SUMMARY

Studies on certain aspects of the biology of the one honred Rhino *R. unicornis*, were undertaken primarily in the Kaziranga National Park, and partially in other neighbouring wildlife sanctuaries, viz. Manas, Orang, Pabitora and Sonai-Rupai of Assam, India. Observations were also made on captive stock maintained at the Assam State Zoo, Guwahati. The study on different behavioural and biological aspects were made and recorded, with reference to distribution and taxonomic status, ecology of the natural habitat, food and feeding habits, general behaviour, physical features and anatomy common diseases, causes of death and longevity.

i) Of the living Rhinocerotidae family under grand order 'Ungulata', order 'Perissodactyla', only 5 species exist in the Africa and Asian continents. Other species of Rhinocerotidae which flourished in the tertiary period became extinct owing to the failure to cope with the evolutionary process or competition with other ungulata. The taxonomic status of 5 species of living rhinoceroses are as follows.

<table>
<thead>
<tr>
<th>Phylum</th>
<th>Sub-phylum</th>
<th>Class</th>
<th>Sub-class</th>
<th>Infra-class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chordata</td>
<td>Vertebrata</td>
<td>Mammalia</td>
<td>Theria</td>
<td>Eutheria</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Grand order</th>
<th>Ungulata</th>
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<tbody>
<tr>
<td>Order</td>
<td>Perissodactyla</td>
</tr>
<tr>
<td>Family</td>
<td>Rhinocerotidae</td>
</tr>
<tr>
<td>i)</td>
<td><em>Rhinoceros unicornis</em> (The Great Indian one horned rhinoceros).</td>
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<td><em>Rhinoceros sondaicus</em> (One horned, small Javan rhinoceros).</td>
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<td>ii) Sub-family-</td>
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<td>iii)</td>
<td><em>Diceros bicornis</em> (African, black and hook-lipped rhinoceros).</td>
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<td>iv)</td>
<td><em>Ceratotherium simum</em> (African, white square-lipped rhinoceros).</td>
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<td>v)</td>
<td><em>Didermocerus sumatrensis</em> (Two horned Sumatran rhinoceros).</td>
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</table>

ii) Although *R. unicornis* was widely distributed from the Khyber Pass to Sadia (North East India) upto the sixteenth century with the presence of some individual animals in West Bengal and Nepal, the present study reveals the presence of *R. unicornis* mostly in the Kaziranga National Park along with nearby Sanctuaries with Manas, Orang, Pabitora of Assam.

iii) The movement of *R. unicornis* along the North and South banks of the River Brahmaputra from the districts of Kamrup to Jorhat, the absence of their record of occurrence in Karbi Anglong and beyond towards South Kamrup, and further occurrence in the great river island, Majuli is noteworthy. There is no record of the occurrence of *R.*
iv) Altogether 220 food plants of 76 families were identified from the grazing ground of R. unicornis in the habitat of the Kaziranga National Park.

v) The population density of R. unicornis along with other herbivores sharing the same food plants was analysed from the respective census reports. There is a gradual decline of growth in the number of R. unicornis in subsequent years. The percent growth rate showed a gradual declination from 11.25% (1972) to 7.21% (1978), 2.06% (1984) and 1.85% (1990) observed during present studies. The population density of R. unicornis per square kilometre showed a gradual increase from 0.93 (1966) --- 1.56 (1978) --- 2.23 (1984) to 2.79 (1990) during the present observation in the Kaziranga National Park.

vi) The environmental parameters recorded were rainfall, minimum 1100 mm and maximum 2554 mm, temperature minimum 10.3°C and maximum 32.7°C and humidity, minimum 60% and maximum 95% in the Kaziranga National Park.

vii) The R. unicornis has been observed to feed chiefly on grasses in the natural habitat. The grasses include tall and short varieties, shrubs and aquatic plants. The animal spent most of the time in the
day in grazing. Though the animal was found to pick up varieties of species while grazing, it prefers mostly the following species of grasses: *Erianthus ravenae*, *Cynodon dactylon*, *Hemertheria compress*, *Arundo donox*, *Imperata cylindrica*, *Pollinia cilitia*, *Pseudostachyum polymorpum*, *Saccharum arundinaceum*, *S. elephantium*, *S. nerenga*, *S. spontaneum*, *Vetiveria zizaniodes* etc.

viii) The scarcity of food during and immediately after floods has been observed, where the animal suffers from starvation and the development of diarrhoea and other diseases like parasitic infections etc. The feeding behaviour during grazing, floods and during the burning of the forest has been observed in different periods.

(ix) In the captive state *R. unicornis* were supplied with 100 kg of grass along with 5 kg of concentrate (mixed feed), with the addition of 2 kg of fruits and 20 g common salt. In some cases they were supplied with mineral mixture too. This food ingredients were supplied daily to an adult animal.

x) The rhino calves are naturally brought up on the mother's milk. During their early life they solely depend upon the mother's milk upto 2 months of age. Thereafter, they start picking up new succulent grass occasionally,while moving with the grazing mother.

xi) The tender calves could be well raised by feeding on cow's milk along with the supplement of mineral mixture, starting with a
dose of 8 litres of milk which was increased up to 15 litres per day per calf. Boiled rice and banana were given as solid starter foods.

xii) The R. unicornis were found to possess habits consisting of easy walking, roaming, galloping, free grazing, wallowing, swimming, defecation and making dung heaps, urination by passing jets of urine different types of vocalization for communication among themselves, having symbolic relations with other ungulates and birds, reactions to man and other adult male rhino, maintaining the cow-calf pair and adult male-female pair.

xiii) The duration of oestrus lasted for 26 hours. The duration of oestrous cycle was found to vary from 38 to 46 days in the captive state and 24 to 49 days in the natural habitat at the Kaziranga National Park. The length of gestation period was 461 and 506 days as observed in 2 cases. The act of parturition was observed as - duration of labour pain varied from 170 to 760 minutes; the time of expulsion of the foetus varied from 22 to 25 minutes; time taken from expulsion of foetus to expulsion of placenta varied from 120 minutes to 190 minutes; weight of the placenta 4.2 kg inter-calving period 624 days. The biometrics of the new born calf were recorded as length 105 to 110 cm, girth 93 to 97 cm, height 45 to 66 cm and body weight 60 to 64 kg.

xiv) The study of the physical features and anatomy of the adult R. unicornis revealed the following biometrics - total body length
345.6 (278-391) cm, length of head 92.6 (80-116) cm, length of body (from point of shoulder to point of buttock), 191 (159-223) cm, length of neck 49.6 (39.58) cm, length of tail 60.7 (58-62) cm, girth at chest 258 (246-273) cm, height 166 (158-178) cm and body weight 1938.3 (1808-2020) kg. The size of the head in the male is bigger than in that of the female.

xv) The skin of the R. unicornis is peculiar with an armour like plating with possesses some rivets like out of growth "tubercles" or projections. The projections were found to be of different sizes large, medium and small numbering 34, 32, 27 respectively counting over an area of 10 x 10 cm², on the buttock region. A distinct sexual dimorphism with reference to skin folds in both sexes was observed, where the neck folds were more distinct in the adult male than in the female.

xvi) The single median horn on the nose is the main point of attraction of the species. The biometrics of the horn were found to be; girth at base 48 to 62 cm, middle part 31 to 42 cm, end part 20 to 27 cm, height 16 to 51 cm, weight 300 to 1082 gm. The horn is a modified skin, there is no horn core. Female R. unicornis has a smaller horn than the male is a characteristic point for distinguishing the sex from distance.
xvii) The R. unicornis was found to bear 3 nails in each leg, numbering 12 in total. The nails are almost of equal size.

xviii) The R. unicornis was found to have very scanty hair on its body. These are distributed only on the eye lids, edges of the ears, and the switch of the tail. The maximum length and the diameter of the hair were found to be 3.2 cm and 0.017 mm respectively.

xix) The endo-skeleton of the R. unicornis was found to be very strong and stout. The maxilla was found to be very heavy, bearing the nasal bones and the upper jaw. The nasal bone is completely curved and pointed which bears the horn and unlike other ungulates it is complete. The mandible is lighter than the maxilla and bears the lower teeth. The total length of the maxilla was found to be 60 cm, girth at middle 68 cm and in mandible 54 cm and 52 cm respectively, while the total length of the skull was found to be 70.3 cm and girth at base to be 143.6 cm. The arrangement of the teeth were found to be \(2\left(\frac{1}{1} + \frac{0}{1} + \frac{3}{4} + \frac{3}{3}\right)\) total 30-34. There is no canine teeth in the upper jaw. The vertebral column comprises a series of bones with cervical (7), thoracic (18), lumber(6), sacral (5-6) and coccygeal (17-19), total 53-56. The bones of the fore limbs consist of scapula or shoulder girdle, humerus carpal bones, meta-carpal bones and the phalanges on both right and left sides. The ribs are the paired bones and they are eighteen in number. The bones of the hind limbs are heavier than the fore legs. They comprise the
pelvic girdle, the femur, the tibia and fibula, petala, tursus, meta
tursus and phalanges.

xx) The digestive system was found to consist of the mouth, pharynx, oesophagus, stomach, small intestine, large intestine and anal aperture, while the digestive glands consist of liver, spleen, and pancreas. The tongue which is the prehensile organ of the R. unicornis, is muscular with many glands on its dorsal surface; the ventral surface is smooth as in the horse and other herbivores.

(xx1) The heart of R. unicornis is a musculofibrous conical organ which possesses two surfaces, a broad base and a narrow apex. The lungs are spongy and extensive in structure. The urinary system consists of kidney, urinary bladder and urethra. The urine of R. unicornis is peculiar, its specific gravity is 1.022 with colour yellow, and volume 3.36 litre. The urine showed sedimentation on standing and forms foam on shaking.

xxii) The genitalia of the female R. unicornis comprises two ovaries, two oviducts, two horns, body of the uterus, cervix, vagina and two vulvar lips, while the male genitalia comprises the two testes without scrotum and penis along with their accessories. The male copulatory organ is the penis. The penis of R. unicornis on its glans part possesses 3 rows of petal like structures. The placenta of the R. unicornis is of the diffuse type. The mammary glands are two in number and inguinal in position.
xxiii) The rhinoceros suffers rarely in natural habitats, but diseases are detected in the captive state. Diseases like diarrhoea, tympanites, cardiac failure, still birth, horn decay, wound and ulcer, parasitic disease were detected in the study. Death due to poaching, drowning during flood, killed by tigers, death due to fighting, due to accidents, senility were recorded during the study.

xxiv) Positive thoughts about the future conservation of the species have also been contemplated in this study, in order to check the causes of diminution, extension of habitat, periodical examination of the existing habitat with reference to food plants, soil and flood problem along with diseases. Extension education with regard to love and sympathy for the R. unicornis was suggested. A detailed analysis of the causes of the decreasing tendency of the population and other problems of the R. unicornis in the Kaziranga National Park, along with possible remedies and developmental aspects for propagation and conservation and creation of a new Rhino land have also been elucidated.

The research on the Biology of reproduction in further detail along with the ecology studies would provide informations on measures to be adopted for future propagation and conservation of the valuable endangered species.