



Habitat and population ecology of *Rhinoceros unicornis* in Dudhwa National Park, Uttar Pradesh

Arun K. Tripathi

Department of Zoology, Sacred Heart Degree College, Sitapur, (U.P.) - India

Abstract

Dudhwa National Park (DNP), located in the foothills of Himalayas in Uttar Pradesh, has become an ideal home to the Great Indian one-horned rhino, *Rhinoceros unicornis*. The present population of Rhino in DNP restricted to a 28.11 sq km enclosure known as Rhino Rehabilitated Area (RRA). Although, RRA offered the desired diversity of habitats including higher level woodlands, low lying grasslands, swamps, lakes, streams etc., but with the rising of rhino population the fight over food and territory has become intense. Indian Rhinos are habitat specific and prefer alluvial plain grasslands, but are also found in adjacent swamps and forests. These mega herbivores are not very specific in their food choices and chiefly feed on grasses, shrubs and herbs. They also prefer few species of aquatic plants and climbers. Knowledge about the habitat and preferred plant species is important strategic information that should be incorporated into the conservation and management plan for the threatened One-horned Rhinoceros. The present study, conducted between January-December (2011), provides vital information to strengthen the available data and to supplement the gaps in conservation and management plans for the animal.

Key-Words: Rhino, *Rhinoceros unicornis*, Dudhwa National Park, Savannah, Grazer, Tarai

Introduction

One of the three Asian Rhino species, Indian one-horned rhino, *Rhinoceros unicornis* were once widespread throughout the northern floodplains and nearby foothills of the Indian sub-continent between Indo-Myanmar border in the east, and Sindh River basin, Pakistan in the west. Hunting and habitat destruction in the last 400 years, however, finished off them from most of their past distribution range except in few pockets left in north-east in the states of Assam and West Bengal along with Nepal where such vestiges of tarai constitute the last strong hold for rhinos (Fig.1). The Indian one-horned rhinoceros has been classified by the IUCN Red List recently as vulnerable and is listed in CITES Appendix I. Due to successful conservation strategies the populations are rising in some areas. The current estimates of Indian rhino in India and Nepal are in between 2700-2800 of which about 2300-2370 are distributed in India while about 400-430 in Nepal. In India, the rhinos are mainly recorded from Kaziranga National Park, Orang National Park and Pabitora Wildlife Sanctuary in the state of Assam, Jaldapara Wildlife Sanctuary and Gorumara National Park in West Bengal and Dudhwa National Park in Uttar Pradesh.

Dudhwa, the only National Park in Central North India, possess a substantial population of the Indian rhinos. In 1984-85, under Central Government Project, Rhino Rehabilitation Program was began with a seed (founder) population of 7 Rhinos (2 males and 5 females), which were traslocated from Pabitora Wildlife Sanctuary, Assam and Royal Chitwan National Park, Nepal (Sale and Singh 1987). The Rhinos from two different habitats have been adopted the new area and bred very well. By the year 2011, after 27 years of reintroduction, rhino population in Dudhwa National Park raised to 31 individuals (8 males, 16 females and 7 calves of unknown sex) and population density reached approx. 0.91 rhino/km² in the RRA.

Material and Methods

Observations were carried out by means of elephant riding and watchtowers at suitable locations to know about feeding, resting, wallowing habits of rhinos. During the dry season a jeep or motorcycle was used for rapid survey. Ground-based methods were used to define and evaluate the various habitat types on the basis of presence of major factors, including terrain, open water, swamps and vegetation types. Detailed records were maintained regarding the food plants available as well as eaten by Rhinos in the RRA. Direct

* Corresponding Author

E.mail: ak_tripathi1968@rediffmail.com

observations of feeding rhinos were also made in Zoos (Lucknow & Kanpur).

Study Area

The Dudhwa National Park (coordinates, 80°28'-80°57'E and 28°18'-28°42'N), declared as Dudhwa Tiger Reserve under Project Tiger in 1987, is situated in the Lakhimpur-Kheri district of Uttar Pradesh in Northern India, approximately 30 km south of the Nepal Himalayas. It is 490 sq km in extent with buffer zone of 124 sq km under the Park administration (Fig. 2).

The area of the park is a vast alluvial plain, which shows succession of beds of sand, loam and clay. There are three distinct seasons viz., winter (October to mid-March), summer (mid-March to mid-June) and rainy season (mid-June to September). The Park receives about 150 cm of average annual rainfall

The intensive study area i.e. Rhino Rehabilitated Area (RRA) is situated in the South Sonaripur Range of Dudhwa NP (Fig. 3). The RRA is enclosed by 2.8 m high electric fence with 7-strands of which the lower two strands are energized to prevent the entry of tigers within the RRA to preclude the threat to rhino-calf predation.

Results and Discussion

a) Habitat Ecology

All the ecological requirements such as water sources, vegetation cover, habitat types, food plants and wallows were studied in the Rhino Rehabilitated Area.

i) Water sources

The RRA has as many as eleven Lakes viz., Kakraha, Bada Puraina, Chhota Puraina, Chhedha, Chaitua, Bargadha, Bhandara, Amha, Bela, Kurmunia and Kaimahia. First seven of them are permanent water sources for rhinos and other wild animals, whereas the last four tals get dried during the summer and water is augmented by tube wells. The chain of these water bodies lies along the damar Sal forest and Grassland ecotone. The lakes and streams (Andhra, Chabkawa and Khaptahua nala) are old courses of the river Suheli. During monsoon, major parts of the grassland inside the RRA get flooded and water currents can be seen in three streams and chain of lakes while other areas have up to 4 feet of standing water.

To supplement the water supply especially during summer, seven tube wells are available in RRA. These are one each at Amaha, Chaitua, Bela, Purania and Kurmunia Tals and two at Kakraha Tal. All are running in good condition except the tube well at Bela Tal. There are three artificial water holes. These are one each in comptt.-5, Comptt.-2 and comptt.-3. Tube well borings are available for first two water holes. Third one is filled with rain water during monsoon.

The annual submergence of southern most part of the RRA due to high flood levels of the Suheli is a regular phenomenon. Because of this regular and cyclic phenomenon, the habitat structure and floral composition are affected. Under the existing situation, the rhinoceros has had to adjust and change its feeding behaviour and selectivity of plant species. Another external factor, the grass burning influences the flora and fauna of the area. A large part of the savannah grasslands are subjected to annual controlled burning during the winter months. Such burning helps to promote vegetative reproduction in rhizomatous grasses (Kucera, 1981; Kushwaha *et al.*, 1983). Thus, the quality of an ideal habitat for the terrestrial fauna is retained, particularly for larger mammals. The emerging shoots attract the herbivores immediately after burning.

ii) Vegetation covers

The Rhino Rehabilitated Area comprises of higher level woodland and typical low lying wet tall and less moist short grasslands. On the basis of vegetation, habitat may be classified into six major types, viz., Woodland, Tall grassland, Short grassland, Marshy grassland, Aquatic area and Fringes and Riparian. Higher level woodland is about 584.0 ha and covered by trees like *Shorea robusta*, *Terminalia tomentosa*, *T. arjuna*, *Ficus glomerata*, *Schleichera oleosa*, *Cordia dichotoma*, *Mallotus* spp., and numerous creepers like *Tiliacora acuminata*. Grasslands are also interspersed with trees like *Accacia catechu*, *Salmalia malabarica*, *Dalbargia sissoo*, *Ficus religiosa*, *Syzygium cumini*, *Butea monosperma* etc. Patches of tree forest are mainly close to the water bodies in low lying area, which are resting places for the rhinos during hot period of the day especially in summer season.

Tall grassland (wet low lying area) occupy an area of about 343.0 ha and are dominated by tall grasses such as *Schlerostachya fusca*, *Saccharum munja*, *Apluda mutica*, *Themeda arundinacea* etc. Short grassland (less moist low lying area) cover an area about 807.0 ha and consists of most common species of short grasses like *Imperata cylindrical*, *Saccharum spontaneum*, *Vetiveria zizanioides* etc. Marshy grassland area (563.0 ha approx.) is covered mainly by the grasses such as *Typha augustata*, *Phragmites karka*, *Cynodon dactylon* and *Bothriochloa* spp.

All the water bodies (aquatic habitat) contain different hydrophytes, which are as follows:

Free floating hydrophytes- *Lemna perpusilla*, *Trapa natus*, *Hygrorhiza aristata*, *Spirodela polyrhiza* etc.

Suspended submerged hydrophytes- *Apomogeton crispum*, *Potamogeton pectinatis*, *Hydrilla verticellata* etc.

- a) Anchored submerged hydrophytes- *Otella alismoides*.
- b) Anchored hydrophytes with floating leaves- *Nelumbo nucifera*, *Nymphaea nouchali*, *Nymphaoidae cristata* etc.
- c) Anchored hydrophytes with floating shoots- *Monocharia vaginalis*, *Sagittaria guayanensis* etc.
- d) Amphibious hydrophytes- *Echinochloa colonum*, *E. stagnina*, *Panicum paludosum* etc.
- e) Wetland hydrophytes- *Cyanotis cristata*, *Salvia plebia*, *Xanthium strumarium*, *Cyperusiria* etc.

iii) Vegetation used as food

The Grassland of Rhino Rehabilitation Area has been studied in details by several workers prior and subsequent to the reintroduction of Indian one-horned rhinoceros. It has been recorded that Indian rhino use 55 species of plants as food belonging to different families. These include 23 species of grass and herbs, 8 species of aquatic plants, 12 tree species, 5 species of woody climbers and shrubs each and 1 species of fern. In winter rhino's diet constitutes 45% grass, 18% aquatic plants and rest 37% includes woody plants, climbers, shrubs, and trees. They are listed in the Table-1 according to their frequency of occurrence and feeding by rhinos.

During March most of the grass species attain full maturity and start drying. The water level in the water bodies also starts receding. During the burning of grasslands (between February to March) rhinos feed on bark of *Acacia catechu*, leaves of *Teliacora acuminata* and leaves and twigs of a median sized tree, *Mallotus philippinensis*. Around water bodies they feed mainly on *Cynodon dactylon*, *Hygrorhryza cristata*, *Trappa* and *Vallisnaria* sps. Within 2-3 days following the grass burn rhinos start feeding on burned swards of tall grasses and also lick the ash on the ground.

The wide range of materials eaten by rhinos suggests that the animal is not very specific in its food choices. Their food chiefly comprise of grasses. Tall Grassland is the most suitable type of feeding ground in the summer while Short Grassland and scrub during the winter. Young shoots of the tall grasses made up the bulk of the diet in tall grassland in spring and they were also the most preferred food items. During the monsoon, however, short grasses such as *Cynodon dactylon* and the tall grass such as *Saccharum spontaneum* are eaten most but the most highly preferred food types are the grasses *Imperata cylindrical* and *Vetiveria zizanioides* and aquatic plants

such as *Hydrilla verticillata* and *Hygrorhiza aristata*, which made up only a small proportion of the diet.

iv) Wallows

Indian rhinos are invariably fond of wet muddy pools (wallows) that protect them from external parasites and flies which lay eggs between the folds of their armoured skin. Many muddy pools and ditches in the RRA give abundant scope for this activity. Wallowing not only cools their huge bodies but protect them from the infection of ectoparasites. Indian rhinos sometimes rest and sleep in water, as do the African rhinos. After wallowing whole body is covered with a layer of wet mud which on drying becomes white. In summer they expend their more time in wallows and water. Wallows are to be found on the bank of 'tals' or 'nalas'. Calve with mother were also observed in wallows. It was also observed several times that there was fight among adult rhinos for the same wallow. During the monsoon these wallowing areas were filled with rainwater.

b) Population Dynamics

The original target was aimed at releasing 30 rhinos, but only 10 could be released between 1984 to 1992, including one captive male *Lohit* (from Kanpur Zoo). An adult male *Raju* and two females *Asha* and *Saheli* have died during translocation and *Lohit* had been sent back to Zoo. So, the breeding started with one male (Bankey) and Five females (*Swayambara*, *Narayani*, *Himrani Rapti* and *Pabitri*). After about 23 years duration of breeding (1989-2011), a total of 36 calves were born out of which 24 are still surviving. Hence, the vital index (birth-death ratio) will be as under:

$$VI = 100 \times \text{Birth/Death} = 100 \times 36/12 = 300$$

It indicates population increase because during 23 years under existing conditions the realized natality is still greater than the realized mortality. The population size as of now stands at 31, which composed of 8 males, 16 females and 7 calves of unknown sex. Hence, present sex ratio between male and female is about 1:2 excluding calve who's sex have not been confirmed. Presently, 31 rhinos living in 28.11 sq km area give a density of approx. 0.91 rhino/km².

Recommendations

1. Studies on the food preferences of other herbivores e.g. deer be carried out to determine the availability of the plants occurring in the RRA, their utilization and preferred herbivore stocking density.
2. Two proposals are currently being considered by the forest department to create a separate enclosure and/or to expand the existing area. However, both may prove short-term as the electric fencing around the enclosure blocks the movement of other wild animals.

3. There is also need to have a security arrangement in place in case the rhinos stray outside, and damage crops and property. Adequate compensation has to be given to the affected people.
4. Most of the water bodies of the Park are heavily silted with the result that start drying in the month of April, so silt should be removed to create perennial bodies.

Acknowledgement

I wish to express my sincere thanks to Sri Shailesh Prashad, Director and Sri Sanjay Pathak, Deputy Director, Dudhwa Tiger Reserve for their kind support. I am also thankful to park staff including range officers, forest guards and 'mahavats' for their help and co-operations time to time during the study.

References

1. Bauer J.J. (1988). Reintroductions as a management tool for critical species in Nepal. Int. Symp. on the Biology of Pacific Mammals, Beijing, China, 26.7-31.7, 1988
2. Bhattacharya A. (1992). An Instance of Interspecific Aggression between Great Indian One-horned *Rhinoceros* (*R. unicornis* Linn.) and Indian Elephant (*Elephas maximus* Linn.) at Gourumara Wildlife Sanctuary, West Bengal, *J. Bombay Nat. Hist. Soc.*
3. Bhattacharya A. and Acharya S. (1994). Identification of Great Indian One-horned Rhinoceros
4. (*R. unicornis* Linn.) by foot impression. *J. Wildl. Mngt.*, U.S.A.
5. Bhattacharya, A. and Pal, B. C. (1982). Daily Activity Cycle of Great Indian one horned rhinoceros at Gorumara and Jaldapara wildlife sanctuary in West Bengal. *All India Symposium on Wildlife Biology* 12: 1-5.
6. Chaturvedi A.N. and Mishra C.M. (1985). Ecological survey of grasslands at Dudhwa National Park. *Indian foresters* 11(8): pp 579-82.
7. Dutta, A. K. (1991). *Unicornis*. Konark Publishers Pvt. Ltd., New Delhi.
8. Day R. and Singh R.L. (2000). Management Plan of Dudhwa National Park for the period 2000-01 to 2010-11, pp 236-301.
9. Hajra P.K. and Shukla V. (1982). Dudhwa National Park: Some botanical aspects of the proposed new habitat for rhinos. Botanical survey of Indian Howrah. April 1982: 1-12(1): pp 41-48.
10. Lahan, P. (1974). Aggressive behaviour of the Great Indian one-horned Rhinoceros (*Rhinoceros unicornis* Linn.). *The Rhino, Journal of Kaziranga Wildlife Society* 2 (1):13-19.
11. Laurie, W. A. (1978). The Ecology and Behaviour Of the Greater One-Horned *Rhinoceros*. Ph.D. Dissertation, University of Cambridge.
12. Laurie, W. A. (1982). Behavioural Ecology of the Greater One-Horned Rhinoceros (*Rhinoceros unicornis*). *Journal of Zoological Society of London* 196: 307-341.
13. Kucera C.L. (1981). Grasslands and Fire. In: *Fire regimes and Ecosystem properties* (Eds. Mooney H.A., Bonnicksen T.M., Christensen N.L., Lotan J.E. and Reiners W.A.), General
14. Technical Report WO 26, Honolulu, Hawaii.
15. Kushwaha S.P.S., Ramakrishnan P.S. and Tripathi R.S. (1983). Population dynamics of *Imperata*
16. *cylindrica* (L.) Beauv. Var. major related to slash and burn agriculture (Jhum) in Northern Eastern India. *Proc. Indian Acad. Sci. (Pl. Sci.)*, 92(4):313-321.
17. Kushwaha S.P.S., and Madhav Unni N.V. (1986). Application of remote sensing techniques in forest cover monitoring and habitat evaluation-A case study at Kaziranga National Park, Assam. (Eds. Kamat D.S. and Panwar H.S.). A seminar-cum-workshop on Habitat Evaluation Using Remote Sensing Techniques. Dehradun. Pp. 265.
18. Martin E.B. (1983). The trade in rhino products in India, Indonesia, Malaysia, Burma, Japan and South Korea. Martinus Nijhoff Publisher, London, pp 415.
19. Mishra C.M. and Chaturvedi A.N. (1985). Ecological survey of grasslands at Dudhwa National Park. *Indian Forester* Vol. 111(8): pp 579-582.
20. Patar, K. C. (1977). Food preferences of the One-horned Indian Rhinoceros, *Rhinoceros unicornis* in Kaziranga, National Park, India, M.S. Thesis. Michigan State University, U.S.A.
21. Sale J.B. (1981). Final Recommendation of the Rhino Sub-Committee of the Wildlife Status Evaluation Committee of the IBWL, on the Translocation of Great Indian Rhinoceros. Government of India, New Delhi, Mimeo Sale J.B. and Woodford M.H., 1981: Preliminary Report on Drug Immobilization and Transport of the Great Indian Rhinoceros. Project

- IND/74/046, India: Crocodile Breeding and Management FAO, Rome.
22. Sale J.B. (1986). Rhinos re-established in Uttar Pradesh. *Indian Forester*, 112 (10): pp 945-48.
 23. Sale J.B. and Singh S., 1987: Reintroduction of greater Indian rhinoceros in to Dudhwa National Park, *Oryx*. 21 (2); pp 81-84.
 24. Schenkel R. (1983). Report on the suitability of Dudhwa National Park, U.P. as potential site for reintroduction of the Indian Rhinoceros. IUCN species survival Commission, Gland, Switzerland, Mimeo.
 25. Singh V.P. (1982). Bio-ecological studies on *Cervus duvauceli duvauceli*, Swamp deer (Barasingha) in Dudhwa near Indo-Nepal Border. Ph.D. dissertation submitted to Kanpur University.
 26. Singh Samar and Rao K. (1984). India's rhino reintroduction, Govt. of India, Department of Environment, pp 76.
 27. Sinha S.P. and Swarkar V.B. (1991). Habitat and dietary selection by the population of reintroduced Great India one-horned rhinoceros (*Rhinoceros unicornis*) in Dudhwa National Park. International Rhino conference, Rhinoceros Biology and conservation, San Diego, California, U.S.A.: 9-10 May 1991.
 28. Sinha S.P. and Sawarkar V.B. (1992). Management of the reintroduced Indian one-horned Rhinoceros (*Rhinoceros unicornis*) in Dudhwa National Park. IVth World Congress of National Park and Protected Areas. Caracas, Venezuela. 10-21 Feb. 1992.
 29. Sinha S.P., Sawarkar V.B and Tiwari A. (2001). Management of Re-introduced Greater one-horned Rhinoceros (*Rhinoceros unicornis*) in Dudhwa National Park & Tiger Reserve, Uttar Pradesh, India. Proceedings of the International elephant and rhino research symposium, Vienna, June 7-11, 2001. 222-230.
 30. Tripathi, A. K. (2004). Ecology and Behaviour of Rehabilitated Rhino, *Rhinoceros unicornis* in Kakraha Block of Dudhwa Tiger Reserve. Ph.D. Thesis, C.S.J.M. University, Kanpur, India.
 31. Tripathi A.K. and Singh V.P. (2011). Re-Evaluation of Rhino Rehabilitation Programme in Dudhwa Tiger Reserve. In: Proceedings of the National Conference on 'Climate Change, Biodiversity and Conservation', Rajkumar S.D., C.O. & Lal J.K. (eds.). IJBT (2011) 2 (Special Issue) Gayatri Technological Publication, Palayamkattai, India, Pp. 1-9.
 32. Yadav, V. K. (2000). Male-male aggression in *Rhinoceros unicornis*: A case study from North Bengal, India. *Indian Forester* 126: 1030-1034.

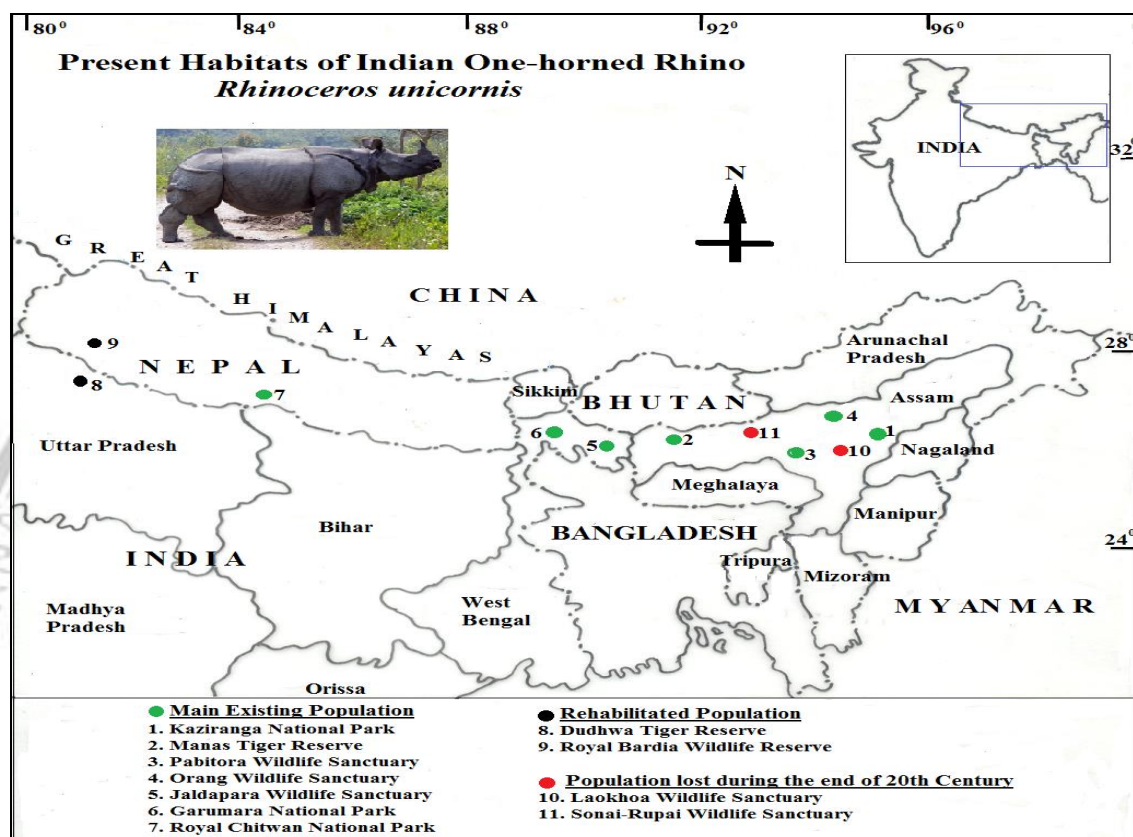


Fig. 1: Present Habitats of Indian One-horned Rhino, *Rhinoceros unicornis*

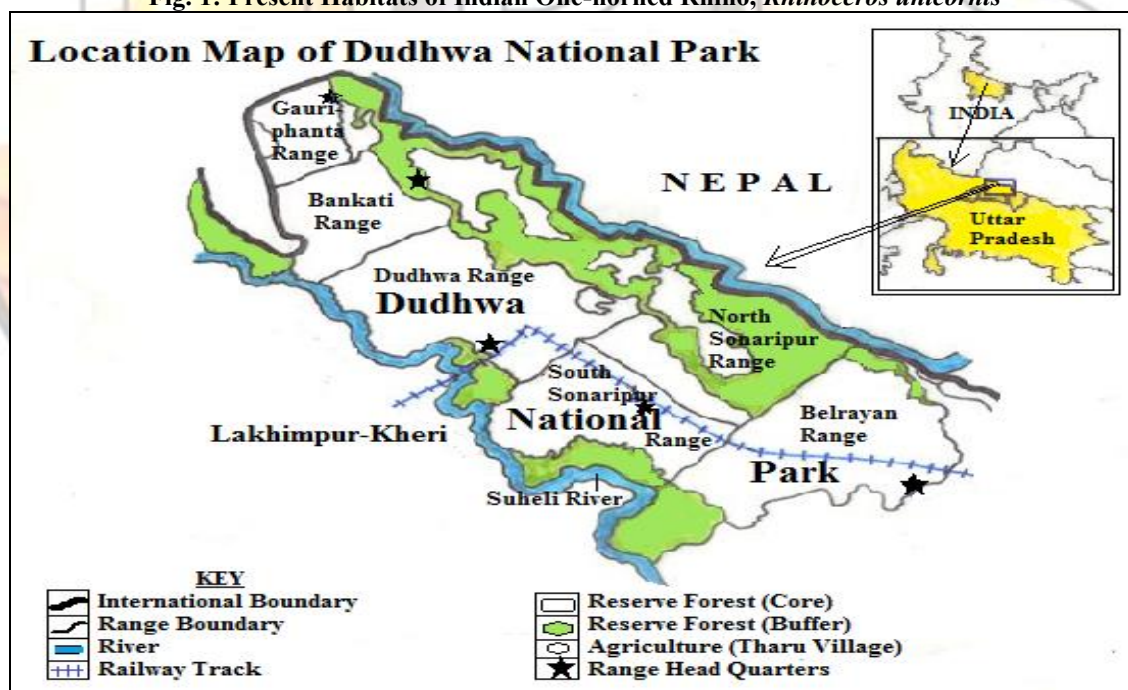


Fig. 2: Location Map of Dudhwa National Park

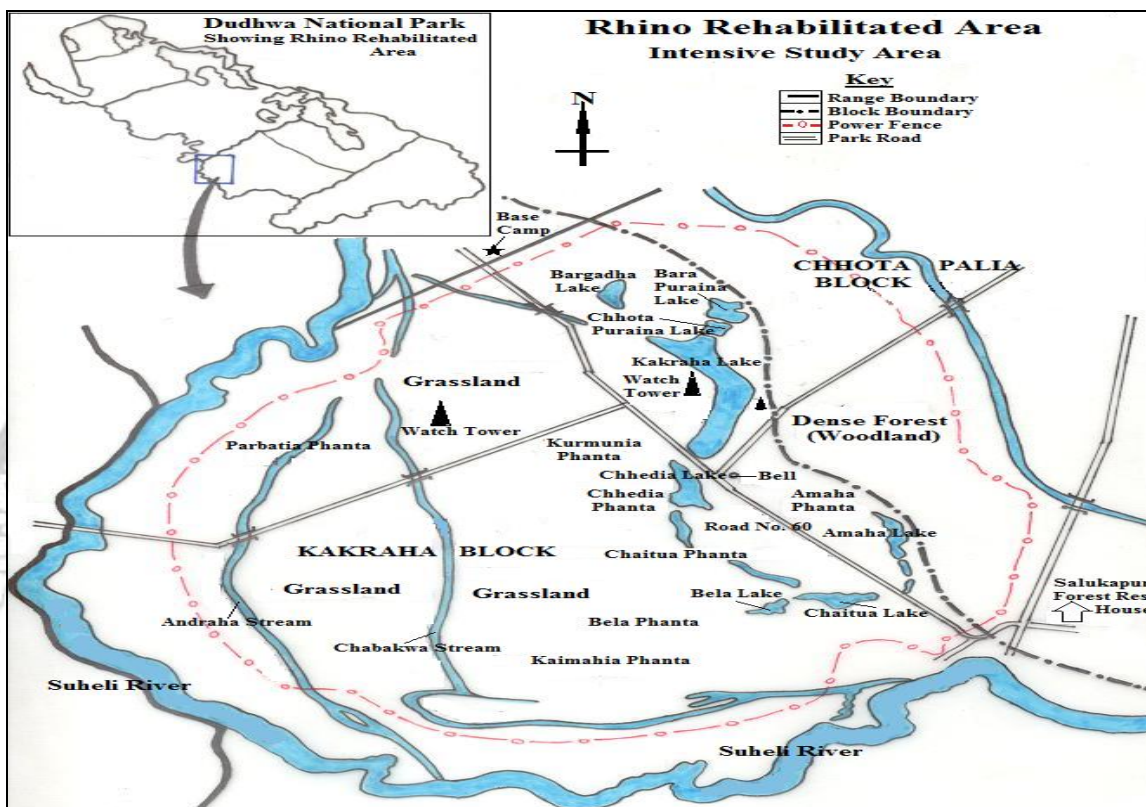


Fig. 3: Rhino Rehabilitated Area in Dudhwa NP

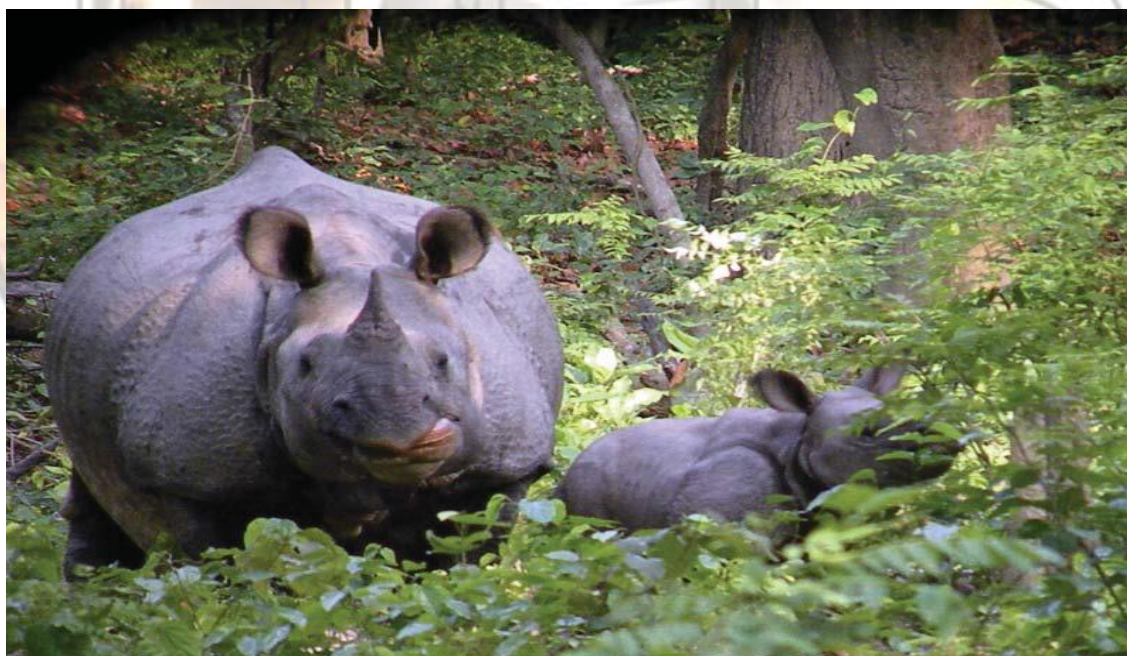


Fig. 4: Mother with calf (Courtesy: Mr Shailesh Prashad)

Table 1: List of food plants of Indian Rhinoceros

Grasses	Herbs and shrubs	Aquatic Plants	Climbers & Trees
1. <i>Imperata cylindrica</i> 2. <i>Imperata arundinacea</i> 3. <i>Narenga porphyrocoma</i> 4. <i>Saccharum spontaneum</i> 5. <i>S. bengalensis</i> 6. <i>S. munja</i> 7. <i>Vetiveria zizanioides</i> 8. <i>Setaria verticellata</i> 9. <i>Themeda triandra</i> 10. <i>Phragmites karka</i> 11. <i>Arundo donax</i> 12. <i>Arundinella bengalensis</i> 13. <i>Sclerostachia fusca</i> 14. <i>Hygrorhiza aristata</i> 15. <i>Chrysopogon aciculata</i> 16. <i>Cynodon dactylon</i> 17. <i>Eragrostis tenella</i> 18. <i>E. japonica</i> 19. <i>E. atrovirens</i> 20. <i>E. unioloides</i> 21. <i>Hemarthria compressa</i> 22. <i>Pennisetum polystachyon</i> 23. <i>Bothriochloa intermedia</i> 24. <i>Politoca digitata</i> 25. <i>Paspalidium flavidum</i>	1. <i>Cyperus</i> sp. 2. <i>Solanum nigrum</i> 3. <i>Murraya koenigii</i> 4. <i>Ehretia acuminata</i> 5. <i>Polygonum plebelium</i> 6. <i>Ageratum conyzoides</i> 7. <i>Eupatorium odoratum</i> 8. <i>Colebrookia oppositifolia</i> 9. <i>Erigeron</i> sp. 10. <i>Artemesia nilagirica</i> 11. <i>Trewia nudiflora</i> 12. <i>Litsaea</i> sp. 13. <i>Premna</i> sp. 14. <i>Typha elephantine</i> 15. <i>Tamarix dioica</i>	1. <i>Hydrilla verticillata</i> 2. <i>Vallisneria spiralis</i> 3. <i>Hygrorhiza aristata</i> 4. <i>Potamogeton crispus</i> 5. <i>Trapa natus</i> 6. <i>Trapa bispinnosa</i> 7. <i>Eichornea crassipes</i> 8. <i>Nymphaea nouchali</i> 9. <i>Ipomoea reptans</i> 10. <i>Nelumbo nucifera</i> 11. <i>Pistia stratiotes</i> 12. <i>Ceratophyllum demersum</i>	Bark of <i>Acacia catechu</i> , Leaves of <i>Teliacora acuminata</i> Leaves and twigs of <i>Mallotus philipinensis</i> <i>Bombax ceiba</i> and Paper mulberry