Annexure IV

Dudhwa National Park

Some botanical aspects of the proposed new habitat for Rhino

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The Dudhwa National Park in the Kheri District of U.P. has recently been proposed as a possible new habitat for the rhinoceros. The Indian rhinoceros which had a much wider distribution in the past is now confined to the Brahmaputra valley in Assam, Jaldapara Sanctuary in West Bengal and Chitawan range in Nepal. In this paper an attempt has been made to compare the rhinoceros habitat of Assam and that of Dudhwa National Park with special reference to the availability of food plants.

The Indian-one-horned rhino (*Rhinoceros unicornis* L.) had a much wider distribution about 500 years ago in the foot-hills of Himalayas and the plains of the Ganges and Brahmaputra. Now its population is inordinately depleted due to human interference and is restricted only to isolated pockets in the Brahmaputra valley (chiefly in Kaziranga National Park, Manas Wild Life Sanctuary and Orang Wild Life Sanctuary), West Bengal (Jaldapara) and Nepal (Chitawan range). However, the rhinos are a significant attraction in most of the zoos. The species is represented by about 1500 animals and is presently under severe threat of poaching, owing to its precious horn. The Assam Government realizes amounts like Rs. 62,000/- per kg. of horns. It has been strongly felt that new sites should be located for introduction of the rhino. The Dudhwa National Park in the Kheri District of Uttar Pradesh has been identified as one such site for introduction of the rhino. The Uttar Pradesh Forest Department has proposed an area of approximately 90 sq km or 8939 ha in the south Sonaripur and south Bellraien ranges consisting of 2765 ha grassland, 5580 ha woodland and 594 ha water-logged areas. The centrally located

Bakat Tal with an area of 60 sq km or 5958 ha, much of which remains flooded throughout the year containing two perennial swamps and an adjacent high ground where rhinos could take shelter during exceptionally high flood has also been suggested as an alternative site.

In this paper, the habitat and vegetation of the Kaziranga National Park and Manas Wild Life Sanctuary, the chief locations of the rhino have been compared with that of the Dudhwa National Park. Primary needs of the rhinos, i.e. swampy habitat and plenty of food are available in the area selected for introduction in the Dudhwa National Park. In fact, this place was in the belt of rhino distribution in the past. Similar and dissimilar features of these areas are discussed.

Area and topography

The Kaziranga National Park lies approximately between 90°5'—93°40' E and 26°30'-26°45'N. The park is situated partly in the Nowgong district and partly in the Sibsagar district of Assam at the foot of the Mikir Hills (Karbi-Anglong) south of National Highway No. 37.

It is bounded in the north and west by the Brahmaputra river, in the south by Mora Diphlu river, Mikir Hills and a number of villages of Nowgong and Sibsagar districts and in the east and west by many villages and cultivated fields of Nowgong and Sibsagar Districts. The important small streams draining into the park from south to north are Borjuri, Dring, Kohora, Dihing, Bhalukjhuri, Deopani, etc. There are many 'Bils' inside the park.

The total area of the Kaziranga National Park is 429·96 sq km. The terrain is a flat land.

Manas Wild Life Sanctuary lies approximately between 26°30'—27° N and 91°-92° E. It is bounded in the north by the international boundary between India and Bhutan, in the south by the thickly populated regions of North Kamrup district of Assam; but in east and west, the different reserved forests are separated by cultivated fields and gardens. Of the total area of 2837 sq km under the Tiger Project in Assam, Manas has about 580 sq km.

The terrain is a flat land gently sloping to the south with a number of rivers draining from north to south. The main rivers are Manas, Mora-Manas (or Beki), Jong-rong, Gyati, Chorphuli, Garuchara and Rahang.

The Dudhwa National Park lies approximately between 28°18'-28°-42' N and 80°28'80°57' E. It is bounded in the north by international boundary of Nepal and remaining sides are contiguous with the Kheri district of Uttar Pradesh. The total area of the Park is about 490 sq km and adjoining area of 123 sq km is also under the administrative control of the Park, thus making it a complete block of 613 sq km. The Park area is a vast alluvial plain, traversed by a number of small rivers and rivulets and tals, the important among these being Mohan which more or less forms an international boundary between Nepal and Suheli which forms southern boundary of the Park and Jauraha, Neora, Nagroles nalas and Kakraha, Nagra, Churela tals. The mean elevation above sea level ranges from 182 m in the extreme north to 150 m in the south-east.

Climate

Kaziranga : There is heavy rainfall from July to October. The mild winter occurs from November to February and the summer is from March to May. The climate is tropical, hot and humid. Maximum temperature often approaches 35°C between March and September and minimum temperature rarely falls below 10°C during December and January.

Manas : The climate is warm and humid, maximum temperature goes up to about 37°C and the mean minimum is about 11°C.

Dudhwa : There are distinctly 3 seasons, winter from mid-October to mid-March, summer from mid-March to mid-June and rainy season from mid-June to mid-October. Average rainfall is $\pm$ 160 cm. About 90% of the total rainfall is between June and September. During rainy season the Park roads get water-logged and remain so till the end of November.

Vegetation of Kaziranga National Park

Vegetation of Kaziranga National Park (Hajra, 1980) can be broadly classified into Alluvial inundated grasslands, Tropical wet evergreen forestry and Tropical semi-evergreen forests.

Alluvial inundated grasslands : Almost two-third of the Park is covered by grasslands. Amidst grasses there are numerous herbaceous plants and scattered trees of *Bombax ceiba* L., *Dillenia indica* L, *Careya arborea* Roxb., *Emblica officinalis* Gaertn., etc. In the extensive grasslands the dominant grasses are *Saccharum procerum* Roxb., *S. spontaneum* L., *Vetiveria zizanio ides* (L.) Nash, *Themeda villosa* (Poir.) A. Camus, *Apluda mutica* L.,

Arundinella bengalensis (Spreng.) Druce, *Digitaria setigera* Roth, *Hygroryza aristata* (Retz.) Nees, *Narenga porphyrocoma* (Hance) Bor, *Phragmites karka* (Retz.) Trin., *Sclerostachya fusca* (Roxb.) A. Camus, etc.

Tropical wet evergreen forests : Besides grasslands there are patches of evergreen forests near Kanchanjhuri, Panbari and Tamulipathar blocks. The common trees in these forests are *Aphanamixis polystachya* (Wall.) Parker, *Dillenia indica* L., *Syzygium tetragonum* (Wt.) Kurz, *S. cumini* (L.,) Skeels, *Talauma hodgsonii* Hook. f. & Thoms., *Garcinia tinctoria* (DC.) Wight, *Ficus rumphii* Bl., *Cinnamomum bejolghota* (Buch.-Ham.) Sweet, etc.

Tropical semi-evergreen forests : This type of forests occurs in the Baguri, Bimali and Haldibari surroundings. Here the common trees and shrubs are *Albizia procera* (Roxb.) Benth., *Duabanga grandiflora* (Roxb. ex DC.) Walp., *Lagerstroemia speciosa* Pers., *Crateva unilocularis* Buch.-Ham., *Sterculia urens* Roxb., *Grewia serrulata* DC., *Mallotus philippensis* Muell.-Arg., *Bridelia retusa* Spreng., *Aphania rubra* (Roxb.) Radlk., *Leea indica* (Burm.) Merrill, *L. umbraculifera* Clarke etc.

The vegetation of Manas Wild Life Sanctuary (Jain & Hajra 1975) is basically wet alluvial grasslands but there are patches of *Dillenia* swamp forests (High Savannah *Bombax-Albizia* type of Rajkhowa, 1961), Semi-evergreen forests and Riparian fringe forests.

Wet alluvial grasslands form extensive areas. The common grasses are *Apluda mutica* L., *Chrysopogon aciculatus* (Retz.) Trin., *Cynodon dactylon* (L.) Pers., *Cyrtococcum accrescens* (Trin.) Stapf, *Digitaria ciliaris* (Retz.) Koel., *D. longiflora* (Retz.) Pers., *Echinochloa colonum* (L.) Link, *Eleusine indica* (L.) Gaertn., *Erianthus longisetosus* Anders., *Hemarthria protensa* Steud., *Imperata cylindrica* (L.) P. Beauv., *Neyraudia reynaudiana* (Kunth) Keng, *Saccharum procerum* Roxb., *S. spontaneum* L. etc. In the grasslands several tree species occasionally grow. These are *Dillenia pentagyna* Roxb., *Emblica officinalis* Gaertn., *Bombax ceiba* L. etc. The common shrubs and herbs are *Clerodendrum viscosum* Vent., *Grewia sapida* Roxb., *Pygmaeopremna herbacea* (Roxb.) Moldenk, and *Mussaenda roxburghii* Hook. f.

Dillenia Swamp forest : It is a fairly dense forest of medium height with many evergreen and semi-evergreen species and this type occurs in flat areas periodically flooded during the wet season with intervening dry periods. This type of vegetation is met with near Mothanguri and Uchilla Beat of Manas Sanctuary.

The conspicuous species in this area are *Dillenia indica* L., *Bischofia javanica* Bl., *Albizia procera* (Roxb.) Benth., *Lagerstroemia speciosa* Pers., *Terminalia chebula* (Gaertn.) Retz., *Bombax ceiba* L , *Duabanga grandiflora* (Roxb. ex DC.) Walp., etc.

Semi-evergreen forests : In this type of vegetation common trees are *Aphanamixis polystachya* (Wall.) Parker, *Anthocephalus chinensis* (Lour.) A. Rich. ex Walp., *Syzygium cumini* (L.) Skeels, *S. formosum* (Wall.) Masamune, *S. oblatum* (*Roxb.*) Wall. ex Cowan et Cowan, *Bauhinia purpurea* L., *Mallotus philippensis* Muell.-Arg., *Cinnamomum bejolghota* (Buch.-Ham.) Sweet, *Actinodaphne obovata* (Nees) Bl., *Kydia calycina* Roxb., *Casearia vareca* Roxb., etc.

The undergrowth consists mainly of *Leea aequata* L., *Coffea bengalensis* Wall. ex Roxb., *Phlogacanthus thyrsiflorus* Nees, *Adhatoda zeylanica* Medic., *Piper mullesua* D. Don, etc. This kind of vegetation is met with chiefly along the international boundary of India and Bhutan.

Riparian fringe forests : This type of vegetation is met with along the banks of Manas, Mora Manas, Jongrong, Gyati & Rabang rivers inside the Sanctuary.

A few species of large trees form a narrow fringe along the water courses. These trees are of sub-evergreen type. They stand widely spaced with smaller trees and shrubs in between and often with much coarse grasses mainly *Saccharum* spp. The common trees are *Bischofia javanica* Bl., *Polyalthia simiarum* (Hook. f. & Thoms.) Hook. f. & Thoms., *Aesculus assamica* Griff., *Lagerstroemia speciosa* Pers., *Bridelia retusa* Spreng., *Macaranga denticulata* (Bl.) Muell.-Arg., *Litsaea salicifolia* (Nees) Hook. f., *Trema orientalis* (L.) Bl., etc.

AQUATIC FLORA

There are a number of rivers and 'Bils' inside the Kaziranga National Park and Manas Sanctuary which harbour a variety of aquatic flora. About 5·58 percent of the total area is covered by the 'bils' and rivulets. In the treatment of aquatic plants the classification as suggested by Mirashi (1957) has been followed.

Free-floating hydrophytes

Eichhornia crassipes (Mart.) Solms, *Azolla pinnata* R. Br., *Utricularia flexuosa* Vahl., *Trapa natans* L. var. *bispinosa* (Roxb.) Makino.

Suspended submerged hydrophytes

Ceratophyllum demersum L.

Anchored submerged hydrophytes

Limnophila sessiliflora Bl., *Ottelia alismoides* (L.) Pers., *Vallisneria spiralis* L., *Cryptocoryne retrospiralis* (Roxb) Kunth.

Anchored hydrophytes with floating shoots

Limnophila sessiliflora Bl.

Emergent amphibious hydrophytes

Polygonum caespitosum Bl., *Typha elephantina* Roxb., *Monochoria hastata* (L.) Solms.

Wet land hydrophytes

Cyperus brevifolius (Rottb.) Hassk. *Lasia spinosa* (L.) Thw., etc.

VEGETATION OF DUDHWA NATIONAL PARK

The vegetation of Dudhwa National Park is of Tropical moist deciduous type. It may be categorically stated that it is one of the best natural Sal forests, apparently a climatic climax in Uttar Pradesh. Champion & Seth (1968) have classified this Sal forest into Moist Bhabar Sal and Moist Plains Sal and further sub-types being Damar Sal forest and Western light alluvium plain Sal. These are found at Dudhwa, Bellraien, Bankati and several other places within the area. However, Sal gives the major coverage either natural or by plantation. Grasslands (phantas) are also seen within the area along with riparian fringe forest, Sal forest, mixed Sal and teak and semievergreen forests. The composition of these various forest types are as follows :

Grasslands (Phantas)

The various types of forests throughout the park are interrupted by wide stretches of mesophyllous grasslands locally called the 'phantas'. The common perennial grasses are *Themeda arundinacea* (Roxb.) Ridley, *Saccharum spontaneum* L., *S. bengalense* Retz., *Narenga porphyrocoma* (Hance) Bor, *Vetiveria zizanioides* (L.) Nash., *Cymbopogon flexuosus* (Nees) Wats., *Desmostachya bipinnata* (L.) Stapf, *Apluda mutica* L , *Dichan-*

thium annulatum (Forssk) Stapf, *D. glabrum* (Roxb.)Jain et Deshpande, *Pseudosorghum fasciculare* (Roxb) A. Camus, etc. *Hygroryza aristata* (Retz.) Nees is the common aquatic grass, and on the margins of ditches *Panicum paludosum* Roxb., *Echinochloa* spp. are frequent.

Trees Shrubs

Occasionally scattered trees or shrubs of *Syzygium cumini* (L.) Skeels, *Lannea coromandelica* (Houtt.) Merr., *Mallotus philippensis* Muell-Arg. with climbers like *Ventilago denticulata* Willd, *Dioscorea belophylla* Voight, *D. bulbifera* L. and *Trichosanthes cucumeriana* L. are also seen.

Riparian fringe forests

This type of forest is found on the bank of Suheli river near Dudhwa and elsewhere. *Acacia catechu* Willd. and *Dalbergia sissoo* Roxb. are found associated with *Trewia nudiflora* L., *Mallotus philippensis* Muell-Arg. and occasionally with *Syzygium cumini* (L.) Skeels and *Barringtonia acutangula* Gaertn.

Sal forests.

Thick Sal forests are met with in Dudhwa, Bankati, Bellraien and several other places and occupy a fairly large area in the National Park. The common associates of *shorea robusta* Gaertn. f. are *Mallotus philippensis* Muell. Arg., *Syzygium cumini* (L.) Skeels, *Ardisia solanacea* (Poir.) Roxb., *Callicarpa macrophylla* Vahl., *Murraya koenigii* (L.) Spreng., *Clerodendrum viscosum* Vent, *Mitragyna parviflora* (Roxb.) Kunth, *Flemingia macrophylla* (Willd.) Prain ex Merr., *Grewia elastica* Royle, *Ziziphus mauritiana* Lamk., *Z. oenoplia* (L.) Mill., *Z. xylocarpa* (Retz.) Willd., *Carissa spinarum* L., *Aegle marmelos* Corr. The common grass in undergrowth is *Desmostachya bivinnata* (L.) Stapf.

Mixed Sal and teak forests

These mixed forests are found in Dudhwa, Bankati and elsewhere. The characteristic species in these forests are *Mitragyna parviflora* (Roxb.) Kunth, *Adina cordifolia* (Roxb.) Hook. f. ex Brandis, *Dalbergia sissoo* Roxb., *Aegle marmelos* (L.) Corr., *Kydia calycina* Roxb., *Emblica officinalis* Gaertn., *Ziziphus mauritiana* Lamk., *Ehretia laevis* Roxb., *Ficus semicordata* Buch-Ham., *Desmodium triangulare* (Retz.) Merr., *D. pulchellum* (L.) Benth.

Semi-evergreen forests

This type of forests occupies a small portion of land in Gauriphanta, Bankati and Bellraien. The forest of these areas have no uniformity in composition of vegetation and with no apparent dominant species. The important constituents in this type are *Cassia fistula* L., *Kydia calycina* Roxb., *Mitragyna parvifolia* Korth., *Adina cordifolia* Benth, *Terminalia belliriza* Roxb., *Mallotus philippensis* Muell-Arg., *Syzygium cumini* (L.) Skeels, *Acacia Catechu* Willd., *Casearia elliptica* Willd., *Tectona grandis* L., *Emblica officinalis* Gaertn., *Phyllanthus reticulatus* Poir., *Holarrhena antidysenterica* (Roth) Wall. ex A. DC., *Millettia auriculata* Baker, *Helicteres isora* L. and *Xeromphis spinosa* (Thunb,) Keay.

Climbers

The stragglers and climbers frequently met with are *Dioscorea belophylla* Voight, *D. bulbifera* L.. *Phanera vahlii* (W. & A.) Benth., *Porana paniculata* Roxb., *Ipomoea cairica* (L.,) Sweet, *Cryptolepis buchanani* Roem et Schult., *Ichnocarpus frutescens* (L.) R. Br., *Thunbergia grandiflora* Roxb,, *Abrus precatorius* L., etc.

Occasional occurrence of *Naravelia zeylanica* (L.,) DC., a climber and *Olax nana* Wall, a short woody herb at Bellraien is interesting.

Herbs

The herbaceous undergrowth often encountered in these forests has *Ajuga macrophylla* Wall. ex Benth., *Alternanthera sessilis* (L.) DC., *Borreria brachystema* (R. Br. ex Benth.) Valet, *Mazus pumilus* (Burn. f.) Steen , *Hemigraphis hirta* T. Anders., *Uraria picta* Desv. and hedges like *Cyperus rotundus* L.

AQUATIC FLORA

There are a number of rivulets and temporary water pools and permanent tals in the Dudhwa National Park which support a variety of aquatic plants; some are listed below :

Free-floating hydrophytes

Trapa natans L. var. *bispinosa* (Roxb.) Makino, *Utricularia flexuosa* Vahl, *Hygroryza aristata* (Retz.) Nees, *Lemna perpusilla* Torrey, *Spirodela polyrhiza* (L.) Schleid.

Suspended submerged hydrophytes

Aponogeton crispum Thunb., *Hydrilla verticillata* (L.f.) Royle, *Potamogeton pectinatus* L.

Anchored submerged hydrophytes

Ottelia alismoides (L.) Pers.

Anchored hydrophytes with floating leaves

Nelumbo nucifera Gaertn., *Nymphaea nouchali* Burm. f., *Nymphoide cristata* (Roxb.) Kuntze.

Anchored hydrophytes with floating shoots

Monochoria vaginalis (Burm. f.) Presl, *Sagittaria guayanensis* H.B.K. ssp. *lappula* (D. Don) Bogin.

Amphibious hydrophytes

Echinochloa colonum (L.) Link, *E. stagnina* (Retz.) P. Beauv., *Panicsum paludosum* Roxb.

Wet land hydrophytes

These occur in low lying areas of the park and in marshy places near Water pools, tals, rivers, drying up rice fields etc. The common species are : *Ludwigia actovalvis* (Jacq.) Raven, *L. prostrata* Roxb., *Salvia plebeia* R. Br., *Alternanthera sessilis* (L.) D. C., *phyla nodiflora* (L) Greene, *Mazus pumilus* (Burm. f.) Steen., *Amischophacelus axillaris* (L.) Rolla Rao et Kammathy, *Hydrola Zeylanica* Vahl, *Gnaphalium luteo-album* L., *Polygonum plebeium* R. Br., *P. barbatum* L., *Xanthium strumarium* L., *Cyanotis cristata* (L.) D. Don, *Commelina benghalensis* L., *Murdannia nudiflora* (L.) Brenan and sedges, e.g. *Cyperus iria* L., *Scirpus articulatus* L., *Scleria levis* Retz., *Eleocharis palustris* R. Br.

The present population of Rhinos is estimated as

Assam : Kaziranga 960, Manas 90, Orang 60, Sonai Rupai 10, Laokhawa 100.

West Bengal : Jaldapara 19.

Nepal : Chitawan 300.

Food

Rhinos generally prefer grasses like *Saccharum* spp., *Cynodon dactylon* (L) Pers., *Arundo donax* L., *Polytoca digitata* (L.f.) Druce, *Hygroryza aristata* (Retz.) Nees, *Vetiveria zizanioides* (L.) Nash, *Imperata cylindrica* (L.) P. Beauv., *Themeda* spp., *Chrysopogon aciculatus* (Retz.) Trin., *Setaria Pallide-fusca* (Schumach.) Stapf et C.E. Hubb, *Paspalidum flavidum* (Retz.) A. Camus, *Narenga porphyrocoma* (Hance) Bor and *Phragmites karka* (Retz.) Trin., sedges like *Cyperus* spp. as well as herbs, shrubs and saplings of species like *Polygonum plebelium* R. Br., *Ageratum conyzoides* L., *Erigeron* sp., *Artemisia nilagirica* (Clarke) Pamp., *Eupatorium odoratum* L.. *Solanum* spp., *Colebrookia oppositifolia* J.E. Smith, *Murraya koenigii* (L.) Spreng., *Trewia nudiflora* L., *Litsaea* sp., *Premna* sp., *Ehretia* sp.

They also prefer aquatic plants like *Hydrilla verticillata* (L.f.) Royle, *Vallisneria spiralis* L., *Hygroryza aristata* (Retz.) Nees ex Wt. & Arn., *Potamogeton* sp., etc. During the rainy season they move along the river beds and in cultivated fields and sometimes take *Oryza sativa* L. It is estimated that the rhino population in Kaziranga takes about 77% grasses and 23% herbs and shrubs. Wide range of materials eaten by the rhinos suggests that the animal is not very specific in its choice, though data on food habit of the animal in captivity have not been gathered. However, majority of the above mentioned food plants are available in the Dudhwa National Park.

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