state of Assam, India ( $90^{\circ}5'$  and  $93^{\circ}40'E$ ) ( $26^{\circ}30'$  and  $26^{\circ}45'N$ ) in the flood plain of the Brahmaputra River at the foot of the Mikir Hills south of National Highway No. 37. The area has been formed by the deep alluvial deposits of the Brahmaputra River and is flat with a east to west slope.

The general climate of the area is tropical characterised by heavy rainfall evenly distributed throughout the year. Comparatively dry months are from November to February and hottest months of the year are June to September.

The mighty Brahmaputra River flows along the northern boundary of the sanctuary, the River Mora Diflu along the southern boundary and the Rivers Diflu and Bhengra flow through the sanctuary from the east to west. Other important small streams originating in the Mikir Hills draining into the sanctuary from south to north are Borjuri, Diring, Kohora, Dehing, Bhalukjuri, Deopani, etc. There are numerous seasonal nullahs inside the sanctuary. All rivers and nullahs discharge into the Brahmaputra River. In addition to the rivers and streams the whole sanctuary is dotted with numerous beels (lakes).

The total area of the Kaziranga Sanctuary is 42,496 hectares or 429.96 sq. km. However there is constant change in the exact area of the sanctuary due to erosion and formation of new land on the northern boundary of the sanctuary by the Brahmaputra River. The present area of the sanctuary is 37,822.43 hectares only.

#### *Legal Status:*

Originally Kaziranga was formed into a reserve forest in the

year 1908 with the primary objective of preserving the rhinoceros and other wild animals. Hunting and shooting in this reserve forest has been prohibited since then. The area was declared as a game sanctuary in the year 1916 for the first time and later rechristened as a wild life sanctuary.

With the passing of the Assam National Park Act of 1968 and obtaining of the assent of the President of India on 29th April 1969, it is now proposed to convert the sanctuary into National Park under this act. Preliminary notifications in this regard has already been published vide notification No. FOR|WL|722|45, dt. 23-9-1969 and other necessary formalities have been completed.

It is expected that the final notification declaring the sanctuary as a National Park will be published shortly.

No rights and privileges are exercised in the sanctuary for any forest produce or right of way etc. There is no exploitation of any forest produce in the sanctuary.

Grazing inside the sanctuary is allowed to a limited extent near Arimora, Bhawani and Kaziranga to some professional graziers. But grazing will be completely eliminated as soon as the sanctuary is declared as a National Park.

#### *Biotic and Edaphic factors:*

**Fire:** Every year the grasses are burnt by the wild life staff of the sanctuary from December to February. Accidental fire is also not uncommon. However burning is never complete all over the area. Burning is done with a view to encourage new growth of grasses as well as to facilitate patrolling. It has been observed that new and tender shoots of grasses come up immediately after the burning as soon as the area gets a winter shower. Animals concentrate in such burnt patches for the ash. The rhinoceros and the elephants relish the partially burnt stems of tall grasses like *Arundo donax*, *Phragmites karka*, *Erianthus* spp. etc.

The frequency of sighting of animals in the unburnt areas is minimal. In areas not burnt every year the grasses grow into a tall thick mass that animals passing through have to tunnel through it. No other grasses grow under such thick masses of tall grass and hence such areas are not used by animals for grazing. The tall grasses grow to such heights that no other animal except the elephant can reach the shoots.

The practice of burning the grasslands have been continued for the last so many years without affecting the nature of the vegetational growth and it appears that fire is one of the essential factors in maintaining the grasslands in its present state. Fire hardy tree species try

to colonise the grasslands every year by profuse natural regeneration along the existing tree patches. But this process is arrested by the annual fires of the grasslands.

No burning takes place in the evergreen tree forests and such areas along with the unburnt patches of grasslands provide shelter for the animals.

**Flood:** Like fire, flood is also an annual feature of the sanctuary. During rainy season the numerous rivers and streams passing through the sanctuary flood the entire sanctuary. During high floods the water of the Brahmaputra River also enters the sanctuary and the entire area is submerged leaving only a few high ground above water. The flood water maintains its highest level from 5 to 10 days. During this period the animals concentrate and take shelter on the roads and high grounds in the sanctuary.

A large number of animals migrate from the sanctuary to the nearby Mikir Hills after crossing the National highway. The deer population suffers extensively during high floods. The rhinos and buffaloes are not much affected.

High floods submerging the whole sanctuary and the highlands inside it and depriving the animals of fodder and shelter is definitely detrimental to the wild animals which are forced to seek shelter in the hills outside the sanctuary exposing themselves to the danger of predation by man. During such high floods herds of deer are found resting at night on the highway. Sighting of elephants, buffaloes, rhinos and pigs crossing over to the hills are also not rare.

The receding flood waters wash away the water hyacinth from the beels, streams and nullahs which grows into thick impenetrable mass depriving ducks etc. of foraging grounds. The flood waters replenish the beels and nullahs. The flood waters recede slowly and it takes considerable time for the low lying areas to dry maintaining the swampy nature which helps to arrest species succession. The flood waters add to the fertility of the soil with fresh alluvial deposits which in turn support a rich growth of fresh green grasses throughout the year.

With the flooding of the beels the numerous fishes living in them come out to lay eggs in the current of the flood water. The fishes from these beels go out to the Brahmaputra River along with the receding flood water. Thus Kaziranga serves as a breeding ground for fishes and for replenishing the fish stock of the Brahmaputra River.

The flooding of the sanctuary has been a recurring feature for the last so many years that it is difficult to think of Kaziranga without flood. Fire and flood are considered to be two essential agents for maintaining the present vegetational stage. Floods of lower intensity are beneficial to the wild life and the sanctuary in general. But high

floods submerging the entire sanctuary is definitely injurious as animals are lost during such floods. However high floods do not occur annually.

**Erosion:** Erosion is one of the major factors playing a vital role in the future of the sanctuary. Every year large chunks of land from the northern boundary of the sanctuary are washed away by the Brahmaputra River. New river islands are also formed near the sanctuary.

But due to legal complications such islands cannot be added into the sanctuary prior to completion of many formalities. Other new areas formed by silt deposition adjoining the sanctuary takes time to stabilise and support vegetational growth. The seriousness of the damage done by erosion can be gauged from the fact that the present area of the sanctuary is 37,822.43 hectares against the original area of 42,496 hectares.

The areas of severe erosion go on changing according to the change in course of the Brahmaputra River. At present the worst affected area is in the western part of the sanctuary in Baguri block near Kawaimari.

**Water Hyacinth:** Water hyacinth has invaded almost all the rivers and beels of the sanctuary. The rapid growth and excessive spreading capacity of this weed has covered up many beels of the sanctuary depriving the migratory and resident water-birds of the sanctuary of their feeding grounds. The dry mass of water hyacinth lying on the banks of the beels after the drying up of the water is so thick during winter that it does not allow any grass to grow under it. However during high flood the bulk of the water hyacinth is washed out to the Brahmaputra River by the receding flood water.

**Mikania:** Recently this climber has been observed to be spreading in many areas of the sanctuary. Though it has not created any problem until now it is a weed to be observed and controlled.

**Disease:** The wild animals of the sanctuary have not been affected by any serious epidemic disease during recent years. In 1944 and 1947 heavy casualties were reported amongst the rhino population due to Anthrax and another unidentified disease. As the sanctuary is within easy reach of the village cattle of the surrounding population the danger of epidemic spreading to the wild animals is always present. As such preventive measures against epidemic diseases are taken by inoculating the cattle population of the surrounding villages.

**Poaching:** Poaching has been almost eliminated from the sanctuary. The measures taken against poaching have become so strict and severe that no one thinks of taking the risk for shooting deer and such other animals. Poaching is confined to rhinoceros only. This problem will have to be faced for an indefinite period due to the

high value attached to the rhinoceros' horn. In Government auction market the horn fetches a price of Rs. 10,000 per kilogram. However the poaching of rhinoceros has also been brought almost under control. The incidence of rhino poaching can be judged from the following figures:—

Year	No. of rhinos killed by poachers
1965	18
1966	5
1967	12
1968	10
1969	8
1970	2
1971	8

Some animals get killed during high flood when they migrate from the sanctuary and take shelter in the surrounding villages. But such incidents are inevitable. Occasional cases of illegal fishing inside the beels of the sanctuary in the vicinity of the villages are detected.

#### **Other human interference:**

The sanctuary is free from all other human interference as there is no exploitation. No one is allowed to enter the sanctuary except visitors accompanied by wild life staff. The only human interference is by way of patrolling and cutting of roads and paths by labourers under supervision of the wild life staff during winter.

Regular traffic of visitors on elephant back to the Mihimukh centre near the Tourist Lodge has so conditioned animals in the area that one can approach as near as 2 metres of a rhino, drive close to swamp deer and hog deer without disturbing them in any way and approach to within 3 to 4 metres of a herd of buffaloes. The rest of the sanctuary is an undisturbed wilderness.

#### *The Habitat:*

The entire area of the sanctuary is covered by extensive grasslands interspersed with evergreen tree forests and numerous beels. The number of such beels are more towards the western part of the sanctuary (i.e. Baguri block). The following table gives the areas under grassland, tree forests and beels (water) in different blocks.

Name of block	Forest areas in acres	Grassy areas in acres	Water areas in acres	Total area of the block in acres
Baguri	3,969.98	11,429.24	1,601.02	17,000.24
Haldhibari	1,111.80	8,146.66	551.26	9,809.72
Kaziranga	2,047.02	8,652.42	346.86	11,046.30
Panbari	2,071.00	8,155.38	593.16	10,819.54
Tamulipathar	3,211.14	6,271.86	436.00	9,919.00
Boralimora	3,464.02	4,549.66	444.72	8,458.40
Charighoria	5,909.98	6,110.54	316.34	12,336.86
Bhawani	4,379.62	8,921.18	929.04	14,229.84
<i>Total:</i>	<u>26,164.56</u>	<u>62,236.94</u>	<u>5,218.40</u>	<u>93,619.90</u>

27.95 per cent of the total area of the sanctuary is covered by tree forests 66.47 per cent by grasslands and 5.58 per cent by the beels. The percentage of tree forests is more towards the eastern part of the sanctuary than on the western part. Champion and Seth (1968)<sup>1</sup> have described the forest type as eastern wet alluvial grasslands (4D/252) which is an early arrested stage of a primary sere.

#### Tree forests:

The tree forests occupy the comparatively higher grounds along the bank of the streams and nullahs. The newly colonised areas along the bank of the Brahmaputra River consist mostly of scattered and sparse growth of semul and koroi. Evergreen trees predominate in the stable high grounds with scattered cane breaks. The undergrowth is very dense and the forests are almost impenetrable. Grasses are completely absent from the ground. On the other hand the undergrowth in the open forests of semul and koroi consists mainly of grasses.

Profuse regeneration of fire hardy species occurs in the periphery of the tree forests trying to colonise the grasslands. But the annual fire and flood prevents such colonisation by tree species and maintains the status of the habitat.

The main species found are *Salmalia malabarica*, *Albizzia procera*, *A. lebbek*, *A. stipulata*, *A. odoratissima*, *A. lucida*, *Careya arborea*, *Premna latifolia*, *P. bengalensis*, *Lagerstroemia parviflora*, *L. flosreginae*, *Trewia nudiflora*, *Tetramalis nudiflora*, *Stereospermum chelonoides*, *Alstonia scholaris*, *Spondias mangifera*, *Vitex peduncularis*, *V.*

<sup>1</sup> CHAMPION, H. G. & SETH, S. K. (1968): A revised survey of the Forest types of India. Manager of Publication. Delhi. 404 p.

*trifolia*, *Dysoxylum procerum*, *Eugenia jambolana*, *E. operculatum*, *Ehretia acuminata*, *Chukrasia tabularis*, *Ficus cuneata*, *F. glomerata*, *F. religiosa*, *F. bengalensis*, *Bischofia javanica*, *Dillenia indica*, *Pterospermum acerifolium*, *Cedrella toona*, *Anthocephalus kadamba*, *Bridelia retusa*, *Kydia calycina*, *Sterculia villosa*, *Crataeva religiosa*, *Terminalia bellerica*, *Listea polyantha*, *Sterculia alata*, *Artocarpus chaplasha*, *Mallotus philippensis*, *Oroxylum indicum*, *Salix tetrasperma*, *Talauma hodgsoni*, *Wrightia tomentosa*, *Holarrhena antidysenterica*, *Barringtonia acutangula*, *Aesculus punduana*, *Schima wallichii*, *Emblica officinalis*, *Zizyphus jujuba*, *Gmelina arborea*, *Bauhinia* spp., *Cassia fistula*, *Randia dumetorum*, *Erythrina indica*, *Zanthoxylum budrunga*, etc.

The main species forming the undergrowth are *Polyalthia jenkinsii*, *Laportea crenulata*, *Phlogacanthus curriflorus*, *Melastoma* spp., *Alpinia allughas*, *Clinogyne dichotoma*, *Calamus* spp., *Rauwolfia serpentina*, *Solanum ferox*, *Solanum indicum*, *Xanthium strumarium*, *Ageratum conyzoides*, *Eupatorium odoratum*, *Mimosa pudica*, *Tamarix dioica*, *Amaranthus spinosus*, *Flemingia chappar*, *Chenopodium album*, *Clerodendron infortunatum*, *Colocasia esculenta*, *Aeschynomene indica*, *Cassia tora*, *Polygonum* spp. etc.

The main species of climbers are *Vitis latifolia*, *Paederia foetida*, *Ichnocarpus frutescens*, *Cardiospermum halicacabum*, *Mikania* spp., *Trichosanthes dioica*, *Smilax vaginata*, *Mucuna pruriens* etc.

**Grasslands:** Almost two-thirds of the sanctuary is covered by grasslands consisting of both grasses and reeds. The reeds grow up to a height of fifteen to twenty feet during the rainy season. The main species of grasses and reeds are *Saccharum* spp., *Imperata cylindrica*, *Erianthus* spp., *Arundo donax*, *Phragmites karka*. Although these grasses grow side by side the various species have site preferences depending upon the moisture conditions of the soil.

The newly formed riverain areas along the Brahmaputra River are mostly covered by *Saccharum spontaneum*, *Imperata cylindrica*, *Erianthus filifolius* etc.

*Erianthus ravaneae* (Ekra) is the most common and widely distributed species in the sanctuary. It prefers the areas which get flooded during the rainy season and remain dry during the winter season. Mixed with Ekra, Borota kher (*Saccharum elephantinus*), Ulnkher (*Imperata cylindrica*) and Hankher (*Pollinia ciliata*) are also found. But the later three species prefer slightly drier soils.

*Phragmites karka* (Khagori) and Meghela (*Saccharum arundinaceum*) are found in low lying damp areas. On the other hand *Arundo donax* (Nal) is found in the water-logged and marshy places.

The low grasses which are the favourite fodder grasses are found along the open areas around the beels which remain under water dur-



ing monsoon but dry up during winter. These grasses are *Cynodon dactylon*, *Chrysopogon aciculatus*, *Andropogon* spp., *Cenchrus ciliaris*.

In the beels some floating and creeping species are found in the water. These are Dalgrass (*Andropogon* spp.), Erali (*Andropogon* spp.), Kalmou (*Ipomoea reptans*), Helonchi (*Enhydra fluctuans*), Borpuni (*Pistia stratiotes*), Harupuni (*Lemna panicostata*), Meteka (*Eichhornia* spp.), water hyacinth etc.

**Water areas:** About 5.58 per cent of the total area of the sanctuary is covered by the beels and streams during the dry months. The area under water is much more during the flood season. This 5.58 per cent represents the area permanently covered by water surfaces. In addition to some grasses these beels teem with fishes of different kinds and sizes providing food for birds and other fish eating animals like otters etc.

### CENSUS

The extent of area to be covered, the nature of the terrain and the thick and tall cover of the grasses presented a problem for determining a suitable method of census. Added to these difficulties was the problem of lack of means to traverse the sanctuary except on elephant back. Moreover from experience it was known that preferred habitat of the animals were not evenly distributed all over the sanctuary. As such most of the known methods of taking a sample count had to be discarded. Hence it was decided to take a total count of the animals by dividing the sanctuary into small compartments as was done in 1966.

The whole sanctuary was divided into eight blocks namely Baguri, Haldhibari, Kaziranga, Panbari, Tamulipathar, Boralimora, Charighoria and Bhawani with the help of natural boundaries like rivers, roads and paths etc. The boundary of the blocks and its sizes were kept the same as that of 1966. This was done for the sake of comparability of figures blockwise.

Each of these blocks was subdivided into a number of compartments of 2,000 to 3,000 acres each keeping in view the nature of terrain, density of grass cover, concentration of animals etc. The division of the sanctuary into number of compartments was limited by the number of riding elephants available. With the help of 16 elephants belonging to the sanctuary we could take only 16 compartments for carrying out the census on a single day. Hired elephants were not easily available. However we managed to get four hired elephants. As such the whole sanctuary was divided into 40 compartments with a view to complete the census operation in two days taking 20 compartments on each day. But due to difficulties of moving elephants

from one place to another Baguri compartment number I and III had to be combined as one compartment for taking the census. Thus the total number of compartments became 39.

Considering the large concentration of animals the Baguri block was divided into 10 compartments of smaller sizes. On the other hand the compartments of the Bhawani block which consist of short open grasslands due to the presence of graziers and where there is less concentration of animals were slightly bigger than the average compartment.

For the purpose of completing the census in two days the Diflu River was taken as the dividing line. This river flows through the sanctuary from east to west dividing it into two almost equal halves. The river is quite deep with well defined high banks. The chances of animals crossing over from one side of the river to the other during the night was very little. Except for elephants other animals were not expected to cross the river in large numbers so as to affect the results of the census.

It was also assumed that the two way crossings of animals would neutralize the overall effect of the situation. With this view in mind the compartments falling on the southern side of the Diflu River were censused on the 1st day and the compartments falling on the northern side of the river were censused on the 2nd day. There were 21 compartments on the southern side and 18 compartments on the northern side.

The grasslands of the whole sanctuary was then burnt repeatedly and in areas where there were no natural boundaries artificial compartment boundaries of 10 feet width were cut and burnt. But due to intermittent rains, burning was not very successful and thorough all over the sanctuary.

After completion of the field preparations an accurate map of the sanctuary was prepared in  $1\frac{1}{2}'' = 1$  mile scale showing the blocks and compartment boundaries, beels, grasslands, tree forests, roads and paths etc. On this map the points from where counting was to be started and the point where counting was to be finished was plotted. The direction of traverse in the various compartments was also plotted keeping in view of the nature of the terrain, grass or tree cover, beels, known points of animal concentration etc. Altogether 39 maps were prepared for use in the 39 compartments.

39 census parties were formed, each party consisting of an enumerator as the incharge, one helper, one guide and a mahout with the elephant. The duty of the enumerator was to count the animals and record the figures as well as to plot the approximate location of the animals and the direction of the line of traverse on the map. The duty of the guide was to see that the census parties remained within the

boundary of their respective compartments. The helper assisted the guide and enumerator in locating the animals. The mahout was engaged in driving the elephants as well as in locating the animals.

The guides and the helpers were selected from the local staff and were posted in their own jurisdiction and therefore had intimate knowledge of the area including the location of favourite grounds of the animals, isolated water holes, wallows, nullahs etc.

In addition to the census parties some patrol parties of three to four persons were formed. They were assigned selected boundaries of blocks and compartments to observe and record the movement of animals from one compartment to other noting the time and approximate place of crossing. However such parties were few and could cover only a negligible portion of some prominent boundaries like roads.

Each census party was assigned one compartment to census. The enumerator was supplied with a copy of the map of Kaziranga Wild Life Sanctuary with the compartment allotted to him prominently demarcated and showing the direction of traverse. Two copies of enumeration forms one for the forenoon and one for the afternoon, a clip board and an appointment letter containing instructions regarding the census operation were also given to the enumerator.

Fifteen species of mammals were listed in the counting sheets. Columns were provided against each species for classifying the animals into two age classes of old and young and for sex differentiation into male and female. A column for recording mother with calf and another column for entering the number of animals as "non sexed" were provided. A remark column was provided for recording interesting behaviour observations or for sightings of animals not listed in the form.

The enumerators were instructed to follow the direction of the traverse as far as practicable depending on field situations. While proceeding along the traverse on the elephants they were to record the number of different kinds of animals sighted. They were instructed not to approach too close to an animal so as to provoke it or frighten it into cover.

Mothers accompanied by calf of one year old or less were to be recorded under the column of mother with calf. Since it might not be possible for the enumerator to know the approximate age of the calf they were instructed that a calf of approximately 2' to 2'6" should be considered as one year old.

The guides, helpers and mahouts were trained and tested prior to the commencement of census operation. The enumerators were also trained and given instructions regarding the method of census, procedure to be followed in filling up the forms, different kinds of animals

and their general behaviour etc.

*Operation:*

The census operation was carried out on 24th and 25th March, 1972 in two shifts on each day i.e. from 5.30 a.m. to 10 a.m. in the first shift and 2 p.m. to 5.30 p.m. in the second shift. The elephants along with the mahout, and grass cutters, the guides and the helpers took up positions at their respective starting point of the assigned compartments on the evening of 23rd March. The enumerators were dropped at the starting points by jeep on 24th morning. In places where the jeep could not go the enumerators camped at the starting points on 23rd evening.

The census parties started counting of animals punctually at 5.30 a.m. of 24th March, 1972 setting off from their respective starting point simultaneously in 21 compartments on the southern side of the Diflu River. After completion of the first day's work the enumerators, guides and helpers who were not assigned for duties next day were brought to the camp. The elephants were dispatched to camp at the starting points of next days' compartments on the northern side of the Diflu River. The enumerators, guides and helpers for the count on 25th took up position at their respective starting points on the evening of 24th. Some enumerators were dropped at their respective starting points by jeep on 25th morning. Counting of the animals in the 18 compartments north of the Diflu River also started simultaneously on the 25th at 5.30 a.m. After completion of the day's work some of the enumerators, helpers and guides were picked up by jeep but census parties in areas where the jeep could not go returned to the Range Head Quarters with their elephants the next day, 26th March, 1972.

Most of the rhinos, buffaloes and swamp deer were sighted near and around the beels. The census parties after completion of the counting in the first shift took rest on the banks of the beels.

Since the tendency of the animals was to come to the beels for their afternoon forage the enumerators ruled out any possibility of crossing over of animals from the counted portion of the compartment to the uncounted portion during the rest period. Rhinos are not wanderers and specially during day time prefer to lie down in mud wallows inside the tall grass rather than walk over from one beel to another. The buffaloes and the swamp deer were never seen to go away from the beels which they had selected for the time being. The hog deer population was very numerous and they were encountered everywhere in the sanctuary.

The patrolling parties did not report any incident of crossing over of animals from one compartment to another.

Census parties assigned to compartments consisting mostly of grasslands reported different degrees of burning varying from 30 per cent to 80 per cent. While traversing the census parties avoided the thick patches of unburnt dry grasses. No purpose would have been served by driving the elephant through such tall grasses as the visibility is limited to the portion of the grasses trampled by the elephant and no animal generally prefers such areas excepting an occasional rhino passing through tunnels in the grass. Most of the mud wallows were also dry at this time of the year. Almost all traverses were taken along the burnt patches and open beels and most of the animals were sighted in such areas only. Thus although the area covered during the census was approximately 60 per cent to 70 per cent almost all the animals were covered by the count.

In the compartments consisting mainly of evergreen tree forests the census parties could traverse only areas in which the undergrowth was not very thick. In certain compartments the undergrowth was so thick that many such areas were impenetrable. The heavy cane growth in such forests presented another difficulty. These forests held sambar, barking deer, bear, langur, elephant, tiger etc. There were a number of rhinos also near the beels. Only approximately 40 per cent to 50 per cent of such animals living in them were counted.

#### *Effectiveness of the census Method:*

The method of census employed for counting the animals gave us figures of only the total minimum population of the species inhabiting the area actually covered during census. Since visual counting of animals in dense forests is difficult the method is ineffective for counting animals in dense cover. Similarly nocturnal animals cannot be effectively counted by this method. A drawback detected while analysing the results of the census was that the counting sheets provided no columns to classify the animals into different age groups of adult and young in case of the non-sexed animals. As such the proportion of adult and young animals in the various populations could not be found out correctly.

The census parties found it difficult in the field to differentiate between the adults and the young of the species accurately. All the grown up looking animals including the old ones were classified as adults. There was no difficulty in classifying the comparatively younger looking animals. All the rhinos with undeveloped horns and having smaller horns were classified as young. The confusion was so great in case of other animals that the census parties did not try to classify the age groups at all. This is again due to lack of experience of the census parties and our failure to give them adequate instructions

and a criterion to differentiate the age group of the different species.

Similarly the census parties found it difficult to identify the sex of the animals accurately. In case of rhinos it was much more difficult as the males and females of the species look alike. But as the main emphasis during the census was given to the rhinos the enumerators tried their best to identify the sex of the rhinos. The experienced staff of the sanctuary and the mahouts claim to be able to identify the sex of the rhinos on the basis of size and the shape of the horn and the neck. Some of them were tested from time to time and their identification of sex were found to be fairly accurate. Sometimes the enumerators consulted the guide, helper and the mahout in identifying the sex.

In case of elephants also the same confusion was present. Moreover as the elephants are met in large herds and it was difficult to make a close approach the idea of identifying the sex of the elephants was given up. It was easy to identify the sex of the buffaloes. But the problem was that on closer approach the buffaloes ran for cover. So also was the case with the deer species, the antlers of most of them being in velvet at that time. The number of hog deer were found so numerous running from one cover to the other that the census parties gave up their effort to identify their sex. A great deal of difficulty in this respect could have been overcome if the census parties could have been provided with field glasses.

As a result of these difficulties the age and sex composition of the animals except that of the rhinos could not be collected from the census operation. The census has thus partially failed to achieve the desired objectives. The age and sex composition of a population indicates the status of the species in a given locality. A population well represented by young is a viable and dynamic population where as proportionately higher number of adults with very few young represents a static and senile population.

Thus the result obtained from this census has given us only the basic information regarding the size of the population of various species without throwing any light on the factors governing population dynamics. However the figures have given us enough data for planning the future management of the sanctuary.

#### *Check census:*

After completion of the census operation on the 24, 25 March, 1972 it was proposed to check the data collected by repeating the operation in Baguri block on 8 April, 1972.

The reason for selecting the Baguri block for this purpose was the fact that this block had the highest concentration of animals. But

due to heavy and continuous rain this could not be done on the appointed day.

Due to various difficulties it was later on decided to carry out the check census at least in one compartment of each block selected at random. This was carried out on June, 1972 in three compartments of the Baguri block and one compartment in each of the remaining blocks.

The grasses had shot up by this time and probably the animals had also changed their places of grazing. Though there was appreciable difference in time, weather, temperature, vegetational cover etc. between the original census and the check census the figures obtained for the different compartments do not show any appreciable variation in the number of the various species, suggesting that the earlier figures are reliable.

#### *Population Estimates:*

With a view to present the figures of the census conveniently in round figures to visitors the estimated total population of each species has been shown. These estimates are based on local experience and knowledge.

### RESULTS

The census figures have revealed an overall increase of population of all species of animals. Only in case of sambar the number of animals sighted during this year is slightly less than the number sighted during 1966. This is due to the fact that the compartments consisting of dense forests could not be thoroughly covered. The number of different species of animals counted in the various compartments and blocks are given in Table 1.

A comparative statement showing the figures of 1966 census and that of the 1972 census along with the total estimated population is given in Table 2. It would not be correct to attribute the increase or decrease of the animals sighted during this year entirely due to increase or decrease of population over the period of six years. The increase is probably due to more intensive coverage of the area during this year's census in addition to the natural increase of population. Similarly the decreased number of sighting of sambar during this year is due to the fact that its habitat was not as intensively covered as in 1966. The fall does not represent a decrease of population for the reason that the method of census employed does not provide us a comparable base of the total population of the area. Specially be-

TABLE I  
COMPARTMENTWISE FIGURES OF WILD ANIMALS IN THE KAZIRANGA WILD LIFE SANCTUARY DURING MARCH 1972.

Name of Block	Compartment No.	Rhino	Elephant	Buffalo	Tiger	Swamp Deer	Sambar	Barking Deer	Hog Deer	Bear	Gaur	Leopard	Pig	Capped Langur	Otter	Assam Rhesus	Monitor Lizard	Python	Water monitor Lizard
Baguri I & III	35	3	15	—	—	1	—	2	175	2	—	—	33	—	—	—	—	—	—
	29	—	54	—	—	—	—	2	312	—	—	—	85	25	—	—	—	—	—
	55	—	49	—	—	—	—	—	95	—	—	—	12	—	—	—	—	—	—
	34	—	48	—	—	—	—	—	60	—	—	—	2	—	—	—	—	—	—
	40	—	90	—	—	47	6	—	78	—	—	—	14	—	3	—	—	—	—
	21	—	29	—	1	17	—	—	106	—	—	—	1	—	7	—	—	—	—
	11	—	6	—	—	—	15	—	35	—	—	—	16	—	10	—	—	—	—
	12	—	16	—	—	—	2	2	35	—	—	—	4	—	11	—	—	—	—
	49	1	9	—	—	—	—	—	109	1	—	—	18	—	5	—	—	—	—
	23	9	2	—	—	58	—	—	182	—	—	—	11	—	10	—	—	—	—
Total:		309	13	318	1	123	23	6	1,187	3	—	—	196	25	46	—	—	—	—



TABLE 1 (contd.)  
 COMPARTMENTWISE FIGURES OF WILD ANIMALS IN THE KAZIRANGA WILD LIFE SANCTUARY DURING MARCH 1972.

Name of Block	Compartment No.	Rhino	Elephant	Buffalo	Tiger	Swamp Deer	Sambar	Barking Deer	Hog Deer	Bear	Gaur	Leopard	Pig	Capped Langur	Otter	Assam Rhesus	Monitor Lizard	Python	Water monitor Lizard
Haldhibari	I	6	—	2	—	—	—	—	5	—	—	—	9	—	—	4	—	—	—
	II	18	—	45	—	14	—	—	22	—	—	—	19	—	—	—	—	—	—
	III	50	—	32	1	31	—	13	278	—	—	—	6	—	—	2	—	—	—
	IV	32	—	35	1	9	14	3	350	—	—	—	67	—	7	—	2	—	—
Total:	106	—	114	2	54	14	16	655	—	—	—	101	—	—	7	6	2	—	—
Kaziranga	I	18	1	—	—	—	—	—	28	—	—	—	26	—	—	—	—	—	—
	II	2	—	12	—	—	—	—	9	—	—	—	7	—	—	—	—	—	—
	III	13	31	—	—	62	—	3	20	—	—	—	3	—	—	—	—	—	—
	IV	1	1	1	—	10	—	5	59	—	—	—	10	—	9	—	—	—	—
Total:	34	33	13	—	72	—	8	116	—	—	—	46	—	—	9	—	—	—	—

TABLE 1 (contd.)  
 COMPARTMENTWISE FIGURES OF WILD ANIMALS IN THE KAZIRANGA WILD LIFE SANCTUARY DURING MARCH 1972.

Name of Block	Compartment No.	Rhino	Elephant	Buffalo	Tiger	Swamp Deer	Sambar	Barking Deer	Hog Deer	Bear	Gaur	Leopard	Pig	Capped Langur	Otter	Assam Rhesus	Monitor Lizard	Python	Water monitor Lizard
Panbari	I	19	5	28	2	66	7	2	448	2	—	1	9	—	—	—	—	—	—
	II	25	1	8	—	10	—	1	310	—	—	—	34	—	—	—	—	2	—
	III	9	3	—	—	35	13	—	67	—	—	—	4	—	—	—	—	—	—
	IV	3	1	—	—	—	—	—	5	—	—	—	2	—	—	—	—	—	—
	V	8	15	—	—	—	1	4	52	—	—	—	3	—	—	—	—	—	—
Total:	64	25	36	2	111	21	7	882	2	—	—	1	52	—	—	—	—	2	—
Tamulipathar	I	5	19	1	—	9	—	—	81	—	—	—	9	—	—	—	—	—	—
	II	4	23	14	—	—	—	—	22	—	—	—	—	—	—	—	—	—	—
	III	7	95	—	—	—	1	15	50	—	—	—	7	—	—	—	—	—	—
Total:	16	137	15	—	9	1	15	153	—	—	—	16	—	—	—	—	—	—	—

TABLE 1 (contd.)  
 COMPARTMENTWISE FIGURES OF WILD ANIMALS IN THE KAZIRANGA WILD LIFE SANCTUARY DURING MARCH 1972.

Name of Block	Compartment No.	Rhino	Elephant	Buffalo	Tiger	Swamp Deer	Sambar	Barking Deer	Hog Deer	Bear	Gaur	Leopard	Pig	Capped Langur	Otter	Assam Rhesus	Monitor Lizard	Python	Water monitor Lizard	
Boralimora	I	6	6	28	2	—	11	—	44	—	—	—	23	—	20	—	—	—	—	—
	II	2	—	—	—	—	3	—	37	—	—	—	—	—	—	—	—	—	—	—
	III	1	1	—	—	—	—	—	5	—	—	—	—	—	—	—	—	—	—	—
	IV	5	2	—	—	29	5	2	—	—	12	—	3	—	—	—	—	—	—	—
Total:	14	9	28	2	29	19	2	86	—	12	—	26	—	20	—	—	—	—	—	—
Charighoria	I	12	—	—	—	15	—	—	244	—	1	—	—	—	7	—	—	—	—	—
	II	10	—	—	—	36	13	1	230	—	—	—	6	—	—	—	—	—	1	—
	III	6	162	—	—	—	3	13	40	—	—	—	3	—	—	—	—	—	—	—
	IV	22	30	13	—	—	1	—	48	1	5	—	14	—	—	—	1	—	—	1
	V	10	1	—	—	1	2	—	126	—	—	—	3	—	6	—	—	—	—	—
Total:	60	193	13	—	52	19	14	688	1	6	—	26	—	13	—	—	1	1	1	1

TABLE 1 (contd.)

COMPARTMENTWISE FIGURES OF WILD ANIMALS IN THE KAZIRANGA WILD LIFE SANCTUARY DURING MARCH 1972.

Name of Block	Compartment No.	Rhino	Elephant	Buffalo	Tiger	Swamp Deer	Sambar	Barking Deer	Hog Deer	Bear	Gaur	Leopard	Pig	Capped Langur	Otter	Assam Rhesus	Monitor Lizard	Python	Water monitor Lizard	
Bhawani	I	1	1	4	—	4	—	—	446	—	—	—	1	—	—	—	—	—	—	—
	II	7	1	3	—	—	1	—	199	—	—	—	43	—	—	—	—	—	—	—
	III	29	8	11	—	41	4	—	61	—	—	—	12	—	—	—	—	—	—	—
	IV	18	2	—	—	21	3	8	78	—	—	—	3	—	—	—	—	—	—	—
Total:	55	12	18	—	66	8	8	784	—	—	—	—	59	—	—	—	—	—	—	—
Grand Total:	658	422	555	7	516	105	76	4,551	6	18	1	522	25	95	6	3	3	3	1	1

TABLE 1 (contd.)

TABLE 2

COMPARATIVE FIGURES OF 1966 AND 1972 CENSUS AND THE ESTIMATED POPULATION

Species	Year	Baguri	Haldhibari	Kaziranga	Panbari	Tamulipathar	Boralimora	Charighoria	Bhawani	Total	Estimated Total
Rhino	1966	157	49	32	30	9	8	22	59	366	400
	1972	309	106	34	64	16	14	60	55	658	670
Elephant	1966	45	-	29	7	6	5	-	257	349	375
	1972	13	-	33	25	137	9	193	12	422	430
Wild Buffalo	1966	337	41	33	17	30	-	17	6	471	550
	1972	318	114	13	36	15	28	13	18	555	600
Gaur	1966	-	-	-	-	-	-	1	-	1	20
	1972	-	-	-	-	-	12	6	-	18	18
Swamp Deer	1966	72	25	16	19	-	11	19	1	213	250
	1972	123	54	72	111	9	29	52	66	516	520
Sambar	1966	43	8	1	1	3	1	2	61	120	300
	1972	23	14	-	21	1	19	19	8	105	200
Hog Deer	1966	485	77	95	122	22	5	223	282	1311	4000-5000
	1972	187	655	116	882	153	86	688	784	4551	6000-6050
Barking deer	1966	12	10	-	7	-	-	-	-	29	100
	1972	6	16	8	7	15	2	14	8	76	100
Wild Pig	1966	45	29	33	18	10	10	10	-	155	500-600
	1972	196	101	46	52	16	26	26	59	522	550-650
Bear	1966	1	-	1	-	-	-	-	-	2	30
	1972	3	-	-	2	-	-	1	-	6	30
Tiger	1966	-	1	-	-	-	-	-	1	2	20
	1972	1	2	-	2	-	2	-	-	7	30
Leopard	1966	-	-	1	-	-	-	-	-	1	12
	1972	-	-	-	1	-	-	-	-	1	10
Otter	1966	7	9	-	1	-	-	8	1	26	200-300
	1972	46	7	9	-	-	20	13	-	95	200-300

TABLE 3  
COMPARATIVE FIGURES OF MAIN AND CHECK CENSUS

Name of Block	Compartment No.	Rhino						Elephant			Buffalo		Swamp deer					
		Original Census			Check Census			Original Census	Check census	Original census	Check census	Original census	Check census					
		♂	♀	Total	♂	♀	Total											
		♂	♀	Nonsexed	♂	♀	Nonsexed	Nonsexed	Total	Original Census	Check census	Original census	Check census					
Baguri	IV	15	13	6	15	55	20	—	15	—	50	—	—	49	63	—	—	10
"	VII	8	8	—	5	21	8	7	1	1	18	—	—	29	47	17	—	—
"	XI	9	4	5	—	23	13	7	—	—	20	9	—	2	27	58	—	—
Haldhibari	III	13	12	2	21	50	25	18	8	—	59	—	—	32	36	31	—	56
Kaziranga	II	1	—	—	1	2	10	15	4	—	33	—	—	12	15	—	—	32
Panbari	I	8	1	3	4	19	9	8	2	—	21	5	—	28	—	66	—	44
Tamulipathar	II	2	—	1	—	4	1	—	—	—	1	23	—	14	7	—	—	—
Boralimora	I	3	3	—	—	6	1	1	—	—	2	6	—	28	1	11	—	—
Charighoria	III	1	1	1	2	6	10	1	3	—	17	162	—	—	—	3	—	—
Bhawani	IV	6	4	4	—	18	3	2	1	1	8	2	—	—	4	21	—	25
Total:		66	46	22	48	204	100	59	34	2	229	207	82	194	200	207	167	167

cause of the wide gap of six years between the two census operations. As such probably it would not be wise to draw any conclusion from these comparisons. Perhaps intensive repeated annual counts of the total minimum population or repeated annual sample counts over a considerable period may provide us comparable data to enable us to derive some conclusion regarding the factors governing the population.

In Table 3 the comparative figures of this years' census and that of the check census carried out later in the month of June are given. There was no difference between these two censuses as regards level of efficiency, intensity of area covered etc. except the interval of time, change of weather and vegetation. The number of rhinos counted during the check census was 12.2 per cent more than the original census. In case of elephants it was 60.4 per cent less, in case of buffaloes it was 3.1 per cent more and in case of swamp deer it was 19.3 per cent less. The large variation in case of elephants can be easily understood from the fact that they are great wanderers and are constantly on the move while grazing. The check census show that the figures obtained during the main census operation are authentic as the variation in case of other animals is insignificant.

#### *Analysis of census data:*

##### 1. **Rhinoceros**

A total of 658 rhinos were counted during the census operation. Out of these 203 were classified as adult males, 121 as adult females, 44 as young males, 37 as young females, 119 as non sexed and 67 mothers with calves. These 67 mothers have not been included in the number of 121 adult females. The figures for rhinos are given in Table 4.

TABLE 4

Name of Block	Adult		Young		Nonsexed	Mother with calf	Total
	♂	♀	♂	♀			
Baguri	98	51	17	19	54	35	309
Haldhibari	30	23	3	5	31	7	106
Kaziranga	14	4	9	—	1	3	34
Tamulipatnar	5	3	—	1	3	2	16
Panbari	19	7	5	3	16	7	64
Boralimora	6	3	—	—	3	1	14
Charighoria	13	11	5	6	11	7	60
Bhawani	18	19	5	3	—	5	55
<b>Total:</b>	<b>203</b>	<b>121</b>	<b>44</b>	<b>37</b>	<b>119</b>	<b>67</b>	<b>658</b>

The confusion in determining the sex of the rhinos occurred mostly in case of the young ones where the horn was not properly developed. As such most of the nonsexed animals may be considered to be young ones. On this assumption the age composition of the population will be 59.4 per cent adult, 30.4 per cent young and 10.2 per cent calves less than one year old. As stated earlier only comparatively younger looking animals were classified as young. Considering the fact that the rhinos live up to an approximate average age of 40 years probably many young animals were included in the adult group.

Out of the total count of 658 rhinos 472 were classified into males and females. Of the entire adult population of 391 rhinos, 203 are classified as males and 188 as females (including the 67 mothers). The sex ratio in the adult population thus works out to 100 males for 92 females.

In case of 81 young rhinos of whose sex was identified 44 have been recorded as males against 37 females. The sex ratio in the young population thus works out to 100 males for 84 females.

In the check census out of a total count of 229 rhinos 100 were classified as males, 93 as females, 34 calves and 2 were nonsexed. Here also the sex ratio comes out to 100 males for 93 females. Thus we can roughly estimate that the males and females in a population are equally distributed with the sex ratio of one is to one.

But considering the fact that an adult female rhino gives birth to a calf after every three to four years after a gestation period of 16 to 18 months it is apparent that in any particular time of the year there will be a group of pregnant adult females, females with less than one year old calf and females with 2 year old calf who will not go into heat and will not accept the services of any male. Hence the sex ratio of one is to one appears to be unlikely. Probably the disparity in the sex ratio can be explained to some extent by the fact that for successful mating of rhinos the heat period of both the male and the female must coincide.

In a population of 658 rhinos there were 67 adult females with calves less than one year old. That is 10.2 per cent of the total population were calves less than one year old representing the annual rate of calving. Again out of 188 adult females 67 were with calves. That is 35.6 per cent of the total adult female population were accompanied by calves.

It is not difficult to differentiate between one year old and two year old calves in the field. Yet possibility of error in some marginal cases cannot be ruled out. The calves generally accompany the mother up to 3 years and in some cases till the next calf is born. But the behaviour of a very young calf and its mother and that of a grown up calf and its mother are quite different and can be easily distinguished.



The following table gives us the record of death of rhinos in Kaziranga Wild Life Sanctuary over a period of seven years.

TABLE 5

Year	Natural death				Killed by poachers				Killed by tigers				Total
	Adult		Young		Adult		Young		Adult		Young		
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	
1965	10	9	-	-	14	4	-	-	-	-	4	2	43
1966	4	5	-	-	2	3	-	-	-	-	1	1	16
1967	10	13	-	-	6	4	1	1	-	-	2	2	39
1968	5	7	-	-	7	3	-	-	-	-	8	3	33
1969	9	3	-	-	1	-	2	5	-	-	2	1	23
1970	12	8	-	-	2	-	-	-	-	-	4	2	28
1971	8	5	-	-	4	2	1	1	-	-	6	1	28
Total:	58	50	-	-	36	16	4	7	-	-	27	12	210

From the figures for the last seven years the average mortality of rhinos is 30 annually which is 4.6 per cent of the total rhinos counted during this year. On the basis of these figures the annual rate of growth of rhino population in Kaziranga comes to 37 which is 5.6 per cent of the population.

From this table it appears that most of the deaths amongst young rhinos are caused by tiger. Approximately 6 young rhinos die annually due to tiger attack. The number of natural deaths amongst the adult population are due to old age and fighting. Thus in an average approximately 16 rhinos die of old age and fighting etc. The annual mortality rate is considerably affected by poaching.

Rhinos were found in all the compartments of the sanctuary. The Baguri block was found to have the maximum concentration of rhinos. As many as 309 rhinos out of a total of 658 rhinos were counted in Baguri block only. The reasons for such concentration requires detailed investigation. It is true of course that the area of the Baguri block was bigger than any other block. The following table gives the area in acres available per rhino in each of the eight blocks.

TABLE 6

Name of Block	Total Area in acres	Number of rhinos counted.	Approximate Area available per rhino in acres.
Baguri	17,000.24	309	55.0
Haldhibari	9,809.72	106	92.5
Kaziranga	11,046.30	34	324.5
Panbari	10,819.54	64	169.0
Tamulipathar	9,919.00	16	620.0
Boralimora	8,458.40	14	604.0
Charighoria	12,336.86	60	205.6
Bhawani	14,229.84	55	258.7
Total:	93,619.90	658	142.2 (Ave.)

Thus it is seen that in Baguri block there is one rhino in every 55 acres against 1 rhino in every 142.2 acres for the whole sanctuary. The nature of vegetation and availability of fodder grasses in the remaining parts of the Sanctuary have no appreciable difference with that of Baguri block. The only difference is the fact that the number of beels and the area under water in Baguri block is more than in any of the remaining blocks of the Sanctuary.

The rhinos in Baguri block as well as in the rest of the sanctuary were found in excellent health. Hence it can be safely assumed that the population of rhinos in the Sanctuary has not yet reached the saturation point. This is also indicated by the presence of vast areas of unused grasslands in the Sanctuary.

As a result of increase in population gradual diffusion of rhinos along the bank of the Brahmaputra River to the river islands and other suitable forested areas have started as a natural process. But due to the high value of the horn such animals are not safe in isolated areas where effective protection cannot be given. Till the rhinos establish themselves and build up sizable population in such areas the species cannot be considered as free from the danger of extinction. With more than half of the world's surviving population of Great Indian Onehorned Rhinoceros concentrated in one place, Kaziranga has a special and unique role to play.

### Wild Elephants :

A total of 422 elephants were counted during the census. They were mostly met in herds of varying sizes except a few solitary males. Out of the 39 compartments of the Sanctuary, elephants were met in 24. Most of them were found in the eastern part of the Sanctuary.

The elephant population of the sanctuary does not remain static throughout the year. Some of them migrate to the adjoining Mikir hills on the southern side of the boundary during the rainy season. The to and fro movement of the elephants from the Sanctuary to the Mikir hills take place generally at two different places. One is through the Panbari Reserved Forests situated midway in the southern boundary of the sanctuary across the National highway. The other is near Kanchanjuri on the western end of the sanctuary. Some elephants use the corridor through Haldhibari also.

But such migration of elephants have been greatly reduced during the recent years due to the opening up of the valley lands and the lower hills for cultivation. The tribal population of Mikir hills have started cutting and burning large areas of forests even on steep hills. As a result there are large scale depredation by elephants all along the foot hills as well as along the southern boundary of the sanctuary during the crop season. These elephants then retreat to the sanctuary when driven away. Thus a gradual decrease of habitat in the hills and widening of the gap between the sanctuary and the nearby hills by human settlement will in time force the elephants of the sanctuary to remain within it.

There is no corridor for the elephants to cross over to Mikir hills in the eastern part of the sanctuary. The presence of a large number of elephants in the eastern part of the sanctuary suggest that these elephants have probably already given up the habit of going back to the hills. The elephants are of course great wanderers and are constantly on the move while grazing and the possibility of these elephants coming to cross over through Panbari reserve cannot be ruled out.

Probably the elephant population accounts for the largest contribution to the biomass of the sanctuary. The elephant population needs to be watched carefully because of its wandering habits, the amount of food consumed and the amount of destruction it causes to the habitat. The elephant has the highest reach of any terrestrial mammal in the country. Therefore it can utilize both forested areas and the grasslands for foraging. Though elephants were met in 24 compartments only at the time of census actually they traverse almost all the compartments of the sanctuary at one time or the other.

### **Wild Buffalo**

In the sanctuary wild buffaloes are found grazing around the beels in the morning and afternoon. During day time they are found lying in the mud wallows. Except in case of solitary males they are always in herds of varying sizes. The herds generally consist of one dominant adult male, immature males and cows of all ages. The social grouping

of buffalo is quite cohesive and the most cohesive unit is the cow herd with calves. The immature males may form small sub-groups and the dominant males may wander about in the vicinity.

During the census 555 buffaloes were counted in the sanctuary. They were found in 27 compartments leaving only 12 compartments without any of them. The highest number of buffaloes were counted in the Baguri block (318 individuals).

Though it was not difficult to identify the age groups, count the calves, and identify the sex of the buffaloes the same was not done by most of the census parties due to some reason or the other. However during individual interrogation the census party reported that calves were well represented in the herds. From field observations also I have noticed that an average herd of 10 to 12 buffaloes always included 3 to 5 calves.

### **Swamp Deer**

In olden days the swamp deer was found in suitable localities throughout the basins of the Indus, Ganges and the Brahmaputra Rivers as well as in central India. But today the swamp deer exists only in a few isolated pockets. The main centres of its survival at present are in West Kheri Forest Division of U.P. and its adjoining areas in Nepal, Kanha National Park of M.P. and in scattered places of North Bengal and Assam. Schaller estimates that fewer than 5,000 swamp deer exist in the whole country.

Probably the largest number of surviving swamp deer in the eastern zone at present exist only in Kaziranga Wild Life Sanctuary. During the census 516 swamp deer were counted in the sanctuary against 213 counted during 1966. Nineteen out of the 39 compartments reported no swamp deer. The highest number was recorded in Baguri block. The largest single herd encountered during the census consisted of 58 individuals.

The swamp deer population inside the sanctuary are always found in herds grazing or lying down in the open grassland around the beels. The males were congregated in a separate subgroup in the same herd. At the time of census the antlers of the males were in velvet.

### **Sambar**

In Kaziranga the sambar is distributed only in the heavily wooded compartments. They are usually solitary animals except in case of small social groups of a hind, an yearling and a fawn. Sometimes 2 to 3 adult hinds accompanied by fawns, yearling stags etc. may be found to form bigger herds. The adult stags are solitary except in the

rutting season.

During the census 105 sambar were sighted against 120 sighted during 1966. Out of total 39 compartments 21 compartments reported no sambar. As stated earlier the forested compartments of the sanctuary could not be covered intensively due to the presence of thick undergrowth and cane brakes. This explains the low figure of sighting of these animals. There is no apparent reason to suspect that there is any decline in the population of sambar in the sanctuary.

### **Hog Deer**

Hog deer tops the list in numerical density among all other animals of the sanctuary. They were scattered everywhere in the sanctuary and were too numerous to be counted accurately. Though usually they do not form cohesive herds sometimes groups of hog deer consisting of 50 to 60 individuals were found together, sometimes in smaller groups of 3 to 5 individuals and sometimes solitary males or females with a fawn or an yearling were also found. At the time of census some stags had hard antlers and some were in velvet.

During the census 4,551 hog deer were counted. It was difficult to see them when they were under grass cover or when they rushed into such cover at the sight or sound of the riding elephants. Only one compartment reported no hog deer. It is certain that quite a good number of them were missed.

Judging from their excellent condition and the presence of fawns and yearlings in the groups observed during field investigation probably it can be safely concluded that the population has not yet reached its peak in the Sanctuary.

### **Barking Deer**

The barking deer or the muntjac also prefers the same habitat as that of the sambar. Due to their small size and the forested habitat it was difficult to locate and count them accurately. Only 76 barking deer were counted during the census in 15 out of 39 compartments.

### **Wild Boar**

The wild boar was common in many parts of the sanctuary. They are commonly sighted around the beels as well as in the heavily forested areas. They seem to avoid the tall reed grasses. Except in case of solitary males they are found in family groups of 4 to 6 individuals. Their shy nature and relatively small size make it difficult to locate and count them accurately.

During the census 522 pigs were counted against 155 counted during 1966. Pigs were sighted in 35 out of 39 compartments of the

sanctuary. This distribution itself suggested that probably only a small portion of their total population could be counted during the census.

### **Gaur**

Three census parties reported sighting of the gaur on the second day of the census. No gaur was sighted by any of our sanctuary staff during the last four years. The gaur are actually not residents of the sanctuary. They come to the sanctuary from the Mikir hills during winter when large scale felling and burning for jhum cultivation takes place in the hills. It was thought that due to gradual opening up of the forests in the foothills and widening of the gap between the Sanctuary and the hills by human settlement the gaur have gone to the interior hills never to visit the sanctuary again. However judging from the point of location of these animals it appears that the gaur sighted during the census are permanent residents of the sanctuary.

Altogether 18 gaur were sighted in Boralimora and Charighoria blocks. One was a solitary male in one compartment, 5 in a herd in one compartment and a herd of 12 in another compartment.

### **Tiger**

Seven tigers were sighted by the census parties. But it is apparent that this method of census cannot be employed to count an animal like tiger which is nocturnal in its habits and is extremely alert and shy. However the sighting of as many as 7 tigers is quite significant and is an indication of its relative numerical strength in the Sanctuary.

A separate census for counting the tigers in Kaziranga along with the rest of the state and the country was conducted from 22nd April to 28th April 1972 by Chowdhury's "Tiger tracer" method. The total number of tigers counted by this method in the sanctuary was 29. Out of these 29 tigers 9 were male, 13 female and 7 cubs. During the period of this census there was very heavy rains in this area submerging most of the low lying areas around the beels. As a result the census could not be carried out as effectively as planned. Probably quite a few tigers missed the count. Co-ordinators working on this census have reported definite missing of some known tigers in certain parts of the sanctuary. It is planned to repeat the census during the next winter.

### **Leopard**

Only one leopard was sighted in the sanctuary near Panbari Reserved Forests. There are no leopards in the interior parts of the sanctuary. Only a few leopards probably stay in the periphery of the sanc-

tuary adjoining the villages. But they are quite common in the foot of the nearby Mikir hills where they are heard to call at night and often seen also. There are some leopards even near the Tourist Lodge.

### **Other animals**

Other animals recorded during the census are sloth bear, otters, capped langurs etc.

Though bears are common in certain parts of the sanctuary in wooded areas near Kanchanjuri, Bimoli, Kathpara etc. only 6 of them were seen during the census. This is due to the type of forests where they live during the day time and due to their nocturnal habits.

Otters in large family groups are common in almost all the beels of the sanctuary. The otters usually escaped the notice of the census parties and the number recorded were only the results of sighting. 95 otters were counted during the census.

Langurs and macaques are found in the wooded areas in the periphery of the sanctuary. During the census 25 capped langurs and 6 rhesus monkeys have been recorded. Probably many were missed.

The recorded figures for common lizards, water monitor lizards, pythons, hog badgers are insignificant.

Some census parties have recorded figures of sighting barheaded geese, pelicans etc.

### *Concentration of animals:*

The Baguri block situated on the western end of the sanctuary has the maximum concentration of almost all the animals. 46.9 per cent rhinos, 3.08 per cent elephants, 57.3 per cent buffaloes, 23.7 per cent swamp deer, 21.9 per cent sambar, 26.08 per cent hog deer, 7.89 per cent barking deer and 37.54 per cent wild boar of the total number of animals counted were found in this block. The total area of this block is 17,000.24 acres or 68.79 sq kms representing 18.15 per cent or roughly 1/5th of the total area of the sanctuary. The density of different species of animals in this block works out to 4.49 rhino, 0.18 elephant, 4.6 buffalo, 1.79 swamp deer, 0.33 sambar, 17.4 hog deer, 0.08 barking deer and 2.84 wild boar per sq km. Though the numerical density of various species of animals was so high the habitat as a whole in this block did not appear to be overused. There was lush green grass everywhere and the animals observed were in excellent health.

Against this density in Baguri block the density of various animals in remaining parts of the sanctuary comprising an area of 310.07 hectares representing 81.85 per cent or roughly 4/5th of the sanctuary

works out to 1.01 rhino, 1.31 elephant, 0.76 buffalo, 1.26 swamp deer, 0.26 sambar, 1.84 hog deer, 0.22 barking deer and 1.05 wild boar per sq km. There seems to be no competition amongst the different kinds of herbivorous animals at present even in the Baguri block due to the availability of adequate quantity of fodder. Areas where rhinos, swamp deer, hog deer and buffaloes are seen grazing together are full of green grass. The hog deer population is widely distributed and their grazing grounds are not confined to the beels. So also is the case with the buffalo.

Taking all these factors into consideration it can be safely concluded that the sanctuary is not overcrowded and it has the capacity to support a much bigger biomass than the present one.

#### *Distribution of animals:*

It is not understood why the Baguri block is favoured and preferred by most of the animals even though the range conditions of this block and the rest of the sanctuary have no apparent difference. The vegetational cover is almost the same all over. Though the area under beels are highest in Baguri block, water is not a limiting factor in any of the remaining blocks of the sanctuary. The only difference observed was that the intensity of burning is less in Tamulipathar, Boralimora and Panbari blocks where large areas remained covered with tall grasses. The second difference is that these tall and thick mass of reeds in these areas grow almost upto the banks of the beels leaving very little area of shorter grasses like *Chrysopogon aciculatus*, *Cynodon dactylon*, *Andropogon* spp. around the beels. The third difference is the fact that the Baguri block is nearer to the adjacent Mikir hills and provides a corridor to the animals to cross over to these hills during high floods, in two places. To what extent these factors or any other unknown factor influence the concentration of animals is to be studied further.

From wild life management point of view such heavy concentration of animals are not desirable specially in the present condition when poaching is a major factor. Moreover Baguri block is in the extreme western end of the sanctuary from where the animals may go out of the sanctuary to raid crops of villagers and expose themselves to the danger of poaching. Steps must be taken to disperse these animals into the remaining parts of the sanctuary by providing artificial salt licks, improvement of range conditions and grazing grounds.

### RECOMMENDATIONS

#### *Fodder grasses:*

Most of the animals prefer shorter grasses growing around the



beels and other open areas. The tender shoots of the reeds coming out immediately after burning are also relished by the animals. But as the reeds grow taller shooting upto a height of 10 to 15 feet they go out of the reach of the rhinos, hog deer, swamp deer etc. The reeds dry up during the winter and provide no food for the animals except the elephants. The major portion of the sanctuary's grasslands consist of such tall reeds. Some of these reeds around the vicinity of the beels should be replaced by shorter edible fodder grasses mentioned earlier.

Annual control burning to reduce the density of the thick reeds are to be continued.

#### *Flood and Erosion:*

Though flood is essential for maintaining the habitat and clearance of water hyacinth it must not be allowed to go out of hand. Some of the sanctuary's channels and outlets for flood water which have since silted up need to be renovated.

The large scale migration of animals from the sanctuary to the adjacent hills during high floods should be brought down to the minimum. To provide shelter to the marooned animals during flood high grounds should be created within the sanctuary. This can be done by raising the levels of the existing roads near the beels. If the roads are widened and raised near the beels it will not only provide shelter for the animals during flood but will also enable the visitors during winter to observe the animals grazing around the beels from their motor cars. In the meantime the proposal already initiated to include a portion of the Mikir hills into the sanctuary should be speeded up.

Instead of depending on the annual flood to wash away the water hyacinth some other mechanical device should be provided to clear them. Moreover it must be mentioned here that flood of lower intensity cannot clear the water hyacinth as seen during the last year.

As stated already the erosion of the sanctuary has greatly reduced its area. As such effective steps require to be taken up to halt this process by erecting spurs and dykes in suitable places.

#### *Scientific research:*

Research to collect some of the basic data like population dynamics, reproductive behaviour, food habits etc. of the various species of animals should be carried out, the ecology of the habitat should be studied. Census of animals should be carried out annually.

#### *Financial Aspects:*

Instead of continuing as a burden to the state treasury Kaziranga has the potential to become a major source of revenue for the state, specially much needed foreign exchange. To achieve this objective