

## **In-situ conservation of wild herbivores in Indian Eastern Himalaya – a success story** \*

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### **Introduction**

Webster's dictionary describes environment as the surroundings, especially the materials and spirituals influences, which affect the growth, development and existence of a living being. Since the 1960s growing environmental awareness has focused attention on the over exploitation of natural resources. Human health, terrestrial and aquatic ecological systems and socio-economic systems (agriculture, animal production, forestry, fisheries and water resources) are all vital to human development and well-being and are all susceptible to bioenvironmental change. Hence continued efforts are being made to develop strategies for biodiversity conservation throughout the globe (Samper, 2003).

The Eastern Himalayas is considered a part of the Indo-Burma hotspot biodiversity. The Indo-Burma hotspot encompasses about two million square kilometers of tropical Asia, east of the Indian subcontinent and includes all of Cambodia, Laos and Vietnam and nearly the entire territories of Thailand, Myanmar and Bhutan. In addition, the hotspot covers part of Nepal, far eastern India and extreme southern China, as well as several offshore islands such as Hainan Island in the South China Sea and the Andaman Islands in the Andaman Sea. About 7000 of the 13,500 plant species found in the Indo- Burma hotspot, are endemic, as are 528 of the 2,185 species of terrestrial vertebrates (National Geographic, 2003). The Eastern Himalayan region is also the meeting ground of the Indo-Malayan and Indo-Chinese biogeographical realms as well as the Himalayan and Peninsular Indian elements. Forest cover in the Eastern Himalayas has dwindled over the past several decades along with concomitant decline in biodiversity. Despite this loss, the region is home to botanical rarities and is exceptionally rich in endemic plant species along with mammals, birds and other animals. The Eastern Himalayas is divided into two regions. Region – I includes Nepal, Bhutan, the Indian states of Sikkim, West Bengal, Assam and Arunachal Pradesh. Rests constitute the Region – II.

The Indian Himalayan Region is spread between 21° 57' - 37° 5' N latitudes and 72° 40' - 97° 25' E longitudes. It has an area of 5,31,250 sq km spread over 12 states and constitutes about 16.16 percent of India's total geographical area. The Indian Himalayas is divided into Western, Central and Eastern Himalayas based on biogeographic elements and population features. The Indian Eastern Himalayas is one of the 25 global biodiversity hotspots. The region is not only biologically rich but also culturally very diverse. The topographic diversity of the region generates a range of natural ecosystems, extraordinarily rich in plant and animal life. In case of mammalian species, more than 50 percent of the species recorded in India could be located in the Darjeeling Himalayan region only.

- *Study conducted with WWF (Washington) assistance*

Early eighties saw the latest global resurgence of biodiversity conservation and renewed interest in the preservation of endangered flora and fauna of the world. In keeping with the international trend, the Indian state West Bengal too shifted its priority in forest management towards conservation of natural flora and fauna in the forests and wetlands. Large tracts of forest areas having ecological importance and significance had been declared as protected areas in the form of national parks, sanctuaries and tiger reserves. A protected area by definition should be secured from unrestricted use of its resources. Though, representative biomes of the Eastern Himalayan region in West Bengal are more or less well covered by protected areas, yet in totality they cover only a small portion. Both wildlife and local people are today equally threatened. In the present study, current status of ecosystem of three protected areas viz., Gorumara National Park, Jaldapara Wildlife Sanctuary and Senchal Wildlife Sanctuary vis-à-vis adjoining unprotected forest areas in different seasons has been assessed in relation to prevailing bioenvironment with special reference to selected wildlife herbivores.

## Materials and Methods

Three protected areas and adjoining unprotected areas in eastern Himalaya of West Bengal were brought under present investigation (Figure 1). Protected areas are means of mitigating environmental degradation, especially prevention of biodiversity and are hence considered essential to human welfare. The protected areas under investigation were,

- (a) Senchal Wildlife Sanctuary – It covers an area of 38.88 sq. km. and enjoys the privilege of being the oldest Sanctuary of the country, which was established way back in 1915.
- (b) Gorumara National Park – It is one of the recent (1995) introduction to the National Parks map of India, had been a Wildlife Sanctuary and a Reserve Forest since 1985. The park is spread over 79.45 Sq. Km.
- (c) Jaldapara Wildlife Sanctuary - The area was first declared as a game sanctuary in 1941 and re-notified as Wildlife Sanctuary (WLS) on 24.7.76. Jaldapara WLS having an area of 216.09 Sq. Km.

Unprotected areas under present investigation are those lying outside the protected areas. The unprotected areas virtually consist of villages/human settlement, agricultural land, and tea gardens. Forests have disappeared from the unprotected areas.

Focal herbivores for the present investigation were

1. Rhinoceros (*Rhinoceros unicornis*)
2. Elephant (*Elephas maximus*)
3. Gaur (*Bos gaurus*)
4. Sambar (*Cervus unicolor*)
5. Barking Deer (*Muntiacus muntjac vaginalis*)
6. Hog Deer (*Axis porcinus*)

## 7. Cheetal (Axis axis):

Climate of the study area was analysed to identify different seasons and also to quantify the environment. Three climatic elements viz., air temperature, atmospheric humidity and rainfall were used for the purpose. Data recorded by regional observatory at Darjeeling and Jalpaiguri, Govt. of India from 1<sup>st</sup> January 1990 to 31<sup>st</sup> December 1999 were collected for the study.

Seasonal appraisal of flora and fauna, and anthropogenic pressure was made by direct observation during repeated field visits and interaction with stakeholders and offenders.

Perennial and seasonal distribution and nature of different surface water sources, viz., rivers, streams, rivulets, lakes, pools and wetlands were studied through field visits during different seasons. Seasonal and locational level of pollution of surface water by assessing Coliform content and mineral status were determined. Coliform content was determined in two stages, (a) Field detection of coliform bacteria (Greenberg *et al.*, 1985) and (b) Laboratory confirmation for presence of faecal coliform (Collin *et al.*, 1989). Different macro- and micro-mineral content of surface water samples were analysed as per A.O.A.C. (1990) by atomic Absorption Spectrophotometer. Noise level in the study area was determined by YF – 20 Sound Level Meter. Light intensity in different locations of the forest areas at different times of the day was measured by an illuminometer with capacity of 0 to 50,000 lux. Data on wildlife population was collected from wildlife wing, Directorate of Forests, Government of West Bengal. Statistical analysis of data was conducted as per Snedecor and Cochran (1998).

## Results and Discussion

### **Climate of Eastern Himalayan Region of West Bengal**

Two centers has been identified for climatic study viz., around Gorumara National Park and Jaldapara wildlife Sanctuary in Jalpaiguri districts, mostly plain and located within a distance of 50 km and around Senchal wildlife sanctuary in Darjeeling district with hilly terrain. While maximum air temperature of Gorumara-Jaldapara area reaches  $33.8 \pm 0.4$  °C in July, it is only  $20.0 \pm 0.3$  °C in June at Senchal area. Respective minimum air temperatures were  $10.3 \pm 0.1$  and  $1.8 \pm 0.1$  °C for the two centers during January. Geographical distance between the two centers is 150 Km. Maximum relative humidity in Senchal ( $92.4 \pm 0.6\%$ ) is almost similar to that ( $92.3 \pm 0.5\%$ ) in Gorumara-Jaldapara area both reach in July. Minimum humidity is never less than 70 percent. Average annual rainfall for Senchal and Gorumara-Jaldapara areas is 2642 and 3456 mm respectively. Maximum rainfall is observed in July. Isolated snowfall is recorded in Senchal area. Climatic classification of the study area has been made following two approaches, viz., climograph and as per model suggested by Lee (1953). The later approach is considered best for domestic herbivores and hence can also be taken as appropriate for wild herbivores. In Gorumara-Jaldapara area, climographic analysis identifies two seasons viz., cold-moist (November, December, January, February, March and April) and hot-humid

(May, June, July, August, September and October). Climatic classification as per Lee (1953) reveals three seasons viz., temperate-humid (December, January and February), warm-wet (April, May, June, July August, September, October and November) and a very short lasting warm-humid (March). In the Senchal area as per climograph only one season, cold- moist prevails round the year. However according to Lee (1953) three major seasons have been identified. They are cool-dry (December, January and February), temperate-dry (March, April, May, October and November) and temperate-humid (June, July, August and September). Thus from analysis, it could be inferred that the seasonal fluctuation in the study area is not very wide and hence the wild herbivores are not subjected to much climatic stress in their home range. A long spell of rainy season is enjoyable by the herbivores under investigation.

### ***Floral and Faunal Diversity of the Eastern Himalayan Region of West Bengal***

Floral and faunal diversity is one of the major determinants of ecological richness. The floral diversity is constantly subjected to both long term and short-term manipulations leading to loss of characteristics. The major factors identified during present investigation are discussed below.

Land use situation: Forest land under private ownership has been constantly being converted to human habitation, agricultural land, tea garden etc. Considerable portion of forestland has been devoured by railway, road and river irrigation project. As a consequence, forest has disappeared from unprotected areas except those in very inhospitable zones not suitable for human habitation.

Felling and monoculture practice: Regular felling and raising monoculture or miscellaneous plantation has been carried out in the protected areas since many decades. As a result the diversity value of the vegetation with regard to habitat of wildlife, flora and fauna has been greatly depleted. Therefore presence of large blocks of monoculture/ miscellaneous plantation primarily creates hindrance in conservation of biodiversity and development of habitat for sustenance and growth of wild fauna.

Landslips and Erosion: The occurrence of landslips is quite common during monsoon in the Senchal area. River erosion is also a serious menace to the forest land during monsoon. These caused serious damage to floral diversity. Frequent change of the course of rivers particularly *Torsa*, *Jaldhaka* and *Murti* damages flora.

Frost and Snow: Frost causes considerable damage to seedling of younger plantations in higher altitudes. Smaller seedlings are damaged considerably by uprooting as a result of upheaval of soil. Adverse effects of snow are noticeable in the areas above 8000 meters where seedlings are damaged by freezing. Damage by frost and snow is observed in Senchal area.

Wind and Hailstorm: Wind of very high speed is not very uncommon. Cyclonic damage of limited extent is almost an annual occurrence. A severe cyclonic storm caused havoc uprooting large number of trees during the study period. Pre-monsoon showers with moderate storm do much damage to young plantations annually.

Climbers: Climbers are one of the main limiting factors to flora. The climbers grow fast and covers the entire ground flora, grass species as well as trees, which provide food for wildlife. In open space *Mikania sp.* grows very fast and spread within a very short time. Climbers also infest tall grass species.

Weeds: Weeds are another problem both in plain and hill forests. Except for the teak plantations, all other plantations are infested with prolific weed growth particularly during rainy season.

Fungi and Insects: Several species of fungi and insects are found to cause considerable damage to forests and plantations. Out of several insects, *sal* borer attack is most severe. Damage by red ants, champ, bug, shoot borer is also common.

Parasites and Epiphytes: Lichens and mosses in the hill forests are a source of danger in case of fire, which reaches the crown of trees by way of epiphytic growth on the trunk.

Fire: Fire is another serious limiting factor towers conservation of biodiversity in Gorumara-Jaldapara area but not that hazardous internal Senehal area, as it is damp and moist except one or two months during dry season. The fire is mainly man-made. Illicit fellers, poachers, grazers, thatch collectors, *simul* foss and other non-timber forest product collector knowingly or unknowingly , set the forest on fire dry season i.e. December to March. However typical wildfire is not a serious problem.

Grazing: There are many villages and tea-gardens adjacent to the protected areas. Even there are forest villages within the protected areas. The villagers maintained good number of domestic herbivores prominently cattle and goat. Illicit grazing occurs in the fringes. During dry season and specially during March-April, illicit grazing becomes more acute. Grazing damages younger plantations and hinders natural regeneration.

Fodder cutting and lopping: Cutting of fodder and lopping considerably interfered with the progress of natural regeneration particularly in the areas nearer to human habitation. The practice also seriously disturbs the soil cover leading to soil erosion.

Wild animals: Damage caused by wild animal is noticeable. Rhinos have a tendency of breaking down saplings of *sissoo* and *tantari*. Gour herd damages young plantations. Elephants frequently knock down trees and debark many trees. Pigs and monkeys damage young crops. Barking deer damages *kapasi* , *pipli* and oak seedlings. Bear has been found stripping off bark of *dhupi*.

Illicit felling, collection of timber, fire wood and non-timber forest product: These activities are great threat to forest areas. Possibly these are the major reasons for disappearance of forest from unprotected areas. Occasionally organized mafia employ fringe villagers and inflict heavy damage in the protected areas.

The Eastern Himalayan region in West Bengal is rich in faunatic diversity. Major faunal spectrum includes mammals, avis, insect and other invertebrates.

However, during past no attempt was made to prepare inventory of faunal spectrum. Recently, census on few mammalian species was conducted but not as a regular practice. In the present investigation efforts were made to assess diversity of selected wild herbivores viz., Rhinoceros, Gour, Elephant, Sambar and Deer. Secondary information for the purpose has been collected from respective forest managers. However, except typical migratory species viz., elephant, none of the afore-said selected species could be located in the unprotected areas except few straying cases. None of these species uses unprotected area as their home range.

Distribution of wild animals is mainly governed by the availability of food and water in association with shelter. As the daily food requirement for herbivores is considerably high they need to move over wider area with vegetation of choice to fulfill their requirement. Rhinoceros (*R. unicornis*) is considered as flagship or keystone species of Eastern Himalayan Region of West Bengal.

### **Population Dynamics and Status of Focal Herbivores.**

Status of native fauna is an important indicator of habitat condition. Congenial and stress free habitat helps in survival and propagation of fauna. In the present investigation population dynamics of focal herbivores is analyzed and threats they are receiving are identified to evaluate their bioenvironment.

Rhinoceros: Eastern Himalayan Region of West Bengal is one of the few packets containing natural population of Great Indian One-horned Rhinoceros (besides Nepal and Assam). The species belongs to Schedule 1 under Wildlife (Protection) Act 1972 of India and has been given declared 'endangered' as per Red Data Book. The species receives maximum protection at the national level. They prefer savannah grassland with ample water. Accordingly Rhinos migrate from one block to another in different seasons in search of better grassland water combination.

Rhinos were reported to be plentiful in North Bengal till towards the end of 19<sup>th</sup> century. According to the estimates of Fawcus Committee there were about 200 Rhinos in the *Torsa* region and a dozen so in the other pockets in North Bengal in 1920. The Hunting records of *Maharaja* (King) of *Cooch-Behar* indicate that about 201 Rhinos were either killed or injured in North Bengal between 1871 and 1905 and the death figure for the period 1890-1905 was 42.

The dynamics of Rhinoceros population from 1956 to 2000 was restricted to two protected areas viz. Gorumara National Park and Jaldapara Wildlife Sanctuary. Despite protection the total population from a maximum of 85 in 1966 reduced to 22 in 1985 and subsequently increased to 74 in 2000. Though very precise reasons for these fluctuation could not be pinpointed. Yet poaching and natural death are the two major causes. However since 1985 stricter protection coupled with habitat improvement helps in increasing Rhinoceros population.

Elephant: Asian elephant (*Elephas maximus*) is an endangered animal as per Red Data Book and listed under Schedule I of Wildlife (Protection) Act 1972 of India. Elephant population in the eastern Himalayan Forests of West Bengal is always on move. During last census in 2000, elephants are found to in occupation of about 1000 sq. km of forests despite the availability of about 2200 sq. km of forests at their disposal. During the census, the elephant herds were pressed on account of scarcity of water and forage. As expected, most of the habitats with high intensity occupation by elephants fall within different protected areas. However during movement and in search of food, they visit unprotected areas. A significant part of established migration route falls in the unprotected areas. The species prefers savannah grassland most.

Elephant population in the region is on increasing trend since 1978. Total number was 150 in 1978, which reached 292 in 2000. Different conservation measures have contributed significantly in increasing elephant population.

Gaur: The species (*Bos gaurus*) has been listed as 'Vulnerable' in Red Data Book and has been incorporated under Schedule I of Wildlife (Protection) Act, 1972 of India. Despite being a major large herbivore in Eastern Himalayan Forests of West Bengal, Gaur has so far received less scientific attention. They prefer savannah grasslands and grasslands mixed with several trees viz., Khair, Siris, Simul etc. Gaur highly prefers the leaves, flowers and fruits as food. They also occasionally come out from their home range located in protected areas to enter in the nearby villages and crop fields at night and cause depredations. They can even stray up to a distance of 20 km.

Information on Gaur population is available from 1993 onward. The estimated population was 425 in 1993, which increased to 550 in 1997. It again reduced to 440 in 1998. They reached a total population of 530-560 in 2000. In 1968, 31 Gaurs died in Jaldapara Wildlife Sanctuary due to Rinderpest and subsequently gaur population become sparse in the sanctuary till 1974. There are several incidences of killing of stray Gaur by villagers.

Sambar (*Cervus unicolor*), Barking Deer (*Muntiacus muntjac vaginalis*), Hog Deer (*Axis porcinus*) and Cheetal (*Axis axis*): Comparatively these species have received less scientific attention. All these animals have been incorporated under Schedule III of Wildlife (Protection) Act, 1972 of India.

Though they are the animals of savannah grasslands yet Sambar and Barking Deer prefer wooded land. Cheetals are mainly concentrated in forest fringes and edges and Hog Deers are found in same habitat as of Rhinoceros. All these species have their safe home ranges within the protected areas only. Available population data on different deer species belonging to the study area is far from complete to draw any inference on their population dynamics. The populations in Jaldapara Wildlife Sanctuary from 1964 to 1989 clearly indicate gross and haphazard fluctuations. The major reasons those could be identified are death due to diseases, poaching and failure of reintroduction. Only one survey (1999) in Gorumara National Park reveals thinner concentration of different

species. However, 199 Barking Deer in Senchal Wildlife Sanctuary during 1989 is a good population size considering its total area.

### Limiting Factors for Wild Herbivores

Wildlives in general but large herbivores in particular are facing increasingly several limiting factors which always try to reduce the number of wild animals. Better understanding of the of the factors will help in their removal. Significant aspects of different limiting factors are discussed below.

Poaching: Out of the different herbivores under study, Rhinoceros is most seriously affected due to poaching because of its horn which fetches fabulous amount in clandestine market. As many as 28 Rhinos fell to the bullets of poachers during 1968-72 in Jaldapara Wildlife Sanctuary. Poaching once threatened to eliminate the entire Rhino population from Eastern Sub Himalayan Region of West Bengal.

Elephants are poached mainly out of man-animal conflict to prevent depredation of human life, property and crop. Gradual shrinkage of habitat and corridor and expansion of human habitation have brought man in closer vicinity to elephant. This lead to higher incidence of elephant killing . Gours are invariably killed when they come out from forest during migration. However no account of Gour poaching is available. Deers are killed as their meat is a delicacy. Information on deer poaching is also far from complete.

Inter- and intra-species conflict: There are incidences of inter- and intra-species conflict which lead to even death of the animals. Limitation in home range or habitat as one of the causes is of relevance to the present investigation.

Habitat Destruction : This is the single major cause exerting maximum stress on wild animals. As it has been mentioned earlier. Habitat of wild herbivorous is now limited within protected area only. Even within the protected area, habitat is constantly subjected erosion due to change of courses of rivers following through the protected area, flood, natural process of succession e.g., grassland being invaded by trees, illegal felling, collection of non-timber forest produce, livestock grazing, fire etc.

Epidemics : Wild herbivores are very susceptible to epidemics , most of which are transmitted through domestic cattle. Anthrax, rinderpest, foot and mouth disease, pasteurolosis, tuberculosis etc. are common diseases those cause death of wild animals. In 1968 , 31 gaurs died in Jaldapara wildlife sanctuary due to rinderpest and subsequently gour population became sparse in the sanctuary till 1974. In 1993 and 1994, 3 taskers died due to anthrax. Though no major outbreak has been reported from Gorumara National Park and Senchal Wildlife Sanctuary, yet the threat is always looming large.

Thoroughfare: Entire Eastern Himalayan Region of West Bengal is crisscrossed by railways and roads to cope with the development need of

the area. Though forest and wildlife are now limited in protected areas only, yet railways and highways passing through or in closer vicinity of the protected areas are great damager to the behavioural need of the animal. *Siliguri – Alipurduar* (Meter Gauge) and *New Jalpaiguri – Darjeeling* (Narrow Gauge) sections of N. F. Railway, National Highway 31, *Jorebunglow- Kalimpong* road, *Jorebunglow-Tiger Hill* PWD road and *Aranya Sarani* are the major railways and roads. Passing vehicles and trains create sound pollution. They are exotic elements in natural forest set and hence disturbing to wild inmates. The level of sound pollution created by passing vehicles and trains was estimated by sound level meter at a 10 meter distance from the source. While a speeding truck produced 90 db, a diesel engine hauled meter-gauge train (non-whistling) created 110 db. Though natural sound of forest due to shouting of animals and birds and drone of the cricket reaches up to 55 db, yet they are never disturbing to wildlife. Migratory elephants are often trampled under speeding train.

**Tourism:** Tourism also sometimes lead to damages of vegetation and affect the behavioural need of the wild animals. Tourists go inside the forests on elephant back and in the process, elephants trample vegetation, compact soil and create additional biotic pressure. Wild animals are disturbed due to regular pressure of tourists.

### **Natural Water Sources**

An ideal habitat for wildlife should have not only a good cover (shelter) and abundant fodder but also perennial source of water for drinking and wallowing of the wild animal. In the present study, nature and distribution and microbial quality of water used by wild herbivores in the study area have been investigated.

Nature and distribution of water sources: Though, it is only the surface water which is available to the animals yet, the nature and distribution of surface water regime is to a great extent is determined by ground water. Ground water in Eastern Himalayan Region of West-Bengal occurs both under water table conditions as well as deep aquifers. Slope of water table is generally parallel with the surface slope which is south-wards. At places, the water table slope intercepts the ground surface forming springs. Gradient of the water table is very steep in the bhabar zone ( 5-6 meters per km ) While it is quit gentle in the alluvial plains further southwards (0.4 meters per km ). Different studies indicated the presence of good aquifers consisting of gravels, boulders and coarse sand up to depth of 75 metres in the bhavar zone. In this zone the depth of water is from 7.0 to 10. metres. Further south in terai and alluvial zone it varies from 2.5 to 5.5 metres.

Surface water sources: The surface water sources in the region can be classified broadly as perennial and seasonal water sources . Rivers (major and minor), streams and lakes are the perennial water sources. Some small rivers, streams or *Jhoras* are typically seasonal in nature .

River system: Major rivers flowing through the region, though perennial in nature, become shallow and tame during dry season and remain full and fierce during monsoon. All the rivers originate from Himalaya and move southward. The beds of the river are rising continuously as a result of carrying down a large quantity of silt and detritus material from the hills and depositing the same in the plains. The rivers occasionally change their course. As a result there are many dead streams with abandoned river beds. The major rivers are *Mahananda*, *Tista*, *Jaldhaka*, *Torsa*, *Kaljani*, *Jainti* and *Raidak*.

Smaller rivers and streams: There are innumerable small rivers and stream in the region. Though they are perennial in nature, yet their discharges vary widely in different seasons. They are good sources of drinking and wallowing water for the wild animals.

Lakes and other natural water reservoirs: There are few lakes and other natural water reservoirs in the region. Notables among them are the three lakes in the Senchal area. They are fed by various natural sources and monsoon rains. Many abandoned river beds also act as water reservoirs.

Seasonal water sources: Seasonal water sources retain water during rainy seasons i.e., from June to September and remain dry during rest of the period. Rivulets, streams and smaller water reservoirs are the seasonal water sources.

Quality of surface water: Quality of surface water in the protected areas was assessed in terms of its coliform content and mineral status. A total of 30 water samples during dry and wet seasons from rivers, streams, springs (or *jhoras*) and lakes were analysed. Care was taken to collect samples from sources used by different focal herbivores as drinking water.

Colliform content: Colliform content was determined in two stages- (a) field detection of colliform bacteria and (b) laboratory confirmation for presence of faecal colliforms. All the samples were found positive for presence of colliform during field detection. However, only one sample in dry season from a stream (*Valuka*) of Jaldapara Wildlife Sanctuary was detected positive for faecal colliform. Thus microbial quality of drinking water is quite satisfactory even during dry seasons barring one source.

Mineral status: Mineral status of surface water from different sources during dry and rainy seasons was studied by atomic absorption spectrophotometry. Different mineral content of water did not vary between sources as well as between season. Mean concentrations of calcium, copper, Zinc, manganese and iron were  $0.57 \pm 0.12$ ,  $0.028 \pm 0.003$ ,  $0.27 \pm 0.007$ ,  $0.27 \pm 0.001$  and  $0.96 \pm 0.03$  ppm respectively. The concentrations of different minerals thus observed, were well within the normal limit.

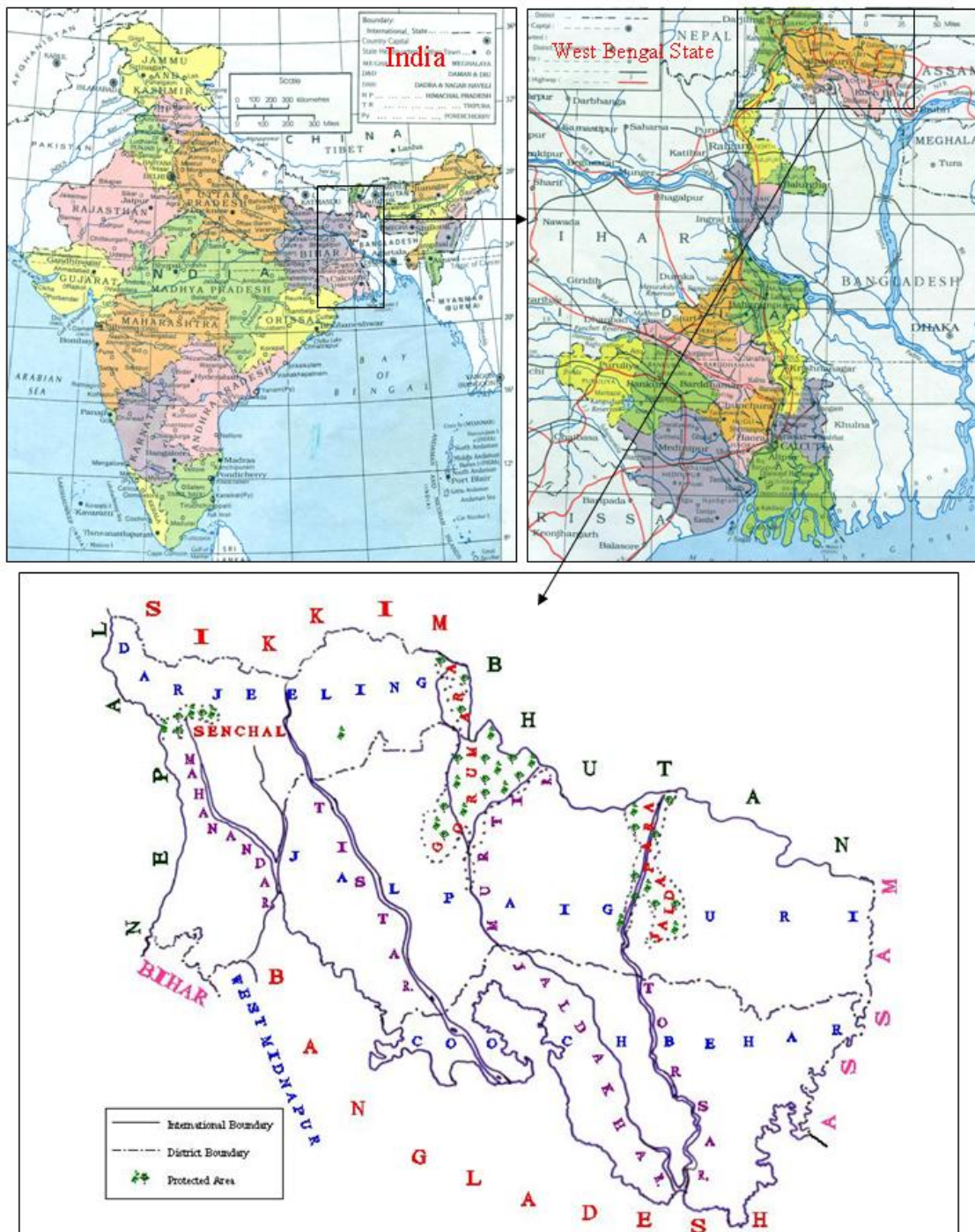


Figure 1 : Location of Gorumara National Park, Jaldapara Wildlife Sanctuary and Senchal Wildlife Sanctuary.

## Conclusion

Thus, it could be concluded that the seasonal fluctuation in the study area is not very wide and hence the wild herbivores are not subjected to much climatic stress in their

home range. A long spell of rainy season is enjoyable by the herbivores under investigation. Maintenance of vegetation of any form by way of protection must have contributed a lot in restricting climatic fluctuation within limit. It is heartening to observe that the focal herbivores are successful in maintaining or even sometime increasing their population after more vigorous protection since mid-eighties. Food, water and cover are identified as the primary habitat resources. Protection has been able to fulfill the minimum requirement of these resources. There is every reason to speculate that, animals would have extinct from that study area with out protection as it has happened in the unprotected areas. Other habitat resources and pollution factors investigated are within normal limit and do not pose any immediate threat to the inmate.

An important conservation goal for the Himalayas should be to conserve large areas of representative habitat types from alluvial grasslands along the foothills to the high alpine grasslands above the tree line. Intact habitat from the lowlands to the alpine peaks are critical for many species that moves up and down the mountains to find food, water, shelter and mates during different seasons. To do this, the countries in the region need to work together to link core protected areas, involve the indigenous people living in the ecoregion in the conservation actions, and encourage cooperation among all the players.

The protected areas have done good work in the conservation of biodiversity, but they have become a sort of mere oasis in meeting their need, aspirations and so are affected by the 'have-not' syndrome. Both wildlife and local people are today equally threatened.

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