



Habitat suitability of Laokhowa Burhachapori wildlife sanctuary complex of Assam, India for *Rhinoceros unicornis* Linn.

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Abstract

The study is an assessment of the present habitat for Great Indian One-horned Rhinoceros in Laokhowa and Burhachapori Wildlife Sanctuaries of Assam. Focused group discussions were conducted with forest staff and fringe villagers who were familiar with the rhino range of the sanctuaries before 1983. Temporal assessment of the land use and land cover of the sanctuaries was done using satellite imageries to understand the change in the overall habitat. Assessment of the present habitat suitability for rhinos in LBWLS complex was done by overlaying a 1x1 km grid over the study area and collection of field data pertaining to 15 parameters from each grid using relevant sampling techniques. The study documents extensive temporal change in the landcover of the two sanctuaries. It also finds that 7.8% of the complex is highly suitable habitat for rhinos while 51.3% is least suitable. The study concludes that the present habitat of Laokhowa and Burhachapori is suitable for supporting rhinos and recommends that the highly suitable and suitable habitat areas can be immediately used for translocation of rhinos under the IRV2020 programme.

Keywords: rhino, habitat suitability, Kaziranga, tiger reserve, Laokhowa, Burhachapori, IRV2020.

1. Introduction

The contiguous Laokhowa and Burhachapori Wildlife Sanctuaries (LBWLS) (Figure 1) are two important Protected Areas (PAs) of central Assam (Ojah *et al.*, 2012, Assam Forest Department, 2014). Laokhowa WLS (LWLS) is located between latitudes 26°28'31.85"N to 26°32'13.95"N and longitudes 92°37'57.91"E to 92°47'23.27"E having a total area of 70.1 sq.km in Nagaon district. Burhachapori WLS (BWLS) is located between latitudes 26°30'34.16"N to 26°33'48.96"N and longitudes 92°34'27.31"E to 92°46'10.667"E with a total area of 44.06 sq.km in Sonitpur district (Bora 2003, Phukan & Sharma 2003, Ojah *et al.*, 2012, Ojah 2014, Yadava 2014, Yadava). The two sanctuaries lie between the Kaziranga National Park (NP) to the east and the Orang NP to the west. In 2007, both Laokhowa and Burhachapori were

declared as the buffer components of the Kaziranga Tiger Reserve (KTR). At present, the sanctuaries are managed by the Nagaon Wildlife Division, under the Director, KTR (Assam Forest Department 2014, Yadava 2014, Yadava).

The biological value of the PAs can be gauged from the fact that Laokhowa was notified as a Proposed Reserve Forest (PRF) along with Kaziranga in the first decade of the 20th century on the basis of its then rhino population (Yadava). In 1955, this area held 41 great one-horned rhinos (*Rhinoceros unicornis*). (Laurie 1978, Menon 1996). During the early 1980s, the area was home more than 70 rhinos. However, due to the unstable political situation of the state during early 1980s (Assam Agitation), poachers massacred more than 40 rhinos within a matter of weeks in 1983 (Menon 1996, Bora 2003, Phukan & Sharma 2003, Ojah 2014). The rest of the surviving rhinos fled to

nearby safer PAs such as Orang and Kaziranga Ojah *et al.*, 2012, Assam Forest Department, (Talukdar 2000, Bora 2003, Phukan & Sharma 2003, 2014, Yadava).

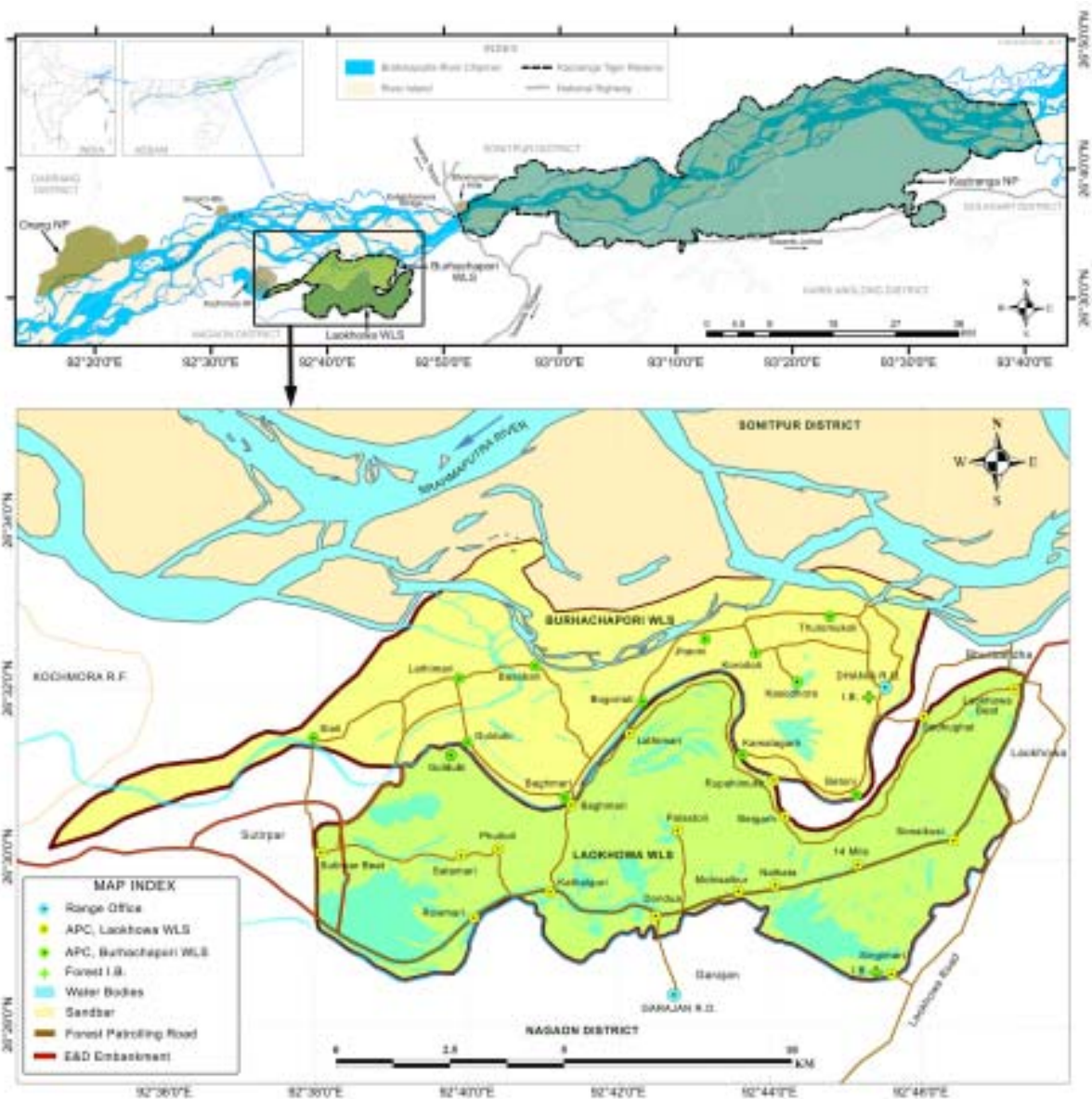


Fig. 1 : Locational Map of the Study Area

Source : Field Work, Assam Forest Department

2. Ecology and conservation significance

The region is primarily a flood plain area on the bank of the Brahmaputra representing the ideal alluvial Brahmaputra Valley ecosystem with a unique combination of grasslands, woodlands, wetlands and different riparian forest types. It falls under the sub-tropical monsoon climatic regime. The region has a gentle slope gradient from south to north and east to west and the elevation varies from 35 to 60 meters above M.S.L. Most of the low-lying areas are prone

to monsoon-induced floods which inundates about 50 to 70 % of the total land mass every year. (Bora 2003, Phukan & Sharma 2003, Ojah *et al.* 2012, Yadava).

The PAs are home to large mammals like Asiatic wild buffaloes (*Bubalus arnee*), Royal Bengal tigers (*Panthera tigris*) and elephants (*Elephas maximus*). Besides, the alluvial grasslands sustain a large number of herbivores like sambar (*Rusa unicolor*), barking deer (*Muntiacus muntjak*) and hog deer (*Hyelaphus porcinus*). Many rare and endangered species of small

cats, reptiles, turtles, butterflies and nocturnal species like binturong (*Arctictis binturong*) and slow loris (*Nycticebus bengalensis*) are found in the PAs. The perennial and seasonal wetlands functions as breeding ground for numerous local fish species and important bird species. Large number of migratory birds, including water fowls, visit the rich wetlands of the two PAs every winter. The sanctuaries are Important Bird Areas (IBAs) (IN393) (Birdlife International 2015). About 290 bird species have been documented within the LBWLS complex (NWLD-LBCS 2014). The sanctuary complex is home to the critically endangered Bengal florican (*Houbaropsis bengalensis*) (Birdlife International 2015) and is the breeding ground to thousands of Blue-tailed Bee-eaters (*Merops philippinus*). Gangetic River Dolphins (*Platanista gangetica*) are regularly seen in the waters of the Brahmaputra River flowing through and adjacent to BWLS (Bora 2003, Phukan & Sharma 2003, Islam & Rahmani 2004, Ojah *et al.* 2012, Yadava).

Along with Kaziranga and Orang NPs, both LWLS and BWLS form the central Assam conservancy landscape. These PAs are connected to each other through the Brahmaputra River and its numerous islands, locally known as *chars* (Bhagabati & Lahkar 1998). This riverine area acts as an important wildlife migratory corridor. Ahmed *et al.*, (2010) and Ojah *et al.*, (2011) have documented the use of the corridor along with LBWLS by tigers and rhinos for migration between the NPs. There are many reports of rhinos visiting the two sanctuaries during the course of their migration between Kaziranga and Orang throughout the 1990s and early years of the first decade of this century. Considering the importance of this corridor, LWLS and BWLS were declared as buffers components of the KTR in 2007 with the primary aim of ensuring connectivity among the central Assam conservancy landscape components (Yadava) and at the same time, link the meta-population tigers of Kaziranga NP with Orang NP (Ahmed *et al.*, 2009).

3. Objectives of the study

The Assam Rhino Range Expansion Project (ARREP), also known as the Indian Rhino Vision-2020 (IRV-2020) programme is aimed at increasing the wild rhino population of Assam to 3000 by the year 2020 and at the same time ensure expansion of rhino habitat by translocating rhinos from source regions like Pobitora and Kaziranga to destinations like Manas, Laokhowa, Burhachapori and Dibru-Saikhowa (Foose & Strien 1997, IUCN, 1997, Assam Forest Department

2014, Yadava). The present study was conceptualised with the background of understanding the suitability of the prevalent habitat of LBWLS as home for rhinos proposed to be translocated under the Indian Rhino Vision (IRV) 2020 programme. The study was undertaken with the following objectives:

- To identify the historical rhino range of Laokhowa Burhachapori WLS complex;
- To assess the temporal change in the habitat of the sanctuaries &
- To study the suitability of the present habitat of Laokhowa-Burhachapori for rhinos.

4. Methods and materials

4.1 Identification of the historical rhino range

In order to understand and identify the habitat range used by resident rhinos of Laokhowa and Burhachapori before the massacre of 1983, focused group discussions as a Participatory Rural Appraisal (PRA) tool, was employed (Mukherjee 1993). The pre-1983 rhino range of Laokhowa and Burhachapori region was worked out by conducting discussions among the following two groups -

- Village elders who have been residing in the fringe and forest villages and saw first hand, rhinos in Laokhowa and Burhachapori region before 1983;
- Forest staff who served in Laokhowa and Burhachapori prior to 1983.

Participants from each group were asked to identify and mark the locations which were used by rhinos for activities such as foraging, grazing, wallowing, drinking and resting on outline maps of the sanctuary complex. Field visits were then undertaken with 13 participants from the first group and 7 from the second group. The data so collected was used to prepare the pre-1983 rhino range map of LBWLS.

4.2 Assessment of temporal change in the habitat of the sanctuaries

To assess the temporal change in the overall habitat of of LBWLS, satellite imageries belonging to different temporal periods (Table 1) were analysed using ERDAS 8.5™ software. Training sites comprising of 156 locations were collected from the field using Garmin Etrex Vista HCX™ handheld GPS device and they were used to carry out detailed supervised classification of the imageries (Kushwaha *et al.*, 2000, Hazarika & Saikia 2006, Kushwaha *et al.*, 2009).

Table 1: Details of Satellite Imageries used in the study

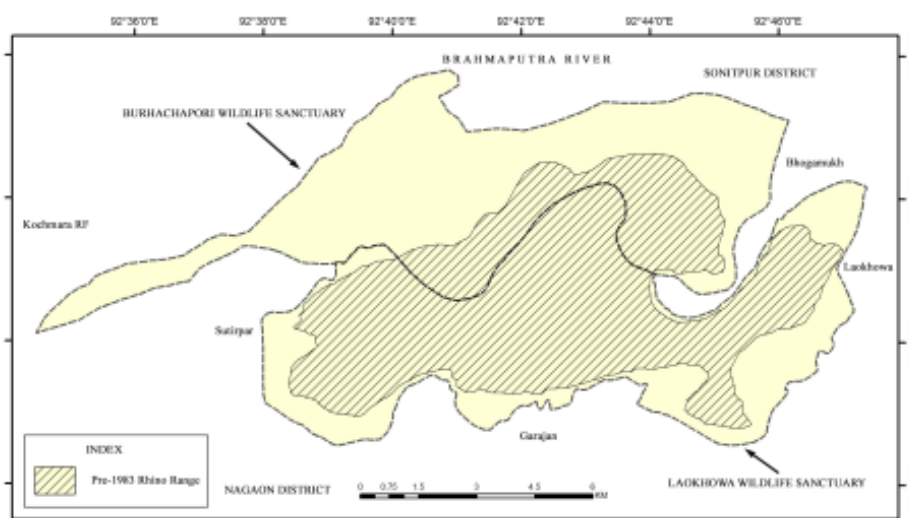
Imagery	Year	Path	Row	Date
Landsat 3 MSS	1979	146	42	14 March
Landsat TM 5	1987	136	42	12 December
Landsat TM 4-5	2001	136	42	07 February
IRS P6LIII	2008	111	53	29 February
IRS P6LIV	2013	111, 112	52D, 53A, 53B	13 March

A 1 sq.km. grid overlay was made over the study area using ArcGIS 10.1 software on the classified image. Parameters specific to rhino habitat were identified through review of relevant literature (Laurie 1978, Dutta 1991, Konwar *et al.* 2009). In all, the following 15 habitat parameters were considered in the analysis - 1. Fodder Quality, 2. Fodder Availability, 3. Drinking water availability, 4. Wallowing space, 5. Perinuality of wetlands, 6. Land cover distribution, 7. Highland presence, 8. High flood inundation, 9. Ungulate presence, 10. Pre 1980s rhino presence, 11. Soil / Bank erosion, 12. Human presence, 13. Thatch collection, 14. Fishing and 15. Livestock grazing. Out of the 15 parameters, the first 11 belonged to ecological aspects while the remaining 4 belonged to anthropogenic aspects. Field data pertaining to these parameters from each grid were collected, assessed and scored on a scale of 1 to 10 (from low to high rating). The cumulative score for all the parameters for each grid was converted into percentage (100%) and finally maps were prepared using ArcGIS 10.1™ to visualise the suitability of the present habitat for rhinos in LBWLS.

5. Findings

5.1 Identification and mapping of pre-1983 rhino range

On the basis of the focused group discussions conducted among the fringe villagers and forest staff who were familiar with the situation of the LBWLS complex prior to the 1983 massacre of rhinos, it was seen that about 54 sq.km. of the sanctuary complex was used by rhinos as their habitat before 1983 (Figure 2). The areas where significantly high number of rhinos were reported to be concentrated in the past were Rupahimukh, Arimora, Lathimari, Palashtoli, Phultoli, Satamari, Guldubi, Sutirpar, Raumari, Danduwa, Saralani, Singimari, and Tongghar regions of LWLS and Chenimari, Kasodhora, Koroitoli, Bogoriati, Baghmari and Guldubi regions of BWLS. Further, significant concentration of rhinos used to be seen along the *Dhania suti* (offshoot stream) which forms the boundary between LWLS and BWLS along with the wetlands of LWLS stretching east to west all along the flood control embankment which runs along the southern boundary of LWLS.

**Fig. 2 :** Pre-1983 Rhino Range of Lakohowa and Burhachapori WLSs

5.2 Assessment of temporal habitat change

Land cover of the LBWLS Complex changed significantly from 1979 to 2013. An observation of the pattern of temporal change in the land use and land cover classes of LWLS (Figure 3) shows that there has been a gradual decline in the woodland from 1979

till 2008. This loss of woodland stabilized from 2008 onwards. The area under grassland showed a steady increase throughout the period of analysis. On the other hand, area under non-forest activities (area under encroachment, forest and taungi village) showed a slight decline after 2008.

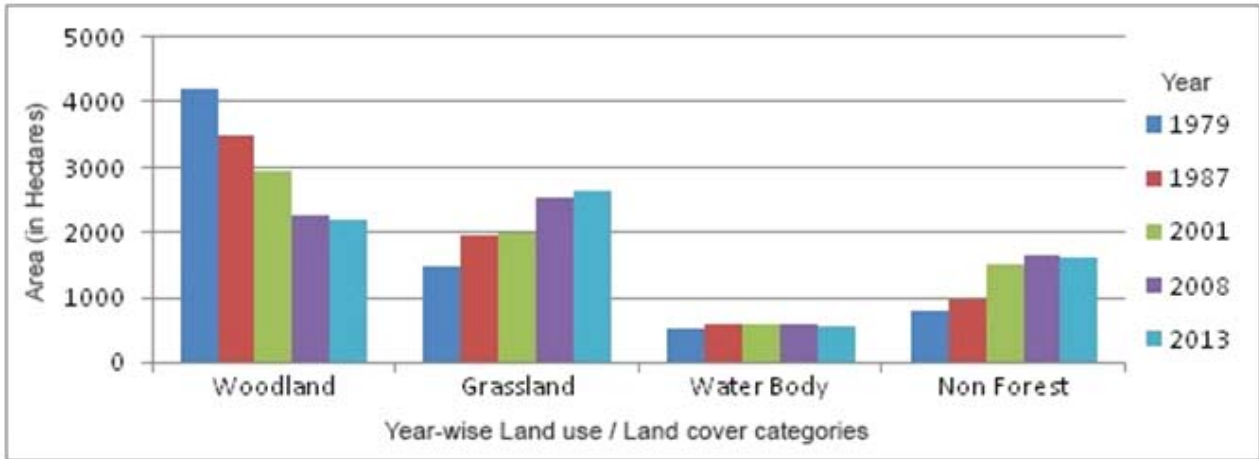


Fig. 3 : Temporal change in Land use and Landcover of Laokhowa WLS

Woodland cover in BWLS decreased exponentially till 2008 and after this period till 2013, the woodland cover showed an increasing trend (Figure 4). Further the area under grassland too increased post 2008. Interestingly, the area under sand deposit in BWLS has shows a constant increasing trend throughout the period of analysis. Post 2008,

the area under non-forest activities shows significant decrease. Increase in the area under grasslands for both LWLS and BWLS indicate an improving rhino habitat. Field verification revealed that grassland growth occurred mostly in the *Impereta cylindrica* and *Saccharum ravanna* patches which are preferred rhino fodder (Konwar *et al.*, 2009).

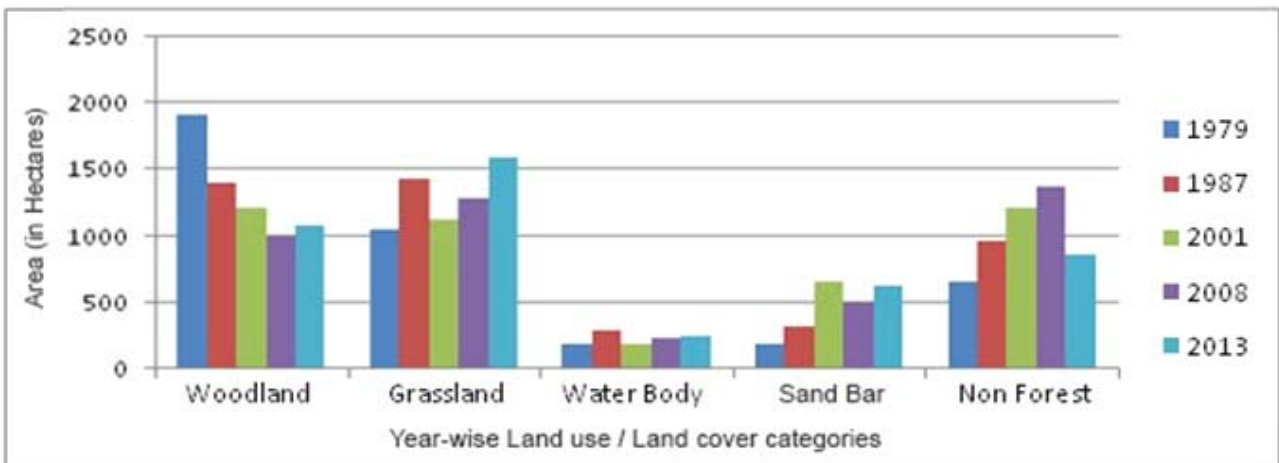


Fig. 4 : Temporal change in Land use and Landcover of Burhachapori WLS

5.3 Study of suitability of present habitat suitability for rhinos

The grid-wise cumulative score for the 15 rhino habitat suitability assessment parameters, was

categorised into 4 groups of hierarchical order categorization of habitat suitability, viz. least suitable, moderately suitable, suitable and highly suitable habitats (Table 2). The grid wise cumulative scores

were then converted into percentage (100%) to arrive at the prevalent rhino habitat situation for LBWLS complex (Figure 4).

Table 2 : Rhino Habitat Categorization Score and Number of Grids against each Habitat Category

Habitat Suitability	Habitat Score	Total No. of Grids
Least Suitable	<25%	79
Moderately Suitable	26-50%	40
Suitable	51-75%	23
Highly Suitable	> 75%	12

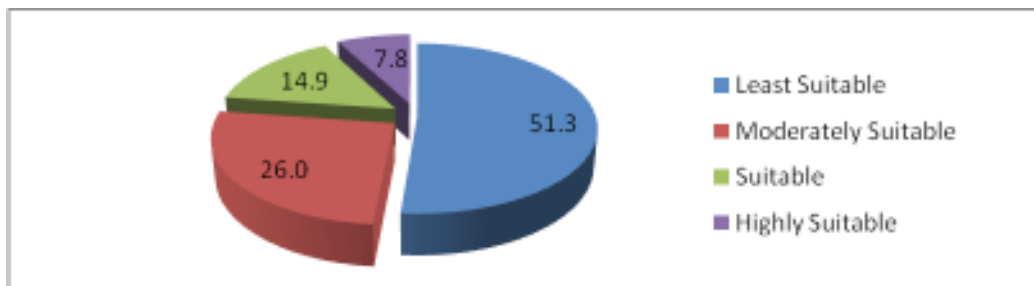


Fig. 4 : Category-wise Distribution (in %) of Rhino Habitat in LBWLS

Figure 5 shows that only 7.8 % (12 sq.km.) of the total grids assessed had highly suitable rhino habitat while 14.9% (23 sq.km.) of the grids have suitable habitat. Further, 26% (40 sq.km.) have moderately suitable rhino habitat. Finally, 51.3% (79

sq.km.) of the total grids surveyed have least suitable habitat for rhinos. Figure 6 gives us a visual depiction of the rhino habitat suitability categorization for the Laokhowa Burhachapori complex on the basis of the grid analysis.

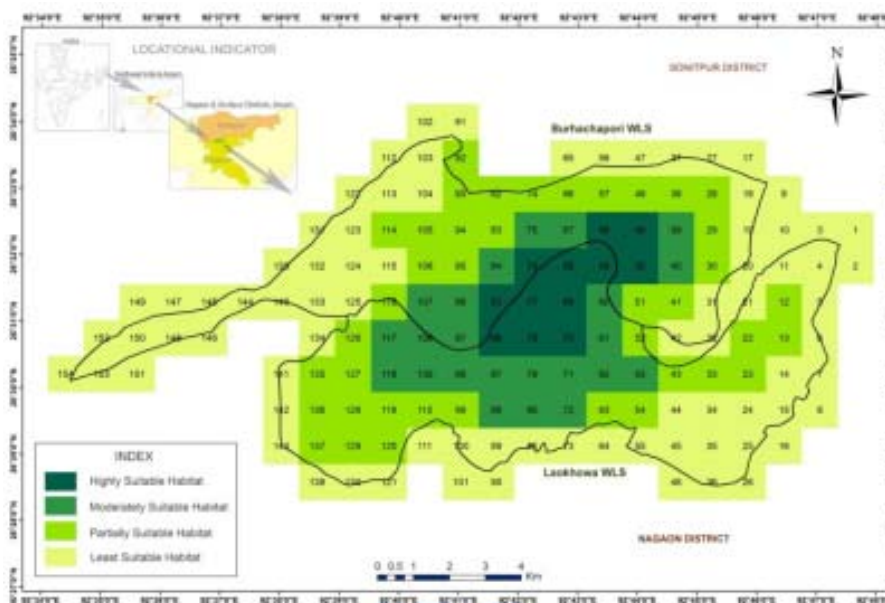


Fig. 5 : Grid based habitat assessment for Rhinos in Laokhowa Burhachapori WLS complex

Source : Field work

6. Discussions

Assessment of the pre-1983 rhino range of LBWLS shows that rhinos were using an extensive habitat of the two PAs. Most of the rhino population was concentrated along the central and southern parts of LWLS while some rhinos inhabited the wetland dominated regions of BWLS.

Temporal land cover assessment of LWLS reveals that there has been significant decrease in the woodland cover of both sanctuaries between 1979 and 2008. Between 2008 and 2013, the woodland cover has recorded a marginal increase in BWLS while the same seems to have stabilised in LWLS. Grasslands are the prime habitat for the greater one-horned rhinoceros. Since 1979, the area under grasslands has seen a considerable increase in LWLS. BWLS too has seen steady increase in the area under grasslands since 2001. This can be attributed to the illegal felling induced loss of area under woodlands. Area under grasslands has increased between 2008 and 2013 in both the PAs and can be attributed to the implementation of grassland management strategies by the forest department, such as annual burning of grasslands (during February and March) which has controlled the invasion of woodlands into grassland areas. Significant decrease in the area under non-forest use in BWLS is due to the removal of encroachment and 147 traditional dairy farms (*khuttis*) from inside the sanctuary.

The total area of the LBWLS falling under the highly suitable habitat category was 12 sq. km which included the regions of Kasodhora, Koroitoli, Hijalbari, Kherbari and south of Jhaoni, areas all along the Dhania *suti*, up to Bogoriati and Baghmari of BWLS and lies contiguous in LWLS in Arimari, Lathimari, Palashtoli up to Bogoriati. The area is confined entirely to the central region of the sanctuary complex. The presence of 4 perinneal and numerous seasonal water bodies offer excellent wallowing and drinking water sites to rhinos. Extensive patches of aquatic plants like *Hemarthria compressa*, *Arundo donax*, *Ipomea aquatica* and *Hymenachne pseudointerrupta* in these wetlands are prime rhino fodder. The grassland patches are dominated by rhino fodder like *Imperata cylindrica* and *Saccharum ravannae*. Patches of palatable *Cynodon dactylon*, *Saccharum spontaneum*, *Vetiveria zizanioides* and trees like *Ziziphus zuzuba*, *Lagerstroemia flos reginae*, *Barringtonia acutangula* among others, comprise a diverse and abundant fodder base. There are a few highland patches in the region which remain

inundation free even during high floods. The presence of a significant ungulate population was recorded during the surveys in the regions. All the grids of this category were extensively used by rhinos before 1983. Overall, 27 different rhino fodder were identified in the areas under this category. Grazing and anthropogenic disturbance in the grids falling under this category was comparatively less than other regions, though some amount of disturbance in the form of fishing and livestock grazing was documented in these regions.

The regions falling under suitable habitat category enjoyed all the ecological advantages *vis-a-vis* the highly suitable regions. However, noticeable degradation of grasslands were seen induced by heavy livestock grazing and illegal thatch cutting. Illegal fishing was also seen extensively in the wetlands. However, ungulates presence was seen to be satisfactory in this region. This indicate that in spite of some degree of anthropogenic and biotic disturbance, the regions under this category still harbours good wilderness value. Given the wide availability of rhino fodder and presence of perinneal water bodies, with some degree of management intervention in the form of protection and grassland management, this zone can easily attain the qualitative and quantitative values that defines the highly suitable category.

Regions falling under the moderately suitable habitat category suffered from high degree of habitat degradation and anthropogenic pressures. However, these, too can be checked with sustained management intervention and the regions under this category can be brought under suitable to highly suitable category in time. In the areas falling under the least suitable category, apart from extensive biotic and anthropogenic disturbances, presence of human encroachment is a serious threat in many of the grids of this category, making them least suitable as rhino habitat.

7. Conclusion

In spite of years of neglect of Laokhowa and Burhachapori WLSs by the forest department in particular and the society in general, the study shows that the PAs still harbour a habitat which is essential to make it home for rhinos once again. About 35 sq.km. (26.9%) (highly suitable + suitable categories) of the sanctuary complex has habitat to which rhinos can be translocated and soft-released (within a security enclosure) immediately under the IRV2020 programme

with adequate security measures. The study also reveals that with some degree of management intervention in the form of reducing livestock grazing pressure, controlling illegal thack cutting and fishing can lead to increase the suitable habitat of rhinos from 26.9% up to 52.9% (addition of the moderately suitable habitat category to highly suitable and suitable categories). Given the more or less intact rhino habitat of the complex, translocation of rhinos to LBWLS under the IRV2020 programme can be undertaken under a controlled environment. Strengthening the participatory conservation mechanism which is being implemented in the fringe villages of the two sanctuaries, making the on-going eco development and alternative livelihood

programme self-sustaining in the long run, enhancing the protection paraphernalia and undertaking scientific habitat management measures by the forest department would go a long way in bringing back rhinos once more to their historic homes, the Laokhowa and Burhachapori Wildlife Sanctuaries of Assam.

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